Chapter 3
Influence of Natural Conditions on Land Use

Abstract This chapter deals with the influence of natural conditions on land use patterns. It also examines the human impacts on land use. Basic overview of natural conditions in Czechia is outlined with special regard to geology, climate and soils. Geological conditions are seen as the key factors that form landscapes and influence the diversity of soils. Climate, of course, also has profound influence on regional farming patterns; very warm (VW) and warm climatic regions are best suitable for agriculture. The biggest part of the Czech territory is covered by moderately heavy soils. Soil types are crucial for the spatial distribution of forests, arable lands, and permanent grasslands. Climatic zones and soil types are shown in maps. Regional patterns of Czech agriculture are discussed and the so-called less-favoured areas (LFA; important for allocation of EU subsidies) are explained. The history of human impacts on land use patterns over the past two centuries (covered by this research) has three phases. First, important changes in agriculture were taking place (changing balance between extensive and intensive farming). Second, forests began to shrink as more agricultural land was needed; with the advance of intensive farming, however, this process was reversed ("forest transition"). Third, new technologies and pressures exerted by the modern society brought a significant rise of built-up land and "other" areas. The ways how recent trends influenced the natural environment are explained. Changing political climate, especially the collapse of Communism and reintroduction of market conditions, has had profound effects on land use. The same applies to mining that caused large-scale devastation in some areas. Conservation programmes that accelerated after 1990 are seen as a "return to nature".

Keywords Natural conditions · Geology · Climate · Soils · Human impacts on land use · Ecological balance

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3.1 Natural Conditions as Limits to Agricultural Land Use

Hampl (2000) argues that there are three phases of nature–society interaction depending on how developed the society is: dependence, competition, and cooperation. Humans, first of all, try to adapt to the natural conditions during the first phase and also exploit the nature. In the second phase, the society is developed enough to be able to transform the natural environment to a greater extent. The last phase (cooperation) applies to selected areas in rich countries only. It should be based on a harmony between nature and society and includes institutional environmental protection plus reclamation schemes.

Location of Czechia (landlocked state on the main European watershed) has a great influence on natural conditions (for overview of natural conditions in Czechia see Physical map in Fig. 3.1). Korčák (in: Häufler et al. 1960) draws attention to the fact that the confluence of Vltava (Moldau) and Berounka in Prague is equally distant from the Baltic and Adriatic Sea and thus supports the thesis that Bohemia is in the centre of Europe. Some 98 % of the Czech territory is drained by three rivers: Labe (Elbe), Morava, and Odra (Oder) (see Fig. 3.1). Each of these rivers, however, empty to a different sea. Prevailing winds blow from North West and bring enough precipitation (500–750 mm per year in most cases) to balance the evaporation. The altitude ranges from 1603 m a.s.l. (Sněžka) down to 115 m a.s.l. (Hřensko). Height above sea level influences temperatures and precipitation and consequently also conditions for farming.

Terrain and climate have had profound effects on natural land cover; until centuries ago, mixed forest prevailed. Lipský (1994) specifies that forests covered some 80 % of Czechia at the turn of first and second millennium A.D. In that time, exploitation of nature by humans was limited to hunting, fishing, and gathering, plus there were patches of fields created by early farmers.

Until the tenth century, Slavic tribes have practised the so-called bush fallow system (*příloh* in Czech); the more advanced grass fallow system (three-field rotation) was introduced only at the turn of twelfth and thirteenth centuries. In the Middle Ages, forests were being gradually cleared and transformed to arable land and pastures. This process, however, was not a continuous one as due to numerous wars and epidemics the size of agricultural land fluctuated widely (Lipský 2000). The population increase, though a modest one, should be seen as the main driving force behind the transformation of most natural areas into cultural landscape. Subsistence farming was practised on more than 60 % of the territory (agricultural land) in the early nineteenth century. Moreover, at least one third of all forests were utilized by humans for logging, collection of wood for heating, gathering, etc.

