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POLITICAL CHANGES AND CONSEQUENCES OF THEIR ACTIONS FOR LAND COVER IN THE CZECH REPUBLIC AFTER 1989

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Political changes and consequences of their actions for land cover in the Czech Republic after 1989.

The article deals with land cover change at a countrywide scale in the Czech Republic (i.e. Czechia) after the demise of the Communist regime in 1989. By using satellite images and calculating the change index, we were able to monitor the shifts from one class to another. Using a second method, we were able to analyse the differentiation within land cover structures within the individual spatial units (regions) of Czechia in 1990 and 2000. The article focuses on the consequences of political and economic processes as well as the determining influence of natural conditions on agriculture. With regard to the structure of land cover classes, the data revealed the growing heterogeneity of the regions of Czechia. Prior to 1989, the influence of the centrally planned economy on the uniformity of the land cover was considerable. Natural conditions did not play such an important role. By the end of the period of transformation, around the year 2000, the role played by natural conditions had become key in the changes in land cover.

Key words: Land cover changes, driving forces, political changes, CORINE database, Czechia

INTRODUCTION

Landscape systems are increasingly treated as exemplars of interconnected natural and human systems (frequently socioecological systems, which are considered here to be exactly synonymous). Changes in land systems reflect socioeconomic processes that operate at a very wide range of spatial and temporal scales, including globalization, trade and markets, policy and land management decisions at the national, regional, local, or household/individual level. McNeill et al. (1994). define political driving forces (degree of public participation: open/closed, centralized/decentralized, decision making processes etc.) as the primary human driving forces behind land use change.

Land use is the result of interaction between physical, social, economic and legal factors within specific geographical contexts. Technical and methodological developments that will help to address land use issues and decision-making processes include spectral, spatial and temporal resolutions in remote sensing, increased quantity and quality of data from existing and new remote sensing platforms, movement toward interoperability in GIS, and construction of novel modelling methods that focus on provision of integrated understanding of land use systems (Hill and Aspinall 2000).

The terms “land cover” and “land use” are not synonymous. Land use can be described in the formula “Land use = land cover + land utilization” (Burley 1961). Land use includes everything land is used for by residents of the country, from farms to golf courses, houses to fast food establishments, hospitals to

graveyards. Land cover refers more to the vegetational and artificial constructions covering the land surface (Lindgren 1985). Land cover, a concern principally of the natural sciences, denotes the physical state of the land; it embraces, for example, the quantity and type of surface vegetation, water and earth materials. However, land cover classes include artificial or human-made areas, e.g. urban fabric, roads, ports, dump sites, or mineral extraction sites (Zonneveld 1988).

Land use, primarily a term of social scientists (economists and geographers) and planners, denotes the human employment of the land, includes settlement, pasture and recreation. Land use change at any location may involve either a shift to a different use or an intensification of the existing one. Land cover changes in two ways: 1) conversion – change from one class of land cover to another (from grassland to cropland, for example), 2) modification – change of condition within a land-cover class, such as the thinning of a forest or a change in its composition (Coppin et al. 2004).

Human driving forces mirror human goals in land uses, and the land use change that drives land cover change, in turn, is shaped by human driving forces. The range of social, economic, political, and cultural attributes of humankind that shaped the direction and intensity of land use. Land cover change may also lead to secondary environmental impacts, e.g. biodiversity loss, microclimatic change, water flow and water quality changes, soil erosion and degradation (Meyer and Turner 1994). Environmental changes also have feedback effects on land cover, land use, and human driving forces. These effects, real or perceived, have a further set of human dimensions to the extent that they provoke societal responses intended to manage or mitigate harmful changes.

Watson et al. (2000) describe the relationship between changes in land cover and land use and global warming, and with the production or reduction of greenhouse gases. For example, the most important land use changes that result in CO_2 emissions and removals are: changes in forest and other woody biomass stocks, forest and grassland conversion. The conversion of forest and grasslands to pasture, cropland, or other managed uses can significantly change carbon stored in vegetation and soil.

Land use science can be defined as an inclusive, interdisciplinary subject that focuses on material related to the nature of land use and land cover, their changes over space and time, and the social, economic, cultural, political, decision making, environmental, and ecological processes that produce these patterns and changes (Aspinall 2006). A variety of theories, methodologies, and technologies underpin research on land use science, and, consequently, a number of basic and applied science themes that are characteristic of land use research can be identified. These reflect the interdisciplinary and integrated analysis required to comprehend land use, as well as the role and importance of land use, land use change, and land cover management and policy, and the importance of land use for sustainability (Raquez and Lambin 2006).

Land use science is also an applied science with clear links to policy and practice through decision making and other intervention and action on land use and land cover. Application of land use science to understanding the practical consequences of change for human and environmental systems and their com-

ponent subsystems potentially provides links to a wide variety of areas of concern in environmental management and provision of ecosystem services (Haberl et al. 2004 and Rounsevell et al. 2005). Three issues seem particularly important in relation to emerging trends and needs for land use sciences as an applied science: 1) addressing evolving public and private land management issues and decisions, 2) interpretation and communication of scientific knowledge for adaptive management of change in land use systems, and 3) understanding human and environmental responses to change. Communication of case study content and information on land use change is no less important today, not only for input to policy and land management decisions, but also for understanding local human processes that produce many aspects of contemporary change in land use and land cover (Aspinall 2008).

The authors of this paper try to find answers to the following questions: In what ways has land cover changed in Czechia following 1989? What are the prevailing trends in the development of land cover? How has it varied in the individual regions of Czechia? Can we detect similarities and cluster the individual regions into specific types? Can we arrive at a typology of regions based on land cover changes? In what ways have land cover change impacted on other basic economic and social characteristics of the regions and Czechia and vice versa?

METHODS

To monitor land cover changes, many scientists make use of satellite images from the Landsat TM (e.g. Walsh et al. 2004, Iovanna and Vance 2007, Porter-Bolland et al. 2007 and Kusimi 2008). The CORINE land cover project (CLC) is a major database tool for the comprehensive assessment of landscape development. It is suitable for the purposes of spatial analyses at various levels (predominantly at a regional and nationwide level, that is, at a larger scale). In this article, we deal with an area of approximately 79 000 km^2 (the size of the Czechia), mapped by means of the CLC databases from 1990 and 2000 at a scale of 1:100,000.

