

CHANGES IN AGRICULTURAL LAND USE IN THE CONTEXT OF ONGOING TRANSFORMATIONAL PROCESSES IN SLOVAKIA

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TARASOVIČOVÁ, Z. – SAKSA, M. – BLAŽÍK, T. – FALŤAN, V.: Changes in agricultural land use in the context of ongoing transformational processes in Slovakia. *Agriculture (Poľnohospodárstvo)*, vol. 59, 2013, no. 2, pp. 49–64.

Transformational changes after 1989 were primarily caused by major social changes, including those in the economy and agriculture. Slovakia is also affected by globalization processes. The aim of this article is to characterize the changes in agricultural land use and their spatial distribution in relation to the political transformation of society after 1989, using the *Dunajská Streda*, *Levice*, *Prievidza* and *Stará Ľubovňa* districts as examples. These districts contain all individual agricultural production types in Slovakia. Changes in agricultural land use were analyzed on the basis of the total areas of land use categories for these districts between 1980 and 2010 and for municipal cadastral areas in selected districts between 2000 and 2010. Two basic indicators of changes in land use were

selected for this purpose. The first was the percentage increase or decrease in individual land use categories and the second was the dominant processes in land use based on analysis of the main landscape processes. The cumulative surfaces of selected crops and their products were analyzed using a simple continuous diagram depicting the course of harvesting areas between 1980 and 2010. Crop yields were analyzed by linear regression. The tendency for disappearance of agricultural land use was confirmed in the less agriculturally active areas of Slovakia. This decrease in agricultural land use was at the expense of an increase in urban areas and in the processes of greening, forestation and water body construction.

Key words: land use, transformation of economy, agricultural policy, agricultural production regions

Despite extensive socialist industrialization and subsequent urbanization, it remains quite specific that almost half the Slovak population lives in the countryside, in areas with significant agricultural activity. Transformational changes after 1989, as expressed in many aspects of our societal life, had a great impact on agricultural production and caused many land-use changes. These changes continuously established fundamental changes to economic policy following Slovak acceptance into the European Union (EU). In conjunction with globalization

requirements, Slovakia was also forced to adapt to all these new conditions (Blažík 2004).

The transformational processes in agriculture were clearly expressed in changes in the extent of agricultural areas, and also in the structure of agricultural land utilization as a result of economic and other processes. These landscape structural changes also greatly affected animal taxocenoses in arable land, meadows and pastures (Kalivoda *et al.* 2010). The consequences of these transformations are manifested in the structure of Slovak agricultural production regions; and here statis-

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tical analysis enables us to conclude a loss of some key agricultural crops in individual agricultural production regions, together with changes in the production orientation of agricultural enterprises.

The issue of land changes in the Slovak Republic has developed in recent decades. Although an overview of landscape changes in Slovakia, reflecting changes in land use since 2000 is presented in Feranec and Nováček (2009), current studies, focused on changes in land use in the various types of agricultural regions were lacking. Transformations in the Slovak cultural landscape have been recorded in Olah *et al.* (2009), changes in land use in the lowland agricultural landscape presented by Boltížiar and Chrastina (2008), changes in arable land diversity with particular emphasis on alternative agricultural crops documented by Kopecká (2010), changes in land use and the manifestations of selected transformational processes in the diffuse settlement regions examined by Lauko (1999), by Muchová and Petrovič (2010) and Petrovič (2006), long-term changes in soil utilization in the Czech Republic reported by Kabrda *et al.* (2006) and discussion of land use from the viewpoint of local impact and global processes in the work of Lambin and Geist (2006).

The aim of this article is to characterize changes in agricultural land use, their spatial distribution and influences on the choice of arable crops using relevant statistical data analysis. Based on these analyses, we wish to characterize the impact of transformations in our society after 1989, with special emphasis on agricultural production in selected Slovak districts. This especially involves changes in the size of various areal types of all agricultural production areas reported by Spišiak (2004). The chosen districts were Dunajská Streda – maize, Levice – maize and beet, Prievidza – beet and potatoes and the Stará Ľubovňa – highland areas. In geographic terms these areas represent Western, Middle and Eastern Slovakia, and according to Bezák (1995) they fall into the two basic Slovak macroeconomic units of the developed West and Northwest regions and the less developed Southern and Eastern areas. Each has special natural conditions for agricultural production and special marketing position.

Although this article is partly linked with results achieved in Blažík *et al.* (2011), where the authors dealt with general changes in land use, here are de-

scribed changes in agricultural land use with special emphasis on plant production.

MATERIAL AND METHODS

Due to significant climate change in the moderate zone, assessment of climatic conditions is necessary to determine the suitability of different areas for specific crop production (Vilček & Bedrna 2007). Classification of investigated areas into climate areas and districts is based on Lapin *et al.* (2002) map. In addition, the soil types and subtypes of agricultural land in individual districts were interpreted according to Land Evaluation Units (source of: Soil Science and Conservation Research Institute (VÚPOP) Bratislava).

The 1076 km² *Dunajská Streda* district lies in the warm climate area. Here, the climate has changed from hot and dry in the 2nd half of the 20th century to hot and very dry today. This district gradually extends towards the Malé Karpaty Mts. (Melo *et al.* 2010) and frequent drought increases the importance of arable land irrigation in this region. The soil is loamy, with particular subtypes of Chernozems, Fluvisols and Phaeozems (WRB 2006). Agricultural distribution here is affected by socio-economic factors in combination with soil conditions. The district has good transport facilities, and its western and central areas are easily accessible to Bratislava, which has the largest agricultural markets in the Slovak Republic.

The 1551 km² area of the *Levice* district makes it the largest district in Slovakia. Its Lowland portion is in the warm climate area, and its northern part reaches the Štiavnické vrchy Mts. situated in the moderately warm climate area. No significant shift in climate district boundaries has occurred here in recent decades, and agricultural land lies on fertile Luvisols and Chernozems (WRB 2006). More than 2/3 of these soils are loamy. The Levice district is located on the border of the economically less-developed part of Slovakia, where it is currently difficult to switch to more sophisticated economic sectors. Its agricultural potential however, is very clear from the number of foreign interests in this region.

Agricultural production in the 960 km² *Prievidza* district is mostly concentrated in the warm cli-

mate area of the Horná Nitra Valley and on the lower slopes of surrounding mountains in the moderately warm area. There are less fertile Cambisols, and loamy- to clay-loamy Luvisols in this agricultural area (WRB 2006). Although cultivation of fruit trees was developed in the Horná Nitra area in the 16th century and significant fruit production still continues. Many farmers are now cultivating cereals, fruit and vegetable crops which are more suitable to the climatic and economic conditions. Prievidza is one of the less attractive districts for agricultural production due to secondary succession of bushes and mixed woody species in the highland foothills and marginal district areas. These occur on former meadows and pastures as a result of decreased livestock production.

Except for its valleys, the 623 km² *Stará Ľubovňa* district lies in the moderate to cold climatic region. Due to the particularities of the basin climate, together with climate changes and the more frequent occurrence of temperature inversions, the slightly warm climate area described by Lapin *et al.* (2002) is now reduced compared to data issued for this district 30 years ago (Konček 1980). Most of the area has various Cambisol soil sub-types (WRB 2006), and agricultural production accounts for approximately 50% of the area. Potatoes, barley, oats and forage crops have been produced in the *Stará Ľubovňa* vicinity since at least the 1990's, while permanent grassland and cattle and sheep husbandry occurs on the lower slopes of the surrounding mountains. *Stará Ľubovňa* is a typical example of areas in the Prešov region with appropriate conditions for highland farming.

The following data sources clearly reflect ongoing changes in agricultural land use at district and municipal cadastral levels, and these sources were used to analyze the agricultural land use changes:

1. the database of the total areas of land use categories (hereinafter referred to as ÚHDP) – reflects basic land use in the following 10 categories: arable land, hop fields, vineyards, gardens, fruit plantations, permanent grasslands forming agricultural areas, forests, water areas, built-up and other land (greater detail is available in Feranec 2008). This data is published in statistic annuals of agricultural land issued by the Geodesy, Cartography and Cadastre Authority of Slovak Republic (ÚGKK SR),

where issues on the 1st January summarize data from the previous year. The advantages of the ÚHDP database include its annual update and its division into relevant categories of assessed agricultural areas. However, although it reflects changes as values in territorial units, it does not record transfers in land use in each of these units.

