



Changing rural landscapes along the border of Austria and the Czech Republic between 1952 and 2009: Roles of political, socioeconomic and environmental factors



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Cross-border research enables studying the importance of broad-scale political and socioeconomic factors on land-cover changes. Our plot-based study using GIS analysis of interpreted aerial photographs evaluates changes in rural landscape patterns on both sides of the Austrian–Czech border during 1952–2009. The method compares 20 pairs of 1×1 km unit square samples distributed along the entire common border and equally divided into four growing regions. Our findings confirm the key significance of historically dissimilar political and socioeconomic systems in the two countries that led to the occurrence of decidedly different farmland and landscape patterns in similar environmental conditions. Broad-scale political and socioeconomic factors also markedly affected the rates of change and direction of trends in landscape development during the examined period. The variability of environmental conditions had a similar influence in the two countries on the proportions of farmland and of permanent elements. We did not, however, confirm an influence of the environmental factors on heterogeneity of the landscapes. Overall, the study presents a markedly more homogenous landscape pattern in the Czech Republic than in Austria. While between 1952 and 2009 the agricultural landscapes increased in homogeneity in both countries, this occurred more so in the Czech Republic than in Austria.

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Introduction

The influence of humankind, which is the most important factor affecting the structure and functioning of ecosystems (Vitousek, Mooney, Lubchenco, & Melillo, 1997), can be observed both on a direct level (i.e., reflecting individual decisions of the owners or tenants of the land) and, more typically, on an indirect level, which means the political and socioeconomic level (Dale, O'Neill, Pedlowski, & Southworth, 1993). This influence becomes the main driver of land-use change, as it determines local factors (Lambin et al., 2001). Despite that these are crucial factors, the importance of broad-scale political and socioeconomic factors on land-cover changes has been little explored, particularly due to the fact that these factors cannot be altered experimentally (Kuemmerle, Radeloff, Perzanowski, & Hostert, 2006). A good and practical approach is comparative study that evaluates changes in two or

more regions or countries having different political and socioeconomic predictors (e.g., Southworth et al., 2011).

There have been several cross-border studies focused on land-use/land-cover (LULC) changes (e.g., Klug, Gottsmann, & Heredia, 2005; Scott & Buechler, 2013; Tasser, Walde, Tappeiner, Teutsch, & Noggler, 2007), but these mostly have been designed as case studies. Kupkova, Bicik, and Najman (2013) analyzed the speed of land-cover changes in the territory of the Czech Republic and in the border areas of Austria and Germany using aggregated statistical data from cadasters. We have found no studies in the expert literature that at the plot-scale level would systematically map the differences between two or more countries depending on selected indicators such that the results could be generalized. We likewise have found no studies that would systematically evaluate the spatial pattern changes along the entire border of two neighboring states while considering the regionally or locally changing environmental or socioeconomic factors in the given states as well as the different political developments of the two states. In this respect, our contribution is the first to introduce such an approach.

Europe provides a study area advantageous for this type of research, as it includes two large groups of states: The first group of states went through a relatively continuous development as

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countries with democratic regimes and market economies (western and central European countries). The second group had such development interrupted for ca 40 years during the second half of the 20th century, at which time the principles of totalitarian regimes accompanied by socialist planned economies were applied in the individual countries with varying intensity (these currently are the so-called post-socialist or transition countries; Myant, 2010). The two historically markedly different political and economic systems today offer a unique opportunity for examining the effects of broad-scale political and socioeconomic factors on LULC changes. Moreover, this opportunity exists in a period when there are relatively high-quality tools to support such analysis on a local scale (aerial photographs, land registers, cadastral maps, etc.). Also interesting is to study the influence of the transition countries' different approaches in transforming themselves after 1990 into democratic societies with market economies (Csaki, 2000; Lerman, 2001).

In our plot-scale study we evaluated changes in the border areas of two neighboring countries, Austria and the Czech Republic, the social and political conditions of which began markedly to differ in 1918 due to the collapse of the Austrian–Hungarian monarchy. Since that time, the two countries have been going through wholly separate political developments, and particularly so between 1948 and 1989, when the Czech Republic followed the path of a socialist planning system while Austria continued in the market system. Since the 1950s, both countries had tried to achieve self-sufficiency in agricultural production. While Austria managed to do so in the 1970s through intensifying its agriculture, the Czech Republic did so only after 1990. Subsequently, after 1990, the Czech Republic gradually returned to the path of a democratic society with a market economy (Fish, 1997). Meanwhile, it needed gradually to reduce agricultural overproduction in a manner similar to that seen in Austria 20 years earlier. While a goal of Austrian agriculture since the 1970s has been to protect the existing farm structure (Krausmann et al., 2003), however, the Czech Republic needed to initiate a transition process through which since the 1990s it has been transforming former large-scale state farms and agricultural collectives into a new structure encompassing farms of all forms and sizes (Lerman, 2001). From 1995 in the case of Austria and since 2004 in that of the Czech Republic, agriculture and land use have been directed by the EU Common Agricultural Policy. The differences between two political systems so crucially divergent and their influence on changes in the rural landscape pattern in various growing regions are the subject of this study.