3.2 Basic Overview of Natural Conditions in Czechia

Geology plays the key role in forming landscapes and influences the diversity of soils. On the Czech territory, much of the bedrock consists of Palaeozoic rocks, especially granite and gneiss. These rocks were overlain by varying sequences of

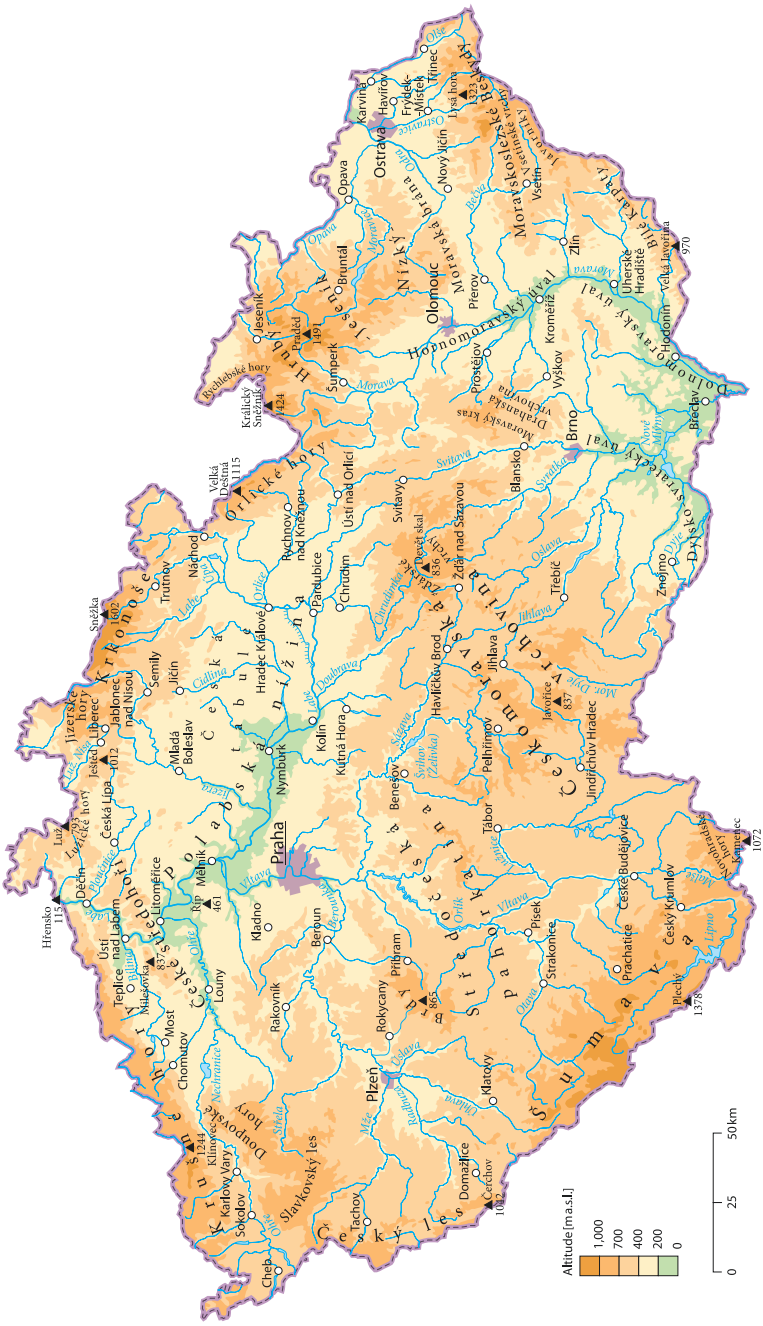

Fig. 3.1 Physical map of Czechia. *Source* Authors

Table 3.1 Proportion of arable and agricultural land by inclination of slopes (%)

	Inclination of slopes				
	0–3° flat terrain	3–7° gentle slope	7–12° middle-graded slope	12–17° steep slope	17–25° very steep slope
Agricultural land	44	41	11	3	1
Arable land	45	44	10	1	0

Source ČSÚ (1996)

marine sediments in the Mesozoic era. During the Alpine Orogeny, which also formed the Carpathians, these were significantly deformed and uplifted, especially on the margins of Bohemian Massif. The Carpathians cover the easternmost part of Czechia (Eastern Moravia) near the Slovakian border and show more varied landscapes than the Bohemian Massif (for the location see Figs. 3.1 and 4.3).

The Mesosoic sediments have been heavily eroded since the Tertiary uplift. Nowadays, their remnants have the form of isolated "islands", so-called rocky towns (picturesque sandstone formations). Rocks of varying composition and age formed the current terrain and, together with climatic conditions, influenced the composition of soils (Král in: Häufler et al. 1960). Geology also has important effects on the degree of sloping. Bičík and Jančák (2005) and also Voltr et al. (2011) argue that the inclination of slopes affects the farming methods significantly: the use of machinery is limited or even impossible on too steep slopes (Table 3.1). Most authors agree that farming is viable only on slopes up to 12–20° of gradient. In other words, geology influences the character of agriculture including the production costs. In the past, even very steep slopes were cultivated using animals and manual work.