2. statistical data on harvesting areas [ha] and yields [t/ha] of all agricultural crops grown on arable land for the selected districts of Dunajská Streda, Levice, Prievidza and *Stará Ľubovňa* from 1980 to 2010 emanate from the Statistical Office of the Slovak Republic (ŠÚ SR).

The analysis of agricultural land use changes was based on ÚHDP in these districts between 1980 and 2010 (Table 1), and for their municipal cadastral areas between 2000 and 2010 (Table 2, Figures 1, 2, 3). The following two basic indicators of land use changes used in other studies dealing with similar problems were also utilized here in Bičík and Kupková (2006), Blažík *et al.* (2011), Šveda (2010), and Šveda and Vigašová (2010).

The first indicator is the **percentage increase or decrease in individual land use categories**, where the following formula is used to calculate the indicator:

$$ZR_{k(a-b)} = \left(\left(\frac{r_{ib}}{c_{ib}} \right) \cdot \left(\frac{r_{ia}}{c_{ia}} \right) \right) \times 100 - 100 [\%]$$

where $ZP_{k(a-b)}$ is the change in the size of the land use category, r_{ia} is the area of the land use category at the beginning and r_{ib} is the area at the end of the reporting period; c_{ia} is the total size of the observed territorial unit at the beginning and c_{ib} is the total size at the end of this period.

This indicator is used to analyze changes in agricultural land use, (1) specific arable land in all selected districts, (2) permanent grasslands in the Levice and *Stará Ľubovňa* districts, (3) vineyards in the Dunajská Streda region and (4) the orchards in Prievidza. The selection of individual categories was subject to significant area changes in which the category in a given district.

This method has limitations resulting from operating with absolute values which favor catego-

ries which cover a small surface area. Here, large changes can greatly influence results, but only in categories which have a very small absolute size. This would be documented, for example, in an increase in a particular village cadastral area from 0.6 ha in 2000 to 1.4 ha in 2010, thus denoting a 120% increase in area.

The second method of **dominant processes in land use** is based on main landscape processes. The methodological procedure is based on evaluation of changes in the following 5 main categories of land use during the reporting period: (1) arable land + vineyards + hop-fields + gardens + orchards; (2) permanent grasslands; (3) forest areas; (4) water areas and (5) urban areas and other land. Here, positive and negative changes within two time horizons are determined in these category areas, and each individual category is calculated as a percentage of the summarized positive change value. A strong process has a value of 75% while 50–74.9% is medium and 25–49.9% is weak. The prevailing process and its rate of change in agriculture intensification, grassing, reforestation, enlargement of water areas and urbanization are thus determined. This method was used for all selected districts.

There are some limitations in this methodology as previously mentioned. Here, categories with a large absolute extent are favoured, and even a small change in a category with a large absolute extent can be dominant over a strong change in categories with a small absolute extent.

The cumulative surfaces of selected crops and their produce were analyzed using the simple continuous diagram of the course of harvesting areas between 1980 and 2010. Crop yields were analyzed by linear regression, highlighting the relationship between two variables, with the independent variable on the x-axis, and the dependent variable on the y-axis. The variable data forms a straight line graph in this linear regression model.

Typical crops and also crops characterized by significant change in a given district during the monitored period were selected for analysis of the harvesting areas and yield changes in a given district (Figure 4).

RESULTS AND DISCUSSION

Partial changes in the total area of all categories in the listed districts between 1980 and 2010 were assessed. Table 1 indicates the trend of increased built-up areas in all districts and the subsequent significant loss of orchards and arable land areas in less productive regions. This loss was particularly noticeable in the Prievidza and Stará Ľubovňa districts. Significant loss was also noted in vineyards in the Dunajská Streda district related to transformational processes in the 1990's and EU policy subvention. A similar trend was strongly reflected in fruit growing areas; with the exception of the Dunajská Streda district where fruit production remained linked with arable land.

Based on evaluation of the total increase or loss in land use categories in individual districts, the most significant loss of 74% of orchards occurred in the Prievidza district. In addition, losses clearly related to the overall decline in fruit production in Slovakia were also noted in the Levice and Stará Ľubovňa districts. The loss of floodplain forests in the Dunajská Streda district is uniquely related to the construction of the Gabčíkovo hydro-electric plant. An increase in both relative and absolute forest areas occurred in the remaining districts. This was due to continuous increase in secondary succession on agricultural soil borders over several decades. A significant decrease in the area of permanent grassland and coverage due to construction of the Gabčíkovo hydro-electric plant also led to intensified cultivation of densely sown agricultural crops and technical crops such as canola. In addition, potato cultivation moved from former classical highland regions to areas in Slovakia with more favourable conditions. The Stará Ľubovňa district, however, was not so badly affected by the general trend of rapid increase in built-up areas, because of its marginal position.

Created maps mainly focused on the critical agriculture transformation period; with the largest impact on agricultural land use change noted in the 2000–2010 period.

The increase and the loss in arable land area in all districts for the 2000–2010 period is shown in Figure 1.

T a b l e 1

Increase / decrease in area of each land use category in the districts in 1980–2010 period [%]

Category of land use	Dunajská Streda district	Levice district	Prievidza district	Stará Ľubovňa district
Arable land	-0.57	-0.65	-16.38	-24.37
Vineyards	-38.09	-1.60	0.00	0.00
Gardens	0.99	-5.68	-1.57	-0.43
Orchards	-1.40	-7.68	-74.06	-9.54
Grasslands	-21.76	-1.51	9.86	-2.29
Agriculture land (jointly)	-2.05	-0.94	-4.94	-1.80
Forests	-11.88	0.89	2.49	1.33
Water bodies	15.25	10.03	2.45	-1.14
Urban areas	88.05	84.01	104.46	0.95
Other land	-27.10	-45.89	-42.60	8.77

The following general trends in changes of arable land area in selected districts were established for the 2000–2010 period:

There was a decrease in arable land area of between 10–20 % in most cadastral areas of the *Dunajská Streda* district and in the *Dunajská Streda* town area this was over 30%. Although slight increases in arable land area up to 10% were registered in approximately one quarter of this territory, an increase of 10% was recorded only in two cadastral areas. While increases in arable land area were particularly concentrated in villages near the Danube and the Little Danube rivers, decreases were mainly recorded in the western and northwestern district areas and also along the district's main transport axis in the Bratislava–Komárno direction. These changes are most likely due to the new construction activities in the *Dunajská Streda* town area and in municipalities suitably situated close to convenient transport. The increase in arable land in the vicinity of the Gabčíkovo hydro-electric plant and along the Little Danube River is related to dam completion and the protection of water sources, where further land use and building development is restricted. There is the possibility of a partial return of the soil to agricultural use on completion of these processes.

The *Levice* district is in the best position of all studied districts with regard to arable land. Here, the arable land area increased in approximately half

the cadastral areas, with the exceptional increase of more than 10% in two cadastral areas. However, except for the continuous belt along the Ipel' River in the southeast, there were decreases of up to 10% in cadastral areas scattered throughout the district. This condition was most likely affected by its inconvenient transport availability and also by the great risk of flooding in the Ipel' River plain. A further reason for the decreasing trends is the particular local economic situation of these agricultural farms. Their outlying position and lack of alternative employment opportunities due to weak economic activity in this region enhanced suitable conditions for agricultural production.

