

## CZECHIA: CHANGES IN LANDSCAPE USE IN THE TRANSFORMATION PERIOD

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*Key-words:* land use of Czechia, driving forces, transformational period, methods of evaluation.

**Abstract.** This article analyzes processes of land use changes realized in transformational period after 1990 in Czechia. Land use Czechia database is a source having six time horizons for almost 9000 cadasters or joined cadasters covering all territory of Czechia. Time horizons give us chance to compare trends of land use changes among them – 1845, 1896, 1948, 1990, 2000 and 2010. This article uses mainly data from 1990 and 2010. In this period we observed relatively huge increase of grassland (meadows and pastures) influenced by abolishing of socialist support of agriculture shortly after 1990 and following decrease of agricultural intensity. We are concerned also on the regional trends in land use structure changes in Czechia. We used special methods (index of change, typology of change, main landscape change prepared earlier by Slovenian authors: Kladnik, Gabrovec, Petek). Transformational changes in land use show continuation of earlier started trends but in different intensity and shorter time. Main driving forces are differential land rent I, II. Main regional differences are visible between lowlands and regions of higher altitude, in lower level plays important role distance from main core regions and main axis of social economic development. There is important long term creation of special typological regions of specific land use structure and also its development. This process is influenced by new functions given to different parts of landscape in modernization of Society in last two centuries.

### 1. INTRODUCTION

Recently, the landscape in Central Europe has featured as a very frequent research topic. This covers not only geographical works, but also a wide array of further branches that examine the landscape and its dynamism. Hampl (2000) presents three main stages in the development of interaction: determination, competition and cooperation. On the basis of the three cited stages, the present-day Central Europe may be finding itself at the beginning of the third stage. In fact, the countries here are among the richer ones for which the efforts at cooperation of the functions between nature and society have been visible, especially after the change in the political and economic situation that started after 1990. The research into the interaction “nature vs society” by means of the data on land use/land cover is a very frequent topic, with an accelerated focus in the past 30 years (see Table 1). One should consider this not only evidence of the growing problems of this interaction, but also of an increased interest expressed by geographers and further specialists.

In the geographical research into landscape changes, a major role is played by maps of various scales, by the data derived from the maps of land use/land cover as well as the data from cadastral registration of land use. Our approach to the assessment of long-term landscape changes is based just on the latter data, derived from the cadastral mapping within the territory of Czechia in 1824–1843. By means of the data, one can analyse the situation in individual localities and microregions from the viewpoint of land use structure (dated uniformly as of 1845). If there are a number of time horizons,

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one can evaluate the development of land use as well as changes between the individual time horizons and one can speak about a dynamic or historical land use (Jeleček, 1985; Worster, 1987, 1990; Bičík, Jeleček, Štěpánek, 2001; Bičík *et al.*, 2010). In the course of time, land use structure changes in the individual localities under the pressure of changing functions from the viewpoint of a modernising society. Just the land use data of a given locality/microregion reflect the functions that a specific society and local community (but the latter increasingly less) demand from the specific area in a given stage of development.

Table 1

The development of the number of articles with selected LUCC key-words at WoS and Scopus  
1970–2010

|                   |                   | 1970 | 1980 | 1990 | 2000 | 2005 | 2010 |
|-------------------|-------------------|------|------|------|------|------|------|
| Web<br>of Science | key words         |      |      |      |      |      |      |
|                   | landscape ecology |      |      | 21   | 114  | 119  | 177  |
|                   | landscape metrics |      |      |      | 15   | 57   | 74   |
|                   | land use          | 65   | 132  | 228  | 1350 | 2653 | 4335 |
|                   | land cover        |      | 3    | 28   | 361  | 810  | 1267 |
| Scopus            | landscape ecology |      |      | 15   | 159  | 174  | 408  |
|                   | landscape metrics |      |      |      | 13   | 60   | 73   |
|                   | land use          | 19   | 48   | 256  | 1456 | 2373 | 4102 |
|                   | land cover        |      | 1    | 9    | 295  | 603  | 1119 |

Source: Balej (2012).

The land use data provide information on the current state of the interaction “nature vs society” in the form of numerical information on the individual land plots, cadastral units, and administrative units (districts, regions, and states). This means that the land use data make it possible to evaluate the state of interaction on the varying order level of territorial units in various time horizons. Obviously, the smaller the territorial units in which the land use is evaluated in an area, the bigger the differences in the state of and changes in the individual categories and the total land use structure. Given the character of this contribution, we consider this explanation necessary. We will adopt a geographical approach with a focus on changes in the interaction “nature vs society” in the regional impact in Czechia’s transformation period. The first part presents a discussion of the selected literature on the broad topic of dynamism of land use, with a focus on the transformation period of post-Communist society (since 1990). The second part tries to present an attempt at a detailed look at regional differentiation of the development of the interaction “nature vs society” by means of land use data according to Czechia’s cadastral units.

## 2. DISCUSSION OF LITERATURE AND OBJECTIVES OF THE ANALYSIS

Out of the quantity of literature published on the topic, we will primarily deal with the authors who characterise the social and economic development and its most important processes with an impact on new functions of certain parts of the landscape and on land use changes. From the viewpoint of land use changes, the work by Worster (1987, 1990) is crucial for the study of the interaction of nature and society. Worster has analysed man’s long-standing impact on landscape by various ways of its (agricultural) use.

Turner II and Meyer 1994, Turner II (1995, 1997) characterised the driving forces as the causes underlying changes in the functions of certain areas. He distinguished the natural, economic, political, social and other forces. Along with a change in the function, there is a gradual land use change. Hampl and Müller (2011, p. 211–212) studied the uneven speed of transition in different structures triggered by the post-1989 transformation. “They argue that political and economic structures have changed quite fast (within days, weeks, or months). Social, cultural, and demographic changes are much slower and usually take years. Even analyses of land use driving forces (Hampl and Müller take land use as one of social-geographical structures) show that within all examined periods land use changes have been somewhat slower than changes of other social-geographical structures. The increase in regional differences of land use types, resulting in new typological regions with similar land use patterns, was the slowest process of all. To sum it up, the uneven speed of changes mentioned by Hampl and Müller applies also to land use changes that have been always slower since the beginning of Industrial Revolution” (Bičík *et al.*, 2015, in print).

