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Ekológia (Bratislava) Vol. 35, No. 1, p. 50–65, 2016
DOI:10.1515/eko-2016-0004

DRIVING FORCES OF MAIN LANDSCAPE CHANGE PROCESSES FROM PAST 200 YEARS IN CENTRAL EUROPE - DIFFERENCES BETWEEN OLD DEMOCRATIC AND POST-SOCIALIST COUNTRIES

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Abstract

Skokanová H., Falťan V., Havlíček M.: Driving forces of main landscape change processes from past 200 years in Central Europe - differences between old democratic and post-socialist countries. Ekológia (Bratislava), Vol. 35, No. 1, p. 50–65, 2016.

The article compares and points out differences in driving forces of four main landscape change processes that shaped post-socialist countries and old democratic countries of Central Europe during the last two centuries. Studying landscape change processes and corresponding driving forces helps in understanding patterns of present landscape and can help among others in better prediction of future landscape change trends. Here, the presented results are based on review of scientific articles published in peer-reviewed journals between 2000 and 2014. Driving forces affecting these processes were grouped into four categories. Economic forces drove mainly agricultural intensification; agricultural land abandonment and urbanisation and were pronounced especially in the second half of the 20th century and at the beginning of the 21st century. Technological driving forces affected agricultural intensification especially in the 19th century and the second half of the 20th century while cultural driving forces had the biggest impact on urbanisation at the beginning of the 21st century. Political driving forces affected agricultural intensification, urbanisation as well as agricultural land abandonment and were pronounced mainly during the second half of the 20th century in the post-socialist countries. Political forces in the form of subsidies drove agricultural extensification at the beginning of the 21st century. The drivers for the agricultural intensification as well as urbanisation seem to be similar for both old democratic and post-socialist countries. In contrast, agricultural land abandonment in the old democratic countries was driven by technological, cultural and economic driving forces while in the post-socialist countries the political driving forces were mainly responsible. Changes in systems for subsidies and changes in the agricultural commodity markets are also responsible for different frequencies and rates of extensification of agriculture between the two groups of countries.

Key words: driving forces, landscape change processes, old democratic countries, post-socialist countries, Central Europe.

Introduction

Landscapes are constantly changing due to environmental and anthropogenic factors (Biró et al., 2013). Changes in landscape structure significantly affect its ecological stability (Lipský, 2001), as well as biological (Löfvenhaft et al., 2004), environmental and aesthetic value (Nassauer, 1995). The structure of a cultural landscape is largely determined by human decisions – by direct or indirect impacts of human activities. In Europe, the human impact is mainly determined by agriculture but differs from region to region (Mander, Jongman, 1998).

The most widespread and important changes are urbanisation and agricultural intensification, on the one hand, and agricultural extensification and agricultural land abandonment, on the other. It is well known that land use changes reflect different phases of socio-economic development and political climates, as well as environmental changes (Bičík et al., 2001; Łowicki, 2008). Studies of landscape changes used to focus mainly on analysis of spatial patterns (Haase et al., 2007; Bieling et al., 2013; Feranec et al., 2003). However, understanding of landscape changes requires a sound understanding of the underlying processes that can be triggered by different driving forces (Hersperger, Bürgi, 2009).

Driving forces are the forces that cause observed landscape changes, i.e. they influence trajectories of landscape development. One of the main motivations for studying the driving forces of landscape changes is to find their general patterns, valid beyond the specific situation under study (Bürgi et al., 2004). We can distinguish five major types of driving forces: political, economic, cultural, technological and natural/spatial (Bürgi et al., 2004; Schneeberger et al., 2007). The economic driving forces include consumer demands, market structure and structural changes, while governmental subsidies and incentives can be considered as political driving forces. Since economic needs and pressure are expressed and reflected in political programmes, laws and policy, the economic and political driving forces are strongly interlinked (Hersperger, Bürgi, 2009). Culture leaves deep imprints on landscape and at the same time landscape significantly affects culture in terms of attitudes, beliefs, values and traditions. Cultural driving forces can be expressed by way of life but also by demography in terms of population growth/shrinkage, migration, etc. Technological driving forces, such as modernisation of agriculture, also shape landscape enormously. Natural conditions are important factors that set limits to land utilisation and they tend to form the framework for the way in which land is finally used. Within the natural/spatial driving forces we can distinguish between site factors such as spatial configuration (Pan et al., 1999), topography (Havlíček, Chrudina, 2013) and soil conditions (Wulf et al., 2010), as well as natural disturbances, e.g. avalanches (Kulakowski et al., 2011) or wind throws (Falťan et al., 2011). The site factors represent relatively permanent natural conditions that provide the matrix for socio-economic drivers, but according to Bieling et al. (2013) they do not cause changes themselves. Therefore, they should not be interpreted as natural driving forces, unlike natural disturbances (Bieling et al., 2013). All five types of driving forces are interlinked, with the first four having quite tight links.