The CORINE project (COoRdination of INformation on the Environment) was set up in 1985. The aim of the project, established by the European Commission, was to gather, coordinate and ensure the consistency of geographical information on comparable landscape and natural resources in the Community. The programme consisted of several individual parts: Land Cover, Biotopes and Air. In 1991 the European Commission decided to extend the CORINE project to the countries of Central and Eastern Europe by means of the Phare programme. Former Czechoslovakia was among the first countries to become involved in the programme, working as early as 1991 on a pilot study of the suitability of the implementation of the CLS classification and methodology for Czechoslovakia. The vector database CLC1990 was generated through the interpretation of satellite images from the LANDSAT 5 TM taken between 1989 and 1992. The output of this effort was a land cover map at a scale of 1:100 000 with 44 land cover classes (Tab. 1; classes in Czechia). Because of the need to update the land cover data, in 1989 the European Environment Agency entered into cooperation with the European Commission Joint Research Centre on the

IMAGE2000 and CLC2000 projects (I&CLC2000, e.g. Perdigao and Annoni 1997, Steenmans and Perdigao 2001, Nunes de Lima 2005 and Feranec et al. 2007). The IMAGE 2000 project involved a database of satellite images of Europe acquired by the LANDSAT 7 ETM satellite. With a view to ensuring the comparability of the two databases, the primary methodological principles for processing the satellite images were retained. The minimum mapping unit was set at 25 ha, the minimum width of mapped linear objects was 100 m. Only planar objects (polygons) were identified. Another important part of the project was correction of the CLC1990 database.

Tab. 1. Land cover classes monitored in the Czechia (CLC1990, CLC2000)

1 Artificial surfaces	*24 Heterogeneous agricultural areas*
11 Urban fabric	242 Complex cultivation patterns
111 Continuous urban fabric	243 Land principally occupied by agriculture with
112 Discontinuous urban fabric	significant areas of natural vegetation
12 Industrial, commercial and transport units	**3 Forest and semi-natural areas**
121 Industrial or commercial units	*31 Forests*
122 Road and rail networks and associated land	311 Broad-leaved forests
123 Port areas	312 Coniferous forests
124 Airports	313 Mixed forests
13 Mine, dump and constructions sites	*32 Scrub and/or herbaceous vegetation associations*
131 Mineral extraction sites	321 Natural grasslands
132 Dump sites	322 Moors and heathland
133 Construction sites	324 Transitional woodland-scrub
14 Artificial, non-agricultural vegetated areas	*33 Open spaces with little or no vegetation*
141 Green urban areas	332 Bare rocks
142 Sport and leisure facilities	334 Burnt areas
2 Agricultural areas	**4 Wetlands**
21 Arable land	*41 Inland wetlands*
211 Non-irrigated arable land	411 Inland marshes
22 Permanent crops	412 Peat bogs
221 Vineyards	**5 Water bodies**
222 Fruit trees and berry plantations	*51 Inland waters*
23 Pastures	511 Water courses
231 Pastures	512 Water bodies

The results of a study of land cover changes at a regional scale reveal both, the regional specifics in the Czechia and the diverse landscape development of the regions of Czechia after 1989. By applying a modified methodology devised by Feranec et al. (2006), we assess land cover changes in all the regions of Czechia in 1990 and 2000. Based on the CLC1990 and CLC2000 data, we can monitor the mutual flows and shifts in land cover classes with their spatial location. The changes in land cover class were categorized into individual predominant types by means of the index of change of the relevant land cover classes:

$$I_Z = \frac{(P_2 - P_1)}{P_1} \times 100,$$

where P_1 stands for the size of a LC class at the beginning of the period under evaluation and P_2 the size of the LC class at the end of the period.

The first type – urbanization (or industrialization) – represents the change of agricultural, forest and semi-natural LC classes (21×-32×) into classes of artificial surfaces (11×-14×) and classes of mining, dumping and construction sites (13×) into industrial, commercial and transport units (12×). Four subtypes fall under this type:

U1 – enlargement of continuous or discontinuous built-up areas,

U2 – enlargement of industrial, commercial, transport built-up area and construction sites,

U3 – enlargement of exploitation of natural resources.

The second type – intensification of agriculture – is characterized by changes of mining and construction sites, classes of less intensive agricultural use and forest classes (13×, 231 and 243) into classes of a more intensive agricultural use (211, 221, 222 and 242). Under intensification of agriculture the following subtypes were identified:

I1 – enlargement of arable land,

I2 – enlargement of vineyards,

I3 – enlargement of orchards, fruit trees and berry plantations,

I4 – enlargement of complex cultivation pattern area.

The third type – extensification of agriculture – represents changes of classes of more intensive agricultural land use (211) into classes of an extensive agricultural use (e.g. changes of class 211 into 231 and 243 and classes 221, 222 into 211, 231 and 243). Under extensification of agriculture the following subtypes were determined:

E1 – reduction of arable land area,

E2 – reduction of vineyards,

E3 – reduction of orchards, fruit trees and berry plantations,

E4 – reduction of complex cultivation pattern area,

E5 – enlargement of land principally occupied by agriculture, but with significant areas of natural vegetation.

The fourth type – deforestation after felling or natural disasters (caused by wind, emissions or forest fires, etc.) – is interpreted according to the change of classes 31× into 324 or classes 31× and 324 into 211 and 243. It contains one subtype:

D1 – felling or natural disasters in forest areas (deforestation and enlargement of agricultural land).

The fifth type – forestation (natural overgrowing and cultivation of forest) – represents the change of classes 131, 132, 211, 231, 243 and 321 into class 324 and classes 211, 231, 243 and 324 into 311, 312 and 313:

F1 – natural or economic development of forest.

The sixth type – other changes contains the following subtypes:

O1 – enlargement of water areas,

O2 – reduction of water areas.

Using the second follow-up method, we analysed the differentiation of land cover structures in Czechia in 1990 and 2000. By applying a method to calculate the $\boldsymbol{\rho}$ metric, it was possible to determine the distance of structures of land cover classes between individual land units (Balej et al. 2008). The application of the metric may be of use in other scientific disciplines as well. Its principle is based on the following steps. Let A and B be such n-member sets of a_i, b_i, elements so that their sum equals 1. That is:

$$A = \{a_1, a_2, \ldots, a_n\}, B = \{b_1, b_2, \ldots, b_n\}, \text{ where } \sum_{i=1}^{n} a_i = \sum_{i=1}^{n} b_i = 1$$

Then the function defined by the formula

$$\rho(a,b) = 1 - \sum_{i=1}^{n} \min(a_i, b_i)$$

generates a metric space AB with the $\boldsymbol{\rho}$ metric.

