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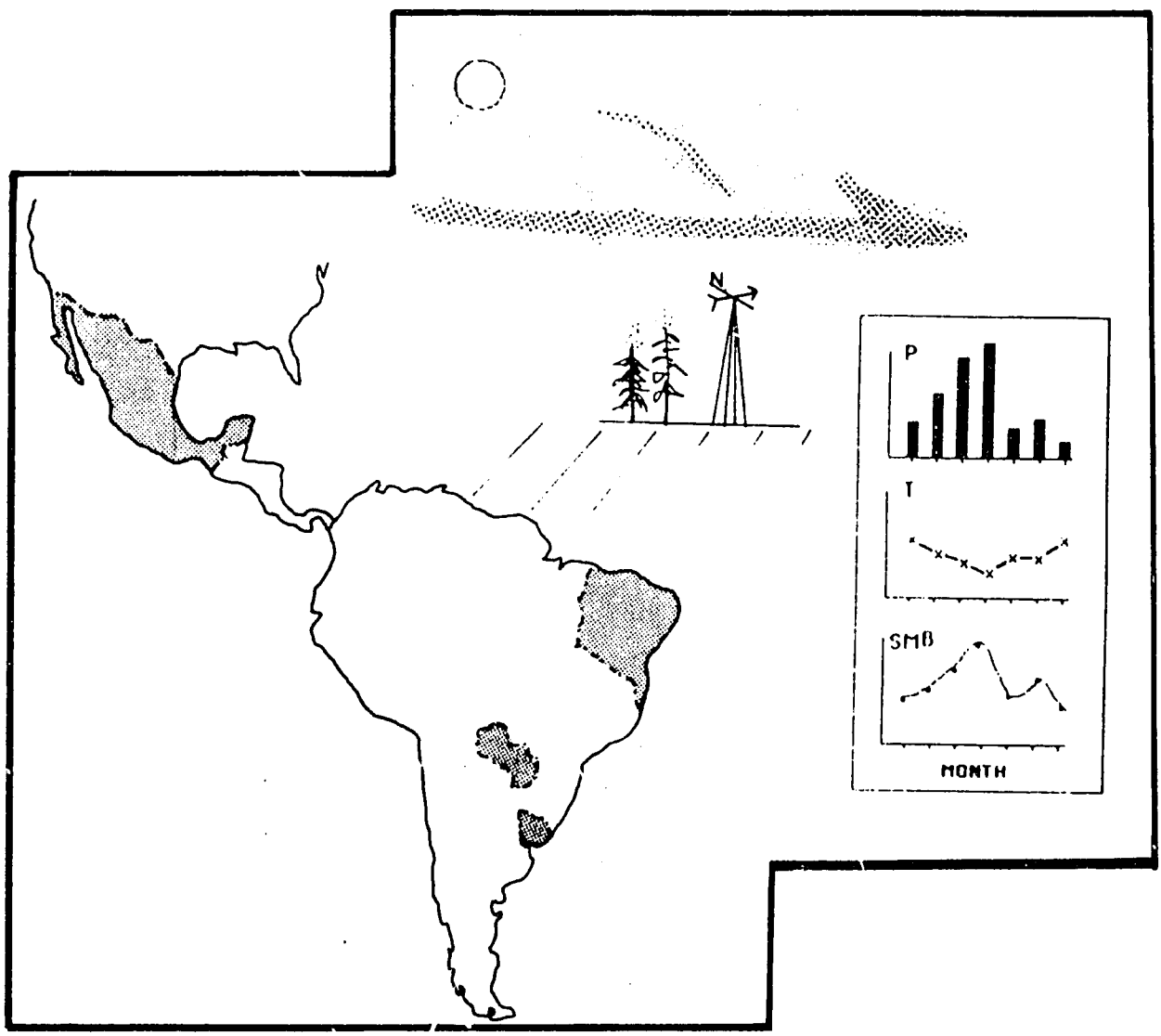
DROUGHT/CROP CONDITION ASSESSMENT METHODS FOR

NORTHEAST BRAZIL, MEXICO PARAGUAY AND URUGUAY

AN AGROCLIMATIC APPROACH



MAY 1985

DROUGHT/CROP CONDITION ASSESSMENT METHODS FOR NORTHEAST BRAZIL, MEXICO, PARAGUAY AND URUGUAY 1/

to

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Office of U.S. Foreign Disaster Assistance
Washington, D.C. 20523

by

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EXECUTIVE SUMMARY

DROUGHT/CROP CONDITION ASSESSMENT METHODS FOR NORTHEAST BRAZIL, MEXICO, PARAGUAY AND URUGUAY

Ana M. Planchuelo-Ravelo and Andres C. Ravelo[1/]

The Agency for International Development (AID) needs reliable early warning of potential food shortages to make decisions affecting many of its programs for disaster relief, preparedness, and food security in Latin America. Many of these agriculturally oriented economies are highly vulnerable to climate variability. Severe drought and flooding have historically led to crop failures, economic losses, and food-security problems. For these reasons, the AID/Office of U.S. Foreign Disaster Assistance sponsored this project, Drought/Crop Condition Assessment Methods for Northeast Brazil, Mexico, Paraguay and Uruguay.

The objectives of this project were accomplished. An inexpensive Early Warning Program was developed to provide reliable, timely information on potential food shortages triggered by climatic events. Computerized data bases were assembled and used to determine historical relationships between climate anomalies, crop failures and the causes of abnormal food shortages.

The Early Warning Program is based on 1) biweekly weather assessments and 2) monthly assessments of crop conditions. Weather assessments begin with an analysis of precipitation amount, the most important meteorological element influencing crop productivity in temperate and subtropical regions. Regional rainfall estimates are determined from ground station reports received through an international communications network. Satellite cloud data are used to improve the accuracy of precipitation estimates, particularly in those regions where weather data are sparse and unreliable. Weather data are then interpreted by agroclimatic indices which indicate potential crop production in relative terms. Finally, the potential for abnormal food shortages is identified from these indices.

Agroclimatic indices are the core of the assessment program. Various historical data bases were developed to determine the appropriate index for each region. Local agricultural practices, historical episodic reports and results of experimental studies were incorporated in the choice of each index. Episodic reports on documented occurrences of famine, drought, crop failure and other events are used to establish critical thresholds for potential food shortages and to interpret indices.

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Agroclimatic indices and associated crop calendars for major food crops were defined for agroclimatically homogeneous regions in each country.

This program can potentially benefit AID by:

1) increasing lead time for planning food assistance strategies,

2) enhancing the U.S. capacity to identify disaster conditions, thus improving recommended measures for disaster avoidance and mitigation, and

3) transferring agroclimate modeling and impact assessment technology to developing countries.

The methods proposed in this report provide inexpensive and timely information which is consistent with known local agricultural practices. This Early Warning Program can provide reliable information 30-60 days before harvest of the crop. This could represent a 3-6 month warning prior to drought-related food shortages.

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CHAPTER I

INTRODUCTION

The agriculturally oriented economies of many nations in Latin America are highly vulnerable to annual variations in climate. Severe drought and abnormal flooding can lead to crop failures and economic losses. For example, severe droughts during 1979 through 1983 resulted in crop failures and had a disastrous impact on the economy of Northeast Brazil. Historically, these anomalous climatic conditions have also been associated with disastrous food shortages in developing countries of Latin America. This vulnerability to adverse climate is frequently compounded by other complex factors including increasing population pressure, diminishing natural resources, the rising cost of energy, expansion of agriculture into marginal lands, and less than optimum land conservation practices.

When a country experiences climate-related food shortages, there frequently is a request for international relief assistance. Decisions on such requests must be based objectively on an evaluation of all available information to determine the magnitude of the problem and human needs. A reliable early-warning program designed to alert decision makers to potential problems is a key element of disaster preparedness, as well as a basis to support decisions for assistance. Knowledge of the antecedent conditions associated with the disaster is also important. The sources of information, particularly the data, necessary to develop an operational early warning system frequently are quite limited in those developing countries where the potential for climate-related food shortages is greatest.

Because of these considerations, the NOAA/NESDIS Assessment and Information Services (AISC) was asked by the Office of U.S. Foreign

Disaster Assistance (OFDA), Agency for International Development (AID), to investigate early-warning procedures for disaster assistance needs associated with drought in Northeast Brazil, Mexico, Paraguay and Uruguay. This multi-discipline effort is being conducted by the Climatic Impact Assessment Division (CIAD), Models Branch, located at Columbia, Missouri and Climatic Assessment Branch (CAB) located in Washington, D.C., and the Cooperative Institute for Applied Meteorology (CIAM), University of Missouri-Columbia in the development of this program.

The goals of this project for Northeast Brazil, Mexico, Paraguay and Uruguay include:

1) developing agroclimatic and other data bases to investigate the impact of weather and non-weather factors on crop failures and food shortages, and
2) developing a low-cost Climate/Subsistence Food Early Warning System based on agroclimatic analyses to provide timely, reliable information on potential food shortages due to drought, and
3) providing AID/OFDA with qualitative bi-weekly weather assessment reports on the impact of anomalous weather events such as flooding, frost and short-term climatic conditions.

This report summarizes and discusses the accomplishment of the above goals. It is written to provide background information for those potentially involved with weather/crop condition assessment analysis. Chapter II provides information on data bases and climate/crop condition assessment procedures. The analysis of climate and agriculture and the results of climate/crop yield indices for individual countries are discussed in Chapter III. The proposed early warning program is discussed in Chapter IV. Substantial data bases are provided in various Appendices and Supplements.

CHAPTER II

METHODOLOGY

A. Overview

This early warning program is designed to quantitatively assess the impact of drought on agriculture, thereby providing reliable information on the potential for abnormal food shortages. Agroclimatic assessments are based on a combination of bi-weekly weather analyses and climate/crop condition indices, both of which are objectively determined for agroclimatic regions.

Bi-weekly weather assessments were initiated by AISC during the early stages of this developmental project to provide timely information to potential users. These assessments are primarily based on available real-time meteorological and satellite data which are statistically compared to long-term precipitation "normals," usually for the most recent two and eight week periods. The impacts of anomalous weather events such as flooding, tropical storms and temperature extremes are also discussed.

B. Agroclimatic Analysis

The components of agroclimatic analysis used to develop weather assessments and climate/crop models are shown by Figure 2.1. Major components include the data bases, information on agricultural practices for agroclimatic regions, agroclimatic indices, and assessment procedures. Test and evaluation will be required prior to operational implementation.

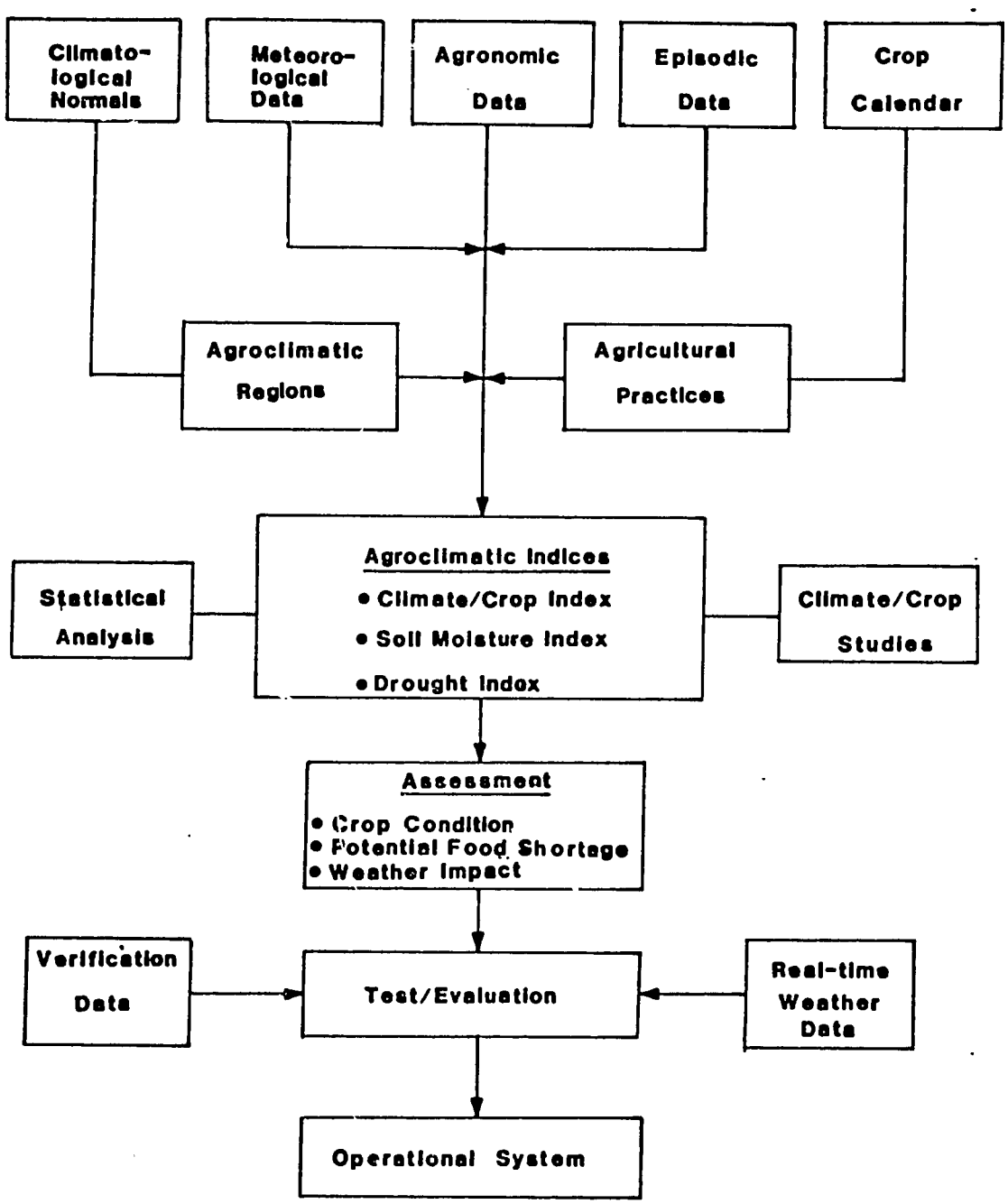


Figure 2.1. Components of Agroclimatic Analysis for Investigation of Drought Impact on Crop/Food Shortage Conditions.

1. Data

Four major data bases were developed for this project: meteorological, climatological, episodic event, and crop calendar.

The meteorological/climatological data base includes long-term records of monthly precipitation (1960-1982) for selected locations. Mean monthly temperature records were available for selected locations (Wernstedt, 1972). Meteorological data for some countries also include monthly records of maximum and minimum temperatures. Because these data are used to investigate crop/weather relationships, extensive historical records displaying a wide range of climatic conditions are essential to the development of crop/food shortage assessment techniques.

Episodic event data include documented reports on the historical occurrences of drought, flooding, frost and other anomalous weather events associated with crop failure or abnormal food shortages. Additionally, non-weather related factors which can have a disruptive impact on agricultural production/food supplies are also documented, for example, reports of pests and crop disease, inappropriate application of improved technological inputs to agriculture, civil unrest, and others. These data are generally qualitative in nature and obtained primarily through extensive literature searches. They are used to help select, determine the role, and "calibrate" agroclimatic predictors of potential crop failure and food shortages. The episodic data base is included in Appendix A to this report.

The final major data base involves regional and national level crop calendars for various crops and crop growing seasons. For example, the crop calendar for corn provides the "normal" sowing, growing and harvesting dates. Conflicts among various published sources on crop calendar dates were clarified.

2. Methods

Considerable effort was made in investigating the nature of agricultural practices and quality of agronomic data in each country prior to the selection of a specific procedure to individually model the selected crops. The determination of the quality of agronomic data, locations and crop calendars for important food crops and subsistence cropping practices were among the many considerations investigated primarily by literature searches, but also from interviews and agroclimatic analysis. For example, U.S. Government officials representing various agencies (including US/AID, USDA, DOC, etc.), university officials, and local government officials were among those interviewed for first hand information concerning local agronomic practices or climatic conditions.

This investigation resulted in the conclusion that agroclimatic/crop condition assessment indices, such as the Yield Moisture Index, the Soil Moisture Index, and/or other agroclimatic indices are best suited for developing a reliable, timely subsistence food monitoring system based on climatic data.

a. Agroclimatic/Crop Condition Assessment Indices

The objective of the agroclimatic/crop condition indices is to provide relative information on the impact of weather on crop production. Indices are related to the crop water demand and based on monthly precipitation data. These indices can be expressed in metric (mm) units or in non-dimensional form (e.g., percentiles or percent of long-term mean, depending on the available historical data). Information from the following indices may be used to provide monthly crop condition assessments.

Yield Moisture Index (CEAS, 1979)

The Yield Moisture Index (YMI) is defined as:

$$YMI_j = \sum_{i=1}^{n} P_i \, KC_{ij}$$

where:

YMI_j = Yield Moisture Index for the jth crop (i.e., corn)

P_i = precipitation during the ith crop stage (1 = planting, 2 - vegetative, 3 = flowering/reproductive, etc.), and

KC_{ij} = appropriate crop coefficient for the ith crop stage and jth crop (Doorenbos and Pruitt, 1977).

The YMI is a drought index and represents an improvement over cumulative rainfall because the weights (KC_{ij}) are a function of the crop water requirement at each crop stage of the individual crops. For example, the water requirement at the reproductive stage is much higher than at earlier crop stages. The index is computed for 20-30 years and calibrated from episodic data. Assessments during the current year are interpreted according to the historic index values.

Soil Moisture Index (Ravelo and Decker, 1979)

This index is based on the assumption that the seasonal distribution of soil moisture characterizes the effects of climate and weather variability on plant growth better than any single climate parameter. The ratio between plant available water (PAW) and the maximum plant available water (PAW_{max}) is defined as the soil moisture index (SMI). This ratio normalizes the soil moisture according to variations in the type of plant and soil.

The SMI is defined as:

$$SMI = PAW/(PAW_{max})$$

where $0 \leq SMI \leq 1$, and

FC = the field capacity or the maximum moisture that can be retained by the soil after excess gravitational water has drained away.

As in the case of the YMI, the historic time-series of the SMI may be used to assess current conditions relative to conditions that have existed in the past. Relative yield information may be determined from the percentile ranking of the SMI.

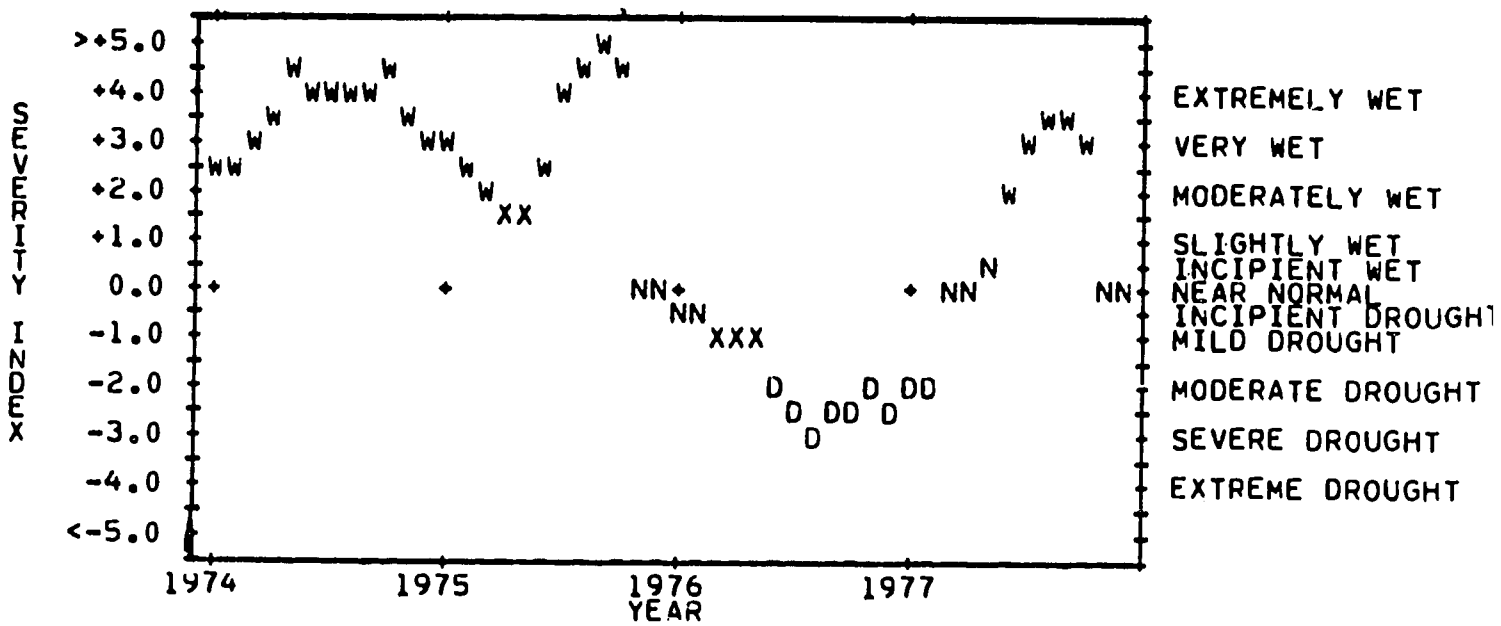
Palmer Drought Index (Palmer, 1965)

The Palmer Drought Index (PDI) provides information on the duration and intensity of drought. The index is based on monthly fluctuations of soil moisture conditions which are estimated from a hydrological accounting system (Palmer, 1965). The required input data include the water holding capacity of the soil, monthly precipitation and monthly potential evapotranspiration.

The PDI is designed to monitor both dry and wet periods. The index values are scaled such that negative values indicate drought and positive values indicate wet conditions; an index value of zero indicates normal conditions. Figure 2.2. shows the PDI for Quixeramobin, Brazil. Severe droughts are indicated for 1976, 1979 and 1981.

PALMER DROUGHT INDEX (PDI)

QUIXERAMOBIM, N.E. BRAZIL



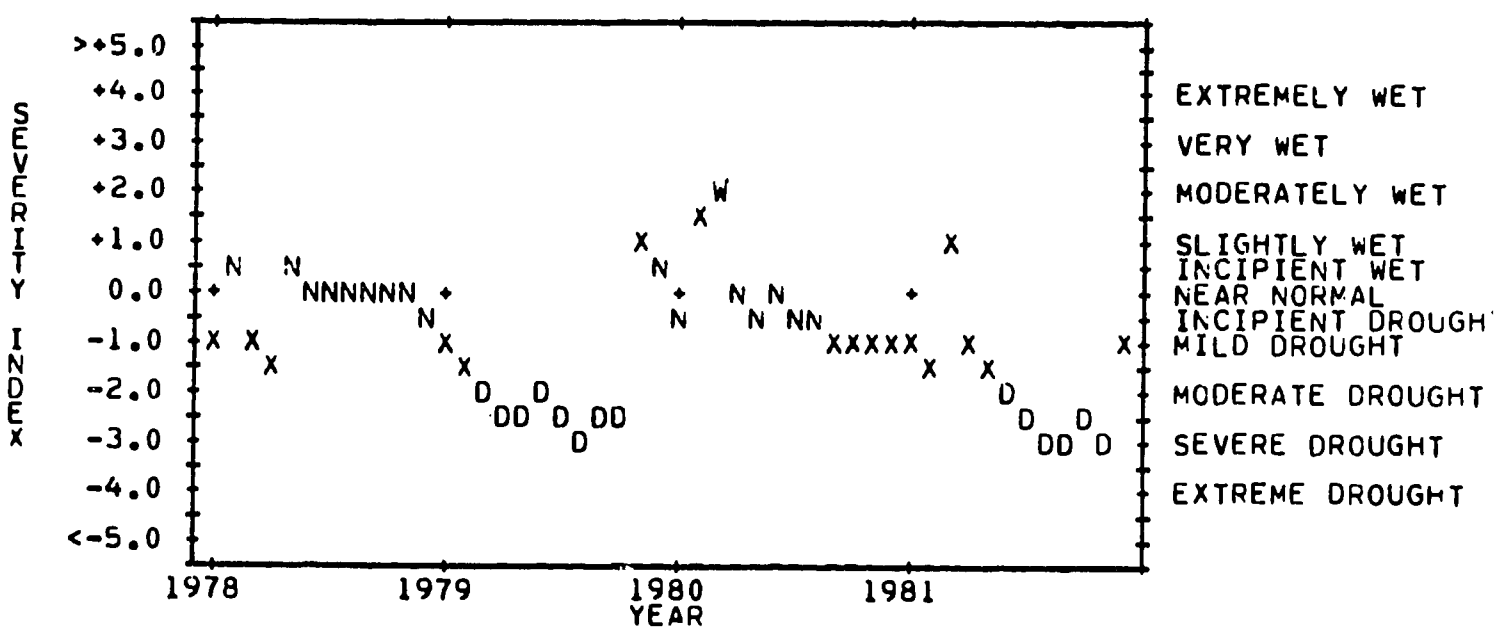


Figure 2.2

CHAPTER III

NORTHEAST BRAZIL

A. Physical Environment

1. Overview

The Northeast Region of Brazil, located between 1° and 19° S Latitude and 35° and 47° W Longitude, comprises 18 percent of the national territory with an approximate area of one and a half million square kilometers. The region contains the states of Maranhao, Piaui, Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Sergipe, Bahia and the small island of Fernando de Noronha; Figure 3.1 shows the state boundaries.

The Northeast has been described as the cultural heart of Brazil. It was the first focus of European settlement. However, it has continuously been plagued by poverty and social problems attributed to intermittent droughts, severe soil depletion, uneven land distribution and population pressure.

The heaviest concentration of rural population and the largest cities are located along the Atlantic coastal belt. The principal ports are Salvador, Recife, Natal and Fortaleza.

Northeast Brazil can be divided into four major geographic and natural areas: the "Sertao," a dry central zone that occupies about 49 percent of the northeast region; the "Middle North" that includes an extensive area of Piaui and Maranhao states; the "Zona da Mata," a humid coastal strip with a width of up to about 90 kilometers; and the "Agreste," a semi-humid transitional zone between the Zona da Mata and the Sertao that occupies the eastern portion of the Borborena Plateau and extends from

NORTHEAST BRAZIL
STATE BOUNDARIES

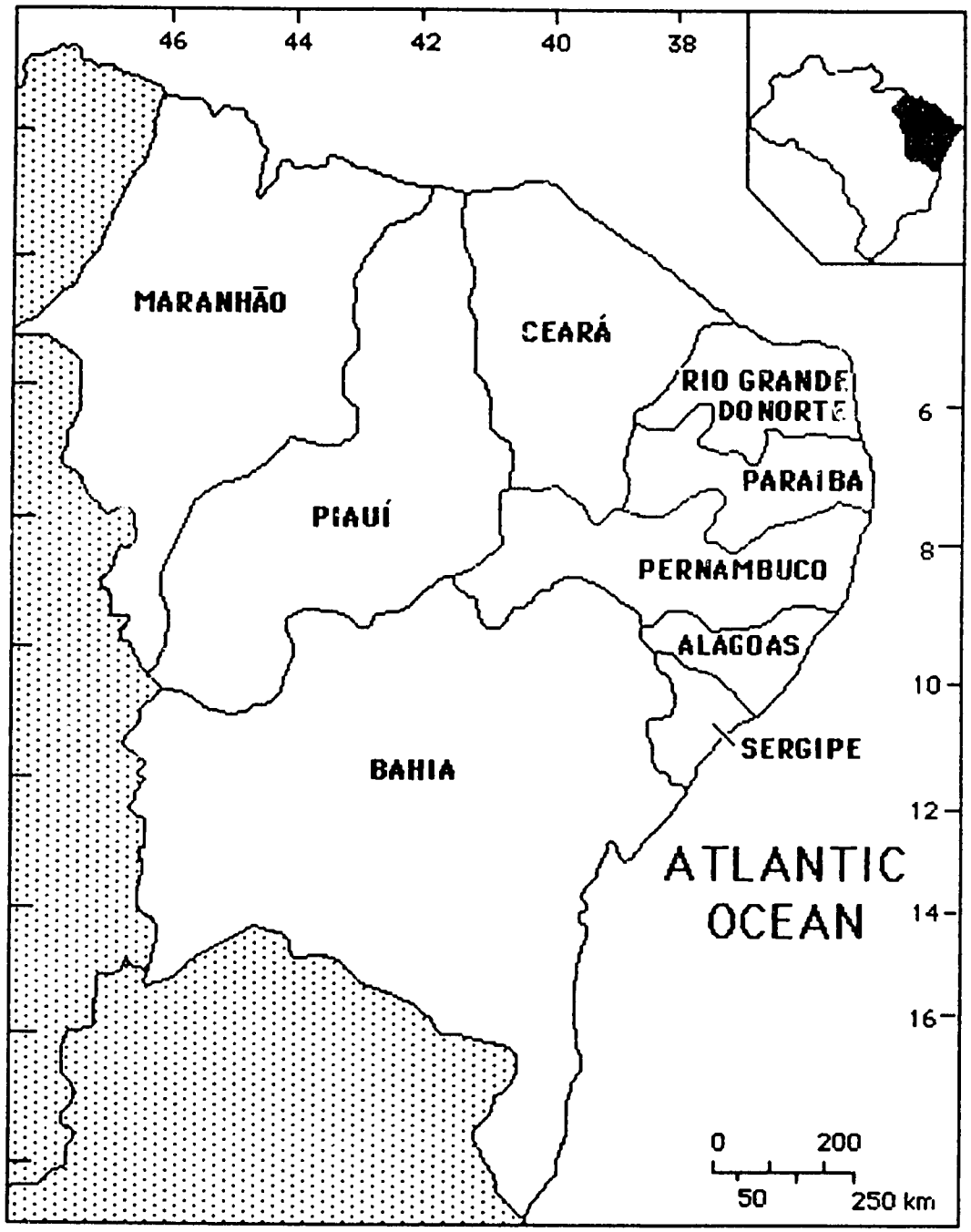


Figure 3.1

Rio Grande do Norte to Bahia. Figure 3.2 shows the four major geographic areas.

Most of the Sertao is in the so-called "Drought Polygon" that includes large portions of all of the states except Maranhao and encompasses more than 10 percent of the country's territory. The Drought Polygon was delimited by law to designate the beneficiaries of special federal programs to fight the drought. The polygon is more a political than physiographic area and has a range of climatic variation and a variety of soils. Figure 3.3 shows the Drought Polygon boundaries.

The principal river in the northeast is the Sao Francisco which rises in the Serra do Canastra near Belo Horizonte in Minas Gerais and flows northeastward for 1500 kilometers along a line parallel to the coast before turning eastward toward the sea between the states of Alagoas and Sergipe. The Parnaiba river flows northward from Chapadas des Mangabeiras, bordering the states of Piaui and Ceara, to the sea at the north coast. All the other rivers of the Sertao Region almost dry up during the dry season. Figure 3.3 shows major rivers.

2. Soil and Natural Vegetation

The landscape of the Sertao consists of broken scrubland marked by rock outcroppings. Much of the soil of the area is shallow, poor in organic content, rich in soluble bases and unable to accumulate water. Salinization is a widespread problem. If the soil is improved by mulching and irrigation is applied, the land becomes suitable for cropping, but drought and flood problems and dense population make agriculture hazardous.

The vegetation of the Sertao, known as "Caatinga," is a tropical scrub woodland of thorny drought-resistant trees with some cactus.

