# ORIGINS OF LANDSCAPE DIFFERENCES AND RELATED CAUSES OF CHANGE IN LAND USE (LU): EAST CENTRAL AND SOUTHEAST EUROPE FROM 1960s UNTIL THE POST-COMMUNIST PRESENT.

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**Abstract**

In this contribution Land Use changes in regions of East Central Europe and South East Europe are assessed and compared. During the last 50 years, covered by FAO LU databases, both regions experienced common fate. The installation of centrally planned economy after the Second World War and subsequently the transition period in the 1990's affected significantly the development of LU patterns. Considerable differences in LU structure had existed undoubtedly already in pre-war period due to specific physical geographical conditions and also diverse historical evolution of landscapes and societal forces. Here we try to reveal how geographical and historical contexts shaped LU developments in both regions and led to important distinctions.

## 1. Introduction, objectives, underlying assumptions

The main task we undertake in this contribution is to assess the Land Use changes in two regions of the former communist Eastern Europe – East Central Europe (ECE) and Southeast Europe (SEE). These two parts of the former Soviet bloc present differences in physical geographic characteristics and geographical, geopolitical and geoeconomic position; but their differences derive above all from their diverse historical developments. In short, we can stress the distinctive evolution of civil society under the Ottoman (SEE) and the Austrian (ECE) Empires, which both ceased to exist at the end of the First World War and thus set the scene for the subsequent developments.

Here we try to determine the impact of the crucial societal driving forces on the development of Land Use in the second half of the 20th century in these two selected regions. In order to define the specific roles of certain socioeconomic factors in this historical process, we apply a comparative analysis. This method should enable us to compare and contrast the trends in land use (LU) developments in two different periods: 1) under the communist regime (1961–1990) and 2) during the transformational period (1990–2002). Simultaneously, we try to reveal how different geographical and historical contexts shaped LU developments in both regions and led to important distinctions.

The main source we employed is the databases of the FAO. Despite their inaccuracy, the data provided serve our purposes well – in geographical sciences, the scope of inquiry is commonly restricted to the analysis of long-term trends. Due to the imperative of cost-effectiveness, such an attitude seems to be inevitable. More detailed studies would usually be either impossible (no data) or too expensive, and their results might later also be deemed redundant.

## 2. General geographical characteristic

### 2.1 East Central Europe

"East Central Europe" (abbr. ECE) we grasp as a part of standard definition of Central Europe (CE), usually delineated according to its historical evolution. By coincidence, the term ECE denominates also the group of states in which, during the period 1948–1989 communist regimes ruled. Its area is app. 550,000 km2, and comprises 5.3 % of the total area of Europe. Besides countries embracing West Central Europe (WCE) – Austria, Germany, Switzerland and Liechtenstein, the ECE is comprised of the ECE's largest and most populous country Poland (39 million inhabitants), inland Czechia, Hungary (both about 10 mil.), Slovakia (5,5 mil.), and Slovenia (2 mil. inh.).The density of populations is 102 inh./km2, and the GDP of these 5 countries was 685,7 billion USD in 2006 (The World Bank data and statistics - http://web.worldbank.org/).

Czechia, Slovakia and the western part of Poland belonged in the past to the so-called Holy Roman Empire. After 1806, these countries, together with Slovenia, became part of the Austrian and, since 1867, Austro-Hungarian Empire. During the period of the dual monarchy (1867–1918), all these territories, except for Slovakia, belonged to its western, more developed part called Cisleithania, which formed a main part of most definitions of Central Europe (together with Germany). The eastern part of the Empire was called Transleithania.

After the abolishment of the dual monarchy in 1918, Hungary lost about two thirds of its historical territory. While Slovakia, formerly called Felvidek or Upper Hungary, and Hungary itself are widely considered as a part of Central Europe, the rest of Transleithania belongs to SEE and differs from ECE physical-geographically (Balkan Peninsula) and historically as well as by their economic-societal and cultural character (strong Ottoman influence, Orthodox Church etc.). Ironically, the results of the First World War deepened the differences between ECE and SEE. Unfortunately, there are not data available on Slovenia for the period 1960–1990. FAO databases contain only data for the whole territory of former Yugoslavia en masse. For that very reason, we have to incorporate Slovenia into the SEE region.

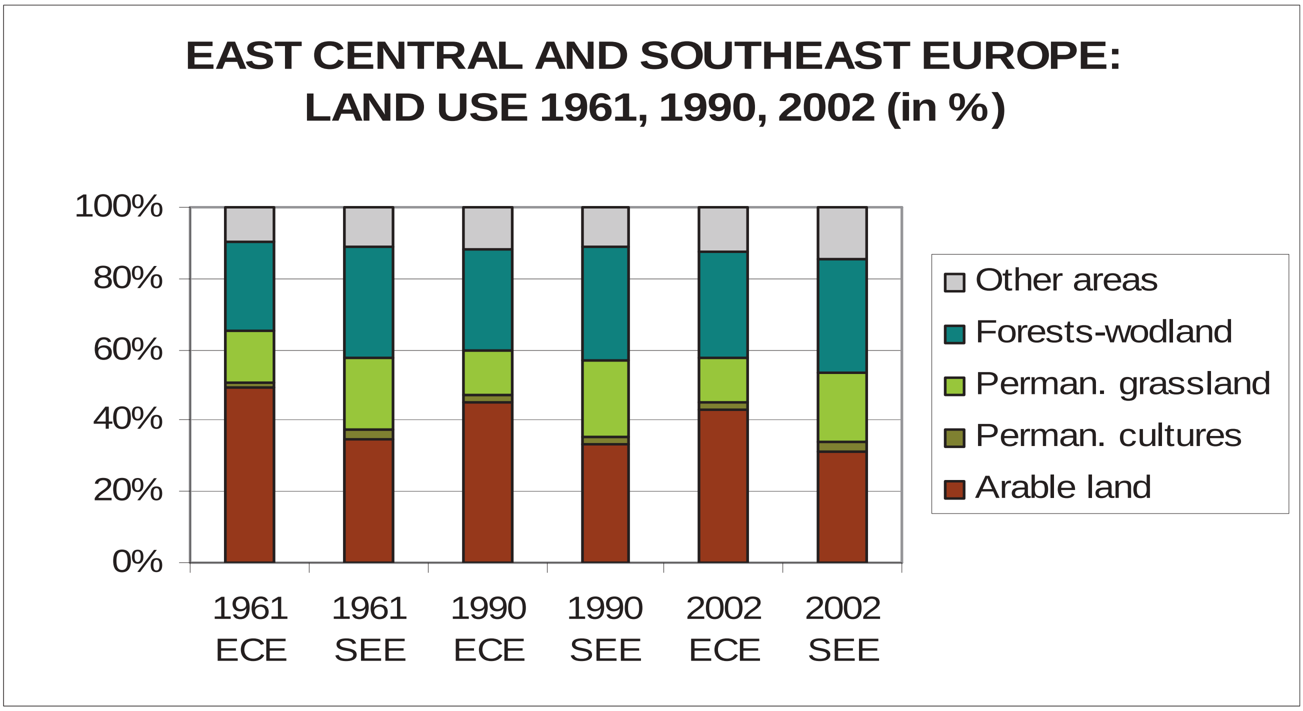
After the Second World War, the sharp demarcation line of the Iron Curtain divided Europe into two antagonistic parts. The whole area of ECE and SEE (except for Yugoslavia) ended up under Soviet rule until 1989. These countries generally have copied the Soviet way of "socialist" industrialization (again except Yugoslavia), which was basically less suitable and convenient for countries more or less experienced with pre-war, democratic regimes and with higher levels of economy. In this way, fundamental political and economic history has been imprinted into the different trends in land use changes after 1945 (Bičík, Jeleček, Štěpánek 2001, Bičík, Jeleček 2004, Milanova, et al. 2004)

Landscapes of ECE are not uniform – in Hungary and Poland, lowlands or plains prevail, while hilly or even mountainous character with smaller share of lowlands is typical for Czechia and Slovakia. Thus, the ECE offers a rich mosaic of industrial and intensively agricultural regions.

Analogically, historical developments cast a profound effect on the character of agriculture in different regions. Lowland Poland is typical for its agricultural specialization. Even during the communist period, the private sector had almost fully preserved its characteristic, atomized structure consisting of a huge number of small, unproductive farms. This situation considerably fragmented cultivated land, and has led to a high proportion of employment in agriculture (about 20 % in contrast to 4 % in Czechia – Turnock 2001). Currently it signifies a problem for the common European market and agricultural policy. On the contrary, on the lowlands of Hungary, endowed with more fertile soils and more favorable climatic conditions, intensive agriculture of large scale farms has been successfully introduced in the post-war period. Hungarian, but also Czech and Slovak agriculture, previously (before 1950) typical for their high share of small farms, in average area up to 20 hectares, was collectivized and transformed into large co-operatives or state farms. The transformation and land reform in 1990's did not change the situation significantly here. The co-operatives and state estates generally survived by merely updating – or modernizing - their organizational form.

The area used in ECE for settlement, transportation and industry recently covers about 12 % of the total area (in case of Czechia only 4 % in 1900 yr) and permanently continues to grow. For more on ECE physical-geographical features (see Jeleček, pp. 188–193, Král 1999.)

*Figure 1: East Central and Southeast Europe: Land Use 1961–1990–2002 (in %)*




*Sources: Statistical database of the UN Food and Agricultural Organization (http://www.fao.org)*

## 2.2 Southeast Europe

"Southeast Europe" (abbr. SEE) encompasses the whole Balkan Peninsula excluding Greece. It represents the least-developed region in Europe. Centuries-long occupation by the Ottoman Empire (from 14th to 19th century) cut the Balkans out of Europe. Such inconvenient geo-economic position was not much improved by the Iron Curtain after the Second World War. Current situation of SEE economies might be ascribed mainly to such 'historical developments' combined with the impact of the Soviet-type, centrally planned economy, based on the exhaustion of all natural and human resources. Naturally, this major factor affected negatively the development of ECE as well.

After disintegration of Yugoslavia in the early 1990's, SEE comprises seven countries on the total area of 600,000 km2, i.e. about 6 % of Europe's area. In 2002, SEE had about 55 million inhabitants, which was 8.5 % of the European population. The population density was some 88 inh./km2, i.e. significantly less than in ECE. Five countries (including Slovenia) were in 2002 post-Yugoslavian republics. Among them, the most populous country was the still-united Serbia and Monte Negro (10 million inhabitants), and the least populous was Macedonia (2 mil.). Bosnia-Herzegovina and Croatia had each some 4.5 mil. of inhabitants.

Within the whole SEE, the most populous country is Romania (22 mil.) Bulgaria and Albania hold populations of 8 and 3 mil. respectively. Due to the above-mentioned structure of FAO statistics, SEE, as used in this paper, consists of former Yugoslavia, Romania, Bulgaria and Albania.

Except for Macedonia, all SEE countries have access to the sea. Romania and Bulgaria are situated at the Black Sea coast, separated by the Danube River. The Danube enters the Black Sea through an ecologically valuable marshy delta in the boundary territory between Romania and Ukraine.