Provided that the n-member sets represent percent values of a specific sign on the evaluated element of the system, the given metric is as follows:

$$\rho(a,b) = 100 - \sum_{i=1}^{n} \min(a_i, b_i).$$

The $\boldsymbol{\rho}$ metric is also suitable for application to the set of geographical sets (A_1 to A_{14}), where – in the case of our investigation of the changes in structures of land cover classes in the regions of Czechia between 1990 and 2000 – A_1 stands for the first region, A_{13} for the 13th region and A_{14} for Czechia. The $\boldsymbol{\rho}$ (a_1, a_{14}) metric defines by how much we are to decrease (or increase) the individual elements of, for example, the sets A_1 and A_2 (a_{1i} and a_{2i}), for which it holds true that $a_{1i} > a_{2i}$ (or $a_{1i} < a_{2i}$), in order to change A_1 to A_2.

Using the $\boldsymbol{\rho}$, proximity metric, we are able to investigate the "distance" (similarity or difference) of land cover class structures in the individual regions of Czechia. We are able to monitor the distance between the regions; distance between a particular region and Czechia over the same period (territorial aspect), or the distance by which a particular region has itself "distanced/ neared" over a certain period of time (temporal aspect). The uses to which the metric can be put are even more numerous. We are able to determine the distances between spatial sets of various scales and orders (districts, regions, and towns) or even various time frames.

We have included 13 individual area units (regions) and Czechia. Given the specific characteristics of the capital Prague, for our purposes we merged Prague with the Central Bohemia Region (Tab 2).

Tab. 2. The basic characteristic of the regions of Czechia

	Area	Population density	Population	Migration (increase or decrease)	Share in GDP (CR=100)	Share in GDP (EU25=100)	Registered unemployment rate	Agricultural land	Arable land	Cattles
	km^2	inh. per km^2	inh.	‰	%	%	%	%	%	thous. pcs
PH	496	2 386.2	1 183 576	5.3	24.0	154.8	2.7	41.9	30.8	153
CC	11 013	105.9	1 166 537	14.1	10.4	68.6	5.3	60.5	50.3	
JC	10 056	62.5	628 831	3.2	5.5	66.4	5.7	49.1	31.7	210
PL	7 561	73.1	552 898	5.7	5.0	69.4	5.6	50.5	34.8	156
KV	3 315	91.9	304 573	0.3	2.2	55.9	9.2	37.5	16.9	36
UL	5 334	154.3	823 193	-0.2	6.5	60.1	13.8	52.0	34.6	40
LB	3 163	135.9	429 803	3.3	3.5	62.4	7.0	44.4	21.6	41
HK	4 758	115.4	549 122	2.7	4.7	65.0	6.3	58.7	40.6	109
PR	4 519	112.2	506 808	3.2	4.1	61.0	6.9	60.5	44.2	120
VY	6 926	73.8	511 114	1.1	4.2	62.7	7.1	59.5	46.1	216
JM	7 067	160.0	1 130 990	2.1	10.0	67.4	8.8	61.0	50.7	75
OL	5 139	124.4	639 423	0.9	4.7	56.1	9.0	54.8	40.8	97
ZL	3 964	148.8	589 869	0.0	4.7	59.8	7.8	49.3	31.7	59
MS	5 555	225.0	1 249 909	-1.0	10.4	63.2	12.6	49.9	31.4	79

Note: The regions are designated as follows: Prague (PH), Central Bohemia Region (CC), South Bohemia (JC), Plzeň (PL), Karlovy Vary (KV), Usti nad Labem Region (UL), Liberec Region (LB), Hradec Kralove (HK), Pardubice (PR), Vysočina (VY), South Moravia (JM), Zlin (ZL), Olomouc (OL), Moravia-Silesia (MS). Share in GDP (¯EU25=100).
(Source: Czech Statistical Office).

THE CZECHIA FOLLOWING THE POLITICAL SHIFT OF 1989

The development of the former Czechoslovakia took a whole new direction after 1989, with the so-called Velvet Revolution – a massive shift that became apparent in practically all areas of human activity. The political changes also had a marked effect on land use, which varied from region to region (see Tab. 3). We assess land cover change for two time horizonts (1990 and 2000) which have specific significance in Czechia (Bičík and Jeleček 2005). The selected time frame demarcates the transformation period in Czechia. This was preceded by the totalitarian period (1948-1989) and followed by the post-industrial period (Hampl 1998).

The totalitarian period (beginning with the German occupation of Czechoslovakia, taking us through the communist period and ending with the Velvet Revolution of 1989) represents the final phase of industrial society and a deviation from the natural trajectory that the development of Western Europe followed (where some aspects of post-industrial society were already becoming apparent). The totalitarian period was foreshadowed by the expulsion of the Germans (approximately 3 million inhabitants of German nationality were forced to leave the regions bordering on Germany, the Sudetenland). What followed was a fundamental disruption of the settlement structure in that area, the destruction of dwellings and a great number of residences and the fall into disrepair of numerous historical and cultural sites and buildings across almost one third of the territory of Czechia. At the same time, there was a weakening of the

bond between the local landscape and the new "settlers", resulting in the extinction of many local customs and traditions. In agriculture, the newly introduced centrally directed economy took its toll, with the collectivization and nationalization of private property (fields and private farms). Available sources state that only 1% of people were self-employed in Bohemia during the communist period.

The period of transformation (1990-2000) marks a major shift from a society dominated by the communist ideology to a civil society and market economy based on trade and price liberalization, the extensive land and privatization property, and the shaping and defining of a new legislative and institutional paradigm. This transformation involved major social consequences and translates into the area of agriculture as well.

The post-industrial period (2000 up to the present) and post-industrial society is characterized by the rapid development of communication and information contacts (which results in pressure on the transport and communication infrastructure) and a growing tertiary sector (services and travel industry). Within the settlement structure, there is an integration of the system and arrival of new trends (suburbanization and satellite communities). In the case of large centres, depopulating tendencies from the centres to the peripheries are evident. The changes in geo-positional circumstances lead to the rise to prominence of the formerly peripheral territories near the German and Austrian borders.