Studies about driving forces of landscape change can focus either on broad-scale cross-national statistical comparisons or more detailed studies at the regional and local scale (e.g. Bieling et al., 2013; Hersperger, Bürgi, 2009). It is a known fact that driving forces are scale sensitive, i.e. different driving forces operate at different scales (Tzanopoulos et al., 2013).

Our article will focus on transnational and national scales and will give an overview of main landscape change processes and underlying political, economic, cultural and technological driving forces occurring from the 19th century to the present in Central Europe. It is based on review of scientific articles about driving forces of landscape change processes which were published in peer-reviewed publications between 2000 and 2014. The main motivation for the article is the fact that understanding patterns of present landscapes, their changes and underlying forces and pressures can help in learning lessons from the landscape history for the future planning of sustainable landscape utilisation. We are aware of the fact that the main landscape change processes, i.e. agricultural intensification, urbanisation, agricultural extensification and agricultural land abandonment, can be found throughout the whole world. Therefore, we will try to point out differences between post-socialist countries (Poland, the Czech Republic, Slovakia, Hungary and the former East Germany) and old democratic countries (former West Germany, Switzerland and Austria; see Fig. 1). Our hypothesis is that the driving forces were similar in the 19th century but differed in the 20th and 21st century.

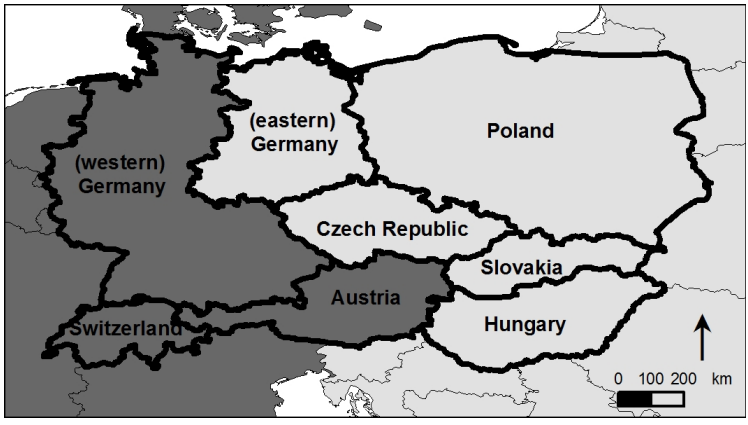

Fig. 1. Analysed countries: three old democratic (dark grey), five post-socialist (light grey).

Material and methods

Our results are based on synthesis of papers that focused on landscape change processes and corresponding driving forces occurring in seven Central European countries (Germany, Switzerland, Austria, Czech Republic, Poland, Slovakia and Hungary), which were published in peer-reviewed journals (databases Scopus and Web of Knowledge) in the period 2000–2014. We are aware that we could not have covered all papers dealing with these topics that were published but we tried to select those that focus on main processes and corresponding driving forces during the past two centuries. The selection criteria were key phrases and words 'driving forces of land use changes'. This key phrase did not yield enough results for some countries; therefore we have substituted it with some of the following key words 'landscape abandonment, urbanisation, agricultural intensification, agricultural extensification, afforestation'. As such, at least four studies per country (with a maximum of 11) were used in our review. There were quite a lot of studies that covered more than one country. These studies were included in all respective countries. Publications used for the review are listed in Appendix 1.

The studied landscape change processes are agricultural intensification, urbanisation, agricultural extensification (including grassing and greening) and agricultural land abandonment (including afforestation). We have included afforestation within the category of agricultural land abandonment since a significant amount of abandoned land is either gradually overgrown by shrubs and trees or artificially afforested. We are aware of the fact that relationship between agricultural land abandonment and artificial afforestation does not have to be direct because artificial afforestation can be implemented for different reasons (e.g. increase of timber production). However, since it usually occurs on less fertile soils, which with the present knowledge would be in foreseeable future abandoned, we have included this process with agricultural land abandonment. Similarly, the processes of grassing and greening (a term used by Hersperger, Bürgi, 2009, which encompass creation or renewal of small green patches, such as orchards, hedgerows and solitary trees in the agricultural landscape) have been included within agricultural extensification because they are very often a result of this process or accompany it.

Results and discussion

Agricultural intensification

Agricultural intensification belongs to the most important landscape processes that have shaped landscape throughout Europe. We can distinguish two major waves of this process - agricultural revolution in the 19th century and productivist agriculture in the second half of the 20th century. Both waves were basically triggered by population growth, i.e. by cultural driving process, which resulted in the demand for food and also technical crops.

