SELECTED CHANGES OF ARABLE LAND IN SLOVAKIA AND BULGARIA DURING THE PERIOD 1990–2006

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Abstract

Changes in arable land use in Slovakia and Bulgaria over two time horizons (1990 to 2000 and 2000 to 2006) are characterized in this paper. Two data layers of land cover changes of the CORINE Land Cover Data Base were used as entry data. The evaluation of changes also considered statistical data about the changing structure of the land resources and sown areas of individual crops for the mentioned periods. The transition from a command economy to a market economy manifested itself in Slovakia by extensification of agriculture in submountainous areas, and by the spatial diversification of plant production as a result of transformation of the original cooperatives into smaller farms. In Bulgaria the changes were mainly represented by transformation of arable land to pastures and they were connected with the closures of agricultural collective farms.

Shrnutí

Změny ve využití zemědělské půdy na Slovensku a v Bulharsku v transformačním období (1990–2006)

Cílem příspěvku je charakterizovat změny ve využívání orné půdy na Slovensku a v Bulharsku ve dvou časových horizontech: v letech 1990 až 2000 a 2000 až 2006. Jako vstupy byly použity datové vrstvy změn krajinné pokrývky CORINE Land Cover a statistická data o měnící se struktuře půdního fondu a osevních plochách jednotlivých plodin za roky 1990–2006. Přechod od centrálně plánovaného hospodářství k tržní ekonomice se na Slovensku projevil především extenzifikací zemědělské výroby v podhorských oblastech a prostorovou diverzifikací rostlinné výroby v důsledku transformace původních družstev na menší podniky. Na území Bulharska jsme zaznamenali především přeměny orné půdy na trvalé travní porosty, což souviselo především se zánikem zemědělských podniků.

Keywords: *arable land, land use changes, CORINE Land Cover, Bulgaria, Slovakia*

1. Introduction

Understanding the patterns of land use change and its drivers is a key challenge for landscape ecology and land use science. The concept of land use transition highlights the assertion that land use change is non-linear and is associated with other societal and biophysical system changes (Lambin and Meyfroidt, 2010). The transition of agriculture in the post-communist countries has deeply affected land use in these countries where two different negative phenomena emerged: simplification of agro-diversity accompanied by the increase of monocultures (Kopecká, 2011; Varoščák, 2009), and abandonment of arable land which further manifests itself in the disappearance of the traditional landscape mosaic and eventual reduction of biodiversity (Zaušková, 2009; Sviček and Gasiorková, 2009; McDonald et al., 2000). These changes can be studied at regional or national levels using information from real estate cadastres, the LPIS (Land Parcel Identification System) database and statistical data concerning farmland resources. Baumann et al. (2011) analysed post-socialist farmland abandonment using Landsat images from 1986 to 2008. CORINE Land Cover (CLC) data layers that reflect the status of land cover in 1990, 2000 and 2006 are also useful in assessment of the changing structure of farmland resources on an all-European level. The CLC Project was conceived as part of the all-European CORINE (Co-ordination of Information on the Environment) Programme and its aim is to ensure collection, coordination and compatibility of land cover data for individual European countries from satellite images. Updating of the original CLC90 database applying more recent satellite images (CLC2000 and

CLC2006) makes possible not only the recognition of the most recent status of landscape structure but also the assessment of short-term landscape changes (Feranec et al., 2007; Feranec et al., 2009).

According to Baumann et al. (2011), the collapse of socialism resulted in widespread farmland abandonment, but the abandonment rate varied across different regions in different countries. The aim of this paper is to characterize changes in the agricultural use of arable land in the territory of two post-communist countries, Slovakia and Bulgaria, using CLC data layers. Since the spatial concentration of arable land changes is irregular and so is their area (from the minimum mapping unit size of 5 ha to several hundred hectares), relative values were used to document these changes, particularly percentages represented by the areas of selected changes in agricultural landscape per 1 km^2. Maps of the change rate in two time horizons (1990–2000 and 2000–2006) are included. These results imply the possibility of further cartographic applications of CORINE Land Cover data and their interpretation in combination with national statistical data.

2. Methodology

Based on satellite image interpretation, the CLC project has produced a compatible land cover (LC) database of Europe at a scale 1:100 000. The main output of the project is the CLC database providing information on the physiognomic characteristics of Earth surface objects approximately in the early 1990s, 2000 and 2006.

Two data layers of LC changes, CLC 1990–2000 and CLC 2000–2006 were used as input data. Detailed information about these data layers is available at http://www.sazpsk/corine and http://nfp-bg.eionet.eu.int/ncesd/bul/clc. The following types of changes were selected from individual layers:

1. Conversion of class 211 into class 231.
2. Conversion of 211 into 242.
3. Conversion of 211 into 243.

The first type represents the change of arable land into grassland. Apart from meadows and pastures, this type of LC includes sporadically unused farmland at initial stages of natural succession. The second type represents the change of arable land into a mosaic of fields, meadows and permanent cultures (complex cultivation pattern). In general, this class includes areas formed by alternation of parcels with annual and permanent crops. In the CLC 2006 mapping of the Slovak Republic (SR), this type of change also included conversion of cultural parts with large-scale farmed arable land into parts with small-block arable land. The third type of change documents transformation of arable land into land cover principally occupied by agriculture. This is the case of changes caused by abandonment of land in mountain and sub-mountain regions followed by natural succession. The spatial distributions of these classes are represented in Figs. 3 and 8.

The methodology presented by Feranec and Nováček (2007) was applied to the assessment of the rate of the above-mentioned changes (Fig. 1).

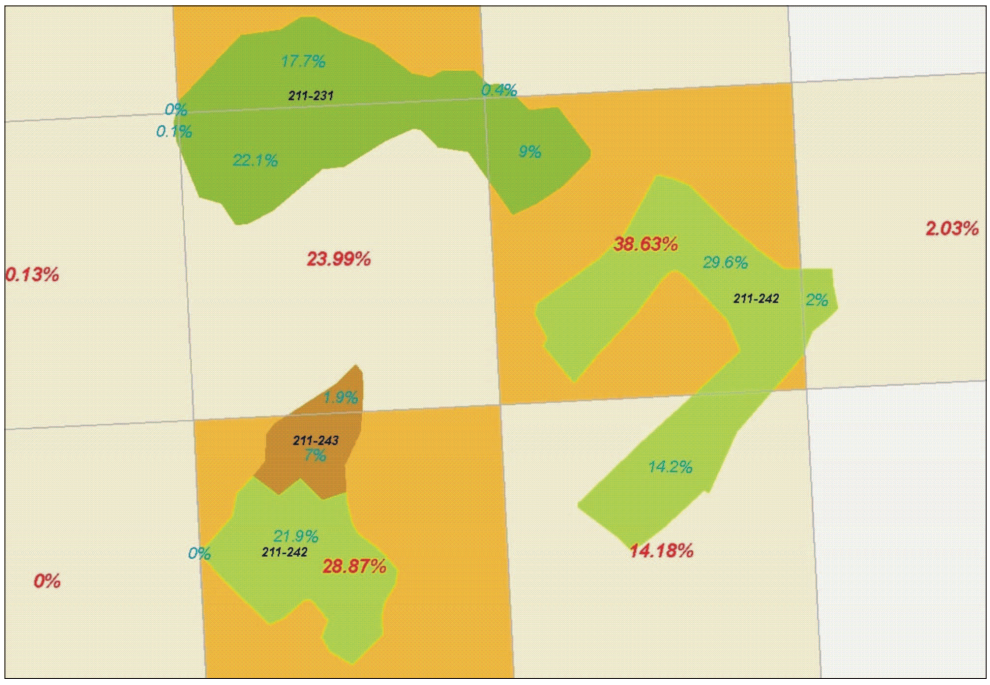

Fig. 1: Example of change rate assessment using the 1 × 1 km grid

According to percentages of changed areas per 1 km^2, the layer of CL change rate per 1 km^2 was divided into four intervals:

- less than 0.1% – no change,
- 0.1–25% – small change,
- 25.1–50% – considerable change,
- 50.1–75% – significant change,
- 75.1–100 % – complete change.

Figures 4, 5 and 9 demonstrate the rate of relevant changes.

The applied kilometre grid makes it possible to represent the frequency of changes that do not exceed 5 ha as well as at a comfortable map scale. As Feranec and Nováček (2007) report, the option for the 1 × 1 km grid was guided by its compatibility with the all-European grid developed for the database of environmental accounting (Land and Ecosystem Account Database, LEAC). This type of information can be compared to and combined with other environmental data, above all those appurtenant to GIS operations which are stored in a 1 × 1 km grid.

Recorded changes in agricultural land use were simultaneously evaluated in the context of overall changes in the structure of agricultural production. Data produced by national statistics offices concerning the changing structure of land resources and the sown areas of individual crops in the period 1990–2006, as well as available environmental and agricultural indicators from the EUROSTAT database, were also taken into account.

3. Slovakia

The total area of agricultural land in Slovakia (according to the real estate cadastre) as of 1st January 2008 amounted to 2,428,889 ha, almost half of the country's total area. This means that 0.45 ha of farmland and 0.26 ha of arable land fall to every inhabitant of Slovakia. Ownership of land in the Slovak Republic (SR) is considerably fragmented in spite of the twenty-year ongoing transformation process involved with restoration of the registry of plots. Regarding what was referred to as the "Hungarian inheritance code", 12.5 million registered plots with an average area of 0.45 ha and an average share of 12–15 co-owners are now the subject of the registry under restoration. The total 2.4 million ha of agricultural land include 52% registered on real property certificates, with the following classification: 1,054,128 ha (43.2%) owned by natural persons, 110,932 ha (4.5%) owned by legal persons and 99,415 ha (4%) owned by the State (source: MP SR 2007). This is one of the principal causes why large-scale farming still survives. Regarding an average farmed area of 119.2 ha per agricultural company, the Slovak Republic ranks second at the EU scale, following the Czech Republic.

The prevailing part of farms work on a leased land and regarding the under-developed land market, this trend holds (Tab. 1). Slow and complicated identification of ownership and fragmented ownership also contribute to conservation of the status quo. Slovakia, in an all-European context has the markedly lowest share of land farmed by owners (less than 10%). The land of unidentified owners and State-owned land is administered by the Slovak Land Resources and is available to lease. The business environment in the SR is still developing. The diminishing number of cooperatives and the increasing number of trade businesses prove this, although the greatest share in the area of farmed land corresponds to agricultural cooperatives.

4. Bulgaria

The total territory of Bulgaria is 11.1 million ha. The land for agricultural use in 2008 was 5,648,206 ha and occupied 50.9% of the country's territory. The utilised agricultural area (UAA) in 2008 was 5,100,825 ha, or 46.0% of the country's territory (Annual Agrarian Report, 2009).

The structural adjustment in Bulgarian agriculture after 1989, delays in land ownership restoration which lasted about 10 years, and the lack of consistent government agricultural policy in the first half of the 1990s resulted in different forms of land abandonment – ended or intermittent farming operations. According to the Annual Agrarian Report for 2009 of the Ministry of Agriculture and Food (MAF) of Bulgaria (http://www.mzh.government.bg/mzh/Documents/reports.aspx), the quantity of lands that are not included in the crop rotation system and are not used for agricultural production for more than two years in 2008 is 547,381 ha – which stands for 4.9% of the country's territory. The areas most affected by land abandonment are mountainous regions, which suffered from the collapse in animal breeding, as well as other disadvantaged regions, such as those with natural constraints and those with poor quality of soil. A study of the Institute of Economics at the Bulgarian Academy of Sciences „Agricultural Lands in Bulgaria: Employment and Incomes" (http://www.iki.bas.bg/en/node/651) shows that for the 10-year period since 1998, about 300 thousand hectares of agricultural lands are lost each year due to land abandonment or transfer of agricultural land for non-agricultural purposes to other sectors - industrial, recreational and protected zones, or for infrastructure and urban sprawl. Another

significant problem for Bulgarian agriculture is strong fragmentation of land ownership and a large number of small farmers (Tab. 1).

The land reform was initiated in 1991 and by 2000 it was almost completed. By the end of December 2001, 98.84% of agricultural land was restored land. The land reform created 8.7 million parcels of land and established approximately 5.1 million new landowners. Almost 65 percent of the population became (co-) owners of land (Kopeva, 2002). The reform produced extreme fragmentation of land ownership in Bulgaria. The average size of agricultural plots is 0.6 ha. The size of the plots varies by region, depending on natural conditions and crop structures – from 0.3 ha in the Smolyan NUTS 3 region to 3.0 ha in the Dobrich region (Annual Agrarian Report, 2009). The fragmentation of land ownership is a significant barrier to long-term investments in agriculture, land improvements and efficient use of agricultural machinery and there is a clear need for land consolidation actions. Based on experience gained during the implementation of pilot land consolidation projects, in 2007 the Law of Agricultural Land Ownership and Use was amended to include rules for voluntary land consolidation (Rural Development Programme). Bulgaria (together with Slovakia and the Czech Republic) has the lowest share of own-farmed utilized agricultural area in Europe. Development of the land rental market, through consolidating land use, helps to overcome the problem of fragmented land ownership. The provision of land for tenant farming continues to be a priority preference for land tenure by the owners. According to the Annual Agrarian Report in 2008, a total of 154,510 tenant contracts were concluded for 327,955 hectares of land. In 2008, land tenants (co-operatives and leaseholders) numbered 7,470. The average size of land leased by one tenant is 43.9 hectares. In 2008, there is an ongoing trend of reducing the area of agricultural land use at the expense of an increase in all other areas, mainly urban and forest.