Since 2000 Czechia has been divided into 14 self-governing units, called regions (Fig. 1). These regions are very varied in number of inhabitants and size. The largest of the regions, that of Central Bohemia, is 4 times larger than the smallest region, Liberec. Similarly, the Moravia-Silesia region is 4 times as populous as the region of Karlovy Vary. The regions are internally very heterogeneous and very much based on the bonds between their centre and periphery. Prague is the centre not only of the Central Bohemia Region but also of Czechia. Brno (in the South Moravia Region) is the second largest metropolitan centre, followed by the agglomeration of Ostrava in the north (Moravia-Silesia Region) and the Ústí nad Labem and Karlovy Vary Regions. The size and significance of the centres is reflected in the area size of the respective regions.

The dynamics of the development of the regions is most marked in the regions west and south of Prague (Jančák and Götz 1997). These formerly peripheral regions became prosperous following the fall of the iron curtain, forming a kind of bridge between the Prague agglomeration and the "well-off" parts of Germany and Austria. These regions show minimal rate of unemployment which is never over 6%. The fundamental changes after 1990 and the integration of Czechia into the European Union brought about a more a dynamic development of the western regions, making them more attractive, both for migrants and for foreign investment. Conversely, the eastern regions have mostly been on the losing side in terms of migration. The decreasing economic gradient from west to east, which is also apparent in some other parts of Europe, applies here as well.

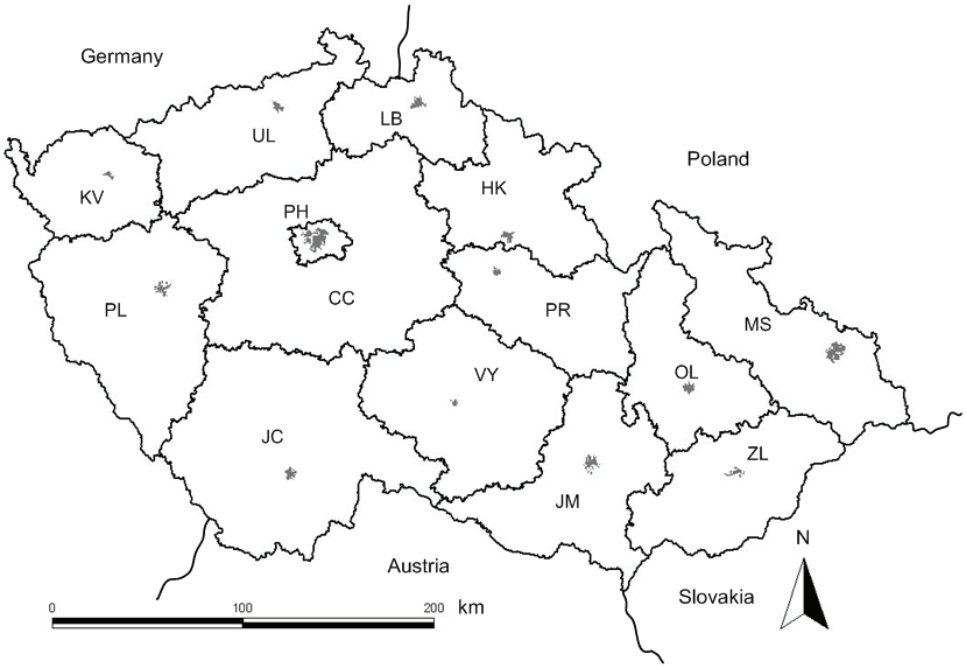

Fig. 1. The regionalization of Czechia

Tab. 3. Comparison of the basic characteristics of the regions of Czechia in the light of recent economic and social development

Region	Geosituation	Economic capacity	Rate of unemployment	Population growth	Migrational growth	Tourism
PH+CC	***	***	***	***	***	***
JC	***	**	*	**	**	***
PL	**	**	*	*	***	*
KV	***	*	**	***	*	***
UL	**	*	***	**	*	*
LB	*	*	**	***	**	**
HK	**	**	**	*	**	**
PR	**	*	**	**	**	*
VY	*	*	**	***	**	*
JM	**	**	**	*	**	**
ZL	*	*	**	**	*	**
OL	*	*	**	*	*	**
MS	*	*	***	*	*	*

Note: For the designation of the regions see Tab. 2; Comparison with the level of Czechia: geographic position, tourist potential – higher ***, average ** and lower *; economic performance (EU25=100) – higher *** over 100, average ** 65-99 and lower * under 65; rate of unemployment – higher * over 10.0 %, average ** 6.0-9.9 % and lower *** under 6.0 %; population growth – higher *** over 0.5 ‰, average ** 0.1-0.4 ‰ and lower * under 0.1 ‰; migration growth – higher *** over 5.0 ‰, average ** 1.0-4.9 ‰ and lower * under 1 ‰.

Based on their geographical position, natural conditions, economic and social indicators, we can classify the regions of Czechia into the following 5 types:

Type 1 – "centre-based" with a high representation of governing functions, dynamic development and a high GNP contribution (35% of the entire Czechia): Prague and Central Bohemia. The Central Bohemia Region, the greater part of which is situated in the fertile lowlands along the rivers Elbe and Vltava, is the leader among the regions in the ratio of arable land to the whole area size (almost 55%).

Type 2 – "prosperous" – growth predominantly due to their advantageous position near the German and Austrian borders, attractive for foreign investment: South Bohemia, Plzeň and Karlovy Vary Regions. The Central Bohemia Region, alongside the Pardubice and South Moravia Regions, are the agricultural regions of Czechia, with the percentage of arable land in excess of 50%. The Karlovy Vary Region and the Liberec Region are in the group marked by a low percentage of arable land (below 20%) and a high percentage of forest land (in excess of 40%).

Type 3 – "mountainous" with a rich potential for the travel industry: the Liberec and Vysočina Regions. Interestingly, because of their different historical development, these two regions share similar natural conditions, yet their land use varies. In the Liberec Region, forest land covers more than 40% of the area and arable land approximately 30%. In the Vysočina Region, undemanding agricultural crops (particularly potatoes) are grown in 53% of the territory, while forests cover only 33% of the area.

Type 4 – "mixed" – includes regions that are rather heterogeneous in terms of natural conditions, economic and social standards: the regions of Hradec Králové, Pardubice, Olomouc and Zlin. The South Moravia Region may also be included in this group, as a borderline subtype 1. The regions of Hradec Králové, Olomouc, Zlín, South Bohemia and Plzeň can be classified as transitional regions as far as land use is concerned. These do not fit into the group of agricultural regions (as they have less than 45% arable land) or the predominantly forest land classes (less than 40% forest land).