The first wave started with the agricultural revolution at the end of 18th and beginning of 19th centuries and is connected mainly with technological driving forces: large-scale planting of new crops (potatoes, corn, and later sugar beet), change from three-field system where one third of the land was kept fallow to four-field system with introduction of seeding clover in the fallow land, the indoor feeding of cattle during summer, and the construction of underground reservoirs for dung-water collection (Bürgi et al., 2010; Krausmann et al., 2008; Kuskova et al., 2008). Other technological driving forces that supported the first wave were early motorization in the 1880s, which additionally fuelled the mechanisation of agriculture, introduction of first artificial fertilisers and more sophisticated melioration of wet soils in the form of clay tubes (Bender et al., 2005; Bürgi et al., 2010; Wulf et al., 2010). Besides technological driving forces, the first wave was supported also by land reforms introduced by Maria Theresa, Joseph II and Franz Joseph I in the Austro-Hungarian Empire in the 18th and 19th centuries (Kanianska et al., 2014; Skaloš et al., 2012).

The main feature of the beginning of agricultural revolution, i.e. abandonment of three-field system dated already to the beginning of the 19th century in some parts of Switzerland (Bürgi et al., 2010); in other parts of Central Europe (e.g. the Czech Republic), it happened by the end of the 19th century (Bičík et al., 2001; Kuskova et al., 2008). In general, we can say that the first wave occurred mainly during the 19th century and ended by the beginning of the 20th century (Fig. 2).

The second wave of agricultural intensification began after the Second World War by implementing so-called productivist agriculture. Productivist agriculture is characterised by increased yield per hectare and is again driven mainly by technological driving forces: adoption of mechanisation in farming based on oil and natural gas which eliminated animal power and largely substituted human labour (Krausmann et al., 2008); wider use of chemicals (such

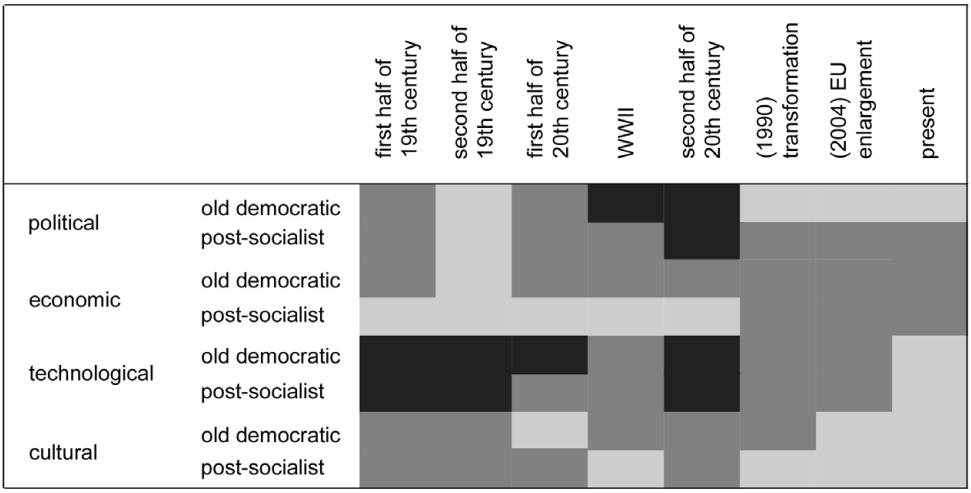

Fig. 2. Frequency occurrences of driving forces responsible for agricultural intensification in old democratic and post-socialist countries according to the reviewed papers (light grey – no occurrence; medium grey – less frequent – occurrence only in one old democratic country or one to three post-socialist countries; dark grey – frequent – occurrence in two to three old democratic countries or four to five post-socialist countries).

as pesticides, fungicides and fertilisers); the uptake of more disease-resistant plant varieties; specialisation with focus on profitable crops; and concentration (Calleja et al., 2012). However, productivist agriculture was also boosted by political driving forces – national and international policies in form of various subsidies (Marini et al., 2011) such as the Common Agricultural Policy (CAP), which was introduced in the 1960s and further increased modernisation, intensification and specialisation of agriculture in the old democratic countries (Hietel et al., 2005). Other important driving forces belong to economic drivers and are represented by market demand and corresponding fluctuations of prices, competitiveness and maximising gains while minimising costs.