Indicator	Unit	Slovakia	Bulgaria	EU - 27
Utilized agricultural area - UAA	*1,000 ha*	1,879	2,729	156, 039
Share of utilized own-farmed area	*%*	9,1	17.0	53.6
Number of agric. holdings	*1,000*	68.6	534.6	14,478.6
Share of legal entities in number of holdings	*%*	11.9	2.7	3.2
Share of UAA farmed by legal entities	*%*	81.8	56.0	25.5
Total farm labour force	*1,000 AWU*	99	625	12,714
Family farm labour force	*% of total*	43	87	81
Agric. holders over 65 years old	*1,000*	20	222	4,722

Tab. 1: Comparison of selected agricultural indicators of Slovakia and Bulgaria (UAA – Utilized Agricultural Area, AWU – Annual Work Unit). Source: EUROSTAT (2009)

5. Results

The total area of agricultural land has been steadily decreasing in the past decades in Slovakia. As evident from Fig. 2, this decrease was also accompanied by the decrease in the area of arable land. The reduction in arable land was partially due to expanding construction but mostly to conversion of arable land into grasslands.

The soils of Slovakia, as a primarily mountainous country, contain a high share of low-productive soil types and those that are specifically disadvantaged (waterlogged, sandy or skeletal types). The size of disadvantaged areas amounts to 1,225,764 ha, or some 50% of the agricultural land resources. Analysis of CLC data layers indicated that in 1990–2000, extensification of agricultural production became obvious especially in mountain and sub- mountain regions (Fig. 3). In total, 271 changed polygons of CLC class 211 to classes 231, 242 and 243 with an overall area of 17,728 ha, were recorded. The dominant type of change was that of arable land into mosaics of fields, pastures and permanent cultures. Conversion of arable land into permanent grasslands was observed in particular in the areas of Orava, Kysuce and Slovenské Rudohorie Mts. Agricultural activities support the settlement of these less favoured areas and help to maintain the landscape diversity.

In the period of 2000–2006, with the progressive implementation of common agricultural policy into the agrarian system, spatial diversification of arable land in the area of the Danube Lowland, with high levels of diversification, was observed due to the transformation of original cooperatives into smaller firms. The recorded changes imply 407 polygons with a total area of 4,067.46 ha. Conversion of class 211 into 242 dominated in this case as well.

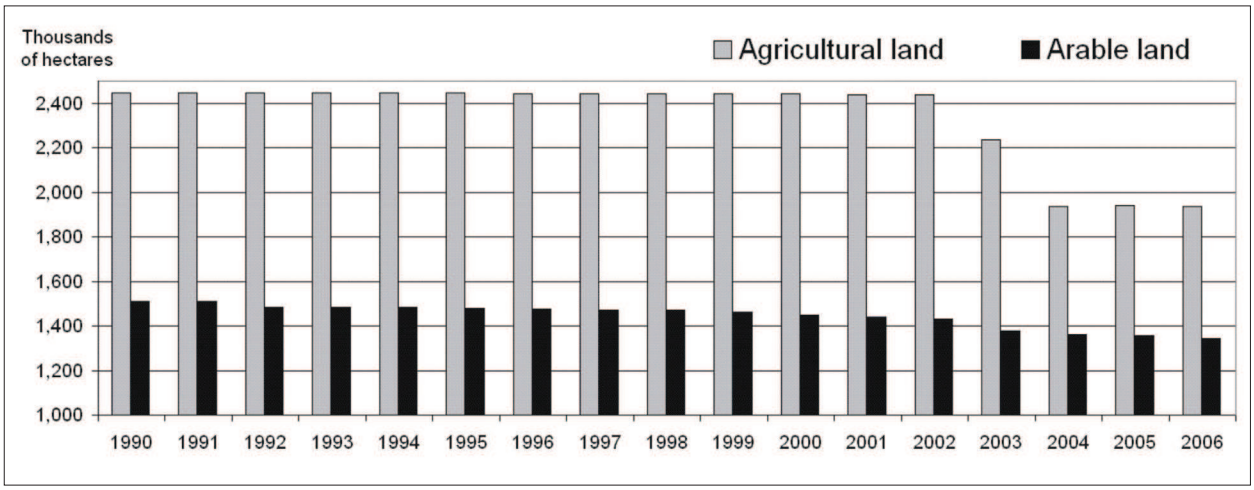

Fig. 2: Area of agricultural and arable land in Slovakia in 1990–2006

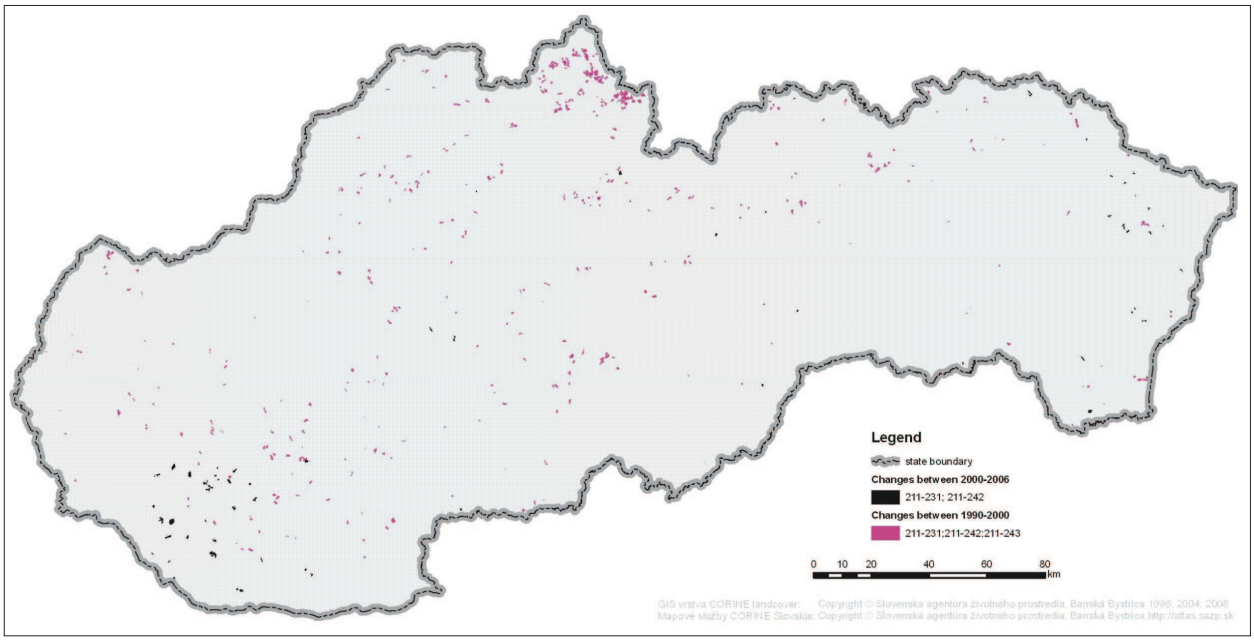

Fig. 3: Change of arable land into permanent grassland, mosaic of fields and meadows, and agricultural land with the significant share of natural vegetation in Slovakia in 1990–2006

Fig. 4 presents the spatial distribution of change rates of arable land into selected land cover classes in Slovakia in the period 1990–2000. Such graphical output provides suitable materials for combination with various elements of topographic maps and the data contained in thematic maps. Areas of small changes (0.1–25% of LC changes) occur irregularly in all sub-mountainous regions of the country. Areas of considerable changes (25.1–50%), significant changes (50.1%–75%) and complete changes (75.1–100%) were observed above all in the region of Orava.