The relationship between the development of society and landscape changes was examined by Mather (2002). With the forest transition theory, he pointed out the transformation of the function and change in forest areas in developed countries. Thanks to the modernisation of these countries, forest areas have acquired new functions. This, along with the prevailing intensification of the development of agricultural production, became a cause of the growth in their area in a certain stage of Industrial Revolution as well as subsequent changes in the form of a Technological and Scientific Revolution, and Scientific and Technological Revolution (Purš, 1973, 1980). Along with traditional, primarily productive functions of the forests, modernising society gives them further functions: water management, recreational, environmental, housing, and other ones. With the process that was started locally, but acquired general dimensions in the 1890s, it was possible to produce, by means of intensification measures, higher volumes of agricultural production. This released the return of a part of farmed land for other purposes (back to forest areas or to built-up and other areas). The process of forest transition provides an explanation of the growth in forest areas in most advanced European states.

In Czechia, the topic of landscape use changes was examined by Häufner (1953, 1960), undoubtedly influenced by the contemporary interest in land use mapping (Stamp, 1948). Häufner analysed the upper limit of agricultural management and the decreases in arable and agricultural land of the mountainous areas of the former Czechoslovakia, strongly affected both by the deportation of Czech Germans and forced collectivisation of agriculture. Jeleček (1985) examined agriculture in the 19<sup>th</sup> century in Bohemia and the impact of Industrial Revolution on the state and development of agriculture and land use. Jeleček and Bičík published analyses of social economic and political influences on the development of Czechia’s land use (2009). Lipský (2001, 1998) has analysed land use changes of Czechia. In this country, he is one of the leading authors with strong geocological approaches applied on minor model areas. Important author from point of view of evaluation of physical geographic components in landscape is Kolečka (2013), who prepared many maps into the Landscape Atlas of the Czech Republic.

Hampl and Müller (2011) have defined the delays in the individual social economic processes. Among others, their approach explains the slow changes in land use structure and increase in its regional differentiation. The long-term development of land use is heading for a formation of typological regions composed of stable territorial units (STU) with a similar structure of areas and also of their development. There is the question of whether the found trends of a gradual formation of certain types of land use structure, as documented by Bičík *et al.* (2012), will be permanent. Lipský (1995) has noted that in the past, there was an oscillation of the growth and decrease in agricultural land.

One has to point out also other concepts analysing landscape changes such as that of driving forces and the DPSIR concept. They are important both for the local and microregional analyses and rather general deliberations on the level of regions and states. The DPSIR concept was established at the turn of the millennium. Its elaboration for Central Europe was conducted, e.g., by Feranec *et al.*

(2001, 2010) and Kupková (2001). Social metabolism is a very interesting concept of the study of landscape changes, developed by Austrian environmentalists. It documents the transformation of energy demands in agriculture during more than one century on the basis of energy inputs/outputs both on the local level in selected municipalities and in the whole of Austria (Haberl *et al.*, 2001, 2003; Kušková *et al.*, 2008).

Our research focuses on the development of land use in the long run, based on the data of a special database that we prepared for the whole area of Czechia (for 1845, 1948, 1990) at the close of the previous century and later widened by the data from 2000 (see <http://web.natur.cuni.cz/ksgrsrsek/lucc/>). Recently, the database was complemented by the time horizons of 1896 and 2010 (so far unpublished). A search for the trends in the development of LUCC within Czechia was one of the research questions of our efforts. It has turned out that in the individual periods (Bičík *et al.*, 2010; Bičík *et al.*, 2015), various processes were under way with a varying intensity and a specific regional impact. There is the question of whether similar trends are generally valid or are only specific for the post-Communist transformation period of European countries. As the social economic conditions were not quite equal and transformation was not equally triggered and implemented in the individual countries of post-Communist Europe, this question has remained the objective of further, perhaps internationally conceived research. These differences are analysed, e.g. by the studies performed in the late 1990s and early 2000s (Turnock, 1998, 2001; Banski, 2008; Bičík and Götz, 1998).

In the past decade, a number of studies using the land cover data according to CORINE from 1990, 2000 and 2006 appeared. They compare the general trends of landscape use changes in Central Europe or even in the whole of Europe (Feranec, Šúri *et al.*, 2001; Feranec, Jafrain *et al.*, 2010 etc.). A later study has documented regional differentiation of the changing area of agricultural land in the form of changes characterised as extensification or intensification. Similarly, there were analyses of changes in forest areas such as deforestation or reforestation as well as changes in the extent of urbanisation (increase or decrease in built-up and other areas; Krausmann *et al.*, 2001, 2003). A number of concrete results of an analysis of decreases/increases in specific categories of areas were also published in the Landscape Atlas of the Czech Republic (Hrnčiarová *et al.*, 2009), including a number of cartograms drawn up by the authors of this contribution.

### 3. LAND USE CHANGES IN CZECHIA 1990–2010

#### 3.1. Political and economic changes in Czechia

While the change in natural conditions was small if any, political, economic and social changes were crucial driving forces of this period. After 1990, there was a property restitution and privatisation. The two processes have basically influenced the tenure and use of primarily agricultural land. Until 1990, agricultural land was de facto owned by the state. It was used by several thousands of agricultural cooperatives (2563) and state farms (174; average size 6259 ha), while there were only a few hundreds of individual farmers (some hundreds only; they only used approximately 1.5% of agricultural land resources). In the course of 1991–1995, agricultural land was returned to its original owners or their heirs in Czechia. The land was suddenly owned by approximately 3.5 million entitled people. The overwhelming majority of them only received a few hectares, mostly fragmented in a number of land plots (sometimes even tens of them), while only a tiny part of the owners started farming the land again. At that time, for the sake of profitability of farming, it was necessary to cultivate about 40–50 hectares of agricultural land. As a result, most of the entitled owners either leased the land or sold its minor parts to buyers. One part even did not take any care of the returned land. One of the reasons of the attitudes was the fact that most of the entitled owners had no experience with farming (even if they had worked in agriculture, this was in quite specialised branches of the Communist large-scale production) or often lived in very distant towns.