NORTHEAST BRAZIL

GEOGRAPHIC REGIONS

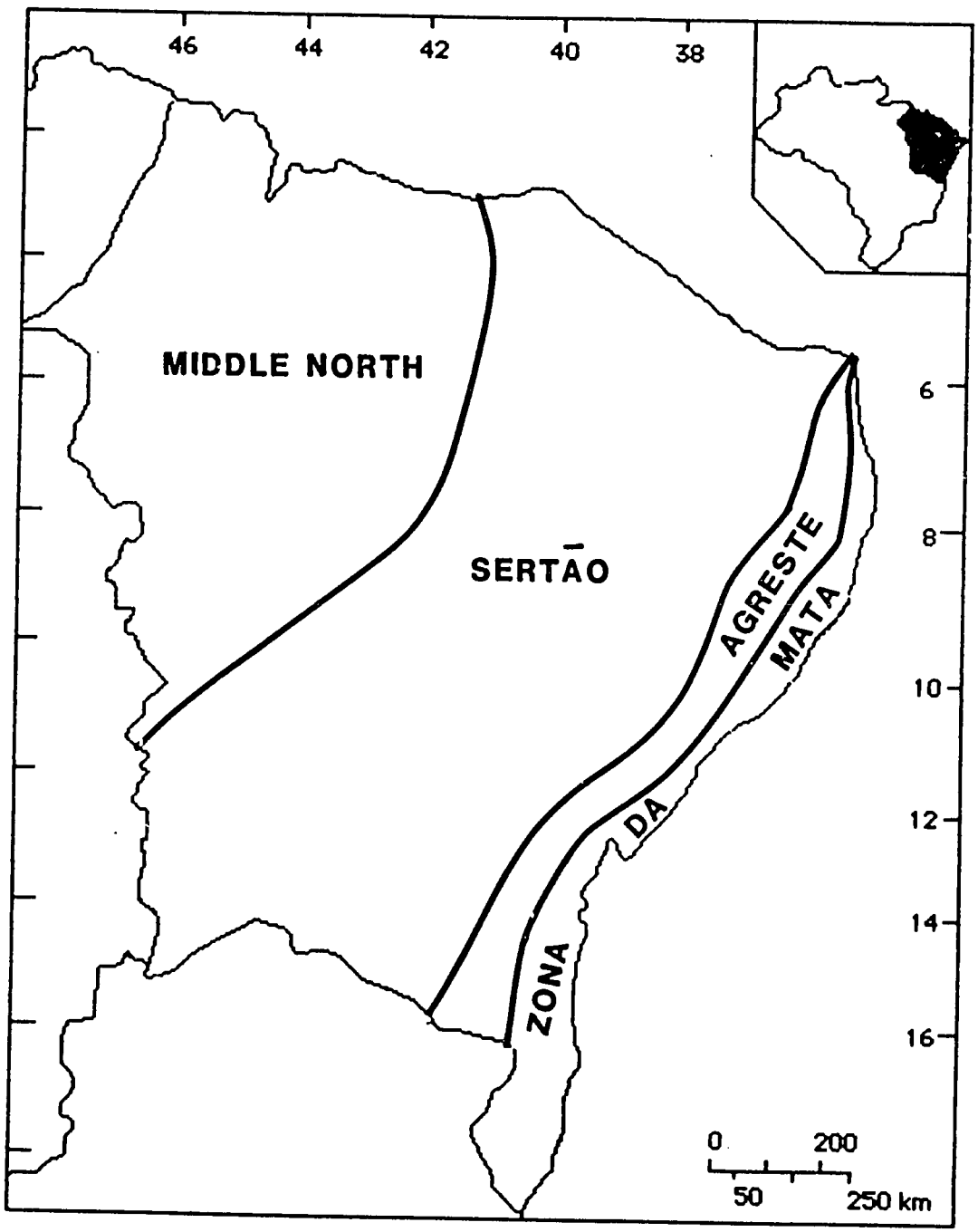


Figure 3.2

NORTHEAST BRAZIL
DROUGHT POLYGON AND MAJOR RIVERS

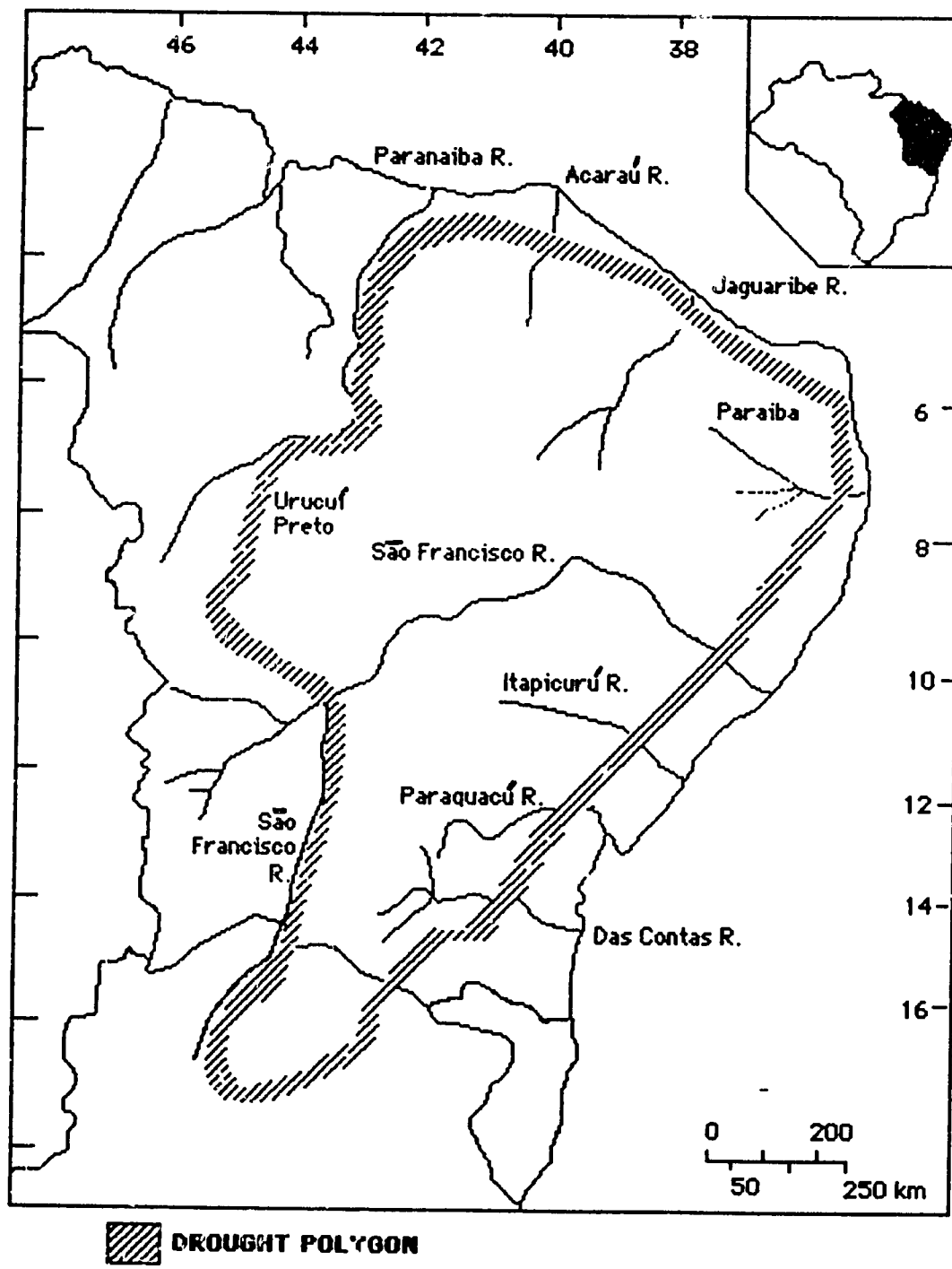


Figure 3.3

The density varies from woodland to thorn-shrub steppe, in formations that respond to the local relief, moisture content of the soil and drought conditions of the area. The clearing of the woodland has led to rapid run-off of heavy rains when they occur and hence to soil erosion.

Another characteristic of the Sertao is the wide river valleys, at times up to 10 kilometers in width, with depressions transformed into lakes during flooding. These depressions are covered by a natural gallery forest of carnauba palms, a valuable plant that produces commercial waxes.

The soil of the Middle North region is colored light yellow to red and belongs to the lateritic group. This area has long dry periods where the soil is less moisture retentive. A sample profile is as follows: a superficially hardened horizon, 40-50 cm thick, with an accumulation of sesquioides; a leached horizon, 12-15 cm thick, of loose sand; a lateritic pan, 2-6 cm thick; and waterbearing parent strata (Valverde, 1970).

The major vegetation in the interfluvial plateau is a woody savanna or "Campos Cerrados." This vegetation is a mixture of short grass and scrubby deciduous woodland with twisted trees up to 12 m tall. The "Cerradao," a formation of dense forest with straight trees and sandy soil, occurs on a small scale. This soil has a deep red, sandy-clay B horizon, without the lateritic elements of the Campos Cerrados. The lowlands and river valleys have a soil with a fertile A horizon and are covered with galleries of palm forest. The natural vegetation of the Middle North has been affected by native and settler burnings. Once the natural forests are destroyed, the babassu palm, with a more rapid growth rate than other trees, completely dominates the secondary forest. The woodland/grass distribution may be closely related to the moisture and temperature

conditions of alternating wet and dry seasons in this tropical climate. In the dry season the soil usually dries out to a depth of 2-3 m but the tree roots reach a depth of 15-20 m and retain their leaves without showing any water stress symptoms.

The Zona da Mata can be considered the most important in Northeast Brazil. A major portion of the population and the most important industrial parks and plantation agriculture are found here. The rivers in the northern part have an irregular regimen that is manifested by the absence of water in the riverbeds during summer, December-January, and by the overflowing of the banks and inundation of floodplains during the rainy season, May-July. In the south most of the region, trees are evergreen but in the north, during the summer, the forest has a gray color due to the many deciduous trees. When man settled the region he cut down the forest, drained the swampy lowland, planted sugarcane and built houses. Now the coastal forests develop fully only in the alluvial area.

The Agreste is characterized by the diversity of the landscape over short distances, with very dry and very humid areas. The existing natural forests were ravaged to meet demands for fuel for railroad locomotives. The destruction of the forests caused the caatinga vegetation to advance toward the sea. In Bahia the Agreste extends in a north-south direction, and it is partially covered by dry forests similar to the Sertao zone.

3. Climate

The Sertao has a hot climate with average annual temperatures of about 25°C and an annual range of less than 5°C. The total annual rainfall is between 500-600 mm, but often falls below 250 mm. The precipitation regimen is highly uncertain and rainfall is heavily concentrated in a short time period during summer and fall, December-April, but may fail

completely for a whole year or may occur only in one or two months or come as sudden and excessive downpours. This area is subjected to calamitous floods and droughts. The causes of the unreliable conditions and the moisture deficiency appear to be related to topography, the general circulation of the atmosphere and to the position that the Intertropical Convergence Zone (ITCZ) takes in the summer.

In the Zona da Mata the rainfall is almost always greater than 1200 mm a year and there are no droughts. The mean January temperature is around 26°C and in July the mean temperature is near 24°C.

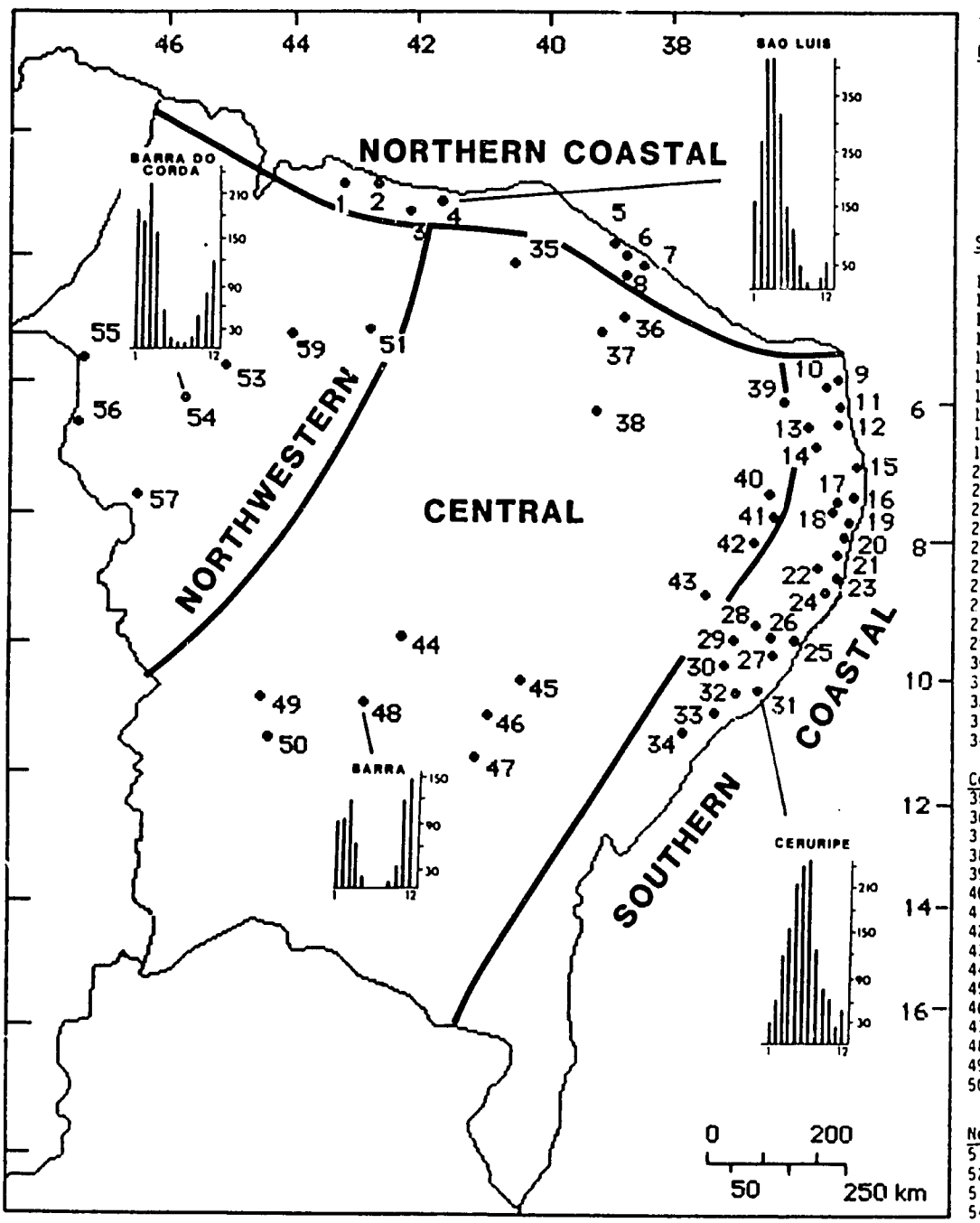
In the Agreste the annual rainfall ranges from 100 to 600 mm. The eastern portion of the Borborema Plateau, from Rio Grande do Norte to Alagoas, benefits from the southeasterly trade winds. Rainfall occurs in the fall and winter, March-August. In the western-most portion the rainfall occurs during the summer months, January and February.

The annual precipitation in the Middle North Region varies between 600 and 2000 mm. The rainy season occurs during late summer and early winter with a peak in March and April. Drought is not a problem in this region.

For the purposes of crop condition assessments, Northeast Brazil has been divided into four agroclimatic regions. Figure 3.4 shows the location of weather stations considered in the analysis of the agroclimatic regions, and the rainfall distribution of selected stations.

NORTHEAST BRAZIL

AGROCLIMATIC REGIONS AND WEATHER STATIONS



AGROCLIMATIC REGIONS

Northern Coastal
1. Tracateua
2. Turiaçó
3. São Bento
4. São Luis
5. Porangaba
6. Fortaleza
7. Mondubim
8. Guaramiranga

Southern Coastal
9. Macaiba
10. Natal
11. Nova Cruz
12. Guarabira
13. Umbuzeiro
14. Areia
15. João Pessoa
16. Goiana
17. Nazare do Mata
18. Nazareth
19. Olinda-Recife
20. Tapacura
21. Barreiros
22. Garanhuns
23. Porto de Pedra
24. Satuba
25. Maceió
26. Correntes
27. Pilar
28. Anadia
29. Palmeira dos Indi
30. Agua Branca
31. Ceruripe
32. Propria
33. Aracaju
34. Itabaianinha

Central Region
35. Sobral
36. Quixada
37. Quixeramobin
38. Iguatu
39. Cruseta
40. Campina Grande
41. Surubin
42. Pesqueira
43. Pao de Acucar
44. Remanso
45. Monte Santo
46. Jacobina
47. Morro do Chapeu
48. Barra
49. Santa Rita Rio Pr
50. Ibipetuba

Northwestern Region
51. Terezina
52. Caxias
53. Barra do Corda
54. Grajau
55. Imperatriz
56. Boa Vista Tocanti
57. Carolina

Figure 3.4

B. Agriculture

1. Overview

The northeast region of Brazil has a diversity of farming systems: extensive cattle ranches and slash-and-burn forest destruction for subsistence agriculture in the western part of Bahia, Piaui and Maranhao States; sugarcane, coconut and cacao plantations in the Zona da Mata; rain-fed rice farming in the coastal area of the Middle North; mixed farming activities in the Agreste; and cotton plantation and subsistence agriculture in the Sertao. Figure 3.5 shows major agricultural land use.

Crops account for the bulk of agricultural production in the Northeast and virtually half of the crop production is made up of subsistence crops, particularly rice, corn, beans and manioc. Cotton, sugarcane and tree crops such as cacao, and the product of two species of palm, babassu and carnauba, are exportable. These exports contribute about 38 percent of the total value of crop output.

Agriculture in the Zona da Mata is monocultural and mainly oriented towards export crops such as sugarcane, cacao and tobacco. The forest in the northern part of Zona da Mata was cut four centuries ago to allow cultivation of sugarcane. The intensive cultivation of sugarcane, usually to the exclusion of all other crops, has depleted the once excellent soils. Cane fields occupy the fluvial valleys from Bahia in the south to the northeastern-most part of Rio Grande do Norte. In Alagoas State sugarcane grows on the hills and the slopes of the Borborema Plateau. The yields of other crops in this region are better than in most other areas of the Northeast, however the production of sugarcane is the major agricultural activity. The southern part of Zona da Mata, near the town of Salvador in the state of Bahia, is famous for its production of sugar and tobacco.

NORTHEAST BRAZIL
AGRICULTURAL LAND USE

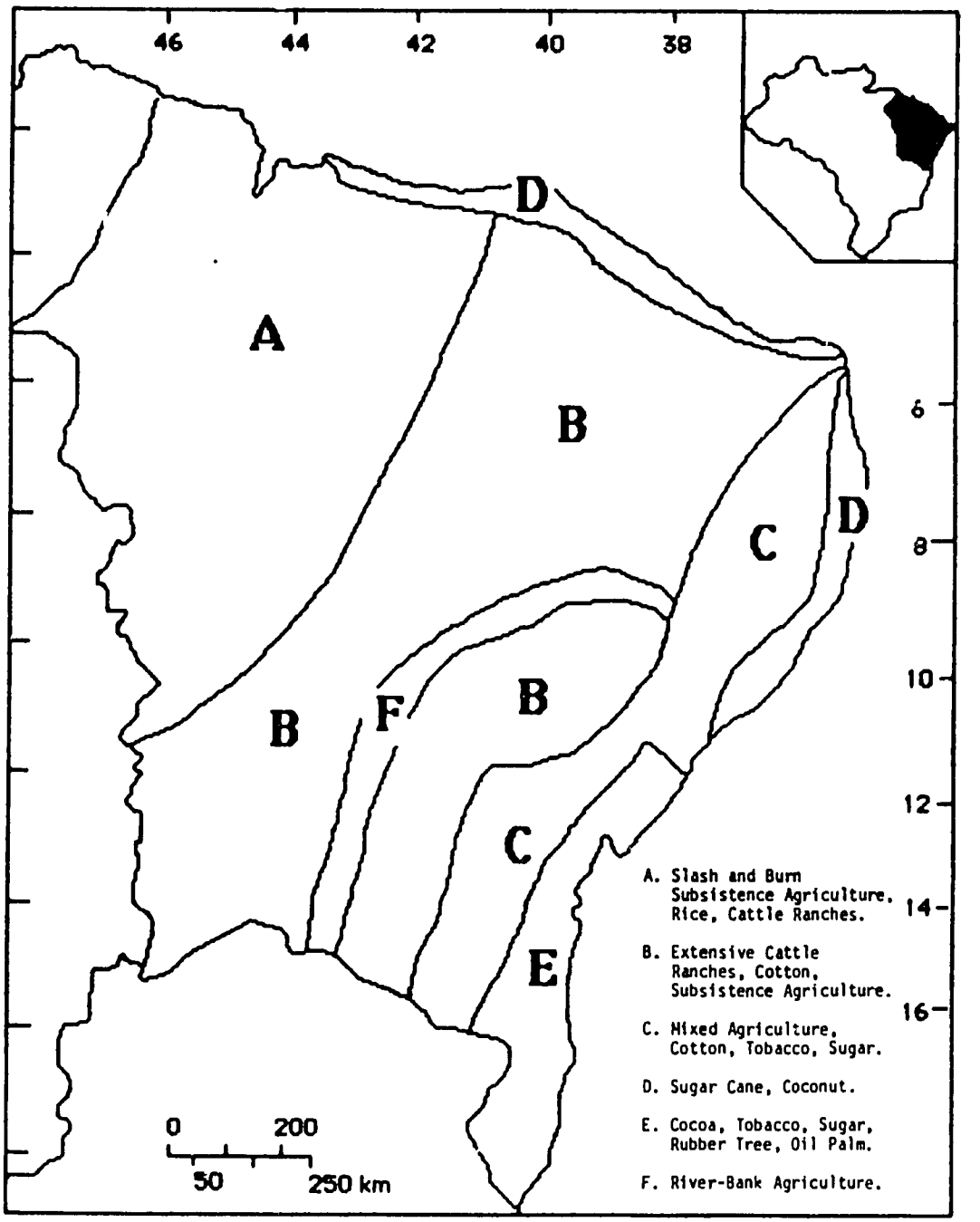


Figure 3.5

Still farther south are the areas of more humid and slightly cooler climates where farmers have developed the production of cacao since the eighteenth century and, more recently, rubber tree cultivation.

Agricultural resources in the Agreste have been entirely devoted to products for the internal market. The proximity to the large cities of the coast has increased the value of the land and created outlets for products. In the highest part of the Borborema Plateau the natural forest has been replaced by large coffee and banana plantations. In the moist areas and foothills of the lower part of the mountains, there is an appreciable division of land and agriculture is oriented to subsistence and cash crops to supply the coastal cities. In the semi-arid portions of the Agreste, in Sergipe, there is too little moisture for sugarcane cultivation but enough for intensive cultivation of manioc, vegetables and tobacco. The sandy soils in Pernambuco are occupied by fruit trees and manioc crops and in Alaogas by tobacco plantations. In Bahia the land is devoted to cattle raising and mixed farming.

The Sertao is a more extensive area where coconut groves cover the coast of the northern littoral. The Serido Valley of Paraiba and Rio Grande do Norte are famous for high quality cotton. Irrigated agriculture is practiced on a large scale in the wide valleys of the rivers. Bananas, cotton, sorghum, corn, beans, peanuts and broad beans are common crops on irrigated lowlands. On the riverbanks of the Sao Francisco River, sugarcane and onions are generally grown as cash crops for the cities of southern Brazil.

Four types of agricultural activity predominate in the Middle North. The water of the Parnaiba River, which stretches throughout the zone, allows the cultivation of irrigated rice. The slash-and-burn practices by

non-propertied farmers can be found scattered throughout the zone. After clearing the land, subsistence crops such as rice, corn, and beans are planted and the following year, because the soil becomes less fertile, the peasants plant manioc. After two or three years of cropping, or until the nutrient value of the soil is depleted, the farmer moves to another plot. The cleared land left behind is often taken over by cattlemen, usually nomadic, who use land-intensive methods. The fourth type of agricultural activity of the region is extractive, involving wild carnauba and babassu palms. Table 3.1 shows an estimated crop calendar for major food crops.

2. Major Crops

a. Commercial Crops

Sugarcane

Sugarcane is mainly cultivated in the Zona da Mata. Production started in the sixteenth century. It remains the largest source of foreign exchange for the rural Northeast. Sugarcane is grown everywhere in the coastal area. The tablelands of Alagoas and Pernambuco are more advantageous for sugarcane cultivation than the slopes and the lowlands because it is not necessary to contour or drain the fields. The generalized use of fertilizers and the introduction of hard varieties of sugarcane extended the crop cultivation to humus-poor soils and areas that until recently were not suited to extensive sugarcane production. Figure 3.6 shows major sugarcane growing areas.

Cotton

Cotton cultivation created a veritable agricultural revolution in the Agreste after the middle of the eighteenth century. Cotton was introduced into Pernambuco and soon spread through the Agreste and Sertao. The most

TABLE 3.1

ESTIMATED CROP CALENDAR FOR NE BRAZIL

/// Planting or Sowing, --- Vegetative/Flowering, 000 Harvesting

Region	Crop	J	F	M	A	M	J	J	A	S	O	N	D
Coastal	Corn (veg)			//	//-	---	-00	000					
	Corn (grain)				///	---	---	---	-00	000	00		
	Beans			//	//-	---	-00	000					
	Rice		///	///	//-	---	000	000	000	000	0		
						///	---	---	---	000	000	000	0
	Sugarcane						///	///	---	---	---	---	---
		---	---	---	---	---	---	---	---	-00	000	000	000
		000	000	000									
Central (1)	Corn (veg)		//	///	---	-00	000						
	Corn (grain)			//	//-	---	---	-00	000				
	Beans	///	///	---	---	000	000						
	Rice	///	///	---	---	--0	000	000					
	Sugarcane	---	-00	000	000	///	///	---	---	---	---	---	---
						000	00						
	Sorghum		//	///	---	-00	000	00					
	Vegetables						///	///	---	---	000	000	
North-western (2)	Corn									///	//-	---	000
	Rice									///	---	---	000
	Beans									///	//-	---	000

(1) Riverside agriculture
(2) Slash and burn agriculture

common variety is the long-fiber "moco", cultivated in the Sertao, which is highly drought-resistant and has a life cycle of five to eight years. A hybrid between moco and the annual herbaceos is the "verdao" variety. Although this hybrid is of lower quality, it is drought-resistant, has a cycle of about three years and, because it is bushlike, makes the land easier to clear. Figure 3.6 shows major cotton growing areas.

Tobacco

Tobacco is cultivated on the sandy soils of the Agreste region of Paraiba, Pernambucco, Sergipe, Alagoas and Bahia and intensely cultivated on Arapiraca plains. Planting is done in the rainy season beginning in March. The plants undergo two transplants before harvest in August. About thirty days after the first cutting the crop can produce a second harvest. Tobacco has a short vegetative cycle, which allows crop rotation. The crop that follows can benefit from the fertilizer used on tobacco. In the major tobacco growing areas (Figure 3.6), tobacco is rotated with herbaceous cotton.

Cacao

Cacao originated in the Amazon region and was introduced in southern Bahia at the end of the eighteenth century. The Zona da Mata of Bahia has favorable soils and a hot humid climate with well-distributed rainfall for cacao production. Because the cacao tree requires shade in order to grow, cacao cultivation did not bring total destruction of the forests. Cacao production in the area is entirely for the external markets; more than 90 percent is exported. Figure 3.7 shows major cacao growing areas.

Coffee

Coffee was introduced into the Northeast at the beginning of the nineteenth century. Coffee cultivation began in humid areas such as hillsides,

NORTHEAST BRAZIL
DISTRIBUTION OF MAJOR CROPS

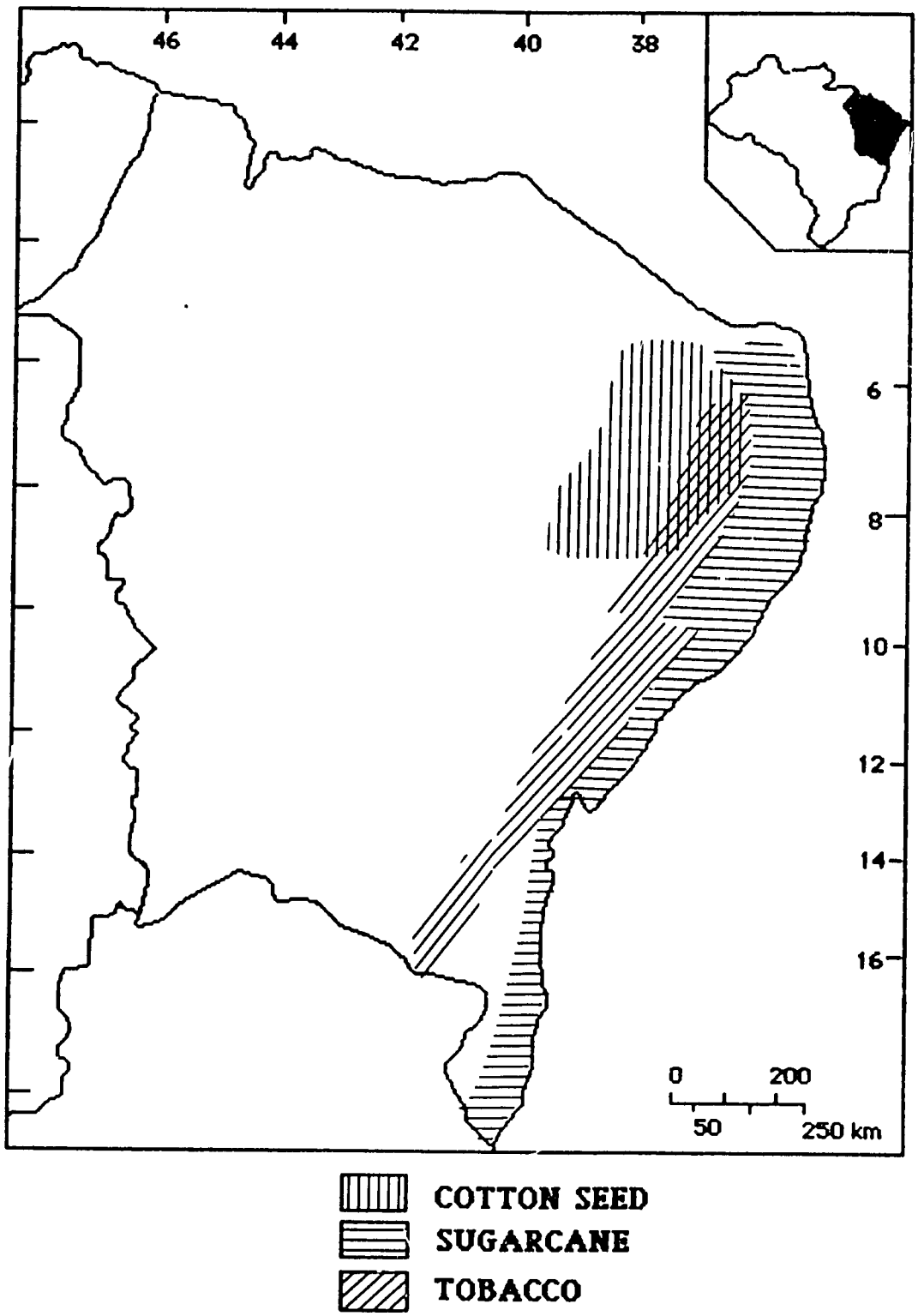


Figure 3.6

upland of about 500 meters and slopes of the Borborema Plateau in Paraiba, Alogoas and Pernambuco (Agreste region) and in the Sertao of Pernambuco. In Bahia, coffee was grown in some areas of the Diamantina Plateau. In Paraiba, coffee cultivation was important from the last decades of the nineteenth century until 1925 when it was wiped out by pests. In 1965, coffee production began to decrease in the Northeast. The federal government, through the IBC (Brazilian Coffee Institute), carried out a policy of removing coffee trees of low productivity. Today the IBC is stimulating the planting of new coffee trees in the traditional coffee-producing areas.

