

LAND USE CHANGES OF RIVER DYJE FLOODPLAIN IN REACHES NOVÝ PŘEROV – BROD NAD DYJÍ AND NOVÉ MLÝNY – LEDNICE, CZECH REPUBLIC, IN THE PERIOD OF 1830–2001 AS A REACTION TO THE RIVER DYJE CHANNEL REGULATIONS

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Abstract

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This article focuses on land use changes of the river Dyje floodplain in reaches Nový Přerov-Brod nad Dyjí and Nové Mlýny-Lednice, Czech Republic, in the period 1830–2001 and attempts to analyse how these changes were influenced by river channel regulations. These regulations were realized in three phases – at the end of 19th century, in the first half of 20th century and in 1973–1988. Both reaches show an increase in arable land to the detriment of meadows and pastures which was caused by these river regulations, as they restricted flooding of the area, and by increased pressure on fertile soil occurring in 1970s. This pressure was lessened after the change of the political system in 1990 and since then arable land has been abandoned. Another factor influencing changes in land use is the status of the reaches: the reach Nový Přerov-Brod nad Dyjí has no official protection, on the other hand the reach Nové Mlýny-Lednice is part of UNESCO cultural heritage Lednice-Valtice area and Protected Landscape Area Pálava.

Key words: floodplain, river regulations, land use changes, the Dyje river

Introduction

Study of land use/changes in land cover is considered to be one of the better approaches to the study of landscapes and to the understanding of human-nature relationships. Land use changes reflect different phases of socio-economic development and political climates as well as environmental changes (Bičík et al., 2001).

In the Czech Republic, Bičík (1992), Bičík et al. (1996), Jeleček (1995), Lipský (1995), Kolejka (2001), Kupková (1996) and Štěpánek (1992) concentrate on the studies of land use/land cover changes, at both national and local level.

This article concentrates on land use changes of the river Dyje floodplain in the period of 1830–2001 with particular focus on river regulations as a possible factor influencing the land use. This body of work is divided into two parts: the first concentrates on the phases of the river channel regulation and on the factors influencing land use; the second deals with the land use changes in the stated period.

The study area is situated in south Moravia (Czech Republic) in the area of the lower reach of the river Dyje (Fig. 1). The river Dyje bypasses Pavlovské vrchy hills and Valtická vrchovina upland here, creating a wide alluvial plain. Its surface is gently rolling with the slope approximately 1.55%. The annual flow rate in the Dyje is 41.55 m³/s bellow the lower Nové Mlýny reservoir.

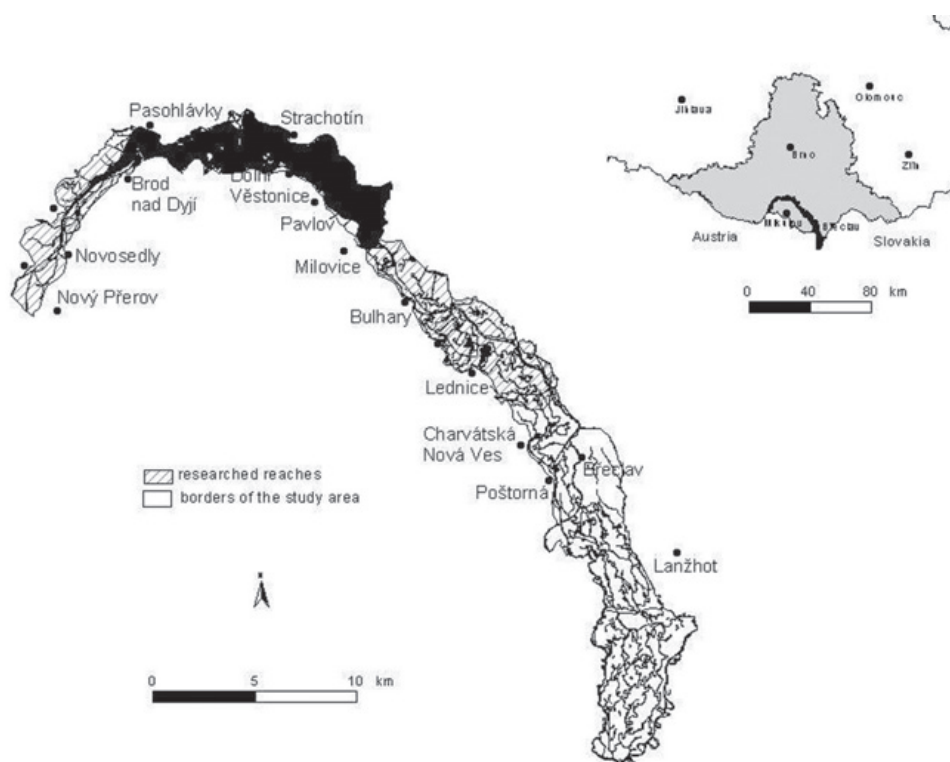


Fig. 1. Allocation of the study area.

The study area was divided into five reaches due to the periods of river adjustments. Land use changes were researched in reach one, demarcated by a state border (near Nový Přerov) and levee of upper Nové Mlýny reservoir, and in reach three, demarcated by the levee of lower Nové Mlýny reservoir and former Austrian-Moravian land border (southeast of Lednice). These reaches were chosen because they represent the reaches with the biggest regulations of the Dyje. Reach two, consisting of Nové Mlýny water body, was a subject of many studies (e.g. Kolečka, 1988; Kincová, 1990) and thus it was not included in this research.

Materials and methods

Maps and aerial photographs from four periods were used: 2nd military maps in a scale 1:28 800 based on the maps of stable cadastre from 1826–1843, 3rd military maps in a scale 1:25 000 from 1870–1883 (their later versions), topographical maps in a scale 1:25 000 from 1955 and aerial photographs from 2001. All maps were scanned and digitized in a program ArcView, version 3.2.

