Chapter 15
Long-Term Experiences with the Action "Soil of the Year" in Germany

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Abstract Soils are valuable because they provide the basis for food and are the habitat for many animals, plants, and microorganisms. They are integral parts of landscapes, protect water resources, and store and transform nutrients. Soils act as a buffer against climatic effects and tell stories. This incomplete list already shows that soils are multifunctional and not replaceable. They are a limited resource whose protection has to be specially considered. Soils are threatened in their multi-functionality by pollutants and chemical substances, climate change, sealing, and erosion. All human activities use soils in a direct or indirect way. Therefore, everybody is a "soil stakeholder" and has to bear responsibility for soil protection. However, conservation cannot be successful without an awareness of and knowledge about soil valuation. This insight, which means understanding soils and their problems, has to be developed through education and the transfer of knowledge. This was the background against which the members of the German Soil Science Society (DBG) and the Federal Soil Association of Germany (BVB) initiated the action "Soil of the Year" in 2004. A committee prepared a concept for the launch and a guideline for the annual election procedure. The action is evaluated based on a presentation of 15 different soils.

Keywords Soil · Soil functions · Soil type · Landscape · Soil awareness · Soil of the year

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15.1 Obliviousness Versus Awareness of Soil Value

In speeches by the chiefs of various Native American tribes, it says: "The earth is our mother, she nourishes us. What we put into the ground she returns to us" (Big Thunder, Wabanaki Algonkin), "We have not inherited the land from our parents, we have only borrowed it from our children" (Sammüller 2007).

There are good reasons for improving awareness of and responsibility for our soils. With the rapid development of engineering, technology, and trade, the basic attitude toward soils has changed in recent centuries. Individual scientists and politicians have repeatedly warned about natural catastrophes: "A nation that destroys its soils destroys itself" (Fallou 1862; Roosevelt 1936). However, this has hardly led to any changes. Thus, David Montgomery warns us, "Will modern soil conservation efforts prove too little and too late, like those of ancient societies? Or will we relearn how to preserve agricultural soils as we use them even more intensively? Extending the life span of our civilization will require reshaping agriculture to respect the soil not as an input to an industrial process, but as the living foundation for material wealth. As odd as it may sound, civilization's survival depends on treating soil as an investment, as a valuable inheritance rather than a commodity—as something other than dirt." (Montgomery 2007, p. 246).

What are the reasons why warnings are not taken seriously and our perception of the meaning and value of soils is currently warped?

Soils in industrialized countries are no longer perceived today as an indispensable basis of life. People's diet has largely become disconnected from food production. Much food is imported today from all over the world. This leads to "soil obliviousness" or to soil being treated too carelessly, since life-threatening food shortages are hard to be feared there (Rees 2015). This carelessness is all the more serious as it comes at the expense of developing countries. The increasing existential needs of large parts of the world's population in underdeveloped and developing countries have created a vicious circle: People there struggle daily with the limited resources of nature, and their fates suffer from the consumption of fertile soil (European Soil Charter 1972, 1996). This means that "forgotten land" in Europe has led to disinterest in the global "soil destruction." The purpose of the Soil of the Year action must be to bring new impetus into many strata of society that generates curiosity and interest in soils.

15.2 Aims of the Action Soil of the Year

Some special features of the medium of soil (as opposed to water or air) must be noted, to which attention must be paid when formulating the goals.

- Soils are largely out of our direct sensory experience; they are rare (e.g., on harvested arable land) and then only visible in two dimensions. They are not demarcated, clearly defined bodies. They form a continuum with very gradual

transitions between the different soils. Soils are referred to both microscopically and globally.