In the post-socialist countries, the second wave of agricultural intensification was expressed by so-called socialist agriculture, which was also implemented after Second World War. Socialist agriculture can be viewed as a specific example of productivist agriculture. It is closely connected with transformation of traditional extensive farming to forced collectivisation with overall interest in land exploitation (Bezák, Petrovič, 2006) and was particularly rapid between 1969 and 1989 (Stoate et al., 2009). During collectivisation, large collective and state farms formed in many socialist countries regardless of natural conditions; for instance in Czechoslovakia they were formed in the 1950s and 1960s in the lowlands and at the beginning of the 1970s in the mountain regions (Bezák, Mitchley, 2014). Socialist agriculture was characterised predominantly by political driving forces in the form of political intentions to have self-sufficient agriculture within a socialist bloc and to meet production targets resulting in massive subsidies oriented towards modernisation, land reforms leading to confiscation of all agricultural land and to the establishment of centrally managed collective and state farms managing

T a b l e 1. List of potential driving forces (DF) influencing main land use processes in Central Europe, based on documents analysis; AI - agricultural intensification, U - urbanisation, AE - agricutural extensificaion, AA - agricultural land abandonment; X - driving force of the respective land use process.

Driving force		AI	U	AE	AA
Technological	Irrigation/drainage	X			
	Specialisation	X			
	New crops	X			
	New technologies	X			X
	Mechanisation	X			
	Motorisation	X			
	Fertilisers	X			
	Road construction	X	X		
	Industrialisation	X			X
	Underdeveloped infrastructure				X
Political	Self-sufficiency	X			
	Land reforms	X			X
	Subsidies	X	X	X	X
	Collectivisation	X			
	Defence policy				X
	Environmental laws			X	X
Economic	Prices	X			
	New markets/market change/loss	X			X
	Structural changes		X		
	Economic development		X		
	High costs/low yields				X
	International competition				X
	Better income sources				X
Cultural	Population growth	X	X		
	Population decline				X
	Life preferences		X		
	Recreational facilities		X		
	Environmental awareness			X	

vast areas of land (Grešlová Kušková, 2013; Kanianska et al., 2014; Kohlheb, Krausmann, 2009; Skaloš et al., 2012). It was also driven by technological driving forces in terms of high level use of pesticides, fertilisers, artificial manure (Kohlheb, Krausmann, 2009; Kuskova et al., 2008; Szilassi et al., 2010), vast melioration projects (e.g. in Hungary - Biró et al., 2013) and industrialisation expressed among others by construction of roads and using heavy mechanisation.

The main difference between socialist agriculture and productivist agriculture is that the former is centrally planned and commanded (policymakers dictate what farmers produce), i.e. political driving forces play main role, while the latter is market based (farmers choose what to produce), i.e. economic driving forces dominate and political driving forces (governments subsidise key crops or protect producers) are moderate (Fraser, Stringer, 2009) (Fig. 2).

While productivist agriculture in the old democratic countries prevailed until present, socialist agriculture was abandoned after 1990 and productivist agriculture driven mainly by economic driving forces has been introduced also in the post-socialist countries. Besides economic driving forces, agricultural intensification in post-socialist countries was affected also by political driving forces expressed by restitution and privatisation of land (Hartvigsen, 2014; Bezák, Mitchley, 2014). Both types of driving forces instigated further agricultural intensification in core areas, mostly found in fertile lowlands, and abandonment of less fertile, mostly mountainous, areas. This process occurred in both old democratic and post-socialist countries; however, it was more pronounced in the latter group (see e.g. Łowicki, 2008; Kanianska et al., 2014; Szilassi et al., 2010).

An overview of driving forces grouped into the four types of driving forces is shown in Table 1.

Urbanisation

Urbanisation is closely connected with the industrial revolution initiated in the first half of the 19th century. Urbanisation is a complex process that transforms the rural or natural landscape into an urban and industrial one (Antrop, 2000; Gennaio et al., 2009). As such we can also include, besides expansion of urban areas/settlements, development of transportation infrastructure, recreational areas and mining areas in this group.

The main driving forces behind steady expansion of settlements in Central Europe during the 19th and 20th centuries were economic development together with high demand for living space from the growing and affluent population. Urbanisation linked with population growth and large spatial mobility of citizens was pronounced especially after the Second World War in the whole Central Europe (Jaeger et al., 2007; Kanianska et al., 2014; Sallay et al., 2012). Economic growth associated with post-war reconstruction and increased industrialisation contributed to the spread of urban areas and the development of transportation infrastructure that further stimulated urbanisation (Antrop, 2004; Müller et al., 2010). This was caused by progress in technical innovations as well as political decisions to subsidise road construction as was shown, for example, in a study by Schneeberger et al. (2007).

While in the old democratic countries the economic and technological driving forces of urbanisation were the most important group (e.g. in Switzerland – Hersperger, Bürgi, 2009), political decisions most affected urbanisation and related processes in the post-socialist countries during the Communist period (1948–1989) (Bičík et al., 2001). Due to these decisions, agricultural land was vastly confiscated for non-agricultural activities, such as construction of industrial plants, transportation lines and residential housing as well as open-pit mining.