A database for every cadastre in the Czech Republic covering land use since 1845 was created at the Department of Social Geography and Regional Development, Charles University in Prague. Unfortunately this database could not be used because there are several cadastres covering the study area and this coverage is only partial which means that the database data would not reflect real proportion of land use categories. Another problem with statistical data for a cadastre is that these data do not cover landscape microstructure which is expressed by landscape diversity size, connectivity, integration or isolation of patches. That is why an extension in ArcView program (Xtools) was used to calculate the size of all digitized patches in the following categories: arable land, meadows and pastures, forests and shrubs, built-up areas, water areas, gardens, permanent cultures, communications, barren and swamps. The patches were summed up in these categories. Thanks to the mistakes which were unconsciously developed during the process of scanning and digitizing, the assumed precision of the patch size is about 80%.

Results

The river Dyje channel regulations

Colonization of the upper parts of the Dyje basin in the 13th century, which was accompanied by deforestation, caused an increased flooding in lower parts and many villages ceased to exist. The 15th and 16th centuries, characterized by building pond systems, experienced both restrictions of the floods and shrinkage of the area affected by these floods. This phenomenon was caused by the fact that ponds have an effect on precipitation and cloudiness, increase of air humidity, smooth annual temperature amplitudes and, above all, catch up flood flows. Deforestation of upper parts of the Dyje basin culminated in the 18th century which was reflected in repeated increase in flood occurrence. Protection of the settlement and its surroundings was based on levee building.

Important factors extending the water stagnation were millraces that also increased the underground water level. Millraces were built in Novosedly, Drnholec, Mušov, Dolní Věstonice, Nové Mlýny, between Nové Mlýny and Nejdek (so called Panenský mlýn), in Nejdek, Ladná, Břeclav and Ranšpurk. The Nové Mlýny weir caused water swell which

resulted in many swamps during floods and the landscape was waterlogged up to Pavlov. Thanks to the Břeclav weir water spilled through the low right bank into the Horní forest even during small increase in the water stage. (Veselý, 2004)

The first Dyje regulations were not completed until the middle of the 19th century when, during 1834–1855, works proceeded in a reach between Tasovice and Nový Přerov. These works consisted of a straightening and widening of the channel and the construction of a levee system. This regulation had indirect impact on the study area because it caused the disturbance of natural fluvial processes. Further regulations were not carried out because the Břeclav estate and some villages (e.g. Mušov) opposed them. That is why only basic measures to fight flood waters i.e. “Clean the channel, remove gravel and sand during low water stage, smooth meanders, cut branches hanging into the channel etc.” (Bíňová et al., 1992) were taken.

Other channel adjustments were carried out in 1882–1902 when a reach between Nový Přerov and Mušov was regulated. The main channel was transferred about 400 m to the south and a weir above Mušov was abandoned during these adjustments. Local adjustments were accomplished in Stará Břeclav and Břeclav in 1911 and in 1934–1936 the Dyje channel was regulated in the reach Mušov-Dolní Věstonice, which consisted of widening and deepening the main channel and filling up two adjacent branches.

However, the biggest influence on the channel and its floodplain was caused by the so called “complex” river engineering works, which proceeded in 1975–1988. They included channel adjustments in the reaches from Bulhary to Janův hrad castle and from Břeclav to the confluence with the river Morava, which lay in cutting of meanders, embankments and, in the case of the reach Bulhary-Janův hrad castle, in the building of a new channel. A body of water called Nové Mlýny was created in the confluence area of the Dyje, Svratka and Jihlava rivers. This body consists of three reservoirs – upper, middle and lower – out of which the middle has the nature reserve status.

Revitalization works in the area below Nové Mlýny were initiated at the beginning of 1990s. They consisted of spring flood simulations with water from Nové Mlýny reservoirs and in restoring forest water channels and several oxbows. Other projects aimed at improving the environment and organism migration, included reconnection of cut-off meanders and the Dyje River channel below Břeclav, reconnection of floodplain forests below and above Nové Mlýny by building a bio-corridor along the lower reservoir, building islands in the middle reservoir and constructing fish passages (Bulhary weir, Břeclav weir).

Factors influencing land use

We can divide the factors influencing land use into two groups – environmental and socio-economic. The main environmental factors are geological substratum with soils, georelief and hydrological conditions. From the geological point of view, the Dyje floodplain consists of fluvial gravels which were covered by loams carried down during floods from the upper parts of the Dyje basin. Bogs can be found in the areas of oxbows. Aeolian sands build mounds, called hrůdy. Fluvisols and their gleyic varieties are major soil types. Other soil

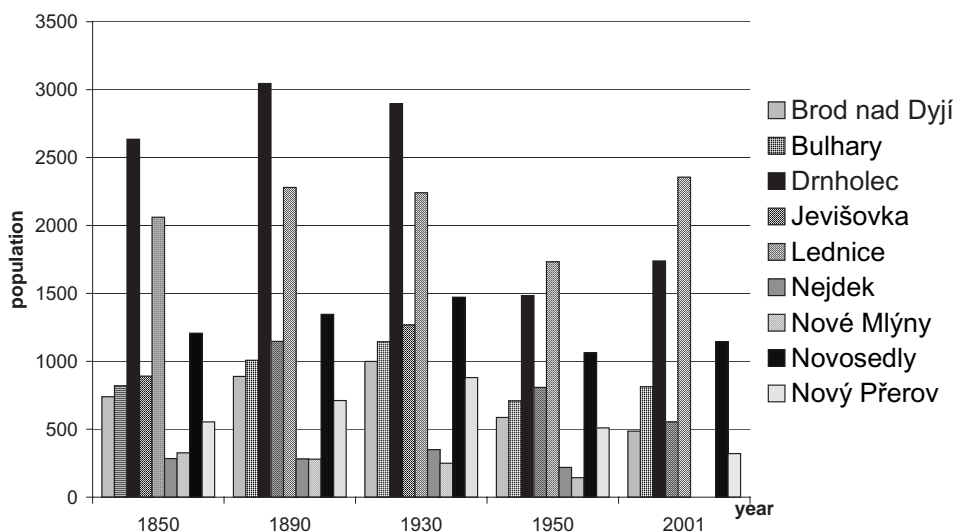


Fig. 2. Demographic progress in municipalities in the study area in 1850–2001.

types include stanogleys in wetter patches, phaeosols and chernozems in drier patches. As stated earlier, the georelief is gently rolling, with many cut-off meanders and oxbows or their remnants, and mounds.