Climate is the key factor when it comes to regional patterns of farming with regard to structure, intensity, total output, and land use. Detailed climatic studies have been published a number of times by climatologists, geographers, and agronomists (Král in: Häufler et al. 1960; Quitt 1971; Jůva et al. 1975; Hrnčiarová et al. 2009; Tolasz 2007, etc.). A comprehensive information on climate including maps (scales 1:500,000 and 1:1 mil.) and methods can be found in the Landscape Atlas of the Czech Republic (Hrnčiarová et al. 2009).

Climatic classification by Quitt (1971) is used in this publication. Quitt defines five basic climatic regions on the Czech territory: very warm (VW), warm (W, with three subregions), moderately warm (MW, with four subregions), moderately cold (MC), and cold (C). It is the climate (and also geology) that has profound effects on soils and consequently also on the spatial distribution of forests and fields, including the way of cultivation (Fig. 3.2).

The areas best suitable for farming are located in VW, W, and MW climatic regions. These areas produce most crops and also include the major economic and population centres—an important fact in a densely populated country.

Population numbers and economic performance still keep increasing in the VW and warm climatic regions with strong influences on land use patterns. As farmers

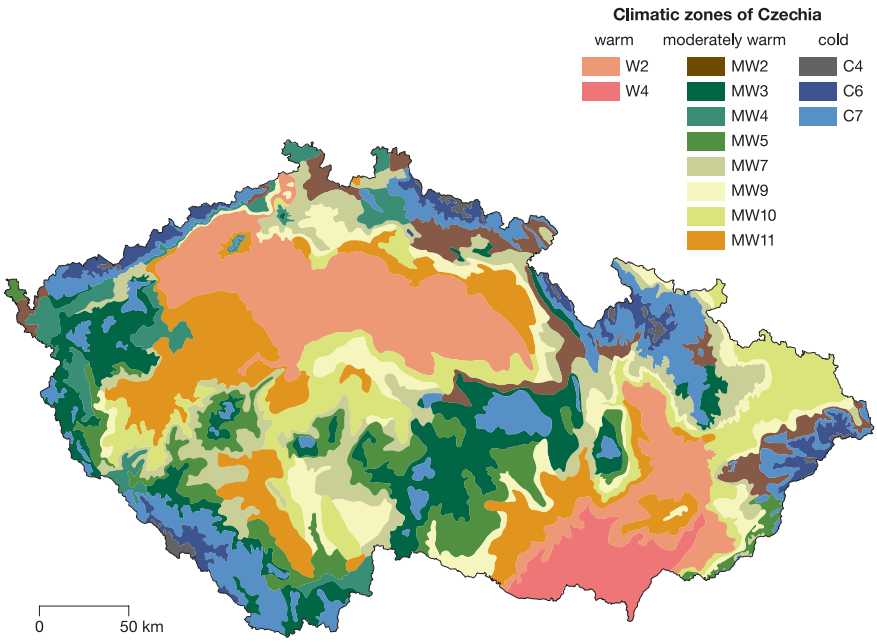

Fig. 3.2 Climatic zones of Czechia. *Source* Quitt (1971)

Table 3.2 Proportion of agricultural and arable land by Czech climatic regions

	Climatic region										
	VW	W1	W2	W3	MW1	MW2	MW3	MW4	MC	C	Total
Agricultural land	5	5	6	14	5	21	4	26	11	3	100
Arable land	6	6	6	16	6	21	4	25	9	1	100
Proportion of arable land on agricultural land	96	92	90	92	88	82	80	75	65	40	

Source ČSÚ (1996)

tend to abandon poor soils, the VW and warm regions with fertile soils account for an increasing share of agricultural production. Thus, the fact that more and more quality farmland is being developed should be seen as a threat for future self-sufficiency in food production. This problem occurs especially in the close vicinity of cities and towns where new suburban settlements, warehouses and commercial centres mushroom on former farmland (Bičík et al. 2012; Spilková and Šefrna 2010; Ouředníček 2007, etc.).

MC and cold (C) climatic regions are less favourable for farming (Table 3.2) and usually suffer from long-term depopulation.

