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SOCIEKONOMICKÝ POHLED NA STAV PŮDY V ČESKÉ REPUBLICE

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SOCIOECONOMIC VIEW OF THE SOIL CONDITION IN THE CZECH REPUBLIC

ABSTRAKT
Půda patří mezi neobnovitelné přírodní zdroje, je nezastupitelnou složkou životního prostředí, bez ní by život na zemi vyhasnul; je tedy nutné k ní z tohoto pohledu přistupovat. Půda má široký rozsah funkcí - je multifunkční. Je stanovištěm a prostředím pro rostliny, filtračním a kumulačním prostředím pro vodu a zprostředkovává výměnu energie a plynů. Půda hraje zcela zásadní roli ve stabilitě ekosystémů a v ovlivňování bilancí látek a energií. Působí také jako enviromentální pufrační médium, jež mimo jiné zadržuje, degraduje, ale za určitých podmínek i uvolňuje potenciálně rizikové prvky. Mnohé půdy jsou však v současnosti antropicky ovlivněny nebo degradovány; je však nutné těmto degradacím zabraňovat a chránit jejich cenné produkční a mimoprodukční funkce. Je nutné si uvědomit, že ohrožení půd bude zesilovat i vlivem očekávaných klimatických změn.
***Klíčová slova**: Ochrana půdy, degradace půdy, klimatická změna, Česká republika*

ABSTRACT
Soil is one of the non-renewable natural resources, it is an irreplaceable component of the environment and without it, the life on earth would be extinct; as such, it is necessary to approach it from this point of view. Soil has a wide range of functions - it is multi-functional. It is the habitat and environment for plants, a filtration system and accumulation environment for water and provides an exchange of energy and gas. Soil plays a crucial role in the stability of ecosystems and in influencing the balance of substances and energy. It also acts as an environmental buffering medium which, among other things, retains and is degradable, yet releases potentially hazardous elements under certain conditions. However, many soils are currently anthropogenically affected or degraded making it necessary to prevent these degradations and to protect their valuable production and non-productive functions. It is important to note that the threat to soils will also increase due to the expected climate change which is anticipated.
***Keywords:** Soil protection, Soil degradation, Climate change, Czech Republic*

Introduction

The spiritual and mental development of humankind has played a decisive role in the region in which it lives and has evolved, as well as in the nature of the local climate. With the first agricultural settlements, it can be seen that the places of their origin coincide with the agronomically most valuable which means those with the most fertile soils.
In the Neolithic Revolution, the deciding motif for the population was most likely overpopulation and the lack of land in their original homes. Groups of people moved along the rivers into places with fertile loess soils.

Medieval colonization then altered the structure of our country. The three-field sowing system and the technique used divided the plowing into three integrated similarly large areas, and thus the field blocks gained solid boundaries. Growing settlements and soil cultivation affected not only forest cover but increased the susceptibility of the soil to erosion (its susceptibility to erosion by water) which quite often caused regular floods. The valleys of streams and rivers were covered by layers of washed away soils.

In the seventeenth century, the population grew rapidly, thus intensifying the economic activities. However, this trend was especially hampered by the lack of nutrients in the soil. New crops have been used since the 18th century such as potatoes, corn and forage crops (clover). The expansion of potato cultivation increased the fertility of inappropriate climate locations for farming. The long-term land stabilization, especially erosion and sedimentation processes (landfill and soil deposition) and plowing technology have led to developments of boundaries. Roughly from the year 1800, a gradual fall of the amount of fallow soil went from 25% to about 1-2%. The recovery of nutrients in the field was not possible without replenishment which was done using manure fertilizers putting forage crops into the system and fertilizing with mineral fertilizers. During the first half of the 19th century, the area of arable land here increased by about a quarter while the pasture and the fallow land decreased due to the introduction of an alternative farming system and a transition to livestock breeding. The high proportion of areas planted with potatoes then led to a scattering of runoff conditions and significant water erosion with the middle troughs of rivers' then started getting deposits. The development of the sugar industry also manifested itself in the countryside - the mass drying of ponds in flat filed planes ensured the need for heavy and wet soils for sugar beet production.

The division of Europe and the pursuit of self-sufficiency in food production has led to a further reduction in the area of grasslands in favor of arable land. Wind and water erosion increased tenfold. It was also influenced by growing broad-leaved crops (corn, potatoes, and beets) on inclined soils, especially on hills and highlands. The variety of crops has also declined. Massive and often unnecessary fertilization with mineral fertilizers and the use of chemical agents in agriculture which together with the spoiling meadows, boundaries and accompanying greenery, meant a deterioration of the quality of the farmland itself. Unfortunately, this condition is still present in many places in our country. The more extensive the agricultural economic system, the more society was dependent on the land [1].