In the Sertao of Pernambuco, coffee was planted under other trees for shade. This practice helped maintain a reasonable soil acidity and reduced erosion. Coffee trees do not begin to bear until the third year and represent a major investment of capital for the land-owner.

Coffee harvest begins in August and extends until November or December. It is done slowly; only the beans that are ripe are picked and those that are still green are left for the next picking. There are two or three pickings per harvest. Figure 3.7 shows major coffee growing areas.

Coconut

Coconut groves are confined to the narrow litoral strip extending from Rio Grande do Norte to Bahia. Despite taking more than seven years to begin production, coconut production does not require local industrialization or expensive machinery like sugarcane. The land does not require constant weeding and upkeep occupies only a few men. The five harvests per year furnish the property owner with an almost permanent income. Figure 3.7 shows major coconut growing areas.

NORTHEAST BRAZIL
DISTRIBUTION OF MAJOR CROPS

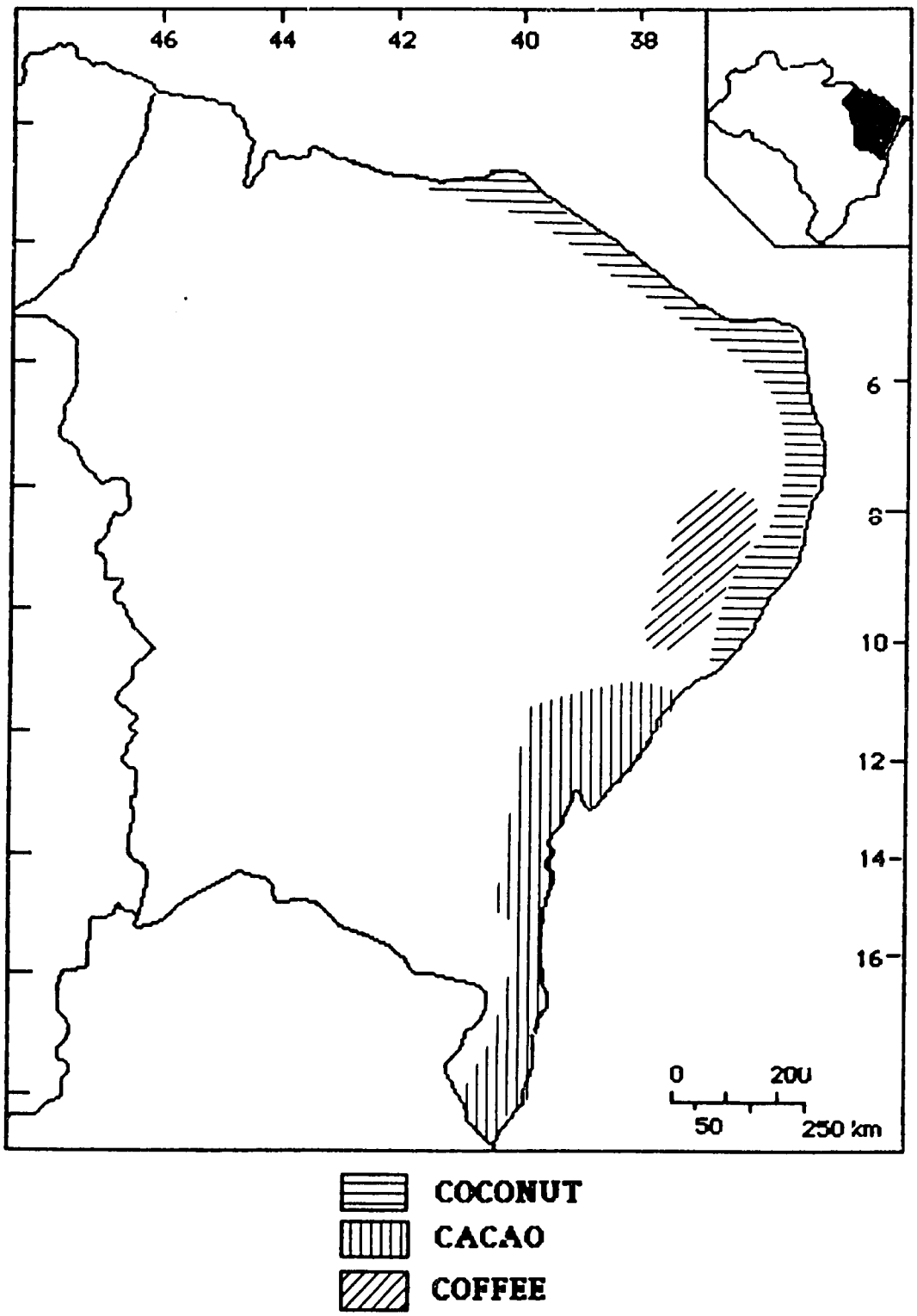


Figure 3.7

b. Food Crops

Rice

Rice cultivation has been carried on in the Sao Francisco River Valley since the last century. The first red-grained variety cultivated in the region had little economic importance, but was easily propagated and resistant to enviroment adversities. A newer variety, "purple stem," dominates today's market. Other varieties which originated in Sete Lagoas, Minas Gerais, are also cultivated in the region. Planting and harvesting times differ, depending on location. Near the river mouth rice fields can be naturally irrigated, but harvest must begin before August because during that month the volume of the river is greatly reduced causing salty ocean water to invade the river. Rice is planted in seed-beds in February or March, transplanted in April-May and harvested between July and October.

In Maranhao, rice is planted after clearing the forest by the slash-and-burn method. Maranhao is the fifth largest producer of rice in Brazil and represents nine percent of Brazil's production. The varieties cultivated in Maranhao are of a lower quality than those from Rio Grande do Sul and the lower Sao Francisco Valley. However, rice production in Maranhao has a large market in the Northeast and the Southeast, due to its lower price and to the expansion of the urban population.

Other Food Crops

Corn, beans, manioc and rice are the main food crops cultivated in the Northeast. In the Agreste, corn is sowed after the first rain in March and April. In June, part of the crop is harvested for consumption when it is still green; the grain harvest takes place later in August-November.

About 80 percent of the corn produced is a common variety and 20 percent improved hybrids. Beans are cultivated in all the regions. In the Agreste beans are sowed in March-April and harvested in June-July. The most common varieties are "de arranca" and "de corda". In Sergipe, corn, broad beans and other beans are cultivated between the oil palm rows for a period of three to four years, when the palm is not large enough to shade the ground.

Manioc is widely grown because the crop does not need storage facilities at harvest time. The root can be left in the ground for up to two years and harvested when needed.

In the Sertao the most favorable land areas are surrounded by fences of rocks or wire and planted with manioc, beans and corn. The cultivation of food crops is continously expanding in the river bed. On the bank of the Sao Francisco river, the chief irrigated crops are onions, followed by sugarcane and fruit. In the caatingas, the agricultural land constitutes small isolated areas restricted to the cultivation of manioc, corn, beans, watermelons and other melons.

3. Agroclimatic Indices

Figure 3.8 shows the historical Yield Moisture Index (YMI) in percentiles for Quixeramobin (Central Region). The YMi was computed for a corn corp during the main growing season, March-June. YMI values in the lower 15th percentile suggest poor corn crop conditions during 1970, 1972, 1981 and 1983. The critical YMI value for crop failure may be determined by using episodic data (Appendix A) and historical crop yield data.

AGROCLIMATIC INDEX

QUIXERAMOBIM

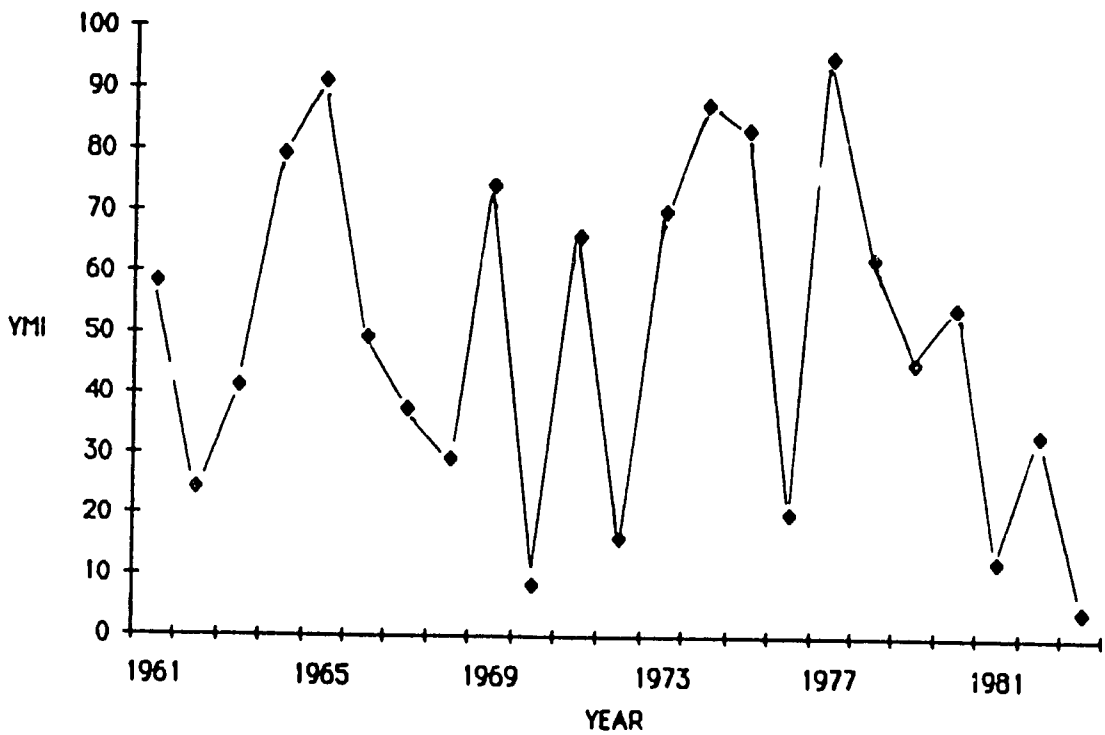


Figure 3.8

CHAPTER IV

MEXICO

A. Physical Environment

1. Overview

Mexico is located in the southern portion of the North American continent. It is bordered on the north by the United States and on the South by Guatemala and Belize. The country has two shorelines: 6,608 kilometers on the Pacific Ocean and 2,611 kilometers on the Atlantic Ocean. It covers an area of 197 million hectares and is divided into 32 states. The total population is 67.7 million (Wilkie and Haber, 1983), of which about one-third is engaged in agricultural activities. Figure 4.1 shows country and states boundaries.

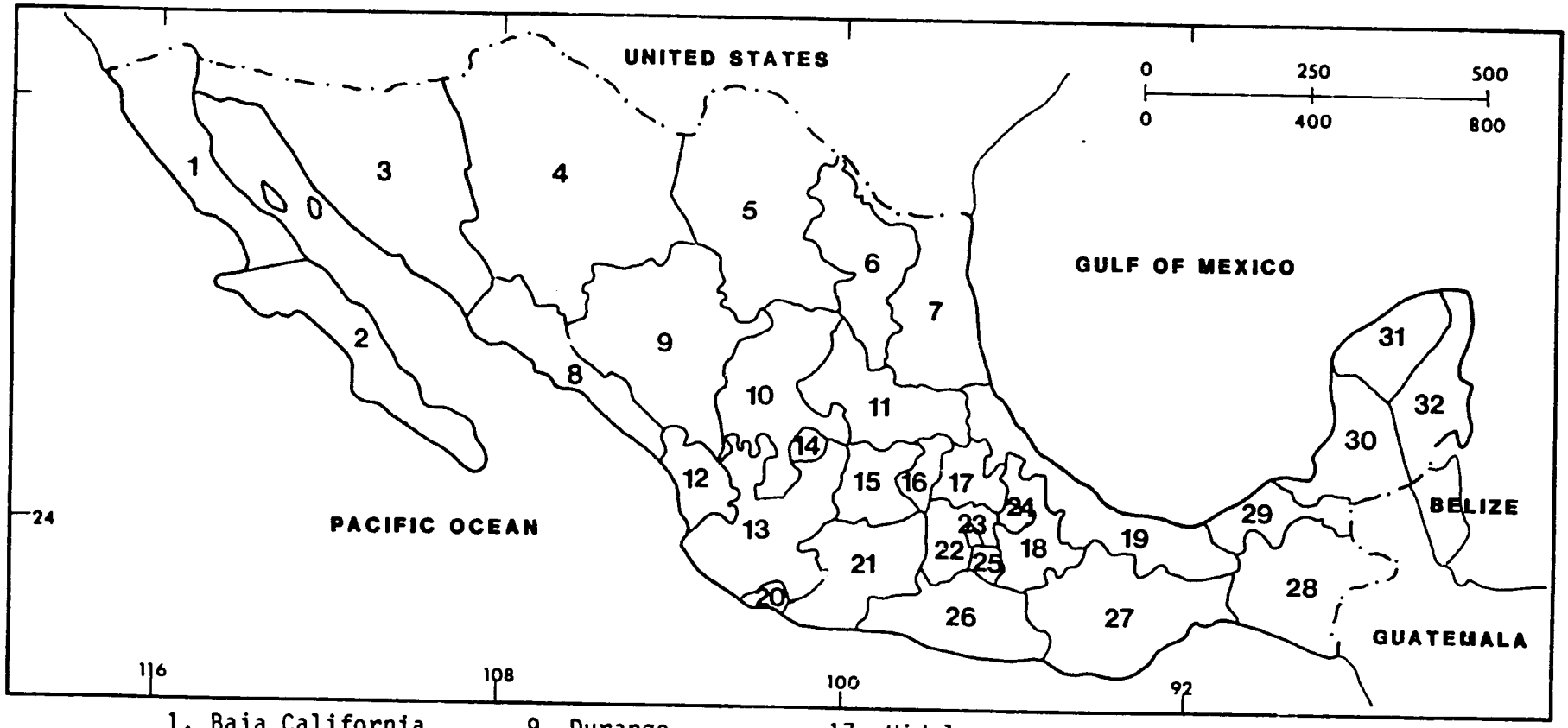
The main physiographic features of Mexico are the continuations of the more northern parts of the North American continent. The Sierra Madre Oriental is an extension of the Rocky Mountain range and the Sierra Madre Occidental is an extension of the Sierra Nevada range of the United States. A series of volcanic peaks that terminate the southward extension of North American physiographic features lie south between 18° and 20° north latitude. South of 18° north latitude the land descends to a broad depression formed by the Balsas River and its tributaries.

2. Soil and Natural Vegetation

Throughout the Pacific coast area the width of the lowland strip is relatively narrow and the soils are derived almost entirely from the erosion products of the highlands.

MEXICO

STATE BOUNDARIES



1. Baja California
2. Baja California Sur
3. Sonora
4. Chihuahua
5. Coahuila
6. Nuevo León
7. Tamaulipas
8. Sinaloa
9. Durango
10. Zacatecas
11. San Luís Potosí
12. Nayarit
13. Jalisco
14. Aguascalientes
15. Guanajuato
16. Queretaro
17. Hidalgo
18. Puebla
19. Veracruz
20. Colima
21. Michoacán
22. México
23. Distrito Federal
24. Tlaxcala
25. Morelos
26. Gerrero
27. Oaxaca
28. Chiapas
29. Tabasco
30. Campeche
31. Yucatán
32. Quintana Roo

Figure 4.1

In the highlands there are two distinctive areas where soils show special relationships caused by fine volcanic ash in the soil material, the northern uplands and the volcanic lands on the southern border of the country. Calcic cambsols are characteristic of the central region. Rendzinas derived from hard white crystallized limestone are common along the eastern flank of the Mexican highlands. Lithosols are found chiefly in desert areas.

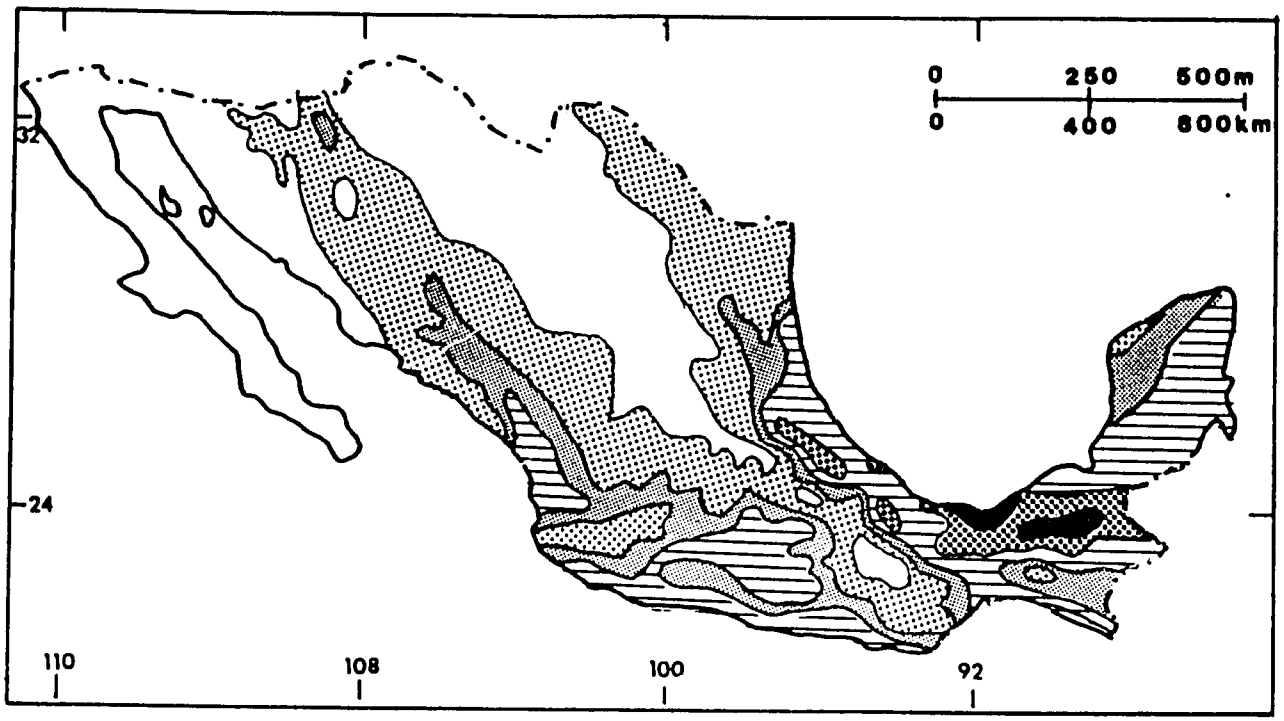
Conifer, cedar and oak forests predominate in the northern mountains. At lower levels, grass-covered savannas are dotted with palm and poplar, and willows grow along river banks. Mahogany, cedar, rosewood, ebony and logwood are found in the tropical rain forest that borders the Gulf of Mexico. Dry scrub and grassland are characteristic of most of the flatter lands of the north and central part of the country. Mexico's tropical forest has cacao trees and vanilla orchids.

3. Climate

Because of its topography and geographic location, Mexico has a variety of climates. The trade winds are the prevailing winds, blowing out of the northeast across the Gulf of Mexico and influencing most of the land mass. Extratropical cyclones crossing the Sierra Madre cause occasional rain in the northern deserts. During summer and fall both the Pacific and the Atlantic coasts are subject to hurricanes.

Rainfall ranges from extremely scanty in the northern deserts to extremely heavy in the tropical wet climate of the southeastern slopes of the Sierra Madre and portions of the Gulf coast (Figure 4.2). In most of the country the rainy season extends from late May to October or November. Scarcity and maldistribution of rainfall are the major problems for agriculture, particularly in temperate areas.

MEXICO
MEAN ANNUAL RAINFALL



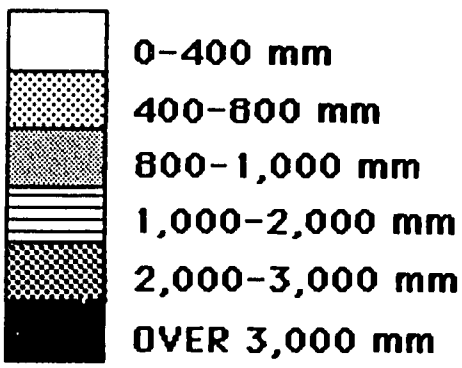


Figure 4.2

Mexico is frequently plagued with climatic disasters. Prolonged droughts, floods and frosts are common occurrences in many parts of the country. Tropical hurricanes occur between July and October.
For the purpose of crop condition assessment, Mexico has been divided into six agroclimatic regions. Figure 4.3 shows the agroclimatic regions and rainfall distribution of selected stations. Figure 4.4 shows the location of weather stations considered in the analysis of the agroclimatic regions and Table 4.1 shows station names.

B. Agriculture

1. Overview

Agriculture accounts for more than half of export-earnings. Agricultural production and the marketing of produce is made complex by the country's geography, climate and different forms of farm organization and land tenure.

Although most farmers no longer practice shifting (rotating) cultivation because of the growing use of fertilizer and irrigation, some shifting cultivation does take place in the states of Chiapas, Guerrero, Oaxaca, Tabasco and Veracruz and in the Yucatan Peninsula. In the state of Campeche, shifting cultivation is the dominant form of land use and much valuable forestland is lost annually. Plowing is done with animal or mechanical power. Commercial fertilizer is applied by those farmers who can afford it.

Irrigation plays a prominent role in Mexican agriculture. About 80 percent of all water use in the country is for agriculture and almost 70 percent of government investment in agriculture has been for irrigation projects.

Table 4.2 shows an estimated crop calendar for major food crops.

MEXICO

AGROCLIMATIC REGIONS

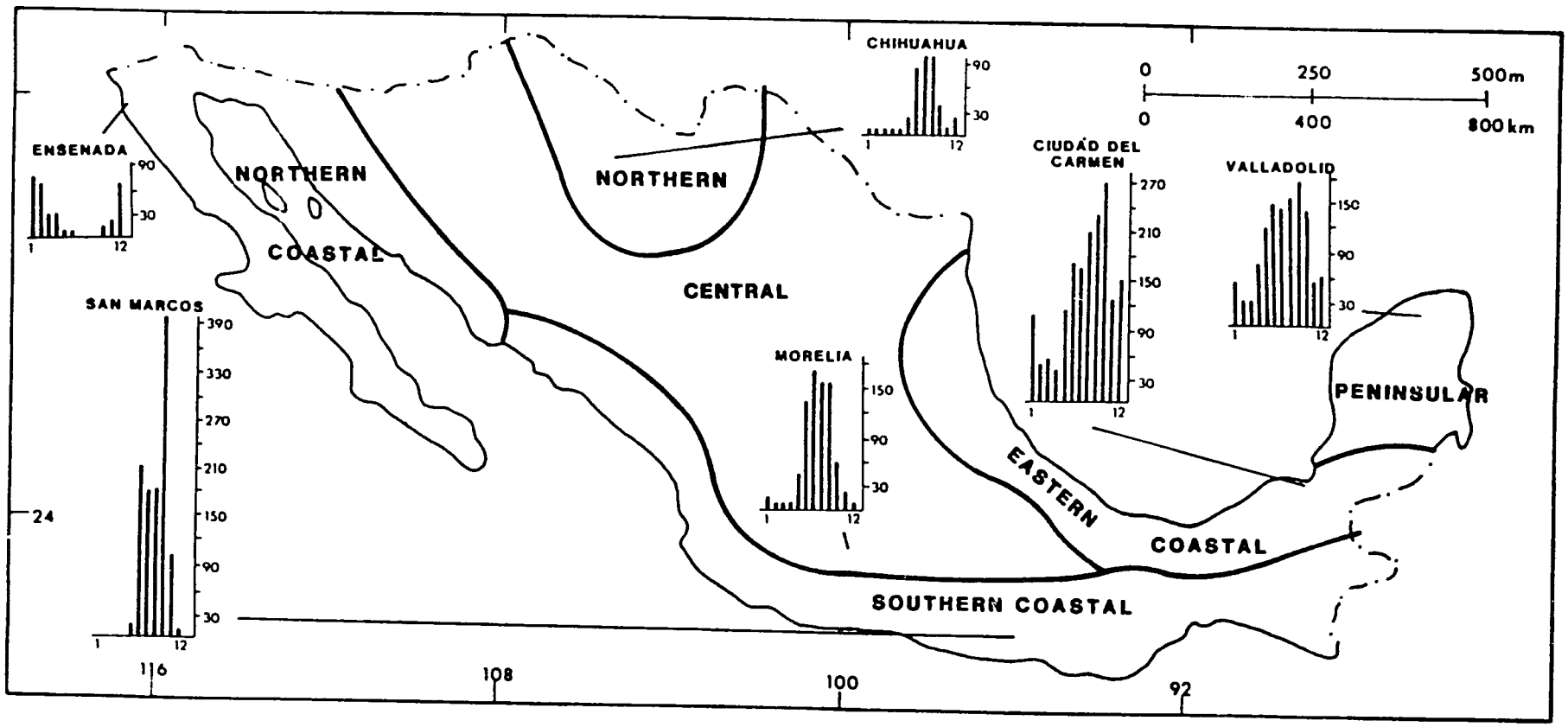


Figure 4.3

MEXICO

WEATHER STATIONS

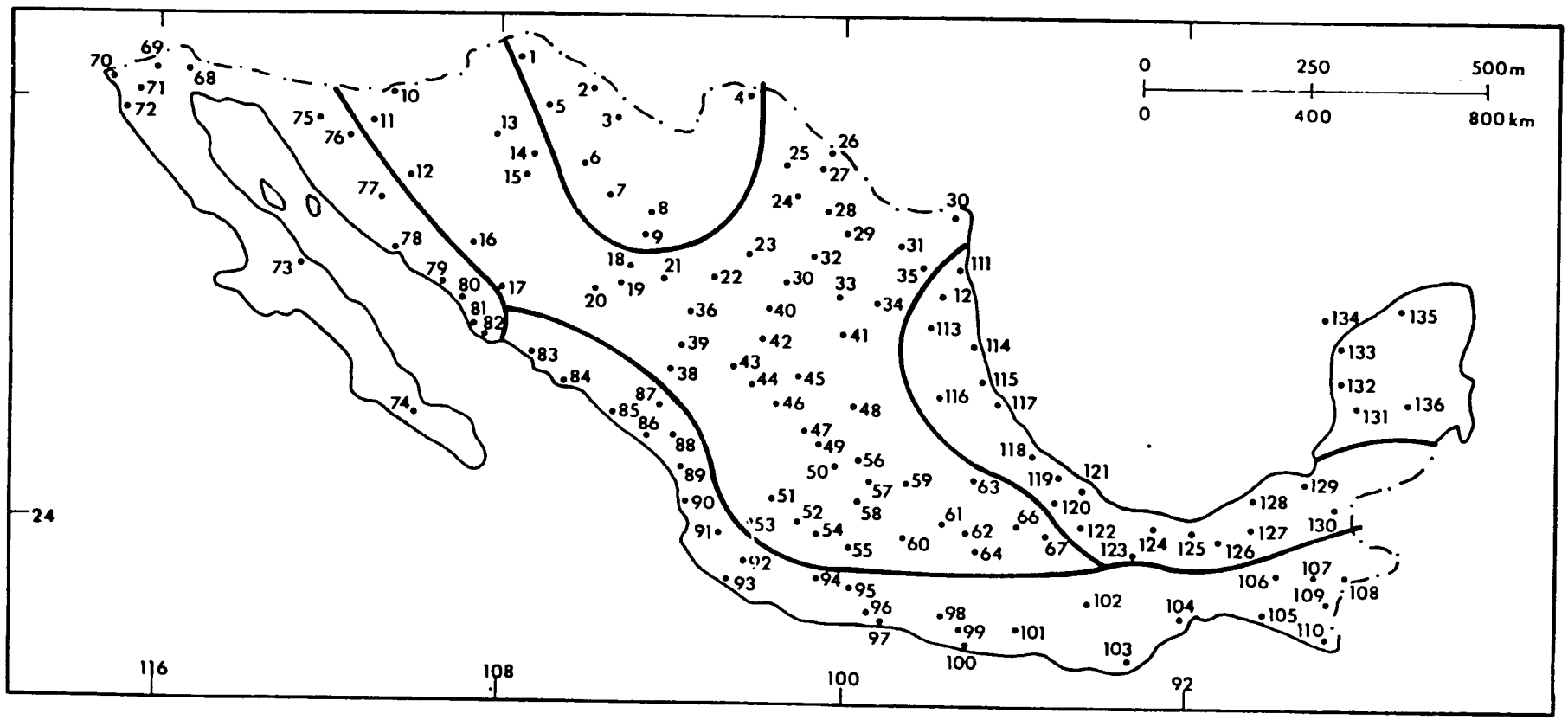


Figure 4.4

Table 4.1

AGROCLIMATIC REGIONS AND WEATHER STATIONS

NORTHERN

1. Ciudad Juárez
2. Casas Grandes
3. Ojinaga
4. El Burro
5. González
6. Chihuahua
7. Ciudad Camargo
8. Sierra Mojada
9. Carrillo

CENTRAL

10. Macó
11. Cananea
12. Ures
13. Garcia
14. Madera
15. Temosachic
16. Quiriego
17. El Fuerte
18. Choix
19. El Oro
20. Guanacevi
21. El Rodeo
22. Torreón
23. Cuatrociénegas
24. Monclova
25. Sabínas
26. Nuevo Laredo
27. Camarón
28. Villa Aldama
29. Monterrey
30. Matamoros
31. Méndez
32. Saltillo
33. Galeana
34. Linares
35. Burgos
36. San Juan del Río
37. Durango
38. El Salto
39. Mazapil
40. S. J. de Guadalupe
41. Matehuala
42. Río Grande
43. Sombrerete
44. Fresnillo
45. Zacatecas
46. San Pedro
47. Aguascalientes
48. San Luis Potosí
49. Lagos de Moreno
50. León
51. Guadalajara
52. Penjamo
53. Tapalpa
54. Zamora
55. Morelia
56. Guanajuato
57. Celaya
58. Abasolo
59. Queratarо
60. Zitacuaro
61. Toluca
62. México City
63. Pachuca
64. Cuernavaca
65. Taxco
66. Puebla
67. Tehuacán

NORTHERN COASTAL

68. San Luis
69. Mexicali
70. Tijuana
71. Bellavista
72. Ensenada
73. El Boleo
74. La Paz
75. Altar
76. Santa Ana
77. Hermosillo
78. Guaymas
79. Ciudad Oregon
80. Navojoa
81. Ahome
82. San Blas

SOUTHERN COASTAL

83. Cullacán
84. La Cruz
85. Mazatlan
86. Aponeta
87. Maclovia Herrera
88. Rosa Morada
89. Tepic
90. Pto. Vallarta
91. Tomatlan
92. Colima
93. Manzanillo
94. Uruapan
95. Curumuco
96. El Ticuf
97. La Union
98. Atoyac
99. Tierra Colorada
100. Acapulco
101. San Marcos
102. Oaxaca
103. Puerto Angel
104. Salina Cruz
105. Tonala
106. Tuxtla Gutierrez
107. San Cristobal de las Casas
108. Comitán
109. Aurora
110. Tapachula

EASTERN COASTAL

111. San Fernando
112. Abasolo
113. Ciudad Victoria
114. Punta Jerez
115. Aldama
116. Rio Mante
117. Tampico
118. Tuxpan
119. Nautia
120. Jalapo
121. Veracruz
122. Tierra Blanca
123. Venustino Carranza
124. San Andrés Tuxtla
125. Coatzacoalcos
126. Cadenas
127. Villa Hermosa
128. Alvaro Obregon
129. Ciudad del Carmen
130. Tenosique

PENINSULAR

131. Cuautla
132. Champotón
133. Merida
134. Progreso
135. Valladolid
136. Chetumal

TABLE 4.2

ESTIMATED CROP CALENDAR FOR MEXICO

/// Planting or Sowing, --- Vegetative/Flowering, 000 Harvesting

Region	Crop	J	F	M	A	M	J	J	A	S	O	N	D
Northern	Corn					///	///	---	---	---	---	000	
	Wheat	---	---	---	-00	000	000	---	---	---	---	///	///
	Beans						///	---	---	--0	000		
Central	Corn						///	---	---	---	---	000	000
	Wheat	---	---	---	000	000	000					///	///
	Rice						///	---	---	---	000	000	
	Beans						///	---	---	--0	000		
	Potatoes						///	---	---	--0	000		
Eastern Coastal	Corn				///	///	---	---	---	000	000		
	Rice					///	---	---	---	-00	000		
	Beans					///	---	---	--0	000			
	Potatoes					///	---	---	--0	000			
Northern Coastal (1)	Corn					///	///	---	---	-00	000	000	
	Wheat	---	---	---	000	000							///
	Rice						///	---	---	000	000		///
	Beans						///	---	---	000	000		
Southern Coastal	Corn						///	---	---	---	000	000	
	Rice						///	---	---	-00	000		
	Beans						///	---	---	-00	000		

(1) Irrigated

2. Major Crops

a. Commercial Crops

Cotton

Mexico usually accounts for about 3 percent of world cotton production. The acreage planted to cotton has been declining but the yield has been increasing. Cotton is the most heavily irrigated crop. The leading cotton-growing areas are in Sonora, Sinaloa, Baja California and the La Laguna area. Figure 4.5 shows major cotton growing areas.

