

## Chapter 5

### Soil crusting and sealing

As many as 500 million people live in the semi-arid regions of the world, and most of them depend on agriculture for their livelihood. The populations of many of the countries in such regions have doubled in the past three decades and are still growing rapidly. These increases have not been accompanied by similar rises in food production. The pressing need to assure an adequate and reliable food supply is obvious.

The dominant characteristic of the semi-arid zone is an insufficient water supply to support stable agriculture. Not only is there insufficient rainfall, but its occurrence is also highly erratic between years, during the year, and spatially, during any single rainfall event. In general, the rainfall pattern becomes more variable as the mean annual rainfall decreases.

The semi-arid zone includes climates of two main kinds: the Mediterranean climate, where rain falls during the cool season of the year, and the semi-arid tropics where most or all of the rainfall occurs during the warm summer months. The minimum annual rainfall necessary to support a crop in the Mediterranean zone is approximately 250-400 mm, while in the semi-arid tropics it is 400-600 mm or even higher.

It is in the **sub-humid to semi-arid tropics**, however, that the problem of sealing, hardsetting, or soil capping, appears to be the most serious. Such conditions are typically found in the Sudan-Sahelian region of West Africa as well as in large parts of eastern and southern Africa, India, Thailand and elsewhere. Where the bare soil surface is sealed rainfall cannot penetrate and runs off laterally, even on very gentle slopes.

In many such localities the overall climatic conditions could allow one annual crop in most years. A 3-month rainfall of 700-1000 mm is sufficient for economic yields of crops like millet, sorghum, cowpeas and groundnuts. The success of dryland agriculture depends, however, on whether this rainwater can penetrate and be stored in the soil.

Moisture storage is usually not a restriction, unless the soils happen to be very sandy or very shallow. Many of the soils in the semi-arid tropics have effective depths of approximately 100 cm, with a subsoil structure and a clay minerals assemblage which guarantee an effective soil moisture storage capacity of at least 100 mm. A critical factor, however, is the degree to which the surface allows the rainwater to penetrate, right from the start of the rainy

season. A significant part of the water does not enter the soil even though the water storage capacity of the soil is far from taken up.

It is not generally realized that runoff losses from a field can amount to 30-35% of storm rainfall (Hoogmoed and Stroosnijder 1984). Much of the rain in semi-arid zones falls at high intensities, causing runoff and severe erosion. Since African rainstorms are usually heavy, such erosion is common even on moderate slopes.

Sealing also impedes seedling emergence, because of the strength needed to break through the crust, and the formation of an oxygen-deficient layer immediately below the crust.

When trees and bushes are cut, leaving the soil surface bare and unprotected, crust formations develop rapidly, preventing adequate moisture from entering the soil. This is the main cause of the progressive desertification in the Sudan-Sahelian region.

## **TERMINOLOGY**

There are three main kinds of crusts and seals. These are described below.

**Surface seal** is defined as the orientation and packing of dispersed soil particles which have disintegrated from the soil aggregates due to the impact of rain drops. By definition surface seals are formed at the very surface of the soil, rendering it relatively impermeable to water.

A **structural crust** is defined as a surface layer of the soil, ranging in thickness from a few millimetres to a few centimetres, which is much more compact than the material beneath. The import of external materials is not involved in the formation of the crust. **CONTINUE---->**