Three basic soil classes are recognized in Czechia: light soils (9 % of agricultural land), moderately heavy soils (83 %), and heavy soils—clays (8 %). Such distribution is favourable for farming (Häufler et al. 1960, p. 197; Hrnčiarová et al. 2009).

Table 3.3 Soil types in Czechia

Soil type	KA	KAd	PG	CE	LU	HN	KP	FL	PZ	PR	PE	O
Proportion of total area (%)	42.19	12.83	8.73	7.77	6.64	6.46	3.72	3.15	2.40	1.53	1.30	3.28

Explanations KA—cambisol, KAd—dystric cambisol, PG—stagnosol, CE—chernozem, LU—luvisol, HN—brown earth, KP—entic podzols, FL—fluvisol, PZ—podzol, PR—haplic leptosol, PE—haplic cambisol, O—other soil types
Sources Own calculations; Půdní mapa Česka 1:500,000, Sedláček et al. 2009; Šefrna in: Bičík et al. 2010)

Light soils are mostly found in the Elbe Plain in Central-Eastern Bohemia and along the lower course of Morava. These soils are prone to erosion, can easily dry up, and usually are not really suitable for farming. Such areas are often covered by pines, oaks, and black locusts (Šefrna in: Bičík et al. 2010). Heavy soils are usually found on tertiary sediments in the Northern Bohemian Basin and also on Permian-Carboniferous sediments (environs of Rakovník, Český Brod, Trutnov, etc.; for the cities location see Fig. 4.3) (Häufler et al. 1960, p. 197; Hrnčiarová et al. 2009). Heavy soils are difficult to cultivate and do not absorb water easily. Most Czech agricultural regions are covered by moderately heavy soils that are best for cultivation.

Soil types are more complex. Cambisol is the most widespread soil, covering 55 % of agricultural land in Czechia (see Table 3.3) and found mostly in hilly regions with sloping grounds (Šefrna in: Bičík et al. 2010, p. 57).

The structure of soil types has been undergoing gradual transformation recently. Especially, the most fertile soils, usually found in the plains, are under a strong pressure from developers. Though these quality soils enjoy legal protection and developing such areas requires special payments, the total area of fertile soils is shrinking.

Territorial patterns of soil types are rather scattered due to varying climate and landscape types. It is common that a number of different soil types are found within just one small cadastral area. Figure 3.3 shows STUs where the proportion of one soil type on agricultural land was more than 75 % or 50–75 %. Only the most important soil types are taken into consideration. Great many white spaces on the map reflect the very complex patterns of soil types in general plus the fact that apart from the soil types selected there are many more types. The average STU area is just 700 ha; even in such small units it is often impossible to define a single soil type that would account for more than one half of the agricultural land.

Soil types are crucial for the spatial distribution of forests, arable land, and permanent grassland. The soils best for farming are mostly found in South East Moravia and to a certain extent also in the Elbe Plain (Polabská nížina; see Fig. 3.1); forests cover only a very small portion of these areas. On the contrary, the least fertile soils (acidic soils) are covered by forests by more than 80 %. Šefrna (in: Bičík et al. 2010, p. 58) claims that "…The potential fertility of soils, including soil texture and inclination of slopes, is crucial for the way how landscape is used by humans—either for farming or forestry."

A very detailed soil mapping (scale 1:5000) was carried out in former Czechoslovakia during 1960s and 1970s. It included soil quality, slope orientation, climatic data and enabled to create the network of so-called soil-ecological units (BPEJ in Czech) (Jůva et al. 1975). Thanks to this network, potential conditions