In the *Prievidza* district, the greatest decreases in arable land area occurred in 62 of its 72 cadastral areas in the 2000–2010 period. The strongest decreases were observed in the marginal areas. This downturn in agricultural production was due to climate and the soil condition restrictions, and also due to the opening of new markets with concomitant inability to compete with foreign production. This also entailed the appearance of foreign commercial chains and their supply networks. The slight 10–20% decline noted in the remainder of the district's territory is related to the relatively large non-agricultural activities of industrial construction and increased building. However, a small 10% increase in arable land area was noted, but this occurred only in the

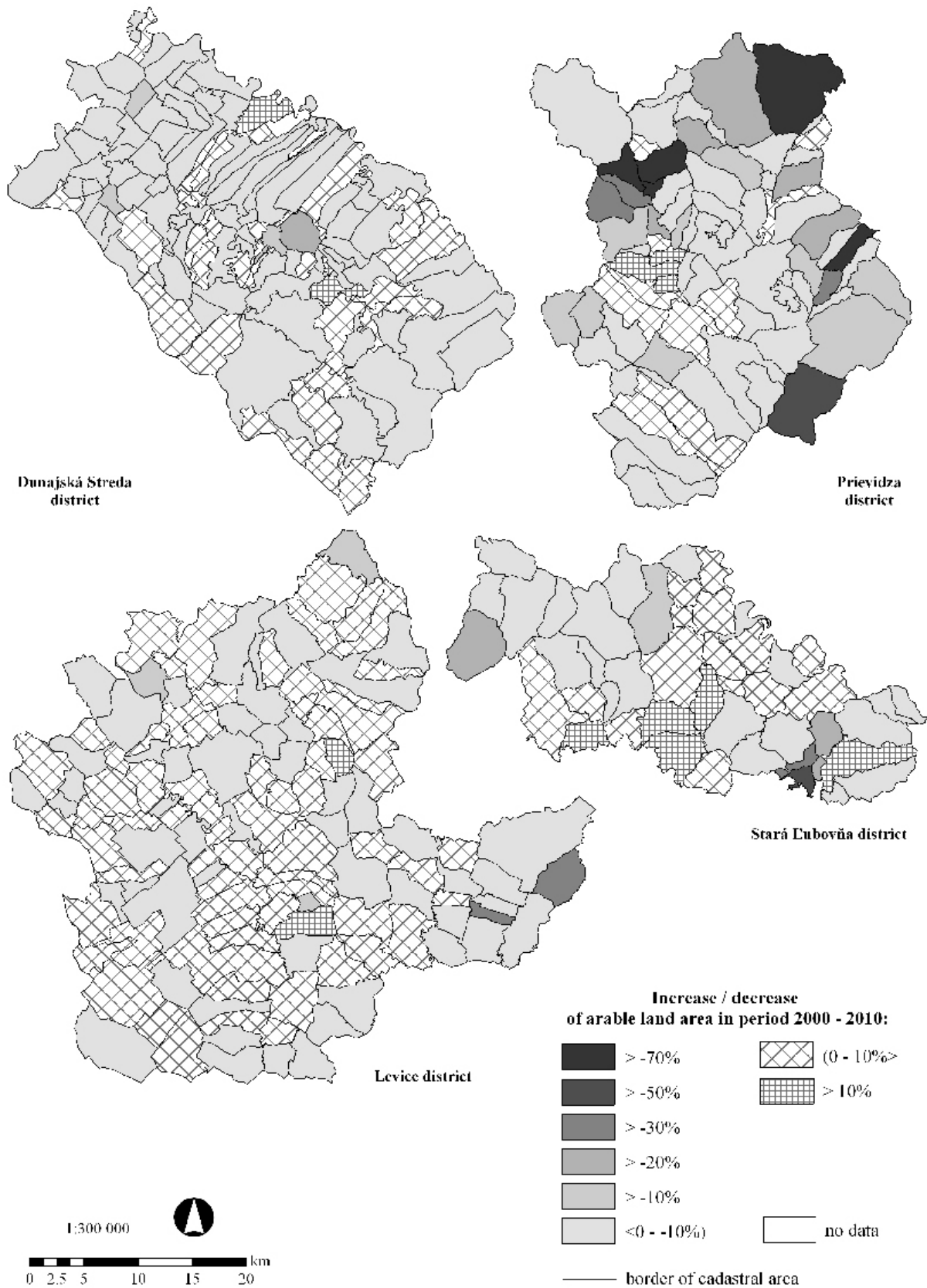


Figure 1. Increase / decrease in arable land area in the 2000–2010 period [%]

central areas and in southern areas which enjoyed more favourable climate and the most appropriate soil conditions.

The *Stará Ľubovňa* district has the least suitable conditions for agricultural production of all investigated territories. Two regions here experienced decreases from 10 to 30% in arable land. One of these is located in the northwest of the district in the mountainous region of Pieniny Mts., and the second is in the Spiš-Šariš inter-mountainous area on dominantly northerly orientated slopes. These areas are used especially for extensive grazing. The trend of agricultural landscape abandonment is mainly evident in the hilly and marginal regions of Slovakia (Midriak *et al.* 2011). Territories with increased arable land area occur in the central part of Stará Ľubovňa town, where natural conditions are relatively suitable for agricultural production. This production was influenced to a large extent by the social situation of some sections of the population, resulting in cultivation of particular crops, such as potatoes. This signified the generalized changes occurring in cultivation activities throughout Slovakia.

Figure 2 gives examples of the most significant changes occurring in selected land use categories in the investigated districts in 2000–2010. In the broader context, these examples can also be applied to other Slovak regions.

In the *Dunajská Streda* district, our interest focused on changes in the vineyard area. These are predominantly concentrated in the central part of the district in cadastral territories which lie west of the Dunajská Streda town. The vineyard area there has decreased by almost 40% over the last 30 years, and the dramatic decline also continued during this decade. This signifies the generalized wine growing regress throughout the Slovak Republic. Reasons for this decline include competition pressure from foreign wines emanating from EU member countries and also Brussels politics. Under these policies, subsidies are paid for destruction of vineyards and this mechanism is associated with efforts to reduce EU surpluses. In Slovakia, this situation is clearly illustrated in the Dunajská Streda district. Here, reduction in vine production is due to lack of consistent optimal growing conditions, and this make it unsuitable for vine cultivation at existing prices.

This results in continually rising imports and diminution of the proportion of domestic wine products on the market.

Although the *Levice* district has very good natural agricultural conditions, its location far from major transport routes and its greater distance from major market centers has resulted in reduced animal production capacity. In addition a decline in local product consumption has occurred, and plant cultivation has therefore centered on the most marketable plants. However, the decrease in agricultural soil area recorded here is the smallest of all investigated districts. It is located on the border of the economically less developed part of Slovakia, where redirection to more efficient agricultural sectors is currently difficult. The agricultural potential here is reflected in the interest of foreign enterprises; particularly Danish and Dutch. The decrease in livestock production and rising imports of dairy and meat products led to an even bigger decrease in livestock production and consequently to 10 to 50% less grassland. In two cadastral areas this loss was up to 70%. A slight increase of up to 10% in permanent grassland has occurred due to favorable natural conditions for agricultural production in more than one-third of this district's territory. This is especially reflected in cadastral areas where livestock production still exists, although much of this is due to the arrival of foreign investors. There is a striking and long-term trend of decline in worker numbers in animal production due to the decrease in the proportion of Slovak products in food consumption. However, while many traditional processing enterprises have finished, a number of new enterprises have developed (Spišiak & Némethová 2008).

The *Prievidza* district was a significant fruit production area until the 1990's. Although the growing area is now reduced up to 70% in some parts, this loss is reflected to a lesser extent in many parts of the district. This caused the fragmentation of the land since 1989 although many orchards were already under private ownership under socialism. The supply of cheap fruit production from southern and south-western Europe countries such as Spain, Italy and France began after 1995. This was associated with accession of large commercial networks to Slovakia and their connection with large-scale producers in those countries. Consequently, fruit pro-