In the period 2000–2006, all the change rate categories were recorded in the Danubian Lowland (Fig. 5). Areas of small changes occur also in Eastern Slovakia.

Graph in Fig. 6 presents a more detailed classification of change rate per sq. km in the period of 1990–2000. Obviously, more than a half of grid cells were affected by changes in question in the rate of 0.1–10%. The most extensive were the grid cells with 20,1–30% change rate.

In the past decades, the total area of agricultural land has been decreasing also in Bulgaria. The decrease in arable land was even more intensive than in Slovakia (Fig. 7). Out of 4,643,000 ha of arable land farmed at the end of socialist times, more than 1,550,000 ha were changed in 2006.

Based on the CLC analyses, arable land in the territory of Bulgaria changed above all in the years 1990 and 2000 (Fig. 8). These changes were mainly represented by the transformation of arable land to pastures, and they were connected with the closing down of agricultural collective farms.

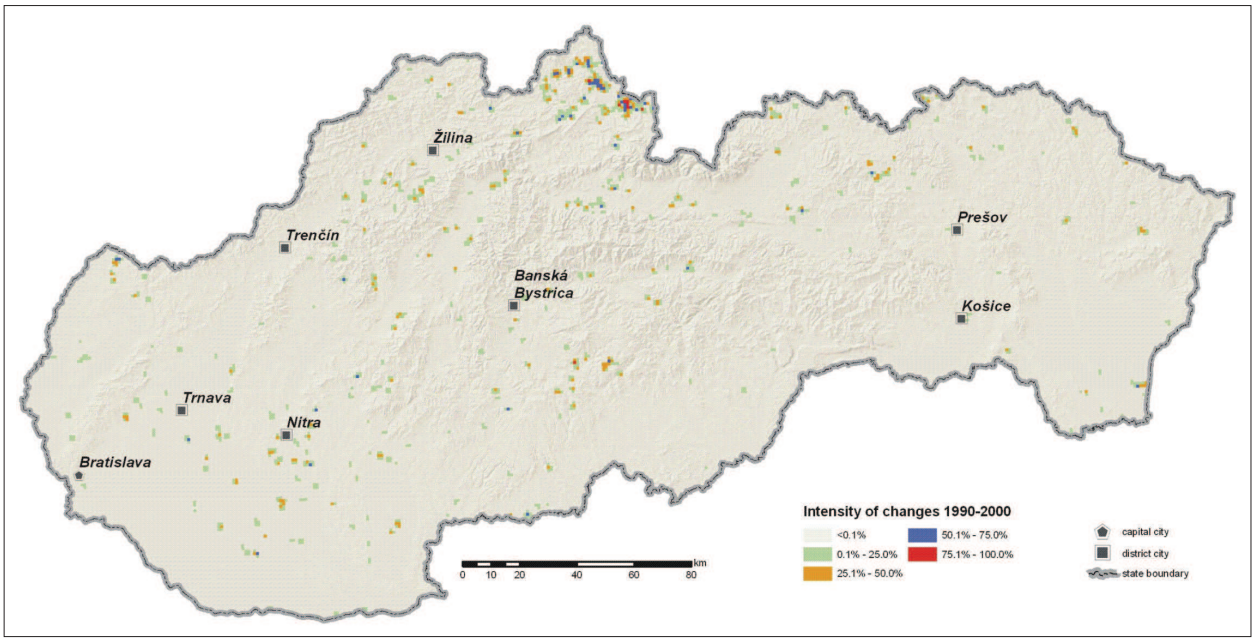

Fig. 4: Change rate of arable land in Slovakia in the period of 1990–2000

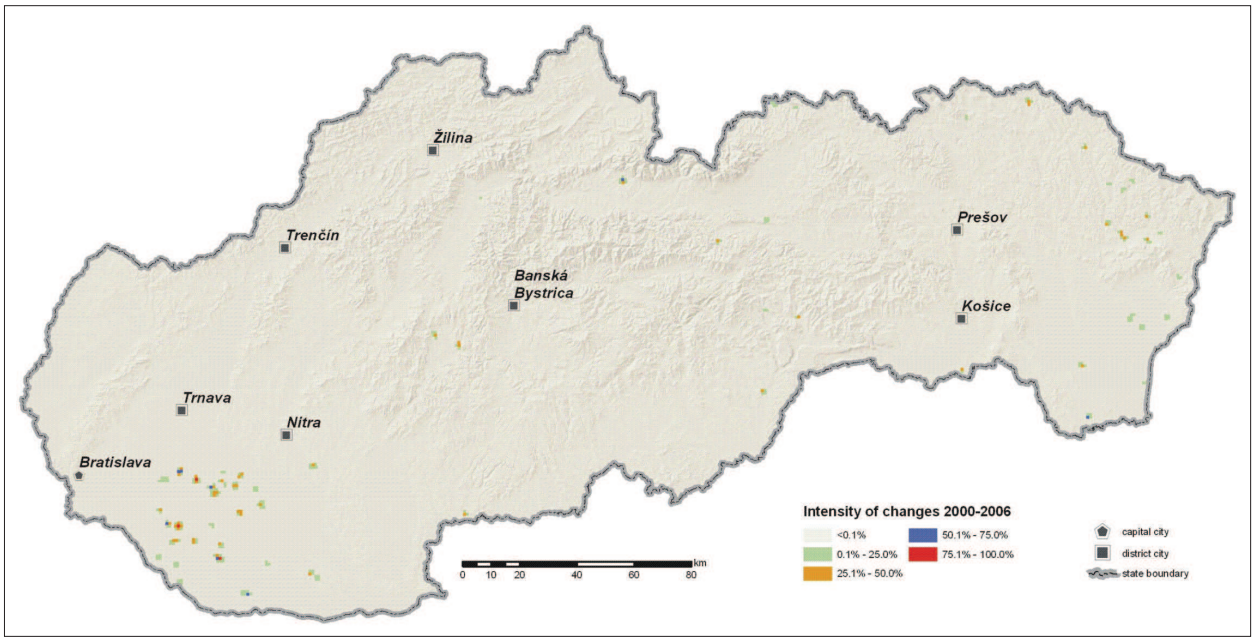

Fig. 5: Change rate of arable land in Slovakia in the period of 2000–2006

During the period 1990–2000, different change rate categories (considerable, significant and complete changes) were observed in the regions of Sofia, Plovdiv – Stara Zagora (the Upper Thracian Lowlands), as well as Veliko Tarnovo – Pleven – Montana (the Danubian Plain). Areas of small changes were registered in the Varna region (the northern Black Sea coastal zone).