Geologically, SEE is one of the youngest regions in Europe, as a part of the tertiary Alpine-Himalayan folder zone. The surface is predominately mountainous. Plains and lowlands comprise only about 20 % of its total area. Large lowlands are situated in eastern Croatia and central northern Serbia (surroundings of Beograd and Vojvodina) and also in Romania and Bulgaria along the Danube. Forests, covering altogether about one third of the SEE territory, are located in the inland mountainous parts of the SEE. Original oak forests in the Mediterranean region had been almost entirely depleted as early as the medieval period. This deforestation led to the significant soil erosion and surface denudation especially on steep slopes of the Dalmatian coast and its islands, where rocky ground of gray limestone emerged. These make any reforestation in certain areas almost impossible. The Balkan as well as the Apennine peninsulas are examples of longest human impact on landscape configuration in Europe. For more on SEE physical-geographical features (see Král 1999 and Jeleček 2006, pp. 557–560.)

Industrialisation and the ensuing spill-over of mechanization and scientific knowledge into agriculture has been promoted mainly in Slovenia, Croatia and Serbia since the close of the 19th century. Nonetheless, the whole SEE preserved a remarkably agrarian character. Even after the First World War, Yugoslavia remained an underdeveloped agrarian country with insignificant industry and underdeveloped agriculture in comparison with Czechia, Hungary or Slovenia. The same applies to Romania. However, due to the extensive cereal cultivation in the fertile Walachian lowland, Romania became the fifth biggest producer of corn and the ninth largest producer of wheat in the world before World War II. Today we expect that this role of Romania will probably be renewed – see conclusion.

### 2.3 Some major causes of regional differences between ECE and SEE

Undoubtedly, historical and geographical differences affected evolution of land use patterns and kept on influencing its development also throughout the period of inquiry (1960–2005). Let us here briefly list several major factors influencing LU developments:

Physical-geographical factors – SEE is more mountainous with smaller share of lowlands. Agriculture is also affected by lower precipitations and higher temperatures - more see in chapters 2.1. and 2.2.

Historical factors – Ottoman Empire’s long-term occupation led to different results than Holy Roman Empire’s Civilization, which is typically apparent in the case of Slovenia, in comparison with the rest of the former Yugoslavia.

Geopolitical factors – ECE is positioned closer to Western Europe as the core innovative area and is also an important market (especially for perishable products like milk.)

Geo-economic factors – Czechia and South-west Poland (Silesia) have been the most developed territories within ECE since medieval. This character was fortified by the process of Industrial Revolution and after it, by very rich deposits of coal.

Economic and social factors – SEE altogether has been behind ECE in the onsets and completion of fundamental historical processes of Industrial Revolution (abbr. IR), Agricultural Revolution and Technological-Scientific Revolution (called also 2nd IR). Also after the Second World War, Scientific-Technological Revolution (3rd IR) has been introduced here later and less efficiently. (For more on the notions of IR, see Jeleček 1995, 2006.)

In other words, the societal driving forces of land use changes began to affect the ECE earlier than SEE and have been more powerful in the former. After the fall of feudalism the different ways of introducing capitalism into agriculture during the 2nd half of the 19th century have influenced productivity and efficiency of agriculture. Different trends in the farm structure according to their area might be understood as one of the most distinctive outcomes of such developments. In countries such as Czechia or Hungary, large feudal estates formed about 40 percent of total area (i.e. including forests) even before the Industrial Revolution; and the numbers of small farms with area up to 20 ha (in 1850 app. 80 % of all farms on the remaining 60% of the area) tended to diminish slowly under the socio-economic pressures. On the other side Poland, following the French example, retained the structure of very small farms.

These differences caused not only the delay of SEE behind ECE, but also of both regions behind Western Europe. General underdevelopments have had more historical reasons in the past. For instance, the ECE and SEE possessed no colonies, in contrast to the Western European Empires such as the United Kingdom, France or the Netherlands. This reality was one of the causes that Industrial Revolution reached climax here about 40–50 years later (e.g., in Czechia) than in Britain.

### 2.3.1 Common „destiny“

Common „destiny“ of ECE and SEE within 1948–1989 period, i.e. communist regime, was of course not experienced as completely uniform. We can mention several important particularities, such as 1) huge differences in the socio-economic levels within the regions; 2) uneven development of “state-socialism” among some countries inside ECE and SEE, e.g., Czechia as compared with Slovakia or Poland; Slovenia with the rest of Yugoslavia (mainly with Macedonia, Monte Negro, Bosnia and Herzegovina) after the Second World War and then followed by smaller differences in 1980’s; 3) relatively low level of agriculture collectivization in Poland; 4) close market alliances after 1948 (even 70 % of foreign trade) between ECE and the Soviet Union which lasted until 1989.

The foreign trade in both regions has recently been redirected to the European Union in many cases, especially to Germany. Agricultural production has thus become fully exposed to the much more competitive environment of heavily subsidized EU agriculture and cheaper commodities from overseas (e.g. USA, also characterized by its equally subsidized agriculture). Simultaneously, mechanisms of differential land rent II started working again after 1989. As a consequence, less fertile soils have been abandoned and subsequently transformed into permanent grasslands or forests. In the 1990’s these two land categories began to increase for the first time in 150 years.

## 3. LU structure and its changes in ECE and SEE 1960–1990–2002 – the comparison

In 2003, the average gross domestic product (GDP) (purchasing power parity per capita) in SEE was about half that of East Central Europe (i.e., about $ 6,390 – see The World Trade Book). These differences are reflected also in the share of agricultural sector in the total GDP. On average it reaches almost 12 %, which is four times more than in the ECE. Together with the low technological and organizational level of agriculture, these data indicate the prevailing rural character of SEE.

Figure 1 and Table 1a present overall data of different developments in land use in SEE for the last forty years, including the influence of transformational period. The share of agricultural land in the total territory of SEE in 2002 was highest in Romania (62 %) and Croatia (56 %), and lowest in Albania (40 %) – see Figure 3. Similar trends apply to arable land. Croatia and Macedonia (28 % and 25 %, respectively) hold the highest share of permanent grassland. The landscapes of SEE are largely wooded, but with large regional differences in the types of forests. Bosnia-Herzegovina and Macedonia show the highest share of forest areas (44 and 35 %, respectively), Albania much less (34 %), Bulgaria (33 %), Romania (27 %) and Serbia and Montenegro (28 %) – see Figure 3.

*Table 1a: Southeast Europe: Land Use Changes 1961–1990–2002 (in %)*

| **Land Use Category** | **Share in total area** | | | **Change in period** | | |
|---|---|---|---|---|---|---|
| | **1961** | **1990** | **2002** | **1961–1990** | **1990–2002** | **1961–2002** |
| Arable land | 35,1 | 33,0 | 31,4 | -6,0 | -4,7 | -10,4 |
| Permanent cultures | 2,6 | 2,7 | 2,3 | 5,4 | -14,9 | -10,3 |
| Permanent grassland | 19,9 | 21,3 | 19,7 | 7,2 | -7,3 | -0,6 |
| ***Agricultural land*** | 57,5 | 57,0 | 51,9 | -0,9 | -9,0 | -9,8 |
| Forests-wodlands | 31,6 | 31,9 | 31,7 | 0,9 | -0,5 | 0,3 |
| Other areas | 10,9 | 11,1 | 14,8 | 2,2 | 33,1 | 36,0 |
| **TOTAL** | **100,0** | **100,0** | **100,0** | | | |

*Sources: Statistical database of the UN Food and Agricultural Organization (http://www.fao.org)*

*Table 1b: East Central Europe: Land Use Changes 1961–1990–2002 (in %)*

| **Land Use Category** | **Share in total area** | | | **Change in period** | | |
|---|---|---|---|---|---|---|
| | **1961** | **1990** | **2002** | **1961–1990** | **1990–2002** | **1961–2002** |
| Arable land | 49.2 | 45.3 | 43.2 | – 7.9 | – 4.7 | – 12.3 |
| Permanent cultures | 1.8 | 1.8 | 1.6 | – 1.7 | – 9.4 | – 10.9 |
| Permanent grassland | 14.0 | 12.9 | 13.1 | – 8.0 | 1.6 | – 6.5 |
| ***Agricultural land*** | ***65.0*** | ***60.0*** | ***56.8*** | ***– 10.9*** | ***– 3.51*** | ***– 11.0*** |
| Forests-wodlands | 25.2 | 28.0 | 29.6 | 11.2 | 5.4 | 17.2 |
| Other areas | 9.8 | 12.0 | 12.5 | 22.5 | 5.1 | 28.7 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | | | |

*Sources: Statistical database of the UN Food and Agricultural Organization (http://www.fao.org)*

It is remarkable that ECE has a much higher share of arable land than SEE. On the other hand, SEE shows a higher proportion of permanent grasslands, is much more forested and also shows a higher share of the other areas (e.g., lakes and denudated karst areas). Trends of land use changes after 1989 in SEE differ slightly from the development in ECE countries. The area of arable land decreased there significantly because mechanisms of differential land rent started to work again, and as a consequence, less fertile soils have been abandoned and mostly transformed to permanent grasslands. The share of permanent grassland increased during 1961 to 1990, but decreased within the period 1990 to 2002. No changes occurred in forest areas and woodlands in SEE, but in ECE these increased appreciably. In contrast, "other areas" increased considerably after 1990 especially in ECE, also as a consequence of its more intensive economic progress. From the point of view of land use and environment, there are many negative aspects. For instance, the fields lying alongside highways or crossings of major roads are build over by many huge stock halls (called “for one use”) with goods for hypermarkets located in the outskirts of big cities.