- This uppermost part of the earth's crust, which we call "soil," formed over very long periods of time, often more than 10,000 years, so it is hard for a single generation to relate to it. In addition, very different soils were created, which can also change. Soil formation and alteration can rarely be traced (e.g., in case of erosion events). The negative changes are often very slow and therefore different from those of air or water (Frielinghaus and Sommer 2005).
- The functions of soils in landscapes and ecosystems are very complex and therefore difficult to understand.
- Soils are primarily associated with price and value from an economic point of view. They are perceived in the context of building land, settlement structures, motorway construction, commercial space, and related jobs. As yet, their value has not been assessed under the aspect of social and ecological functionality (Thoenes et al. 2004).
- As a result, soil-related environmental problems are scarcely communicated in society, e.g., only marginally and without continuity in schools.
- Knowledge about the very complicated circumstances found in the soil must be disseminated in a clearly understandable form. Thanks to the continuity of the action, recognition and "aha" effects are to be generated year by year in order to create a basic attitude shaped by emotions. This is regarded as a basis for positive behavior toward soil protection (Miehlich 2009).
- The action Soil of the Year is one of many activities designed to send out clear signals. These involve many actions in all German Federal States and even internationally. Awareness-raising communication is to be initiated in public. The different roles, awareness, and interests of the individual target groups must be observed by the multipliers. Knowledge transfer must be modified accordingly. This should support different networks over a lengthy period of time. Awareness does not arise at any particular place or time, but grows slowly, influenced by different, repetitive stimuli.

15.3 Experiences with the Presentation of the Soils of the Years 2005–2019

The International Soil Science Union launched "World Soil Day" on December 5, 2002, at its World Congress in Bangkok. In Germany, in 2004, the three Soil Science Associations German Soil Science Society, Federal Soil Association and Engineering Association for Contaminated Sites Management and Land Reclamation founded a "Soil of the Year" program together with the Federal Environment Agency. They commissioned a committee to steer and accompany the action "Soil of the Year," especially regarding public relations. Its members organize the presentation of the recommended soil of the next year. They publish

posters and flyers and a "Soil of the Year" Web site (Boden des Jahres 2019). They organize events about soil protection. Together with members of the German soil agencies which propose the specific soil, they prepare a special event in the Federal Government Representation in Berlin. On December 5, 2004, the first Soil the Year 2005 was presented.

Experience shows that there have been very different expectations regarding the didactic suitability of the proposed soils. For the members of the committee, this required a learning process in order to achieve the formulated goals (Frielinghaus 2010). This will be explained using several examples. The following soils have been elected Soils of the Year in Germany (Table 15.1).

Some examples are described below to assess their suitability (Milbert 2018; Bodenwelten 2019; Boden des Jahres 2019)

Table 15.1 Soils of the Year 2005–2019

Year	Soil (German name)	WRB classification (closest name)	Didactic suitability[a]	Presenter of the soil (Country, Federal State)
2005	Schwarzerde	Chernozem	+++	Germany, Saxony-Anhalt
2006	Fahlerde	Albeluvisols/Retisols	+	Germany, Mecklenburg-Vorpommern
2007	Podsol	Podzols	+++	Germany, Lower Saxony
2008	Braunerde	Cambisols/Arenosols	+	Austria
2009	Kalkmarsch	Gleyic Calcaric Fluvisols	+++	Germany, Schleswig-Holstein
2010	Stadtboden	(Urban soils)/ Technosols	++	Germany, Berlin
2011	Brauner Auenboden	Fluvisols/Fluvic Cambisols	++	Germany, Baden-Württemberg
2012	Niedermoor	Histosols (Fens)	+++	Germany, Brandenburg
2013	Plaggenesch	Plaggic Anthrosols	+++	Germany, Lower Saxony
2014	Weinbergsboden	Regic Anthrosols	+++	Germany, Rhineland Palatinate
2015	Stauwasserboden	Stagnosols/Planosols	+++	Germany, North Rhine-Westphalia
2016	Grundwasserboden	Gleysols	++	Germany, Schleswig-Holstein
2017	Hortisol/ Gartenboden	Hortic Anthrosols	+++	Germany, Thuringia
2018	Felshumusboden	Folic Histosols/ Suprafolic Leptosols	++	Germany, Bavaria
2019	Kippenboden	(Dump Regosols)/ Technosols	++	Germany, Saxony

[a] The didactic suitability is based on a clear picture of the horizons, the recognition of the origin, the recognizable endangerment through use or climate change, or the possibility to tell stories: + moderate, ++ good, +++ very well suited