The main socio-economic factors include demographic progress, economic development and political situation. Demographic progress in the study area is shown in Fig. 2.

The population was at its height in 1930 in the majority of municipalities. The only exceptions were Lednice and Drnholec whose peak occurred in 1890 and Nové Mlýny which peaked in 1850. Nejdek was integrated with Lednice in 1960, so the information about population for 2001 is for both villages. The situation is similar in Nové Mlýny which was integrated with Příkladky.

Due to the fact that the majority of population in all municipalities had German or Croatian nationality, there was a dramatic drop in the number after the Second World War which is reflected in the data from 1950. The expulsion of these nationalities caused land abandonment and dilapidation. The population never again reached pre-war numbers despite resettlement efforts, mostly from other municipalities in south Moravia. Moreover, expelled people possessed knowledge about how to minimize the duration of floods and to control the damage caused these floods.

From the economic point of view, which is closely connected with political situation, it was the agricultural revolution in the 19th century which was the most important and that, eventually, evolved into a technological and scientific revolution. The agricultural revolution was characterised by an extensive expansion of cultivated land, especially arable land, to the detriment of pastures. This expansion reached its height in the 1860s and 1870s. From

1880s, agriculture began to concentrate on intensive tillage of the better soils and the area of arable land started to decrease. The first half of the 20th century is also characterised by the spreading of the scientific and technological revolution, which lay in more extensive use of mechanisation and chemicalisation, intensification and specialisation in agricultural production. (Bičík et al., 2001)

A new phenomenon in agriculture, the so-called socialist industrialization, can be seen after 1945. This concerns founding unified agricultural cooperatives and state-own farms, or in other words collectivisation. Collectivisation in the study area started earlier, was large in scale and much faster than inland and it also ended earlier than elsewhere. (Nováček, 1979). One of the main features of the collectivisation was farm consolidation that resulted in vast fields. These fields are often pedologically very heterogeneous, vulnerable to wind and water erosion and to rapid pest spread. Thanks to river regulations, which restricted annual floods, meadows in floodplain were transformed to arable land and this caused increased soil denudation. Another reason for meadows ploughing was the increased pressure on soil quality in lowland areas, whereas sub-mountainous and mountainous regions or less fertile regions were left barren or transformed into forests. Also vast industrialisation and urbanisation played an important role.

The main factors influencing land use in 1990s were the restitution of private property that had been nationalised under socialism, the partial privatisation of state property, increasing environmental awareness among the population, transformation of agricultural cooperatives and release of Czech market to foreign market forces (Bičík et al., 2001).

Land use development in the reach 1

Cadastrs of Jevišovka, Drnholec (left bank of the Dyje), Novosedly and Brod nad Dyjí (right bank) can be found in this reach.

The period of the first half of the 19th century, represented by year 1830, was characterised with the biggest proportion of meadows and pastures as well as gardens from all researched periods; on the other hand the proportion of forests and shrubs, barrens, communications and built areas was the smallest. The proportion of arable land was significant (second biggest area after meadows and pastures), so was the proportion of water areas, represented by many branches and oxbows, rich with fish. As we can see from Fig. 3, the Dyje was surrounded by meadows. A large forest complex – Drnholecký luh floodplain forest – is situated south of Drnholec (middle reach). Arable land was situated on left bank river terraces, both north and south of Drnholec. Swamps were mainly present south of Drnholecký luh floodplain forest, west of Brod nad Dyjí and in a locality called Pod silnicí in the northeast.

The year 1890 (Fig. 4) shows the situation after the Dyje channel adjustment. Cutting off the Dyje branches resulted in increase in the area of barren land (barren in this case means unused land in former channels, the surroundings of towns and villages, between a channel and a levee etc.), which was the largest of all periods. Other categories of land use with the largest area in this period were permanent cultures and communications. Channel straightening did not have an influence on the area of arable land at that point. On the contrary,