The process of property restitution, used by agricultural cooperatives and state farms until then, to the entitled owners, was very complicated. In the process, the obligations towards them had to be settled. Only afterwards it was possible, provided the general assembly of the remaining members of the cooperatives decided to continue working for them, to proceed to the transformation of the Communist-era agricultural cooperatives into a new type: the cooperative of owners. Given the difficult character of the task, it is interesting that the process of property restitution was completed in about 90% of the cases in the course of approximately two years. By 1995, the land tenure was quite different.

### 3.2. Database and methods of analysis

At present, a part of the data on which this contribution is based is available online (LUCC Czechia Database – <http://web.natur.cuni.cz/ksgrsek/lucc/>) for the whole area of Czechia, specifically for 1845, 1948, 1990 and 2000, and for 8,903 stable territorial units (80% of them are comprised of a single cadastral unit, the rest of the two or more whose area changed). Taken together, one or more merged cadastral units created a sample of comparable stable territorial units (STUs) whose area was the same in the course of the observed years (the differences were smaller than 1% of their total area). This article mainly focuses on changes during the transformation period, as depicted on January 1, 1990 (in the cited public LUCC Czechia Database) and on December 31, 2010 (so far unpublished). The creation of this widened database was a difficult process because we had to modify:

1. The total number of stable territorial units (STU = 8,832) in order to ensure the same area of the analysed units;

2. It was necessary to simplify the observed structure because in 2010, there was no separate registration of meadows and pastures, but only their sum called permanent grassland;

3. For the given reasons, our original database and the new one, created after the data for 1896 and 2010 were added, are not fully comparable, unlike the previously published analyses. The new database analyses changes in the following seven categories: arable land, permanent cultures (gardens+orchards+vineyards+hopfields), permanent grassland (previously meadows and pastures), forest areas, built-up areas, water areas and remaining areas (taken together, the last three form an aggregate category of “other areas”);

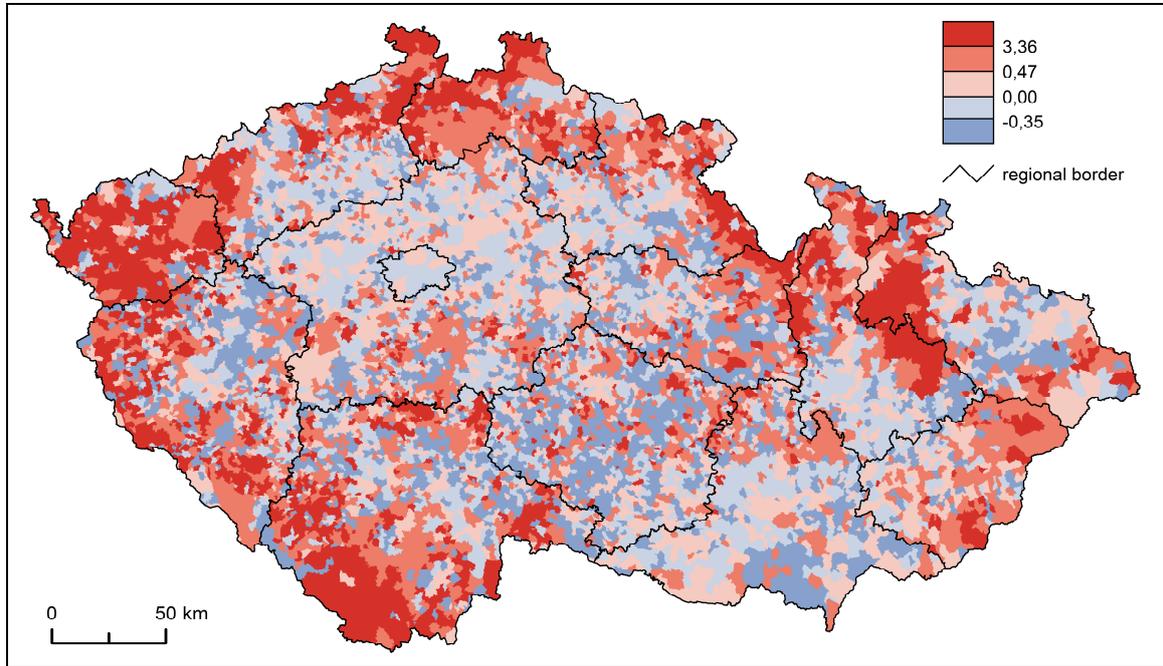
4. In order to watch general trends, we also evaluate the macrostructure of land use or changes in the area of agricultural land, forest areas and other areas.

Along with an assessment of the state of and changes in regional differentiation of individual categories in 1990–2010, we also watch more general trends of changes in total land structure by means of index of change, the type of changes in landscape macrostructure and the main processes of landscape transformation.

### 3.3. Results of changes in land use of Czechia in 1990–2010

Unlike the previously published articles, we work here with a rather different methodology of depiction of land use changes by means of cartograms. We presume that it was crucial to depict regional differences in land use changes and, possibly, to try and interpret possible causes of these differences. While in the past most of our analyses were based on the index of development of individual categories between two particular years, we apply a different principle here. We assess the difference of a given category by its proportion in the size of a STU (= 100%). Moreover, we only work with five, equally numerous classes of the whole sample (8,832 STUs). This approach reflects better the size of the individual STUs on the one hand and there is no distortion in those with a small extent of the category in which a change by a few hectares was sufficient for a large value of the index, on the other. The first cartogram (Fig. 1) depicts change in the area of the category that is

characteristic of the period: change in permanent grassland, primarily as a result of the cancelled Communist subsidies for agricultural cooperatives and state farms after 1990.