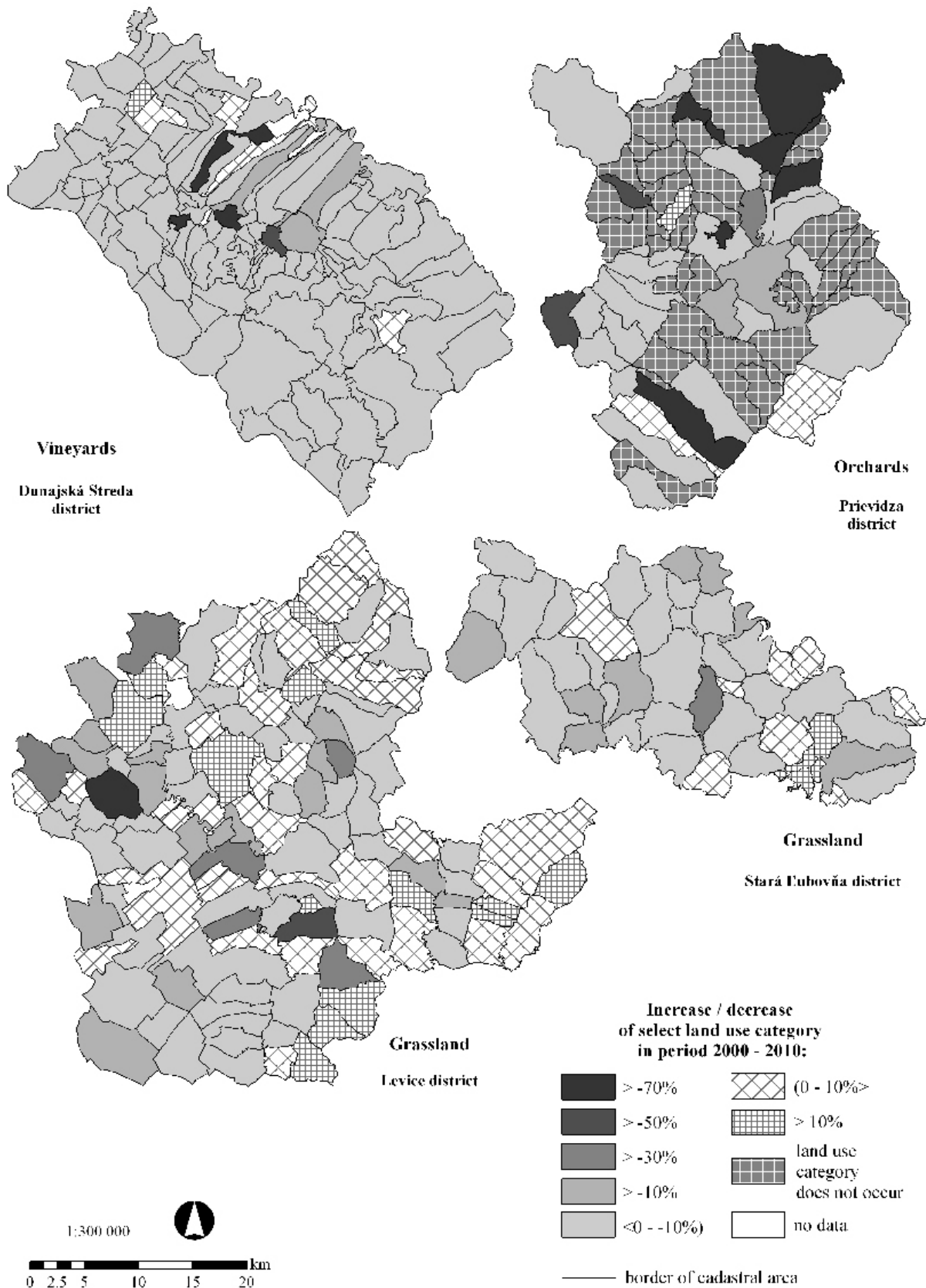


Figure 2. Increase / decrease in select land use categories during the 2000–2010 period [%]

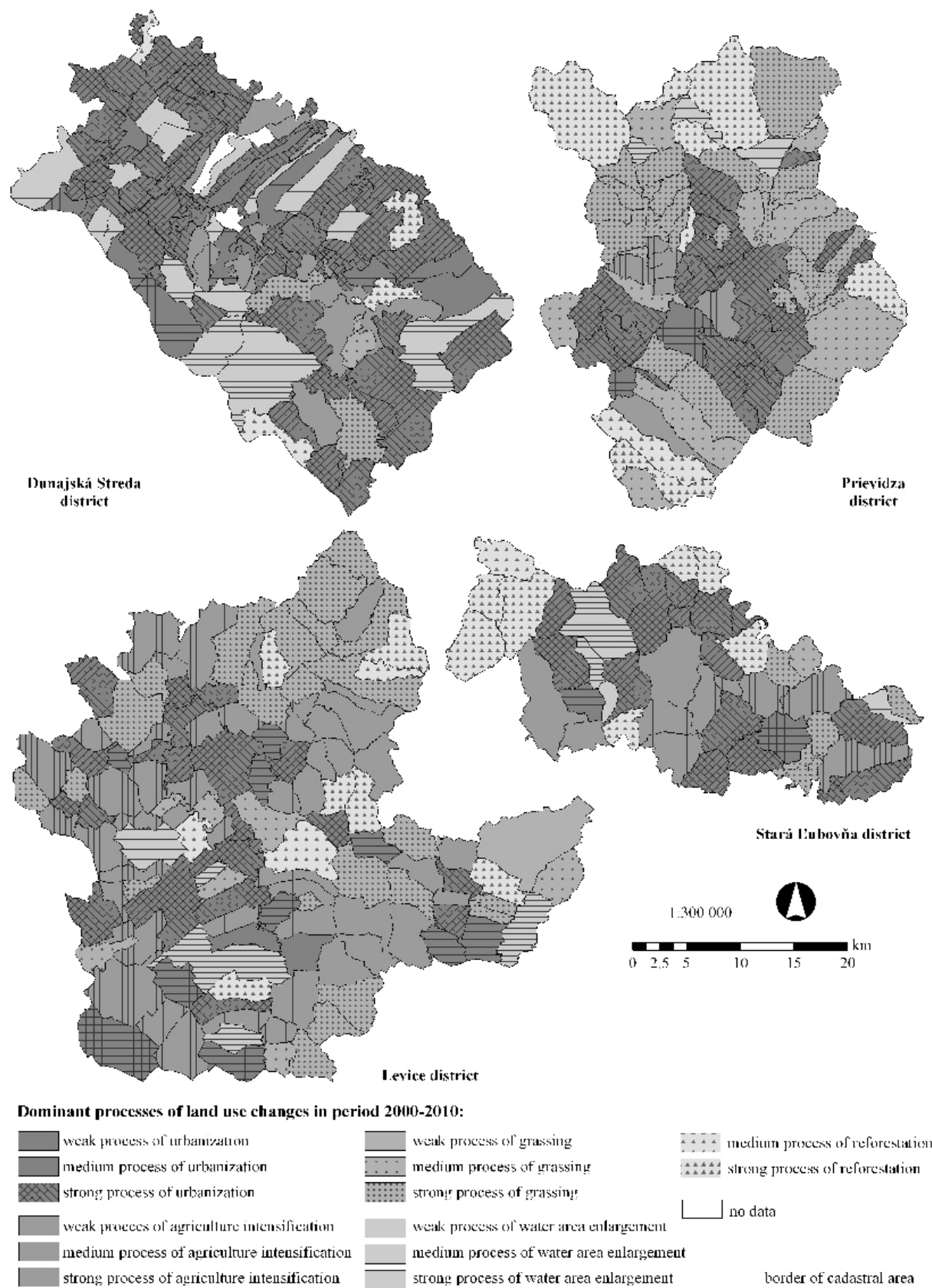


Figure 3. Dominant processes of land use changes in the 2000–2010 period

duction decline occurred not only in this region, but also in the whole Slovak territory.

The situation in *Stará Ľubovňa* district regarding decrease in meadows and pastures is comparable with that in the *Levice* district, and the reasons for the decline are similar. The main difference is only the low number of cadastrals with increasing permanent grassland. In most communities, a decrease of between 10% and 30% has been documented. Growth of over 10% has been recorded only in the southern district villages. In contrast to the *Levice* district, the arrival of foreign investors in agriculture did not occur here. The decline was due to the poor social situation of lack of convenient transport in this marginal mountain region.

Dominant processes in changes in soil usage in selected districts during 2000–2010 are documented in Figure 3.

Prevailing processes in land use changes in the *Dunajská Streda* district during the last decade are medium to strong process of urbanization and medium to strong process of water area enlargement around the *Gabčíkovo* hydro-electric plant.

It is difficult to clearly determine the prevailing trends in the *Levice* district; a medium process of urbanization prevails in its central part with local urbanization in the vicinity of the *Štúrovo* town. Strong process of agricultural intensification has occurred in some villages along the *Danube* and *Ipel'* rivers, where forest enclaves are situated at these watersheds. There is also revitalization of alluvial forests along the *Ipel' River* as a result of environmental protection and forestry association activities.

Prievidza district has significant urbanization processes manifested in its central areas of *Prievidza*, *Nováky* and *Handlová* towns ships. Reforestation has taken place in its peripheral northern areas and grassing is obvious in the exposed NE and NW terrains.

In the *Stará Ľubovňa* district, reforestation is most intensive in the sub-mountainous areas of its western and northern parts, while urbanization and agricultural intensification are apparent in the central and southern areas.