Another wave of expansion of settlement is associated with suburbanisation. This process occurred on a large scale in Western Europe between the 1950s and the 1970s (Ott, 2001; Sykora, Posova, 2011) while in the post-communist countries it intensified after 1990 (Haase et al., 2007). Suburbanisation is largely driven by changes in living standards and long held preferences for living in more rural environments, i.e. cultural driving forces (as was seen, e.g., in Budapest's agglomeration already in the 1980s – see Sallay et al., 2012), but also by increased economic opportunities in less dense areas (Brown, Schafft, 2002), better transportation infrastructure and new technologies.

Technological driving forces, namely introduction of railways at the end of the 19th century, and the use of the automobile after the Second World War, spurred urbanisation significantly (Antrop, 2004; Jaeger et al., 2007). Accessibility became one of the main driving forces, which introduced urbanisation in more remote regions. This was pronounced especially at the end of 19th century but also later on, as was the case in Slovakia (Kanianska et al., 2014), Switzerland (Hersperger, Bürgi, 2009), Poland (Łowicki, 2008) or the Czech Republic (Kuskova et al., 2008).

The frequency of occurrence of the driving forces for urbanisation during the past 200 years according to reviewed papers is shown in Fig. 3.

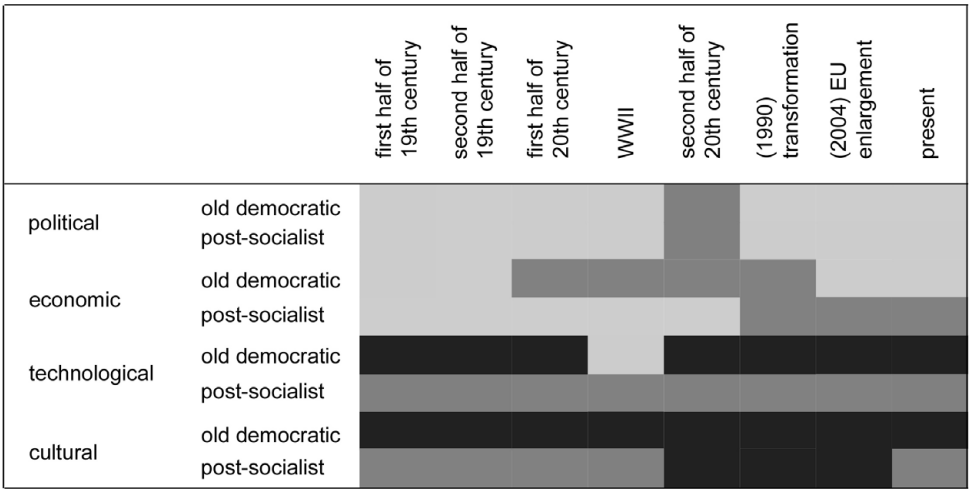

Fig. 3. Frequency occurrences of driving forces responsible for urbanisation in old democratic and post-socialist countries according to the reviewed papers (light grey – no occurrence; medium grey – less frequent – occurrence only in one old democratic country or one to three post-socialist countries; dark grey – frequent – occurrence in two to three old democratic countries or four to five post-socialist countries).

Agricultural extensification, grassing and greening

Agricultural extensification is the process of reducing fertiliser inputs, management intensity and stocking rates, and developing a new set of management skills instead (Marriott et al., 2004). It is connected with post-productivist agriculture, grassing and greening. The post-productivist agriculture regime emerged in the late 20th century as a sort of opposition to the modernisation and industrialisation of agriculture typical for productivist agriculture. Its key concepts are the reversal of intensification (i.e. extensification), specialisation and concentration processes, as well as the greater use of shorter food chains (Calleja et al., 2012). Greening is defined as a process where the agricultural landscape is enriched by hedgerows, orchards, solitary trees and stone walls (Hersperger, Bürgi, 2009). Therefore, it can also be seen as a reversal of productivist agriculture, which removed all potential obstacles for better use of mechanisation and was typical for post-socialist countries during the 20th century.

