



## Land changes in Slovakia: Past processes and future directions



Robert Pazúr<sup>a, b, \*</sup>, Janine Bolliger<sup>a</sup>

<sup>a</sup> Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Zürcherstrasse 111, 8903 Birmensdorf, Switzerland

<sup>b</sup> Institute of Geography, Slovak Academy of Sciences, Štefánikova 49, 814 73 Bratislava, Slovakia

### ARTICLE INFO

#### Article history:

Received 1 November 2016

Received in revised form

15 May 2017

Accepted 23 May 2017

Available online 20 June 2017

#### Keywords:

Landscape change

Socialism

EU

Land use modelling

Future scenarios

### ABSTRACT

The aim of this study is to bring a unique overview of past, current and plausible future land use development in Slovakia. The study assessed land change processes and their spatial determinants related to the most significant socio-political periods that have shaped the former socialist country over the past 30 years, namely, socialism (1980–1990), postsocialism (1990–2000), EU accession (2000–2006), EU membership (2006–2012). Using boosted regression trees, the impact of different bio-physical, socioeconomic, policy and distance-based factors was evaluated on land transitions, categorised as urbanisation, agricultural intensification and extensification, afforestation, deforestation and forest disturbance (natural and management-induced). Results show significant shifts in the landscape management associated with the institutional changes, especially in the postsocialist period.

Agricultural intensification, which dominated the socialist period, was in subsequent periods substituted by afforestation and agricultural extensification. High relative annual rates of forest disturbance have dominated land-use change over the past 30 years, while deforestation was a minor land-use change during the late socialist period. Urbanisation has played a significant role and changed considerably through the studied periods: high urbanisation rates under socialism, a massive decline in the postsocialism and EU accession periods and increasingly high urbanisation rates during the EU membership period.

Taking into account national and international (EU related) demands, we assessed land use development for 2040 within five different future land use scenarios. These scenarios were characterised as either extensions of current development trends, or as developments along axes that target globalisation or regionalisation, and more or less intervention. Results show that afforestation is by far the land-change process that will have the greatest impact on future Slovakian landscapes, mostly in rural areas. Among changes in agriculture, all scenarios uniformly suggest that extensification will exceed intensification mostly at the cost of arable land. In addition, urban areas will expand at the expense of arable land, particularly in the accessible city hinterlands.

© 2017 Elsevier Ltd. All rights reserved.

### 1. Introduction

Land use provides essential ecosystem services whose quantity and quality is changing according to the socio-economic, political and cultural conditions defined by humans (Verburg et al., 2015) and can therefore be considered a geo-manifestation of inherently aspatial political, economic and cultural transitions (Aspinall, 2004). Many countries of the former “Eastern Bloc” have experienced distinct institutional transitions from socialism to

postsocialism to EU membership (Munteanu et al., 2017) that allow us to assess the causes and consequences of socio-economic and political change on land use. Among land change typologies, institutional transitions have facilitated, in particular, agricultural change (Plieninger et al., 2016; Munteanu et al., 2014; Niedertscheider, Kuemmerle, Müller, & Erb, 2014; Bezák & Mitchley, 2014), urbanisation (Nuissl & Rink, 2005; Baumann et al., 2011) and forest management (Kuemmerle et al., 2015; Potapov et al., 2015). Liberalised markets, land restitution, consolidation and privatisation, as well as a decrease in state subsidies, the common trends in the postsocialism, caused a strong decline in agricultural production (Kuemmerle et al., 2015; Schierhorn et al., 2014). At the same time, the urban development decreased and reemerged at the beginning of the 21st century in rural areas in

\* Corresponding author. WSL Swiss Federal Research Institute, Zürcherstrasse 111, 8903 Birmensdorf, Switzerland.

E-mail addresses: [robert.pazur@wsl.ch](mailto:robert.pazur@wsl.ch) (R. Pazúr), [janine.bolliger@wsl.ch](mailto:janine.bolliger@wsl.ch) (J. Bolliger).

form of suburbanisation that hardly existed before 1990 (Nuissl & Rink, 2005). While housing demand and the housing market have put preferred areas under high development pressure since the beginning of the 21st century, less favourable locations have suffered from the exodus of young people due to a lack of job opportunities (Baumann et al., 2011). Forest management was affected by large proportions of forest clearings following the breakup of socialism and the accession to the EU (Potapov et al., 2015). While forest harvesting increased up to 1.8 times between 1988 and 1994 (border region between Poland, Slovakia and Ukraine; Kuemmerle et al., 2007), spontaneous afforestation of agricultural land in marginal areas has partly compensated for this loss (Kuemmerle et al., 2015).

Multiple past political interventions in Eastern Europe have triggered many economic (e.g., transfer to market economy), demographic (e.g., migration to cities in Western Europe; depopulation of rural areas) and ecological consequences (e.g., land abandonment; development pressure in nature parks) for landscapes which are still not fully consolidated. Identifying these consequences may provide insight that is important to the assessment of land system vulnerability (Munteanu, Nita, Abrudan, & Radeloff, 2016).