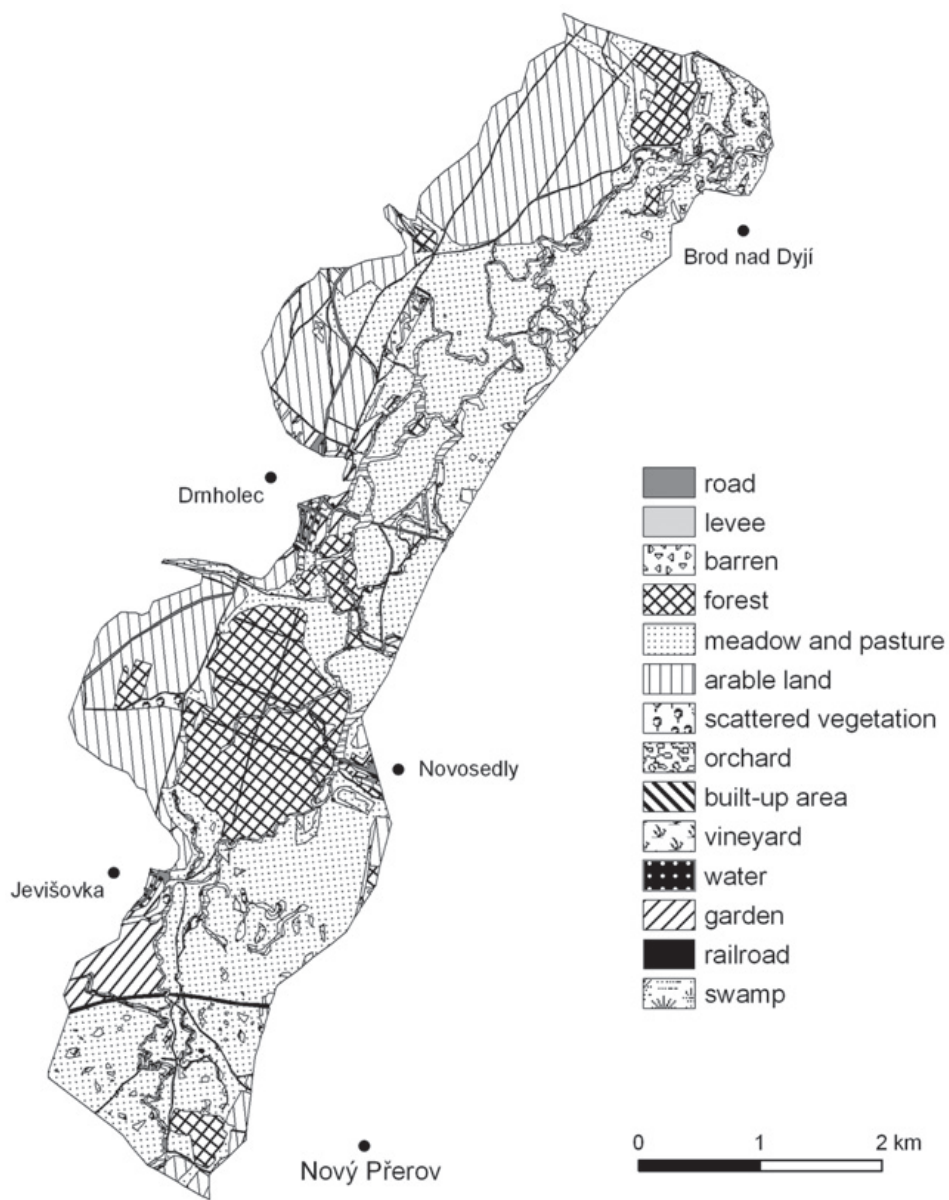


Fig. 3. Land use in the reach 1 in 1830.

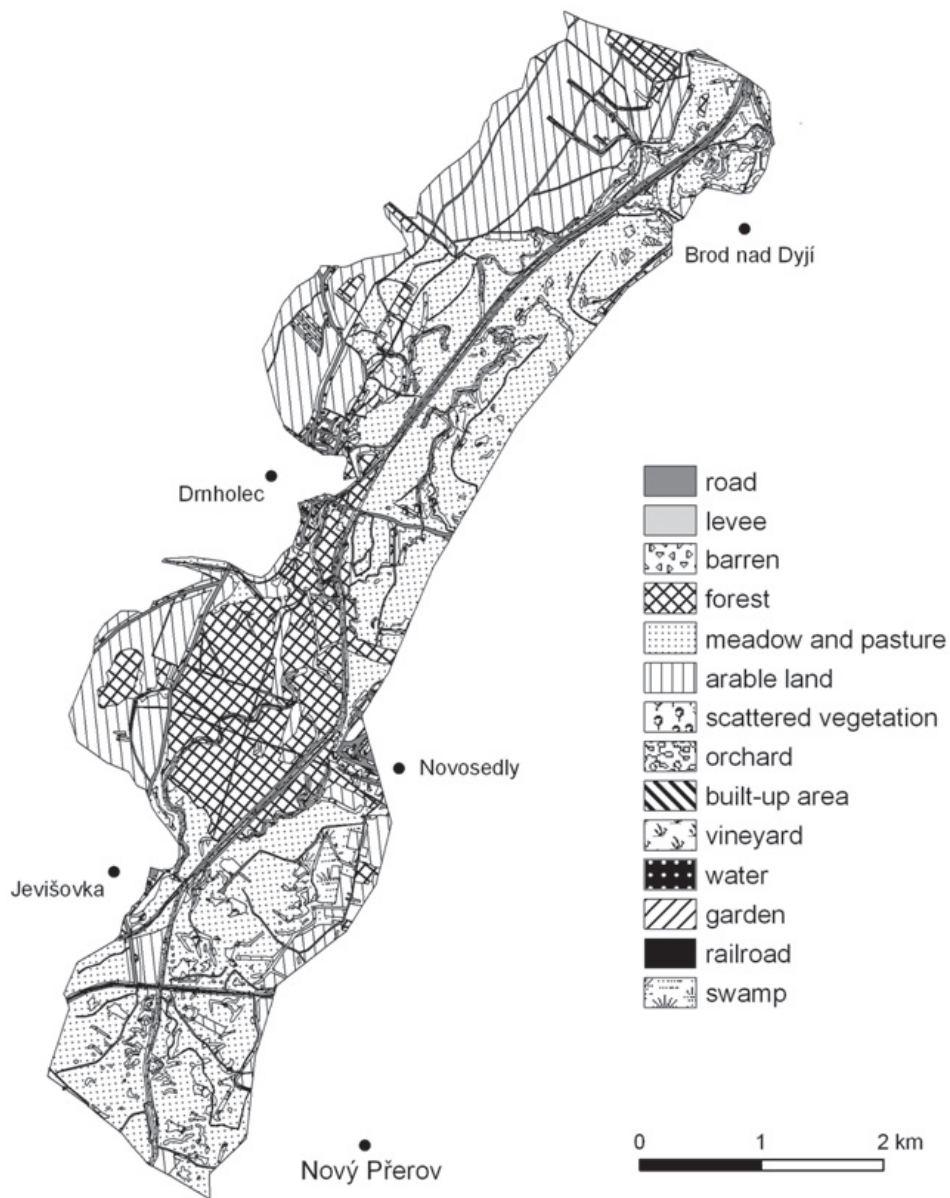


Fig. 4. Land use in the reach 1 in 1890.