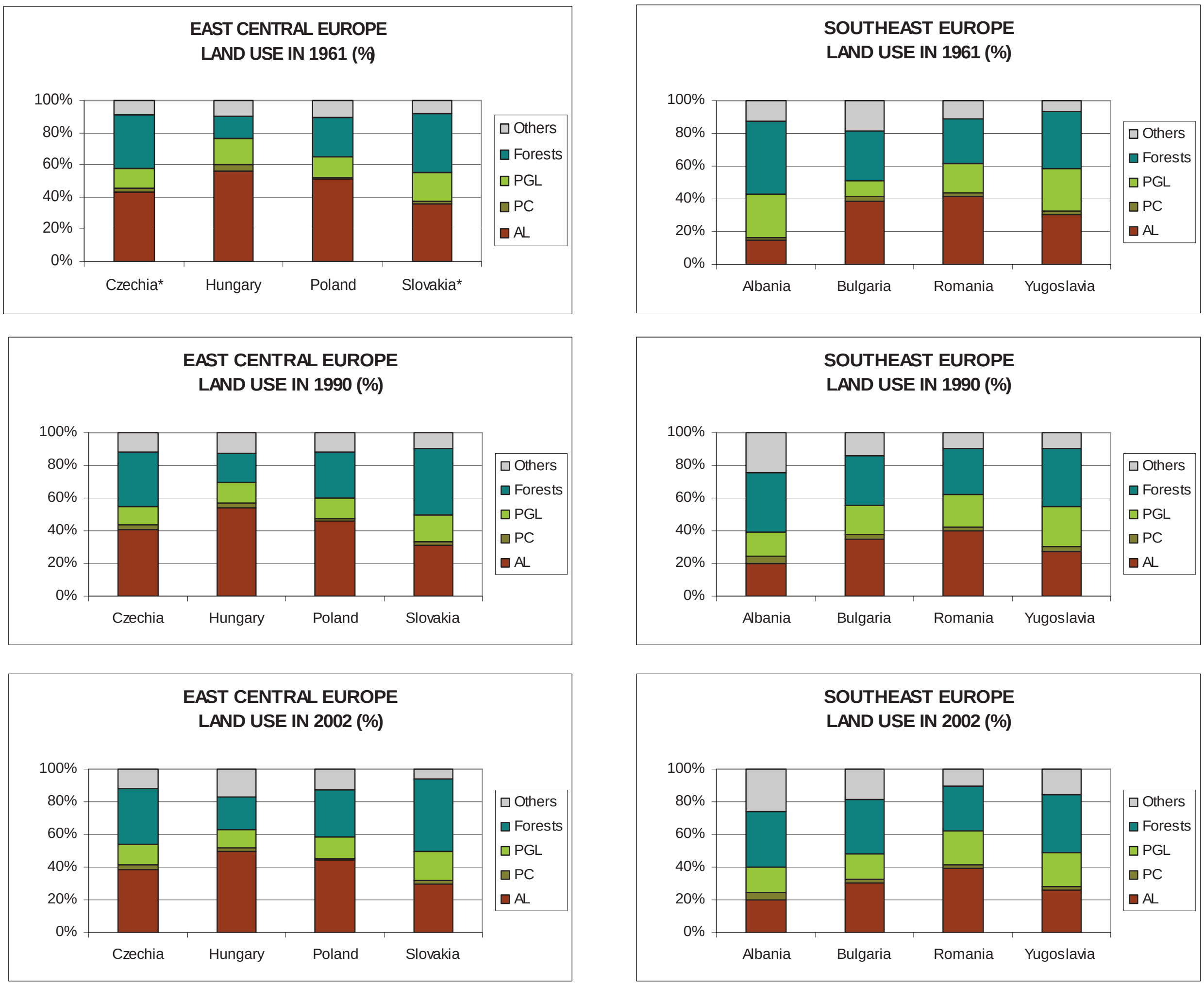
Different from countries in SEE, natural conditions as well as historical evolution, collectivization of agriculture and the so-called “socialistic” industrialization in the period of communism, explain why the share of agricultural land in 2002 was highest in Hungary (63 % of total land), Poland (59 %), Czechia (54 %), and Slovakia (50 %), and only 25 % in mountainous Slovenia (here we involved Slovenia in ECE), with a similar trend for arable land. Permanent grasslands are most widespread in Slovakia (18 %) and Slovenia (15 %). These numbers correlate with the share of forests and woodlands in total land area: Slovenia (55%), Slovakia (45 %), Czechia (34 %), Poland (30 %), and Hungary (20 %) (see Figure 1).

## 4. Conclusions and prediction

Contemporary LU structure will probably change considerably in a relatively short time, but not fully according to factors and trends we have recognized. “Tempores mutantum” and not only on regional (countries) or macro-regional level (ECE, SEE), but globally. Current dramatic developments in production and also in an international trade with cereals and oil plants for food and feed production are fuelled by economic boom in the most populated countries, accompanied by growing popularity of mass-production biofuels. These processes brought about rapid increase in demand for edibles (including structure and quality). In all probability, trends dominating the LU development during the transformational period in the 1990’s will come to an end in the foreseeable future.

In all examined countries the land area of arable land has been on the decline since the end of the Second World War. In some of them, for instance in Czechia, the decline started even earlier. Such a decrease, which exceeded 12 % in the ECE between the years 1961 and 1990 (see tab. 1b), happened mainly to the benefit of so called Other Areas (built-up areas, water areas, transport areas, etc.) After 1989, free impact of differential rent II was restored and agricultural investments were directed mainly to more fertile soils. Under the pressure from foreign producers (EU, US, etc. – more intensive and more subsidized, “unfair” competitors) significant areas of arable land have been abandoned and turned into permanent grasslands. We suppose that this process will be reversed and the share of arable lands will start to grow.

*Figure 2: East Central Europe and South Eastern Europe: Land Use Changes by States 1961–1990–2002 (in %)*




*Sources: Statistical database of the UN Food and Agricultural Organization (http://www.fao.org)*

## References and data sources

BIČÍK, I., CHROMÝ, P., JANČÁK, V. JANŮ, H., eds. (2002): Land Use/Land Cover Changes in the Period of Globalization. Proceedings of the IGU-LUCC International Conference Prague 2001. Prague: Charles University in Prague, Faculty of Science, Dept. of Social Geography and Regional Development, 2002, 215 p.

BIČÍK, I., JELEČEK, L. (2004): Political Events Factoring into Land-Use Changes in Czechia in the 20th century," In: E. Milanova, Y. Himiyama, I. Bičík, eds., Understanding Land-Use and Land-Cover Change in Global and Regional Context. Science Publishers, Inc., Enfield (NH), USA, Plymouth, UK, pp. 165–186.

BIČÍK, I, JELEČEK, L., ŠTĚPÁNEK, V. (2001): Land-Use Changes and their Social Driving Forces in Czechia in the 19th and 20th Centuries. Land Use Policy, 18, No. 1, pp. 65–73.

BIČÍK, I., CHROMÝ, P., JANČÁK, V., JELEČEK, L., KUPKOVÁ, L., ŠTĚPÁNEK, V., WINKLEROVÁ, J. (2001): Land Use/Land Cover Changes in Czechia over the past 150 Years: An Overview. In: Himiyama, Y., Mather, A., Milanova, E., Bičík, I., eds. (2001): Land Use/Cover Change in Selected Regions in the World, Vol. I. Asahikawa, Japan, IGU Study Group on LUCC, Hokkaido University of Education, 2001, pp. 29–39.

WANDRUSZKA, A., URBANITSCH, P. (1973): Die Habsburgermonarchie 1848–1918. Vol. I, Die wirtschaftliche Entwicklung. Wien Österreichische Akademie der Wissenschaften, Wien.

FERANEC, J., ŠÚRI, M., OŤAHEL, J., CEBECAUER, T., PRAVDA, J., KOLÁŘ, J., SOUKUP, T., ZDEŇKOVÁ, D., WASZMUTH, J., VAJDEA, V., VÎJDEA, A.M., NITICA, C. (2001): Landscape Change Detection, Analysis and Assesment in the Phare Countries: The Czech Republic, Hungary, Romania and Slovak Republic. In: Himiyama, Y., Mather, A., Milanova, E., Bičík, I., eds. Land Use/Cover Change in Selected Regions in the World, Hokkaido University of Education, pp. 53–60.

GABROVEC, M., KLADNIK, D., PETEK, F. (2001): Land Use Changes in the 20th Century in Slovenia." In: Himiyama, Y., Mather, A., Milanova, E., Bičík, I., eds., Land Use/Cover Change in Selected Regions in the World, Vol. I., Hokkaido University of Education, 2001, pp. 41–52.

GEIST, H., ed., (2006): Our Earth's Changing Land: An Encyclopedia of Land-Use and Land-Cover Change. Vol. 1: A – K, Vol. 2: L – Z. Greenwood Press, Westport, Connecticut. 715 p.

JELEČEK, L. (1995): Changes in the Production and Techniques in the Agriculture of Bohemia 1870–1945. In: Havinden, M. A., Collins, E.J.T., eds: Agriculture in the Industrial State. Chapter 6. Rural History Centre, University of Reading, UK, s. 126–145.

JELEČEK, L. (2006): Agricultural Revolution, Cadastre, East Central Europe, Industrial Revolution, Land reforms, Land rent, Southeast Europe, Technological Scientific Revolution (in agriculture), In: Geist, H., ed.: The Earth's Changing Land: An Encyclopedia of Land-Use and Land-Cover Change. Greenwood Publishing Group, Westport, CT, USA, Vol. I., s. 25–27; 81–84; 188–193; 302–303; Vol. II, s. 352–355; 356–357; 557–560; 588–590.

KRÁL, V. (1999): Fyzická geografie Evropy. Academia, Praha, 348 s.

KRECH, S., III, McNEIL, J.R., MERCHANT, C., Eds. (2003): Encyclopedia of World Environmental History. Vols. 1–3. Routledge, New York, 1344 s.
ISBN 0-415-93732-9,

LAMBIN, E., GEIST, H., (2007): Causes of land-use and land-cover change. The Encyclopedia of Earth: Content, Credibility, Community," 2007. In: http://www.eoearth.org/article/Causes_of_land-use_and_land-cover_change. Retrieved: Aug 18, 2007

MAGOCSI, P.R. (1993, 2002): Historical Atlas of East Central Europe. University of Washington Press, Seattle, London.

MATHER, A. (2002): The reversal of land-use trends: the beginning of the restoration of Europe," In: I. Bičík et al., eds., Land/Use Cover Changes in the Period of Globalization. Proceedings of the IGU-LUCC International Conference Prague 2001, Prague, pp. 23–30.

MILANOVA, E., HIMIYAMA, Y., BIČÍK, I., eds. (2004): Understanding Land-Use and Land-Cover Change in Global and Regional Context. Science Publishers, Inc., Enfield (NH), USA, Plymouth, UK, 336 p.

TURNOCK, D. (2001): Agricultural Transformation of Land Use in Central and Eastern Europe. Ashgate, Aldershot.

# A NEW DEVELOPMENT OF AGRICULTURE AND FORESTRY IN A RURAL AREA OF JAPAN: A CASE STUDY OF *KASHIMO*, JAPAN

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**Abstract**

Today, most Japanese mountain villages have been facing serious problems such as longstanding depopulation, aging, reduction of the productivity of farmland, expansion of dilapidation and of degraded forest land. Many mountain villages have been threatened with a crisis of their own existence. Despite the severe condition of mountain villages, there are a number of villages which have succeeded in developing sustainable agriculture and forestry. *Kashimo* is one of the typical villages which have survived.

*Kashimo* is located in the central part of Japan. It presents some of the necessary conditions for a mountain village to survive in contemporary Japan. There are four conditions. 1) Creation of new products of high quality in agriculture and forestry, 2) Increase in work opportunities for elderly people, 3) Creation of new work opportunities for young people from outside the village, and 4) Development of a new industry other than agriculture and forestry.