15.4 Chernozem—Soil of the Year 2005

Chernozems (black soils, Fig. 15.1) arise from calcareous parent material (mainly loess sediments) in regions with hot, dry summers, and cold winters (continental climate), preferably in the lee position of low mountain regions. The organic residues of grasses and herbs cannot be completely decomposed due to drought in summer and cold in winter. These humus-rich soils with a thick topsoil, usually 60–80 cm thick, were developed over a long time. Soil-dwelling animals such as hamsters, ground squirrels, and earthworms ensure that the soil is constantly mixed. The formation of black soils began during the end of the last Ice Age more than 10,000 years ago in a climate with predominantly steppe-like vegetation. Black soil areas were colonized very early on by people in the Stone Age for agriculture. In today's climate, no new black soil can arise in Germany. Black soils can store a lot of water and many nutrients and have therefore been particularly productive arable land for thousands of years. Large areas of black soils are to be found in the landscapes around Hildesheim (Lower Saxony), Magdeburg, Halle and Köthen

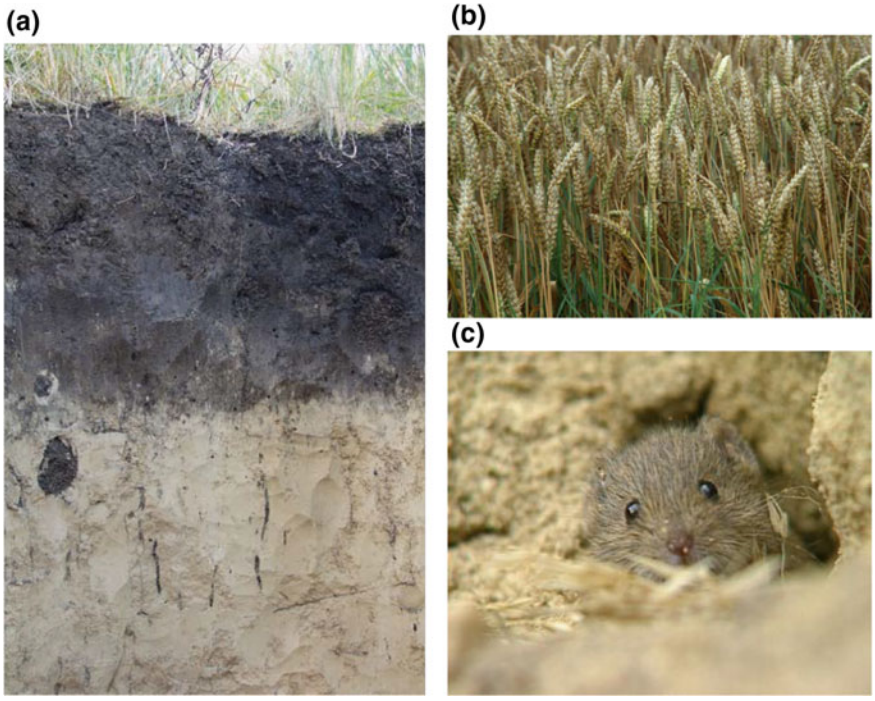

Fig. 15.1 Chernozem—Soil of the Year 2005. **a** Earthworm holes and filled holes dug by small mammals. *Photograph* Schulze-Kellinghaus, Soil of the Year committee. **b** High-yield winter wheat on Chernozem. *Photograph* I. Merbach, Soil of the Year committee. **c** Intensive animal life in black soils. *Photograph* I. Merbach, Soil of the Year committee

(Saxony-Anhalt) or in the Querfurt Basin (Thuringia). Black soils and black-like soils occupy about 3% of the soil surface and about 5% of agricultural land in Germany. The largest areas of black soil (56%) are in the Federal States of Saxony-Anhalt and Thuringia.

Although black soils are one of the best soils, they cannot compensate for the stresses of very intensive land use. The biggest danger is high surface sealing. They are also threatened by water and wind erosion, as well as increasing damage. Soil compaction is a significant risk factor. The best way of protecting black soils and the area in which the greatest experience has been gathered is environmentally sustainable agriculture.