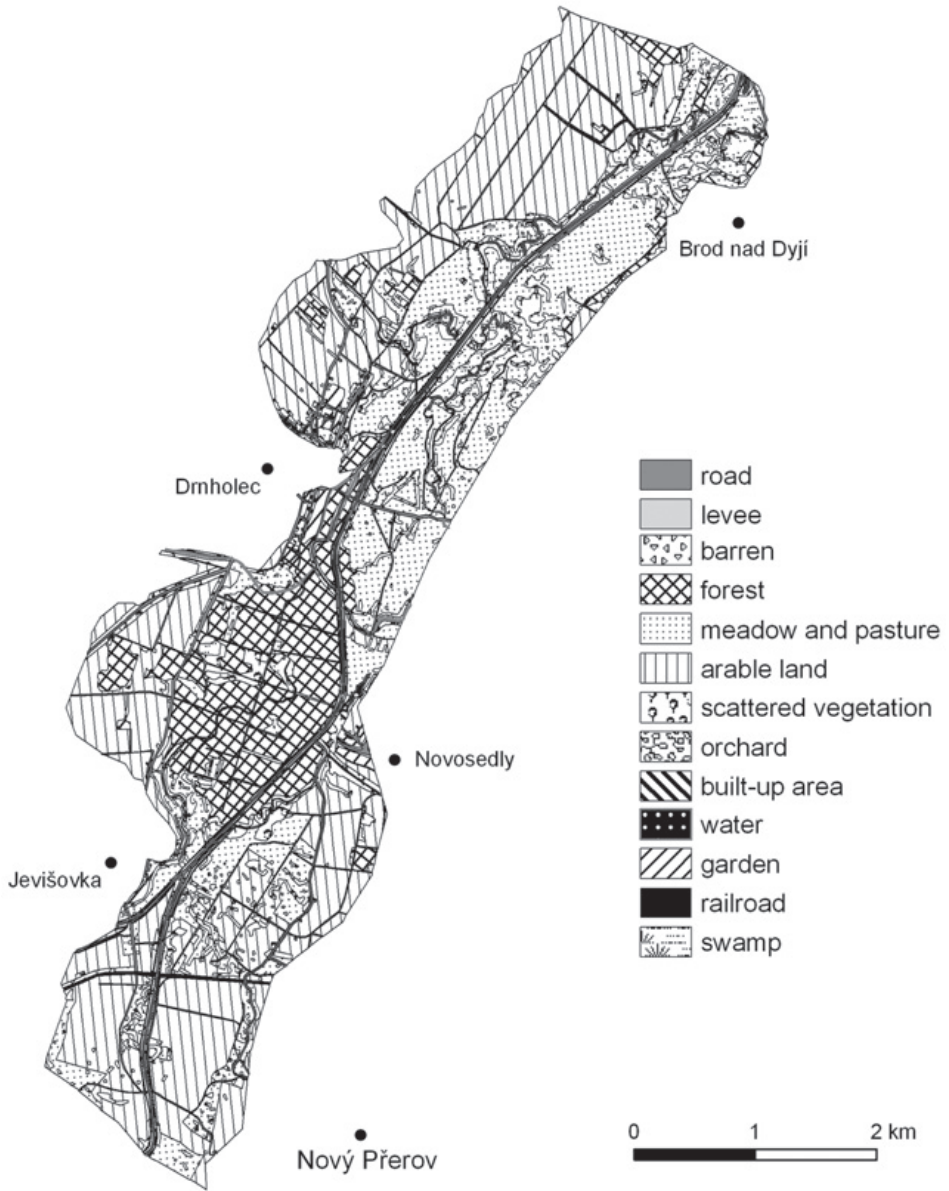


Fig. 5. Land use in the reach 1 in 1955.

arable land area decreased and was the smallest of all periods. Meadows and pastures still represented the biggest proportion (this however, had decreased by 6.8% compared to 1830), followed by arable land and forests and shrubs. The area of forests and shrubs increased 3% compared to 1830 which was caused by the extension of Drnholecký luh floodplain forest and by spreading shrubs in the southern part of the reach. It is also worth noting that an extensive area of a swamp was established southwest of Novosedly. Swamps also occurred northwest of Brod nad Dyjí. In total, their area increased 0.3% compared to 1830.

The most rapid increase in swamps was documented in 1955 (Fig. 5). This increase (for 2.1% comparing to 1890 and 2.4% to 1830) could be caused by the expulsion of Germans and Croats after 1945 after which the traditional means of channel maintenance (maintenance of drainage systems, dredging channel sediments and regulation of a discharge profile) ceased. Swamps occurred mostly in the northern part of the reach, in a locality surrounding oxbows between Drnholec and Brod nad Dyjí and in the area of Drnholecký luh floodplain forest. The expulsion of Germans and Croats also caused an increase in the area of forests and, mainly, shrubs (for 1.5%) because a significant portion of land was abandoned. An increase in arable land was in the detriment of meadows and pastures which were ploughed in the southern part of the reach in particular. This period also shows the smallest number of water areas – many oxbows, created by river regulations, dried out naturally or were artificially drained and filled up.

