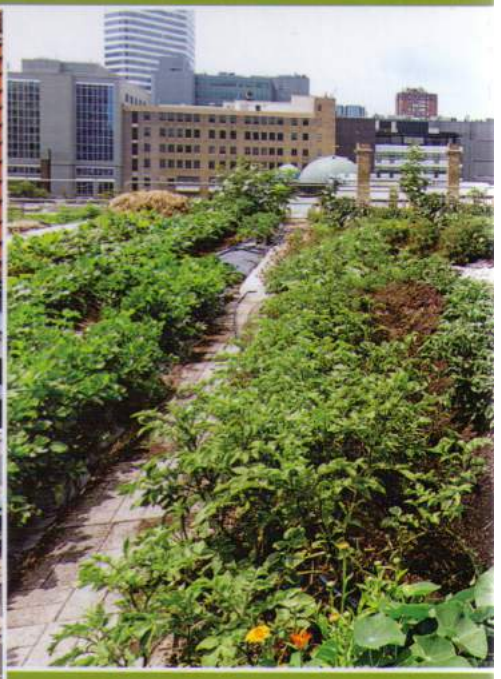
Advances in Soil Science

URBAN SOILS



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Rattan Lal
B.A. Stewart

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7.1 SOIL SEALING AS A GLOBAL PROBLEM

Surface sealing is one of the main causes of soil degradation in the European Union, together with erosion, decrease in the soil organic matter (SOM) content, compaction, and so on (European Commission 2006). Soils are degraded by sealing in all developed countries (e.g., the United States, Japan, and China), and this phenomenon also has an increasing impact on soils in developing countries. Relatively large areas in the cities are sealed. In some municipalities, the percentage of such areas may even exceed 70%, such as in Tirana and Bucharest (Figure 7.1). For example, in the region of the urban agglomeration around Hangzhou Bay, one of the largest metropolitan areas in China, the percentage of sealed soils increased from 2.7 in 1994 to 8.7 in 2009 (Xiao et al. 2013).

Soil sealing is one of the most damaging and destructive processes to the soil environment. The process is basically irreversible and can be defined as a destruction of soil cover by total or partial application of an impermeable layer on the soil surface (Wesolek 2008; Scalenghe and Ajmone Marsan 2009); it has a significant impact on the functioning of soils. This problem often affects the fertile agricultural lands by increasing flood risks and water deficiency, and contributes to global warming (Couch et al. 2007; Scalenghe and Ajmone Marsan 2009; EU Technical Report 2011). Two degrees of soil sealing can be distinguished (Nestroy 2006): (1) total impermeability caused by solid concrete or asphalt and (2) partial impermeability caused by sealing with semipervious surface (e.g., cobblestones, concrete paving setts, or openwork concrete structures), which allow some penetration of moisture and air. In the course of construction work during sealing, the soils are either completely destroyed, especially under asphalt-concrete road surfaces, or are substantially truncated in the case of pavements.

Soil sealing interrupts or greatly reduces the exchange of matter and energy between the pedosphere and lithosphere, biosphere, hydrosphere, and atmosphere. It also affects the processes occurring in the water cycle, biogeochemical cycles, and energy transfer. As a result, this leads to many negative consequences. Depending on the degree of sealing, natural soil functions and ecosystem services provided by such an area are reduced or completely prevented in many cases. Properties of such soils are completely different in relation to morphologically similar but unsealed soil. Changes in temperature, water, and

in a number of soil-forming processes; however, they should be treated the same way as the nearby unsealed soils since they are also a component of the urban pedosphere. They should be researched and charted, because their characteristics affect the ecological situation in urban areas. Sealed soils are also important because they store information about the history of the urban ecosystem and act as the archive of the human settlement history in a given area.

The data presented in the literature demonstrate that artificial sealing by impervious surfaces such as asphalt and concrete, which are very common in urban areas, can result in the alteration of physical and chemical soil properties, as well as the deterioration of microbial activity and its functional diversity. Profiles of the sealed soils have both natural horizons and technogenic layers. Moreover, the degree of soil sealing significantly affects any further soil development. The differences recorded in raw data between impervious and semi-impervious sites are remarkable.

Thus, sealing of soils can be considered as some kind of hibernation and they are ready to be exposed and restored to their original functions. On the one hand, the nearly complete isolation of the soil has mainly a negative impact on the functioning of the soil environment, but on the other hand, it may also contribute to protection of the soil from various contaminants such as heavy metals and PAHs. On the other hand, a permeable or semipermeable pavement system would be helpful to limit the consequences of soil sealing as it allows the exchange of materials and energy between the soil and the atmosphere.

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