Chapter 10

Sources of Soil Pollution

Abderrezak Khelfi
National Center of Toxicology, Algeria

ABSTRACT

Soil, though often overlooked, is a critical component of the earth and is essential for human existence. Soil pollution has deteriorated large areas of agricultural land around the globe. Human health is at risk due to the high concentration of pollutants found in soils and food produced in polluted lands. Soil pollution may arise from a wide range of sources that can be discrete point sources, or diffuse sources. It is usually due to domestic, municipal, industrial, mining, and agricultural wastes as well as agrochemicals such as fertilizers and pesticides. Each source has specific characteristics, briefly presented below. The most dangerous categories of soil pollutants are polycyclic aromatic hydrocarbons, polychlorinated biphenyl, pesticides, heavy metals, and radionuclides. New soil pollutants, such as veterinary medicines, have emerged with industrialization and globalization. This chapter deals with sources of soil pollution, pollutants generated from these sources and their possible adverse effects on the environment.

INTRODUCTION

Soil, though often overlooked, is a critical component of the earth and is essential for human existence. From an environmental fate perspective soil is clearly a well-defined, though highly variable, environmental compartment. It serves as the major source of food production for humans.

Compared to air or water pollution, soil pollution is much less apparent and its sources cannot be easily detected. These could be two of several reasons why it is much less frequently mentioned in the literature. However, concerns about soil pollution have increased in recent decades because of some famous cases in which soil pollution has caused detrimental impacts on populations and the environment. In fact, soil pollutants have decreased soil biodiversity and deteriorated large areas of agricultural land around the globe. Human health is also at risk due to the high concentration of pollutants found in soils and food produced in polluted lands. It is claimed that almost 25% of the soil worldwide is highly degraded, whereas 44% soil is moderately degraded (Tripathi et al., 2015).

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Soil pollution is a broad term that refers to the accumulation of native or introduced substances in soil at a harmful level for the growth and health of organisms (micro-organisms, plants, animals and human beings). However, the term “soil contamination” describes only the introduction of a chemical substance that is not originally present in the soil (De Haan & Van Riemsdijk, 1986). However, many regulatory and non-regulatory programs and assessments use soil pollution and soil contamination as equivalent terms.

In this chapter we use the term soil pollution to mean the presence of a substance, either introduced or native, above the threshold level.

Some of the common types of wastes that lead to the development of soil pollution include municipal wastes, commercial wastes, ashes, non-biodegradable wastes, biodegradable wastes and animal wastes.

Soil pollution may arise from a wide range of sources that can be discrete point sources (commercial activities), or diffuse sources (sprayed pesticides and air deposition). The pollution process itself may be deliberate, as in the case of fertilization processes or following accidents such as oil spills in seawater. Each source has specific characteristics, briefly presented below.

Overall, pollutants find their way to the soil via the air path (dry deposition); the water path (sewage water, precipitation, irrigation water, surface water and wet deposition); and via organic solids, such as sewage sludges, composts and other agricultural inputs (fertilizers, manure or plant-protection agents) (Auerswald et al., 2000).

The most dangerous categories of soil pollutants are the persistent organic compounds such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCBs) and pesticides as well as heavy metals such as lead, cadmium, arsenic, mercury, zinc, copper and radionuclides. New soil pollutants, such as veterinary medicines and surfactants, have emerged with industrialization and globalization.

This chapter deals with sources of soil pollution, pollutants generated from these sources and their possible adverse effects on the environment.

SOIL POLLUTION SOURCES

Mining Activities

Mining activities represent one of the major sources of soil pollution. The number of mining sites may be limited (almost 2% in Europe) but the extent of the contaminated areas is huge, as are the consequences of such pollution for human health and the environment (Tarazona, 2014). Chemical wastes are generated in every stage of mining activity, particularly during the extraction of minerals and the processing of huge quantities of ores. Other concerns during mining operation are related to the tailings.

Minerals are extracted by crushing and processing ores using massive volumes of water and several chemical and physical methods. The mineral content represents a small part of the ore (from 0.00005% to 5%). This means that the rest of the ore is a waste product known as tailings. Tailings usually contain a mixture of water, finely ground ore and any residual chemicals used at large quantities in all processing stages such as cyanide, xanthates and other flotation agents, surfactants and sulfuric acid (Tarazona, 2014). Tailings may also contain undesired metals (arsenic, mercury, copper, lead, cadmium, selenium, zinc and nickel) that can create environmental concerns as well as sulfides due to the natural composition of the ore.
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