Type 5 – "regressive" – is represented by formerly very prosperous regions which used to shape historical and social development as far back as the Austro-Hungarian Empire. They became problematic (with rate of unemployment in excess of 13%) after 1990 due to their one-sided, predominantly industrial, mode of production (the Ústí and Labem Region and the Moravia-Silesia Region). Both these regions differ from the rest by the high percentage of built-up, industrial and mining areas (over 7%).

RESULTS

In 1989 there was hardly any private sector to speak of in Czechoslovakia; two thirds of agricultural land was cultivated by agricultural cooperatives, and the remaining third was owned by state farms. The average area of agricultural land cultivated by a cooperative was 2,500 ha, and that cultivated by a farm was 6,300 ha. By the end of 1990, 3,200 agricultural businesses run by self-

employed farmers had been established in Czechia. These, however, accounted only for 1% of the land under cultivation. After 1990 the cooperatives continued to lose their dominant position, with one quarter of land under cultivation serviced by the cooperatives in 2000. Czech agriculture can be characterized by a great diversity of land ownership and at the same time by a high percentage of leased land (90%) from a large number of landowners. As far as size is concerned, the size structure of agricultural businesses is very different to that in EU countries. Businesses with 50+ ha of agricultural land cultivate 92.2% of all land under cultivation.

In 2000, business companies or cooperatives cultivated the large majority of agricultural land (75%), out of which 98.7% was on leased land. Between 1990 and 2000 employment in agriculture dropped significantly. At the beginning of this period, more than 500,000 people were employed in agriculture. Within 10 years, this number was reduced by two thirds to 170,000. Most of these people were employed in business farming cooperatives (81,000) and cooperatives (54,000). Despite the extensive restitution of land, the private small farmer comes in third place, behind these two forms. The number of self-employed farmers (including hired workers and family members) was about 33,000. By 2000 the first phase of revitalization of Czech agriculture had been completed. This phase was predominantly focused on the recovery and stabilization of the industry as well as laying the legislative and institutional framework for entry into the EU. Some of the characteristics of Czech agriculture therefore, began to resemble those of the EU.

Czech agriculture, compared to its neighbouring countries, has less favourable natural conditions. Most of the territory of Czechia is composed of hilly and upland areas, which obviously has a bearing on other natural conditions (soil and climate). In terms of agricultural land use, the greater part of the territory consists of less favourable areas, out of which mountainous areas (land at altitude above 600 m above sea level and sloping areas at altitudes of 500-600 m above sea level) cover 12.5% of the agricultural land. Other less favourable areas (low-productivity soils, difficult to cultivate areas, areas of limited productive potential) cover 39.5% of agricultural land.

From the perspective of Czechia, the period 1990-2000 saw a considerable increase in the area of forest land (broadleaved forest F1a, coniferous forest F1b and mixed forest F1c), which occurred at the expense of arable land in particular, which was often left fallow after it was restituted to the original owners who were not interested in cultivating it. Similarly, cultivation of agricultural crops is concentrated in areas with favourable natural conditions, which are becoming increasingly significant determining factors. The rising demand for quality housing is one of the factors behind the establishment of satellite communities on the periphery of large agglomerations or the citifying of the rural way of life through building residential houses and villas (suburbanization). Built-up housing areas are therefore on the rise (U1). Industrialization is also rising to a moderate extent, which is related in particular to the development of the transport infrastructure and the subsequent industrial and business construction along the transport infrastructure and to the emergence of industrial zones for foreign investment (U2). The strong trend of enlargement of vineyards (I2) is related to the increase in the size of wine-producing areas in the Ústí Region, brought

about by the recultivation of former coal-mining areas. The spoil heaps are now therefore graced with vines.

Tab. 4. Classification of land cover change in the regions of Czechia, using the change index 1990/2000 (in %)

Processes	U1	U2	U3	(+)I1/ (-)E1	(+)I2/ (-)E2	(+)I3/ (-)E3	(+)I4/ (-)E4	E5	(+)D1a/ (-)F1a	(+)D1b/ (-)F1b	(+)D1c/ (-)F1c	(+)O1/ (-)O2
JM	1.5	3.3	-11.6	-0.6	7.9	2.7	6.2	0.5	1.0	0.0	3.6	-1.3
JC	1.4	-0.1	-18.7	-11.8	0.0	-8.2	7.7	0.0	0.1	7.0	5.8	0.8
VY	0.3	7.0	-13.2	-2.1	0.0	0.0	-0.6	0.4	0.8	9.0	10.0	-2.3
HK	0.2	1.2	2.0	-6.8	0.0	13.1	6.2	2.7	2.2	-0.3	2.2	6.2
KV	1.0	-0.1	-0.3	-37.9	0.0	-5.6	0.0	-0.6	0.4	4.2	2.5	0.0
LB	1.0	0.3	4.0	-33.7	0.0	-12.3	0.0	0.6	0.6	3.4	0.7	9.6
OL	0.5	12.6	4.4	-6.6	0.0	9.1	8.1	0.0	1.2	-6.7	0.1	4.8
MS	1.3	2.5	-1.6	-15.9	0.0	-3.5	2.4	-0.4	1.7	-5.5	0.5	33.1
PR	0.8	1.4	12.8	-3.6	0.0	-10.8	3.1	0.1	2.7	-1.6	1.5	8.4
PL	1.2	2.0	-2.9	-8.1	0.0	8.3	0.0	0.3	0.7	4.1	2.6	1.8
ÚL	0.9	1.6	-12.0	-18.7	17.8	-3.7	2.0	2.5	2.1	5.3	11.8	0.8
ZL	0.9	0.4	29.7	-6.0	6.6	-4.3	3.1	0.1	1.0	-0.1	1.3	7.2
CC+PH	3.1	4.2	9.9	-2.9	0.4	-1.4	0.0	-0.2	2.3	3.0	2.8	3.2
ČR	1.4	3.0	-5.3	-8.2	7.8	-0.6	3.5	0.4	1.4	2.8	3.3	3.4

Note: U1 – enlargement of continuous or discontinuous built-up areas, U2 – enlargement of industrial, commercial and transport built-up areas and construction sites, U3 – enlargement of natural resources exploitation, I1 – enlargement of arable land, I2 – enlargement of vineyards, I3 – enlargement of orchards, fruit trees and berry plantations, I4 – enlargement of complex cultivation pattern area, E1 – reduction of arable land area, E2 – reduction of vineyards, E3 – reduction of orchards, fruit trees and berry plantations, E4 – reduction of complex cultivation pattern area, E5 – enlargement of land principally occupied by agriculture, but with significant areas of natural vegetation, D1 – felling or natural disasters in forest areas (deforestation and enlargement of agricultural land; D1a – broadleaved forest, D1b – coniferous forest, D1c – mixed forest), F1 – natural or economic development of forest areas (F1a – broadleaved forest, F1b – coniferous forest, F1c – mixed forest), O1 – enlargement of water areas, O2 – reduction of water areas.