Sugarcane

The per capita domestic consumption of sugar is one of the highest in the world. Sugarcane is grown in about fifteen states, but the major concentrations are in the coastal areas, mainly in Veracruz. Difficulties have been experienced by the industry. Cane growers are paid by the percentage of the sugar extracted from the cane by the mills, with a guaranteed minimum percentage; however, few refineries have been able to achieve the established minimum percentage.

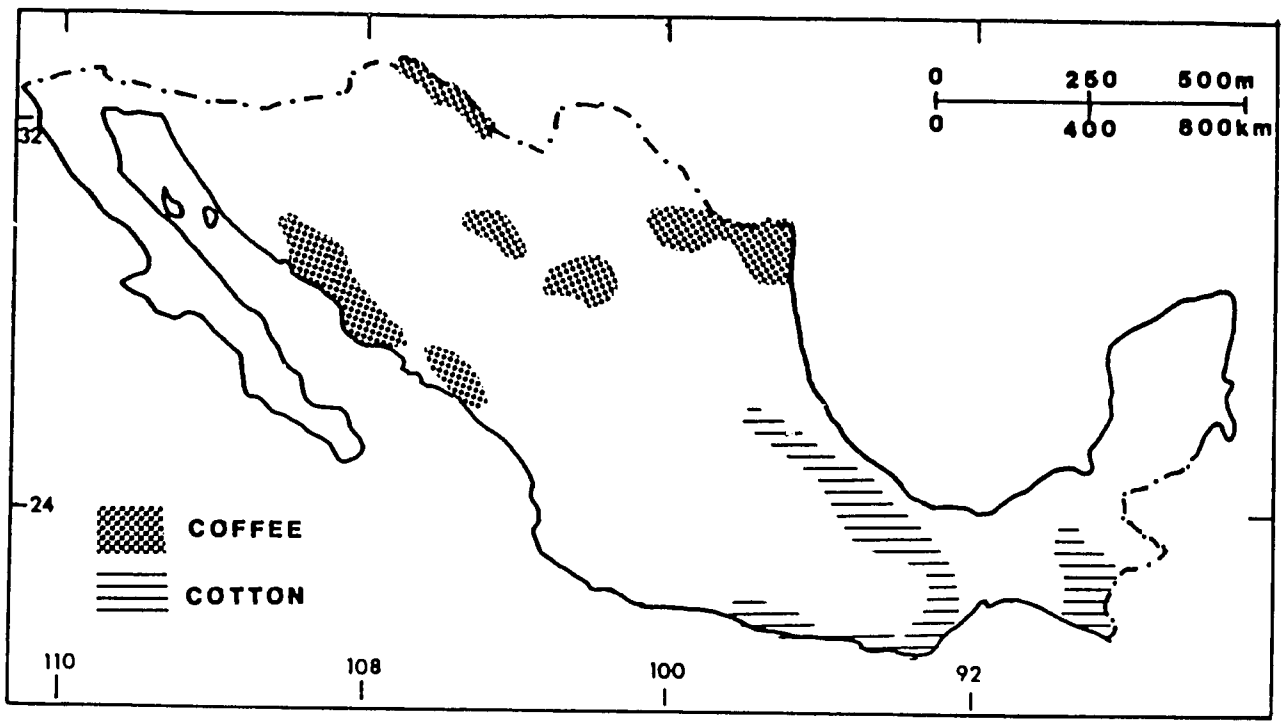
Coffee

Coffee is grown on about 300,000 farms in the Gulf coast and South Pacific regions, mainly in Chapas, Veracruz and Oaxaca. About one-third of total coffee production comes from the Chiapas Highlands. Mexican coffee usually commands a slightly higher price in world markets because of its high quality. Figure 4.5 shows major coffee growing areas.

Bananas

Bananas are cultivated on the lower, hotter floors of many valleys and coastal plains. The major growing areas are the lowest part of eastern slopes of Sierra madre oriental and the southern coastal areas of the gulf and Pacific regions (Figure 4.5)

MEXICO
DISTRIBUTION OF MAJOR CROPS



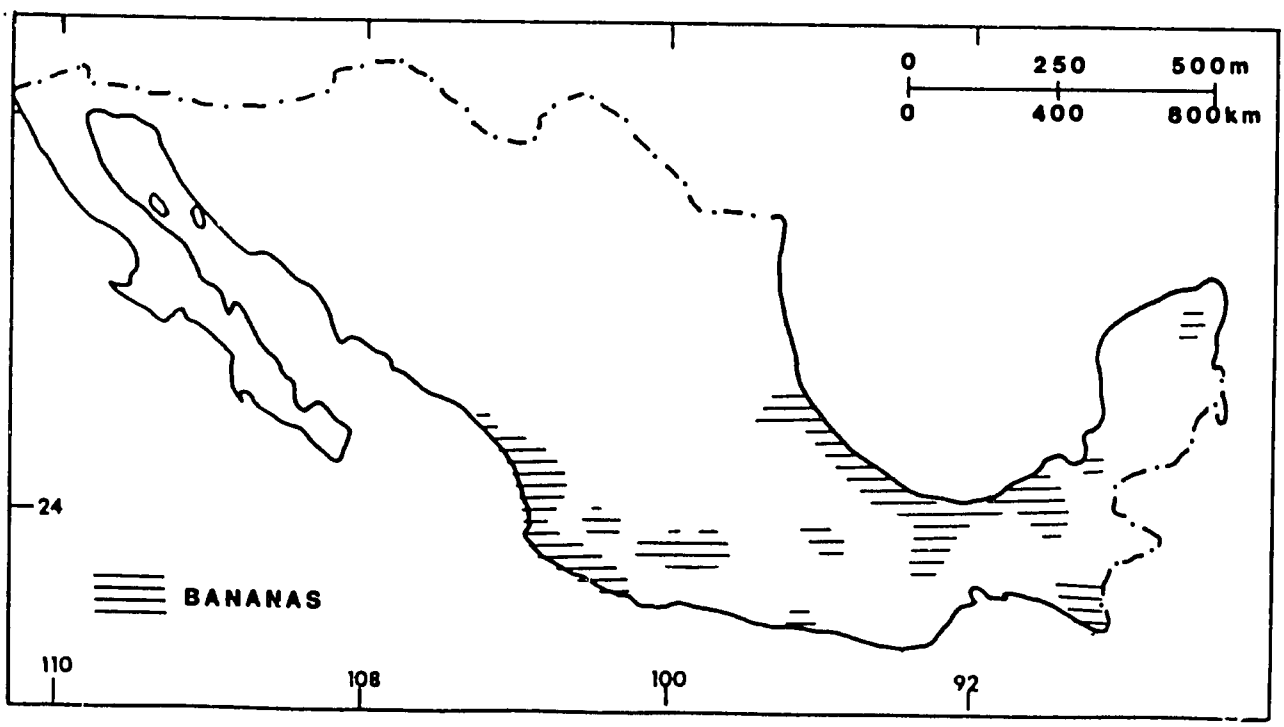


Figure 4.5

b. Food Crops

Corn

Corn, the staple food, is produced in quantities usually sufficient to meet domestic demand with some excess for export. The largest share of acreage, as much as 50 percent of total cropland, is devoted to corn cultivation. In 1979 over 7 million hectares were planted in corn. About half of the corn acreage is in Central Mexico, where subistence agriculture is the most widely practiced. The yield of irrigated corn is more than double the yield on unirrigated land. Figure 4.6 shows major corn growing areas.

Wheat

Wheat is cultivated under irrigation in areas of the North, the Northeast and the Bajio. Yields are very high because of irrigation, improved varieties, fertilization and pest control. Mexican seed is exported to numerous countries. The country is not self-sufficient in wheat and as much as one million tons had to be imported in the 1975 crop year. Figure 4.6 shows major wheat growing areas.

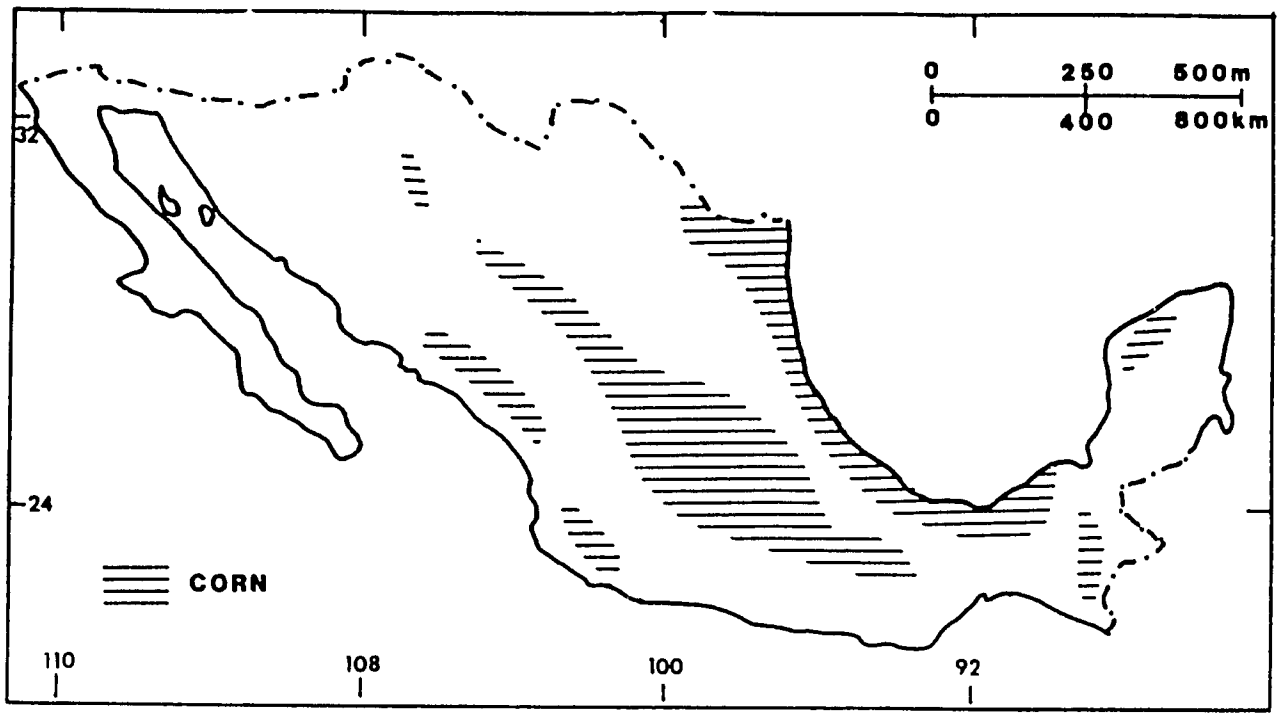
Beans

Beans are another staple food. Although much of the production comes from small plots, the use of improved varieties, pest control and fertilizer has helped to increase yields. Figure 4.7 shows major beans growing areas.

Rice

Rice is mostly grown on irrigated lands. The major intensive growing areas are the coastal plains near Yagui and Fuerte rivers on the northern Pacific region and the gulf area near Veracruz. Also the plains and valleys lowlands of the central region and the coastal land in the Pacific cultivate some rice for local consumption. Figure 4.7 shows major rice growing areas.

MEXICO
DISTRIBUTION OF MAJOR CROPS



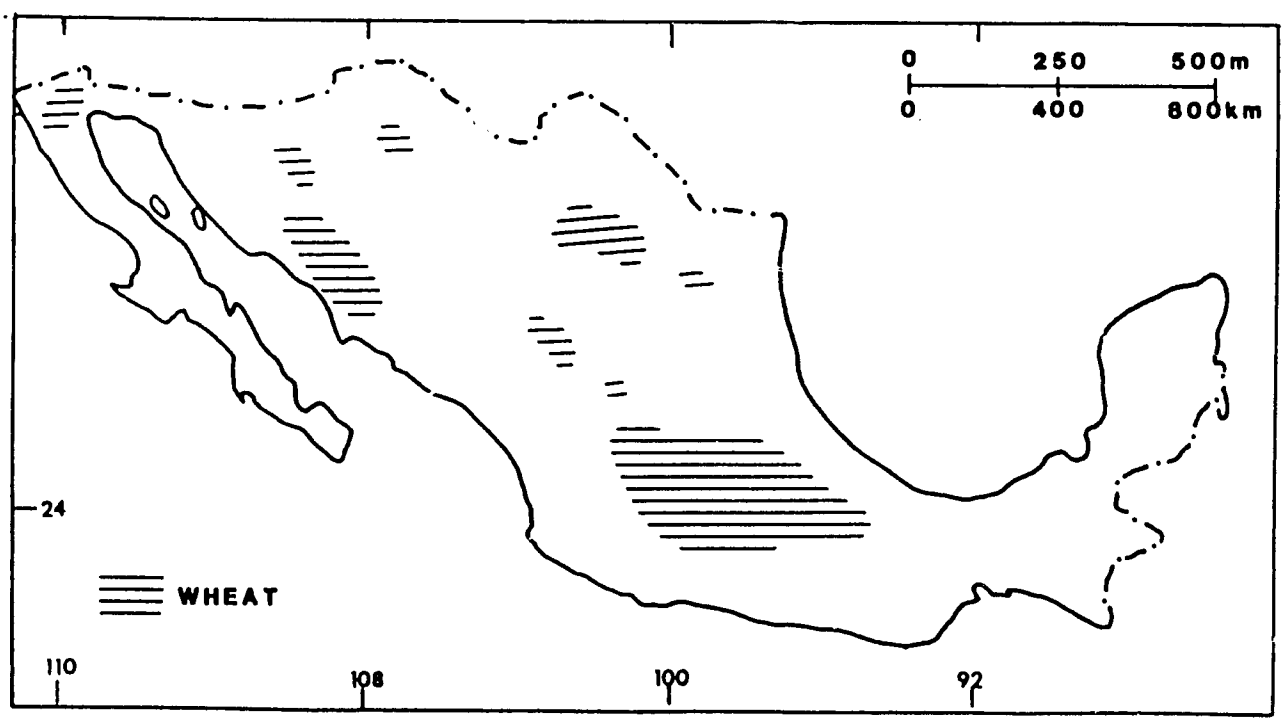
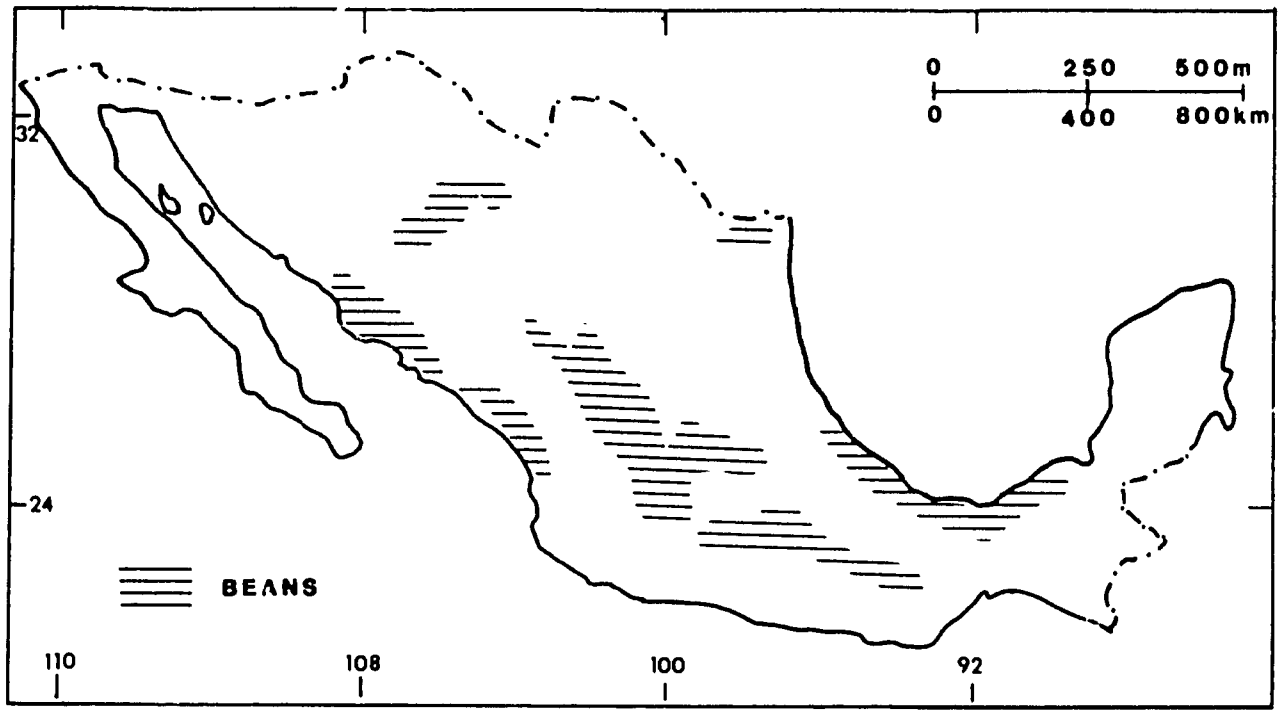


Figure 4.6

MEXICO
DISTRIBUTION OF MAJOR CROPS



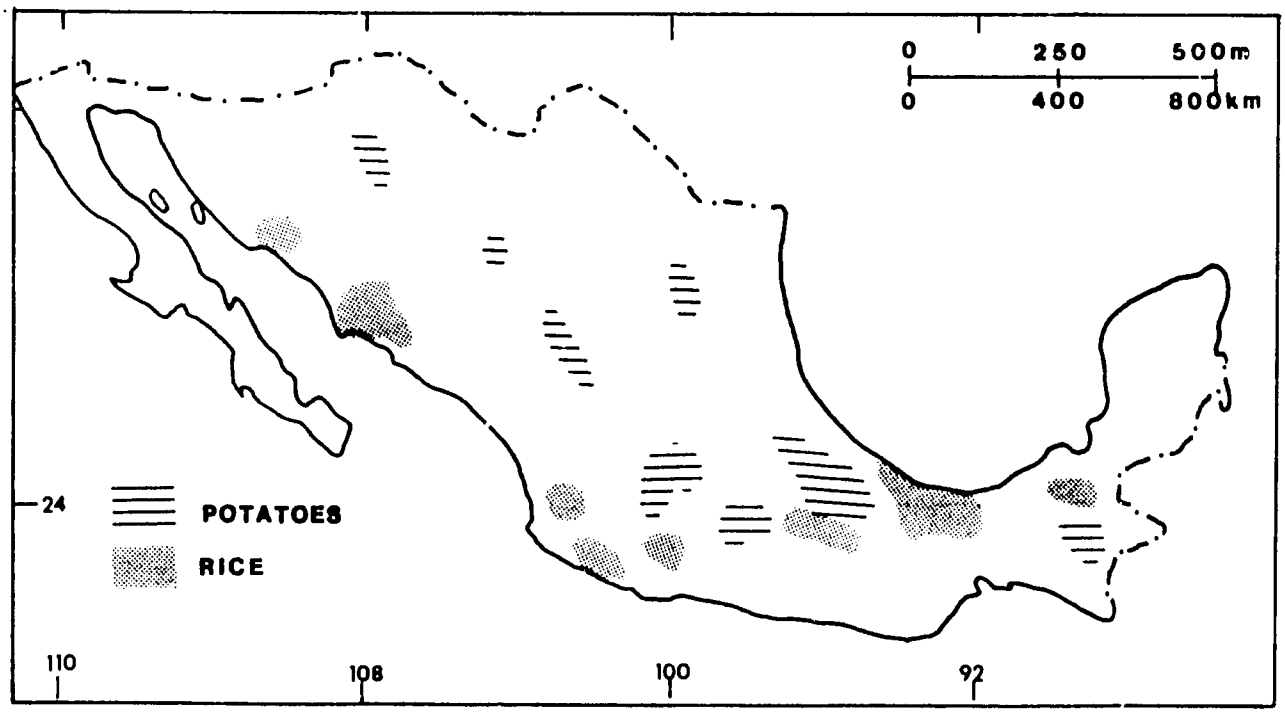


Figure 4.7

Fruits and Vegetables

Large quantities of more than thirty varieties of fruits and vegetables are grown for export. The more important are potatoes (Figure 4.7) tomatoes, cucumbers, eggplant, string beans, strawberries and green papers. The state of Sinaloa is the main producing area for fruits and vegetables grown for export.

3. Agroclimatic Indices

Figure 4.8 shows the historical Yield Moisture Index (YMI) in percentiles for Tapachula (southern coastal region). The YMI was computed for a corn crop during the main growing season (June-November). YMI values in the lower 20th percentile suggest poor corn crop conditions during 1962, 1966, 1967 growing seasons. The critical YMI value for crop failure may be determine by using episodic event data (Appendix A) and historical crop yield data.

AGROCLIMATIC INDEX

TAPACHULA

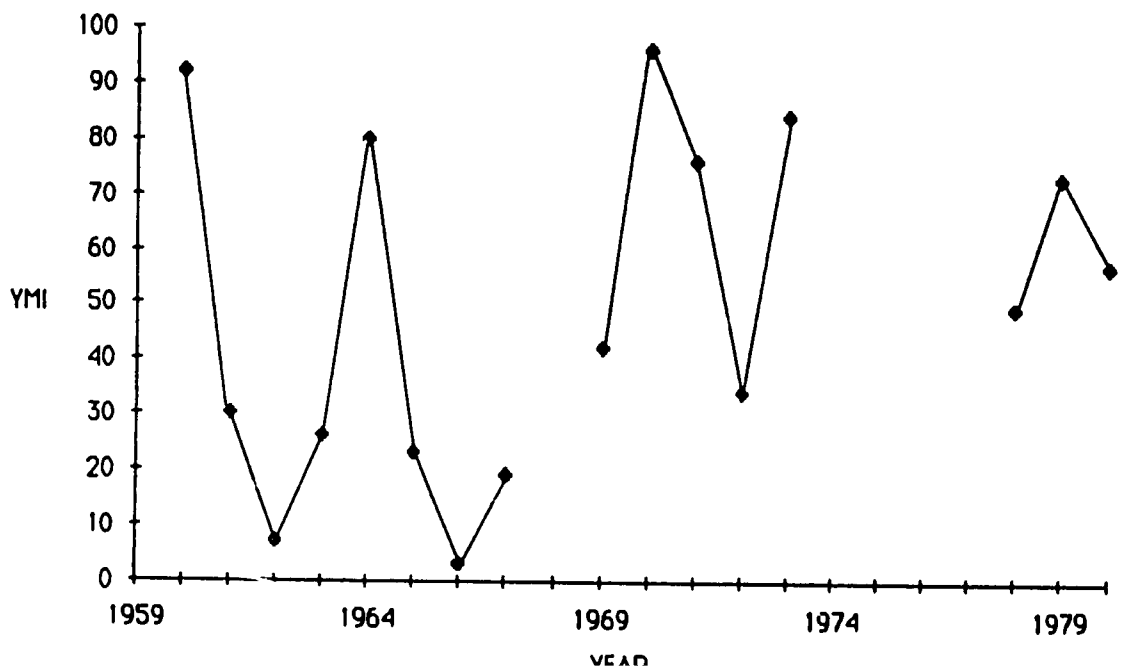


Figure 4.8

CHAPTER V

PARAGUAY

A. Physical Environment

1. Overview

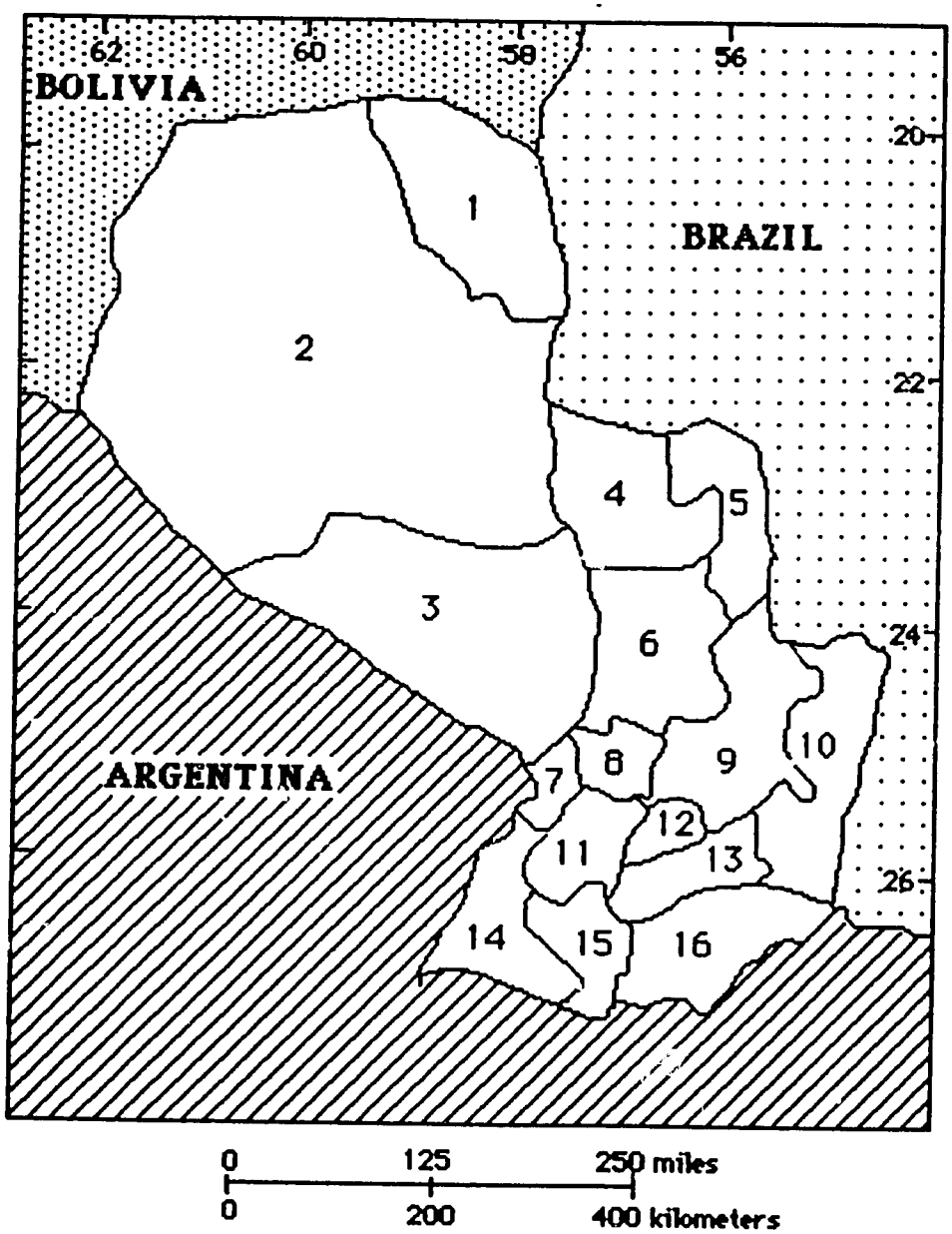
Paraguay is an inland country located in south-central South America. It borders on the North and Northeast with Brazil, on the South and Southeast with Argentina and on the West with Bolivia. It covers an area of 60.6 million hectares and is divided into 16 departments. The total population is 2.9 million (Wilkie and Haber, 1983), the agricultural population is about 1.4 million. Figure 5.1 shows country and departmental boundaries.

The country is generally very flat. Only 20% of the land on the eastern side may be classified as hills, rarely exceeding 500 m in altitude. The highest peak rises 850 m above sea level.

The Paraguay River splits the country into two distinct regions. To the west is the Chaco, which occupies 57% of the total area of the country. This is a hot and semiarid plain with scanty population. East of the river lies the area properly called Paraguay, a region of plains and gentle hills. This region is divided into five physiographic subregions: the heavily wooded Parana Plateau to the east; the Northern Upland consisting of rolling terrain about 200 m above sea level to the north; the Neembucu Plain, an alluvial flatland in the southwest corner; and between these subregions the Central Lowland and the Central Hill Belt, areas of low elevation and relief which slope gently toward the Parana Plateau. Figure 5.2 shows the major natural regions.

PARAGUAY

DEPARTMENTAL BOUNDARIES



1. OLIMPO
2. BOQUERON
3. PRESIDENTE HAYES
4. CONCEPCION
5. AMAMBAY
6. SAN PEDRO
7. CENTRAL
8. CORDILLERA
9. CAAGUAZU
10. ALTO PARANA
11. PARAGUARI
12. GUAIRA
13. CAAZAPA
14. NEEMBUCU
15. MISIONES
16. ITAPUA

Figure 5.1

PARAGUAY
MAJOR NATURAL REGIONS

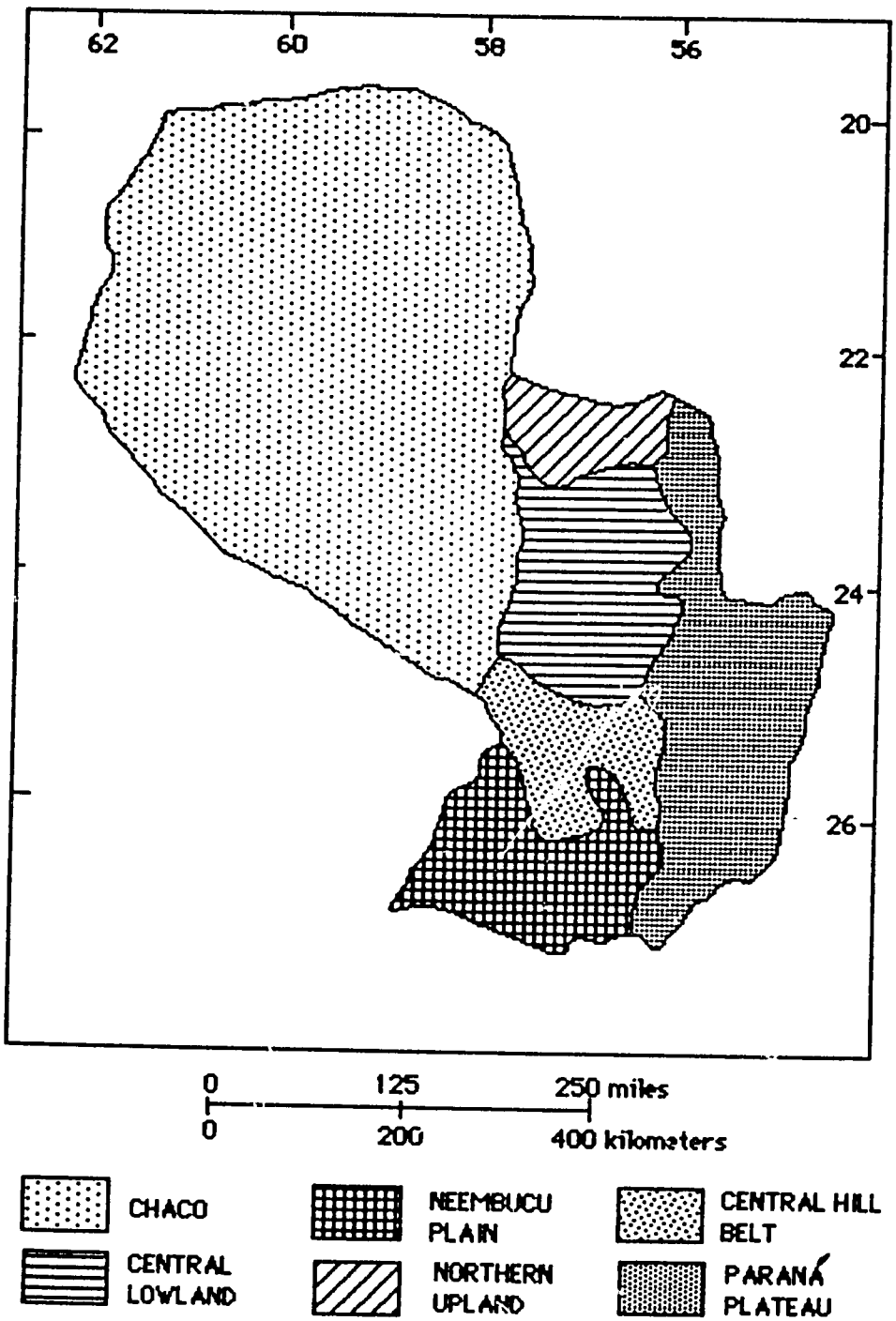


Figure 5.2

The Paraguay and Parana Rivers and their tributaries serve as indispensable transportation routes. Most of the largest towns of the country as well as the capital, Asuncion, are river ports. The riverine lowlands are subject to annual flooding and about 30% of Eastern Paraguay is flooded from time to time. Figure 5.3 shows major rivers.