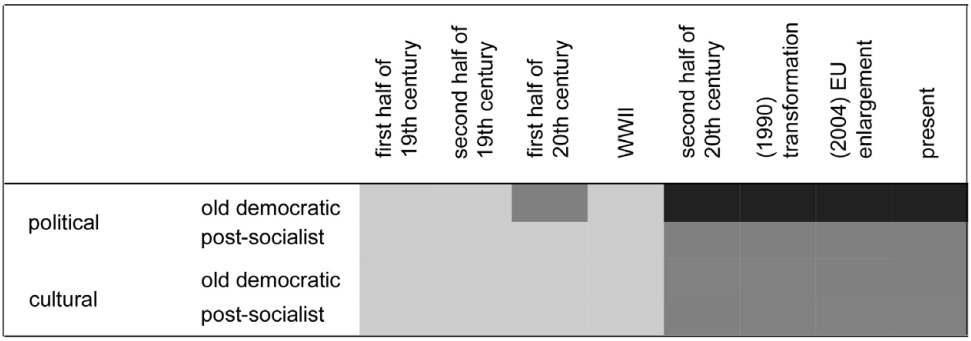

Fig. 4. Frequency occurrences of driving forces responsible for agricultural extensification in old democratic and post-socialist countries according to the reviewed papers (light grey – no occurrence; medium grey – less frequent – occurrence only in one old democratic country or one to three post-socialist countries; dark grey – frequent – occurrence in two to three old democratic countries or four to five post-socialist countries).

Extensification was partly brought forward by changes in the CAP in the 1990s and the introduction of its 'second pillar' in 2000 (Lowe et al., 2002) supporting the development of rural areas. However, the recent CAP is focused mainly on rational maintenance of intensive large-scale farming in the mountain landscapes (Bezák, Mitchley, 2014) and not on small and family farms that better contribute to maintaining traditional management critical for preservation of biodiversity. Additionally, administration and acquisition of subsidies is very complicated and requires a specialised workforce, which is more often available for larger farms (Bezák, Mitchley, 2014).

Increasing environmental awareness among the population, better enforcement of environmental laws, shift of agricultural subsidies from productive to non-productive agricultural functions and implementation of agri-environmental schemes (AES) targeting non-productive agricultural functions, largely affected landscapes across Europe, especially in the post-socialist countries after the transformation of the economy from centrally planned to free market (Bičík et al., 2001; Havlíček et al., 2012; Lieskovský et al., 2013; Plieninger, Schaich, 2014). Environmental awareness and environmental laws already affected landscape changes in some regions of old democratic countries in the first half of the 20th century (Bürgi et al., 2010; Hersperger, Bürgi, 2009; Romao et al., 2012) and have developed further in the whole Central Europe since the 1970s (Bürgi et al., 2010; Skokanová et al., 2012) as can be seen from Fig. 4. AES have been designed and implemented on a large scale in the old democratic countries since the mid-1980s (Primdahl et al., 2003); in the post-socialist countries it was after 1990. One of the outcomes of implementation of AES is increase in the area of permanent grassland as was noted for instance in the Czech Republic (Chromý et al., 2003; Skokanová et al., 2012) or Slovakia (Bezák, Mitchley, 2014).

Agricultural land abandonment, afforestation

Agricultural land abandonment reflects a decline in traditional agricultural practices, depopulation and industrialisation (Gellrich, Zimmermann, 2007; Kuemmerle et al., 2008). It

mostly occurs in remote, mountain areas, which are no longer profitable for economic use or which are not suitable for large-scale agricultural production (on steep slopes). However, it can also occur in areas that used to specialise in some crop but where this specialisation is no longer profitable (e.g. wine specialisation in Slovakia; see Lieskovský et al., 2013). Agricultural land abandonment is closely linked with afforestation via natural vegetation succession as well as artificial afforestation in areas that are no longer profitable for agricultural use.

Agricultural land abandonment was already recorded during the 19th century and was a result of technical innovations, industrialisation and resulting income alternatives to agriculture as well as national and international competition between productions sites (Bieling et al., 2013; Bičík et al., 2001; Wulf et al., 2010). It usually occurred in relation to less productive soil that was subsequently afforested.

Economic reasons for abandoning less profitable regions, namely imbalance between cultivation costs and yields, were largely pronounced during the industrialisation of agriculture in the second half of the 20th century because the use of expensive inputs in the form of fertilisers and pesticides was economically viable only for the most productive soil (Kohlheb, Krausmann, 2009). Therefore, this process was observed throughout Central Europe – not only in socialist European countries (Bezák, Mitchley, 2014; Kanianska et al., 2014; Kohlheb, Krausmann, 2009; Kuskova et al., 2008) but also in democratic European countries (Kohlheb, Krausmann, 2009; Krausmann et al., 2003).

Besides economic reasons, abandonment is often driven by depopulation, which is either natural (migration into cities; see Haase et al., 2007; Kozak, 2003; Kroll, Haase, 2010; Munteanu et al., 2014) or artificial (leaving for war, e.g. First World War; expulsion of Czech/Polish Germans or Polish Ukrainians after Second World War – see Bičík et al., 2001; Breuer et al., 2010; Grešlová Kušková, 2013; Kozak et al., 2007; Latocha, 2013). Artificial depopulation after Second World War was typical for post-socialist countries while in the old democratic countries it did not occur.