Our objectives are to (1) determine past and current trends based on land-use trajectories in Slovakia between 1980 and 2012 and quantify the effects of the most significant institutional transitions on land use between late socialism (1980–1990), post-socialism (1990–2000), EU accession (2000–2006) and EU membership (2006–2012); (2) assess the potential future spatial development of Slovakia to the year 2040 using scenario-based modelling.

All land-change assessment related to the different institutional changes ranging from late socialism to EU membership take advantage of long-term and spatially high-resolution data for land use, biophysical and socio-economic determinants. The future magnitude and location of expected land change was quantified using scenario-based modelling up to the year 2040. Scenario-based models show important policy issues, and serve as an early warning system suitable for incorporation into policies (Price et al., 2015; Verburg et al., 2015). Detailed research questions include: What was the magnitude and extent of changes in land use triggered by institutional changes in Slovakia between 1980 and 2012? Which spatial factors determined these land changes? What are the expected land changes between 2012 and 2040?

## 2. Data and methodology

### 2.1. Study area

The study area encompassed the territory of Slovakia (Fig. 1), covering an area of 49,036 km<sup>2</sup> with 5,421,349 inhabitants living in 2890 communes (Slovstat, 2015). 49% of the country is covered by mostly forested mountains, whereas the lowland and basin region (51% of the area) are dominated by agricultural land and settlement areas. Historically, numerous political transitions have shaped the Slovakian landscape. Socialism's central planning caused industry and private companies to be nationalised and agricultural land to be collectivised in the 1950s (Izakovičová, 2013), resulting in large-scale development of settlement and industrial sites and intense farming management. Furthermore, the lowlands and basin were established as centres of socialistic centrally-planned economic and urban development. Such practices increased the polarisation between intensely used landscapes and marginal remote areas and thus precluded the intensification of the mountainous countryside. This enabled the preservation of some of the typical mountainous agricultural areas which are now part of the cultural heritage

landscape (Hreško et al., 2010; Špulerová, 2013). This trend was interrupted by the breakup of socialism in 1989 and the subsequent market-oriented economy, introducing landscape changes driven by changes in property ownership, privatisation and market liberalisation. The influence of market processes changed substantially based on the adopted legislation, and culminated after Slovakia's EU membership in 2004. Relatively cheap qualified labour and good accessibility to international trades had a positive influence on direct foreign investment (GDP growth from 22 billion EUR in 2004 to 72 billion EUR in 2012, World Bank, 2016) but also triggered international labour out-migration to Western European countries (Bahna, 2015).

### 2.2. Land use and land cover data

Overall, we identified 13 land use/land cover (LUC) classes to assess past, current and future land changes relying on the 2-level hierarchical system of CORINE land-use data (CLC; European Environmental Agency, EEA; Table 1; Appendix A; Table S1). Four classes refer to settlement and infrastructure (urban fabric; industrial/commercial/transport units; mine/dump/construction sites and artificially vegetated areas), five classes describe open land (arable; permanent crops; pastures; heterogeneous agricultural areas; open spaces with little or no vegetation), two classes represent forests and scrub, and another two classes refer to wetlands and waterbodies (Table 1; Appendix A; Table S1). The LUC data was transformed in a raster format at a 20-m resolution. To map past changes, the officially distributed CLC datasets of 1990, 2000, 2006 and 2012 were supplemented by using an additional dataset of CLC change between 1980 and 1990 (Feranec et al., 2000).

#### 2.2.1. Past land use/land cover changes

To reflect land-use change triggered by institutional changes, we analysed the transitions between late socialism (1980–1990), postsocialism (1990–2000), EU accession (2000–2006) and EU membership (2006–2012). For these four periods, six land transitions were studied to describe processes of: urbanisation, agricultural intensification and extensification, afforestation, deforestation and forest disturbance (Table 1). The land-change matrix defining these processes was modified based on previous work (Table 1; Feranec, Jaffrain, Soukup, & Hazeu, 2010, 2017). While urbanisation refers to any LUC changes toward the urbanised areas, intensification and extensification refer to the changes LUC changes within the agricultural areas or transition of forested areas towards the agricultural LUC (Feranec et al., 2010, 2017). Afforestation describes processes related to forest re-growth, while forest disturbance refers to processes resulting in tree removal (Potapov et al., 2015). These two may be summarized as natural disturbances and management-driven clearings. The change of forest to a new LUC category (urban, agricultural land or water surface) is referred to as the process of deforestation.

#### 2.2.2. Future land change

The assessment of future land-use change up to the year 2040 depended on LUC classes provided by the CORINE LUC dataset for 2012) and was evaluated by similar LUC transitions as the past LUC change (Table 1). Yet, datasets for future land-use/land-cover change assessments were supplemented with additional spatially high-resolution data available either at the European (Permanent Waterbodies, Forest Types, Soil Sealing Layer and Urban Atlas project (EEA, 2013), or national level (Reference Spatial Database (ZB GIS; geometric base of the Slovak National infrastructure of spatial information of Slovakia, GCI, 2013). The improvements allowed for more detailed LUC mapping of settlement structure

Download English Version:

<https://daneshyari.com/en/article/6458271>

Download Persian Version:

<https://daneshyari.com/article/6458271>

[Daneshyari.com](https://daneshyari.com)