Figure 4 in the following section highlights illustrated charts depicting the development of harvesting areas [ha] and the yield [t/ha] for typical crops

in individual districts, and also of crops in each district which underwent significant change during the 1980–2010 period.

Despite moderate fluctuations in all four districts, we can confirm increased areas and yields of rapeseed growing due to the attractiveness of growing it, and its increased demand in some districts over the last few years. The rapeseed yield has a stable tendency in the *Dunajská Streda* district and a decreasing one in the *Prievidza* district.

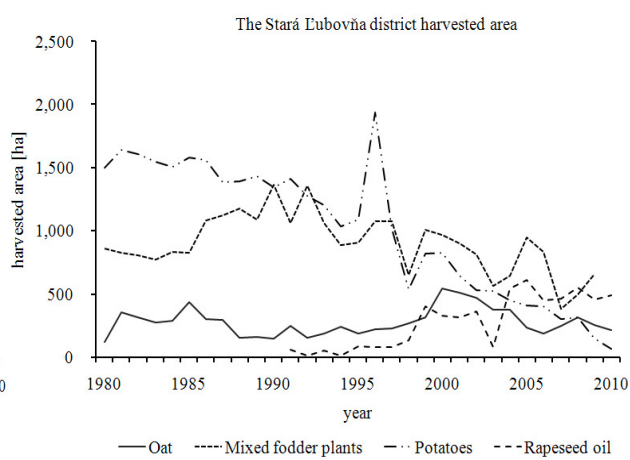
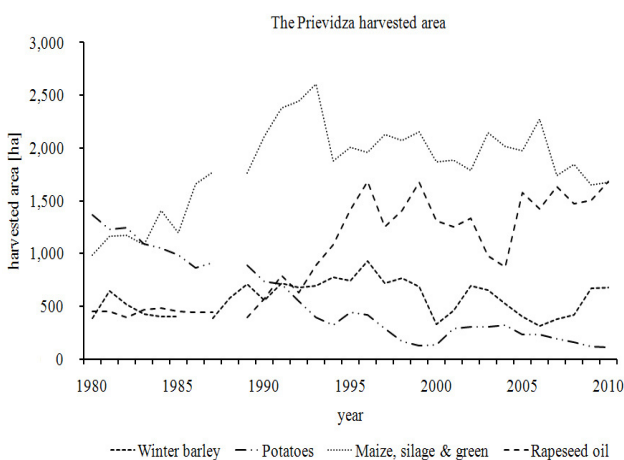
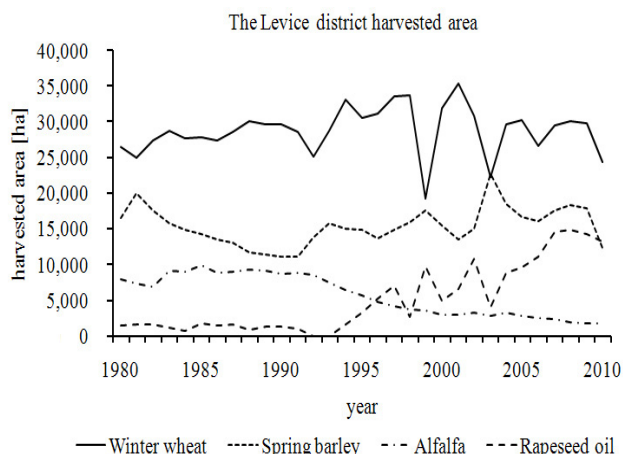
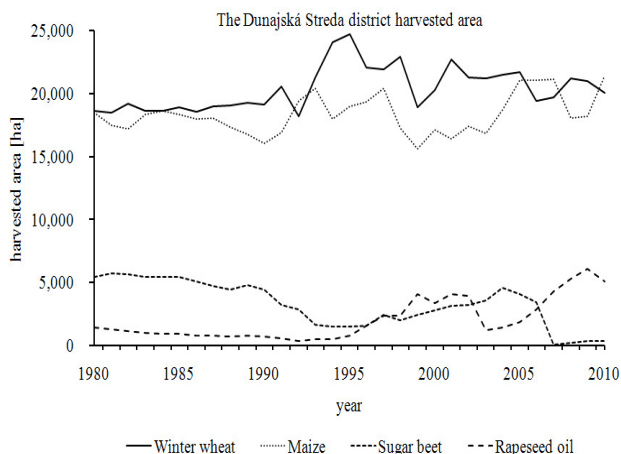
Sugar beet growing was once specific to the *Dunajská Streda* district, but its decrease in production is connected with the elimination of the sugar industry. Due to EU reform in the sugar industry and establishment of sugar production limits from 2008, continual decrease in its production and effects of the economic crisis has seen its price double. The specific consequence is a decrease in quota for several countries. Slovakia had to decrease its quota from 215,000 to 112,000 tons, although the annual Slovak consumption is 150,000 tons. Therefore sugar is now imported here, at a time when poor crops and increasing consumption have occurred in countries outside Europe leading to a worldwide shortage of sugar and an increase in its price.

A relatively stable abundance of seed corn areas keep cereals such as wheat, barley, oats and maize, which are less expensive to produce and undemanding for manpower. In contrast there has been a stable decrease in potato, legume and other crop production in the *Prievidza* and *Stará Ľubovňa* districts. Meanwhile, a marked decrease in the number of farm animals has led to a decrease in alfalfa production in the *Levice* district.

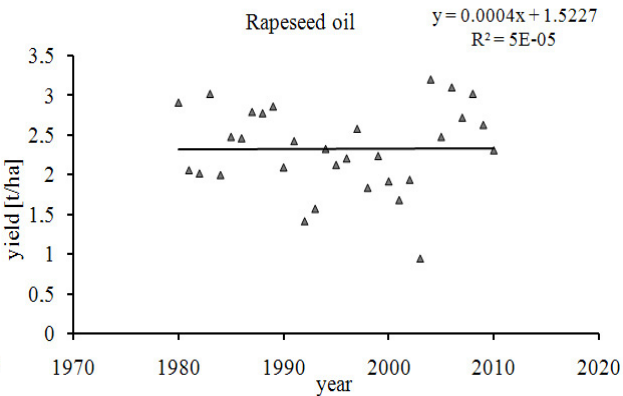
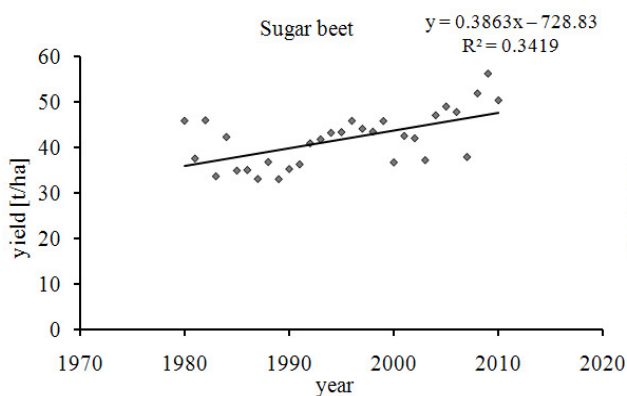
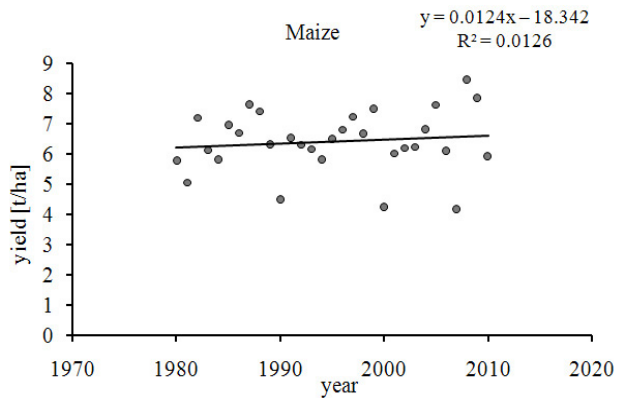
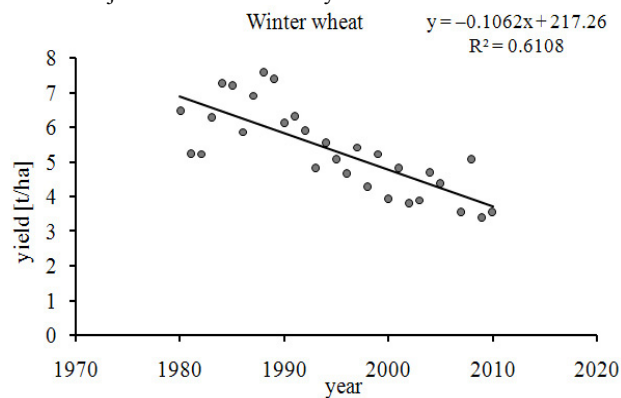
Different tendencies are apparent in the yields of the observed crops. Yield increase or decrease is directly proportional to bioclimatic conditions in the individual years, and being also a measure of care according to marketing law, it has an inconsistent character.