## 1. Introduction

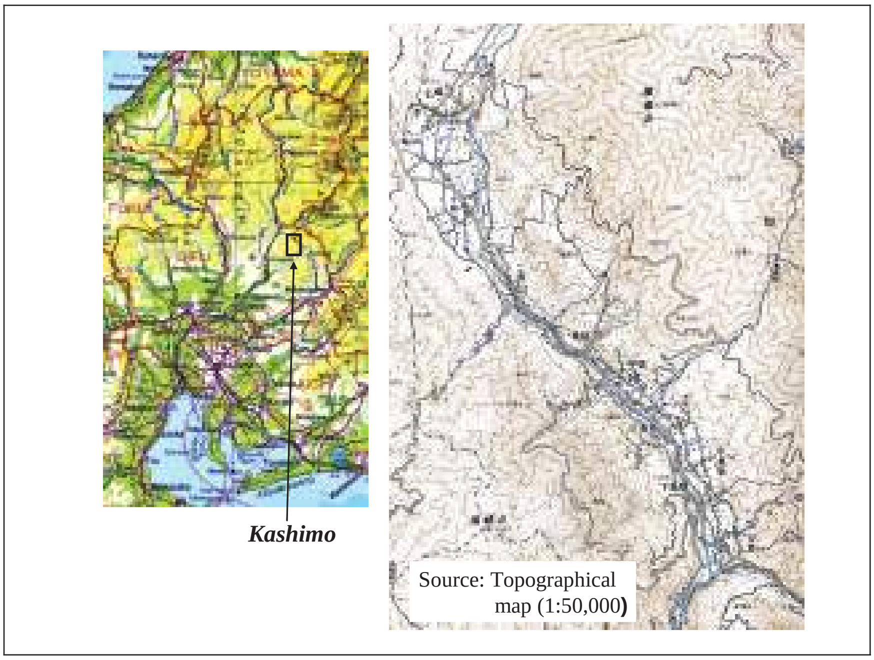
Japan is a mountainous country. Forest occupies 66.4 % of the total area in 2004 (Ministry of Land, Infrastructure and Transportation 2007). In most mountain villages, agriculture and forestry have been major industries. Japanese agriculture and forestry have been declining and the number of persons engaged in farming and forestry has decreased (Ministry of Agriculture, Forestry and Fisheries of Japan 2007). Area of cultivated land has decreased. Farm size in such villages is usually small and productivity is low. Wood price remains stagnant. At present, Japan's wood self-sufficiency ratio is under 20 % (Ministry of Land, Infrastructure and Transportation 2007). Natural conditions of mountain villages are harsh.

Nevertheless, there are some mountain villages which have succeeded in keeping their agriculture and forestry by creating various products. They have made the best use of natural conditions and local resources (Fujita 1981, Yamamoto, S., Kitabayashi, Y. and Tabayashi 1987, Soda 2000, Kobayashi 2007, Honma 2007).

We made a study of Kashimo, a mountain village in Nakatsugawa City of Gifu Prefecture in Japan (Fig. 1). *Kashimo*'s agriculture and forestry have the following distinguishing characteristics. 1) Creation of products by making the best use of natural conditions: Tomato, beef and Japanese cypress are Kashimo's specialties. 2) Unique attribution of farmers and forestry workers: Elder people are engaged in agriculture, and younger people in forestry. 3) Creation of a new industry with added-value: House buildings/selling industry has developed by using the cypress, a high value wood. 4) Distinctive leadership: Not only local government but also productive cooperatives have a unique leadership to develop *Kashimo*'s industries.

*Kashimo* is located in the central part of Japan. It is a mountain village with a population of 3,346 as of 2004. Woodland area occupies 94.0 % of *Kashimo*'s total land area (Nakatsukaga City 2007). Settlements are scattered along the *Kashimo* River (Photo 1). Average temperature of August in *Kashimo* is 23.6°C and of February is – 0.2°C. The annual precipitation is 2,116 mm. Both annual and daily ranges are large. Fig.2 shows the highest and lowest temperature of *Kashimo* by month. The difference of the temperature between the two is large. Such a climate has contributed to the development of *Kashimo*'s agriculture and forestry (Kobayashi ed. 2007).

*Fig. 1 – Research Area*



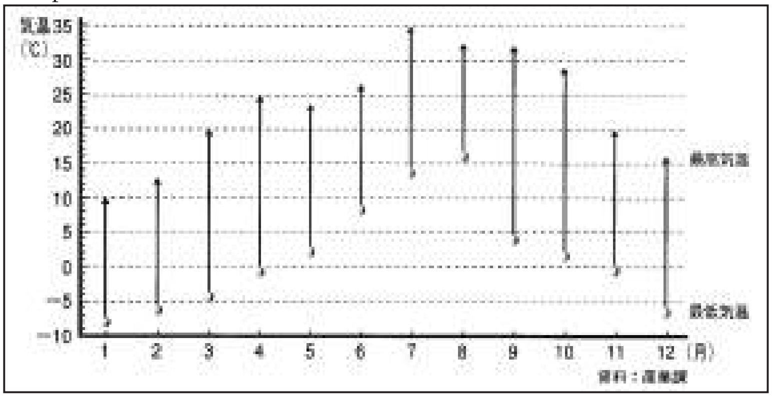

*Source: Fundamental atlas, Ninomiya-Shoten and topographical map (1:50,000)*

*Photo 1 – Scenery in Kashimo (March, 2006)*

Table 1 shows the ratio of the workforce by industrial sectors in comparison with those of Gifu Prefecture and Japan. Ratio of the population engaged in the primary and the secondary sector in *Kashimo* is much larger than those of Gifu and Japan. Table 2 shows the gross agricultural output of *Kahsimo* in 2000. Beef cattle occupy 45.5 % and vegetables 23.7%. The major vegetable product is tomato. Rather high ratio of population engaged in the secondary sector reflects the existence of a number of house-building workers. *Kashimo* is famous for good Japanese cypress trees. Natural conditions of *Kashimo* are suitable for growing Japanese cypress. Villagers have been vigorously engaged in house building using these good Japanese cypress materials.

*Fig. 2 – The highest-and lowest temperature of each month (horizontal axis: months, vertical axis: temperature)*

Temperature




Month

*Source: Data from Nakatsugawa City*

*Table 1 – Work force by industrial sector (%, 2000)*

| Industrial sector | *Kashimo* | Gifu-Prefecture | Japan |
|---|---|---|---|
| Primary sector | 17.1 | 3.8 | 5 |
| Secondary sector | 44.3 | 38.7 | 29.5 |
| Tertiary sector | 38.7 | 57.4 | 64.3 |

*Source: Statistics Bureau, Ministry of Internal Affairs and Communications*

*Table 2 – Gross agricultural output in Kashimo (Million Yen, 2000)*

| Total | Vegetables | Rice | Beef cattle | Dairy cattle | other |
|---|---|---|---|---|---|
| 1157 | 274 | 129 | 526 | 128 | 100 |
| 100.0% | 23.7% | 11.1% | 45.5% | 11.1% | 8.6% |

*Source: Ministry of Agriculture, Forestry and Fisheries*

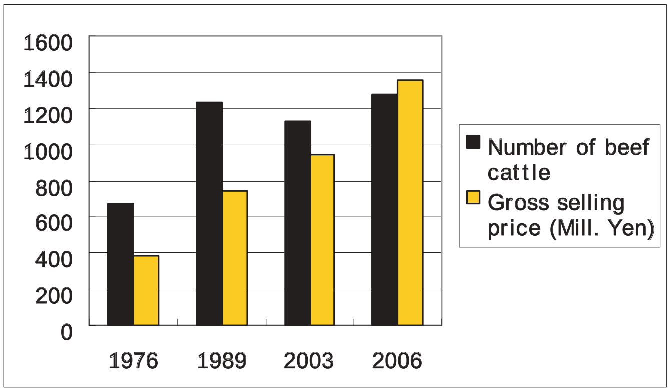
The purpose of our study is to analyze the characteristics of main industries of *Kashimo*, namely, agriculture, forestry and house building, through the perspective of effective use of local resources.

Our method of study is as follows: 1) Analysis of statistics, data and documents: We used various statistics issued by Japan Statistics Bureau such as Census of Agriculture and Forestry 1980–2005, Population Census 1980–2005, and data of the local government of *Kashimo.* 2) Field investigation: We interviewed personnel in charge of the administration of the local government, leaders of agricultural productive cooperatives and workers in forestry and house building. 3) Land use and landscape survey.

## 2. Beef cattle raising

Fig. 3 shows the number of beef cattle and gross selling price in *Kashimo*. The number of beef cattle in 2006 is 1,280 and the gross selling price has reached 1,36 billion Yen. Recently, the gross selling price has been rapidly increasing, which is testimony to the high quality of *Kashimo's* beef. The selling price of beef produced in *Kashimo* is double that of normal meat. Beef cattle raised in the northern part of Gifu-Prefecture including *Kashimo* is called "*Hida-Gyu*". The beef is famous for its quality in Japan. Photo 2 shows "*Hida-gyu*", black Japanese beef cattle.

*Fig. 3 – Number of beef cattle and gross selling price in Kashimo*

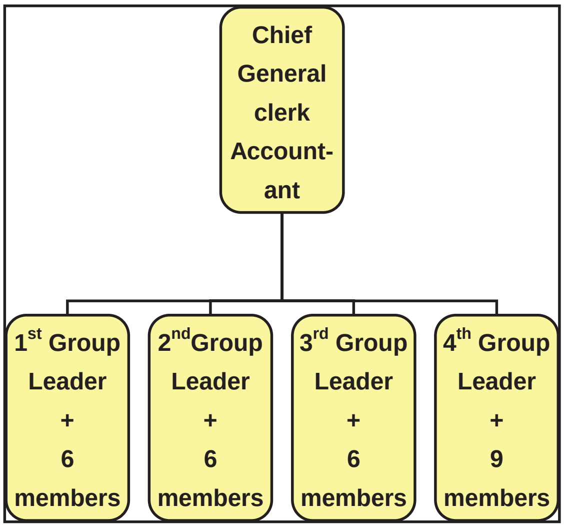



*Source: Nakatsugawa City 2007*

*Photo 2 – "Hida-gyu" (Japanese beef cattle) in Kashimo (July 2007)*

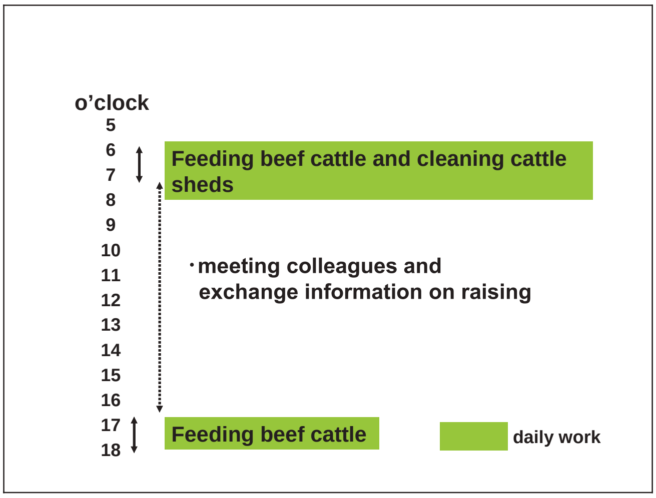
Why is the quality of *Kashimo*'s beef so high? Three reasons can be mentioned: The first is the existence of the *Kashimo* Beef Cattle Production Cooperative. There are 30 beef cattle raising farm households in *Kashimo*. They raise beef cattle in their own way. At the same time, they have formed the *Kashimo* Beef Cattle Production Cooperative. The Cooperative consists of 4 groups (Fig. 4). They usually talk about the methods of raising and selling their beef cattle. They have made several study visits to some advanced beef cattle raising regions. They have received advice on beef cattle raising from lecturers. They buy calves 9–10 months old and raise them for one and a half years, and then sell them. When they sell them, a cow is as heavy as 650 kg and a castrated bull is 850 kg. Fig. 5 shows the daily work of Mr. N. In the morning, he feeds his cattle and cleans up the cattle sheds, and in the evening, he feeds them again. During the rest of his time, he meets colleagues and discusses how to raise good cattle.