The situation from 2001 (Fig. 6) shows a significantly changed alluvial landscape. The biggest area is used as arable land (more than 50%), which has replaced meadows and pastures. The only complexes bigger than these are recorded east of Drnholec, east of Jevišovka and west of Brod nad Dyjí. The water level close to Brod nad Dyjí has raised thanks to the Nové Mlýny reservoirs. Many drainage canals have been built, too. This has caused an increase in the proportion of water areas by 5.1% compared to 1955 and 3.6% compared to 1830. Many shrubs were destroyed during meadow ploughing and farm consolidation in 1970s and 1980s; this can be seen mainly in the south. Swamps remain only in Drnholecký luh floodplain forest and between the channel and levees in the northern part; the rest have been drained out with drainage systems. Another increase is in the area built-up area, in particularly around Drnholec, which as the only municipality in the reach, records rise in population in 2001. The area of barrens has also risen comparing to 1955. This was caused by abandonment of arable land after 1990.

If we compare the changes in land use in the reach 1 during the whole researched period, we can see a dramatic increase in the area of arable land (of 25.8%) which was at the expense of meadows and pastures (which decrease by 35.6%). Also water area increased (by 3.6%) which was caused by the construction of Nové Mlýny reservoirs. An increase in barrens (5.7%) is due to the gradual abandonment of floodplains during last ten years. Less increase is recorded in the area of forests and shrubs (1.7%), built-up areas (0.4%) and the areas of communications (0.1%). On the other hand, there is a decrease in the area of gardens (-1.9%) and permanent cultures (-0.2%). The area of swamps changed during the period but if we compare 1830 and 2001, we can say that it did not differ greatly in these years. However, it is necessary to point out that there are changes in the geographical

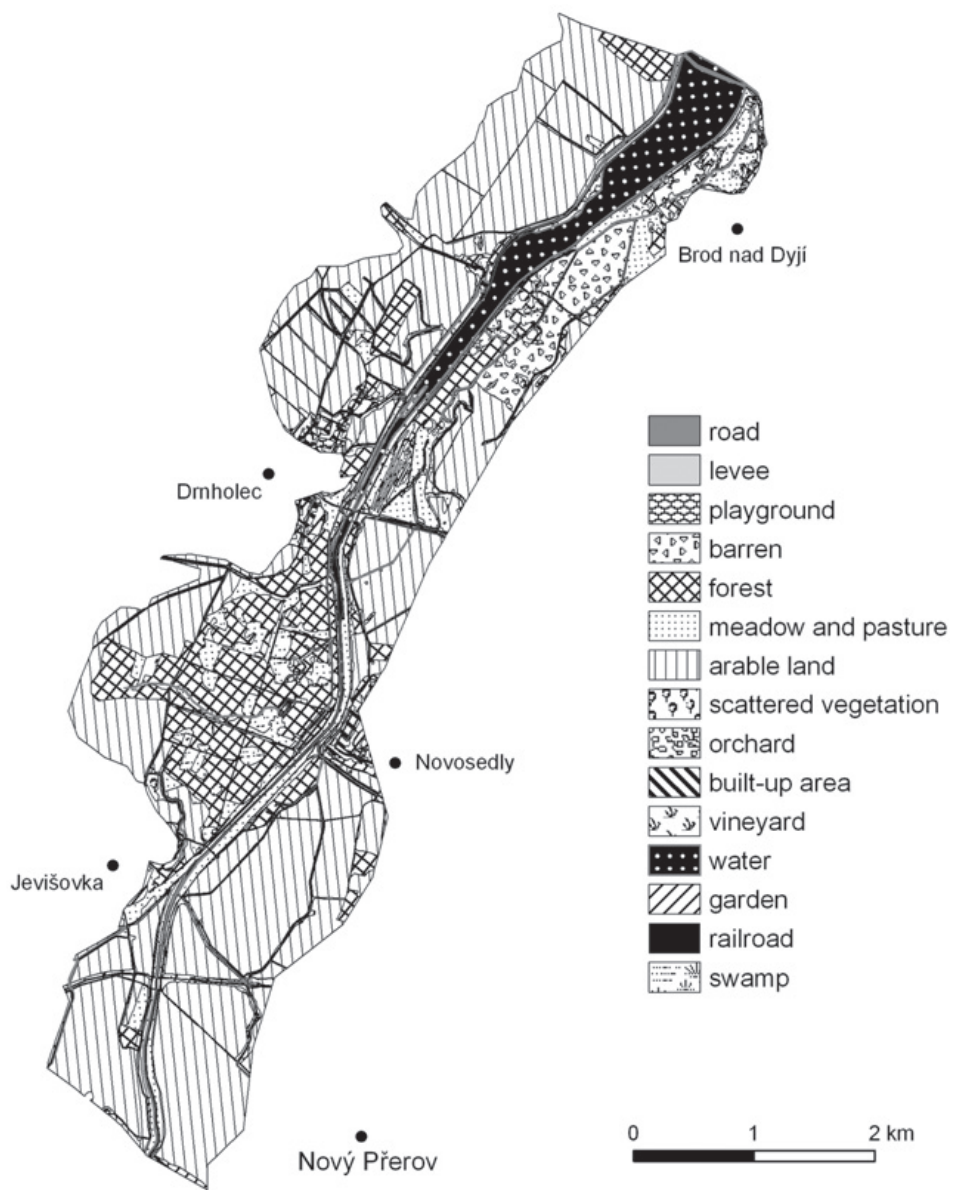


Fig. 6. Land use in the reach 1 in 2001.

distribution – in 1830 it was meadows and pastures with the highest occurrence of swamps, meanwhile the situation from 2001 shows forest areas to be mostly affected.

Land use development in the reach 3

The municipalities of Bulhary, Nejdek and Lednice on the right bank of the Dyje partly cover this reach; Nové Mlýny village on the left bank is included wholly.