Land use changes, however, varied extensively in individual regions, with often opposing trends emerging. The smallest changes in arable land area size (E1) took place in the regions with the highest percentage of arable land. We may also claim that in these regions the conditions are the most conducive to growing crops and thus we can see the highest stability in the development of arable land. In the other regions, there is a much stronger tendency to land abandonment and its being left fallow. The natural process of succession took over on the abandoned land, overgrowing it with shrubs and subsequently forest growth. This was most marked in the Liberec and Karlovy Vary Regions, which also reflects their specific topographic conditions. The trends in U1 and U2 are, apart from a few exceptions, similar in all the regions. The U3 trend varies based on the opening of new mining areas, with the results appearing to be more striking than in the case of other trends (because of the total extent of these mining areas).

The I4 and E5 processes indicate a shift from the intensive cultivation of land towards complex cultivation pattern area and enlargement of land principally occupied by agriculture, with significant areas of natural vegetation. On the whole, forest areas are on the rise in the territory of the Czechia. In particular, meadow and pasture areas, formerly used for grazing cattle, were abandoned and left to become overgrow with vegetation. In the regions where coniferous forest area decreased, in the consequence of the planned replacement of coniferous forests with broad-leaved forests. This is how the composition of forests in the Czechia is managed with the natural composition ratio being 75% broad-leaved forests to 25% coniferous; yet the reality is the opposite.

Table 5 shows the application of the metric on the structure of land cover classes in individual regions between 1990 and 2000. The ρ values in 1990 ranged between 4.1 (between the Hradec Králové and Olomouc Regions) to 37.3 (between the South Moravia and Karlovy Vary Regions). The Karlovy Vary Region differed most (24.2) from the average of Czechia. Two most similar regions were the closest to the average of Czechia (6.3 and 6.2, respectively). In 2000 the process of transformation from the centrally directed to the market economy was completed. From the results acquired through the ρ metric, we can state that the fictitious distance between the regions of Czechia increased. The internal structure of land cover classes of the individual regions is more varied than it was in 1990. The region-to-region values went up, as did the region-to-Czechia values. The two regions most similar to one another are those of Plzeň and South Bohemia (4.4), while the most different are South Moravia and Karlovy Vary (46.7). The region most different from Czechia as a whole is the Karlovy Vary Region (29.9), while the most similar is the Hradec Králové Region.

Tab. 5. The regions-to-Czechia and region-to-region score according to the ρ metric (1990 and 2000)

		1990													
		JM	JC	VY	HK	KV	LB	OL	MS	PR	PL	ÚL	ZL	CC+PH	ČR
2000	JM	-	20.0	8.7	10.1	37.3	29.8	8.5	23.7	8.0	19.8	20.3	18.7	5.5	13.7
	JC	25.0	-	15.2	11.1	19.4	15.2	12.6	11.0	14.2	4.4	15.2	10.3	18.5	7.7
	VY	8.8	18.9	-	9.1	30.9	25.0	8.4	20.4	5.3	15.2	16.1	18.6	5.5	10.6
	HK	13.4	12.9	10.1	-	28.3	21.1	4.1	15.4	5.1	10.6	15.2	13.2	8.1	6.3
	KV	46.7	23.8	39.2	34.4	-	10.2	29.5	15.5	30.4	18.4	23.1	19.9	35.0	24.2
	LB	39.9	19.5	34.0	27.3	9.6	-	21.9	8.8	23.0	14.2	19.4	12.5	28.0	16.9
	OL	11.5	17.2	11.0	4.8	35.6	28.7	-	16.3	5.6	11.8	15.9	14.1	7.5	6.2
	MS	28.9	13.2	24.8	17.7	19.7	12.9	18.9	-	18.0	11.3	16.9	7.6	21.4	12.4
	PR	9.3	17.1	5.2	6.5	37.8	31.1	6.8	21.6	-	14.2	15.8	14.3	6.1	8.0
	PL	23.3	4.4	17.6	11.2	24.3	19.4	14.9	15.1	15.9	-	17.0	9.0	17.8	8.5
	ÚL	26.5	16.9	23.2	16.6	24.7	21.0	17.3	12.4	19.4	18.7	-	15.1	17.1	12.0
	ZL	20.2	8.4	17.9	13.4	27.1	20.2	14.7	12.2	15.1	9.1	16.6	-	18.4	10.3
	CC+PH	6.4	22.1	6.1	10.1	43.0	36.5	9.3	25.3	6.0	19.9	22.4	18.8	-	12.0
	ČR	17.3	10.0	13.3	6.3	29.9	23.3	8.5	13.6	9.8	8.9	14.9	9.6	14.3	-

The increasing heterogeneity of the structure of land cover classes is reflected in the increasing mean distance between the regions (15.8 in 1990 and 19.1 in 2000) and in the distance between the regions and Czechia (11.4 in 1990 and 13.8 in 2000). Similar increases can be found in the amplitude of the ρ metric in 1990 (33.2) and 2000 (42.3) between the individual regions as well as in a comparison of the regions to Czechia (from 18.0 to 23.6).

Even more illustrative from the point of view of the differentiation of the existing structure of land cover classes is Fig. 2, which shows regions with a great degree of similarity (low ρ level). It can be seen that groups of regions with a high degree of similarity, or so-called clusters, were formed. The greatest number of close bonds with neighbouring regions can be found in the Pardubice Region (4, with the majority of neighbouring regions) and the Central Bohemia Region with Prague (3). These regions therefore function as nodal area units, not only in terms of their geographical position, but also from the point of view of land cover structure. The remaining regions are considerably differentiated. Apart from the marked clustering of close regions, there is only one pair of regions with a similar land cover structure (the South Bohemia and Plzeň Regions), with the Zlin Region coming close to these two. The Karlovy Vary and Liberec Regions are very similar to one another in the character of the changes in land cover classes. The Ústí nad Labem and Moravia-Silesia Regions are rather specific in their characteristics.

