

The texture of the upper horizon of the pumiceous soils, which may extend to a depth of 80 cm, is gravelly sand. Despite its coarse texture, this horizon contains about 6 percent available moisture when wet to the field capacity. It usually contains less than 0.5 percent organic matter, has a pH of about 6.5, and a cation exchange capacity of around 6 meq/100 g. The lower horizon may be similar to the corresponding horizon in the deep soils of Popocatepetl or it may be a loose, pumiceous gravel. This latter material has a pH near 7.0, a cation exchange capacity of around 7 meq/100 g, and contains about 6 percent available moisture when wet to the field capacity. When properly managed, the pumiceous soils can be planted with residual moisture.

The soils of La Malinche cover some 34,602 ha with about 25,298 ha under cultivation. These soils have formed from volcanic ash that has been redeposited by water in alluvial fans. The upper layer of these soils, about 30 cm in depth, is usually a sand. This horizon contains 0.5-1.0 percent organic matter, has a pH of around 6.5, is high in phosphorus and potassium, and contains about 7 percent available moisture when wet to the field capacity. A gravelly sand with a depth of a meter or more is usually found underlying this horizon.

Soils with an incipient B horizon are found on the intermediate slopes of La Malinche. This B horizon has a loamy sand to sandy loam texture and a cation exchange capacity of about 15 meq/100 g, with a low base saturation percentage (around 35). On the lower slopes of La Malinche, the lower soil horizon consists of sediments a meter or more in depth, with a sandy loam to silty clay loam texture. These soils are potentially very productive. When properly managed, the soils of La Malinche also can be planted with residual moisture.

The sodic-like soils occupy an area of about 16,560 ha, with 13,121 ha currently under cultivation. The parent material is a light-grey volcanic ash, alkaline in reaction, which is found essentially unaltered at a depth of 60-160 cm, depending upon the degree of weathering of the profile. These soils are similar morphologically to Solonetz soils. The surface or A horizon is a loamy sand about 20 cm deep. This overlies a Bt horizon some 60-100 cm in depth, which is black, contains around 60 percent clay, has a columnar structure, and has a very firm consistency. This horizon is very impermeable and greatly restricts the passage of water and the penetration of maize roots. A thin, greyish-colored A2 horizon showing the effects of reduction processes, is usually distinguishable between the A and Bt horizons.

The Bt horizon has a cation exchange capacity of about 35 meq/100 g, a base saturation percentage of 80, and is slightly alkaline. The content of exchangeable sodium varies from 4-14 percent of the cation exchange capacity; thus, the soils are designated sodic-like rather than sodic. Sufficient moisture to permit early plantings usually cannot be conserved through the winter months. The production potential of these soils is very low under rainfed conditions, but relatively high when irrigation water is available.

The heavy soils of Zone V cover an area of some 3,151 ha, of which 2,700 ha are under cultivation. The morphology of these soils is similar to that of the sodic-like soils, except that the Bt horizon is less developed and the soils thus have better internal drainage. The heavy soils of Zone V have a limited capacity to conserve moisture over the winter months; thus, maize plantings usually can not be made until the rains begin.

The soils with a compacted horizon occupy an area of about 28,912 ha, with 22,403 ha presently under cultivation. The compacted layer that limits both root penetration and water percolation lies at a depth of 20-60 cm from the surface. This layer can be: (a) fragipan, (b) claypan, or (c) *tepetate*. The first two layers are genetic horizons; *tepetate* is a partially consolidated volcanic ash. The surface horizon contains 0.5-1.0 percent organic matter, has a pH of around 6.5, is high in potassium, and contains moderate amounts of phosphorus. Sufficient moisture to permit early plantings of maize cannot be conserved through the winter in these soils.

The soils with a high water table cover an area of some 7,527 ha, of which 6,871 ha are under cultivation. The depth of the water table in these soils varies with their proximity to the Atoyac River, with the seasons, and with the upkeep of the drainage canals. High yields of maize and alfalfa are obtained in soils with the water table more than 50 cm below the surface. These soils are dark-colored loams, high in organic matter, with little profile development. They have pH values around 7.5, cation exchange capacities of about 30 meq/100 g, and contain less than 5 percent exchangeable sodium.

## THE FARMING POPULATION

Most of the farmers in the region are descendents of the Indian populations present in the area at the time of the Spanish conquest. In certain villages, Nahuatl, or "Mexican" as it is known in the area, is still spoken, although everyone understands Spanish. The information presented in this section comes mainly from personal interview surveys for 1967 and 1970 (refer to Chapter 8).

### Number of Farmers

The number of farm operators in the Project area was estimated to be 43,300. This value was calculated by dividing the total cultivated area, 116,800, by 2.7, the average number of cultivated hectares per farm operator. This latter value is the average of the estimates of the number of cultivated hectares per operator from the 1967 and 1970 surveys.

According to the surveys, the average family consisted of 5.54 members in 1967 and 6.17 members in 1971. Assuming there was no change during the 4-year period in the number of farms in the area, this means the total population included in the families of farm operators was approximately 240,000 in 1967 and 267,000 in 1971.