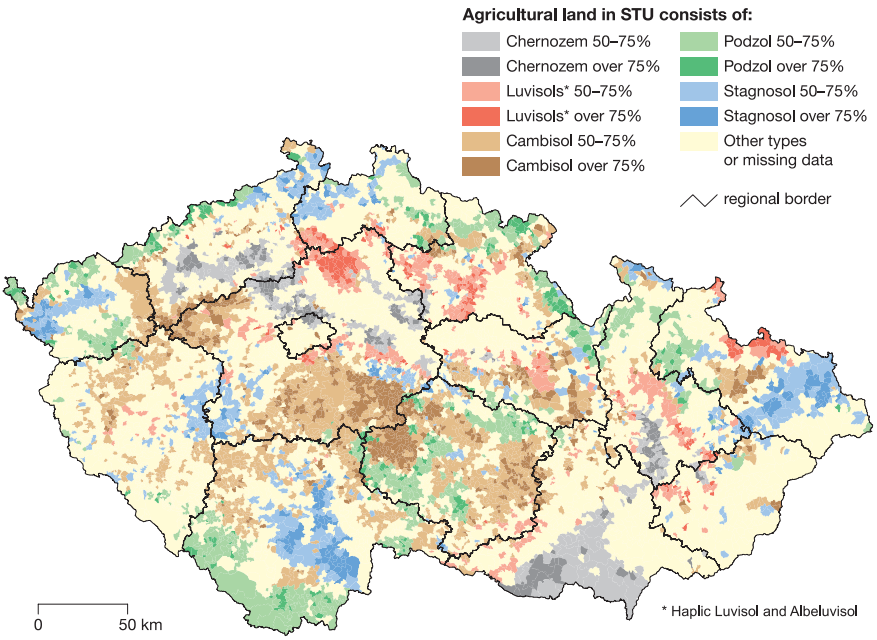

Fig. 3.3 Selected soil types in Czechia by stable territorial units (STU). *Source* Kabrda et al. (2006)

for agriculture can be attributed to any plot, cadastral unit, or larger area. The network has been updated in 2013; at the moment, there are 2278 soil-ecological units in Czechia. Each of them is identified by a five digit code (climatic region, main soil unit, inclination of slopes and slope orientation, soil texture, and depth of soil). Based on soil-ecological units average official price of soil for each cadastral unit has been calculated (see Fig. 3.4). However, real market price differs.

General geographical and ecological rules that influence the utilization of landscape (with regard to natural conditions) were published by Lipský and Brabec (2007) and further developed by Lipský (in: Bičík et al. 2010, p. 52–53). It is emphasized that "… the form in which humans utilize the landscape is influenced by all physico-geographical components; the effects of each component vary spatially. Certain modes of landscape utilization are fundamentally conditioned (and limited) by the character of natural environment."

3.3 Typology and Regional Patterns of Czech Agriculture

In the interwar period, the networks of "agricultural production areas" and "natural agricultural areas" were compiled by Novák et al. (1925). Spatial patterns of natural conditions with regard to agricultural production have been repeatedly analyzed in Czechia for the sake of tax assessment. Under the Communist regime, agricultural businesses were subject to different taxes or eligible for different subsidies (see

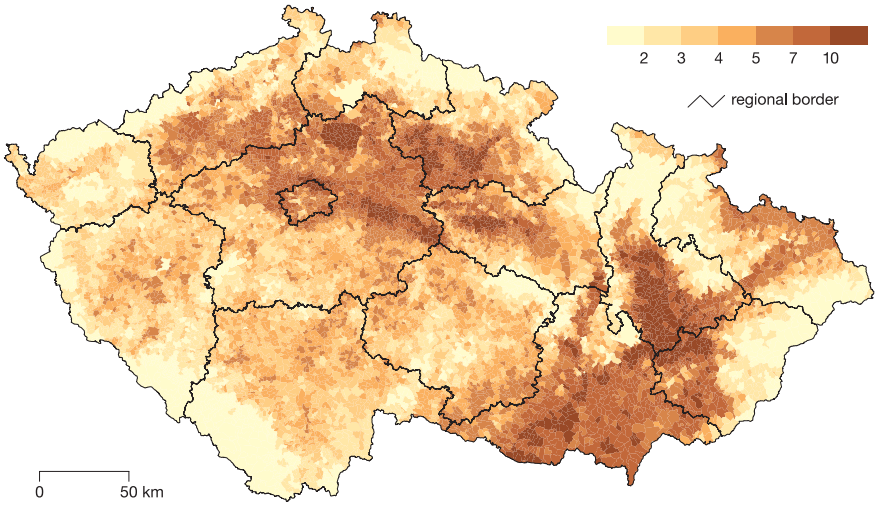

Fig. 3.4 Official price of agricultural land (CZK/m^2, 1996; by cadastral units). *Sources* Vyhláška č. (412/2008) Sb., ve znění pozdějších předpisů; LUCC Czechia Database (1845–2010)

Sect. 6.6, Table 6.12). A number of scholars have produced regional divisions of Czechia based on natural conditions (Novák et al. 1925; Jůva et al. 1975; Jančák and Götz 1997; Bičík and Jančák 2005; Voltr et al. 2011).

An extensive analysis which aimed to create a system of agricultural production types and subtypes has been carried out after World War II (Hamerník et al. 1960).