As only minimum changes of arable land were observed in the time horizon of 2000–2006 in Bulgaria (only one polygon of class 211 into class 242 was observed), no separate map of the change rate was produced for that period.

The spatial distribution of CLC change intensity over the territory of Bulgaria is shown in Fig. 9, the number of grid cells and the respective area divided in 10% intervals. The maximum number of grid cells (236) are gathered in the 0.1–10.0% interval with an equivalent area of 835 km^2 (83,500 ha). The maximum changed area – 1,945 km^2 (194,500 ha) is in the range of 20.1–30%, represented by 77 grid cells.

In the graph for Bulgaria (Fig. 10), the change rate is similar to that in Slovakia in the same time horizon. In this case too, the highest number of grid cells was in the 0.1–10% rate and the most extensive

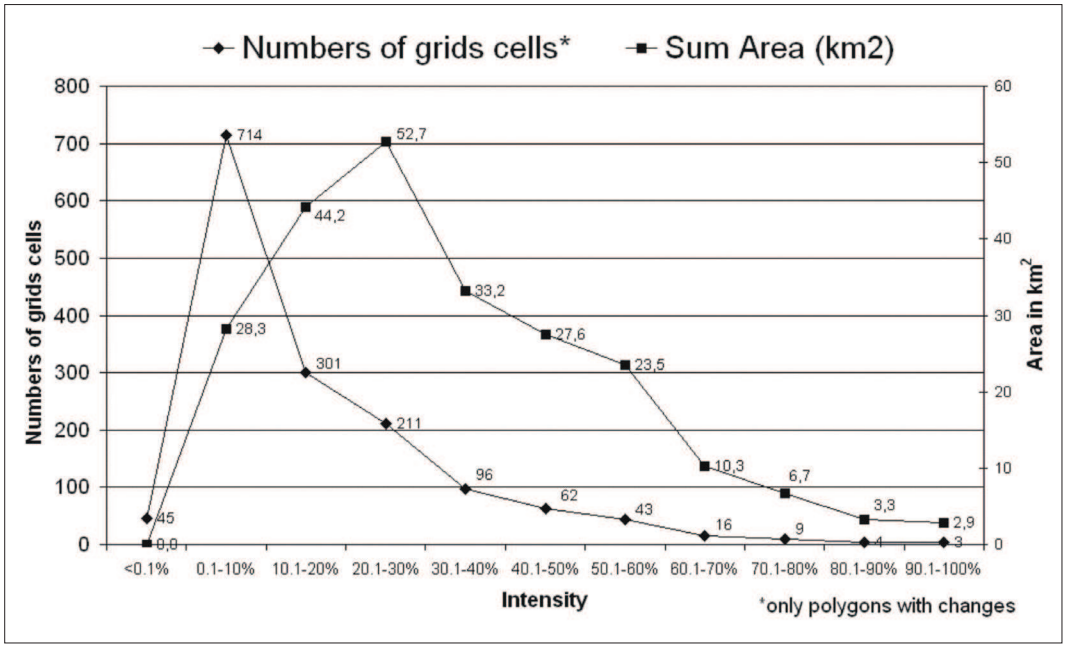

Fig. 6: Change rate of arable land in Slovakia in the period of 1990–2000

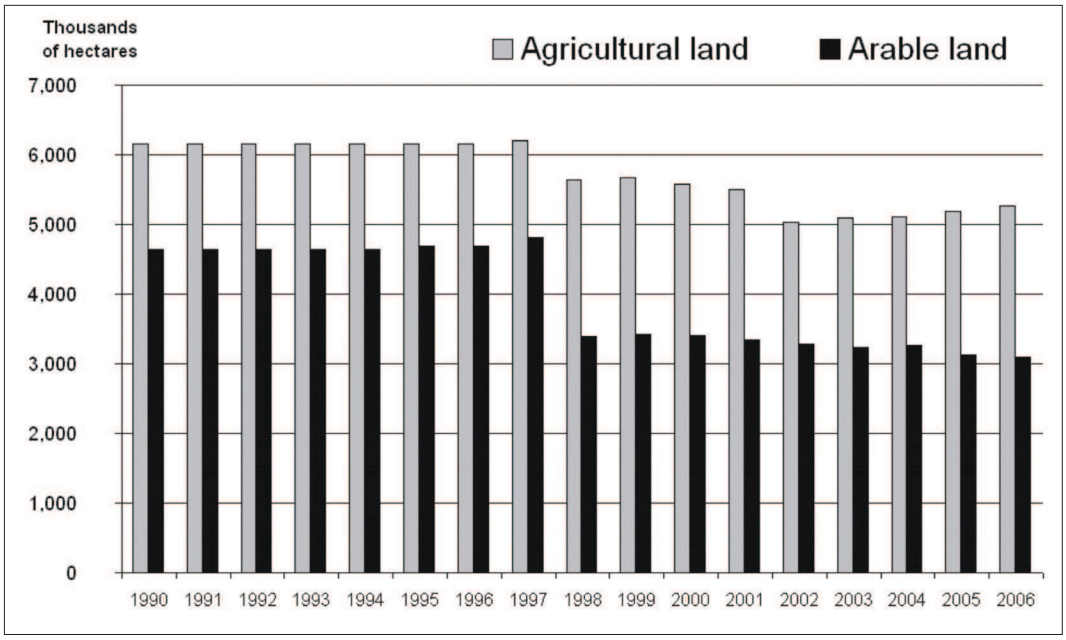

Fig. 7: Area of agricultural and arable land in Bulgaria in 1990–2006

changes were those with the 20–30% change rate. Figures 9 and 10 reflect the predominance of small area changes in Bulgaria.

Transformation processes in post-communist countries after 1989 have affected significantly the utilization of landscapes. The progressive transition from the planned economy to the market economy in both countries was accompanied by a gradual decrease in sown areas and the scale of cultivated crops. A simplification in crop diversity accompanied by the increase of monocultures is one of negative phenomena, which results in the disappearance of the traditional landscape mosaics and reduction of agro-biodiversity. In general terms, conventional, intensively farmed arable land is a poor habitat for species. For many species, however, arable land provides extensive, undisturbed foraging areas. The pattern of cultivation crop rotation and, in particular, the timing of various management activities is an important factor governing the ability of these animals to use arable land.