Similarly to reach 1, the reach 3 had the biggest proportion of meadows and pastures and gardens in 1830 (Fig. 7). At the same time, the biggest proportion was recorded for water areas in the form of many oxbows – remnants of anastomosis. These oxbows were situated mainly in the area of Obelisk (north of Lednice) and Herdy (northwest of Lednice). Regarding swamp area this period, as well as 1890, showed the smallest proportion. Swamps were linked with oxbows both northeast of Obelisk (locality of Trokvis oxbow) and in the area of Herdy (around Azont lake) but they were also situated in the north-western part of the reach. The smallest proportion of arable land and of forests and shrubs from all periods is recorded. The proportion of forest and shrubs, however, was the second biggest (34.5%) after meadows and pastures within this period. Blocks of arable land concentrated mainly on the left bank, in the section between Nové Mlýny and Obelisk.



Fig. 7. Land use in the reach 3 in 1830.

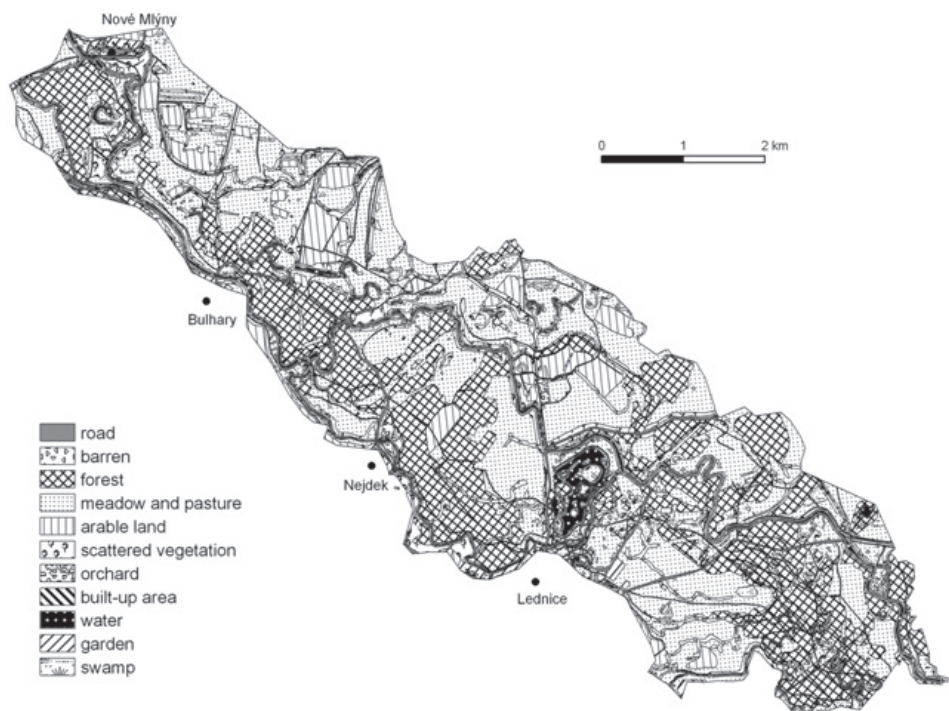


Fig. 8. Land use in the reach 3 in 1890.

The year 1890 (Fig. 8) recorded a rapid increase in the area of barrens (the largest area of all periods) which was not caused by river regulation (to the contrary of the reach 1) but rather by natural processes such as the filling up of oxbows with debris from floods, their drying out, or decline in the underground water level which was a result of low precipitation during this period. All these processes affected the proportion of water area which was the smallest from all periods. Oxbows, which dried out, were situated mainly in the Herdy and Obelisk areas and the locality called Louky od Příklad (between Nové Mlýny and Bulhary). Some channels and canals east of Lednice dried out, too. A small increase in arable land was documented in 1890. Another increase was noted in the area of forests and shrubs (locality Křivé jezero lake – south of Nové Mlýny, locality southeast of Nejdek and locality Horní les forest – eastern part of the reach). Swamps did not change their area but their location moved to the east to the area of Spáleniska, Přední louky meadows and east of Lovecký zámeček chateau. From other categories, gardens showed a decrease (for 0.3% in comparison to 1830) and permanent cultures showed a small increase.

Also the year 1955 (Fig. 9) registered a decrease in meadows and pastures (for 2% comparing to 1890) and gardens (for 0.1%); and an increase in forest and shrubs (0.5%) and



Fig. 9. Land use in the reach 3 in 1955.

arable land (3.3%). The area covered by arable land expanded on the left bank of the Dyje in the locality Louky od Příkladuk and north of Zámecký rybník pond (above Lednice). Several oxbows were restored in Herdy and Přední louky areas and east of Lednice. Their restoration meant a decrease in barrens (for almost 3%). At the same time, a significant increase in swamps was recorded, which was the result of waterlogging meadows at a locality called Pastvisko (northwest of Lednice). Meadows situated at the mound of Včelínek creek (south-east of Lednice) and south of Křivé jezero lake were considerably waterlogged, too.

The most important changes affecting this reach happened in the second half of the 20th century and are shown in Fig. 10, representing 2001. This period registers noteworthy increase in the arable land (14.2% comparing to 1955 and 17.7% comparing to 1830). This increase has been enabled by the construction of Nové Mlýny reservoirs which precluded regular spring floods and thus made it possible to plough meadows and pastures on the left bank of the Dyje from Nové Mlýny to Obelisk. Together with them, meadows on the right bank have been ploughed in the areas west of Křivé jezero lake, northwest of Nejdek and north of Včelínek creek. The only larger areas of meadows remain east of Lednice, in the eastern part of the reach (localities Přední louky and Spálenisko) and north and south of Bulhary. The



Fig. 10. Land use in the reach 3 in 2001.

areas of forests and shrubs have extended at the detriment of meadows and pastures in the Herdy area and east of Zámecký rybník pond. A continuous belt of forests has been disrupted by a construction of an artificial channel in the reach between Bulhary and Janův hrad. 1990s experienced a small increase in water areas thanks to the revitalizations of several forest canals and oxbows. Another increase in an area is recorded for swamps; the largest areas are in two localities: Herdy (Azont lake, Dlouhé jezero lake) and north and east of Panvastr (north of Herdy on the left bank of the Dyje). Also permanent cultures (east of Nové Mlýny) and built-up areas have extended a little. Arable land has started to decrease after 1990 and has been turned into barrens or transferred back into meadows. This process has resulted in similar proportions of both arable land and meadows and pastures (about 24%).