2. Soil and Natural Vegetation

The soil of the Chaco area is formed of clay sediment and sand derived from the slopes of the Andes, which are steadily becoming consolidated. Soils in the southern part of the region are of a more recent origin than those in the north and have lighter structure and more uniform consistency.

In Eastern Paraguay, the Parana Plateau is made up of lava flows resting on red sandstones. This dark chocolate-red soil is one to three meters thick and supports a cover of luxuriant natural vegetation. The rest of the Paraguay region is covered by residual soils, except where fingers of old crystalline rock have intruded as rounded hills. The residual soils are usually red in color, sandy in texture and acid in reaction. They are well suited to shifting agriculture, but mineral deficiencies limit their suitability for sedentary cultivation without the use of fertilizers and improved agricultural techniques.

The Southern half of the Chaco area is open land covered with rough grasses, cacti and native bush which resembles mesquite. The Northwestern half consists almost entirely of thorny shrubs and deciduous dry forest.

About half of Eastern Paraguay is forested, with most of the workable woodland occurring on the Parana Plateau. The forests are dense, luxuriant and consist of mixed species, with some of the trees reaching more than 40 m in height. Directly eastward from the Paraguay River is a series of

PARAGUAY
MAJOR RIVERS

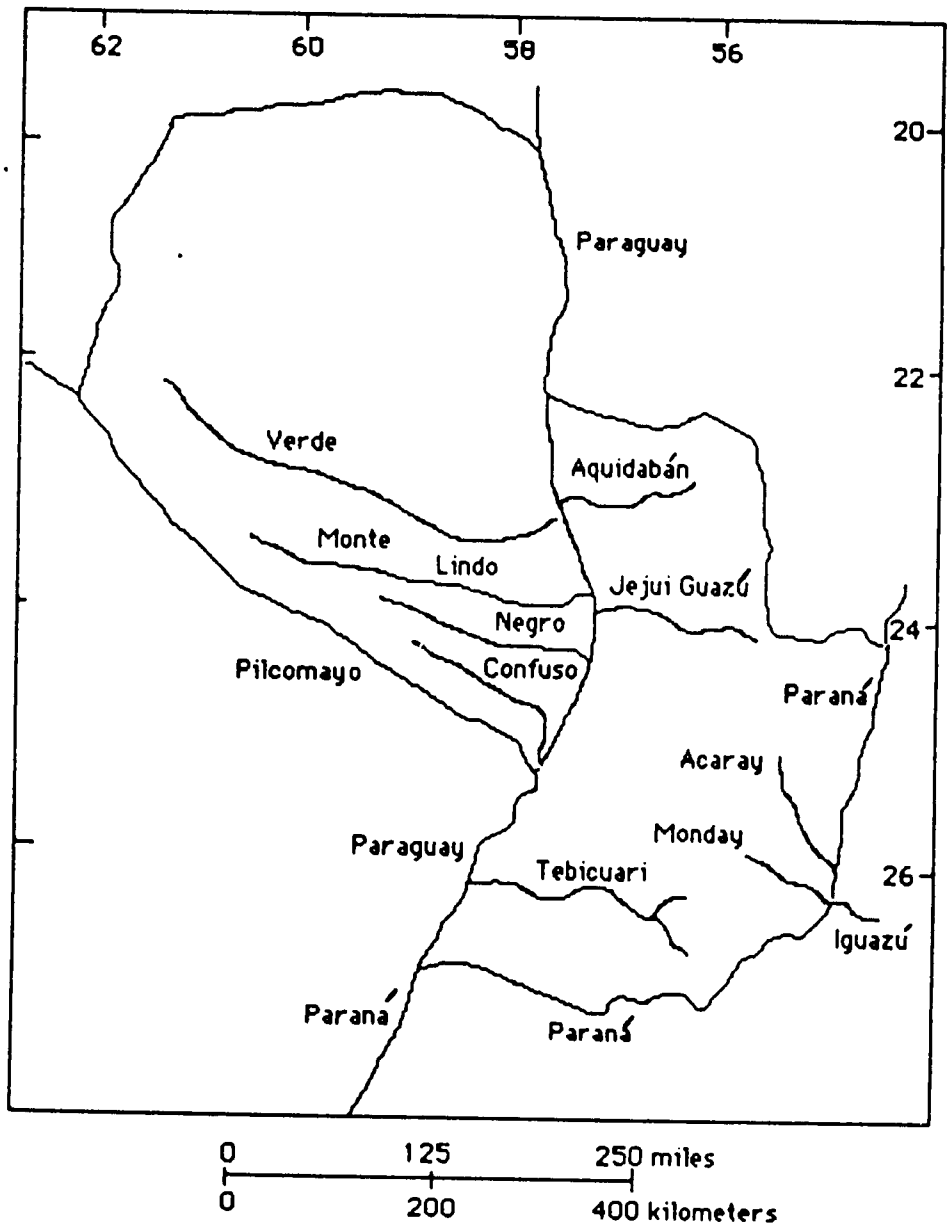


Figure 5.3

vegetation belts. Along the river are low fields and swamps with grasses and scattered clumps of palms, farther inland are rolling savannas. The forests of this area have been cleared by slash-and-burn agriculture or by flooding, creating excellent pasture.

3. Climate

Paraguay has a subtropical climate, with summer rains and dry winters. During the summer months, between October and March, moist tropical air conditions are dominant, the average temperature ranges between 26°C and 37°C. In winter, from April to September, the mean monthly temperature is between 16°C and 25°C. Northwestwards across the Chaco temperatures are usually higher. The average annual temperature in Encarnacion is about 20.8°C while in Bahia Negra it is about 25.5°C.

In eastern Paraguay the average annual rainfall varies from 1,700 mm in upper Parana to 1,200 mm on the lowlands of the Paraguay River. In this region precipitation is evenly distributed throughout the year but the heaviest rainfall occurs during the summer. Most of Chaco receives 400-800 mm of rainfall a year, concentrated between October and April. There is a marked difference between the dry and rainy seasons. The higher rates of evaporation in this area and impermeability of the alluvial soil result in periodic droughts followed by occasional floods.

Figure 5.4 shows mean annual rainfall. For the purpose of crop condition assessment, Paraguay has been divided into two agroclimatic regions. Figure 5.5 shows the location of the weather stations considered in the analysis of the agroclimatic regions and the rainfall distribution of selected stations.

PARAGUAY
MEAN ANNUAL RAINFALL

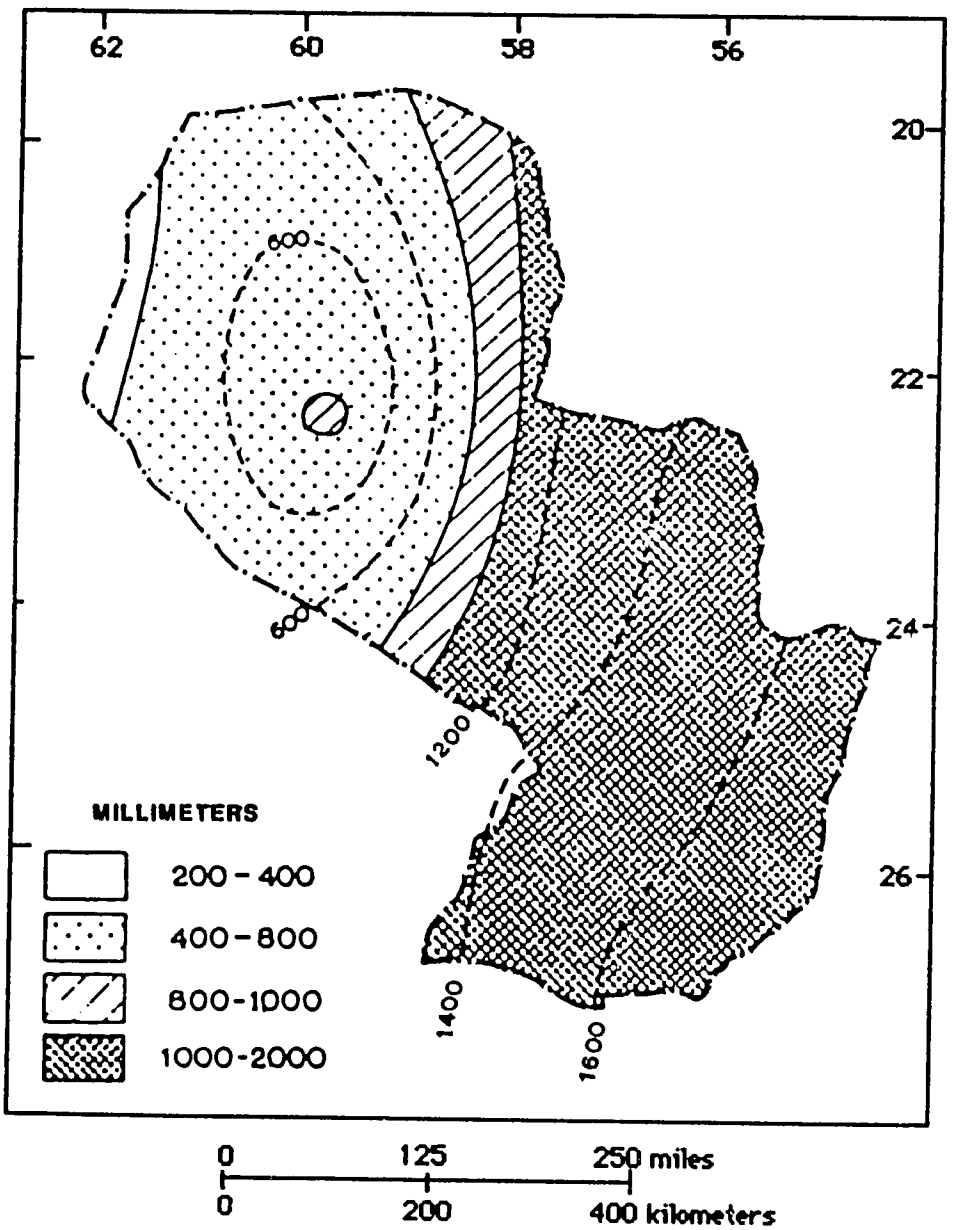
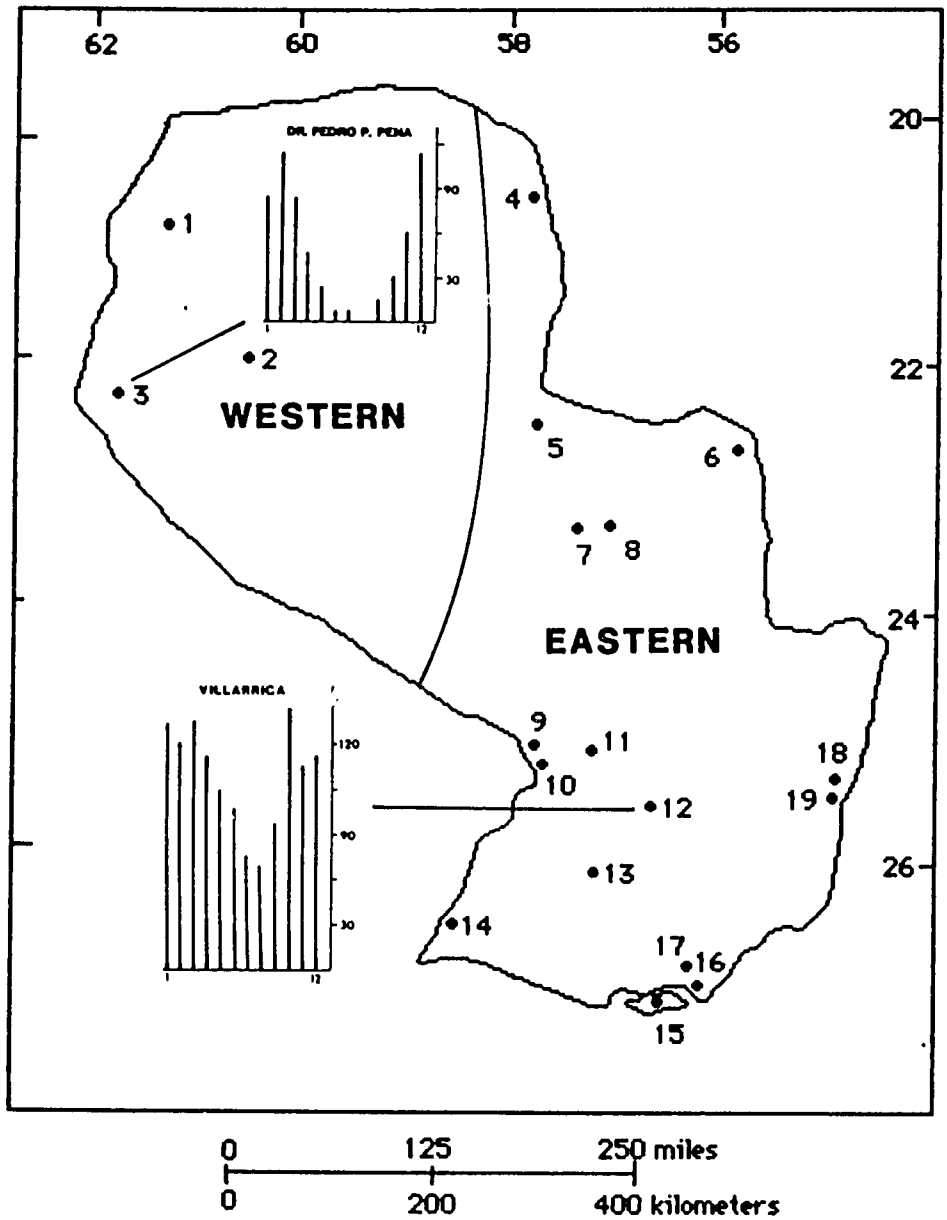


Figure 5.4

PARAGUAY

AGROCLIMATIC REGIONS/ WEATHER STATIONS



1. NUEVA ASUNCIÓN
2. MCAL. ESTIGARRIBIA
3. DR. PEDRO PENA
4. BAHIA NEGRA
5. PTO. CASADO
6. PEDRO J. CABALLERO
7. CONCEPCION
8. HORQUETA
9. ASUNCIÓN
10. SAN LORENZO
11. CAACUPE
12. VILLARRICA
13. SAN JUAN BAUTISTA
14. PILAR
15. ISLA YACYRETA
16. ENCARNACIÓN
17. CAPITAN MIRANDA
18. PTO. PTE. FRANCO
19. PTO. PTE. STROESSNER

Figure 5.5

B. Agriculture

1. Overview

Paraguay is almost self-sufficient in food production, with the exemption of wheat which is imported in large quantities. The main agricultural area of the country is eastern Paraguay. Most foodstuffs and commercial products are cultivated in the central area around Asuncion. The Chaco area is chiefly important only for animal husbandry. Forests, located mainly in Chaco and on the plateau of Parana, produce timber and lumber, tannin extract, coconut and hearts of palm. A number of tree crops raised commercially on farms, such as yerba mate (Paraguay tea) and bitter oranges, also grow wild.

Agricultural practices are traditional and on most farms date back to colonial and precolonial times. Slash-and-burn cultivation is practiced in most isolated areas, and land-fallowing or crop rotation is practiced only near Asuncion. Modern equipment and techniques are used only on the larger farms, chiefly located on the lowlands of both banks of the Paraguay River, as well as in the southern part of the eastern hills and in scattered spots of the Parana Plateau. In general, irrigation is not needed in most parts of the country. Fertilizer use started to increase in recent years, although cost limits its use to high value crops. The soils of Chaco are not as good and require fertilization because of a high concentration of mineral salts. The need for fertilizer is greatest in the central hill bell where cultivation has been practiced longer than elsewhere.

Figure 5.6 shows agricultural land use. The most valuable crops are cotton, sugarcane, tobacco, citrus fruits and yerba mate. The basic food crops are manioc, corn, beans, peanuts, sweet potatoes and rice.

PARAGUAY
AGRICULTURAL LAND

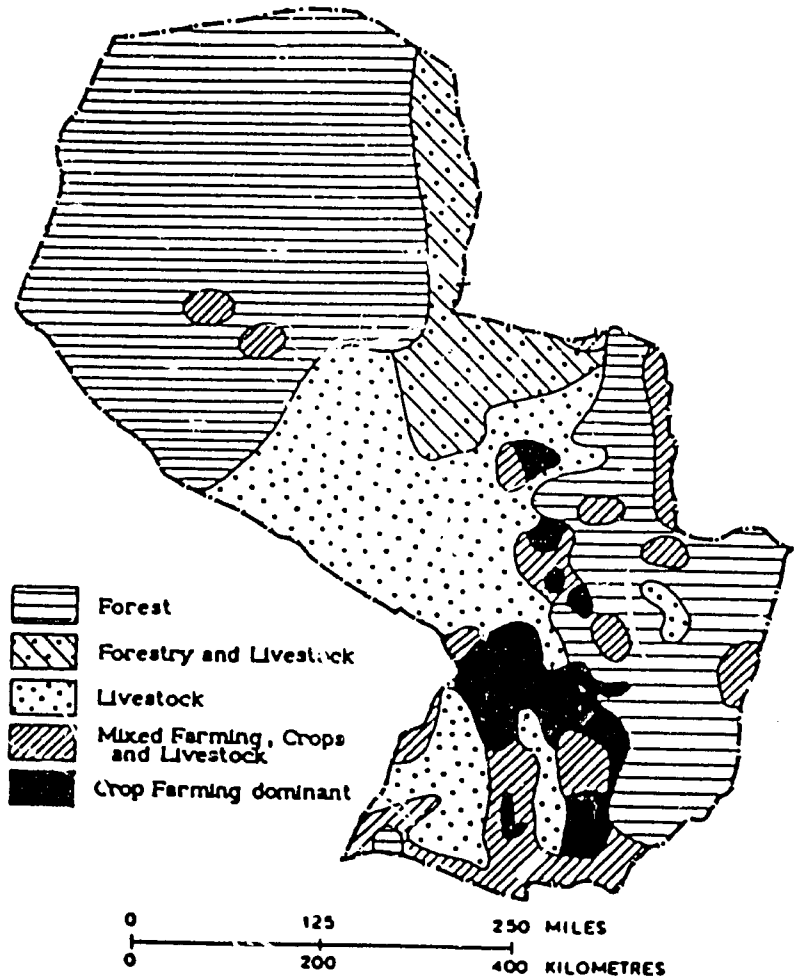


Figure 5.6

Wheat and various oil seeds are also grown on a minor scale. Planting and harvesting seasons are not well defined and many farmers frequently plant out of season which can result in occasional crop failures. Table 5.1 shows crop calendars for major food crops.

2. Major Crops

a. Commercial Crops

Cotton

The largest cotton fields are those the Mennonites farm in Chaco. Cotton is the oldest crop in the country. About 25 percent of total production comes from the Paraguari Department. Between 40 and 50 percent of all farmers produce cotton as a cash crop on some part of their land. Cotton is sowed during September and October and harvested during February and April. Most operations are not mechanized, and sowing and harvesting are done by hand. The fiber is not of high quality. The length ranges from 2.4 to 3 mm, a medium length, and the color is a uniform cream-color rather than white. These qualities apparently do not affect overseas markets. Less than 20 percent of the annual production is consumed domestically. Figure 5.7 shows major cotton growing areas.

Tobacco

Two types of tobacco are grown in Paraguay. A light, mild type is cultivated for export and a dark strong type is used domestically and exported on a minor scale to Argentina. Major production is centered near the town of Caraguaray in the Cordillera Department. Figure 5.7 shows major tobacco growing areas.

TABLE 5.1

ESTIMATED CROP CALENDAR FOR PARAGUAY

/// Planting or Sowing, --- Vegetative/Flowering, ooo Harvesting

Region	Crop	J	F	M	A	M	J	J	A	S	O	N	D
Eastern	Corn	000	000						///	///	/--	---	000
	Manioc	000	000	000	000	000	000	000	/// 000	/// 000	/// 000	000	000
	Rice	000	000							///	///	---	---
	Peanuts	---	000	000						///	///	---	---
	Sugarcane	---	---	---	---	---	---	000	/// 000	/// 000	///	///	---
Western	Manioc	000	000	000	000	000	000	000	000	000	000	000	000
	Corn	---	---	000	000	000					///	///	//-
	Peanuts	---	---	000	000	000					///	///	//-

PARAGUAY
DISTRIBUTION OF MAJOR CROPS

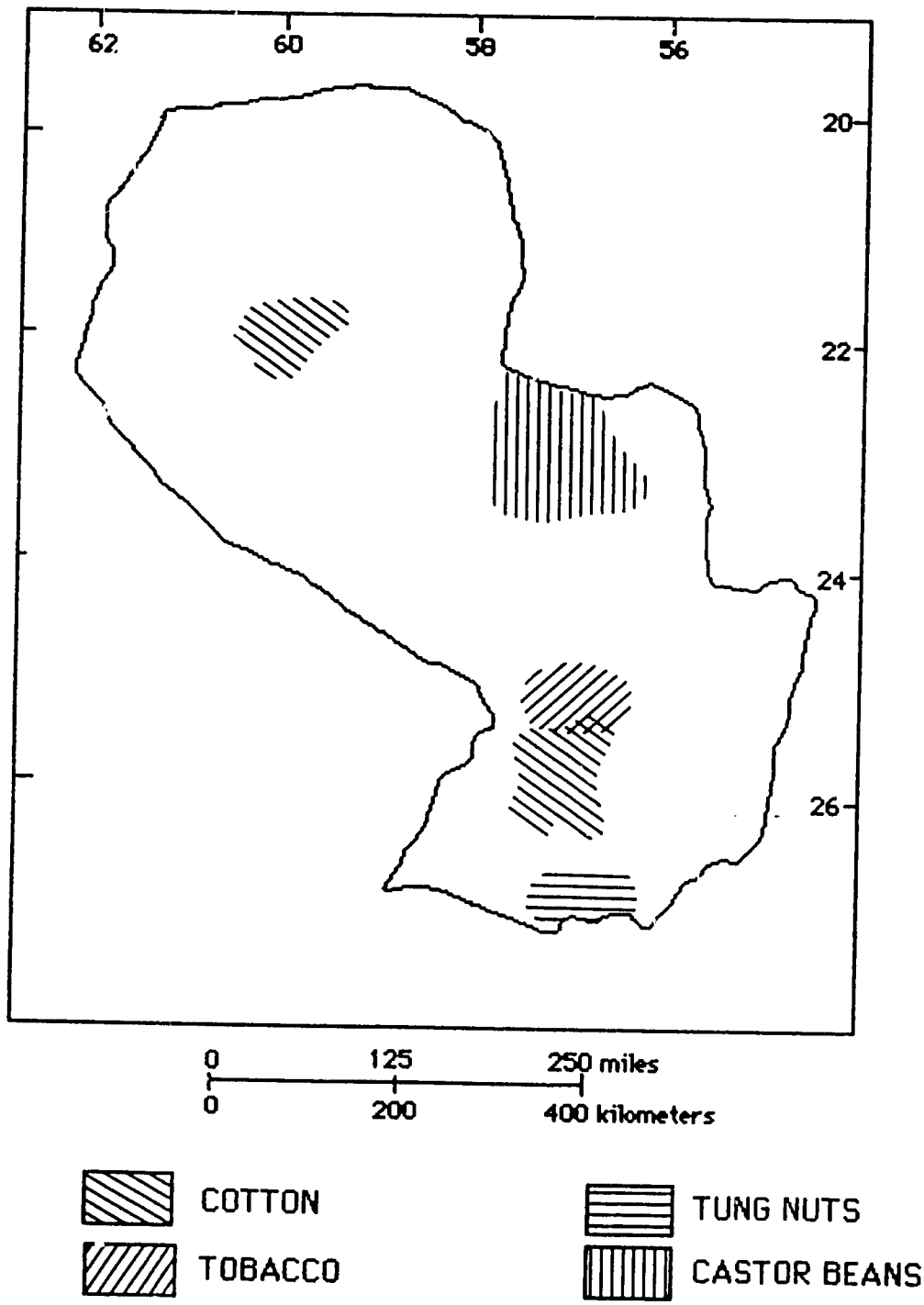


Figure 5.7

Sugarcane

Sugarcane is one of the oldest crops introduced, from Peru in the middle of the sixteen century. Sugar is raised throughout the country on about 20 to 25 percent of the farms, but one-third of the total production comes from large farms in the Guaira Department. Other large quantities are grown in Paraguari and Central Departments. Figure 5.8 shows major sugar growing areas.

Citrus Crops

The soil and climate of the country are considered ideal for citrus production, but the quality of most fruit is not high because of plant diseases. Oranges, tangerines, grapefruit, lemons, limes and bitter oranges are raised. In the late 1970's grapefruit exporters increased the quality of the fruit to take advantage of the growing export market.

Bitter orange fruit, leaves and tree twigs are the source of petitgrain oil, used in perfumes, cosmetics, soaps, and flavoring. The main area of production is the Cordillera Department. Almost all distilled petitgrain oil is exported; Paraguay is the world's leading supplier, providing between 70 and 75 percent of annual world requirements. Figure 5.8 shows the major growing areas for citrus crops.

Yerba Mate

The yerba mate tree or bush is the source of the national beverage called mate, a type of tea. About 60 percent of commercial production comes from Itapua Department, most of the balance being grown in San Pedro and Amambay Departments. About 80 percent of the commercial crop is produced by foregoing colonists, but most of the wild gathering is done by Paraguayans. After the leaves are heat dried and milled, they are ready for use. About 20 mills exist for processing the mate, mostly in Itapua Department. Figure 5.8 shows the major growing areas for yerba mate.

PARAGUAY
DISTRIBUTION OF MAJOR CROPS

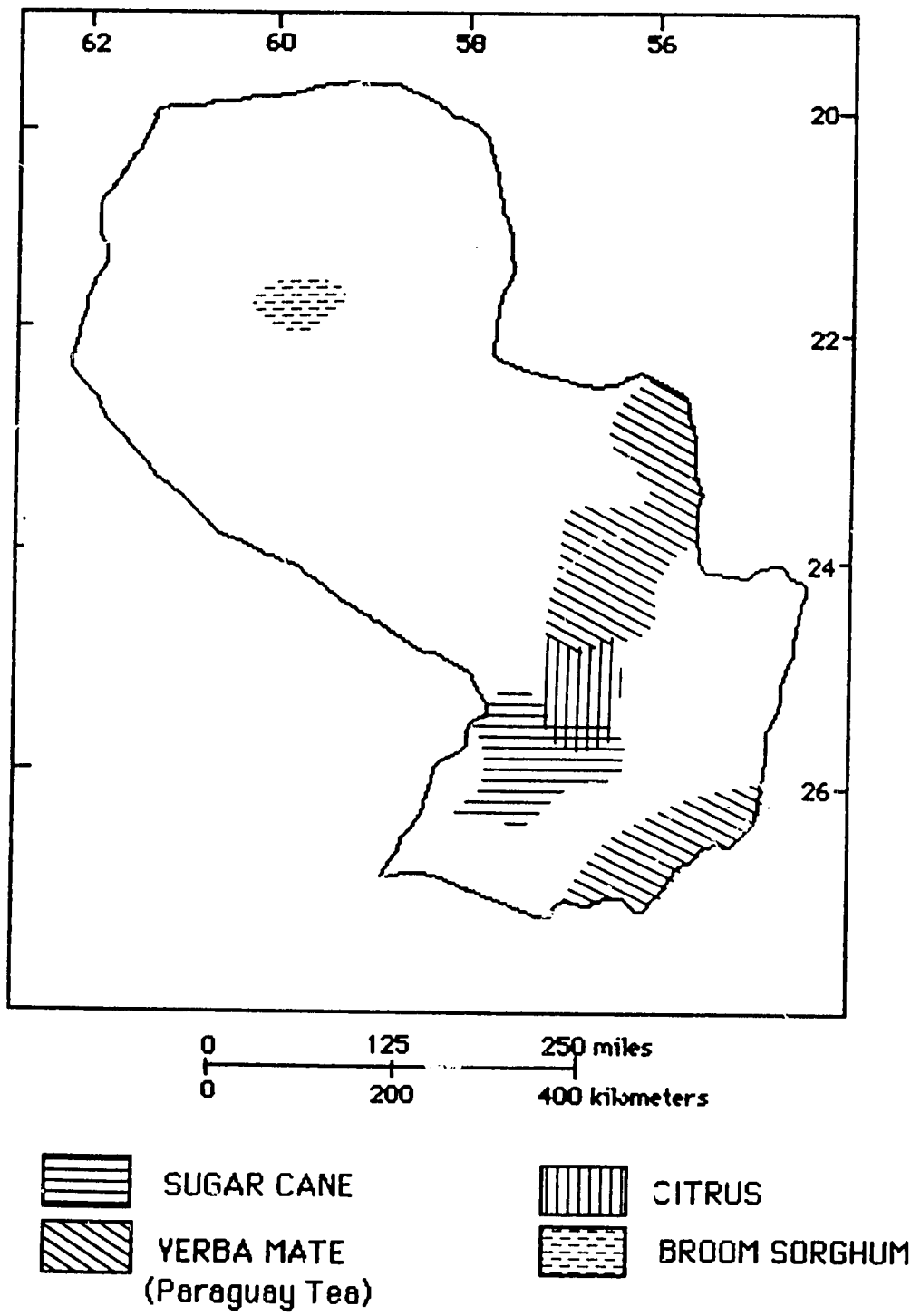


Figure 5.8

Other Commercial Crops

Tung nuts are a minor but valuable crop. They are produced near the town of Encarnacion, in the Itapua Department. The nuts are processed into tung oil, used as a drying agent in paints. Both the nuts and the processed oil are exported.

Castor bean shrubs are grown on farms in the Concepcion Department. The oil obtained from the beans has industrial uses; both the beans and the oil are exported.