Changed macro-economic conditions were manifested in a marked limitation of grown vegetables, sugar beet, potatoes and legumes in Slovakia. As the numbers of

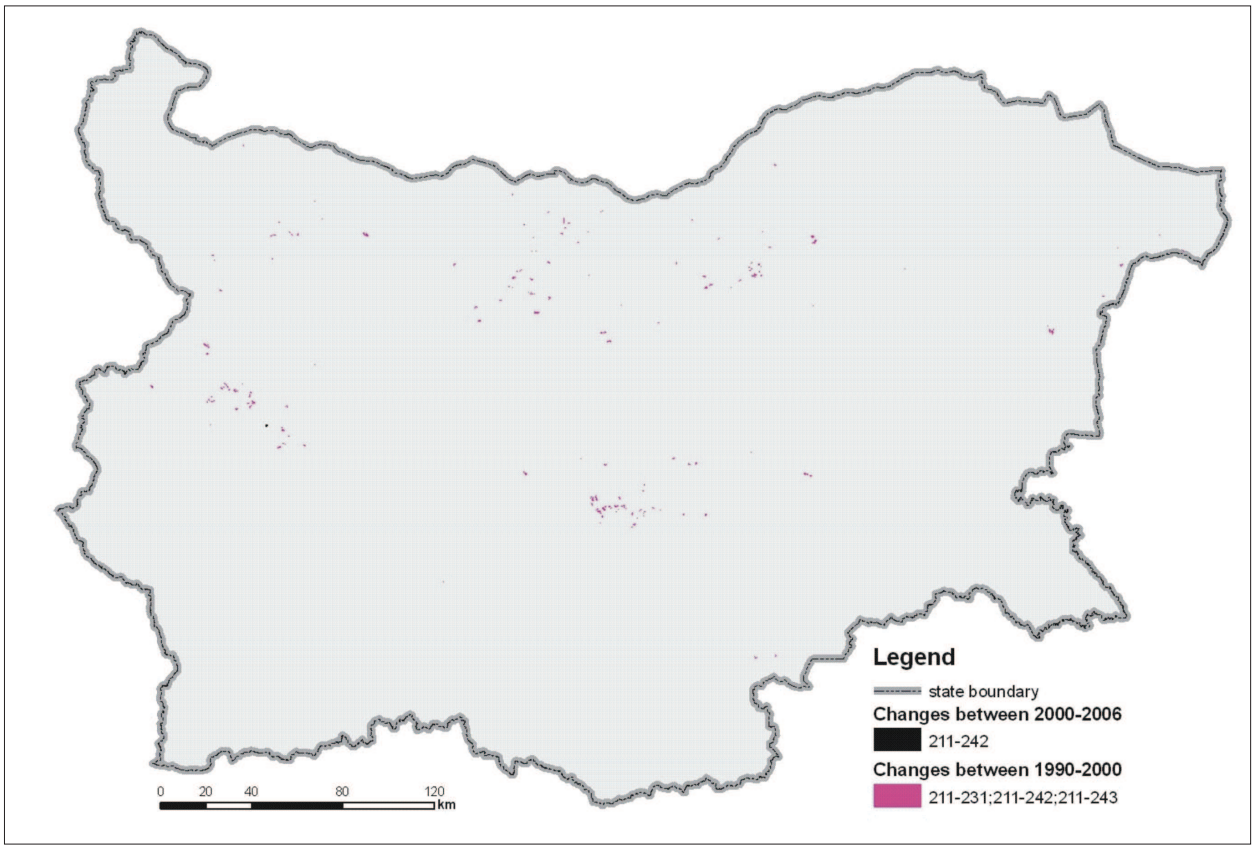

Fig. 8: Change of arable land into permanent grassland, mosaic of fields and meadows, and agricultural land with the significant share of natural vegetation in Bulgaria in 1990–2006