Although agriculture is not the main economic activity in the EU, it is the main user of land. Approximately 39% of Austria's total land area consists of farmland, while 17% is arable land. Those are less than the EU averages of 43% farmland and 26% arable. The figures for the Czech Republic exceed EU averages, at 54% and 37%, respectively (data from 2009; Eurostat, 2012). This points to the decisive role that agricultural policy has in forming agricultural landscape patterns. Growing environmental problems in recent decades frequently ensue from two dominant trends in the current use of agricultural land within Europe (Brouwer, 2001): intensification and specialization in some areas accompanied by marginalization and abandonment in others. Both these processes represent divergences from traditional forms of low-input, labor-intensive crop and livestock production. Hodge (2001) succinctly summarizes the development of the countryside and of priorities in agriculture, beginning with the emphasis on domestic food production after World War II and progressing to a preference for nonproduction functions and the current focus on protecting environmental qualities. Potter and Tilzey (2005) consider the current agricultural policy to be increasingly bimodal, whereby principles of post-productivism and rural development are protected in the public interest. Nevertheless, this policy raises new

questions connected with enforced segregation and commodification of rural space and environmental provision, or even with wide-ranging diversity that exists within the productivist/post-productivist spectrum (Wilson, 2001). These general trends or impacts of the EU's Common Agricultural Policy are complemented by factors specific for the individual states or regions. Primdahl (1999), for example, underscores the various roles of landowners and land users in shaping the agricultural landscape as a "living place". This aspect of changes in the countryside is very important in interpreting the results when comparing changes in the Austrian landscape, where 70% of farmland is farmed by the landowners, and in the Czech Republic, where this share is the second lowest in the EU at just 17% (Eurostat, 2012).

Individually, the two countries have been subject to several partial studies which analyzed in selected areas or the entire states LULC changes, their drivers and consequences. Krausmann et al. (2003) observed in the territory of the whole of Austria from 1950 to 1995 a continuous trend of declining cropland and grassland areas, rapid increases in the areas of built-up and infrastructure land, and a slow increase in forested areas. Plot-scale studies in Tyrol by Dirnböck, Dullinger, and Grabherr (2003) and Tappeiner, Tasser, Leitinger, and Tappeiner (2006) indicate that land-cover changes combined with human-induced changes far exceeded the effect of climatic influences.

A number of authors also have analyzed the area of the Czech Republic from the perspective of LULC changes. Studies focused on the influence of extreme fragmentation of agricultural land ownership as an important driver of homogenization of rural landscape patterns were presented by Sklenicka, Lhota, and Cecetka (2002) and Sklenicka and Salek (2008). Historical maps reaching back to the mid-18th century were used by Skaloš and Engstová (2010) to analyze long-term land-cover changes in 21 cadastral units of Central Bohemia. Those authors ascertained a decrease in permanent grasslands from 18% to 5% and a decrease in water surfaces from 6% to less than 1%. In contrast, the proportion of arable lands increased the most, from 53% to 67%. There have been a rather large number of similar case studies conducted in the Czech Republic, most frequently focused on rural landscapes (e.g., Lipsky, 1995; Sklenicka, 2002). The results of these studies, however, differ depending on local environmental or socioeconomic specifics.

In this sense, the studies to date can be divided into two groups: (1) Studies with results valid for the entire territory of the state, using aggregated statistical data without regard to spatial relations, and (2) case studies at the plot-scale level, providing results taking into account spatial parameters of the landscape pattern but always having only local validity. Thus far, there has been no complete work that would evaluate LULC changes at the plot-scale level in the context of the entire territory of Austria or the Czech Republic.

In this study, we hypothesize the following: (1) Different landscape patterns occur in the Czech Republic and Austria due to different socioeconomic and political conditions while the environmental conditions are similar. We presume a more homogenous pattern in the Czech Republic. (2) From the second half of the 20th century to the present era, landscape patterns changed in both states; nevertheless different political and socioeconomic conditions influenced the direction and extent of those changes. (3) Differences in the rural landscape patterns, or changes in those patterns over time, are affected by environmental conditions. For this purpose, we analyzed changes of the relevant rural landscape pattern indices during 1952–2009, and these displayed the crucially differing development of broad-scale political and socioeconomic factors in the two countries. The start of the examined period is marked by the commencement of a strikingly different political direction in the two countries and also the beginning of industrialization of agriculture in both countries.

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