Broom sorghum, a type of sorghum used to make sweeping brooms, is grown in the Bopueron Department which produces about 85 percent of total annual production.

Figure 5.7 shows the growing areas for tung nuts, castor beans. Figure 5.8 shows the growing area of broom sorghum.

b. Food Crops

Manioc

Manioc or mandioca is the major food staple and the crop grown in the largest quantity. About 92 percent of the farms cultivate some manioc, but its production is concentrated in the Cordillera, Paraguari, Itapua, Central and Caazapa Department. Three major varieties and a number of minor varieties are grown. Manioc is planted from stalk cuttings in the spring (September-October). The tubers usually mature in about nine months and are dug up as needed by the farmer for food or sale. A small quantity of the production is fed to livestock. The undug root will last in the ground for a year after maturity, but gradually becomes more fibrous and less palatable. Figure 5.9 shows major manioc growing areas.

PARAGUAY
DISTRIBUTION OF MAJOR CROPS

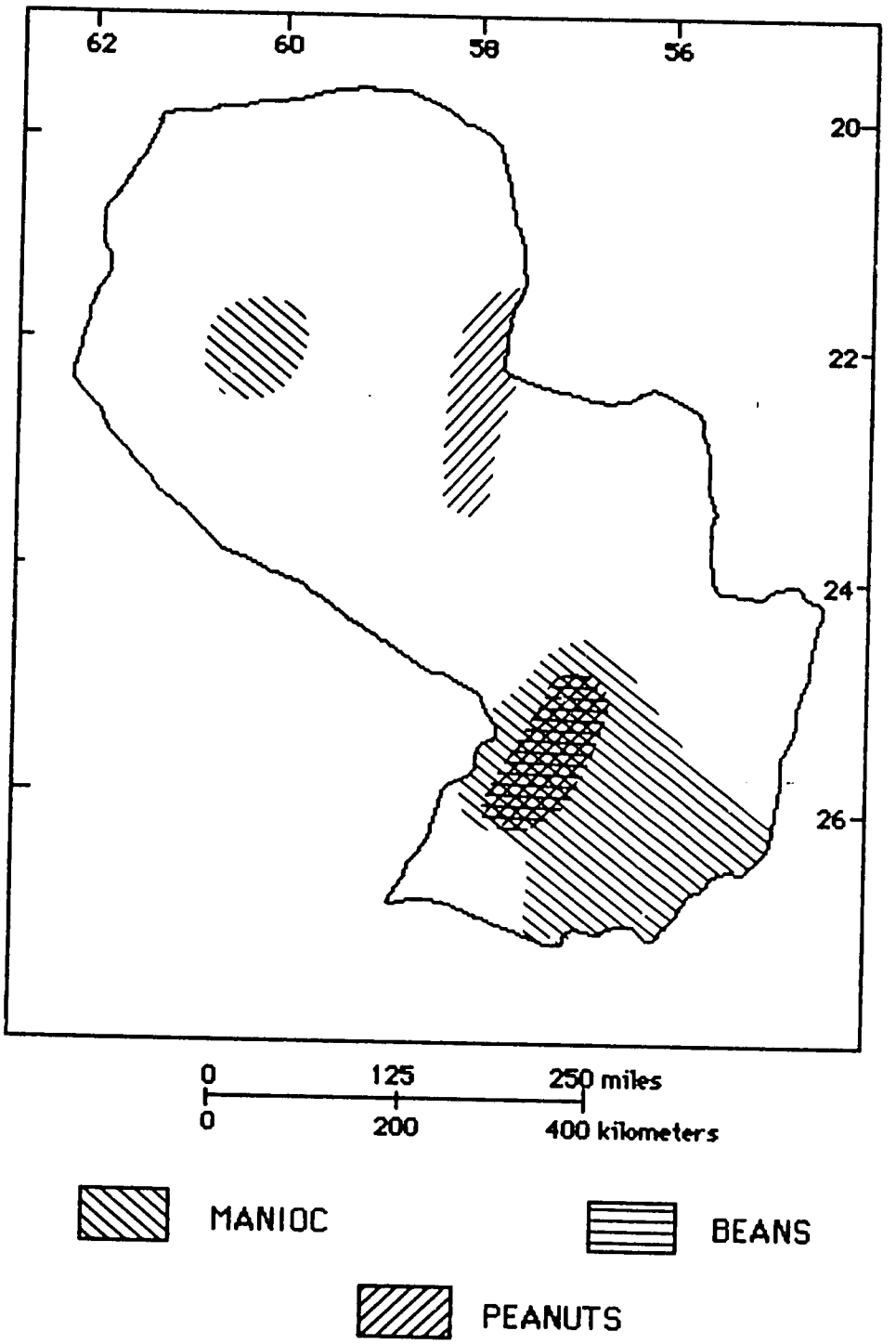


Figure 5.9

Peanuts

Peanuts were one of the crops raised by the Indians before the Spanish conquest. Some farmers plant peanuts between the rows in cotton fields. About half of the total production comes from three departments, Cordillera, Paraguari and Boqueron. The latter has better yields because the production techniques practiced by the Mennonite farmers are more appropriate. About three-fourths of peanut production is consumed, either raw or roasted, and the balance is used to make edible peanut oil. Figure 5.9 shows major peanut growing areas.

Corn

Corn or maize is the most widely planted crop, cultivated on about 90 percent of the farms. The largest production percentages are in the Itapua, Paraguari, Cordillera and Caazapa Departments. However, Alto Parana has the largest average-sized and best yield per hectare. The farms with large plots use machinery and fertilizers, resulting in increased yields.

A number of varieties are grown, but two types of white and one yellow, called Venezuelan corn, predominante. The latter produces a higher yield per hectare than the white varieties. Some hybrid varieties are also cultivated. About one-third of the corn is used for animal feed. Figure 5.10 shows major corn growing areas.

Rice

All rice is paddy grown. Half of that produced comes from Itapua and Misiones Departments. The major varieties of rice grown are Blue Rose and Zenith. Most of the rice produce is consumed domestically, some is fed to livestock and small surpluses are occasionally exported. Figure 5.10 shows major growing areas for rice.

PARAGUAY
DISTRIBUTION OF MAJOR CROPS

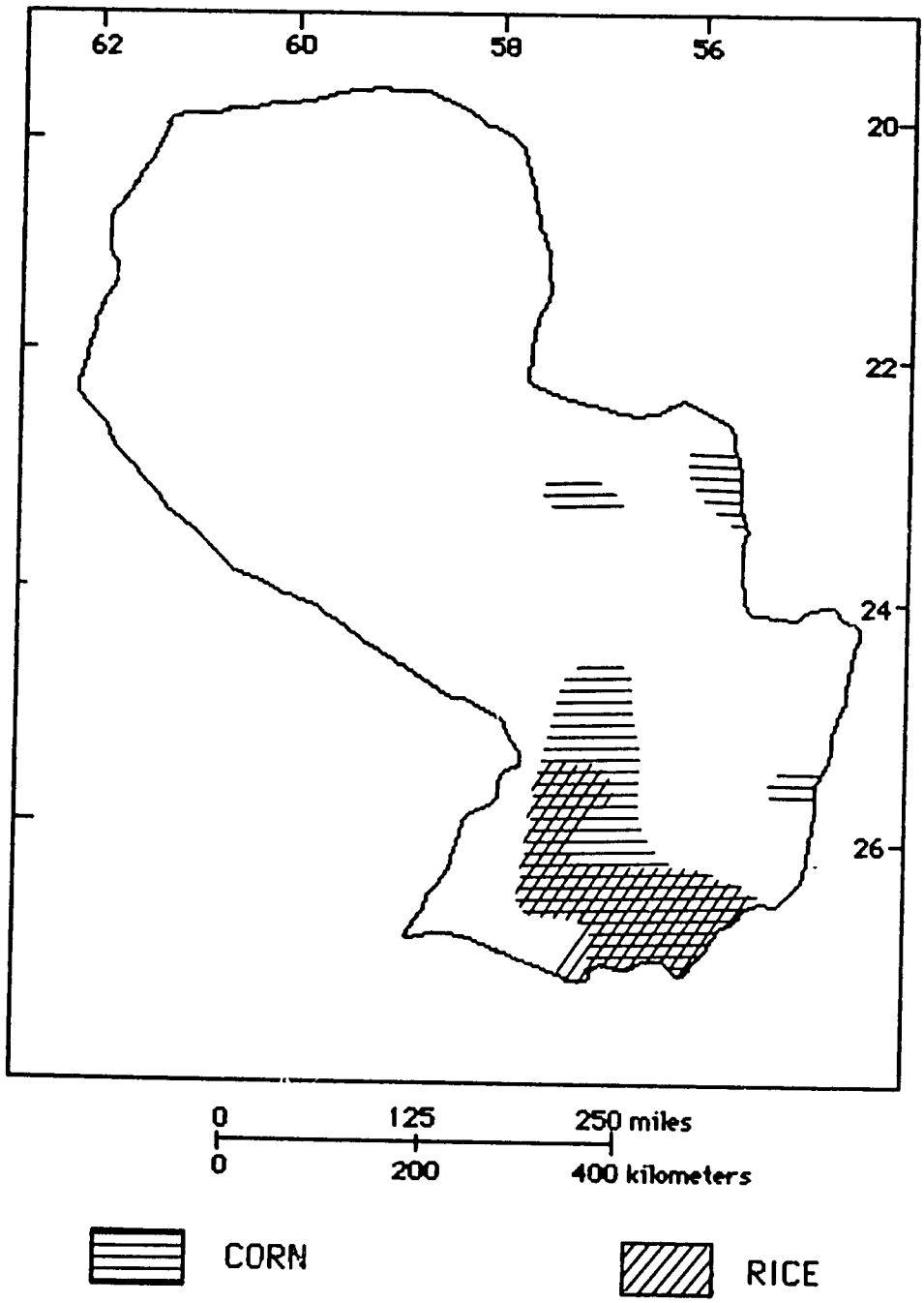


Figure 5.10

Beans and Peas

Various kinds of beans and peas are grown on very small plots on about two-thirds of all farms. About 25 percent of all beans are produced in the Paraguari Department, 13 percent in the Cordillera Department and the rest from all the other departments, mainly the ones located east of the Paraguay River. Half of all sweet pea production comes from the Cordillera and Central Departments.

Other Food Crops

A variety of fruits and vegetables are grown by numerous farmers in varying quantities for domestic consumption. Fruits are more popular than vegetables.

Pineapples are grown on about 15 percent of the farms. Half of the production comes from the Paraguari Department. Bananas are grown in small amounts throughout the country; the yield is reportedly higher than in major banana growing countries. Watermelon and peach production are scattered throughout Eastern Paraguay. Apples, pears, plums and strawberries are grown mainly in Itapua Department, and grapes are grown in Guaira Department.

3. Agroclimatic Indices

Figure 5.11 shows the historical Yield Moisture Index (YMI) in percentile for Asuncion (Eastern region). The YMI was computed for a corn crop during the main growing season (September-December). YMI values in the lower 20th percentile suggest poor corn crop conditions during 1962, 1967 and 1976. The critical YMI value for crop failure may be determined by using episodic data (Appendix A) and historical crop yield data.

AGROCLIMATIC INDEX

ASUNCION

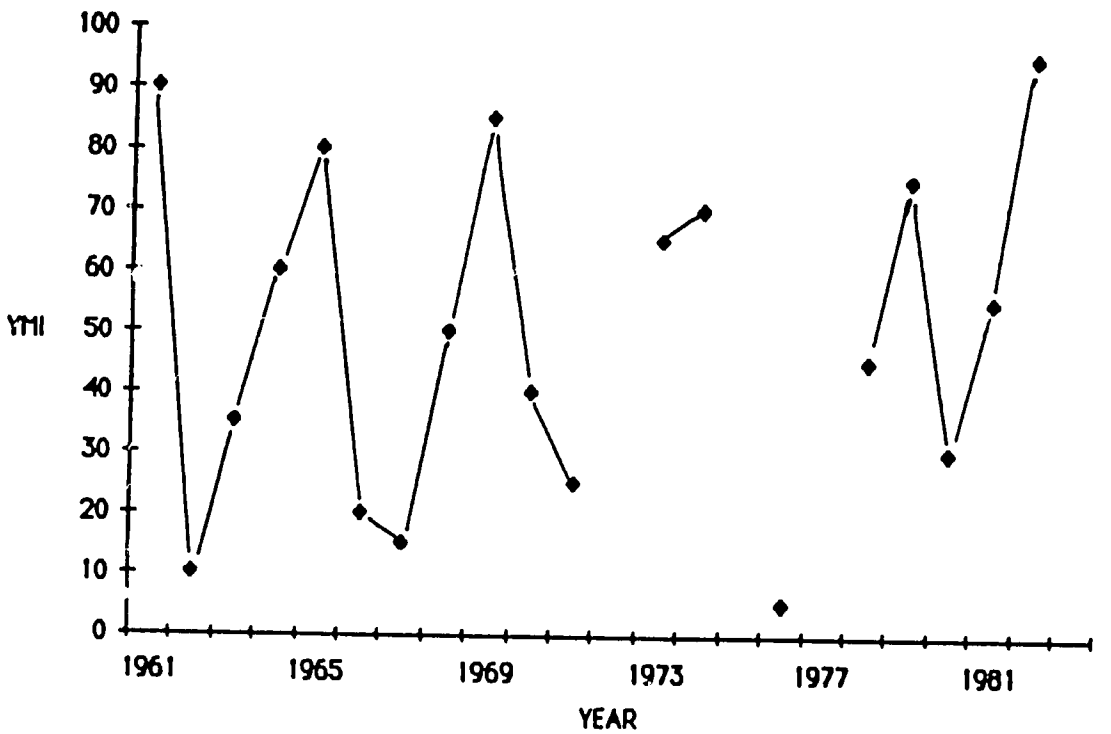


Figure 5.11

CHAPTER VI

URUGUAY

A. Physical Environment

1. Overview

Uruguay is located on the East coast of South America, between approximately 30° and 35° South latitude and 53° 30' and 58° 30' West longitude. It is bordered on the North by Brazil and on the East by the Atlantic Ocean. The designation "Oriental (Eastern) Republic of Uruguay" is derived from the location on the East coast of the Rio Uruguay and the great estuary of the Rio de la Plata, forming the western and southern boundaries between Uruguay and Argentina.

Uruguay with a total land area of approximately 17.7 million hectares, is divided into 17 departments. Figure 6.1 shows country and departmental boundaries. Total population is 2.9 million (Wilkie and Haber, 1983). Almost half of the population lives in the capital city of Montevideo. In 1979, 355 thousand Uruguayans practiced agriculture.

Most of the southern portion of the country, or about two-thirds, consists largely of undulating prairies (plain and hilly upland) of treeless grassland that are an extension of the humid pampas of Argentina. The other third of the country is relatively rugged, an extension of the Brazilian highlands. Two of the major low range mountains, called "cuchillas" (hill ranges), extend southwestward. The Cuchilla Grande on the eastern flank and the Cuchilla de Haedo on the western flank divide the country into two main watersheds and enclose a central plateau. West to the Haedo Hill range, vast lava flows (solerite) dominate the landscape with tabular uplands and hills with steep-sided valleys. A third cuchilla,

URUGUAY

DEPARTMENTAL BOUNDARIES

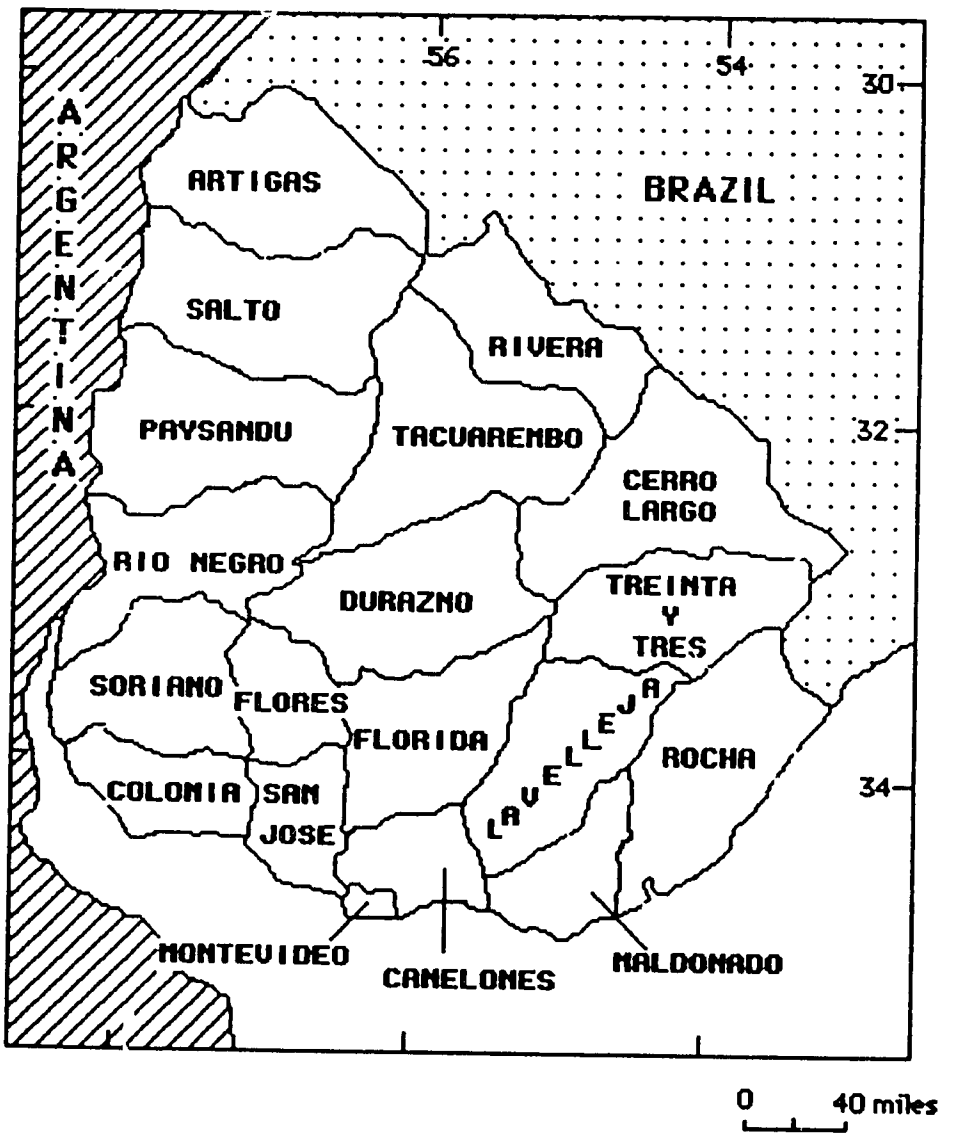


Figure 6.1

Cuchilla Santa Ana, is located along the Brazilian border. The elevation of the cuchillas rarely exceeds 300 m. The highest peak in the country at 548 m is the Cerro Mirador, located in the Maldonado Department near the southern coast. Figure 6.2 shows the major natural regions. There are three systems of internal rivers and streams: Those flowing westward to join the Rio Uruguay; those flowing eastward or northeastward into the Atlantic Ocean or into tidal lagoons; and those rivers flowing southward into the Rio de la Plata. The most important rivers, the 800 km Rio Negro and its tributary the 225 km Rio Yi, flow westward. The eastward flowing rivers are shallower and more variable in flow. Rio Cebollati, the main drainage east of the Cuchilla Grande, flows northeasterly and empties into the Laguna Merin. Rio Santa Lucia is the main stream that flows southward into the Rio de la Plata. Approximately 1,240 km of the country's rivers are reported to be navigable; this includes 378 km along the Rio de la Plata estuary. The Rio Uruguay is navigable by vessels with up to 4.3 m drafts 225 km north to the town of Paysandu. Vessels with drafts up to 2.7 m can continue 96 km farther north to the town of Salto where navigation is interrupted by rapids. Rivers are shown in Figure 6.3.

2. Soil and Natural Vegetation

Most of the soils in Uruguay are suitable for crop production although the topsoil is of varying depth and in many areas is subject to erosion. Almost half of the country, particularly in the south, is covered with fertile Brunizems soils with thick, dark colored silty or loamy surface layers over a somewhat fine textured but permeable subsoil. The Grumusols, most extensive in the northwest, are black to dark gray plastic clays. Humic Gley and Alluvial Soils are scattered in small areas near the coast and

URUGUAY
MAJOR NATURAL REGIONS

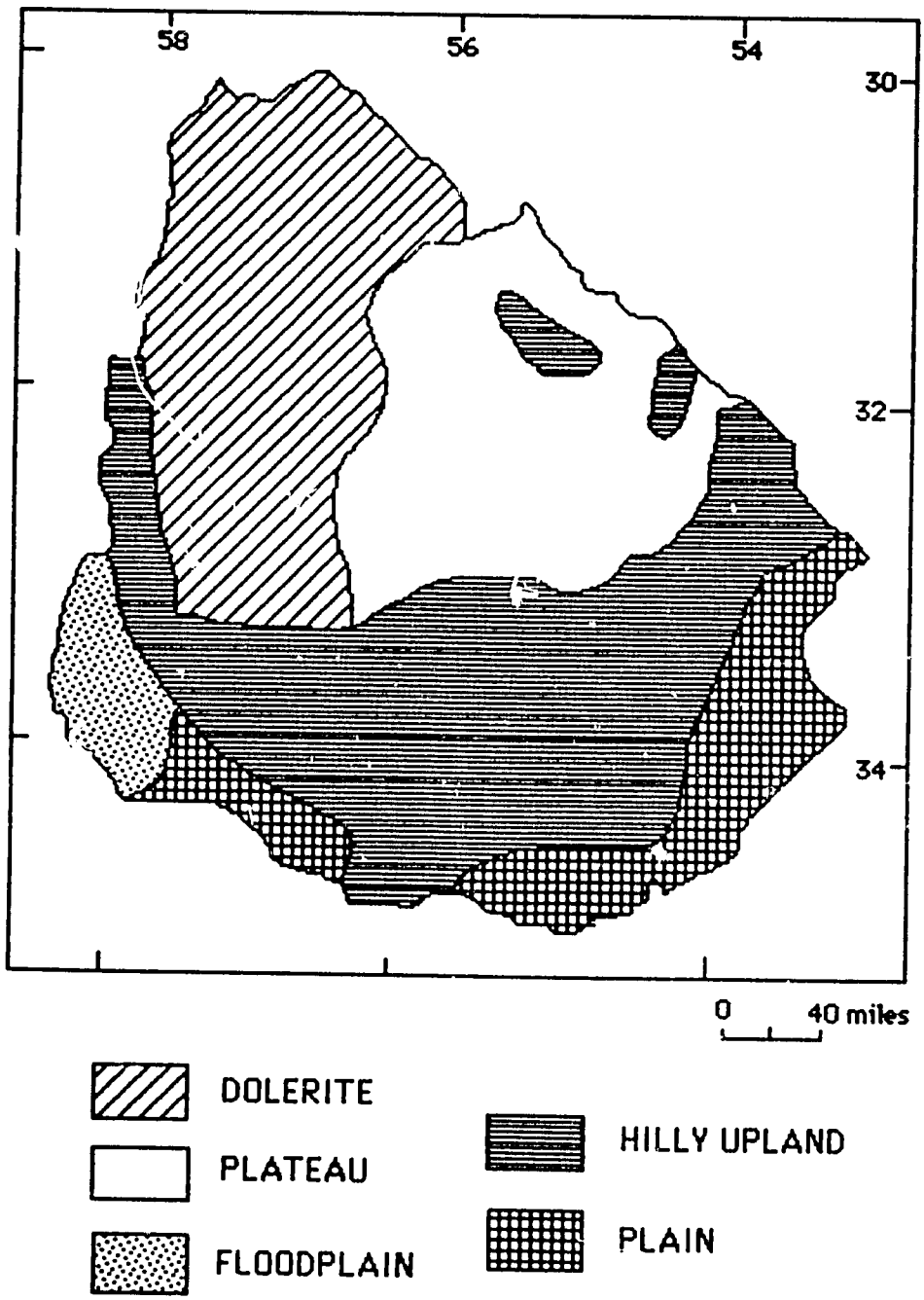


Figure 6.2

URUGUAY
MAJOR RIVERS

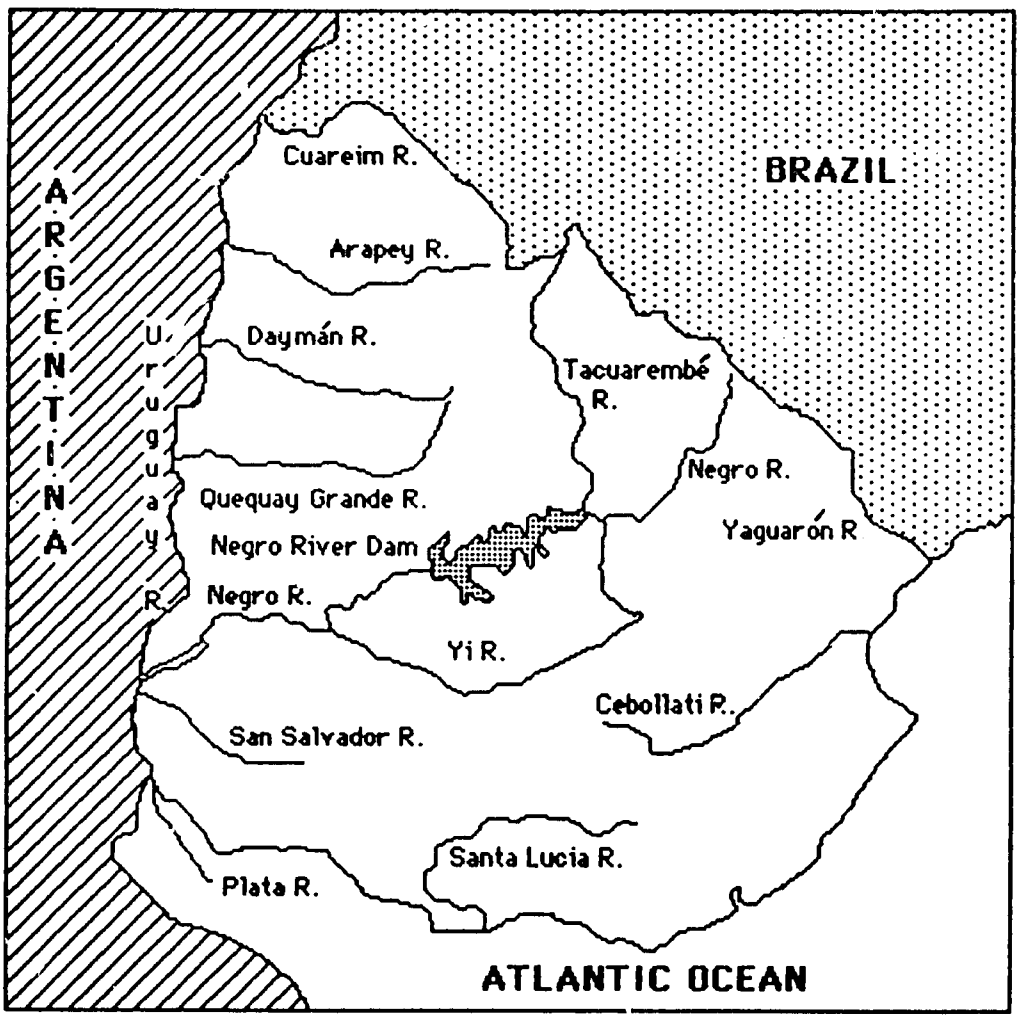


Figure 6.3

along the streams. Planosols occur mostly on level or nearly level areas in the east. Lithosols and shallow or stony Brunizems cover some of the rolling and hilly areas; they provide limited grazing but have little if any potential for crop production.

Most of the country's native grassland vegetation has been replaced by planted varieties with higher yield value. Less than three percent of the country is forested. Most of the natural forest occurs in the northeast. Some hard wood species are quebracho, algarrobo, urunday and guayabo. The only tree like plants indigenous to the grassy plateaus are the palm and the ombu. Plantations of maritime pine, eucalyptus and palm are found along the Atlantic coastline.

3. Climate

Uruguay experiences limited regional variations in climate. The absence of high hills to act as weather barriers make it especially susceptible to climatic variations caused by movement of air masses from the Brazilian highlands, the South Atlantic, and the Argentine pampas. Winters are usually mild in the northwest and cold in the rest of the country. Frost and freezing temperatures are rare. The coldest month is July, with an average temperature of 10°C in the south and 13°C in the northwest. Fog is common from May to October, especially near the coast. Summers are warm, sometimes hot in the north. January is the warmest month with temperatures ranging from 21°C at Punta del Este on the south coast to 26.5°C at Artigas in the northwest.

In all seasons, sudden shifts in wind directions contribute to frequent day-to-day variations in temperature and changes in weather conditions. The mean annual rainfall ranges from 900 mm in the southeast to

about 300 mm in the northeast. Figure 6.4 shows mean annual rainfall in mm. There is no definite dry season, but rainfall tends to be lowest during the summer. Winter rains are the most frequent, but autumn rains are the heaviest. Although monthly rainfall appears to be well distributed, it may be concentrated in a few days of torrential rains followed by several days of dry weather. Occasional droughts cause severe damage to crops and pastures and heavy rainfall in some years results in floods that destroy crop and livestock. For the purpose of crop condition assessment, Uruguay has been divided into two agroclimatic regions. Figure 6.5 shows the location of the weather stations considered in the analysis of agroclimatic regions, and the rainfall distribution of selected stations.

B. Agriculture

1. Overview

Uruguay's economy is based on agricultural products, particularly wool and livestock, which accounted for between 80 and 90 percent of the total value of the country's exports.

Approximately 90 percent of the total land area is considered agricultural land. About 70 percent of the total area is occupied by meadows and permanent grassland devoted to raising livestock. Between 17 to 23 percent is arable, rotated between crops and pasture. About 3 percent is natural forest.