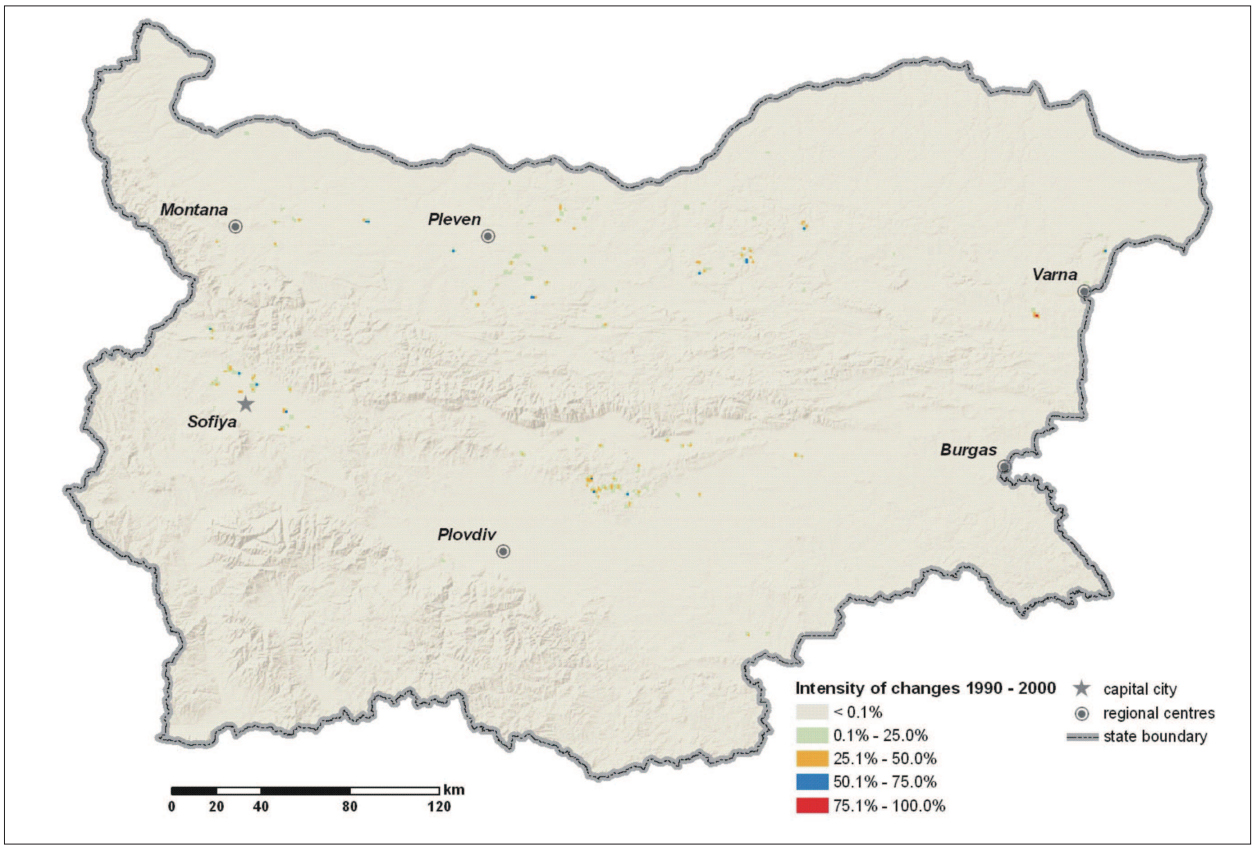

Fig. 9: Change rate of arable land in the period of 1990–2000 in Bulgaria

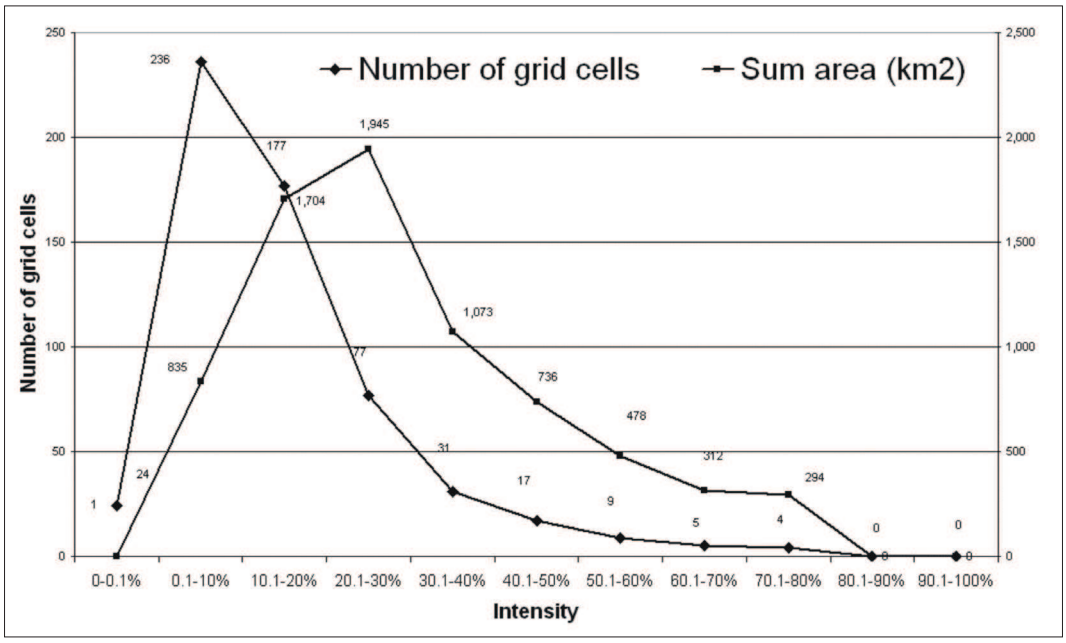

Fig. 10: Change rate of arable land in Bulgaria in the period of 1990–2000

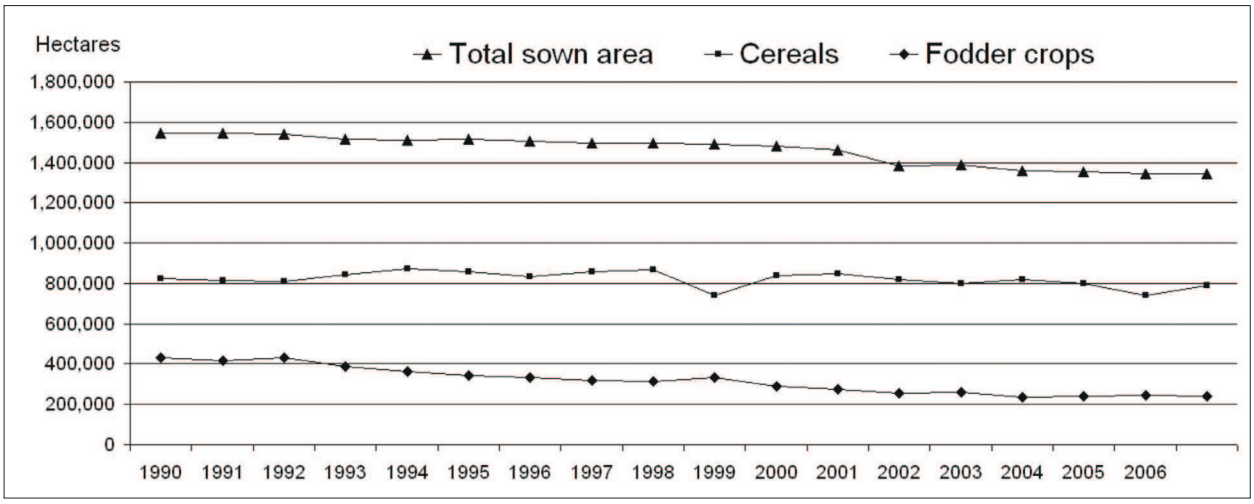

Fig. 11: Total size of sown area, cereals and fodder in Slovakia 1990–2006
Source: Statistical Office of the Slovak Republic

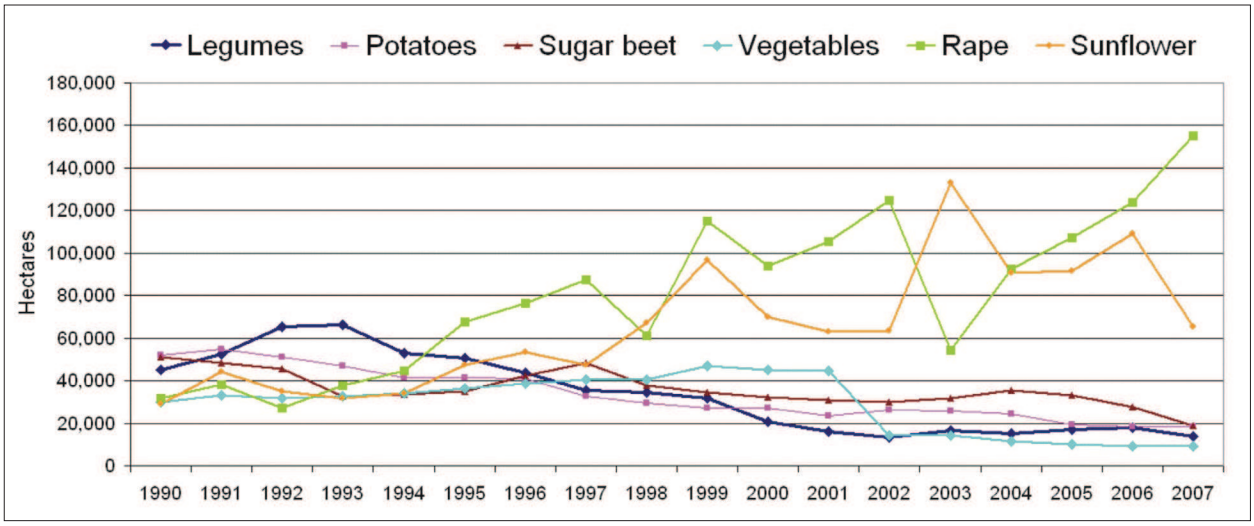

Fig. 12: Sown areas of selected crops in Slovakia. Source: Statistical Office of the Slovak Republic

farm animals dramatically dropped, the area of grown fodder decreased by 45%. In spite of the decreasing area of farmed arable land, the area of grown cereals remained relatively constant. Cereals replaced a substantial part of the originally grown crops. In turn, the area of grown oleaginous plants substantially increased (Figs. 11 and 12). For example, the area with rape seed increased from 31,762 ha in 1990 to 155,220 ha in the year 2007.

In Bulgaria, a general tendency to genetic and ecological uniformity in agro-ecosystem management is observable. The area of traditional crops, including different sorts of vegetables, leguminous plants, sugar beet and fodder plants is decreasing (Figs. 13 and 14). For example, sugar beet was planted on the area of 36,479 ha in 1990, but only on 1,356 ha in 2006. On the other hand, the area of sunflower increased from 280,203 ha in 1990 to 750,521 ha in 2006.