Technological driving forces that contribute to agricultural land abandonment are represented by worsened access due to underdeveloped infrastructure (Gellrich, Zimmermann, 2007). This was, for instance, the case of some vineyards in Slovakia (Lieskovský et al., 2013). On the other hand, a study from Hatna and Bakker (2011) shows that agricultural land can be abandoned in accessible and populated areas. They explain this in terms of the influence of natural conditions (poor soil, steep areas), land bought for development, strong competition between smallholders and large enterprises or presence of attractive job alternatives in larger cities.

Agricultural land abandonment due to economic reasons and migration accelerated especially during the last 30–40 years in the whole Central Europe but the driving forces differed between post-socialist countries and old democratic countries.

In the post-socialist countries changes in political, social and economic systems, i.e. radical institutional reforms (transition from communist regimes to democratic regimes) and economic shocks (transition from centrally planned to free-market systems), largely triggered rapid agricultural land abandonment. The main driving forces were restitution of private property and the land market that had been nationalised under communism; partial privatisation of state property; emergence of small and middle-sized businesses; transformation

of agricultural co-operatives; liberalisation of prices for inputs and agricultural products; introduction of budget constraints; disappearance of guaranteed markets within the socialist bloc; introduction of foreign competition; changes in agricultural policies; and changes in the agricultural commodity market (Bičík et al., 2001; Feranec et al., 2010; Kuemmerle et al., 2008; Varga et al., 2013; Łowicki, 2008; Kanianska et al., 2014; Kopecká et al., 2012; Lieskovský et al., 2013; Szilassi et al., 2010; Tarasovičová et al., 2013).

In the old democratic countries, the agricultural land abandonment was mainly driven by industrialisation, commercial market and depopulation in the form of migration to cities. However, depopulation has recently started to play a significant role in post-socialist countries too as was demonstrated by Bičík and Jeleček (2009) or Lieskovský et al. (2013). Younger people who inherited local properties have often lost interest in traditional land management and migrated to cities or other localities for work opportunities (Petrovič, 2006), or even moved abroad.

The rate of agricultural land abandonment in post-socialist countries after the collapse of socialism was affected by the form of ownership and by the pace of land privatisation and farm restructuring. The former was typical for Poland where abandonment rates were two times higher on former state-owned land than on land owned and managed by private farmers. Also, afforestation was more widespread on collectivised land (Kuemmerle et al., 2008). The latter was the main reason for a high abandonment rate in Slovakia where land tenure is highly fragmented; identifying former owners is difficult and many of them are no longer interested in farming (Kuemmerle et al., 2008). Similar forces also caused agricultural land abandonment in the Czech Republic (Grešlová Kušková, 2013).

Occurrence of driving forces causing agricultural land abandonment during the last 200 years in the old democratic countries and post-socialist countries is shown in Fig. 5.

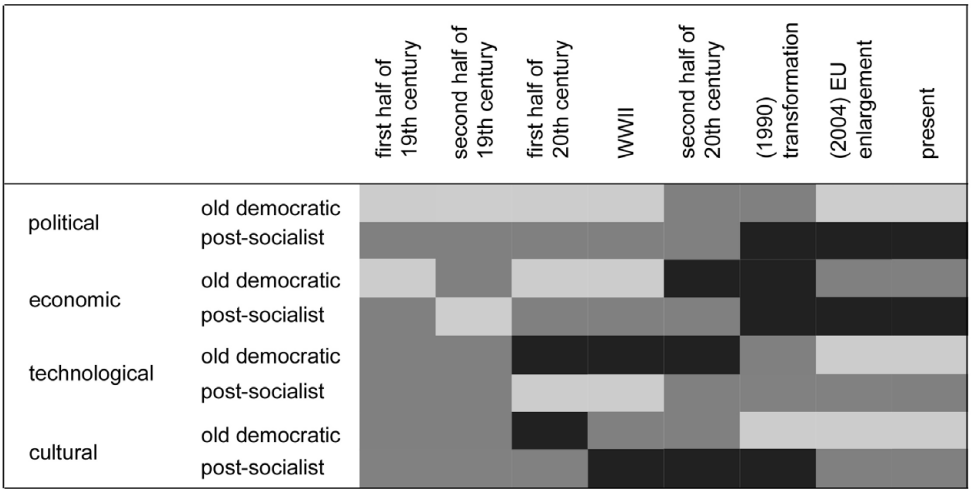

Fig. 5. Frequency occurrences of driving forces responsible for agricultural land abandonment in old democratic and post-socialist countries according to the reviewed papers (light grey – no occurrence; medium grey – less frequent – occurrence only in one old democratic country or one to three post-socialist countries; dark grey – frequent – occurrence in two to three old democratic countries or four to five post-socialist countries).

