Communications within the Project area are adequate, and most villages are connected by a network of all-weather roads. The Project area is a 2-hour drive from Mexico City or the National Agricultural Center at Chapingo, and this ready accessibility allowed consultants at both locations to maintain close contact with the Project.

The remainder of this chapter describes the physical environment of the area, the farming population, local production technology, and agricultural agency services available.

PHYSICAL ENVIRONMENT

The Project area occupies much of the valley drained by the Atoyac River and lies mostly between the rising slopes of volcanos: Popocatépetl and Ixtaccihuatl to the west, and La Malinche to the north and east. It is located between latitudes 18°50' and 19°25' north and between longitudes 97°55' and 98°40' west of Greenwich. The lowest part of the valley lies southeast of the city of Puebla at an elevation of 2,100 m above sea level. Most of the Project area lies between 2,150 and 2,700 m above sea level, although maize is produced on the mountain slopes up to elevations of 2,900 m.

Climate [1]

The climate over most of the region is temperate with mild winters. The warmest part of the year is in May and early June. Temperatures remain fairly constant during the last of June, July, and August, and gradually decline during September and October. Average monthly temperatures during the maize-growing season vary from 18.6° C in May to 16.1° C in October.

Frosts occur mainly during the winter months from October through March, when they cause little or no damage to annual crops. However, a weather station located near the center of the Project area reported frost on one or more days during the month of April in 33 percent of the years; in May, 17 percent; and in June, 5 percent. Weather stations at two other locations in the area reported no frosts during these months. Frosts in May and June can seriously damage early plantings of maize.

Three of the four weather stations in the Puebla area reported an average of one hailstorm a month during July and August, with about half that amount in September. Severe hailstorms during these months would be expected to reduce maize yields significantly.

The average rainfall reported by the four weather stations for the 7-month period from April through October varied from 777-863 mm. The rainfall during this period represents approximately 94 percent of the total for the year.

1. For more information on the climate of the Puebla valley, see Jauregui, E.O. 1968. Mesoclima de la Región Puebla-Tlaxcala. Instituto de Geografía, Universidad Nacional Autónoma de México. México, D.F.

The average rainfall in the Puebla area during the maize-growing season should be sufficient to satisfy the needs of the crop. However, drought damage to maize would be expected when: (a) the total rainfall during the year is considerably less than the average, or (b) the amounts of precipitation are well below average during the critical months of June, July, and August.

In 1967, drought intensities were estimated using existing information on soil characteristics, evapotranspiration losses, and water needs of maize at critical growth periods; and the daily rainfall data available at the four weather stations in the Project area. The drought damage, estimated for individual years, was classified as: zero or very slight; moderate; or severe. As an average for the four stations, it was estimated that there would have been zero or very slight drought damage in 60 percent of the years, moderate damage in 30 percent, and severe damage in 10 percent. Maize growing on soils with a high moisture-supplying capacity would have suffered less from drought than these percentages indicate, while maize on soils with a low moisture-supplying capacity would have suffered more. A moderate effect of drought would be expected to reduce yields by 30-60 percent; a severe effect by 60 percent or more.

Soils [2]

The soils in the Project area have formed from volcanic *ejecta*, mainly from the three volcanos: Popocatépetl, Ixtaccíhuatl, and La Malinche. The parent material ranges in size from very fine ash to pumice particles several centimeters in diameter. The coarser materials are found on the upper slopes of the volcanos and the finer materials near the center of the valley. The *ejecta* has probably been water-reworked over much of the area; some of the ash and pumice, however, have been deposited directly on the land surface during eruptions of the volcanos. The parent materials are distinctly layered due to sorting during these depositional processes.

On the upper slopes of the volcanos the streams are very deep, and the land surface is being continuously eroded away. Little of the eroded material, however, reaches the Atoyac River. Most of the material is deposited as alluvial fan debris. Alluvial fan building is still occurring in the area and is especially noticeable along the San Martín Texmelucan-Huejotzingo highway, where the stream beds are higher than the adjacent land surface.

The external drainage system is well-developed on the upper slopes of the volcanos but is poorly developed toward the center of the valley where alluvial fans are form-

2. The study of the genesis, morphology, and distribution of the soils in the Puebla area was carried out during 1968-1970. Dr. B.L. Allen, soil morphologist, Texas Tech University, Lubbock, Texas, directed and personally conducted much of the field work. He carried out three field studies, each lasting about a week. Dr. Allen contributed most of the ideas and information presented in this section.