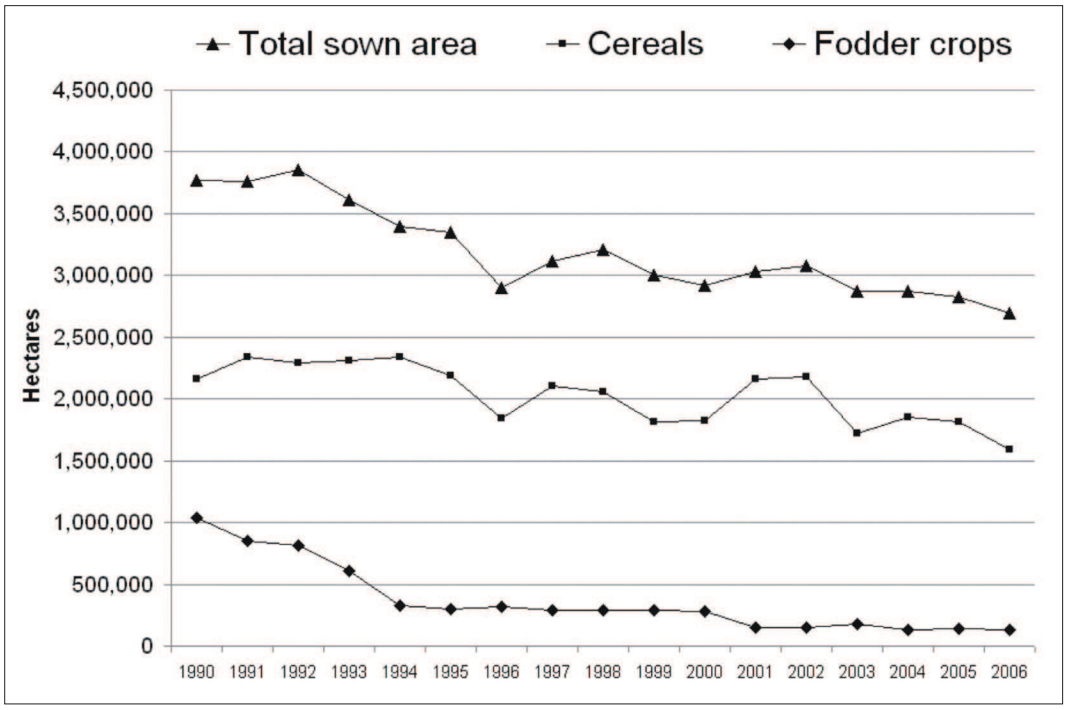

Fig. 13: Total size of sown area, cereals and fodder in Bulgaria 1990–2006. Source: National Statistical Institute

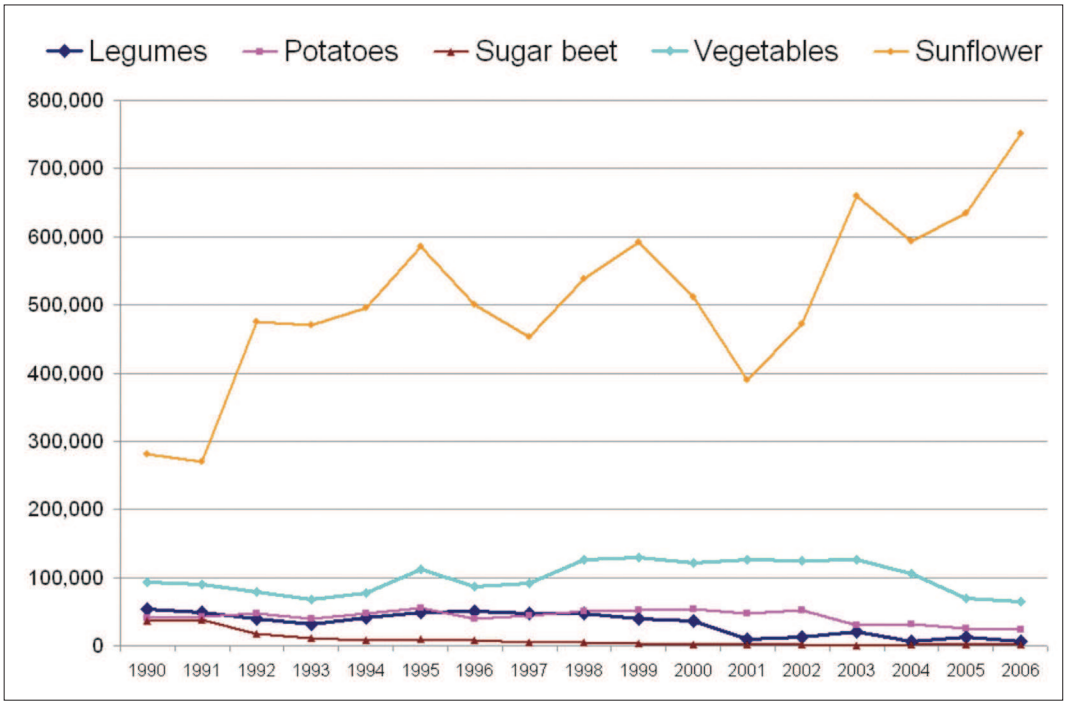

Fig. 14: Sown areas of selected crops in Bulgaria. Source: National Statistical Institute

6. Discussion and conclusion

As pointed out by Baumann et al. (2011), differences in abandonment patterns between Europe's West and East may reflect fundamentally different underlying causes that triggered abandonment and farmland changes. In Western Europe, abandonment appears to be mainly driven by gradual industrialization, market-orientation and urbanization (MacDonald et al., 2000). In contrast, abandonment in Eastern Europe was caused by the collapse of socialism and the following radical institutional and economic reforms.

CLC data make it possible to obtain more detailed information about the spatial spread of analyzed and assessed changes in the agricultural landscape, compared to statistical data related to administrative units which lack spatial identification. Accuracy of the content of CLC data oscillates around 87% (Büttner and Maucha, 2006). Spatial identification and content precision are considered important properties of the data, which represent the information source for the analysis, and assessment of changes in the agricultural landscape.

Our results document similar trends in arable land changes in Slovakia and Bulgaria between 1990 and 2006. We found more intensive farmland changes in the period 1990–2000. The period after the year 1990 was connected with the transformation of agricultural cooperatives in the former socialist countries. Processes of massive privatisation and restitution had crucial impacts on their economies because of the extraordinary drop in the numbers of agricultural workers, obsolete technologies, low buy-up prices of agricultural products, high prices of modern technologies and some other factors (Kopecká et al., 2008). Statistical data related to crop production document changes in agriculture management practices that significantly affected the utilization of agricultural landscapes.

In spite of the fact that information from CLC is not sufficiently detailed and cannot replace information from other quoted sources, this presentation and evaluation, applying a singular European methodology, facilitates international comparison of the rate of selected transformation processes and contributes to a better understanding of its drivers.

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