During the period of 1990 to 2000 the cluster of regions with the "nodal" regions of Pardubice and Central Bohemia was maintained. Within the cluster, however, the bonds became slightly looser and the metric went up. The similarity of South Bohemia Region to Region of Plzeň also remained unchanged. Interestingly, the Karlovy Vary and Liberec Regions grew closer to one another.

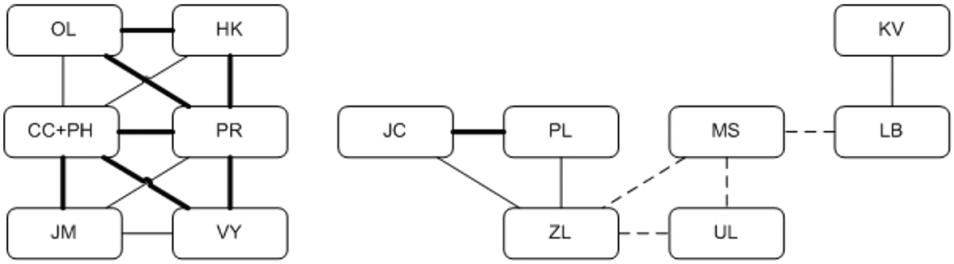

Fig. 2. Clusters of regions (typology) based on the similarity in land cover in 2000

Note: The graph differentiates 3 levels of proximity: maximum proximity ($\rho < 7$, bold), high proximity ($7 < \rho < 10$). In the case of "isolated" regions, the most proximal loose bond is shown ($10 < \rho$, interrupted line).

DISCUSSION AND CONCLUSION

The underlying cause of land cover changes in the territory of today's Czechia were the political driving forces behind the transformation of the centrally planned economy to market economy. The subsequent economic driving forces brought about, for example, a change in composition of the crops grown, a reduction in livestock production and a drop in employment in agriculture, to-

gether with an increase in the number of individual farmers. In addition to these underlying general causes, natural conditions have a role to play in the differentiation of the land cover change in individual regions. Following the opening of the country to the market economy, these conditions began to have a bearing on the production costs (of food products in particular), thus indirectly demarcating areas favourable for a particular agricultural activity and areas less favourable. The shift to a market economy thus brought along a strong pressure to comply with the new economic realities and sale opportunities.

Based on the analyses of land cover changes (see Tab. 4) and the calculation of the proximity metric (similarity/difference) of land cover structures in individual regions (Fig 2) we can assess the manifestations of the political and economic driving forces as well as the growing determining role of natural conditions on agricultural activity. Taking these into account, we can create the following typology of the regions of Czechia.

The regions can be classified into 4 types (Fig. 3 and Tab. 6). Type 1 is characterized by a high degree of inner homogeneity. Regions of this type have favourable natural conditions for agriculture and overall economic prosperity. Their typical feature is the high stability of the dominant land cover categories. As for ownership of land under cultivation, the prevailing form is cooperatives which grow produce on mostly fertile black soils. The percentage of people employed in agriculture is higher compared to the average for Czechia. This type of region includes the region of Pardubice and most of its neighbouring regions (including the nodal areas of the Czechia, that is the capital Prague and Central Bohemia) and the South Moravia Region.

Type 2 is represented by regions which became prosperous after 1989 due to their exposed geographical location. Their characteristic feature is low rate of unemployment, together with below-average natural conditions and average social factors for agricultural activity. The prevailing mode of land ownership is cooperatives, and the land is comparatively less fertile. There was a dynamic increase in pasture areas and to a certain extent forest land as well. This type includes the South Bohemia and Plzeň Regions (type a). The Zlín Region (type b) comes close to this type, but differs in its more favourable natural conditions and social factors for agriculture. The land under cultivation is predominantly cultivated by business companies.

Type 3 (Moravia-Silesia Region, Ústi nad Labem Region) is represented by those regions which were hardest hit by the transformation. Their different situation is determined by their long-term one-sided orientation towards heavy industry (mining, steel and chemical industries in particular) and the related power-producing industry. The often very adverse effect of these industries on the environment and the general health of the population must also be stressed. At present, these regions are characterized by low economic performance and persistently high rate of unemployment. The nodal areas are made up of large agglomerations with an extremely high degree of urbanization. Natural conditions and social factors for agriculture are average. In the period of 1990-2000 the percentage of meadows went up, at the expense of arable land.

4. Type 4 (Liberec Region and Karlovy Vary Region) comprises the smallest frontier regions with a predominantly diversified relief. Because of this, these regions have less than favourable natural conditions for agriculture and there-

fore a low percentage of employment in agriculture. The changes from 1990 to 2000 were the most dynamic in this region type. Almost half of the arable land was transformed into meadow land. Business companies are the predominant mode of land ownership/cultivation.

Tab. 6. Typology of regions based on the development of land cover structure (in 1990 and 2000) and the proximity metric as well as the natural and social conditions for agriculture

	Type	Natural conditions	Social factors	Change index 1990/2000	Regions
1	Predominantly mixed	Above average	Above average	Stability	PH, HK, VY, OL, JM, CC
2a	Prosperous	Below average	Below average	Slight decrease in arable land, increase of forest land, dynamic decrease of pastures	JC, PL
2b	Mixed	Average	Above average	Slight decrease in arable land	ZL
3	Regressive	Average	Below average	Decrease of arable land, increase of meadows	UL, MS
4	Mountainous	Below average	Below average	Dynamic increase of meadows at the expense of arable land	KV, LB

Note: Natural conditions – the productive capacity of land under cultivation (100 points = the most fertile): above average (over 55), average (45-55), below average (under 45); Social factors – economic performance (EU25 = 100) – above average (over 65), below average (under 65); Change Index 1990-2000 (see Tab. 4) decrease in the acreage of arable land: slight (8 to 12), marked (13 to 30) and dynamic (over 30).