Conclusion

The results presented here show that all main landscape change processes have occurred in the Central European space throughout the last two centuries with different intensity. These processes have not been evenly distributed and could have been more pronounced in one region than other within a country. Also all five groups of the driving forces affected these processes throughout the last 200 years but individual types of driving forces within these groups were more pronounced in different periods.

Intensification of agriculture influenced the landscape already in the 19th century. However, this process together with urbanisation dominated in the second half of the 20th century. On the other hand, extensification of agriculture has been most pronounced over the past few decades. This is reflected by respective driving forces as was shown in Fig. 4. Agricultural land abandonment already occurred during the first half of the 20th century, namely in the mountainous regions with underdeveloped infrastructure and population decline. However, it began to accelerate in the second half of the 20th century and has continued until now (Fig. 5). This is similar to extensification of agriculture (Fig. 4).

The drivers for the intensification of agriculture as well as urbanisation seem to be similar for both old democratic and post-socialist countries (Figs 2, 3; Table 1). In contrast, agricultural land abandonment in the old democratic countries appears to be mainly driven by industrialisation, the commercial market and urbanisation, while in the post-socialist countries it was triggered by the collapse of socialism and subsequent institutional reforms and economic shocks (Baumann et al., 2011) reflected in the open markets and changes in systems for subsidies (Lieskovský et al., 2013). Changes in systems for subsidies, especially implementation of AES and changes in the agricultural commodity markets, are also responsible for different frequencies and rates of extensification of agriculture between the two groups of countries. While this process was supported by introduction of AES already in the 1980s/1990s and the commodity markets were solidly established in the old democratic countries, in the post-socialist countries, the support of AES developed more after the collapse of the Eastern Bloc and subsequent accession to the EU and the open commodity markets (see also Feranec et al., 2010).

Our research also confirms that changes in drivers can trigger different processes. For instance, population growth can trigger intensification of agriculture as well as urbanisation whereas its decline causes abandonment of agricultural land. Another example is changes in policy – while the CAP directed subsidies toward food security in the 20th century, nowadays its main goal is to secure biodiversity in the landscape resulting in the extensification of agriculture and greening processes.

We can conclude that the results presented here partly support Antrop's (2005) suggestion to distinguish landscapes before the Second World War and the post-World War landscapes since the rate of change and the actors and driving forces as well as their contributions and interplay show fundamental differences between the two phases. However, we would add a third milestone and distinguish a post-socialist/post-millennial landscape, which is characterised by accelerated abandonment but also by increasing efforts to stop this process and to combat the decreasing loss of biodiversity connected with agricultural intensification.

Acknowledgements

This work was supported by the Silva Tarouca Research Institute under Grant VUKOZ-IP-00027073 and by Scientific Grant agency of the Ministry of Education of Slovak Republic and Slovak Academy of Science (project No. 1/0421/16).

Appendix 1 – List of publications included in the review

- Austria: Kleijn and Sutherland (2003); Krausmann (2001); Krausmann et al. (2003); Krausmann et al. (2008); Sklenicka et al. (2014)
- Czech Republic: Bičík et al. (2001); Bicik and Jelecek (2009); Breuer et al. (2010); Chromý et al. (2003); Grešlová Kušková (2013); Havlíček et al. (2012); Kuskova et al. (2008); Munteanu et al. (2014), Skaloš et al. (2012); Sklenicka et al. (2014); Skokanová et al. (2012)
- Eastern Germany: Haase et al. (2007); Kleijn and Sutherland (2003); Kroll and Haase (2010); Wulf et al. (2010)
- Western Germany: Bender et al. (2005); Bieling et al. (2013); Breuer et al. (2010); Hietel et al. (2005); Jaeger et al. (2007); Kleijn and Sutherland (2003); Kroll and Haase (2010)
- Hungary: Biró et al. (2013); Kohlheb and Krausmann (2009); Munteanu et al. (2014), Sallay et al. (2012); Szilassi et al. (2010); Varga et al. (2013)
- Poland: Klich et al. (2013); Kozak (2003); Kuemmerle et al. (2008); Latocha (2013); Łowicki (2008); Munteanu et al. (2014)
- Slovakia: Bezák and Mitchley (2014); Bezák and Petrovič (2006); Blažík et al. (2011); Kanianska et al. (2014); Kopecká et al. (2012); Kuemmerle et al. (2008); Kuskova et al. (2008); Lieskovský et al. (2013); Mojses and Petrovič (2013); Munteanu et al. (2014), Petrovič (2006)
- Switzerland: Bürgi et al. (2010); Gellrich and Zimmermann (2007); Hersperger and Bürgi (2009); Kleijn and Sutherland (2003); Muller et al. (2010); Schneeberger et al. (2007).

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