*Fig. 4 – Kashimo beef cattle production cooperative*




*Source: field survey*

*Fig. 5 – Daily work of Mr. N. (a beef cattle raising farmer) in Kashimo*




*Source: field survey*

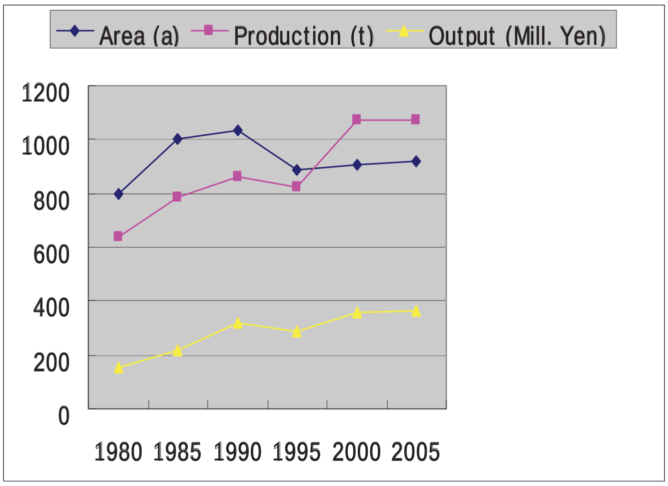
The second is the important role of the Gifu Agricultural Experimental Station. It is indispensable for cattle-raising farmers to get calves of excellent quality. It becomes important to obtain good breeding cattle. The Gifu Agricultural Experimental Station has endeavored to produce high quality bulls and cows for breeding.

The third is a cool climate and good-quality water. As mentioned before, the climate of *Kashimo* is cool, which is suitable for cattle raising. Good-quality water is also indispensable to raise beef cattle in *Kashimo.*

## 3. Tomato cultivation

Fig. 6 shows the area, production and output of tomatoes in *Kashimo*. In 2005, the growing area was 9.21 ha, the production 1,075 tons and the output 367 Million Yen. Production per unit area is very high. Delicious tomatoes have been produced in *Kashimo* (Photo 3*)*. There are two reasons. One is the existence of the *Kashimo* Tomato Production Cooperative. Every farm cultivates and sells tomatoes privately. They belong to the *Kashimo* Tomato Production Cooperative. The Cooperative consists of 40 tomato farm households. It is divided into 4 groups (Fig. 7). Its main activities are 1) exchanging of information on tomato cultivation and shipment, 2) making study visits to advanced tomato-cultivation regions, 3) holding lectures on tomato cultivation and 4) giving lectures on agriculture at elementary and junior-high schools.

*Fig. 6 – Area, production and output of tomato in Kashimo*



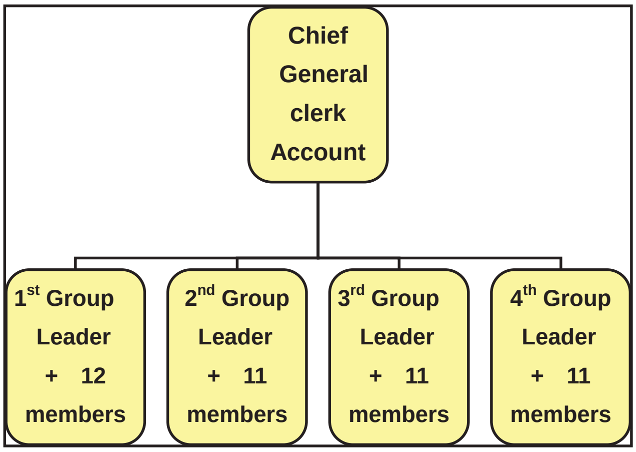

*Source: Nakatsugawa City 2007*

*Photo 3 – Tomato cultivation in greenhouses in Kashimo (6.2007)*

Group members gather very often, talk to each other, eat and drink together frequently. They travel regularly and discuss tomato cultivation. Such activities contribute to the production of safer and more delicious tomatoes. They find more efficient and more rational cultivation methods through the discussion.

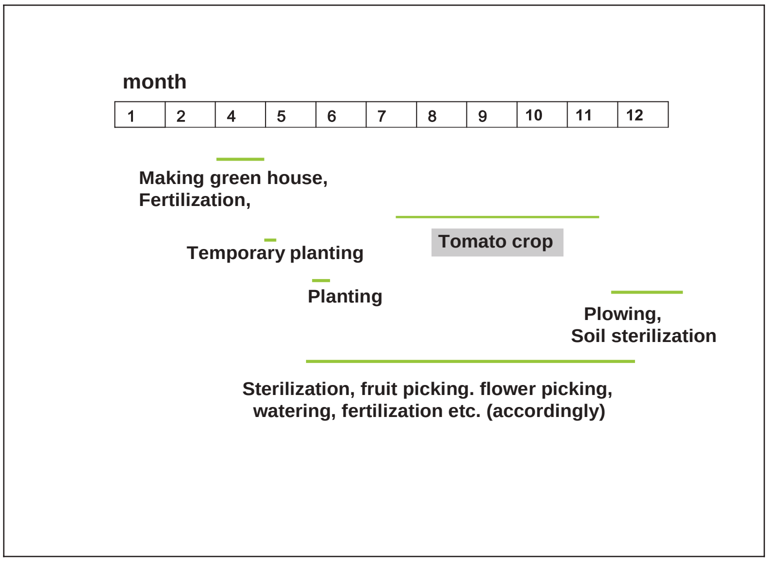
Fig. 8 shows the methods of tomato cultivation in *Kashimo*. In *Kashimo*, tomatoes are shipped in summer. In this season, the lowland areas are too hot to cultivate tomatoes. The climate condition that the annual and daily range is large is one of the necessary requirements for producing delicious tomatoes.

*Fig. 7 – Kashimo tomato production cooperative*




*Source: field survey*

*Fig. 8 -Tomato cultivation in Kashimo*



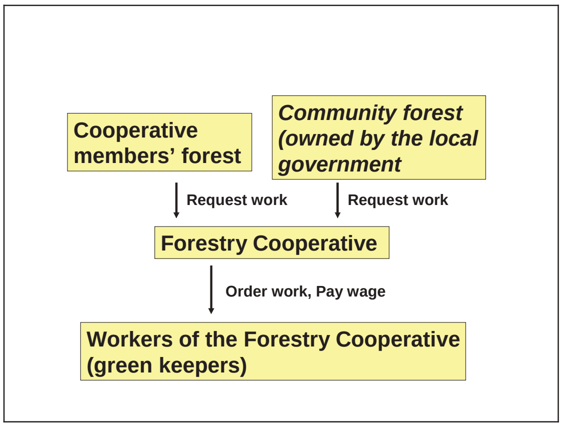

*Source: field survey*

## 4. Forestry and house building

In 2007, the forest land area of *Kashimo* is 5,622 ha, with artificial forest land of 4,110 ha, occupying 73.1 % of the total forest area. Of the total artificial forest land, Japanese cypress forest occupies 83.9 % (The Forestry Cooperative of Kashimo 2007). Japanese cypress is one of the most valuable building woods. The climate of *Kashimo* is characterized by a wide annual and daily temperature range, a lot of rainfall as already mentioned and frequent fog. Japanese cypress of good quality (shiny and good-smelling) has been grown in these climate conditions.

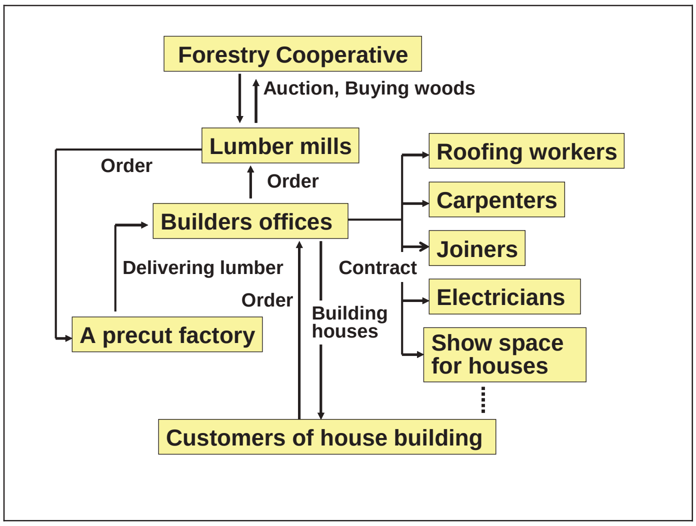
The Forestry Cooperative of *Kashimo* is responsible for the maintenance and cutting of trees (Fig. 9). Actually, five (5) green keepers, who are employed by the Forestry Cooperative, do the work according to the order of the municipality and private owners of the forest. Fig. 10 shows the process of house building. There are Forestry Cooperative, builders offices, a precut factory, carpenters, joiners, a show space for houses and so on. They have organized the *Kashimo* House Building Cooperative to build Japanese cypress houses effectively. *Kashimo* Japanese cypress houses have been built not only in the neighboring regions but also in distant places such as Tokyo, Osaka and Kobe (Photo 4).

*Fig. 9 – Process of Forest work in Kashimo*




*Source: field survey*

*Fig. 10 – Process of house building in Kashimo*




*Source: field survey*

## 5. Conclusion

Today, most Japanese mountain villages have been facing serious problems such as longstanding depopulation, aging, reduction of the productivity of farmland, expansion of dilapidation and of degraded forest land. Many mountain villages have been threatened with a crisis of their own existence (Kobayashi 2002). There are 26,671 settlements in depopulated area, to which most mountain villages belong, in 2006. Ministry of Land, Infrastructure and Transportation predicts that 4.3 % of the settlements will disappear in the near future.

*Photo 4 – A Kashimo cypress house (July 2007)*

Despite the severe condition of mountain villages, there are a number of villages which have succeeded in realizing sustainable agriculture and forestry. *Kashimo* is one of the typical villages which have survived. People of *Kashimo* have endeavored not only to maintain but also to develop their village. Results of their endeavor can be presented as follows. 1) Creation of new products with high quality in agriculture and forestry. Tomato, beef and cypress trees are examples of their efforts. 2) Increase in work opportunities for elderly people. Beef cattle raising and tomato cultivation have been carried out by elderly people. Table 3 shows the age structure of the members of Beef Cattle Production Cooperative and Tomato Production Cooperative. In both cooperatives, about three-fourths of all members are at the age of 50 and over. In particular, members with the age of 60 and over occupy 55 % in all members of the Tomato Production Cooperative. 3) Creation of new work opportunities for young people. Young people have come to *Kashimo* from outside to work as "green keepers" which is a new type of worker. They are constantly employed in forestry. 4) Development of house-building industry by using local cypress trees.

*Table 3 – Age structure of members of Kashimo Beef Cattle Production Cooperative and Kashimo Tomato Production cooperative*

| Age | *Kashimo* Beef Cattle Production Cooperative | *Kashimo* Tomato Production Cooperative |
|---|---|---|
| | Number of people | Number of People |
| 20's | 2 | 0 |
| 30's | 3 | 2 |
| 40's | 3 | 7 |
| 50's | 12 | 9 |
| 60's | 5 | 6 |
| 70's | 2 | 11 |
| 80's | 3 | 5 |
| Total | 30 | 40 |

*Source: field survey*

Japanese cypress trees of *Kashimo* became famous for house-building wood. Today, a lot of people are engaged in house-building industry. 5) Cooperation of leaders to develop

*Kashimo*'s industries. People in *Kashimo* have formed a unique leadership structure. Not only leaders in the local government but also leaders in all agricultural and forestry cooperatives have worked together, helped each other to survive the difficult situation.