When comparing land use changes which occurred through the all periods, we notice a similar development as in reach 1. This similarity concerns arable land (increase of 18.2% in 2001 compared to 1830), meadows and pastures (decrease of 23.8%), forest and shrubs (increase of 6%), built-up areas (increase of 0.2%) and gardens (decrease of 0.5%). However, changes in these categories were not so dramatic comparing to the reach 1 which can be explained by several facts: firstly, the forest areas were already much larger than in

the reach 1 in 1830 (34.5% comparing to 17.6%); secondly, river regulations took place later (not until the second half of 20th century); thirdly, northern part including the locality of Křivé jezero lake has been a part of the Landscape Protected Area Pálava since 1976; fourthly, the area south of Bulhary has been a part of a harmonic cultural landscape, which received the UNESCO heritage status in 1996; and finally, revitalizations of hydrological conditions were realized in 1990s. Concerning swamps, it can be stated that their proportion grew continuously so that it became 0.8% higher in 2001 than in 1830.

Discussion and conclusion

The aim of this article was to evaluate the land use changes in the reaches Nový Přerov-Brod nad Dyjí (reach 1) and Nové Mlýny-Lednice (reach 3) in the period of 1830–2001 and to find out how much were these changes caused by the river Dyje regulations.

Land use development is influenced by both environmental and socio-economical factors. The most important environmental factors in alluvial plains are the relief together with hydrological conditions. The most important socio-economic factors are the political situation together with the economic development, and the demographic progress.

Both reaches show an increase in the area of arable land to the detriment of meadows and pastures during the research period. The cause of this increase was the increased pressure on the quality of alluvial soils. The pressure intensified after 1945 and had its peak in 1970s. It decreased after 1990 and especially after disastrous floods in 1997. Since then the arable land in the floodplain is being abandoned and these barrens are either left to succession or transformed into forest areas as a part of local and/or regional systems of ecological stability.

Increase in the arable land was enabled by the Dyje regulations, which began at the end of the 19th century and ended in the second half of the 20th century. These regulations restricted floods which occurred in spring and/or summer. Earlier phase of regulations in the reach 1 resulted in earlier and faster transformation of meadows and pastures into arable land than in reach 3. Both reaches experience a mild increase in the area of forest and shrubs. Other land use categories oscillated during the study period.

When comparing both reaches, a difference in the proportions of categories was detected. This difference lies in the diverse status of the reaches: whilst the reach 1 has no protective status and it is actually a common agricultural landscape, parts of the reach 3 are included in both Landscape Protected Area Pálava and UNESCO heritage area Lednice-Valtice.

Translated by the author

References

- Bičík, I., 1992: Long-term tendencies of land use in the Czech Republic. *Acta Universitatis Carolinae – Geographica*, 27: 59–63.

- Bičík, I., Götz, A., Jančák, V., Jeleček, L., Mejsnarová, L., Štěpánek, V., 1996: Land use/land cover changes in the Czech Republic 1845–1995. *Geografie – Sborník České geografické společnosti*, 101: 92–109.
- 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: 65–73.
- Bínová, L., Kynčl, M., Horák, J., Štěpánek, V., Kubíček, P., Herber, V., Fiala, P., Vrška, T., Vácha, I., 1992: Project of sustainable development of the Pomoraví region (in Czech). Ústav pro životní prostředí, Brno, 101 pp.
- Jeleček, L., 1995: Land use changes in the Czech Republic 1845–1995: main trends and broader connections (in Czech). *Geografie – Sborník České geografické společnosti*, 100: 276–291.
- Kincová, H., 1990: Landscape research in the region of the Svratka, Jihlava and Dyje rivers confluence (in Czech). Katedra geografie, PřF MU, Brno, 89 pp. (diploma thesis).
- Kolejka, J., 1988: Application possibilities of historical experience with the use of natural landscape units in the area of Nové Mlýny water body in regional planning. Rational use of research results in the area of water engineering works in South Moravia (in Czech). *Pohořelice*, p. 132–140.
- Kolejka, J., 2001: Czech experience with land use and land cover change research. In Bičík, I., Chromý, P., Jančák, V., Janů, H. (eds), *Land use/land cover changes in the period of globalization. Proceedings of the IGU-LUCC International Conference*, Praha, p. 144–152.
- Kupková, L., 1996: Changing land use patterns in the Semily district 1849–1995. *Acta Universitatis Carolinae – Environmentalica*, 10: 15–35.
- Lipský, Z., 1995: The changing face of the Czech rural landscape. *Landscape and Urban Planning*, 31: 39–45.
- Nováček, S., 1979: Collectivization in the border district of Mikulov town in the years 1949–1959 and its several differences from the collectivization in inland districts (in Czech). In Zemek, M. (ed.), *Kolektivizace zemědělství na jižní Moravě. IX. Mikulovská sympozia*, Břeclav.
- Štěpánek, V., 1992: Land use patterns and their post-war changes in the Jablonec nad Nisou district. *Acta Universitatis Carolinae – Geographica*, 27: 47–55.
- Veselý, D., 2004: Water service in the area of the lower reach of the Morava and Dyje rivers, floods and channel regulation from history till present (in Czech). In Hrib, M., Kordiovský, E. (eds), *Lužní les v Dyjskosvratecké nivě*. Moraviapress, Brno, p. 63–79.