15.5 Histosols (Fens)—Soil of the Year 2012

Histosols (Peat soils, Fig. 15.2) typically contain more than 30% organic material and are a dark brown to black color. Depending on their conservation status, fen-forming plant residues are visible to different extents. The subsoil of fen soils

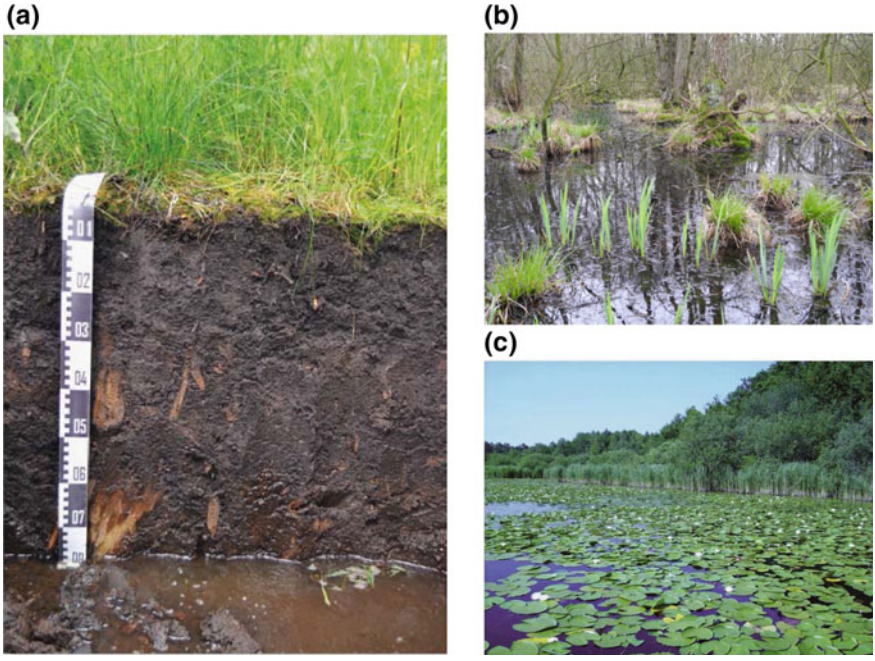

Fig. 15.2 Histosols (Fens)—Soil of the Year 2012. **a** Shallow drained fen soil. *Photograph* G. Milbert, Soil of the Year committee, **b** Terrestrialization process of a lake, leading to an eutrophic fen. *Photograph* Biologische Station Großes Heiliges Meer, Hopsten, Soil of the Year committee, **c** Eutrophic fen, alder swamp. *Photograph* M. Dworschak, Soil of the Year committee

often consists in glacial deposits such as sand, silt, loam and clay, or of lacustrine deposits. Depending on their parent material, lacustrine sediments are white (lime mud), olive green (algal gyttja), or dark brown (clay mud). Fen soils mainly develop in groundwater-influenced lowlands or along rivers and lakes. On a global scale, they are typical of the cool, humid climates of the northern hemisphere. In Germany, fen soils cover a surface of approx. 1 million hectares. The largest areas up to 30,000 ha are situated in Schleswig-Holstein, Lower Saxony, Mecklenburg-Western Pomerania, Brandenburg, Bavaria, and Baden-Württemberg. Usually, the development of fen soils is initiated by paludification at a high groundwater level or increasing sedimentation into lakes. Dead plant material accumulates under water saturation and air exclusion.

In siltation mires, the peat lies on the bottom of a water body above organic or mineral lacustrine sediments. The peats of fen soil areas are formed of dead roots, branches, leaves and sprouts of sedges, reeds, mosses, elders, willows, or other swamp plants. Decomposition of the organic material is slow and incomplete. A peat body only increases a few millimeters per year, directed to the water surface and/or the lake center. The peat increase occurs from the bottom to the top. If the peat layer thickness exceeds 30 cm, it is classified as fen soil (Histosols).

From an ecological point of view, natural fen soils are highly valuable. Only conformist, mostly rare, exceptional animal and plant specialists such as the large copper butterfly, cotton grass, and sedges are adapted to the high water content and special nutrient conditions.

Thick fen soils contain up to 2000 tonnes of carbon per hectare. Worldwide, Histosols store the most carbon per areal unit. Further, peat soils are important archives of nature and civilization. They conserve former vegetation and climate conditions as well as traces of settlements and former use.