As a result, *Kashimo* has succeeded in minimizing the population decrease. Namely the rate of population decrease from 2000 to 2004 in *Kashmo* was 1.9 %. On the other hand, the rate in all depopulated area in Japan from 2000 to 2005 was 5.4 % (Society for Depopulation Measures 2006, Nakatsugawa City 2007). *Kashimo* is a typical village which has succeeded in realizing some of the necessary conditions for a mountain village to survive and to develop in contemporary Japan.

***Acknowledgements***

*We would like to thank Mr. Mitsuhiro ITO and Ms. Nao ZENDA who are working in the Division of Industry Promotion Division of Nakatsugawa City for giving us useful data and information.*

## References and data sources

FUJITA, Y. (1981): Mountain Villages in Japan. Chijin-Shobo, 288 p. (J)

HONMA, Y. (2007): Conditions for the Resurgence of Regions. Iwanami-Shinsho, 222 p. (J)

KOBAYASHI, K. ed. (2007): Report on Industries and Way of Life in Kashimo. Gifu- University, 57 p. (J)

KOBAYASHI, K. (2007): Development and Problems of Tourism in Shirakawa-Mura. IGU Commission on Sustainability of Rural Systems, In Proceedings of the 14th Colloquium of the Commission on the Sustainable Development of Rural Systems of the I.G.U., p. 98–106.

KOBAYASHI, T. (2002): Out-Migration of the Aged from a Depopulated Village. Life Long Education Research Center Vol.1, Gifu University, p. 57–82. (J)

Ministry of Agriculture, Forestry and Fisheries of Japan (2007): White Paper on Food, Agriculture and Rural Areas. p. 97–146. (J)

Ministry of Land, Infrastructure and Transportation of Japan (2007): White Paper on Land 2007. (J)

NAKATSUGAWA City (2007): Data from Nakatsugawa City. 43p. (J).

Society for Depopulation Measures (2006): Data Book for Depopulation Measures. Marui-Kobunsha, p. 3–28. (J)

SODA, O. (2000): Principal of Agriculture and Rural Science. Iwanami-Shoten, p. 145–160. (J)

The Forestry Cooperative of Kashimo (2007): Business Report on the Forestry Cooperative of Kashimo. p. 21–38. (J).

YAMAMOTO, S., KITABAYASHI, Y. and TABAYASHI, A. (eds.) (1987): Rural Space in Japan. Kokon-Shoin, p. 15–52. (J)

*(J) written in Japanese.*

# DRIVING FORCES OF THE MOST IMPORTANT LANDSCAPE CHANGES IN SELECTED REGIONS OF SLOVAKIA AND BULGARIA IN THE PERIOD BETWEEN 1990 AND 2000

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**Abstract**

Significant part of LUCC research is devoted to the analysis of relations between land use and the socio-economic and biophysical variables that act as the "driving forces" of land use change. Our aim with this contribution is to generate from regional-scale case studies from Slovakia and Bulgaria a general understanding of driving forces of the greatest landscape changes in the period 1990–2000. CLC databases were used to derive landscape changes in the region of Trnava (Slovakia) and the region of Plovdiv (Bulgaria). The comparison is based on the extent of urbanization, extensification of agriculture, intensification of agriculture, deforestation, forestation and other landscape changes. As extensification of agriculture and forestation have been recognized the main landscape changes on the study areas, special attention was paid to the analysis of agriculture- and forestry-related factors in the period of agricultural transformation in both countries.

## 1. Introduction

Substantial increase of negative impacts of socio-economic development on the landscape is connected with increased interest in studying the interaction nature-society and the changes of land use (LU) and land cover (LC) in many countries over the world. These changes reflect modifications in the uses of land: intensification or extensification of agricultural practices, including conversion of the natural land into agriculture or farmland abandonment; development of artificial surfaces for housing, recreation, transport and economic activities (urbanization); forestation or deforestation. Land cover change evaluation in a consistent way at the European scale has been made possible because of the CORINE land cover (CLC) inventory, based on satellite images acquired in the early 1990s and approximately in 2000. (Imaging is expected to be repeated in 2006). The main outputs of CLC projects are CLC databases providing information on the physiognomic characteristics of Earth-surface objects related to these time horizons (CLC90 and CLC 2000).

Land use and land cover changes (LUCC) are the result of interplay between socio-economic, institutional and environmental factors. Lesschen et al. (2005) presume that the key to understanding LUCC is to recognize the role of individual decision makers bringing about change, through their choices, on land resources and technologies. These authors also note that much of the LUCC research is devoted to the analysis of relationships between land use and the socio-economic and biophysical variables that act as the "driving forces" of land use change. According to Verburg et al. (2003), different driving forces at different scales of analysis have a dominant influence on the land use system: at the local level this can be the local policy or the presence of small, ecologically valuable areas. At the regional level it is the distance to market, port or airport that might be the main determinant of land use change.

The fact that landscape changes can be effectively managed through understanding their principal driving forces, stimulated research concentrated on their definition and classification. Bűrge et al. (2004) define driving forces as forces that cause observed landscape changes, so they are influential processes in the evolutionary trajectory of the landscape. Their study gave an overview on past, current and new directions in studies of driving forces. Schneeberger et al. (2007) studied actors and driving forces of landscape changes in correlation with transformation rates. Following Brandt et al. (1999) who created analytical framework to analyse the parameters responsible for landscape change, Schneeberger et al. (2007) recognize five types of driving forces: cultural, economic, political, technological and natural.

Driving forces are generally subdivided into two groups: proximate causes and underlying causes (Geist and Lambin 2002, Lesschen et al. 2005). Proximate causes are human activities or immediate actions that directly affect land use, e.g. wood extraction or road building. Underlying driving forces are fundamental social processes, such as human population dynamics or agricultural policies. They underpin the proximate causes and either operate at the local level or have indirect impact from the national or global level. In most cases, a wide range of demographic, economic, technological, institutional and cultural factors is used to represent the underlying causes: examples include soil suitability, population density, and accessibility. Underlying driving forces can be differentiated according their stability into two groups: driving forces that are expected to change over time (population density, market conditions), and conditioning factors that are relatively stable over time, but are spatially differentiated (agroclimate, cultural context).

Our aim is to generate general understanding of proximate and underlying driving forces of the most important landscape changes in the period 1990–2000 from the regional-scale case studies from Slovakia and Bulgaria.

## 2. Data and method

Based on the satellite image interpretation, the CORINE Land Cover (CLC) project has produced a compatible land-cover database of Europe at scale 1:100 000. The main output of the project is the CLC database providing information on the physiognomic characteristics of Earth-surface objects approximately in the early 1990s. Feranec et al. (2006) demonstrated CLC changes on case studies from the above-mentioned study areas. Results of this research are used to explain regional, specific features in the development of the rural landscape.

It is particularly important to understand how the information on land-cover change was interpreted by means of land-cover flows between the years 1990 and 2000.

Applying the methodological approach proposed by Feranec et al. (2002), landscape changes in study regions were assessed on the basis of land-cover flows and interpreted according to types and subtypes of landscape changes. The first type – *urbanization (industrialization)* – represents changes of agricultural, forest and semi-natural LC classes (21x–32x) into classes of artificial surfaces (11x–14x) and classes of mining, dumping and construction sites (13x) into industrial, commercial and transport units (12x). Four subtypes fall under this type:

U1 – enlargement of urban fabric,
U2 – enlargement of industrial, commercial and transport built-up area,
U3 – enlargement of natural resources exploitation,
U4 – enlargement of sport and leisure facilities area.

The second type – *intensification of agriculture* – is characterized by changes of mining and construction sites, classes of less intensive agricultural use and forest classes (13x, 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 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 and berry plantations,
E4 – reduction of complex cultivation pattern area,
E5 – reduction of rice fields.

The fourth type – *deforestation* after felling or calamities (caused by wind, emission forest fires, etc.) – is interpreted according to change of classes 31x into 324 or classes 31x and 324 into 211 and 243. It contains two subtypes:
D1-– felling or calamities in forest
D2 –deforestation and enlargement of agricultural land

The fifth type – *forestation* (natural overgrowing and cultivation of forest) – represents changes of classes 131, 132, 211, 231, 243, 321 into class 324 and classes 211, 231, 243 and 324 into 311, 312, 313. Two subtypes fall under this type:
F1 – natural development of forest
F2 – economic growing of forest

The sixth type – other changes, contains the following subtypes:
O1 – enlargement of water areas
O2 – reduction of water areas
O3 – forest composition changes.

Above-mentioned landscape changes directly influence landscape configuration that can be described by different landscape indices. Landscape pattern changes of the study areas Trnava and Plovdiv were expressed using the following diversity indices:

- Patch density (PD) – number of all patches (polygons) per 100 ha of the study area
- Patch richness density (PRD) – number of different patch types (land-cover classes) within a study area per 100 ha
- Percentage of arable land (%LAND $_{CLC21}$) – percentage of study area occupied by arable land (CLC classes 211 and 213)
- Arable patch density (PD $_{CLC21}$) – number of arable polygons per 100 ha of the study area
- Arable edge density (ED $_{CLC21}$) – length of arable land borders (perimeter of CLC class 211and 213) in meters per 100 hectares of the study area
- Percentage of forest (%LAND $_{CLC31}$) – percentage of study area occupied by forest (CLC classes 311, 312 and 313)
- Forest patch density (PD $_{CLC31}$) – number of forest polygons per 100 ha of the study area
- Total forest edge (TE $_{CLC31}$) – length of all forest borders (perimeter of CLC classes 311, 312 and 313) on the study area in km
- Forest edge density (ED $_{CLC31}$) – length of forest borders (perimeter of CLC classes 311, 312 and 313) in meters per 100 hectares of the study area.

## 3. Study areas

For the purpose of this study we have chosen two study areas situated in Slovakia and two in Bulgaria.

### 3.1. Trnava study area

The study area is situated in the southwestern part of Slovakia. It includes the following districts (NUTS 3): Skalica, Senica, Piešťany, Hlohovec, Trnava, Galanta and Dunajská Streda (Trnava Region – NUTS 2) and districts of Senec and Pezinok (Bratislava Region – NUTS 2). The total area of the studied territory is 4,961 km$^2$ and it covers 10.1% of the Slovak Republic (Fig. 1).

*Fig. 1: Location of the study area Trnava*


As far as the natural conditions are considered, intensively used lowlands (Podunajská nížina and Záhorská nížina) with fluvial plains and loess hilly lands occupy the major part of the territory. The two lowlands are separated by the mountainous landscape (Malé Karpaty Mountains and Biele Karpaty Mountains). Geomorphologically, the lowlands are parts of the Vienna basin and the Great Danube Basin and the mountains are a part of the Carpathian mountain range. The climate of lowlands is warm and dry, that of the mountainous part is moderately warm and wet, in some places wet. The southern boundary of the region coincides with the river Danube and the river Váh flows in its northeastern part. North of the Danube, the gravel sediments of the inland island Žitný ostrov contain a big groundwater reserve.