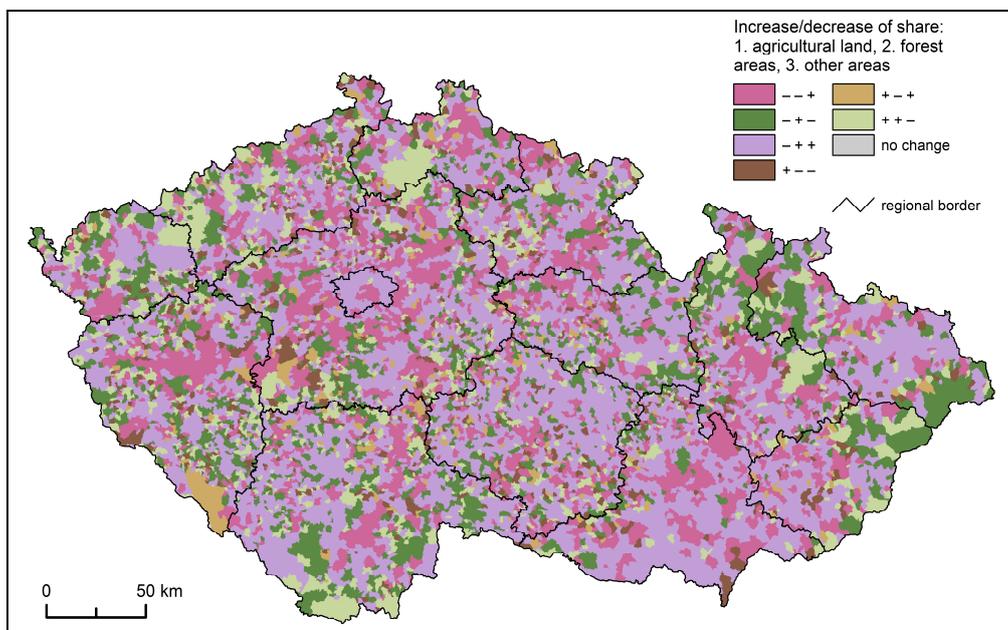
Source: LUCS Czechia Database.

Fig. 1 – Change in area of permanent grassland between 1990 and 2010 (percentage points of BTU area).

After 1990, a falling intensity of farming brought about changes in the structure of agricultural land. On the one hand, this was caused by the loss of Communist-era subsidies and by the property restitution and privatisation of state farms along with a transition to the market prices and a fall in the exports of agricultural products, on the other (Götz, Jančák, 1997; Bičík, Jančák, 2006). This has resulted in abandonment of arable land and a growth in permanent grassland recorded in the cadastre of real estates. Besides, at least 300,000 hectares of arable land (approximately 5% of the area of arable land in 2004, Bičík *et al.*, 2010) remained unused in the long run (fallow land). After Czechia joined the EU in 2004, it was partly ploughed up again. This was largely due to the chance of applying for subsidies for its cultivation after Czechia joined the EU. On the face of it, the regional pattern of decreases in arable land and its replacement with permanent grassland clearly points out a strong dependence on natural conditions: soil quality, altitude and slope of the abandoned arable land. However, there was the stronger impact of the reasons arising from differential rent II: if there is a falling volume of production and loss of Communist-era subsidies in Czechia, it is more profitable to invest in the fertile land in the lowlands, which also has a smaller environmental impact. The extent of permanent grassland is higher in the northern half of Bohemia. There was, in the long run, a relatively strong employment in industry, which gave a chance to the rural population to find jobs outside agriculture, while they could maintain additional small-scale cattle and pig breeding. This is why the process of abandonment of arable land and a transfer to permanent grassland was started here earlier and after 1990, it continued at an even faster pace.

We can similarly evaluate further observed categories, but the limited space of this contribution makes us pay attention rather to the more synthetic approaches in the assessment of land use change in Czechia after 1990.

The first method evaluating landscape change is based on an assessment of land use macrostructure. This is understood as an analysis of merely three elementary macrostructure categories: agricultural land, forest areas, and other areas. The analysis is based on the increase (including the same area), denoted by the sign “ + ”, or decrease (denoted “ - ”) of area of these three aggregate categories, thanks to which one can distinguish six types of the changes between 1990 and 2010 (Fig. 2).



Source: LUCC Czechia Database.

Fig. 2 – Types of macrostructural land use changes in Czechia in 1990–2010.

A comparison of the occurrence of the individual types of changes in the period under observation over the past 170 years is best shown by Table 2. It is obvious from it that in the transformation period of 1990–2010, over 80% of Czechia’s area was characterised by the STUs with a decrease in agricultural land. The growth in forest areas was recorded in approximately 71% of the STUs, while the increase in other areas was recorded in the STUs covering about 67% of the national area.

Table 2

Typology of land use changes by STUs in Czechia in 1845–2010 (proportion of the national territory, %)