It is also apparent that the *Dunajská Streda* region is one of the most suitable regions in Slovakia in terms of production potential. This is documented in yield graphs of the 4 selected most-extended crops in the district. The typical example is maize, which is a key crop in economical attraction. It returns high yields and beneficial economic effects in bio-climatically favourable years, but it also suf-

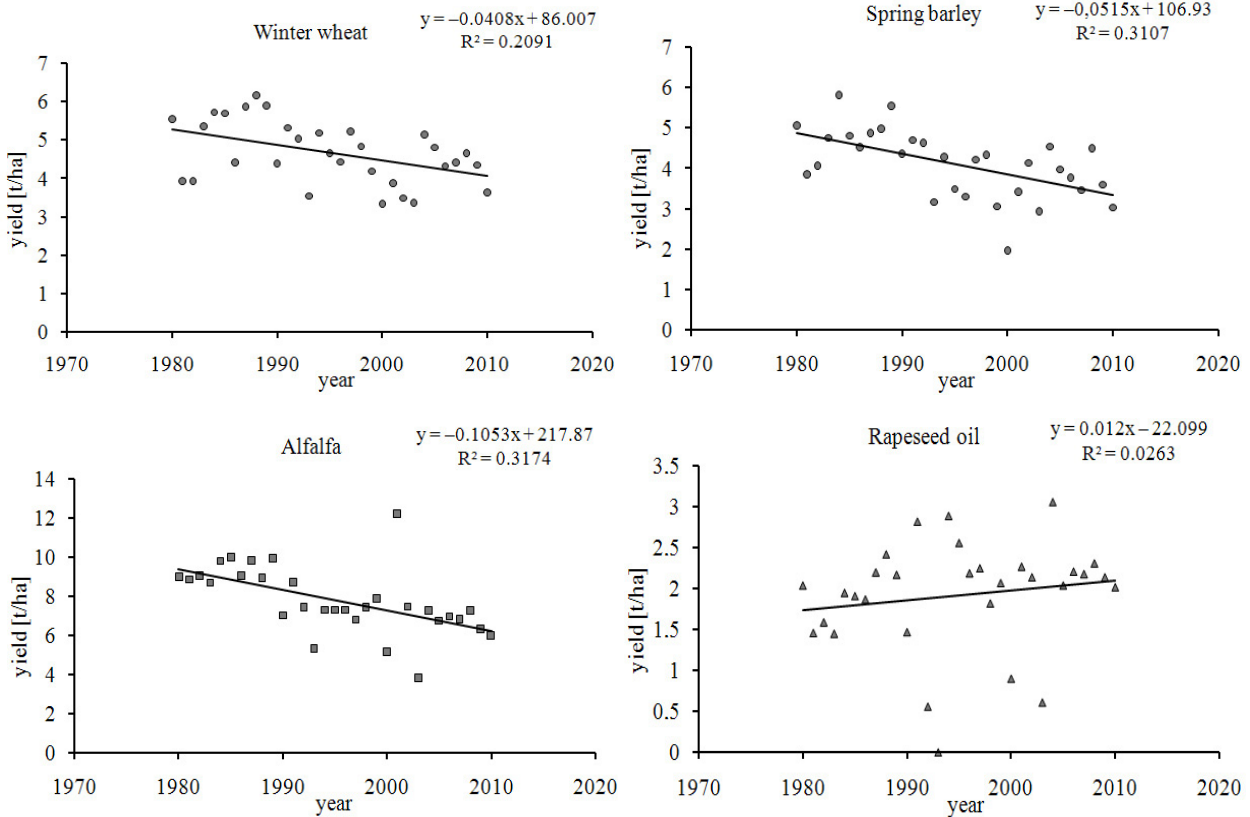
Harvested areas:



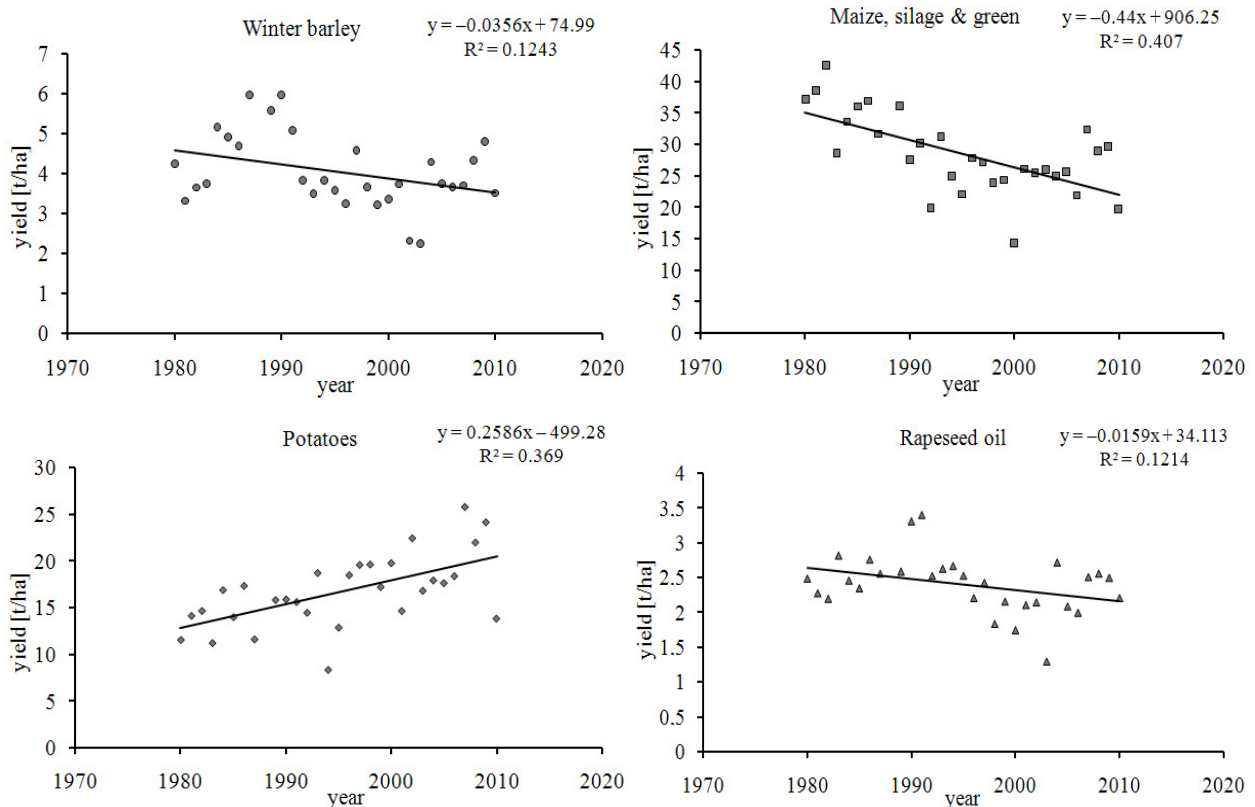
The Dunajská Streda district yields:



The Levice district yields:



The Prievidza district yields:



The Stará Ľubovňa district yields:

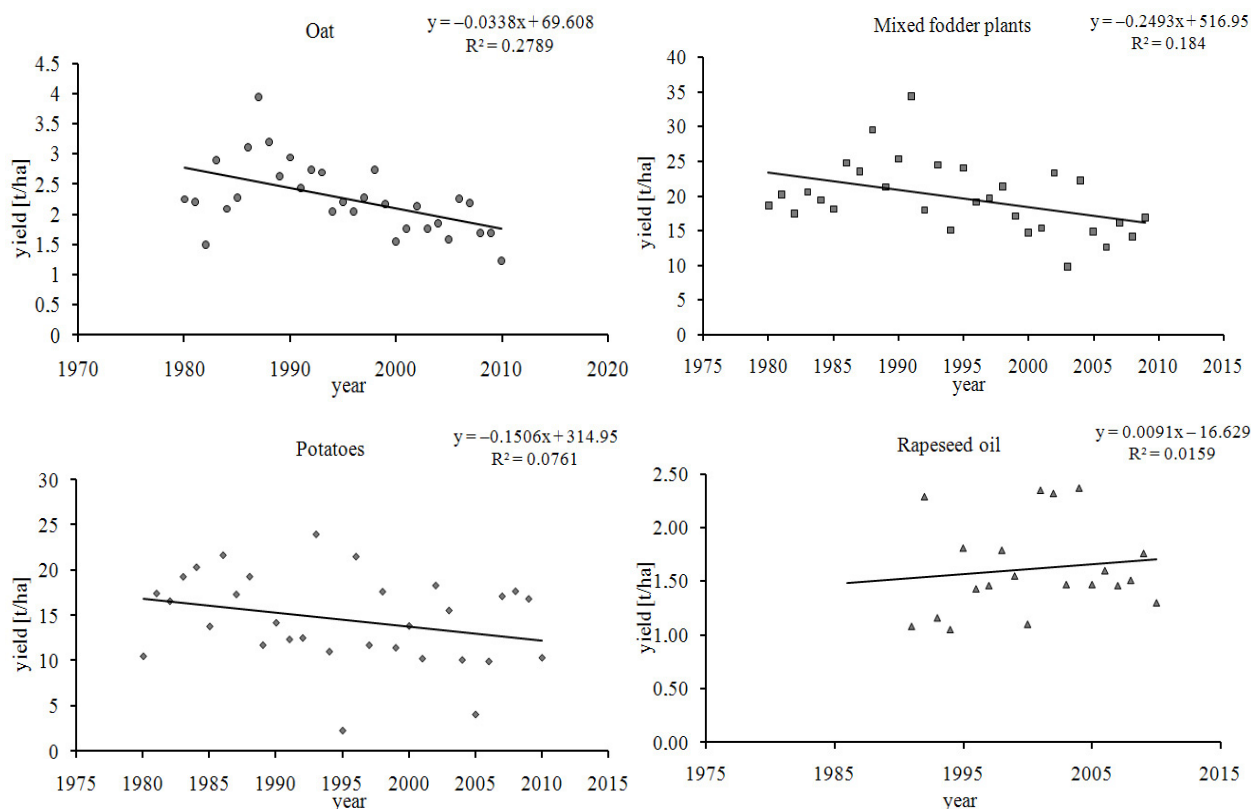


Figure 4. Evolution of harvested areas and yields of selected crops in districts in the 1980–2010 period

fers rapid yield decrease in bad climatic conditions. However, the overall trend is for slightly increasing yields as a result of improved land-care and advanced agro-technical management. A similar tendency is also apparent in sugar beet production. Due to improved crop handling during the study period, an increasing trend in productivity is observed, despite some fluctuations. Here, there exists the paradox of very favourable yields per hectare contrasted with up to 90% decrease in floricultural areas, due to EU ambitions and their economic constraints placed on sugar production. From a long term trend viewpoint, the most stable yields appear to be those from rapeseed which on average remain stable. However, there are large production fluctuations in individual years. This indicates stabilized management in growing this crop, with the fluctuations due to bioclimatic conditions. In the case of wheat, there are fluctuations in relative yields, where decreases are mainly due to continual decrease in interest in

this crop and its lower price. Decreased animal husbandry of beef cattle and pigs also plays a part in this decrease.

Meanwhile, yields from winter wheat experience only milder decreases in the *Levice* district, this is most likely due to the decrease in growing this crop and better care for it when it is grown. A similar trend is apparent in barley and alfalfa, and this is also connected with the decline in animal production. There is a slight increase in rapeseed yields compared to the *Dunajská Streda*. This is apparently caused by gradual transition to this crop in the outlying areas of this district, with a phase shift, however, compared to *Dunajská Streda*. The greater economical effectiveness of growing it here is connected with improved care in seed quality and appropriate fertilization and agro-technical timing.

A perfect example of decrease in yields from the long term aspect is the decrease in maize silage yields in the *Prievidza* district. This phenomenon is

related to the decrease in animal production (Inventory of livestock by Statistical Office of Slovak Republic) in this agriculturally less attractive region, with an overall decrease in yields and care of this crop. The winter barley here follows similar trends, due to the same causes as in the previously mentioned districts. The trend in development of potato yields is different. There had been an increase in yields especially after 1995, but 2010 proved to be one of the worst years in recent decades in this aspect. This phenomenon was strengthened by a massive transfer of potato growing out of traditional regions such as Spiš and northern Zemplín to lower regions in Slovakia. The overall trend of rapeseed yields shows a long term slight decrease, which in this case, however, is caused by high fluctuations of yields in individual years. This trend is also apparently due to less favourable conditions for rapeseed growing in this district compared to the aforementioned districts.

The Stará Ľubovňa district is one of the less attractive areas for agricultural production. It also has a different crop growing structure compared to the other districts. Here, there is an overall decrease in areas and yields of oats connected with animal production decrease. The overall mild decrease in potato yields is also due to loss of interest in growing potatoes in this important potato growing district. The legume-cereals mixture follows similar oat production trends. In contrast, there seems to be an ambition to replace less attractive crops with attractive ones, as occurred with rapeseed. However, large inter-annual fluctuations in yields in this area, makes it a less suitable region for this production. For these reasons, it is difficult to confirm the slightly increasing trend in its yields.

CONCLUSION

Slovak agriculture passed through several basic developmental stages during the latest decades. The 1980's were marked by socialist mass production with its good and bad features. These included secured sale, unnecessary use of fertilizers, varying quality of seed corn and seedlings and a low quality of work organization. After the changes in 1989 and at the beginning of the 1990's the prices were liber-

alized and free markets opened. However, grocery prices were regulated until 1993, leading to degradation of management of agricultural concerns and their recession. At that time, the area and yields of selected planted crops such as sugar beet and potatoes began to decrease. There were insignificant changes in ownership and land use.

After the change of proprietorship in the second half of the 1990's, the second stage began and this ensured. That agricultural production became accustomed to all new rules and circumstances, and also that there was appropriate preparation for accession to the European Union. There was marked inflow of foreign investments, mostly to the food industry and business, and also the arrival of widespread business chains bound to foreign agricultural production. These changes signaled a significant decrease in crop production due to lower numbers of livestock. Privatization and modernization of production increases brought about growing food crops including rapeseed oil and sugar beet. More significant changes in land use became evident.

The third stage of transformation started after the accession of the Slovak Republic to the EU on May 1st 2004. In this new era, Slovakia joined the European agricultural area within Slovak economics resources, including the different use of subsidies and a decrease in the share of Slovak agricultural production on our market.

In the researched districts of Dunajská Streda, Levice, Prievidza and Stará Ľubovňa, we can confirm a tendency of disappearance of agricultural land, the most apparent being in the less agriculturally active areas of Slovakia. Here, there is a marked decrease of orchards. Instead, there is now a pronounced process of greening and forestation of original agricultural land. Another strong trend is the decrease in agricultural land at the expense of increased urban areas and water bodies. These include the Gabčíkovo hydropower structure and industrial parks. The social impact of transformation is more pronounced in marginal areas. However, there is also development of the selected agricultural crop yields in the monitored districts and a decreasing trend in crop yields oriented to consumption in animal husbandry. On the other hand an increase is noted in yields of economically attractive crops such as oily plants, and maize, and the eventual migration of growing

and an increase in yields in bio-climatically more suitable localities.

We can assume a permanent orientation in agricultural production on the chosen selected cereals such as wheat, barley, maize, oats, rapeseed and sunflower and a gradual degradation to almost complete elimination of legume, hops, sugar beet, potatoes, poppy seed and other important products that were formerly part of the agricultural landscape in Slovakia. Recently 5 to 7 chosen grown crops have come to dominate Slovak regions and Slovakia is now more dependent on the import of our other necessary crops.