Results and Discussion

For many people, the soil they walk on is just "unclean" dirt. Only useful so that they can build houses and roads, etc. But in fact, the soil is a fantastic world full of life. When we destroy the life in the soil, this dead soil is no longer soil but rather dead matter, a non-living matter that cannot fulfill any of its basic functions. There is nothing in the dead soil to decompose the organic matter, nothing to dig corridors and restore the soil’s microstructure. A rich and balanced soil life is desirable and essential for maintaining soil fertility. For agricultural production, in particular, it is important that without life in the soil, it would not be possible to cycle through substances in which dead organic matter (of plant and animal origin) decomposes, releasing the nutrients to be reused. The soil is primarily a non-renewable natural resource and has an irreplaceable role in terms of both production and non-production functions, most of which relate to the water cycle in the landscape. This especially concerns the infiltration of water into the soil which is complemented by groundwater supplies. Thanks to infiltration, the volume of surface runoff which causes soil erosion, accelerates the drainage of water from the landscape and thereby the flood conditions of the rivers. Thanks to the pore system, the soil is able to hold large amounts of water, e.g. 1 ha of deep black soil can accumulate up to 3,500 m3 of water [2]. Thanks to these capabilities, soil contributes significantly to maintaining water in the countryside and preventing floods. Some of the soil properties listed above are caused by their development and are virtually unaffected. Other soil properties are directly dependent on soil management and the quality of care. Inappropriate farming of the soil leads to its degradation.We are speaking about the degradation of soil in cases when the soil's ability to perform its natural functions is lost or reduced. The degradation factors impacting the soil either individually or differently and mutually enhance each other [3]. Soil degradation can be very rapid while soil formation processes are

extremely slow (1 cm of soil creation takes hundreds of years). Despite the undeniable importance of soil, we often leave soil to succumb to the irreversible degradation factors. Degraded soil is also declining in its ability to withstand the extreme rainfall occurring in our country with increasing frequency (Figure 1).

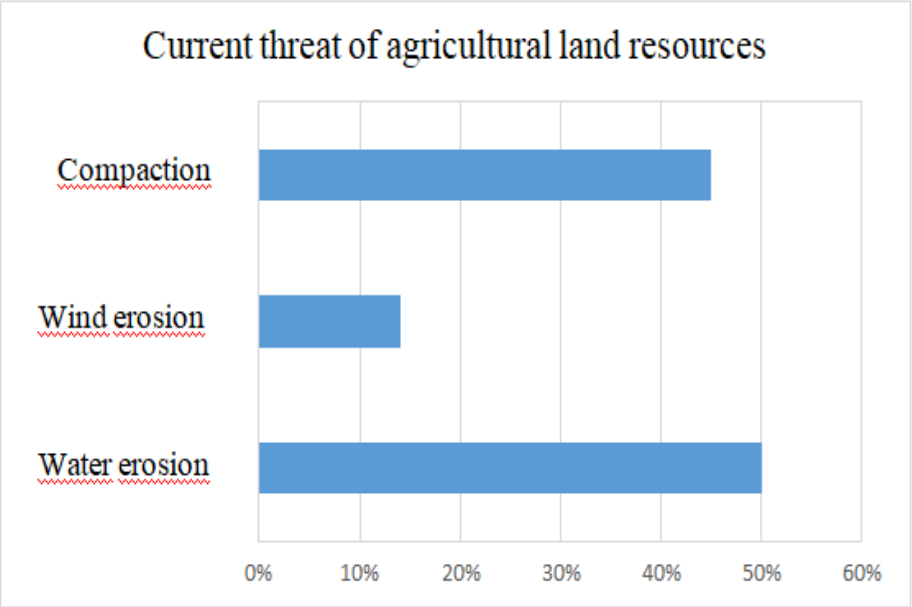


Figure 1: Current threat of agricultural land resources in %

Soil erosion occurs in the upper parts of slopes to reduce the thickness (up to a loss) of humus soil horizons which have the greatest importance for infiltration and water retention. In addition to reducing the depth of the soil (and thus the water storage area), organic soil matter is lost which is deposited in the upper parts of the soil profile and has a significant positive effect on infiltration. On the contrary, the valleys' watercourses and reservoirs are being filled with sediment, thus reducing their accumulation space to capture torrential rains [4].