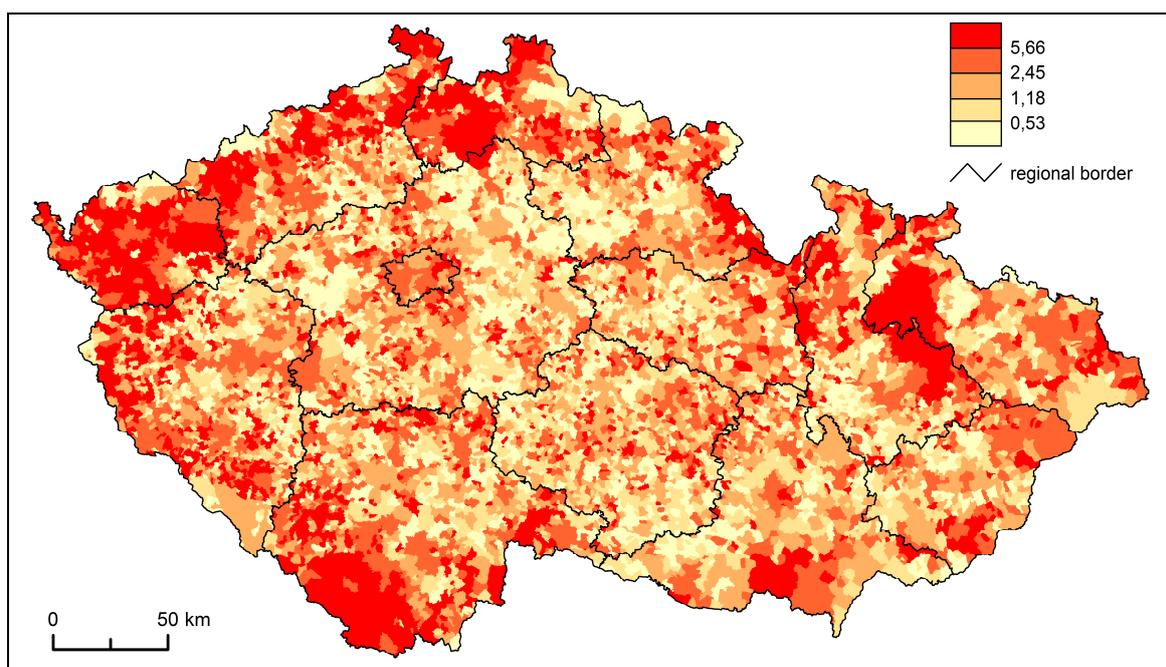
| Type              | Period           |                  |           |           | <b>1845–2010</b>       |
|-------------------|------------------|------------------|-----------|-----------|------------------------|
|                   | 1845–1896        | 1896–1948        | 1948–1990 | 1990–2010 |                        |
| --+               | 3.7              | 17.4             | 9.6       | 21.1      | <b>16.5</b>            |
| -+-               | 22.3             | 2.7              | 0.4       | 15.9      | <b>0.9</b>             |
| -++               | 16.5             | 72.3             | 89.9      | 43.2      | <b>79.3</b>            |
| +--               | 32.7             | 0.6              | 0.0       | 5.0       | <b>0.2</b>             |
| +-+               | 13.5             | 6.2              | 0.1       | 3.0       | <b>2.6</b>             |
| ++-               | 10.9             | 0.4              | 0.0       | 11.7      | <b>0.2</b>             |
| no change         | 0.0              | 0.0              | 0.0       | 0.1       | –                      |
| no data available | 0.4 <sup>a</sup> | 0.4 <sup>a</sup> | –         | –         | <b>0.3<sup>a</sup></b> |

Source: LUCC Czechia Database. Note: The first mark (+, -) indicates increase / decrease in agricultural land, the second forest areas, the third “other” areas (water, built-up, and remaining areas combined). <sup>a</sup> The regions of Hlučínsko and Valticko, plus České Velenice and its environs became part of the present-day territory of Czechia only after World War I.

We published the index of change in the analyses of development of landscape structure of Czechia in a number of previous studies (Bičík *et al.*, 2010). This indicator documents the total intensity of changes in the area of the observed seven categories (there were eight of them before 2000 because there were specific classes of meadows and pastures). In theory, it ranges between 0 and 100%, from localities with no movement between the areas of individual categories to the localities with a total transformation of land structure (IC = 100%). This is the mathematical expression of index of change (IC):

$$IC_{A-B} = 100 \cdot \frac{\sum_{i=1}^n |P_{iB} - P_{iA}|}{2}$$

$IC_{A-B}$  means index of change between year  $A$  and year  $B$ ;  $n$  indicates the number of land use classes;  $P_{iA}$  equals the proportion of relevant land use class at the beginning of the examined period and  $P_{iB}$  equals the same proportion in the end. In this publication, seven land use classes are taken into consideration ( $n = 7$ ): arable land, permanent cultures, permanent grassland, forest areas, water, built-up and remaining areas. In some earlier publications and articles, calculations included all eight basic land use classes (Bičík *et al.*, 2001; Bičík *et al.*, 2010 etc.).



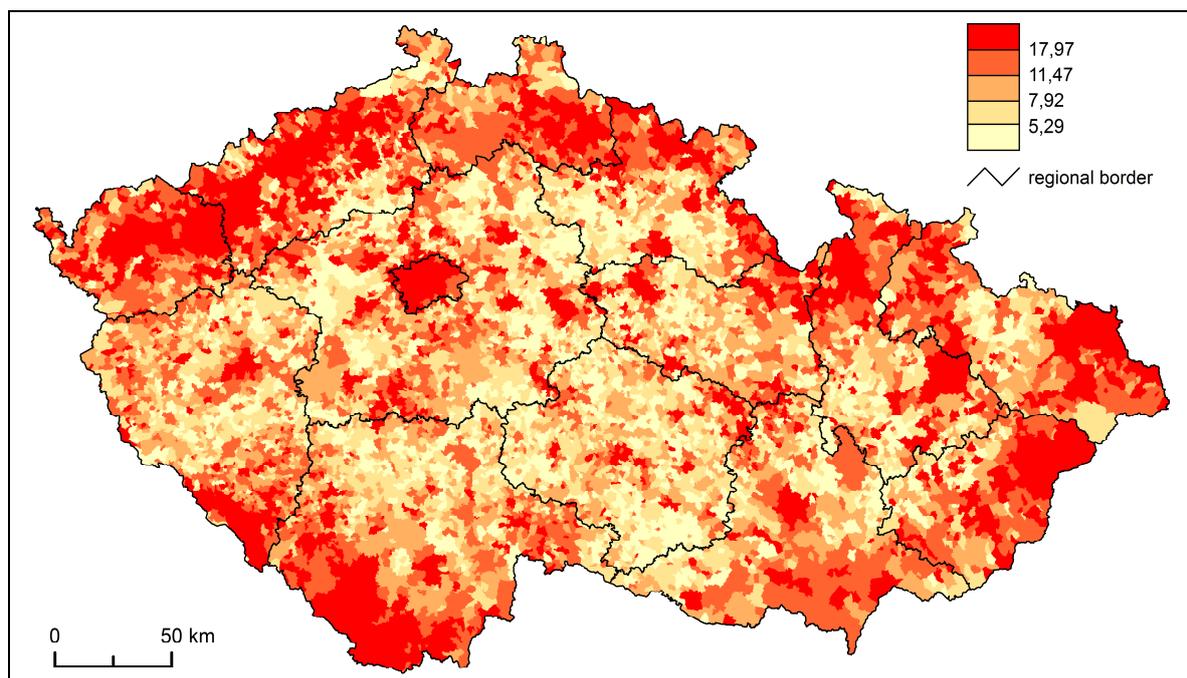
Source: LUCC Czechia Database.