For more than 1000 years, peat has been used as a solid fuel, medicine, and fertilizer. Until the 1950s, peat digging was carried out industrially. Limonite, a formation in fen soils with iron-rich groundwater infiltration, and lime mud were also excavated until the beginning of the twentieth century. Today organic material from peat is obtained for medical use on very few sites in Germany. Because of their rare occurrence, in Germany intact fen soils close to their natural state have been placed under nature conservation. Fen soils are often used for agriculture and forestry. In the past, they had to be drained by ditches or drainage systems which seriously and often irreversibly changed the peat properties. With different intensity, most fen soils in Germany are presently used as pasture land. Intensively used fen soils can release up to 40 tonnes of CO_2 per hectare and year. For the conservation and permanent protection of intact lowland peat soils, carefully elaborated development strategies are needed.

15.6 Stagnosols/Planosols—Soil of the Year 2015

Stagnosols/Planosols (Pseudogley soils, Fig. 15.3) form where precipitation water only drains away into the underground after long delay. Beneath a well permeable layer that is waterlogged after rainfall, there is a dense layer with low permeability. In the German soil classification, most soils affected by stagnating water belong to the Pseudogleys, and those with an extended wet phase to the Stagnogleys. The international classification allocates these soils primarily to the Planosols and Stagnosols.

Fig. 15.3 Stagnosols/Planosols (Pseudogleys)—Soil of the Year 2015. **a** Soil Profile Kottenforst Forest near Bonn. *Photograph* G. Milbert and M. Dworschak, Soil of the Year committee. **b** Wet bleached and orange mottling as well as black colored areas in the Pseudogley profile. *Photograph* G. Milbert, Soil of the Year committee. **c** Soil compaction after intensive soil traffic by agricultural machinery. *Photograph* G. Milbert, Soil of the Year committee

As a function of the soil's water permeability, the weather conditions and plant water use, surface water gley soils alternate between wet, moist, and dry phases. These phases may vary in length and may occur several times during the course of a year. This results in temporary excesses and temporary dearths of soil water. During the wet phases, a lack of oxygen adversely affects plant roots and soil organisms. On surface water above gley soils, only those plant species thrive that tolerate wet soil conditions. Little by little, a mottled to veined soil develops with spots bleached by water, side by side with rust-colored zones. Often, hard iron and manganese segregations form so-called concretions.

Pseudogley soils are unique natural bodies that often support forest plant communities that prefer changing moisture conditions, e.g., Common Oak-European Hornbeam forests. Markedly wet Pseudogley soils are—due to their extreme site conditions—well suited for rare animal and plant com-munities.

Pseudogley soils store precipitation water that evaporates with a time delay or is consumed by plants. In this way, they act as a buffer against precipitation peaks. The perched water drains slowly into the groundwater, possibly of nearby groundwater soils, and into watercourses or bodies.

Forests adapted to changing moisture conditions can be stable, productive ecosystems that are at the same time ecologically valuable. Tree species which tolerate perched soil water are the common oak, European hornbeam, ash, black alder, and downy birch. Those which are adversely affected include the Norway spruce, larch, and beech; they develop only shallow roots in perched water. In dry years, drought damage occurs. After several wet years in a row, roots suffer from lack of oxygen. During storm events, shallow root trees tend to be uprooted.

Timber harvesting does not only harm the soil during dry phases. Surface water gleys are sensitive to weather conditions and the climate. Increasing numbers of heavy rainfall events result in more frequent wet phases. If climate warming extends the vegetation period, plant water consumption will increase, and longer dry periods could occur.

Wet–dry Common Oak-European Hornbeam forests could develop into Beech forests in the long run. During the last 50 years, the vegetation period has already lengthened more than two weeks, and the number of heavy rainfall events has risen.

15.7 Hortisol—Soil of the Year 2017

The name Hortisol is of Latin origin and combines "hortus" (garden) and "solum" (soil). Hortisols (garden soils, Fig. 15.4) belong to the "terrestrial anthropogenic soils" of the German soil classification system. They have been so thoroughly modified by humankind that few characteristics resemble their original state. Similar soils are Plaggenesch (Plaggic Anthrosol) and vineyard soil.

The Hortisol has an active soil life with a particularly high number of earthworms that mix the soil material intensively.