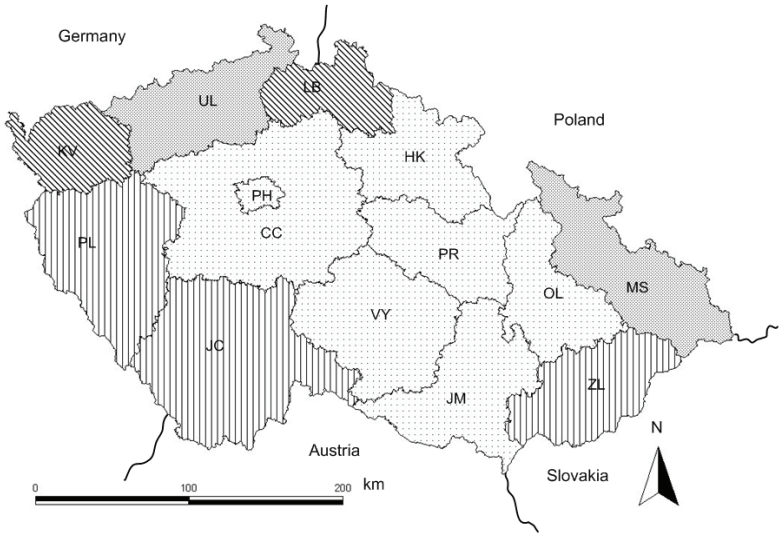

Fig. 3. Typology of regions based on the structure of land cover changes and the ρ metric

The conclusions of our research have demonstrated the way the political shifts and other powerful factors shaped the structure and development of land cover in the regions of Czechia (from 1990 to 2000). As far as the structure of land cover classes is concerned, a growing heterogeneity of these regions was found. At the beginning of the period of transformation (prior to 1989), the adverse role of centrally directed economic planning was clearly in evidence. The role of natural conditions was not relevant. Since 2000, the suitability or lack of suitability of natural conditions have been the key issue.

There are many similar conclusions to be found in the research into land cover changes in the European postcommunist countries in the latter half of the 20th century (Brandt et al. 1999, Bűrgi et al. 2004 and Schneeberger et al. 2007). The specific development inherent to these countries led to a sharp recession in agriculture which was most apparent in the drop in livestock production. The number of heads of livestock dropped by one third in some of these countries, even by one half in the Baltic states. Whereas in Poland 80% of the land was privately owned, in the other communist countries there were hardly any private farmers at all.

In the period of 1990-2000 the percentage of people employed in agriculture decreased (often by almost one half). There are still marked differences in this respect despite the similar trends. The percentage of people employed in agriculture is 5% in Czechia, and 9% in Slovakia, but in Poland it is still a high 22%. Food production dropped significantly as well. In this period the sharpest decreases took place in Bulgaria (by 50%), Hungary (23%) and Poland (17%). The most moderate decrease was in Romania (by 5%). Similarly to Czechia, the percentage of arable land went steadily down, while meadows and forest land went up. In almost all the countries which went through the transformation process, the percentage of arable land decreased, with the exception of Romania where it remained unchanged.

In Estonia, Peterson and Aunap (1998) found a similar trend whereby the area of land under cultivation dropped considerably between 1992 and 1996. Almost one fourth of arable land was no longer cultivated and the area of land left fallow went up twenty times. Lörinci and Balázs (2003) investigated land use and landscape development in Hungary, and Skowronek et al. (2005) in Mid-Eastern Poland. Nikodemus et al. (2005) investigated the impact of economic, social and political factors on the landscape structure of the Vidzeme Upland in Latvia. They arrived at similar conclusions to the above-mentioned researchers. In the first half of the 20th century the Latvian landscape could be described as a mosaic with a dense grid of individual farms. Following World War II and the loss of inhabitants and deportations to Russia, large areas of territory were abandoned in consequence. The property was then collectivized (only 6% of farms remained privately owned). Marginal territories were left to lie fallow, and the centrally directed management of villages was established. In the wake of the agricultural reform of the 1990s, property was restituted and small farms (up to 2 ha) have now become dominant once again. Less than 50% of agricultural land is, however, cultivated. Large tracts of land were abandoned and the natural process of succession, overgrowing with bushes, set in. Milanova et al. (1999) focused on land use/cover changes in Russia. Hietel et al.

(2004) investigated land cover changes in Germany between 1945 and 1995 in relation to selected environmental factors (altitude and the diversity of the relief).

Land-use changes and the social driving forces behind them in Czechia in the 19th and 20th centuries was the subject of study of Bičík et al. (2001) and Lipský (1996). They too formed similar conclusions regarding Czechia. Land cover changes, however, bring with them a number of questions. Natural conditions determine the intensity of agricultural activities. Individual areas differ because of their natural conditions and thus also become more heterogeneous in terms of land cover structure. But does this not intensify the polarization between inhabited, cultivated, cared-for landscapes (landscapes with people) and those abandoned, fallow, peripheral areas that are gradually overgrowing (landscapes without people)? People now farm where it requires less effort, where results are quick to come by and revenue is higher. But does this not strip the landscape of a certain measure of human endeavour, investment of energy, human affinity for the landscape? Is not man ultimately the one disappearing too?

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POLITICKÁ TRANSFORMÁCIA A JEJ ÚČINKY NA ZMENY KRAJINNEJ POKRÝVKY V ČESKEJ REPUBLIKE PO ROKU 1989

Závery výskumu potvrdzujú, že politické zmeny spolu s ďalšími faktormi ovplyvnili štruktúru a vývoj krajinnej pokrývky (land cover) krajov v Česku v rokoch 1990-2000. Z hľadiska štruktúry kategórií land cover sa preukázala rastúca heterogenita krajov Česka. Prírodné podmienky determinujú existenciu intenzívneho poľnohospodárskeho využívania pôdy. Oblasti sa podľa svojich daných podmienok diferencujú a stávajú sa heterogénnejšími aj v štruktúre krajinnej pokrývky. Nenarastá tým ale polarizácia medzi územiami obývanými, obrábanými a obhospodarovanými (územiami s ľuďmi) a medzi tými opustenými, ponechanými ladom, marginálnymi, ktoré postupne zarastajú (územiami bez ľudí)? Hospodári sa tam, kde je to jednoduchšie, najrýchlejšie, kde sú vyššie výnosy a najnižšie vklady práce. Avšak nevytráca sa tým z krajiny určitá miera ľudského úsilia, vkladu ľudskej energie, vzťahu ku krajine? Nevytráca sa tým z krajiny z určitého hľadiska aj človek? Krajina sa mení veľmi dynamicky. Rýchlosť zmien v krajine sa zvyšuje. Obdobné trendy boli pozorované v celom rade ďalších postkomunistických krajín Európy.