Fig. 3 – Index of change between 1990 and 2010 (in %).

Cartogram 3 shows the index of change in five, equally numerous classes. The areas with the highest index of change (5.66% and more) were surprisingly not reached by the regions with large towns and their hinterland. Primarily thanks to the mining, built-up areas and abandonment of agricultural functions of landscape and increasing extent of other areas (mining, industrial and housing development, dumping sites, etc.), the whole Northwest Bohemia is the most important region with the highest values of index of change. Smaller regions with a high value of index of change can be found in the abandoned areas of military training grounds and of three newly established national parks

Šumava, Podyjí and České Švýcarsko (administrative reasons of shifts between categories). On the contrary, the smallest index of change characterises hinterland areas with good to average conditions for agriculture without major development tendencies, due to which they have a stabilised landscape structure.

Unlike the previous period (see Fig. 4), we have to stress a substantially smaller movement between the individual categories of land use areas in 1990–2010, which caused a smaller index of change. This was largely due to the deportation of Czech Germans from the border regions after World War II (its consequences in the form of abandonment of agricultural and, specifically, arable land around the Iron Curtain could be felt as late as the 1950s) that were never fully resettled. In high and poorly accessible locations, agricultural land remained unused. Another reason was the transition from traditional family farms to primarily large-scale companies of the Communist-era type (agricultural cooperatives and state farms) that cultivated 98% of Czechia's agricultural land in 1989. Besides, the development of industrial projects and large housing estates from scratch and, last but not least, large-scale open cast mines along with large areas of overburden contributed to a high level of index of change in the totalitarian era. Large losses of agricultural land were also due to the insufficient legal protection as the first law on the protection of agricultural land resources was only enacted in 1965. Moreover, its efficiency was poor. It was only the law No. 65 from 1976 that ensured a much more efficient protection, although its application was limited by the sprawl of some towns surrounded by quality soils (Olomouc, Hradec Králové etc.). Nevertheless, about one-fifth of agricultural land resources were lost in 1948–1990. The main proportion of the loss was concentrated in 1948–1965. In 1948–1990, the main areas with the biggest index of change were primarily concentrated in the border regions and the regions with mining of raw materials (Northwest Bohemia, Ostrava region, Southeast Moravia).

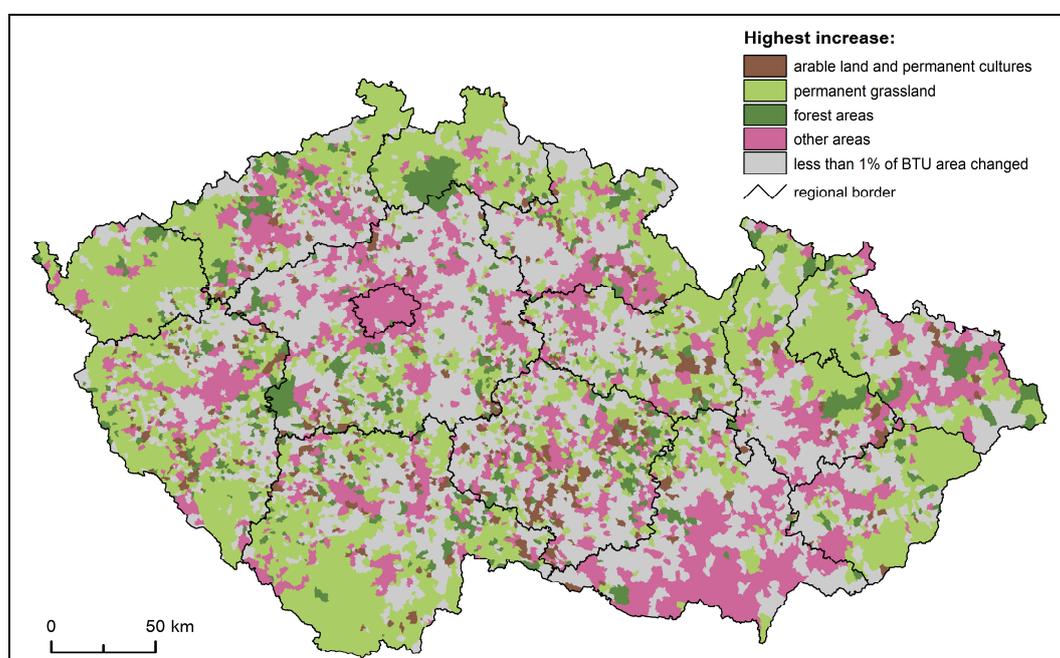


Source: LUCC Czechia Database.

Fig. 4 – Index of change between 1948 and 1990 (in %).

In the international context, further chances of using similar databases have been published. Here we use the indicator that was published by the colleagues from Slovenia who have access to a database similar to that we use for Czechia (Gabrovec, Kladnik, 1997; Gabrovec, Kladnik, Petek, 2001). This is

an indicator assessing landscape changes by means of the main processes that occurred in territorial units between two time horizons. The method works with only five merged categories of areas expressing, with a certain inaccuracy, the pressure on specific function. These categories are as follows: arable land+permanent cultures; permanent grassland (=meadows+pastures); forest areas; built-up+other areas; water bodies. There is an assessment of increase between two time horizons. The merged category that records the biggest increase of all growing categories is denoted as the main landscape process. According to the proportion in the sum of all increases, they are evaluated as follows: a minor process (under 49.9% of all increases), a medium process (50.0–74.9%) and a strong process (75% and more) either as intensification of farming, covering with grass, reforestation or urbanisation. The water bodies virtually fall out from the evaluation because their extent does not much vary. Besides, their proportion in the land structure of each STU is almost invariably under 1%! For the period between 1990 and 2010, cartogram 5 clearly documents covering with grass as a dominant process of Czechia's landscape transformation, influencing about 33% of all STUs. Suburbanisation has turned out to be the second most frequent process, while the process of intensification of farming was all but negligible in this period.

