SECTION 1

Introduction: Vulnerability to Climatic Variations

1.1. Introduction

Late in 1976, Ecuador entered a drought that was to last until 1980. Widely separated stations (Quito, Riobamba, Guayaquil – *see Figure 1.1*) recorded below-normal annual precipitation for all years between 1977 and 1980. According to some estimates (USDA FAS, 1977–1981), hard maize production declined by 16%, barley production by 62% and wheat production by 48% during this period. Effects of the drought were felt in almost every part of the country, with depressed output of feed and livestock as well as cereal crops (USDA FAS, 1981). The FAO World Food Program responded by increasing annual food aid from 947 metric tons in 1975 to 4859 mt in 1978 and 10430 mt in 1979 (PMA, n.d.). Food donations from the USA were also distributed through CARE and Catholic Relief Services – about 8400 mt in fiscal year 1979 alone (USDA FAS, 1979).

Little is known about the effects of the 1976–1980 drought on farmers in Ecuador. The previous major drought (in 1968) contributed to a permanent migration of farmers from affected areas, particularly from Loja in the southern Sierra of Ecuador (Duverneuil, 1983; Gondard, 1983). However, the absence of an effective agricultural extension service or program for gathering data from small farmers in the countryside contributes to our ignorance, as has the scarcity of studies of peasant technology and adaptation in the equatorial Andes. The present case study represents an interdisciplinary effort to improve our understanding of the effects of climatic variability on agriculture in the central Sierra of Ecuador.

1.2. The Design of the Study

1.2.1. The research problem

Ecuador is a diverse land with extensive areas of lowland tropical wet-and-dry and tropical wet climates, in addition to a lengthy if slender highland area in the

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Andean chain extending from the Colombian border in the north to the Peruvian border in the south. About 46% of the nation's economically active population is engaged in agriculture. Perhaps half of the highland farmers are ethnically Indian (Quichua) smallholders, producing for family subsistence as well as for sale. These farmers have only recently been divorced from various forms of noncapitalist labor relationships with haciendas (*see* Subsection 1.6.2), due in part to a partial land reform and in part to the development of new labor-saving and capital-intensive hacienda forms oriented to the growing urban markets. Ecuadorian indigenous farmers are thus both ethnically distinctive and socioeconomically marginal.

The valley interiors of the central Sierra display a variety of regional climates. Some are moist valleys, some are drought-prone according to their disposition to prevailing rain-bearing winds (*see* Section 2 below). Farmers in the dry valleys can escape drought by location higher up the valley sides because, in general, rainfall increases with elevation. But at these higher locations temperatures are generally lower, and there is a greater risk of frosts that can damage or kill crops. Facing a higher risk of drought in the valley bottoms and a higher risk of frost on the higher valley sides, farmers need to consider what crops or combinations of crops represent the best means of combating the effects on agriculture of year-to-year variations in rainfall and temperature. Such is the setting for this case study. It offers the opportunity for us both to learn from the adaptive strategies of indigenous farmers and to consider how these might be improved.

1.2.2. The research approach

The case study focuses specifically on the impact of climatic variations on indigenous farming communities at high elevations (2800–3800 m). The problem is approached on four different scales of analysis: the Ecuadorian highlands as a whole, the central region of these highlands, the province of Chimborazo and the peasant communities of Chauzan and Galte (in Guamote *canton* of Chimborazo province) (*Figure 1.1*). The aim has been to focus closely on a "laboratory" region of manageable size, but it should be remembered throughout that statements made on one scale or level of generalization may not always be true on other scales. The study communities of Chauzan and Galte were chosen on the advice of Proyecto Desarollo Rural Integral de Guamote (DRI-Guamote). The DRI-Guamote project was initiated in October 1981, and subsequently published a three-volume report on the region (SEDRI, 1983). Two field workers from the DRI-Guamote project, who led a farm study for DRI in 1981–1982, also conducted a comparable survey for the present study in 1984, with additional questions related to agricultural terminology, agricultural practices and the like.

Each section of this study reports results from one of the four scales of analysis. As in the case studies reported elsewhere in this volume, attention is given first to the selection of climatic scenarios. Changes in precipitation and temperature under these scenarios are then used as inputs to a range of impact models or climatic indices – in this case, a crop growth model for barley, and