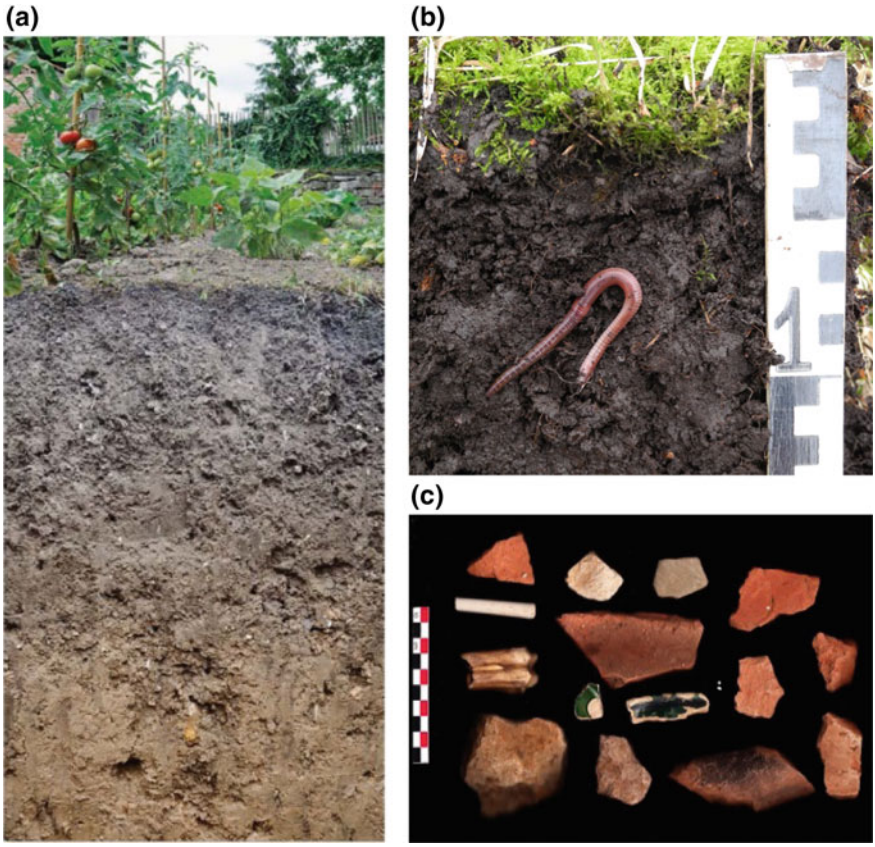

Fig. 15.4 Hortisol—Soil of the Year 2017. **a** Profile of a Hortisol (garden soil) *Photograph* Thüringer Landesanstalt für Umwelt und Geologie, Soil of the Year committee. **b** *Lumbricus terrestris* earthworm in a Hortisol profile. *Photograph* M. Dworschak/Geologischer Dienst NRW, Soil of the Year committee. **c** Ceramic shards and other historically interesting objects found in old garden soils. *Photograph* Geolog. Dienst NRW, Soil of the Year committee

The part of the soil that is subject to so-called bioturbation (Latin "turbare," to churn up) is a specific, humus-rich and often dark gray horizon. In combination with the also humus-enriched topsoil, this reaches down to more than 40 cm below the soil surface.

Why are garden soils so fertile and rich in humus? Human activity in combination with soil organisms, climate, and the parent material are the most important factors behind garden soil development. Garden soils literally grow on or in various soils or materials. Often, human beings have also brought in the material for the soil through laborious efforts, e.g., in old gardens on terraces on the slopes or in castle and cloister complexes. But it is only the gardener's cultivation over decades or even hundreds of years that makes the soil turn into a garden soil:

- The soil is regularly dug and turned, loosened and enriched with materials with spades, hoes and other tools.
- Compost, feces, ashes, sweepings, organic waste, lime, bones, sherds, etc., are put on the soil and mixed in.
- The soil is watered regularly during dry phases in summer and autumn.

Thanks to this work by the gardener, the soil grows by 40 to more than 100 cm, depending on how long the garden is in use. On the top, it develops a new soil layer that is particularly loose, fertile, and rich in humus and nutrients. This soil layer contains much more phosphorous and nitrogen than other soils. Both are important nutrients for crop plants.