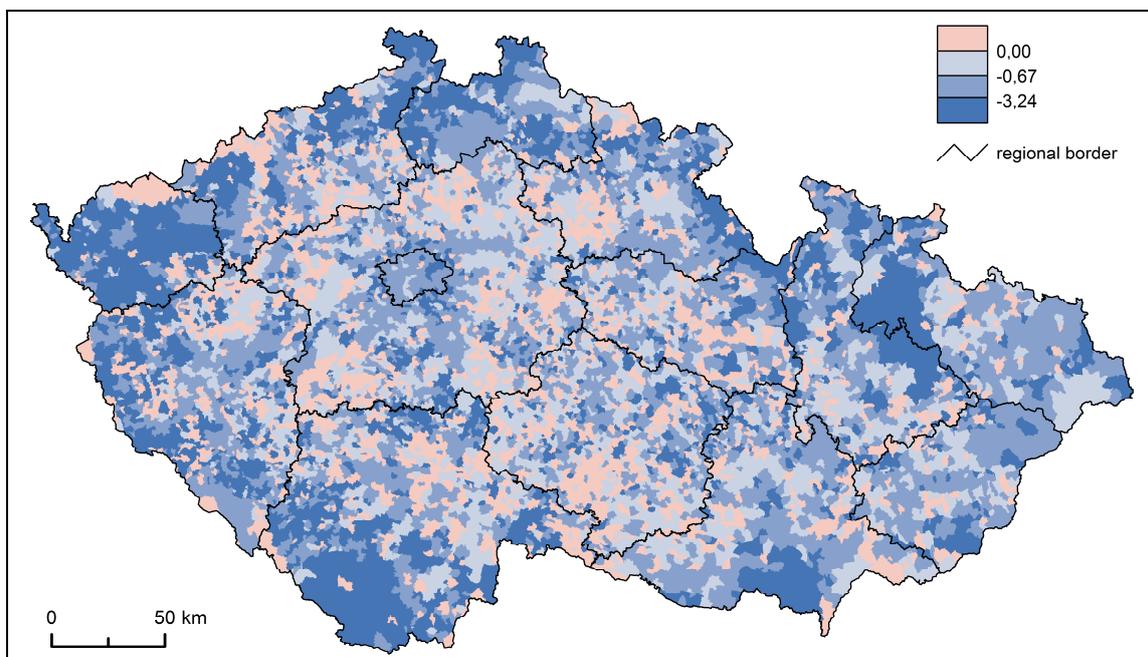


Source: LUCS Czechia Database.

Fig. 5 – Main processes of landscape changes 1990–2010.

Figure 6 depicts changes in the area in the form of differences in the proportion with which arable land contributed to the area of individual territorial units (STU) between 1990 and 2010. This has revealed a continual decrease in arable land area, especially to the benefit of permanent grassland (in Czechia in this period by -220 000 hectares, which meant a fall in arable land by 7% as against 1990). As a result, regional differences are primarily important from the viewpoint of the degree of occurred losses. From this viewpoint, the biggest losses were recorded by the Karlovy Vary, Ústí and Liberec regions. These are the areas with a considerably industrial character, with a high proportion of immigrated population and, at present, with a high unemployment level. A similar situation is alongside the western border in the mountains and foothills of Šumava and Český les. The loss of arable land in southeastern Moravia is more influenced by the transfer of arable land to permanent

cultures, orchards and gardens. In this period, only a tiny quantity of STUs recorded a growth in the area of arable land, but without a clear regional pattern. To some extent, this can be explained as a consequence of large-scale return of agricultural land in the early 1990s and many entitled owners' reluctance to farm the returned land (having to decide on its sale, their own farming, lease, development, etc.).



Source: LUCS Czechia Database.

Fig. 6 – Change in area of arable land between 1990 and 2010 (percentage points of BTU area).

Changes in land use in Czechia and perhaps also in other post-Communist countries after 1990 can be to some extent explained both as a continuation of the past long-term trends in the processes characterising all economically advanced countries of Europe (loss of agricultural land resources, growth in forest areas, suburbanisation, construction of transport corridors, etc.). On the other hand, in the post-Communist countries this has resulted from the efforts at putting right a number of the deformations caused by the central command economy and from their specificities and the extent of their application in these countries (elimination or new definition of subsidies in agriculture, the processes of property restitution and privatisation, the freezing of purchase of agricultural land resources to foreigners, etc.). These changes differed among the individual countries in the observed transformation period (Banski, Bednarek, 2008; Turnock, 1998, 2001 etc.). Changes in LUCS have been under way at a slower, more gradual pace and with a certain time lag after the creation of new social and economic conditions after 1990. According to the evaluation by Hampl and Müller (2011), this mostly only occurred after 2000. This delay in the processes of social and economic territorial restructuring has also resulted in the delayed entry of changes in the categories of cadastral registry within the agricultural land resources and their transfer to other, non-agricultural utilisation. Nevertheless, one can observe a gradual forming of typological regions composed of the STUs of a similar land structure and even of a similar development. Within the framework of the analyses of long-term land use changes in Czechia (Bičík *et al.*, 2010) evidenced a formation of minimally following types of landscape of Czechia with a similar structure of land in the STUs that shape them and different land structures of such formed typological regions.

Our analyses of long-term land use changes make it possible to delineate certain areas of similar functions and similar structures of land and their development in the landscape. These typological regions formed the STUs of a similar structure of land and its development, but they considerably differ from one another. We can distinguish the following typological regions created by long-term land use changes in Czechia (Bičík, Kupková, 2012; Bičík *et al.*, 2010), although their delineation is a question of the future. Moreover, they have not covered the whole territory of Czechia.

