

SOILS

Soil is a layer at the Earth's surface produced from the physical and chemical breakdown of rock under the influence of wind, water, heating by the sun, cooling by snow and ice, and modified by the action of bacteria, plants and soil dwelling organisms. Soils develop slowly over relatively long periods. They may vary, depending on elapsed time and local conditions, from a thin veneer to several metres. In glaciated areas, original soils were often swept away so new soils have formed. Outside such areas, especially in the tropics, deep weathering profiles develop over millions of years.

The mineral component usually reflects the composition of local rocks. The chemical composition and drainage characteristics of the soil, as any farmer or gardener knows, strongly influences suitability as a growing medium for specific plants. Thus the variety of soils is related to botanical diversity and agricultural productivity. The organic content of soil varies greatly depending on past and present environmental conditions. It ranges from a trace in arid conditions to a major part of soil in, for example, peat or leaf-litter layers. Organic components are important plant nutrients and help to retain soil moisture.



Crops affected by drought

Soil texture is also important. Many soils are porous, allowing root penetration, infiltration of rainwater, and water to rise through the soil into plant roots or to evaporate at the surface. Pores allow oxygen and other gases to exist within the soil thus supporting soil forming and soil dwelling organisms. Clay content largely determines whether a soil is heavy and subject to water-logging. Sand and silt provide lighter, free-draining soils. Soils can be drained but care is needed to ensure drains are well designed, installed and maintained and do not become blocked. The texture of even light soils can be destroyed running heavy machinery across the soil, trampling by numerous livestock, or digging and replacing. Once the texture of a soil has been destroyed then it is almost impossible to recreate it.

Soils are the basic substrate for wildlife and for agriculture. The natural cycle of plant growth, death and decay returns nutrients to the soil. Intensive cultivation, with harvesting of crops, break that cycle requiring more drainage, irrigation, and use of fertilizers. Maximising crop yields also leads to more use of pesticides and herbicides. Growing a single species of plant over a large area increases vulnerability to pests and more chemical intervention. Local hydrogeology can be significantly altered and toxic residues may accumulate in soil, water, plants and wildlife. Similarly, intensive livestock farming can lead to excessive amounts of manure or chemicals intended to remove parasites entering natural systems.

Clearing, ploughing, and removal of forest plant cover, also affect water infiltration and local microclimate. Exposure of light porous soils promotes excessive wind erosion. In extreme cases this leads to desertification, dune formation and permanent loss of productivity. Drought, causing loss of crops and demands for more irrigation, is becoming more frequent in some areas due to climate change. Particular caution is needed during irrigation in hot areas because evaporation of water can lead to deposition of mineral salts in soil profile. This can clog the soil, reducing free-drainage, and in some areas sodium chloride (common salt) and other salts may be deposited damaging both cultivated and natural plants.

Intensive agriculture and horticulture tend to increase as nearby urban populations grow. Problems associated with soil contamination affect the water environment and, so, water supplies to cities. But there are also issues concerning urban soils. Soils in parks, gardens, beside roads, or on odd patches of unused ground remain from before urban growth took place and support urban wildlife. In many urban areas, however, significant amounts of industrial, construction and other residues have been spread on the ground over the years, greatly modifying urban soils. It has been said with a fair degree of truth that most urban soils should be regarded as contaminated until proved otherwise. This can have implications for people who grow foodstuffs on small plots of land within urban areas.



Erosion of de-vegetated soil



Poorly drained clay soil

Thin soil in a glaciated area



Regeneration initiatives commonly face the problem that natural soils were removed long ago. It is possible to make artificial soils but mixing appropriate minerals with amendments to encourage plant growth. These can support selected plants if well watered and managed for several years. Plants begin to build up organic material in the soil and, in time, semi-natural habitats begin to develop. However this is less satisfactory than carefully storing and re-using natural soils. In moist tropical areas any surface may become quickly covered by vegetation but the result is often a much less diverse habitat than existed before disturbance.

It is important, therefore, to understand the nature, distribution and behaviour of soils and to design management regimes to get the best from these while safeguarding them for the long-term.



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