Results obtained in this article will facilitate better understanding and knowledge of transformational processes in Slovakia between 1980 and 2010. Our quantitative analysis confirms prevailing trends in the development of agricultural land use associated with the transformation of agriculture in the Slovak Republic. Changes in agricultural land use and their statistical and map expression are important in the process of territorial planning at the regional level and these should serve to ensure practical shaping of agricultural policy. This article also highlights some of the implications of EU agricultural policy for Slovak agriculture (CAP = Common Agricultural Policy). For these purposes it would be extremely useful to process and reflect changes in the use of agricultural land in all districts and cadastral areas of Slovakia in a similar way.

Acknowledgments. The presented research was carried out as a part of the research projects VEGA No. 1/0965/11 and VEGA No. 1/1143/12.

REFERENCES

- BEZÁK, A. 1995. Vzťah medzi vývojom regionálnej a republikovej úrovne nezamestnanosti na Slovensku v rokoch 1991–1994 [The relationship between the development of regional and republican levels of unemployment in Slovakia in the years 1991–1994]. In *Geographia Slovaca*, vol. 10, no. 1, pp. 15–22.
- BLAŽÍK, T. 2004. Slovensko ako súčasť Európskej únie [Slovakia as part of the European Union]. In *Geografické informácie*, vol. 8, pp. 411–416.
- BLAŽÍK, T. – FALŤAN, V. – TARASOVIČOVÁ, Z. – SAKSA, M. 2011. Zmeny využitia zeme vybraných okresov rôznych poľnohospodárskych produkčných oblastí v kontexte prebiehajúcich transformačných procesov [Land use changes in chosen districts of various productive agricultural regions in the context of transformational processes]. In *Geografický časopis*, vol. 63, no. 4, pp. 301–323.
- BIČÍK, I. – KUPKOVÁ, L. 2006. Changes of land use in Prague urban region. In *Geografie-Sborník ČGS*, vol. 111, no. 1, pp. 92–114.
- BOLTIŽIAR, M. – CHRASTINA, P. 2008. Zmeny využitia zeme nížinnej poľnohospodárskej krajiny na príklade obce Nové Sady (1782–2002) [Land use change on lowland agricultural land on example of village Nové Sady (1782–2002)]. In *Geoinformation*, vol. 4, no.1, Nitra: Univerzita Konštantína Filozofa, Fakulta prírodných vied, Katedra geografie a regionálneho rozvoja, pp. 16–35.
- FERANEC, J. 2008. Krajinná pokrývka a využitie krajiny Slovenska v kontexte národnej štatistiky a dát CORINE Land Cover [Land cover and land use in the context of Slovakia's national statistics and CORINE Land Cover database]. In *Acta Geographica Universitatis Comenianae*, vol. 50, pp. 135–144.
- FERANEC, J. – NOVÁČEK, J. 2009. The CORINE Land Cover database of Slovakian and its changes in the period 2000–2006. In *Moravian Geographical Reports*, vol. 17, no. 3, pp. 2–9.
- IUSS Working Group WRB, 2007. *World reference base for soil resources 2006*. In *World Soil Resources Report No. 103*, Rome : FAO. 145 p. ISBN 9.2-5-105511-4.
- KABRDA, J. – BIČÍK, I. – ŠEFRNA, L. 2006. Půdy a dlouhodobé změny využití ploch Česka [Soils and long-term land use changes in the Czech Republic]. In *Geografický časopis*, vol. 58, no. 4, pp. 63–87.
- KALIVODA, H. – PETROVIČ, F. – KALIVODOVÁ, E. – KÜRTHY, A. 2010. Influence of the landscape structure on the butterfly (*Lepidoptera*, *Hesperioidea* and *Papilionoidea*) and bird (*Aves*) taxocoenoses in Veľké Leváre (SW Slovakia). In *Ekológia*, vol. 29, no. 4, pp. 337–359.
- KOPECKÁ, M. 2010. Zmeny využitia ornej pôdy z aspektu biodiverzity poľnohospodárskej krajiny [Changes of arable land use from biodiversity aspect of agricultural land]. In *Geografické informácie*, vol. 14, no. 1, pp. 100–109.
- LAMBIN, E.F. – GEIST, H. (Eds) 2006. *Land-use and land-cover change: Local processes and global impacts*. Berlin : Springer, 222 pp.
- LAUKO, V. 1999. Transformačné zmeny v regióne roztrateného osídlenia na príklade Myjavy [Transformational changes in the region of scattered settlements on example Myjava region]. In *Folia Geographica*, vol. 3, pp. 269–276.
- LAPIN, M. – FAŠKO, P. – MELO, M. – ŠŤASTNÝ, P. – TOMLAIN, T. 2002. Klimatické oblasti [Climatic regions]. In *Atlas krajiny Slovenskej republiky*. Bratislava : MŽP SR, p. 95.
- MIDRIAK, R. – ZAUŠKOVÁ, Ľ – SZABO, P. – GALLAY, I. – GALLAYOVÁ, Z. – LEPEŠKA, T. – HLADKÁ, D. – LIPTÁK, J. – ŠÁLY, R. – KRAJČOVIČ, V. – ELIÁŠ, P. – ŠEBEŇ, V. – ŠMELKO, Š – TURISOVÁ, I. – UHLIAROVÁ, E. – ŠVIDROŇ, I. – COCHOVÁ, S. 2011. *Spustnuté pôdy a pustnutie krajiny Slovenska*

- [Soil dilapidation and abandonment of landscape of Slovakia]. Banská Bystrica : Univerzita Mateja Bela, Fakulta prírodných vied. 401 pp.
- MUCHOVÁ, Z. – PETROVIČ, F. 2010. Changes in the landscape due to land consolidations, 2010. In *Ekológia : International Journal for Ecological Problems of the Biosphere*, vol. 29, no. 2, pp. 140–157.
- OLAH, B. – BOLTŽIAR, M. – GALLAY, I. 2009. Transformation of the Slovak cultural landscape since the 18th century and its recent trends. In *Journal of Landscape Ecology*, vol. 2, no. 2, pp. 41–55.
- PETROVIČ, F. 2006. The changes of the landscape with dispersed settlement. In *Ekológia (Bratislava)*, vol. 25, no.1, pp. 65–89.
- SPIŠIAK, P. 2004. Poľnohospodárske výrobné oblasti a poľnohospodárske prírodné oblasti na Slovensku [Agricultural production regions and natural agricultural regions in Slovakia]. In *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Geographica*, vol. 45, pp. 39–54.
- SPIŠIAK, P. – NÉMETHOVÁ, J. 2008. Agrosubyjekty regiónu Nitra vo vzťahu k odberateľom poľnohospodárskych surovín [Nitra region's agricultural entities in relation to consumers of agricultural products]. In *Geografický časopis*, vol. 60, no. 1, pp. 63–87.
- ŠTATISTICKÝ ÚRAD SLOVENSKEJ REPUBLIKY [Statistical Office of the Slovak Republic]. Štatistické údaje o zberových plochách a výnosoch [Statistical data on harvesting areas and yields].
- ŠTATISTICKÝ ÚRAD SLOVENSKEJ REPUBLIKY [Statistical Office of the Slovak Republic]. Súpis hospodárskych zvierat [Inventory of livestock].
- ŠVEDA, M. 2010. Zmeny vo využití zeme vo funkčnom mestskom regióne Bratislava [Changes in land use in a functional urban region Bratislava]. In *Acta Geographica Universitatis Comenianae*, vol. 54, pp. 137–155.
- ŠVEDA, M. – VIGAŠOVÁ, D. 2010. Zmeny vo využití zeme v zázemí veľkých miest [Changes in land use in the hinterland of large cities]. In *Geografie-Sbornik ČGS*, vol. 115, no. 4, pp. 413–439.
- ÚRAD GEODÉZIE, KARTOGRAFIE A KATASTRA SLOVENSKEJ REPUBLIKY [Geodesy, Cartography and Cadastre Authority of Slovak Republic]. Úhrnné hodnoty druhov pozemkov [The database of the total areas of land use categories].
- VILČEK, J. – BEDRNA, Z. 2007. *Vhodnosť poľnohospodárskych pôd a krajiny Slovenska na pestovanie rastlín* [The suitability of agricultural soils and the country of Slovakia for cultivation]. Bratislava : Výskumný ústav pôdoznanectva a ochrany pôdy. 248 pp.
- VÝSKUMNÝ ÚSTAV PÔDOZNALECTVA A OCHRANY PÔDY [Soil Science and Conversation Research Institute]. Bonitované pôdno-ekologické jednotky [Land Evaluation Units].

Received: March 11th, 2013