The Trnava region is the least compact one in terms of economy and transport because of its highly differentiated orography. Industry and services are represented above all in district centres. Food industry, based on high agricultural productivity of the lowland Podunajská nížina, dominates. The region produces 10.6% of the national GDP, which is one of the highest shares among regions. The agrarian sector is concerned with intensive growing of wheat, maize, sugar beet, but also vines, fruit and vegetables. The CLC2000 classes comprise: agricultural areas – 72.8%, forest and semi-natural areas – 17.5%, wetlands, and water bodies – 1.7%, artificial surfaces – 8.0%.

### 3.2. Plovdiv study area

The region of Plovdiv is situated in the central part of South Bulgaria (Figure 2) with area 5,972.9 km$^2$ or 5.4 % of the national territory. The population of the region amounts to 728,246 (31.12.2000) or 8.9% of the national total. Both in terms of overall population and population density (122 inhabitants per km$^2$), region Plovdiv ranks second following the region Sofia (the Capital).

The relief is quite varied. The central part of the region is a fragment of the Upper Thracian Lowland. It is characterized by plain relief and mainly by agricultural and urban areas. Mountainous landscapes and forests are predominant in the North (Balkan Mountain and Sredna Gora Mountain) and the South (Rhodopes Mountain) part of the region. The climate is moderately continental, with traces of a mountainous climate in the highland areas. The deepest Bulgarian river, the Maritsa, and many of its tributaries run through the region. Thermal mineral water springs occur at Hisarya and Narechenski bani. Fluvisols and humus soils are characteristic for the lowlands, plains and valleys of the region, as well as Luvisols, Cambisols and Leptosols – for the mountains. Mineral resources are of a more limited variety. Those of significance are lead-zinc ore (Laki municipality) and deposits of building materials.

Plovdiv region is characterized by well-developed economy with a strong services sector. The region produces 7.5% of the national GDP, which is one of the highest shares among the regions. Services contribute more than a half (54.5%) to the regional added value, while agriculture holds the smallest share (16.4%). The agrarian sector is concerned with intensive crop growing, such as vegetables, fruit, vines, and tobacco. Specific features of agriculture in the region include rice growing in the Maritsa municipality, and rose growing in the Karlovo municipality. The CLC2000 classes comprise: agricultural areas – 53.4%, forest and semi-natural areas, wetlands, and water bodies – 41.3%, artificial surfaces – 5.3%.

*Fig. 2: Location of the study area Plovdiv*


## 4. Results

### 4.1. Landscape changes in the study areas

Despite the similar natural landscape of the studied regions, the process of transformation of the former socialistic economies caused different changes in landscape structure. Detailed information on landscape changes according to subtypes of urbanization, intensification of agriculture, extensification of agriculture, deforestation, forestation and other landscape changes is given in Table 1.

*Table 1: Landscape changes by area (in ha and %) and count: a/ Trnava b/ Plovdiv*

a/ Trnava

| Type of the change | Extent (ha) | Extent ( % ) | Count |
|---|---|---|---|
| U1 | 853,0 | 4,2 | 73 |
| U2 | 440,3 | 2,2 | 21 |
| U3 | 33,5 | 0,2 | 4 |
| U4 | 66,7 | 0,3 | 1 |
| I1 | 1 290,8 | 6,4 | 63 |
| I2 | 140,5 | 0,7 | 8 |
| I3 | 60,9 | 0,3 | 3 |
| I4 | 1 033,6 | 5,1 | 23 |
| E1 | 428,6 | 2,1 | 16 |
| E2 | 1 522,1 | 7,5 | 39 |
| E3 | 725,3 | 3,6 | 18 |
| E4 | 95,3 | 0,5 | 3 |
| D1 | 1 706,1 | 8,4 | 65 |
| D2 | 25,9 | 0,1 | 3 |
| F1 | 1 721,2 | 8,5 | 45 |
| F2 | 5 785,7 | 28,5 | 104 |
| O1 | 3 783,7 | 18,7 | 20 |
| O2 | 25,6 | 0,1 | 1 |
| O3 | 530,4 | 2,6 | 15 |
| *Total* | *20 269,3* | *100,0* | *525* |

b/ Plovdiv

| Type of the change | Extent (ha) | Extent ( % ) | Count |
|---|---|---|---|
| I1 | 318,9 | 2,2 | 8 |
| I2 | 168,3 | 1,2 | 2 |
| I3 | 52,0 | 0,4 | 1 |
| I4 | 82,7 | 0,6 | 2 |
| E1 | 40,5 | 0,3 | 1 |
| E2 | 234,2 | 1,6 | 7 |
| E3 | 1 812,6 | 12,6 | 20 |
| E5 | 8 767,4 | 61,0 | 15 |
| D1 | 2 109,1 | 14,7 | 39 |
| F2 | 794,7 | 5,5 | 26 |
| *Total* | *14 380,3* | *100* | *121* |

*Source: Feranec et al. (2006)*

Notable landscape pattern changes expressed using landscape indices are presented in Table 2. Conversion of rice fields into arable land caused the decrease of landscape heterogeneity in the region of Plovdiv, which is confirmed by the drop of Arable patch density (-7,28%) and Arable edge density (-3,92%). In the region of Trnava, the percentage of the area occupied by forest increased more than 6%. Process of forestation caused the increase of all the forest-related indices. The indicators Patch density and Patch richness density remained fairly stable for landscapes in both regions.

*Table 2 – Landscape pattern changes expressed by landscape indices*

| | TRNAVA | | | | PLOVDIV | | | |
|---|---|---|---|---|---|---|---|---|
| | CLC90 | CLC2000 | Diff. | Diff. (%) | CLC90 | CLC2000 | Diff. | Diff.(%) |
| PD | 0,299 | 0,301 | 0,002 | 0,66 | 0,431 | 0,428 | -0,003 | -0,69606 |
| PRD | 0,005 | 0,005 | 0 | 0 | 0,004355 | 0,004355 | 0 | 0,00000 |
| %LAND $_{CLC21}$ | 66,074 | 66,237 | 0,1631 | 0,24 | 37,63721 | 37,97601 | 0,3388 | 0,90017 |
| PD $_{CLC21}$ | 0,015 | 0,015 | -0,0002 | -1,31 | 0,034508 | 0,031995 | -0,00251 | -7,28237 |
| ED $_{CLC21}$ | 1041,594 | 1041,308 | -0,2858 | -0,03 | 848,803 | 815,494 | -33,309 | -3,92423 |
| %LAND $_{CLC31}$ | 14,957 | 15,879 | 0,9226 | 6,16 | 29,18873 | 28,97706 | -0,21167 | -0,72518 |
| PD $_{CLC31}$ | 0,052 | 0,0562 | 0,0038 | 7,42 | 0,089119 | 0,089119 | 0 | 0,00000 |
| TE $_{CLC\ 31}$ | 2748,712 | 2835,808 | 87,096 | 3,17 | 6 986,663 | 6 979,084 | -7,580 | -0,11 |
| ED $_{CLC31}$ | 562,085 | 579,895 | 17,8102 | 3,16 | 1 170,387 | 1 169,118 | -1,269 | -0,10843 |

*Source: own calculations based on CORINE Land Cover data*

## 4.2 Driving forces of landscape changes

Proximate causes of the landscape changes, understood as activities or immediate actions that directly affect LU (Geist and Lambin 2002), were derived from identified LC flows. A matrix containing different types of driving forces was used for summarizing information obtained by analysis of CLC data, statistical data and governmental reports related to the main identified landscape changes (Fig. 3).

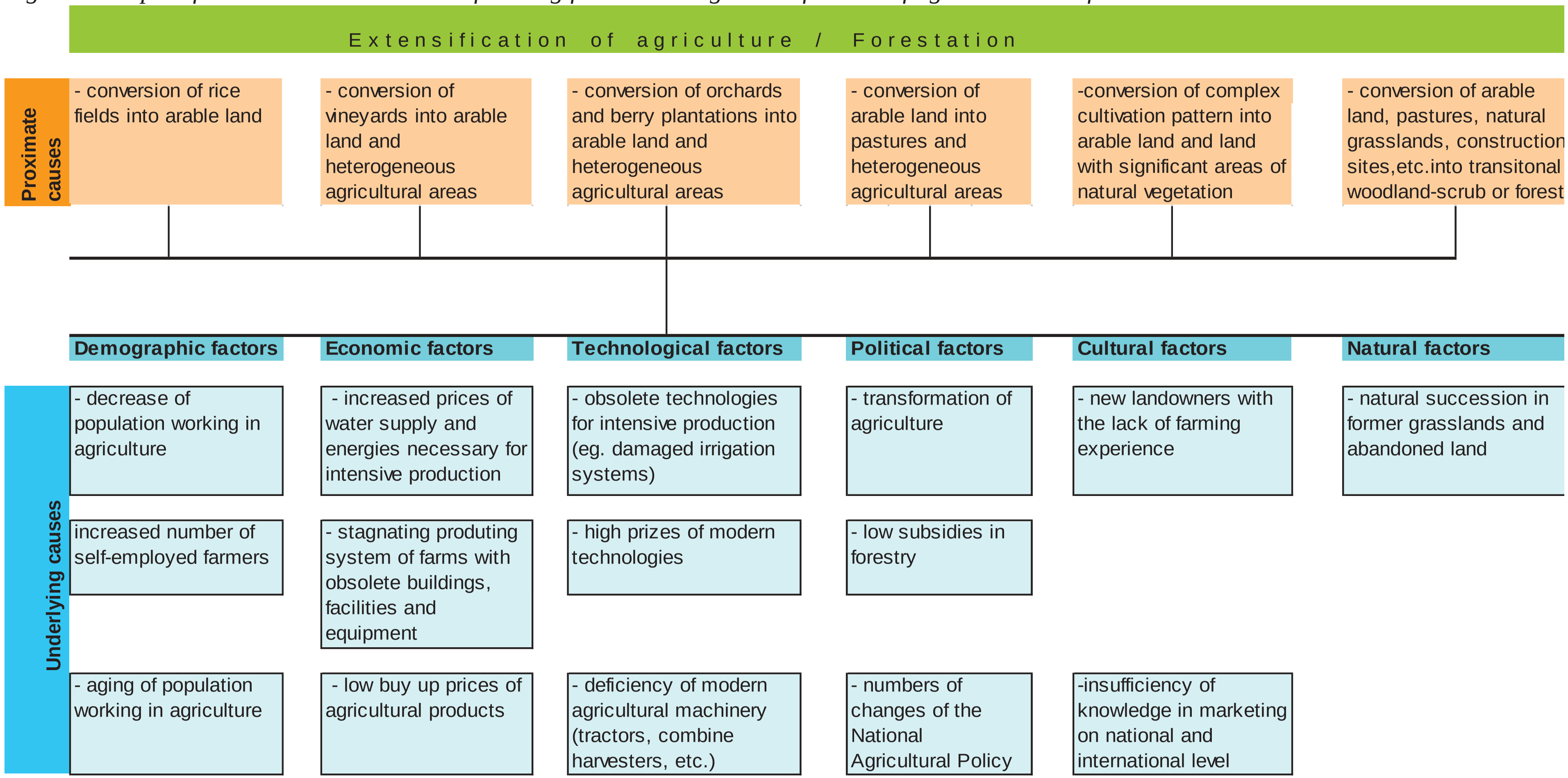
The following description of underlying driving forces is based on analysis presented in governmental reports related to the studied time horizons (Ministry of Agriculture of Slovak Republic 2000, Ministry of Agriculture and Forestry of Bulgaria 1999). Transition of the economy had a stronger impact on agriculture than other sectors of the national economy.
The period after the year 1990 was connected with the important changes in agriculture and transforming agricultural cooperatives in former socialist countries. Process of massive privatisation and restitution had crucial impact on its economies because of an extraordinary drop in number of agricultural workers (Bičík and Jeleček 2005). The decrease of population working in agriculture was remarkable also in Slovakia and Bulgaria. In the area of Trnava, the number of economically active persons in agriculture decreased by 62%, and the decrease in the areas of Plovdiv was 52%. More details about demographic factors related to extensification of agriculture on the study areas are given in Feranec et al. (in print).