The agricultural land extends in a band averaging about 80 km wide from Maldonado Department to Colonia Department along the litoral of the Rio de la Plata westward for the full extent of the estuary and from there northward along the flood plain of the Rio Uruguay through the Department of Salto. There are only two exceptions. The first is the area devoted to

URUGUAY

MEAN ANNUAL RAINFALL

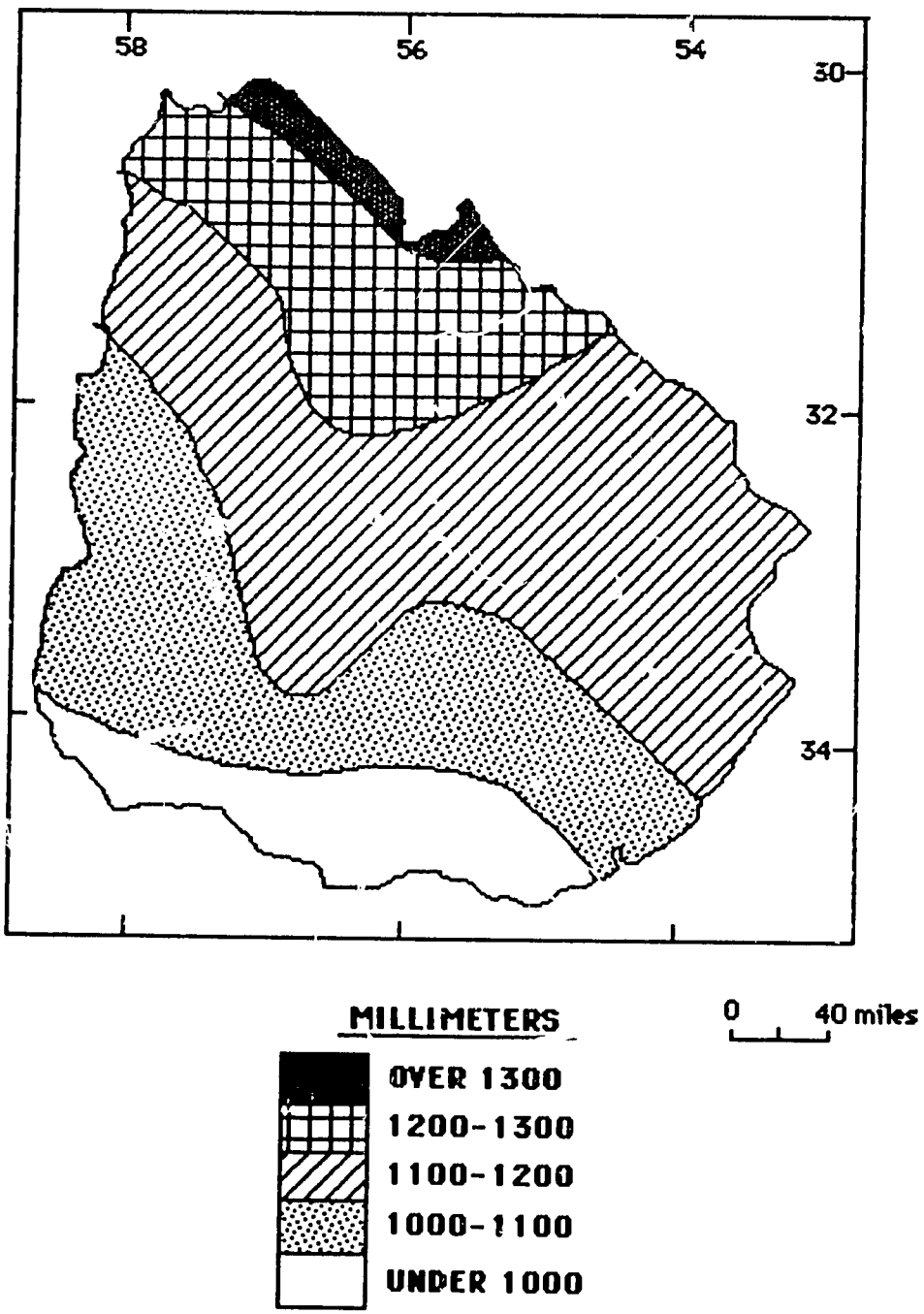


Figure 6.4

URUGUAY

AGROCLIMATIC REGIONS/ WEATHER STATIONS

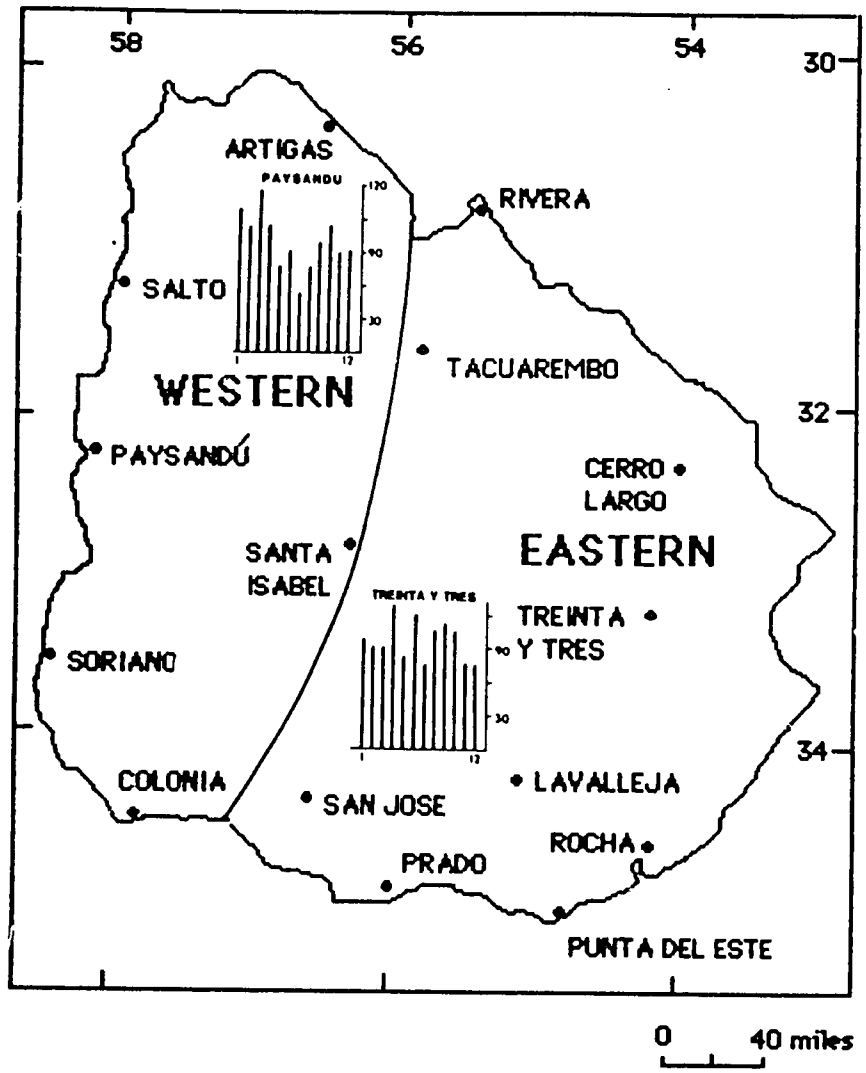


Figure 6.5

sugar beets extending from the sea coast of the Canelones Department northward into the Florida and Lavalleja Departments. The second is the Laguna Merin Basin where most of the country's rice is grown under irrigation. Inland farming is concentrated on the production of cattle for meat and milk and sheep for wool.

Most farmers practice an extractive type of agriculture, drawing on the natural fertility of the soil. Either monoculture or rotation of cash crops is the usual practice on almost all of the harvested land. Many farmers, however, dedicate some arable land to temporary pasture; cattle may be grazed on seedlings. After the cattle are removed the grain is allowed to head and ripen for harvest. Figure 6.6 shows the agricultural land use.

The Rio Uruguay and the Laguna Merin are the principal sources of irrigation water. Rice and sugarcane are grown on irrigated land. Consumption of commercial fertilizers rose sharply in the last 20 years. Most of the fertilizer was used primarily for grain and oil seeds, but in the late 1970's phosphate fertilizers were commonly applied to pastures.

Except for grass, the major crops produced in Uruguay are cereal grains and oilseeds. The cereal group, wheat, rice, corn, oats, barley and rye, has been the most important, both in the total value of production and area. Oilseed crops, consisting of sunflower, flax and peanuts, the second most important followed by the sugar crops, beet and cane. Table 6.1 shows the crop calendar for major food crops.

URUGUAY
AGRICULTURAL LAND

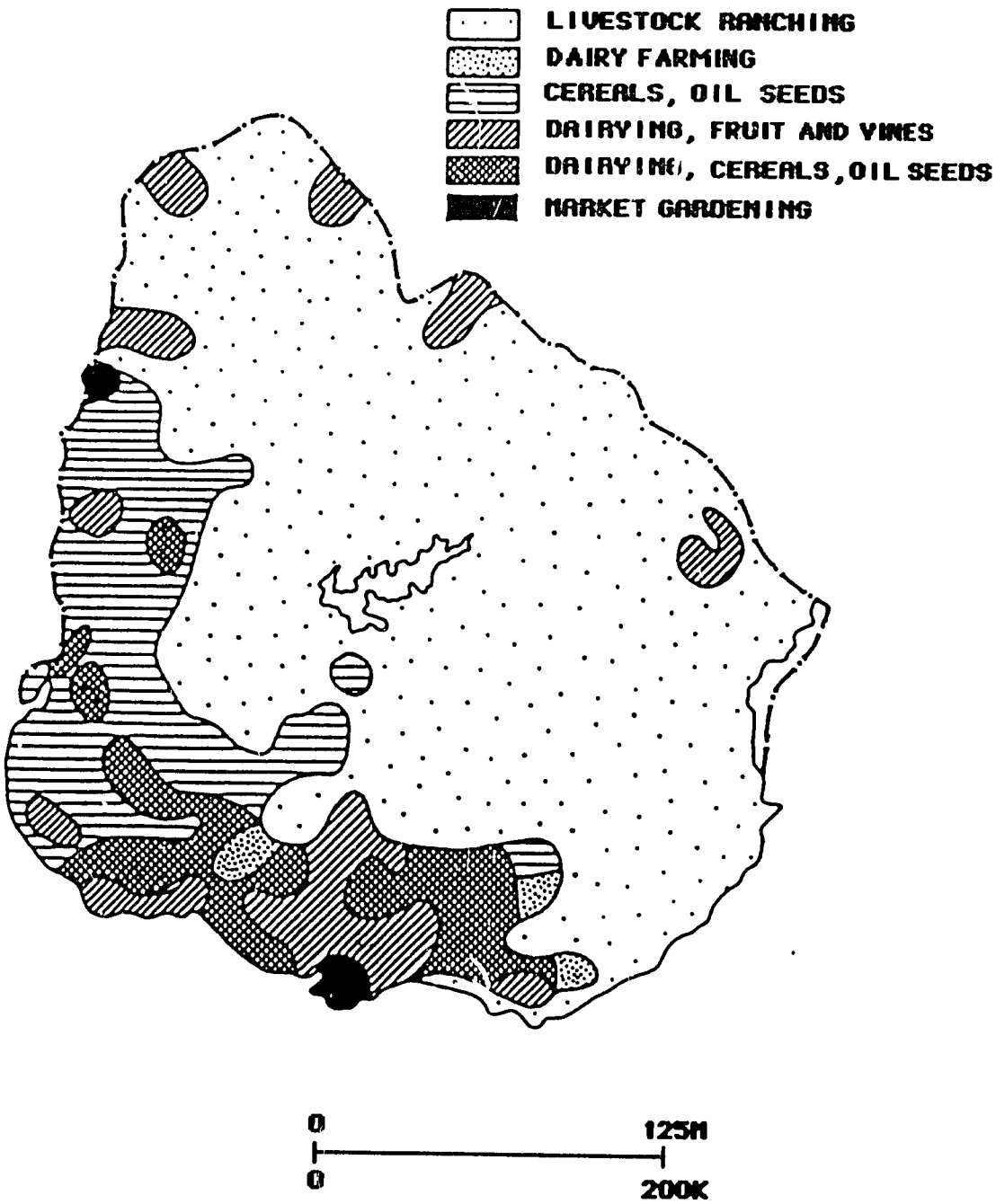


Figure 6.6

TABLE 6.1

ESTIMATED CROP CALENDAR FOR URUGUAY

/// Planting/Sowing, --- Vegetative/Flowering, 000 Harvesting

REGION	CROP	J	F	M	A	M	J	J	A	S	O	N	D
Western	Wheat	000			///	///	///	---	---	---	000	000	000
	Corn	-00	000							///	///	---	---
	Sunflower	---	---	000	000						///	///	---
Eastern	Wheat	000				///	///	---	---	---	---	000	000
	Corn	---	000	000							///	///	---
	Sunflower	---	-00	000	0						///	///	---
	Rice	---	---	000	000	000	000					///	///

2. Commercial and Food Crops

a. Cereal Grain Crops

Wheat

Wheat, Uruguay's major staple food grain, leads the harvested crops in area sown. It became an important export crop in the 1950's. However, production dropped and imports were needed in 1964 and 1968. The country became self-sufficient in production and consumption in the 1970's. Brazil is usually the principal market for Uruguayan wheat in years of exportable surplus. Wheat is grown mostly in the south and west on farms of over 100 hectares, but the main centers of production are the Soriano and Colonia Departments. Sowing takes place in the fall, harvesting in late spring-early summer. Agricultural practices are highly mechanized and most of the harvest is done by combine. Figure 6.7 shows major growing areas for wheat.

Rice

Rice is a major export crop and is second only to wheat as a food crop. Most of the rice is grown under irrigation in the Laguna Merin Basin, in Treinta y Tres and Cerro Largo Departments, by independent growers with medium to large farms. A common practice is to rotate rice with pasture to rebuild the fertility of the soil and eradicate weeds. The most cultivated varieties are medium-grain Carolina and long-grain Double Carolina types that represent 80 percent of the production. Rice is planted from November to December and harvested from March through July, mostly by combine. Figure 6.7 shows the major growing areas for rice.

URUGUAY
DISTRIBUTION OF MAJOR CROPS

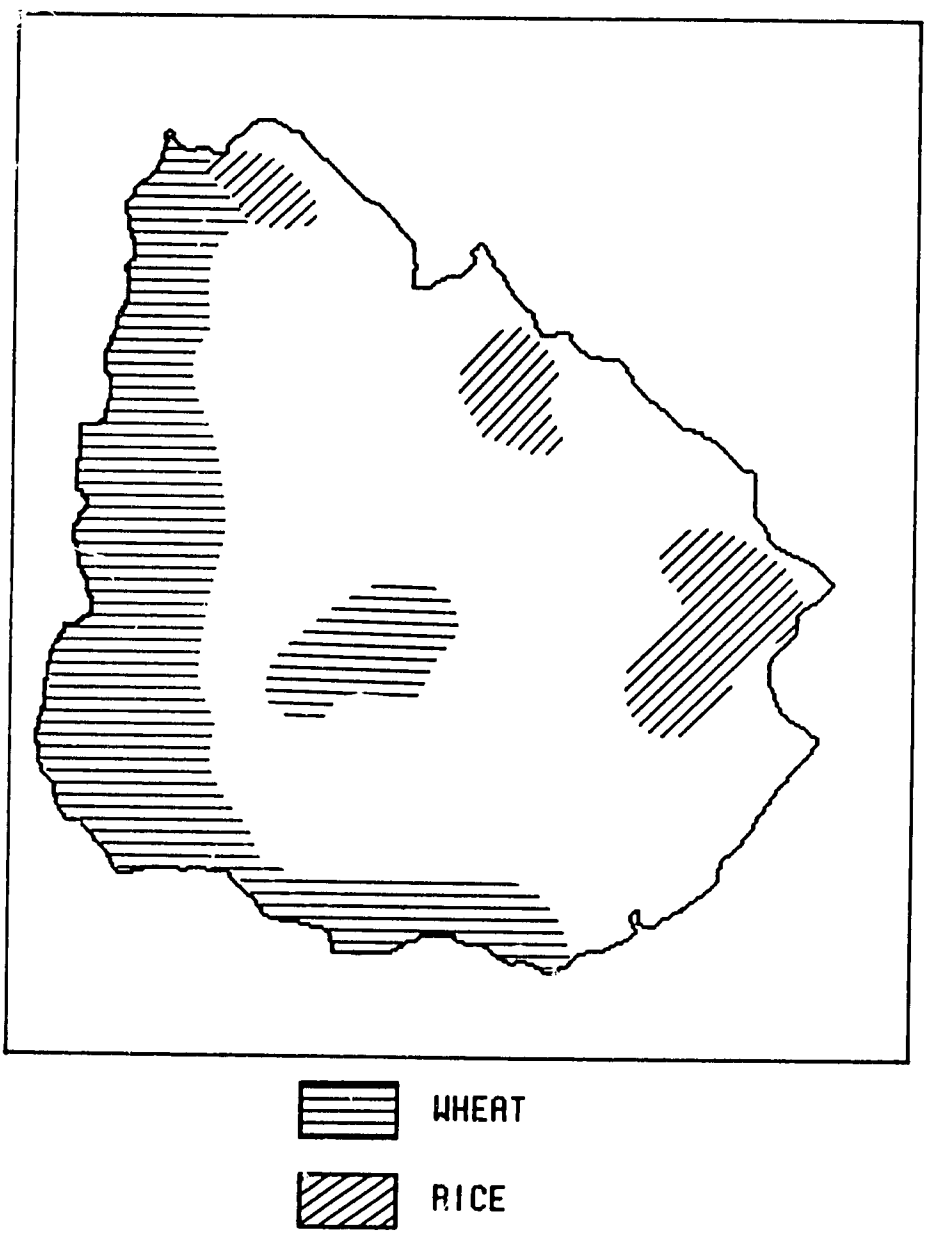


Figure 6.7

Corn

Corn is very important as feed for poultry, hogs and horses. It is grown in all departments, but the major production is concentrated in the south, mainly in Canelones Department. A small part of the corn crop is consumed as green corn or cornmeal and small quantities go into the manufacturing of starch, alcohol or corn oil. Sowing takes place from September to October and the bulk of harvest from February to March. Major corn growing areas are shown in Figure 6.8.

Other grains

Uruguay produces grain sorghum, oats, barley and a small amount of canary seed for feed. Oats are planted more for forage than for harvest as grain. Small amounts of rye for food and barley for malt are also produced. Sorghum is a summer crop. Sowing starts in late spring-early summer (November-January) and harvesting takes place in late summer-early fall (February-April). All the other grain crops are winter crops; sowing takes place in the fall (April-May) and harvesting in late spring-early summer (December-January).

b. Oil-seed Crops

Sunflower seed

Sunflower seeds are grown almost entirely for the domestic edible-oil market, although a substantial part of the residues from pressing for oil are exported as cake and meal. Sunflower is a summer crop; sowing takes place during springtime (October-December) and harvesting in the fall (March-May). Sunflower yields are usually low because of the common practice of sowing sunflowers as a second crop on wheat stubble and because of losses from insects and birds. Major growing areas for sunflower seeds are shown in Figure 6.8.

URUGUAY
DISTRIBUTION OF MAJOR CROPS

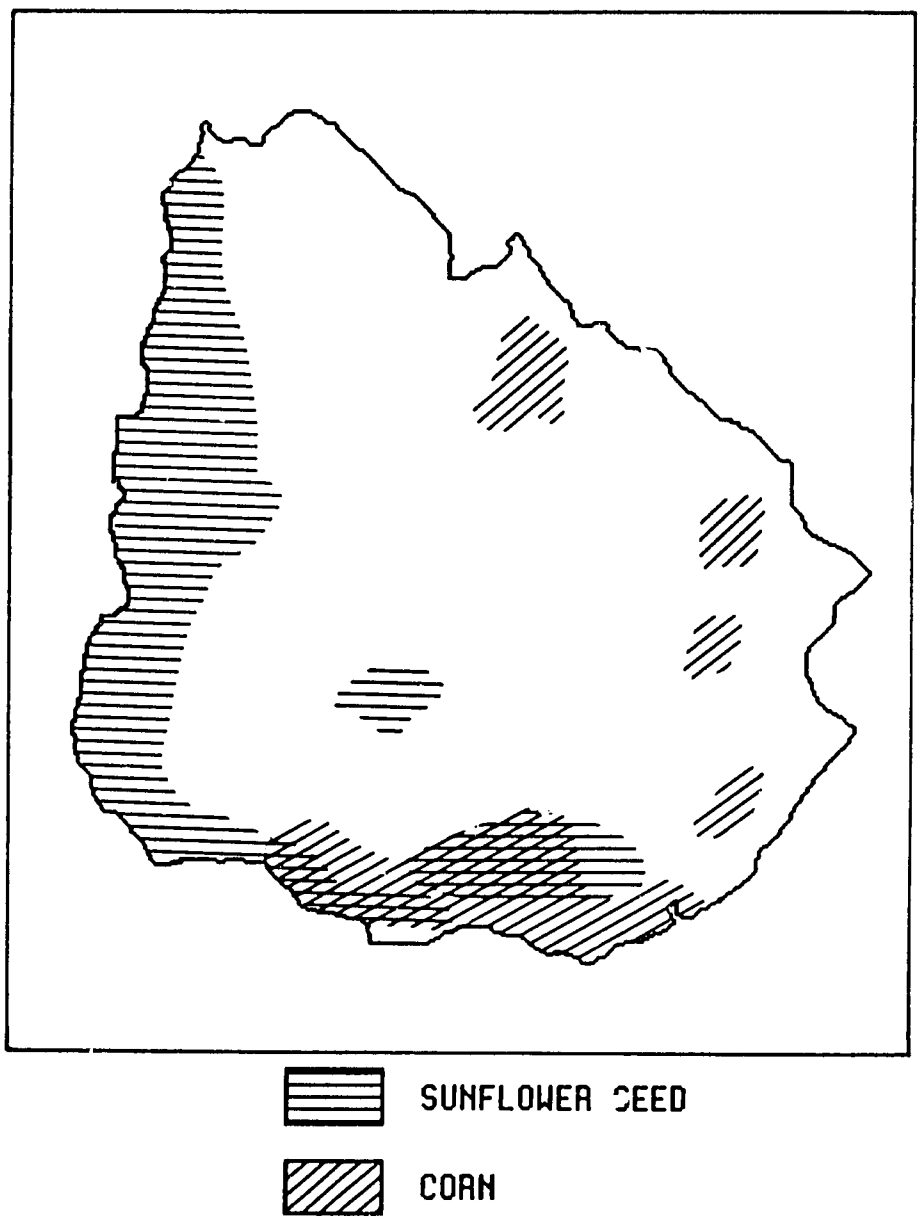


Figure 6.8

Flax (Linseed)

Most flaxseed produced is crushed for oil and by-products for export. Exports are chiefly in the form of linseed oil for industrial use and cake and meal for livestock feed. The major growing areas are in the west and south. Flaxseed is a winter crop, with sowing in July-October and harvesting in December-February. Figure 6.9 shows major growing areas for flaxseed.

Peanuts

Peanuts are also grown but in small quantity. Production is entirely for the domestic edible-oil market. By-products from pressing are cake and meal used for feed and export.

c. Sugar Crops

Both sugar beets and sugarcane are grown in the country, but beets account for more than four-fifths of the total sugar output. Sugar beets are grown in the south in the Canelones, Florida and Lavalleja Departments.

d. Other Crops

Grapes are grown by small landowners for wine production. Other fruits include citrus fruits, apples, peaches, pears, quinces, plums, melons and olives. Grapes and citrus fruit are grown mostly in the north, while other fruit production is highly concentrated in the south. Except for citrus fruits, which have been exported in small quantities, all fruits are destined for the internal market.

Vegetables are grown in some quantity in all departments. Potatoes and sweet potatoes account for almost 40 percent of vegetable production.

URUGUAY
DISTRIBUTION OF MAJOR CROPS

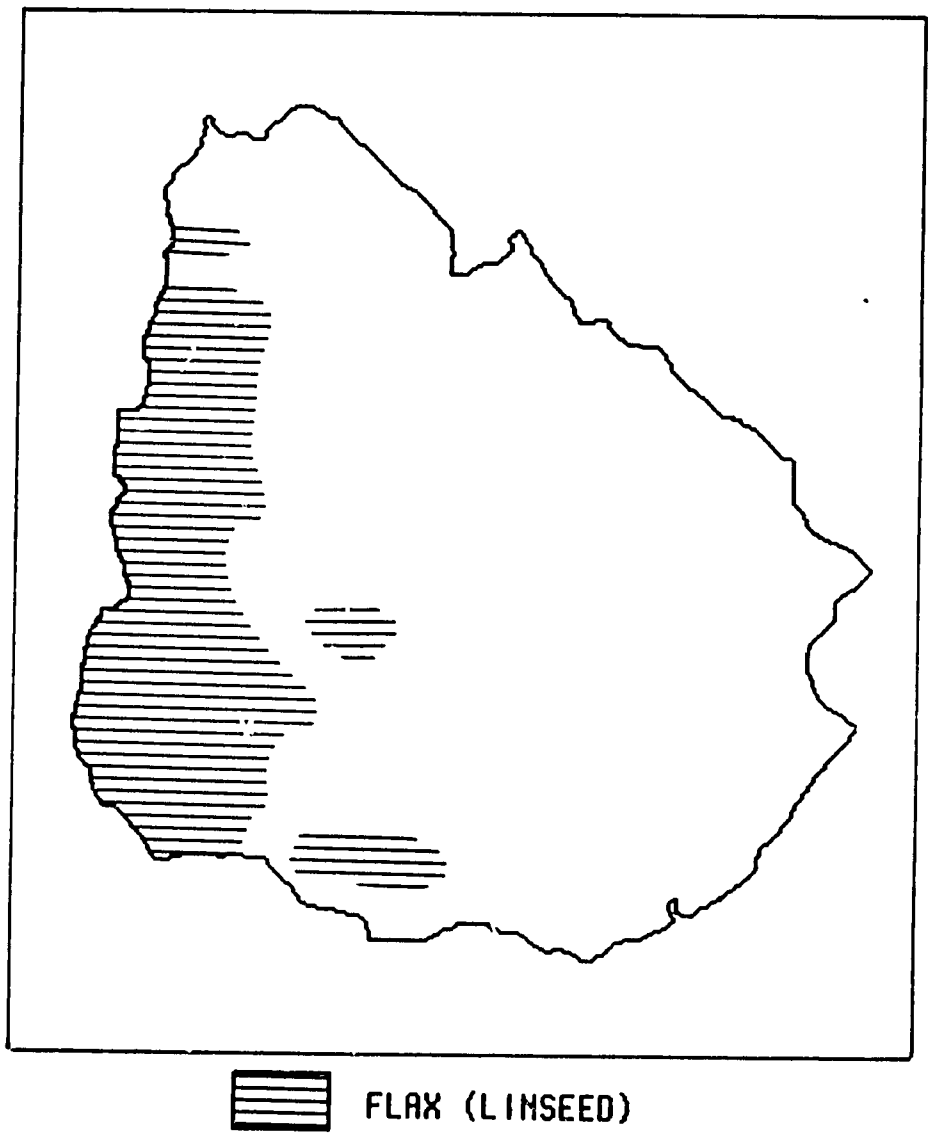


Figure 6.9

3. Agroclimatic Indices

Figure 6.10 shows the historical Yield Moisture Index (YMI) in centiles for Montevideo (Eastern region). The YMI was computed for a sunflower crop during the main growing season (October-February). YMI values in the lower 20th percentile suggest poor sunflower crop conditions during the 1969/70 and 1972/73 crop growing seasons. The critical YMI value for crop failure may be determined by using episodic event data (Appendix A) and historical crop yield data.

AGROCLIMATIC INDEX

MONTEVIDEO

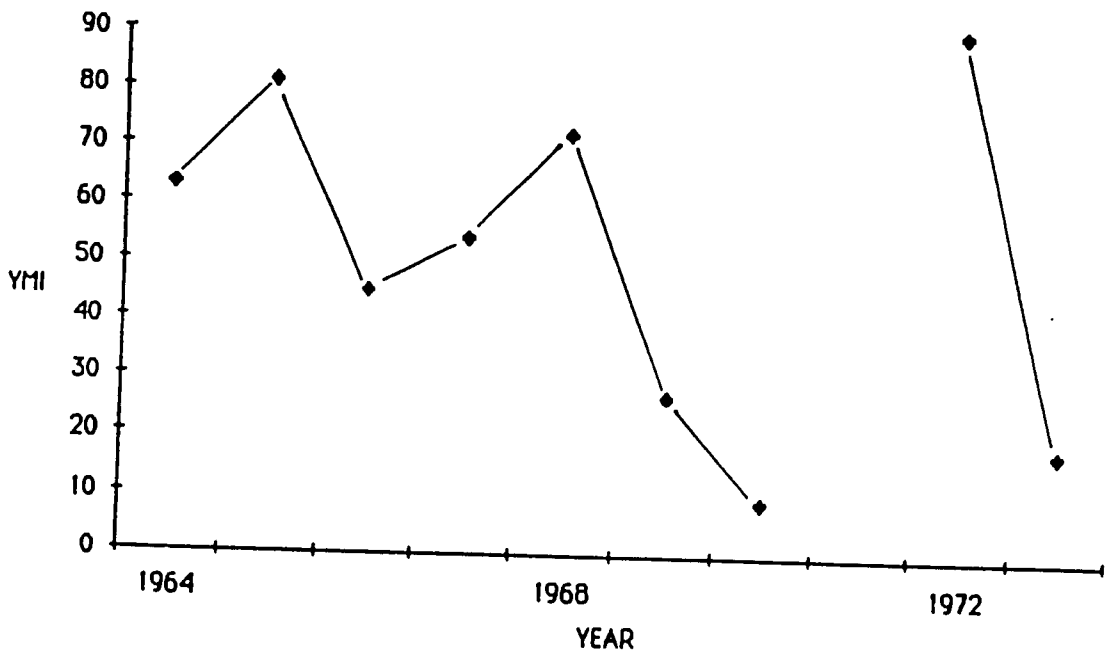


Figure 6.10

CHAPTER VII

SUMMARY

The goal of this project has been accomplished; an Early-Warning Assessment Program has been developed to provide reliable information on the potential for disastrous subsistence food shortages due to drought in Northeast Brazil, Mexico, Paraguay and Uruguay. This proposed early-warning program, based on a combination of biweekly weather and crop condition/food shortage assessments, is objectively determined by climate/crop relationships. It is also sufficiently economical for practical real-time operation.

These assessments have the capacity to provide useful information by about 30-60 days prior to the final harvest of the crop. This could represent a potential 3-6 month early-warning prior to drought-related food shortages.

The data bases, background information, techniques, agroclimatic models and computer software necessary to implement these assessments have been developed. Preliminary agroclimatic models and crop condition/food shortage assessment methods are proposed. This early-warning program has to be tested and evaluated prior to implementation on an operational basis.

It is suggested that this program can potentially benefit AID in attaining the following goals:

1) to monitor and assess potential and actual disaster situations due to drought in these developing countries, thereby providing increased leadtime for planning strategies on food assistance.

2) to increase the U.S. technical capacity to define disaster-prone conditions and to recommend disaster-avoidance measures.

3) to apply and transfer both technology and information to developing countries, international organizations and others.

Within the context of applying weather and climatic data to agro-climatic systems, the methods proposed are: 1) inexpensive, 2) timely, 3) consistent with known agronomic practices in these countries and 4) considered to be potentially capable of providing reliable early warning information.

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APPENDIX A: EPISODIC DATA

Prepared by Joan Darkow

INTRODUCTION

Episodic event data (1970-1984) for NE Brazil, Mexico, Paraguay and Uruguay are contained in this appendix. An episodic event as defined in this project represents a qualitative statement on a weather or non-weather impact on agriculture. For example, weather events could include flooding, drought, severe tropical storms and others. Non-weather events could include civil strife, crop pests and disease, agricultural technology changes or natural disasters such as a volcanic eruption. In addition, reports of crop failure, food shortages and famine are included. The episodic event codes are provided in an attached table. Data in this supplement were obtained by searches of published material (e.g., reports, books, and newspapers) and computerized data bases. The sources and source codes are also provided in an attached table.

Data are listed in chronological order of occurrence for each country. Each entry contains the year, month if known, the episodic event code, the qualitative statement, the source and citation number. The year has the postscript "PUB" indicating publication date if there is uncertainty in the exact year the event occurred. In some cases the date and page number of the source publication are provided at the beginning of the citation. The call letters, author and title of books contained in the University of Missouri-Columbia library are also noted.