After the political changes of 1989, new agricultural production regions (APR) and subregions were created (Němec 2001)—see Fig. 3.5. The following APR were defined: APR corn (C); corn-sugar beet-potato type (6.7 % of agricultural land); APR sugar beet (SB); sugar beet-grain type (24.3 %); APR grain (G); grain-fodder type (40.5 %); APR potato (P); potato-grain type (18.5 %); APR forage (F); forage type with animal husbandry (10 %).

The regional patterns of land use/cover in Czechia are also influenced by the so-called less-favoured areas (LFA). These have been important for allocation of EU subsidies—before and after the accession to the EU—as LFA should primarily serve as a tool to assist regions with less advantageous conditions for farming. First, population stability and maintenance of cultural landscape are among the chief targets. Second, many LFAs are located in regions protected by law (national parks etc.—see Fig. 6.37) where cultivation and farming in general is either restricted or impossible. As natural conditions vary to a great extent in Czechia, the network of LFAs is a complicated one. In total, LFAs cover about one half of the national territory. The eligibility is specified in Governmental Order No. 75/2007 (Mareš and Štych 2005; Voltr et al. 2011).

The LFA scheme (see Fig. 6.29) is fundamental for retaining the agricultural functions in such regions. It also constitutes a big change as during 1990s schemes aimed at assisting farmers were rare. As a result, the agricultural transformation in the last decade of the twentieth century was chiefly influenced by natural conditions. Since 2013, farmers and cooperatives in Czechia are eligible for subsidies comparable with those in EU-15. This fact and also the changing character of EU Common Agricultural Policy

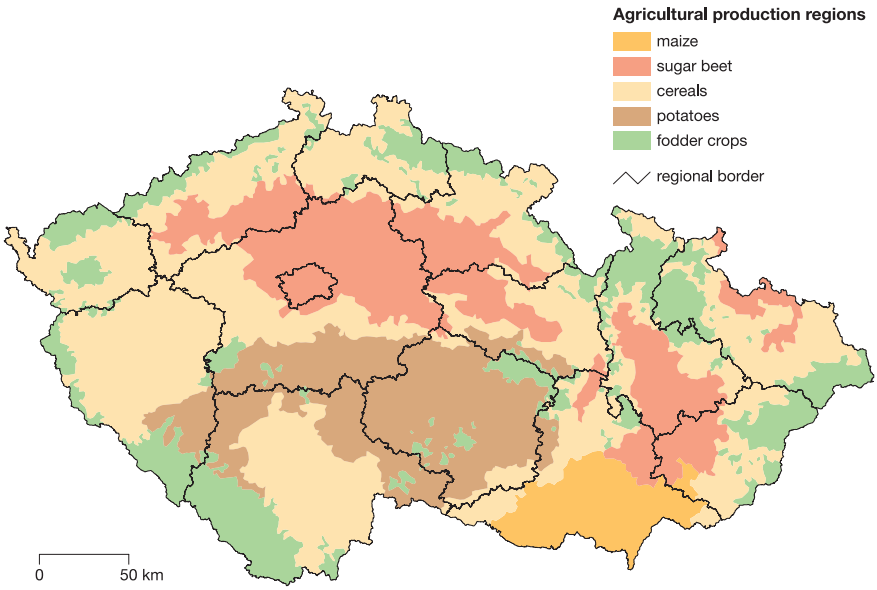

Fig. 3.5 Agricultural production regions (generalized). *Source* Němec (2001)

will definitely shape Czech agriculture in the following years. The present patterns of land use/cover in Czechia are demonstrated on the following photos (Figs. 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22, and 3.23).

Fig. 3.6 Picturesque rocky formations in Český ráj ("Bohemian Paradise") near Turnov provide sweeping view towards Kozákov hill (744 m a.s.l.) in the background. The scene shows a mixture of small fields, meadows, and forests that are typical for the Czech cultural landscape. *Photo* Ivan Bičík

Fig. 3.7 Rapeseed field in blossom bisected by a former field road, now overgrown by bushes and trees: typical scene from Central Bohemia south of Prague near Neveklov. A patch of former agricultural land converted into "new wilderness" can be seen in the foreground. *Photo* Ivan Bičík

Fig. 3.8 Gently sloping highlands, often covered by agricultural land, form a typical feature of Czech landscape. In many places, the use of modern machines is complicated or even dangerous. *Photo* Radim Perlín