Clay particles and humus retain a lot of rainwater that is then available to plants. The high humus content provides for high biological activity. In particular, the many earthworms help incorporate plant residues and compost into the soil, even down to a depth of more than 1 m. Roots, soil organisms and lime make for a soil structure composed of crumbs and consistent soil particles that keep the soil loose, but stable. As a result, garden soil can supply plant roots with oxygen and release carbon dioxide at its surface.

Wherever humans settled, they changed part of the land near their houses and cottages into gardens. This is where the oldest and deepest Hortisols can be found. Old villages contain sizeable areas of garden land even today, including land on their outskirts (Grabeland—land that is dug up). Various kinds of cabbages and root crops such as potatoes and beets were once cultivated there. Through long, intense use, typical Hortisols were developed.

Many innovations in gardening practice started out from cloisters, as they were once part of a pan-European network. In many cloister gardens, nuns and monks bred new kinds of fruit and vegetable. In Thuringia, there are more than 200 historical cloisters and parishes. Many of them still have old gardens.

In urban settlements, kitchen gardens became common from the twelfth and thirteenth centuries. The oldest gardens are situated in the core area developed in the High Middle Ages, and younger ones in the areas where the towns expanded within or outside their walls. These vegetable and kitchen gardens were very small. Cultivated for hundreds of years, they now contain typical Hortisols. They are rare in the city centers, where much of the soil has been removed or overbuilt. Furthermore, the soil is often polluted with fire debris, brick fragments, cement, and metal remnants. Urban areas (unlike rural areas) often used fertilizers such as liquid feces from the cesspools, organic household waste, and ash. Since the middle of the nineteenth century, sewage sludge, compost, and artificial fertilizers have been used. These gardens primarily contribute to the production of food, particularly in times of hardship, but also serve as a place to meet and communicate.

If soil is to be used carefully, it must be thought of as a living organism. Soil life needs to be preserved, and chemicals (mineral fertilizer, pesticides) used cautiously. Garden soils should not be sealed or heavily compacted, as they may lose their many functions for the ecosystem.

Unfortunately, many garden soils in the town centers and on the outskirts of villages are now being overbuilt and are no longer a "green lung." They are losing their social function.

In many cities, school garden projects play an important role in teaching children and young people about the value of and threats to soil.

15.8 Conclusions and Outlook

Experience with the Soil of the Year action confirms the difficulties associated with the perception of soils as a limited resource with essential functions. The action drew very different responses every year, with corresponding setbacks, but it can now be stated that it has taken a firm place in the soil-related activities of various institutions when it comes to improving society's awareness of soil. The continuity of naming a Soil of the Year and preparing interesting material, the continuous Internet presentation (Boden des Jahres 2019; Bodenwelten 2019), and the creation of a soil network have increasingly aroused national and international interest.

Under the patronage of the respective Federal State representation, the presentation of the next soil will take place on the World Soil Day. This annual event increases political interest in responsibility for soil protection.

Basic funding is essential to realize this action. For example, the German Soil Science Society, the Federal Association of Soil, and the Association for the Management of Contaminated Sites and Land Recycling assume responsibility on the committee. The Federal Environment Agency deals with the financing of printing and dispatching the materials. The committee members can only offer input to the "Soil of the Year campaign" for initiatives related to the Federal States' target groups. The regional soil specialists communicate with farmers, gardeners, foresters, museum staff, the staff of botanical and zoological gardens, landowners of all kinds, artists, parishes, association members and soil specialists employed by the authorities. These regional target groups have to find intelligent solutions and ask for political and technical decisions. Interested citizens in towns and rural areas and all types of media can only be reached effectively and with special regional or problem-oriented activities in the Federal States.

A memorandum from the Scientific Advisory Council on Soil Protection states: "We have discovered that citizens do not think as much about the use and protection of soils as scientists and soil protectors believed they did" (Wissenschaftlicher Beirat 2002).

The activities used to impart knowledge about soils as an essential basis for human existence and showing how endangered this limited resource is, unless action is taken to protect soils, have to be made even more goal-oriented and more effective. New knowledge of effective communication must lead to constant reviews and improvement of knowledge transfer methods. Various events (such as World Soil Day, Day of the Environment, Earth Day) and regional projects should take place regularly for all target groups. The exchange of experience between the

actors should be encouraged. There is a very wide range of material available for each Soil of the Year from 2005 to 2019, enabling the various target groups to be reached.

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