Excessive soil consolidation is the result of intensive farming. It is the compaction of land by repeated crossings with heavy agricultural technology, especially for unsuitable (high) soil moisture. By compaction, the soil structure breaks down, resulting in changes to the porosity, bulk density, infiltration and permeability, and decreased retention capacity. In particular, the change in the representation and size of the soil pores has a negative effect on soil water movement.The humus content in the soil significantly decreases with intensive agricultural activity without the organic matter being supplied, as increased aeration and more intensive hydrothermal processes in the soil subdue the humification of organic residues and increases mineralization. The lack of organic matter in the soil has, among other things, a negative impact on the soil structure and the ability to infiltrate and accumulate rainwater [5]. It also reduces the ability to capture contaminants from the water. When the soil is covered with impermeable materials, the majority of its functions are totally and permanently lost. Precipitation water is taken directly to the watercourse from this area, thus speeding up the drainage of the water from the landscape (Figure 2).

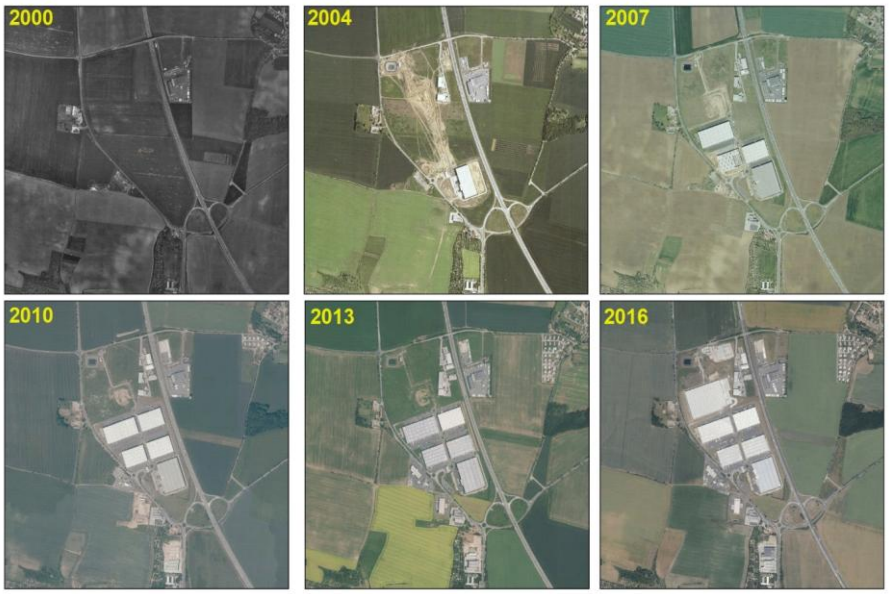
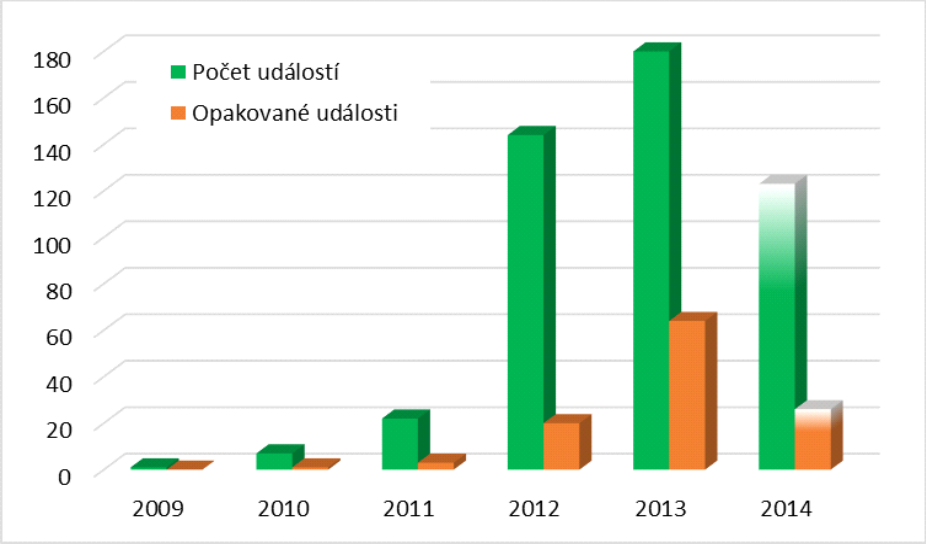


Figure 2: An example of agricultural land resource confiscation in a period 2000 – 2016

In order to obtain a detailed overview and current state of the erosion on agricultural land, Výzkumný ústav meliorací a ochrany půdy, v.v.i. (the Research Institute for Soil Reclamation and Protection) is monitoring erosion. Its output is mainly to find out the extent of the problem with the erosion of agricultural land, the causes of this condition, the correctness of targeting existing policies in the field of erosion control and efficiency and the ineffectiveness of some anti-erosion measures. These findings can be used to design effective anti-erosion measures, preparing new policies in this area, and including repeatedly monitored soil blocks with erosion into vulnerable and strongly erosive areas (Figure 3).