Changes in the crop structure were recorded in plant production. Generally, the share of cereals (especially wheat) and oil seeds on arable land increased. Areas planted with annual and permanent fodders and sugar beet remarkably decreased. In the area of Trnava, changes in crops' output trends were due to economic driving forces. Building of a new processing facility for oil products near Bratislava caused increased areas sown with rape and sunflower. At the same time, several sugar beet processing factories in the region were closed. A permanent reduction of the numbers of animals was typical for cattle husbandry in 1990–1998. Decrease of areas with fodder crops was a side effect of reduced animal production. In Bulgaria, total crop output suffered a significant decline as a result of smaller areas under crops, with sunflower and pepper being the only exceptions, and also because of lower yields (tobacco excluded). The decline was brought about not only by the unstable production structures, but also by the very fact that agriculture was taken over by the increasing number of small private producers. They used inefficient production technologies and non-standard seeds of poor quality.

In the region of Plovdiv, the most important LC flow was changes of rice fields into arable land. The main reason for this phenomenon was the issue of irrigation. Stemming from the instability and disturbances in the agricultural market, the decreasing water demand for irrigation purposes, poor technical condition of irrigation facilities and low percentage of actually irrigated land have grown into major problems encountered by agriculture. It is noteworthy that about 40% of the country's irrigation system in Bulgaria is of low efficiency while 80% of the internal canal system is practically unusable. In 1990, the land area actually irrigated amounted to 570,000 ha, steadily decreasing to only 50,000 ha in 1997. The reasons behind the decrease in the land areas actually irrigated stated by Ministry of Agriculture and Forestry of Bulgaria (1999) are as follows:

- Changes in the agricultural production structure and higher irrigation costs; high delivery costs of pump station water and hence price increases;
- Poor maintenance and breakdown in service of the irrigation network;
- Absence of viable structures, taking over the management of the irrigation system and network, given the enormous number of new landowners and potential water users.

*Fig. 3: Example of detailed characteristics of driving forces causing extensification of agriculture and forestation*




*Sources: own research based on CORINE Land Cover data and reports published by Ministry of Agriculture and Forestry of Bulgaria (1999) and Ministry of Agriculture of the Slovak Republic (2000)*

After the changes made in the 1990s, co-operative enterprises still maintained their dominant position in agriculture by the year 2000, although their share on the overall area of agricultural land decreased. In Slovakia the numbers of trading companies, in particular of limited liability companies, kept growing as a result of the privatisation of State farms and reducing numbers of agricultural co-operatives. Consequently, the area of land managed by them increased.

Transformation of agriculture was connected with changes in land ownership. However, only a few of the new landowners went farming. In both countries, the majority of non-farmer restituents lacked the farming experience after a 40–year period of cooperative farming. They prefer leasing their land to transformed cooperative farms or private farms that continued in large-scale farming. Nevertheless, the number of cooperative-farm employees notably decreased in both study areas.

On the other hand, the number of self-employed farmers per 1000 ha of the utilized agricultural area increased from 0.63 in the year 1991 to 5.95 in 2001 in Trnava (data concerning self-employed farmers were not collected in the censuses in Bulgaria).

The development tendencies of the technological base of agriculture have been markedly characterized by outdated technological equipment due to a rather slow rate of its renewal both in Slovakia and in Bulgaria. Compared to other countries, farm machinery lagged significantly behind in terms of both quantity and quality. Most of equipment is technically obsolete as well as physically worn out. At the outset of the economic reform there were tractors of total horsepower (h. p.) up to 70 per 100 ha of farmland in Bulgaria against 200–300 h. p. in EU Member States and over 460 h. p. per 100 ha in Germany (Ministry of Agriculture 1999). As far as the increase of production profitability and environmental protection is concerned, modernisation and acquisition of technical and technological equipment are necessary in both countries**.**

Fragmentation of land ownership created by the land restitution remains a significant barrier to long-term investments in agriculture, land improvements and efficient use of agricultural machinery. To improve this situation, there is a clear need for land-consolidation measures in both countries.

An important part of the reforms in Slovakia after the year 1989 was a transformation of the ownership relations to forests. The reform has been based on restitution of property to original owners. As of 31 December 1998, 40.8% of forestland resources was given back as the property of authorized persons. At that time, 43.7% of forestland resources were owned by the State. A user of forests was responsible to manage that forest, following the relevant provisions of legislation. Almost 38% of forestland resources were used by the non-state forestry sector. This proportion was supposed to increase in the following years.

Despite the fact that the area of forestland resources in Slovakia was continuously increasing, the share of gross domestic product (GDP) in forestry in overall GDP of the Slovak Republic was decreasing (1990 – 0.97%, 1998 – 0.69%).

In 1990–1998, forestry subsidies came from several sources: from the State Budget and from the Slovak State Fund of Forest Improvement. As compared to 1990, the volume of the 1998 subsidies dropped to 49.6%. In 1990, subsidies covered 23.28% of production costs in Slovakia’s forestry, dropping to only 5.7% in 1998. Compared to Slovakia’s smallest neighbouring countries (FRG, Austria, the Czech Republic), Slovak forests received the lowest subsidies per hectare. (Ministry of Agriculture of the Slovak Republic 2000).

The forestry sector, as well as agriculture suffered a remarkable decrease of employees. In the region of Trnava the number of employees in forestry decreased from 4030 in 1990 to 1179 in the year 2001 (a reduction of about 70%).

## 5. Discussion

Despite of undoubted value of CLC data for evaluation of land cover changes there are some technical limitations associated with these data that may be noted in order to evaluate the quality of the outputs that have been derived from them. The scale used for basic CORINE mapping is 1:100 000. Although this level of spatial resolution is adequate for assessment at the European scale it is relatively coarse for local mapping. Thus, CLC is not sufficiently detailed for most of the local applications such as urban planning, forest management or risk assessment, which would require larger scale approach. A second aspect of the limitations associated with the spatial resolution of CORINE land cover data concerns the size of minimum mapping unit, which is 25 ha, with a minimum width of 100 m. As a result of this limitation some changes (especially connected with the process of urbanization), are not reflected.

Despite classification of driving forces into five basic types (Figure 3), all of them are interlinked. As Schneeberger et al. (2007) point out, economic needs are, for example, often expressed in political programs, laws and policy, so the economic and political driving forces are sometimes hard to separate clearly.

## 6. Conclusions

The presented case studies identify the group of different driving forces that appeared in two post-communist countries during the transition period of national economies from centrally planned to market controlled ones. Different combination of forces that were connected with the transition lead to specific landscape changes. Knowing these consequences is especially important for future decision-making, policy and environmental planning.

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## References

BIČÍK, I., JELEČEK, L. (2005): Political events factoring into land-use changes in Czechia in the 20th century. In: Milanova, E., Himiyama, Y., Bičík, I. (eds.): Understanding land-use and land cover change in global and regional context. Enfield, USA and Plymouth, UK, Science Publishers, p. 165–186

BRANDT, J., PRIMHDAL, J., REENBERG, A. (1999): Rural land-use and landscape dynamics – analysis of driving forces in space and time. In: Krönert, R., Baudry, J., Bowler, I. R., Reenberg, A. (Eds.): Land-Use Change and Their Environmental Impact in Rural Areas in Europe. Parthenon, London, p. 81–101

BŰRGI, M. HERSPERGER, A., M., SCHNEEBERGER, N. (2004): Driving forces of landscape change – current and new directions. Landscape Ecology, 19, p.857–868.

FERANEC J., CEBECAUER, T. OTAHEL, J. SURI, M. 2002. Methodological aspects of landscape changes detection and analysis in Slovakia applying the CORINE land cover database. Geografický časopis, Vol. 54, p. 271–288.

FERANEC, J., KOPECKA, M., VATSEVA, R., OTAHEL, J., STOIMENOV, A., BETAK, J., HUSAR, K. (in print): Landscape change analysis and assessment (case studies in Slovakia and Bulgaria), Journal of Land Use Science (in print)

FERANEC, J., STOIMENOV, A., OTAHEL, J., VATSEVA, R., KOPECKA, M., BETAK, J., HUSAR, K. (2006): Changes of the rural landscape in Slovakia and Bulgaria in 1990–2000 identified by application of the CORINE land cover data (case studies – Trnava and Plovdiv regions). In: Braun, M. (ed.): EARSeL Proceedings of the Second Workshop of the EARSeL SIG on Remote Sensing of Land Use and Land Cover. Application and Development, EARSeL and Universität, Bonn, p. 441–454

GEIST, H. J., LAMBIN, E.F. (2002): Proximate Causes and Underlying Driving Forces of Tropical Deforestation. Bioscience, Vol. 52, No. 2, p. 143–150

LESSCHEN, J. P., VERBURG, P. H., STAAL S. J. (2005): Statistical methods for analyzing the spatial dimension of changes in land use and farming systems. LUCC Report Series No. 7. The International Livestock Research Institute, Nairobi, Kenya and LUCC Focus 3 Office, Wageningen University, the Netherlands, 80 p.

Ministry of Agriculture and Forestry of Bulgaria (1999): National Agriculture and Rural Development plan over the 2000–2006 period under the Special Accession Program for Agriculture and Rural Development (SAPARD), Sofia, 101 p.
available at : http://www.mzgar.government.bg/MZ_eng/Sapard/NationalPlan.htm

Ministry of Agriculture of the Slovak Republic (2000): Agricultural and Rural Development Plan of Slovak Republic, Bratislava, 84 p.
available at: http://www.land.gov.sk/slovak/dok/sapard/english/sapard.htm

SCHNEEBERGER, N., BŰRGI, M. HERSPERGER, A., M., EWALD, K.C., 2007: Driving forces of landscape change as a promising combination for landscape research – an application on the northern fringe of the Swiss Alps. Land Use Policy, 24, p. 349–361.

VERBURG, P. H., de GROOT W. T., VELDKAMP, A. (2003): Methodology for multi-scale land-use change modeling: Concepts and challenges. In. Dolman, A. J., Verhagen, A., Rovers, C. A. (eds.): Global environmental change and land use. Kluwer Academic Publishers, Dordrecht, the Netherlands, p. 17–51