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Soils are sensitive reactors – do we need a paradigm change towards a more sustainable soil use?

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The aim of the lecture is to clarify the effect of soil management and the consequences of physical degradation on processes like soil aggregation and changes in the accessibility and functionality of structured soils. If due to soil management strategies the internal soil strength will be exceeded by external stresses applied not only the available pore space is reduced while the solid mass is increased but especially the pore continuity and the accessibility of exchange places for nutrients or heavy metals are altered. In addition, the root distribution in soils becomes not only reduced but also unevenly distributed which again hinders the possibility to evenly uptake plant available water and nutrient out of the pores. The applied stresses also create an anisotropic arrangement of the pores and their functions and also result in a more pronounced lateral mass transport by surface runoff including soil erosion by water and wind. Thus, also the water balance on all scales (from the pedon to the catchment) shows an increased water loss by evaporation and surface water while the groundwater recharge and the transpiration rates are reduced. If we analyze the scale dependency of nutrient adsorption and desorption phenomena it has to be stated, that the accessibility of exchange places within soil aggregates are the better the more structured and the more rigid these aggregates are, while with increasing mechanical stress applied aggregates are deformed and as a consequences they become less porous with a severe differentiation between the outer and the inner part of the aggregate volume. On the bulk soil scale, we can analyze the platy structure as a visible hint for anthropogenic soil degradation which affects amongst others also the ion exchange processes. Furthermore an uneven aeration within such degraded soils results in a very pronounced anoxia on all scales (from the aggregate to the hectare scale) which can be quantified not only by corresponding measurements of the spatial distribution of redox potential values. In recent studies under “normal” wheeling conditions in arable fields and also in harvested forest sites it was proofed that Eh values close to 0 mV or even a methane emission have to be expected (with consequences for the global warming). Finally anoxic conditions also affect the redox induced mobilization of Fe and Mn which even results in a more rapid soil development with consequences also for yield and further soil functions. Consequently a shift to a more sustainable landuse or soil management strategy is urgently requested in order to prevent a further soil degradation. The scenario of peak soil must and can be prevented by a more site specific soil management.
In the lecture, these effects will be discussed as well as a soil protection guide line (based on the German soil protection law) will be presented in order to prevent further irreversible soil degradation phenomena.
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