Number of events
Recurring events

Figure 3: The number of recorded "Erosion monitoring" erosion events per year (2009 – 2014)

Some progressive climate change has contributed to the acceleration of some degradation processes in recent years, alongside inappropriate farming practices. The climate of the Czech Republic is characterized by its high dynamics, i.e. volatility. More and more frequent torrential rains alternate with long periods of drought. This situation often has negative consequences for agricultural production and also contributes to the increased risk of floodsthroughout the whole republic. It is not possible to record all the erosion events, yet it gives a good idea of the overall state of erosion in the Czech Republic and is an important tool in the fight against it.

The risk of extreme water conditions in the countryside, i.e. floods and drought, can be greatly reduced by good care for the soil, i.e. by protecting it from erosion, minimizing soil compaction, maintaining optimal soil pH and sufficient organic soil fertilization, etc. The issue of processing soil, which needs to be adapted to local conditions, e.g. include subsoiling on congested land, reduction in plowing in the absence of organic fertilizers, use of minimization technology on eroded endangered plots, etc [6].

Besides these measures, other negative contexts cannot be omitted in terms of preventing floods, e.g. accelerating the drainage of water from the countryside by straightening watercourses, shutting down wetlands and excessive building on drainage systems in the past. A major problem is that vast areas of often very good soils in the vicinity of large cities are occupied by warehouses, logistics centers or residential developments. This results in the loss of most soil functions and a significant change in drainage rates.

An important means of promoting soil protection against degradation is the subsidy policy of the Ministry of Agriculture through appropriate agronomic practices. From the point of view of water erosion, the most effective enforcement of the Good Agricultural and Environmental Status (Dobrý zemědělský a environmentální stav půdy - DZES) standards is in the system of the subsidy policy. Soil protection through DZES is based on setting the minimum conditions for farmer access to agricultural land. The DZES 5 standard, focusing on water erosion, determines the erosive susceptibility of the land and limits agricultural technology which has an erosion risk to the vulnerability of the land [7].

Although this standard is based on logical principles, there is an insufficient representation of eroded areas, which could be partly helped by the proposal to redefine erosion areas.

The DZES system focuses on measures throughout the Czech Republic. However, it is preferable to use complex land modifications for detailed targeting and designing complex landscape solutions, in particular, a plan of joint facilities, which can be a very effective tool in combating water erosion and other degradation factors (e.g. reducing the congestion of road networks). Despite the indisputable advantages of reallocation of land, where the design of common facilities, including water management and anti-erosion measures, can be tailored to the specific needs of the site, reallocation of land also has some negatives. The major problems facing reallocation of land are the low percentage of proposals which have been implemented and the slow completion of reallocation of land in relation to the size of the state.

Effective approaches for fighting soil degradation may be aided by the forthcoming amendment to the Agricultural Land Resources Protection Act prepared by the Ministry of the Environment, which newly addresses the issue of erosion and soil contamination, solving practical problems related especially to managing land leased and the disaffection of landowners, introduces a soil information register and contains new sanctioning provisions for cases of uneconomical management of land not covered by the subsidy policy.

Conclusion

At present, humanity is affected by floods and droughts across continents and countries. What role does it play in balancin the abnormal climatic events and their impact on land? Global and local natural disasters remind people of the non-productive function of soil; soil as a medium that absorbs water holds it, cleans it and preserves it for plants and animals which ultimately belongs to human beings. It is precisely because of the high infiltration and retention capacity that soil is able to hold a great amount of water and then gradually release it during a period of drought. In many areas, humankind has adversely affected the ability of soil to face heavy rainfall, local torrential rains and floods or droughts. A simple equation applies - healthy soil resists adverse effects, while degraded soil loses its ability to defend itself!

World organizations are already pointing out that soil is scarce for the ever-increasing human population, yet is constantly declining, even though humanity is dependent on fertile soil. Quality soil is also the main requirement for producing quality food. Increased production can be achieved by further increasing yields using fertilization, irrigation, and drainage, expanding farmland at the expense of natural habitats, or improving the energy efficiency of food production. On the other hand, these processes cause soil degradation, the loss of biodiversity, the contamination of soil and water, growing land use by urbanization and the conversion of agricultural land to non-food use (e.g. biofuel cultivation).

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