Fig. 3.9 Small fragmented fields worked by private farmers had been replaced by large ones managed by cooperatives and state estates after 1948. Since 1990, former arable land has been converted to permanent grassland and used for organic farming, especially cattle breeding, around 1994 (Vysoký Újezd, ca. 450 m a.s.l., some 40 km south of Prague). *Photo* Ivan Bičík

Fig. 3.10 Landscape changes on the territory of abandoned village Stodůlky (Southwestern Bohemia, altitude 850 m a.s.l.). Some 500 people lived here around the year 1900; the village then covered an area of 236 km^2 (second largest municipality in the country after Prague). Following the post-war transfer of ethnic Germans, the locality became part of military training area and served as target for artillery fire. It ceased to exist in 1952. Nowadays the area is part of Šumava National Park. *Photo* Ivan Bičík

Fig. 3.11 A group of second homes have developed on the south bank of Dyje on former sloping agricultural lands. The valley near Znojmo opens to a fertile plain where large amounts of fruit, vegetables, and wine are produced. *Photo* Ivan Bičík

Fig. 3.12 Aerial image of Kobylí and Bořetice (South Moravia) show the most fertile soils where the former Kobylí Lake used to be located. The lake was drained in mid-nineteenth century to provide fertile soil for sugar beet (now mostly cereal crops, fruit, vegetables, and wine). *Photo* http://geoportal.gov.cz/

Fig. 3.13 Farmers around Kobylí, South Moravia, have specialized in wine since ca. 70 years ago. A shallow freshwater lake had existed on the place of the current winery until mid-nineteenth century. *Photo* Leoš Jeleček

Fig. 3.14 Jizerka, one of the highest villages in Czechia (862 m a.s.l.), was founded by hunters and gemstone gatherers. Glass furnaces originated here since early nineteenth century. Fir and beech forests were cleared to provide place for extensive farming (animal husbandry, cabbage, potatoes, logging). More than 420 permanent inhabitants in 42 houses lived here in 1884. *Photo* Ivan Bičík

Fig. 3.15 Large tracts of Norway spruce forests on the slopes of Sněžka (1603 m a.s.l., the highest Czech mountain, the Krkonoše Mts. National park) were damaged by storms. Protected area without any agricultural activity. *Photo* Lucie Kupková

Fig. 3.16 The deep, winding valley of the central stretch of Vltava including beautiful rapids was flooded by the Štěchovice Lake (ca. 30 km south of Prague). In the centre of the photograph, one of the oldest groups of second homes called Ztracenka (Hidden Valley) can be seen. The area is intensively used for leisure time activities. *Photo* Ivan Bičík

Fig. 3.17 Transition zone between intensively farmed Dolní Pomoraví and hilly Protected Landscape Area Bílé Karpaty near the border with Slovakia. Part of the area shows fragmentation resulting from restitution of property after 1990. In the past, the land was even more fragmented. *Photo* http://geoportal.gov.cz/

Fig. 3.18 Agrobrownfields. Following the disintegration of large cooperatives, many former farm buildings and agricultural complexes fell into disuse and neglect (often due to unclear ownership rights). Such buildings keep decaying and gradually become overgrown by shrubs and trees. *Photo* Radim Perlín

Fig. 3.19 Dalešice Water Reservoir flooded the deep, forested valley of the Jihlava River near the protected area Mohelenská hadcová step (*right*). The lake serves the needs of the nearby nuclear power plant. *Photo* Ivan Bičík

Fig. 3.20 The foothills of Krušné hory, Northern Bohemia, were much altered by human activities, namely by open pits where lignite is exploited (environs of Most). *Photo* Ivan Bičík

Fig. 3.21 Former fertile fields had been converted into open pits and after some 50 years the area has been reclaimed to provide space for a large recreation centre that also includes a horse racing track. The modern town Most can be seen in the background. The original mediaeval town used to be located some 2 km to the north; in 1970s it was demolished for the sake of lignite. *Photo* Ivan Bičík

Fig. 3.22 This aerial picture shows the highly urbanized landscape immediately west of Prague (Rudná u Prahy). In the past, intensive farming prevailed here; nowadays much of the area is covered by residential and commercial development

Fig. 3.23 Improper application of EU standards on renewable energy sources plus high state subsidies resulted in a solar boom. Large tracts of agricultural land have been abandoned to make place for solar plants. *Photo* Ivan Bičík

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