There are also certain transition zones between them:

- Urbanised regions of big towns;
- Hinterland of big and medium-sized towns with a transformation of agricultural function of a part of the hinterland to housing, servicing, storage and transport areas with a microregional environmental impact;
- Lowlands outside main settlement centres with good natural conditions for agriculture with a dominance of arable land, a minimum of forest areas and grassland;
- Areas of medium altitude (450–600 m) with average, sometimes slightly below-average natural conditions with a prevailing agricultural, housing and locally also recreational functions;
- Foothills and lower mountain areas with a restructuring and even loss of agricultural function and depopulation;
- Military training grounds, both abandoned and existing, with limited chances of development and a possible revitalisation of landscape use, search for new functions (most land use changes were caused by changes in categorisation);
- National parks and protected landscape areas with limited chances of change and a relatively stable structure along with a considerable proportion of forest areas and grassland;
- Areas of outer and inner periphery with a strong depopulation and long-term extensification of agricultural use of landscape, locally also with a recreational function;
- Mountain areas with specific functions and a high proportion of forest areas, that has been growing in the long run, and of a largely depopulation nature;
- Mining and industrial areas with a strong devastation of landscape and its revitalisation in the past 30 years;
- A new wilderness appears on the local level as a relatively new element in the landscape that was previously intensively used. Now, it is outside economic use for various reasons. These are primarily small areas, mostly on abandoned agricultural land, but also from the category “other areas” (quarries, abandoned field paths or previously built-up areas of agro-brownfields, etc.).

#### 4. CONCLUSIONS

Like in other countries that bordered with the West by the Iron Curtain, in Czechia, too, its removal in the areas with quality natural conditions triggered a robust boom of tourism (the case of Šumava and Český les, the Harz area straddling the border between East Germany and West Germany, the Hungarian areas around Lake Neusiedl, etc.) and also a growth in the area of landscapes with specific protection (Chromý and Rašín 2010 – national parks, reserves, etc.).

One has to realise that the degree of centralisation in decision-making processes varied in the individual countries. When it comes to the impact on the landscape, changes in the land use structure after 1990 have been much bigger in the countries in which the number of small farmers had been reduced or even eliminated (Czechia, Slovakia, East Germany, and Hungary) and agricultural cooperatives and state farms cultivated almost all agricultural land. They were influenced by property restitution and privatisation of the land owned and used by the state, which had a serious impact on changes in functions, intensity of farming, etc. In addition, after 2000 Czechia was under the influence of its forthcoming entry to the EU whose agricultural policy (CAP) influenced changes in agriculture and its efficiency and, subsequently, in land use structure (HAMPL, Müller, 2011).

The creation of large industrial brownfields was a typical process that influenced land use structure on the national level and even more on the regional level. The brownfields were partly redeveloped into servicing projects (shops, galleries, loft housing, etc.). Besides, there was the establishment of new industrial and storage zones on the fringes of towns and a gradual urban sprawl into the free landscape, often with an intensive agricultural use, by the development of suburbia, etc. (Kupková, 2001; Ouředníček, 2007; Grigorescu *et al.*, 2012). In Czechia, there was one negative aspect: “the postponement” of the transfer of unused arable land to the category of permanent grassland (under the law, fallow arable land had to be transferred to permanent grassland in the land registry within four years at the latest). A number of old-new owners of arable land were waiting for Czechia’s joining the EU in order to be able to use it again with the help of European subsidies! Another example is posed by the growth in the area of vineyards in south Moravia. A few years before joining the EU (after it, the land could no longer be enlarged), it increased by approximately 2,000 hectares, or about one-sixth of its original area from 2000.

After 1990, Czechia’s land use and its character were influenced by the fact that out of the 3.5 million people who received back their land, only a fraction decided to start farming it again. Most of the returned land was leased, a small part sold, and another small part was fallow. In fact, Czechia is an extreme country in the EU as there is a high proportion of agricultural land resources as leased! There is another characteristic feature: a general lowering of intensity of farming. Along with nature protection (foundation of new national parks, protected landscape areas and localities), this influenced the higher level of this care and its consciousness in the population. Moreover, about 57% of national area was classified as less favoured areas.

In addition, there were the processes of internationalisation and globalisation (construction of supranational transport corridors, construction of new border crossings and customs offices, that soon lost their function and transfers of a large number of agricultural products across Europe influenced the production and intensity of farming both on the national and regional levels, etc.).

Last but not least, one has to mention the impact of natural disasters on the landscape of these countries. These were primarily the floods that afflicted a part of the area in 1997, 2002, 2007 and 2013 and, to a smaller degree, the wind calamities that caused devastating damage especially in forest stands (Šumava). Naturally, this influenced the quality of the environment, but it did not change the classification or function of these forest areas.

The release of state ownership of land brought about changes in the functions in some returned or purchased plots by their new owners. There were also partial changes in the structure of their area. In the hinterland of towns, the old-new owners were interested in transferring agricultural land into building sites and then selling them. This phenomenon, of whose harmful consequences warned some “western” town planners, geographers and sociologists at the beginning of the 1990s already, caused the development of the suburbia whose urbanistic standard, the proportion of greenery and public space are mostly mediocre. The projects that lack any concept caused the creation of an “urban sprawl” (Kupková, 2001; Ouředníček, 2007; etc.). In Czechia, the end of centrally commanded construction, territorial planning and a certain chaos caused by the general process of property restitution and privatisation logically liberalised the protection of agricultural land and its transfer to non-agricultural functions and caused a belated compulsory registration of transfer of categories within agricultural land. Hence the unexpected changes in land use, such as the growth in the area of permanent grassland. In Czechia, an increase in registered areas was recorded in about 40% of STUs in 1990–2000. Another approximately 300,000 hectares of arable land were fallow for a number of years without being transferred to permanent grassland. The abandonment of agricultural land whose use did not bring the relevant economic effect to the owner brought about an increase in the area of “new wilderness”. On the one hand, it has a revitalising function from the environmental viewpoint, but it has become a source of spread of weed and undesirable species to the surrounding, farmed land, on the other.

To conclude, we would like to express the belief that the development of land use (in particular long-term loss of agricultural and arable land along with a growth in built-up and other areas) constitutes an urgent and vital topic for further research in post-Communist countries. It may be interesting to compare both the driving forces that brought about the change and their regional impact to verify the processes that were described here, using the example of Czechia. In order to achieve such an objective, one can use not only a special project with the support by the EU, but also one of the further volumes of LUCC Atlas (Land use changes in selected regions in the world). The Volumes I–IX were published on the basis of a project prepared by (IGU vice-president) Himiyama in Japan as well as authors of this article in Prague. We consider it possible to use various data sources and various methods of their processing from the local up to the international levels. Given the urgent and rapid nature of landscape changes, we consider such a project very beneficial and usable in practice.

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