POSSIBLE EPISODIC SOURCE CODES AND THEIR MEANING

Abbreviation	Meaning
CAB	COMMONWEALTH AGRICULTURE BUREAUS ABSTRACTS (DATABASE)
CAI	CAIN -- NATIONAL AGRICULTURE LIBRARY (DATABASE)
CDT	COLUMBIA DAILY TRIBUNE, COLUMBIA, MO (NEWSPAPER)
CEAS	DOC/NOAA/EDIS CENTER FOR ENVIRONMENTAL ASSESSMENT LIBRARY
CM	COLUMBIA MISSOURIAN, COLUMBIA, MO (NEWSPAPER)
FAO	FOOD AND AGRICULTURE ORGANIZATION
LAT	LOS ANGELES TIMES (NEWSPAPER)
MGA	METEOROLOGICAL/GEOASTROPHYSICAL ABSTRACTS (DATABASE)
MISC	MISCELLANEOUS BOOKS, PAMPHLETS, AND PERSONAL COMMUNICATIONS
MWR	MONTHLY WEATHER REVIEW (JOURNAL)
NOAA	NOAA/EDIS LIBRARY AND INFORMATION SERVICES DIVISION
NYT	NEW YORK TIMES (NEWSPAPER)
NYTDB	NEW YORK TIMES DATABASE (DATABASE)
OFDA	OFFICE OF FOREIGN DISASTER ASSISTANCE
PSD	U.S. POLITICAL SCIENCE DOCUMENTS (DATABASE)
SSC	SOCIAL SCIENCE CITATION INDEX (DATABASE)
TWHAGSIT	THE WESTERN HEMISPHERE AGRICULTURAL SITUATION (JOURNAL)
USDA	UNITED STATES DEPARTMENT OF AGRICULTURE
WBR	WORLD BANK REPORTS
WORAGSIT	THE WORLD AGRICULTURAL SITUATION (JOURNAL)
WSJ	WALL STREET JOURNAL (NEWSPAPER)

POSSIBLE EPISODIC CODES AND THEIR MEANING

Abbreviation	Meaning
A	CROP CALENDAR INFORMATION
B	FAVORABLE WEATHER
C	TYPHOON, CYCLONE, OR HURRICANE
D	DROUGHT
E	DRY SPELL
F	FLOOD
G	WET SPELL
H	CHANGE IN ACREAGE
I	FIRE
J	LANDSLIDE
K	TRANSPORTATION &/OR COMMUNICATIONS DISABLED
L	MISCELLANEOUS NON-AGRICULTURAL EFFECTS OF WEATHER
M	BAD CROPS
N	NORMAL OR GOOD CROPS
O	POWER SHORTAGE
P	PESTS OR PLANT DISEASE
Q	EARTHQUAKE
R	RELIEF, AID
S	TSUNAMI, TIDAL WAVE
T	TECHNOLOGY (IRRIGATION, FERTILIZER, ETC.)
U	DEFORESTATION, DESERTIFICATION
V	VOLCANO
W	WAR, CIVIL DISTRUBANCE, STRIKES
X	UNFAVORABLE WEATHER
Y	FAMINE
Z	ABNORMAL FOOD SHORTAGE

EPISODIC EVENTS FOR NORTHEAST BRAZIL

YEAR	MO	CODE		SOURCE
1971		GNDEM	HD1411.U5, 328-339, USDA, TWHAGS, R71-072, p. 17 Abundant rains early in the year in the Northeast restored production of tree cotton, a crop harvested from perennial cotton plants which were stricken by drought in 1970. However, dry conditions prevailed later in the coastal sugar areas and the Northeast was unable to fill its national quota allocations. Despite the drought, sugarcane production was up about 4 percent in the sugar area of the northeast.	TWHAGS
1971		GNDM	HD1411.U5, 328-339, ERS-FOR 334, p. 18 Abundant rains early in the year restored production of tree cotton. A drought in 1970 had stricken this crop harvested from perennial cotton plants. Dry conditions later prevailed in the coastal sugar areas so that the Northeast couldn't fill its national quota allocation.	TWHAGS
1972	Sep	T	HD1411.U5, 341-355, ERS-FOR 351, p. 14 A new bulk-loading sugar terminal in the northeastern port of Recife was completed.	TWHAGS
1973		B	HD1872.K87, The Agricultural Economy of Northeast Brazil, p. 24. This was a year without drought.	MISC
1973		NA	HD1411.U5, 356-365, ERS-FOR 360, p. 18 Although the bean harvest increased, there was still a shortage; so beans and peas were imported. The northeast harvest which came in August, relieved the shortage.	TWHAGS
1975	Jul	FM	353.8, A93.29/2, WAS 1-12, 8, p. 5. Torrential rains and flooding in the North hurt crops.	WAS
1976	Feb	G	3-3-76, 5/2, p. 10 Heavy rains at the beginning of February interrupted a severe drought in north-eastern regions.	FAO
1976	Feb	E	4-1-76, 23/3, p. 10 The wheat crop was affected by continuing dry weather in the northeast areas.	FAO

EPISODIC EVENTS FOR NORTHEAST BRAZIL

YEAR	MO	CODE		SOURCE
1976	Apr	EB	5-6-76, 30/4, p. 10 A complete lack of rain was reported in a small band of north-eastern Bahia. Otherwise, weather across the country was mostly favorable.	FAO
1976	May	FEB	6-14-76, 30/5, p. 10 In the northern area heavy floods affected the regions of Manaus and Bolem while dry weather continued in the northeast region, and normal weather remained in the central part.	FAO
1976	Jul	EM	7-28-76, 20/7, p. 10 In the northeast, dry weather affected rice and corn outlook as well as pasture conditions.	FAO
1976	Oct	ME	10-29-76, 4/10, p. 11 Foodgrain output estimates especially in the northeastern region were reduced because of the exceptionally dry conditions.	FAO
1977	Jan	DG	2-8-77, 25/1, p. 11 The drought in the northeast was broken by heavy end-January rains.	FAO
1977	Mar	E	3-7-7, 1/3, p. 10 The central and northeast regions were dry.	FAO
1977	Sep	E	10-10-77, 27/9, p. 15 More rains were needed in the northeast where precipitation was light.	FAO
1977	Dec	EG	1-12-78, 20/12, p. 17 After suffering from a moisture deficiency; the northeastern area received much needed moisture from mid-December rains.	FAO
1978	Feb	EN	3-10-78, 27/2, p. 16 A two month dry spell was broken by good rains over most of the northeastern regions. Summer crops benefited.	FAO
1979	Feb	GF	5-11-79, 27/4, p. 19 Heavy rains in February and March caused extensive floods in the state of Bahia.	FAO
1979	May	EA	6-15-79, 22/5, p. 20 Weather continued dry in the state of Ceara and Pernambuco, but the corn crop due for harvest in the second half of 1979 was thought not seriously damaged.	FAO

EPISODIC EVENTS FOR NORTHEAST BRAZIL

YEAR	MO	CODE		SOURCE
1979	Jun	ER	7-16-79, 26/6, p. 21 Weather remained mostly dry with above average temperatures. FAO/WFP emergency food assistance was in operation for flood victims in Bahia.	FAO
1980	May	DM	6-13-80, 27/5, p. 22 Five states faced a severe drought which affected rice, bean and corn crops. The Government declared a state of emergency in the entire area and organized emergency assistance to small land owners. This loss of crops is only 2-3 percent of Brazil's total, but is a huge loss for the affected areas.	FAO
1980	Jun	ER	7-11-80, 27/6, p. 22 Weather continued dry and the Government provided emergency assistance to small farmholders.	FAO
1981	Mar	DGA	4-13-81, 25/3, p. 20 Rains that fell in drought-affected areas allowed resowing of corn and rice crops.	FAO
1981	Jun	EMN	7-9-81, 26/6, p. 20 This year's paddy rice crop was expected to be lower than last season's because of dry weather, but the harvested corn crop was excellent.	FAO
1983	Feb	D	353.8, D101.22, 550-20/4, Brazil: A Country Study, p. xxvii The Northeast entered the fifth year of the most devastating drought in over a century.	MISC
1983	Nov	DG	11-18-83, 9/11, p. 22 Drought-stricken states in the coastal areas received rains that brought some relief to the affected population, but in the interior there was little rainfall.	FAO
1984	Jan	G	Vol. 71, No. 4, 1-31-84, p. 15 Widespread showers and thunderstorms covered most of Brazil's crop area. Goias was one of the locations receiving the heaviest rain which amounted to 50-135 mm.	WWCB
1984	Apr	GA	Vol. 71, No. 14, 4-10-84, p. 23 Heavy rain in Goias delayed soybean harvesting.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1971		NHBDMT	HD1411.U5, 328-339,ERS-FOR 334, p. 8 Agricultural production was well above the rate during the late 1960's, but advanced only half the rate of gain for 1970. Much of the 5 percent gain was due to increased planted area resulting from higher prices in 1970 and timely rains in the second half of 1971. Lower government priority of irrigation water availability for wheat reduced its production. Drought conditions in the non-irrigated zones of the main sorghum producing areas cut its production. Larger areas harvested helped increase production of corn, rice and oats.	TWHAGS
1972		XMHDNG	HD1411.U5 341-355,ERS-FOR 351, p. 4 Due to adverse weather, agricultural production dropped below the record 1971 level. Low support prices for wheat encouraged some shift to other crops in the important irrigated zones and resulted in a downtrend of production from the 1969 peak. Unsually heavy rains in the commercial producing zone of northeastern Mexico cut sorghum yields and production declined for the second year. The corn harvest was later reduced 12 percent below 1971 by drought which covered much of the country. Soybean plantings as a double crop on irrigated wheat land increased nearly 50 percent resulting in a record production of 360,000 tons. Sugarcane production was down slightly.	THWAGS
1972-73		MX	353.8 D101.22, 550-79/2, Area Handbook for Mexico, p. 298 Production of sorghum in the 1972 and 1973 crop years was badly hurt by storms in the Tamualipas growing area.	MISC
1973		GNHXMT	HB1411.U5 356-365, ERS-FOR 360, p. 6 Heavy midyear rains that broke the severe drought and filled most irrigation reservoirs helped agriculture recover to a level 6 percent above 1972. Yields of late harvested grains and other food crops were the major gains that raised total crop production above trends of recent years. Higher support prices encouraged expansions in area planted to 1973 grain crops to a peak near 10.5 million hectares. Wheat production increased 18 percent from greater area and yields. Corn production equaled the alltime high record of 9.2 million tons, since there was a sharp recovery in	TWHAGS

YEAR	MO	CODE		SOURCE
			area and yields. Although tropical rains hit the northeastern state of Tamaulipas causing a serious harvest loss to sorghum, production was near a record for recent years. With improved moisture, the bean harvest recovered to a normal level and area and yields of rice and oats were higher. Total oilseeds continued a downtrend but soybean production increased sharply as high prices stimulated its expansion as a double crop with wheat in irrigated areas of Sonora and Sinaloa. Because of advancing prices harvested area for sugarcane increased for the second year. There were also higher yields.	
1974	Apr	T	5-30-74, 9/4, p. 4 The government prepared various short and long-term agricultural development programs promoting self-sufficiency in basic foodstuffs while planning to import 1,000,000 tons of corn and 500,000 tons of wheat in 1974.	FAO
1974	Jul	EN	7-24-74, 3/7, p. 4 The weather was dry, but crop conditions were normal.	FAO
1974		BNHEMT	353.8, A93. 29/2, U.S. ERS, WAS 1-12, 5 Sept 74, P.5,13. There was generally favorable weather in the first half of the year and production was estimated up nearly 3 percent, resulting from a larger cotton harvest after low production in recent years and further expansion in wheat, corn and sugar. In the agriculturally important state of Sonora there was an abnormally long dry period but finally rain fell during July, bringing relief and alleviating the situation. The sorghum harvest was reduced by the dry weather and there were smaller plantings of soybeans and safflower seed. Irrigation water supplies continued to be restricted by lack of rainfall in northwestern areas.	WAS
1974	Oct	FMN	10-28-74, 8/10, p. 4 Localized flooding brought about a partial failure of the corn crop. A larger wheat crop mostly offset a fall of 7 percent in 1974 corn and a 10 percent in bean production.	FAO
1974		NXM	353.8, A93. 29/2, U.S. ERS, WAS 1-12, 6 Dec. 74, p. 14. The midyear wheat harvest was estimated up near the 1969 record of 2.2 million tons. The corn crop in central areas was badly damaged by September cold weather and the harvest was estimated at 8.1 million tons, down 1.1 million tons from last year.	WAS

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1975	Jan	DFX	1-31-75, 14/1, P. 4 Droughts in northern states, previous floods in Veracruz and September frosts in southern states reduced corn crop estimates. Wheat, corn and vegetable oils were expected to be imported.	FAO
1975	Apr	MND	4-30-75, 8/4, p. 11 The staple foods, corn and beans, dropped 7 percent in output in 1974 compared to 1973; but wheat production, up 32 percent, offset that drop. Drought reduced 1975 corn and wheat crop outlook for the July harvest. The year's grain imports were estimated at 2.35 million tons.	FAO
1975	May	EN	5-30-75, 14/5, p. 9 Although the weather was dry, crop conditions were average.	FAO
1976	Jan	BN	2-3-76, 8/1, p. 12 Rainfall and crop conditions were normal.	FAO
1976	Feb	N	3-3-76, 18/2, p. 11 Through increase in domestic output, self-sufficiency in corn was programmed for 1976.	FAO
1976	Feb	XM	4-1-76, 24/3, p. 11 Over 50 thousand hectares in Guanajuato, Jalisco, Michoacan, Nuevo Leon, Coahuila and Puebla states were hit by frost that damaged the wheat and beans.	FAO
1976	Apr	HDMN	5-6-76, 30/4, p. 11 Only 20,000 hectares of soybeans were sown in the northern state of Sinaloa because of prolonged drought. This was 50,000 hectares less than last season. Although some March rains fell in the central areas and also in lower Rio Grande where it brought some relief and improved prospects for sorghum; water supplies in the northwest irrigated area continued to remain critically short. 1976 wheat output was officially estimated at 2.7 million tons, nearly the same as in 1975. Soybean output was expected to be only about half of last year's, but the dry beans crop was turning out larger than expected.	FAO
1976	Jun	DHMZ	6-14-76, 11/6, p. 11 March arable areas in the country's breadbasket in the states of Sonora and Sinaloa were affected by drought that persisted in northern parts of the country, resulting in about 200,000 hectares of rice and soybean land not being planted in those	FAO

YEAR	MO	CODE		SOURCE
			two states. Water levels in five big dams was down 10 percent and farmers were advised to switch to corn and other cereal grains for the season. Rice stocks for the emergency were available from the previous crop, but soybeans would have to be imported.	
1976	Jul	FMZ	7-28-76, 16/7, p. 11 Torrential rains caused such heavy floodings that five states were declared disaster areas. 70,000 hectares of wheat, corn and sorghum were reportedly destroyed.	FAO
1976	Sep	FZ	9-27-76, 16/9, p. 12 Cereal crop production outlook for 1976/77 was mixed. Production of corn and wheat was expected to be about the same or last year's, sorghum less because of flood damage in the Bajo, rice less due to lack of rain for the spring crop and the bean crop less because of too much rain and lowering of guaranteed price in some areas.	FAO
1976	Oct	CMR	10-29-76, 29/9, p. 13 On October 1, hurricane Liza struck the state of Sonora where it seriously damaged crops and property. Relief measures were organized.	FAO
1976	Nov	B	12-7-76, 15/11, P. 13 Grain output was estimated at 15.8 million tons; 1975's had been 16.2 million tons. Normal weather prevailed.	FAO
1976	Dec	M	1-11-77, 29/12, p. 13 Difficulties met the enforcement of recent agrarian reforms and production was expected to suffer.	FAO
1977	Jan	THM	2-8-77, 20/1, p. 13 Seeding and fertilization of crops was delayed because of uncertainty from recent tenancy disputes. Continued lack of irrigation water and a shift in area to safflower and cotton contributed to the expectation of less area being planted to winter wheat in Sinaloa and Sonora. The 1977 wheat crop was expected to decline.	FAO
1977	Feb	MD	3-7-77, 22/2, p. 11 Second-crop soybean plantings and wheat output were affected by drought in Sonora where about 55 percent of the country's total wheat crop is grown.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1977	Apr	P	5-11-77, 13/4, p. 16 Wheat rust was overcome in Sonora and Sinaloa.	FAO
1977	Jun	A	6-10-77, 1/6, p. 17 Harvesting of wheat, due April/May, was delayed.	FAO
1977	Jul	D	8-11-77, 27/7, p. 18 During the first half of July, light rains slightly relieved the drought situation in Yaqui and Mayo valleys in northwest Sonora. Six reservoirs in the state increased somewhat in water levels during the first half of the month.	FAO
1977	Aug	DM	9-12-77, 12/8, p. 19 Sonora and Sinaloa which account for 10 percent of the country's wheat and soybean crops, were affected by drought. Since there was low soil moisture; the 1978 winter wheat was down by half.	FAO
1977	Sep	DM	10-10-77, 21/9, p. 16 In the states of Sonora and Sinaloa where 10 percent of the country's soybeans and wheat are grown, a drought reduced soil moisture and winter wheat was down by one-half. Wheat imports for 1977/78 were expected to be 700,000 tons as opposed to very little the year before.	FAO
1977	Oct	DM	11-14-77, 10/10, p. 21 Early-year drought reduced wheat productions.	FAO
1977	Nov	NMP	1-12-78, 21/11, p. 18 1977 corn and sorghum production was still expected to be more than in 1976, but the wheat output was still estimated to be 30 percent less than in 1976 since there was leaf rust, lower water availability and land tenure problems.	FAO
1978	Mar	G	4-7-78, 9/3, p. 18 Prolonged drought over most of the northern states was relieved by heavy rains at the end of February.	FAO
1978	May	EH	6-9-78, 11/5, p.17 Dry weather continued over most of the country after the end-February heavy rains over the northern states. 1978 wheat output expectation was lowered since a smaller than expected area was planted. Corn production may be larger with the increased government support price.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1978	Jun	G	7-11-78, 8/6, p. 18 The valley of Mexico experienced the rainy season, and dry conditions in western regions were also eased.	FAO
1978	Dec	BN	1-15-79, 22/12, p. 18 Planting weather was favorable. Prospects for 1979 cereal production were good.	FAO
1978	Dec	BN	2-9-79, 22/12, p. 17. Adequate moisture at planting time and continued good weather favored an increase in cereal production, probably both in wheat and coarse grains.	FAO
1979	Apr	AEMH	5-11-79, 4/4, p. 20 The 1979 wheat crop being harvested was expected to be smaller than 1978's because excessive rain at planting time reduced area planted in the wheat-producing state of Sonora.	FAO
1979	Jul	AM	7-16-79, 6/7, p. 22 The 1979 wheat crop harvested between April and July was estimated 20 percent smaller than the 2.6 million tons produced in 1978. Imports of wheat were forecast to rise since 1979 wheat production was reduced.	FAO
1979	Nov	BXM	1-18-80, 19/12, p. 22 Some relief to grain crops in most of the northern regions was brought about by light rains in mid-November. The 1979 total grain production was expected to be lower than 1978's, as was the corn crop and the sorghum, following adverse weather.	FAO
1980	Jan	EB	2-15-80, 22/1, p. 22 Generally dry weather in December over most of the agricultural regions in December continued into part of January. Recent good rains partially restored below-normal soil moisture in north and northwest regions.	FAO
1980	Feb	GNA	3-14-80, 26/2, p. 20 Heavy rains in the northeastern sorghum areas improved soil moisture and favored the recently sown crop. Northern wheat areas and some south-central corn and wheat areas received light rains.	FAO
1980	Mar	E	4-18-80, 1/4, p. 21 Weather turned dry in March throughout most of the country but sub-soil moisture was expected to be sufficient for regular crop growth after the good February rains.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1980	Apr	ENT	5-19-80, 22/4, p. 21 April rains were below normal but sorghum and corn crops were reported to be in good condition especially in the Northeast where irrigation water was generally adequate.	FAO
1980	May	EA	6-13-80, 28/5, p. 23 Yield prospects of rice, soybeans and other summer crops were reduced by continued dry weather in the northwestern and central regions. Normal rains maintained adequate irrigation supplies for corn and sorghum crops in the northeastern region. The 1980 wheat crop was harvested recently.	FAO
1980	Jun	BNDM	7-11-80, 24/6, p. 23 Seasonable rains the second half of the month brought some relief to northwestern regions severely affected by drought. Wet conditions helped the growing of grain and bean crops in the other parts of the country. Drought that affected the northern regions almost one year was expected to reduce the overall 1980 agricultural productions by 30 percent.	FAO
1980	Jul	BTA	8-8-80, 25/7, p. 23. Good rains partly restored irrigation water supplies and improved the growing conditions of rice and other crops in the northern mountain regions. Early maturation and harvest of corn and sorghum crops in the northeastern region resulted from above normal temperatures. In the south, lighter rains helped maintain the soil moisture required for corn crop growth.	FAO
1980	Aug	FCM	9-19-80, 4/9, p. 21 Localized floods resulted after heavy rains fell on the northern mountain regions following the passage of hurricane Allen on August 11. Heavy rains continued during the second half of August affecting cotton crops in the Chihuahua regions but benefiting corn crops in the southern plateau.	FAO
1980	Sep	GFCM	10-20-80, 29/9, p. 18 Heavy rains flooded large agricultural areas in southern states of Veracruz, Chiapar, Oaxaca and Guerrero during the last week of the month, following passage of hurricane Hermine. Corn, rice and bean crops were affected.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1980	Oct	E	11-14-80, 28/10, p. 18 Over most northwestern regions where water reservoir levels were reported well below normal, dry weather persisted, and over southern corn areas weather was also dry, but soil moisture was more than adequate from recent heavy rains.	FAO
1981	Jan	BNTA	1-26-81, 13/1, p. 20 Above normal rains and temperatures in most northwestern regions benefited the wheat crop at the beginning of January and restored irrigation water supplies depleted during previous dry months. Harvesting of corn and beans was favored by continued dry weather in southern regions.	FAO
1981	Jan	BNA	2-17-81, 3/2, p. 21 Heavy rains in January in northwestern mountains benefited the wheat crop and increased the water supply for sowing spring and summer crops. Light rains and relatively low temperatures resulted in the corn harvest being finalized slightly below schedule in the southern plateau.	FAO
1981	Mar	BN	4-13-81, 27/3, p. 21. Warm temperatures and relatively dry weather at the beginning and end of March in the northeast areas favored corn and sorghum crop development. Mid-March was wet in these areas and there was abundant moisture for grain crops. 1981 agricultural production is expected to be an all-time record resulting from increased cultivated area.	FAO
1981	Apr	EABNT	5-15-81, 28/4, p. 22 April was sunny and warm over most of the country, but water reserves were adequate for spring crop needs. After dryness in the southern plateau where corn was recently sown mid-month moderate rain improved soil moisture and averted possible deterioration of crop conditions. Northern regions had received heavy rains which replenished reservoirs and benefited corn and sorghum crops by the end of the month.	FAO
1981	May	EMTBNA	6-12-81, 1/6, p. 21 Only light rains fell in northeastern areas where corn and sorghum needed irrigating. The eastern sections of the southern plateau had wet weather benefiting recently sown corn, but the western sections remained dry with crops under moisture stress.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1981	Jun	GBNAEMAT	7-9-81, 7/7, p. 21 The rainy season by mid-month had extended northward along the east coast benefiting corn and citrus but temporarily interfering with early sorghum harvests. In the north, dry weather benefited irrigated summer crops, but that ended in late June in the northwestern areas. Heavy rains occurred in the southern mountains. Dry weather stressed young corn crops in the southwest plateau in mid-June but there was some relief by end-month rains. The northeast in early July was generally dry, aiding grain harvesting but stressing non-irrigated citrus orchards.	FAO
1981	Jul	BN	8-7-81, 21/7, p. 21 Over many areas of the country the rainy season was well established benefiting corn and citrus. The Northwest and its mountainous watersheds received especially widespread rain. Beneficial rains also fell over the extreme northeast by the second week, bringing an end to the dry weather. The southern plateau corn belt, the grain region around Matamoros and some northwestern areas also received beneficial rains until early August. Around the cirtrus-growing areas the weather was dry and hot.	FAO
1981	Sep	BN	9-18-81, 9/9, p. 23 In the first three weeks of August the corn areas in the Yucatan Peninsula received seasonal rains consistently. In the state of Chihuahua beneficial showers fell in early August. The maturing corn crop in the southern plateau received two weeks of modest rains beginning the second week of August: temperatures were near-normal. In early September wet weather continued with good rains especially in the northwestern watersheds.	FAO
1981	Oct	GATBCM	10-16-81, 8/10, p. 1 The southern plateau and south-central coastal areas experienced generally wet weather in the first half of September. Summer crop harvests continued because there was less rain in northwestern areas. Irrigation water supplies for winter wheat were restored during the second half of the month when good rains also fell in northwestern states. A tropical storm hit the state of Sinaloa Oct. 8 with loss of life and heavy crop damage.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1981	Oct	CMBA	11-16-81, 27/10, p. 20 Two consecutive tropical storms affected west coastal states of Sinaloa and Sonora as well as States of Chihuahua and Durango during the second ten days of October. Much damage occurred to food crops including wheat, rice, tomatoes, soybeans and sugarcane. Ten percent of local crop production in Sonora was lost. Sunny and dry weather later in the month in previously flooded areas favored drying up of agricultural lands and allowed replanting of crops in some cases.	FAO
1981	Dec	BAN	1-22-82, 30/12, p. 20 Mid-December moderate rains fell in areas of the east-central coast and southern plateau. Favorable weather allowed the conclusion of the harvest in the southern plateau. The wheat crop in west coastal areas was reported in excellent condition.	FAO
1982	Jan	ABEM	2-12-82, 2/2. p. 21 Field preparation for early sowing of corn was favored over most parts of the country since January weather was generally dry and sunny. Weather was slightly drier than normal with some adverse effects on the wheat crop in its final growing stage in some wheat areas in the southern plateau and northwest.	FAO
1982	Feb	XA	3-12-82, 2/2, p. 20 Unseasonably cold weather during February prevailed in northeastern states and delayed completion of planting operations for corn and sorghum crops but crop germination took place toward the end of February when the weather turned warmer. In northern and northeastern areas localized rains improved the soil moisture situation.	FAO
1982	Apr	XMA	4-16-82, 13/4, p. 20 Most agricultural areas were affected by a continued and unseasonably hot and dry spell and only the northeastern areas received light showers. The heat helped maturation of winter wheat in northeastern and northwestern areas but adversely affected rainfed crops. Lack of moisture delayed corn planting in some southern plateau areas.	FAO
1982	May	GNBA	5-14-82 5/5, p. 19 The rainy season started the end of April in most agricultural areas and abundant rainfall favored grain crop growth and improved production prospects in the east coast and southern plateau. However, dry weather that favored development of the wheat crop continued in northwest and northcentral regions.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1982	May	NBEM	6-11-82, 2/6, p. 18 Corn and sorghum growth was favored by seasonable heavy rains over the northeastern region in mid-May, but continued dry weather caused some delay in crop growth particularly in rainfed regions over southern plateau corn areas. Grain and other crops in previously dry areas and the western gulf coast regions were benefited by end of May rains resuming, but in the southern plateau corn area, light showers were insufficient to improve crop conditions.	FAO
1982	Jul	ABG	7-16-82, 13/7, p. 18 Harvesting of sorghum and early corn crops in the Northeast was favored by continued dry weather. Relief to the previously dry southern plateau cornbelt area resulted when tropical rains occurred.	FAO
1982	Jul	EAMG	8-13-82, 3/8, p. 18 In northern areas continued dry weather favored the harvest of corn and sorghum crops during the first half of July, but late-planted crops suffered from lack of moisture. Irrigation water supplies in the western mountains and improved corn crop conditions in the southern plateau resulted from abundant rains. Late July, lighter rains allowed early corn harvesting in the southern plateau.	FAO
1982	Aug	BN	9-10-82, 31/8, p. 18. Light showers in the second half of the month brought some relief to corn and other crops in the northeast.	FAO
1982	Sep	GMAET	10-19-82, 5/10, p. 18 Heavy rains adversely affected central-west coastal regions as well as the southern coast and Yucatan peninsula during September. The still to be harvested summer crops were severely hurt. Weather remained generally dry and greater use of irrigation water was needed to maintain adequate moisture for maturing crops in other regions.	FAO
1982	Oct	CABN	11-15-82, 26/10, p. 19 Hurricane Paul, occurring in September, affected some areas, but sunny weather in October improved overall conditions considerably. Vegetable crops could be replanted and summer crops harvested. Moderate rains favored citrus, sugarcane and coffee crop growth in other regions, particularly the east coast.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1983	Jan	GMABHT	1-14-83, 4/1, p. 19 The east coast, southwestern and northwestern areas continued to have wet weather until mid-December and this interfered with late corn and soybean harvests. Sunny weather which resumed thereafter allowed field work and land preparation for winter wheat, sorghum and corn. Larger areas were expected to be planted in winter season sowings than for 1982, but due to a shortage of irrigation water in reservoirs a lower output was forecast.	FAO
1983	Mar	GTAE	3-18-83, 8/3, p. 19 Heavy rains after a prolonged dry spell increased soil moisture and replenished water in irrigation reservoirs in the northwest region and recently sown corn and sorghum crops especially benefited. Field operations in central and southern areas were favored by dry weather but soil moisture continued to be reduced.	FAO
1983	Mar	BEA	4-15-83, 5/4, p. 19 Good rains in February were followed by prevailing unseasonably dry weather in March. Corn planting due in April-May in the southern plateau could have been delayed because of dryness.	FAO
1983	Apr	ETA	5-20-83, 10/5, p. 19 Unseasonably dry weather that continued over the whole country during April and first week of May favored field operations but further depleted soil moisture in non-irrigated areas and kept irrigation water levels below normal in reservoirs as well as possibly reducing corn plantings especially in the southern plateau.	FAO
1983	May	GM	6-17-83, 1/6, p. 19 In most agricultural areas during the last days of May the rainy season started and drought was relieved particularly in northeastern and central regions where crop prospects were poor.	FAO
1983	Jun	GNEM	7-18-83, 12/7, p. 19 Widespread rains over the southern plateau during June and early July benefited corn and bean crops, but in northeastern and central regions, pasture and vegetable crops were stressed by mostly dry conditions.	FAO

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1983	Jul	GN	8-12-83, 7/26, p. 20 Widespread rains over the southern pleateau during late July continued to benefit corn and bean crops, and drought-stressed pastures and vegetable crops in northeastern and northwestern regions were relieved some by rains.	FAO
1983	Oct	AENCMTR	11-18-83, 8/11, p. 21 Harvesting operations during October in west coastal areas and throughout the southern plateau cornbelt were favored by mostly dry weather prevailing. Cereal and other crops were damaged toward the end of the month by hurricane Tico when it hit northwest coastal areas. Heavy storms increased supplies of irrigation water and improved pasture conditions over northwestern mountains. FAO/WFP emergency food assistance for 40,000 Guatemalan refugees was in operation.	FAO
1983	Sep	BGCETA	Vol. 70, No. 37, 9-13-83, p. 26 Immature crops were benefited and reservoirs partially replenished when light to moderate rains fell over the southern plateau corn belt and western mountains. Northeastern citrus orchards received only temporary relief when light rains fell, but heavy rains from tropical weather systems drenched the southwestern coast while the prolonged dryness continued over the north-central region.	WWCB
1983	Sep	EGTNAFM	Vol 70, No. 40, 10-4-83, p. 22 The northwestern mountain watersheds north of Los Mochie received heavy rains that helped fill reservoirs and improve rangeland vegetation but interfered with crop harvest and caused some localized flooding that may have caused some damage. Only light rain fell across most of the Culiacan Valley, but southward through the state of Colima the rain increased. Most of the southern plateau corn belt received light rain, and the central part had dry, sunny weather. Since some of the early fields were thought to be almost mature, the peak period of water demand was generally past. Dryness that stressed rangeland vegetation and livestock continued over the north-central region.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1983	Oct	GNAFTE	Vol. 70, No. 41 10-12-83, p. 27 Over the upper northwestern mountains and watersheds, unusually heavy rains continued. Reservoir water levels increased and rangeland vegetation benefited while there was harvest interference and localized flooding. Although rainfall further south became light, it still helped increase irrigation supplies for west coast fall and winter vegetables. The remaining major agricultural areas were mostly dry, including the southern plateau corn belt where some late crops were probably not quite mature. Harvest of sugarcane and citrus, which had been generally stressed by dryness throughout the summer, was beginning in the northeastern and east-central coastal regions since the weather was dry.	WWCB
1983	Oct	EA	Vol. 70, No. 42, 10-18-83, p. 31 The west coast and most of the southern plateau corn belt experienced dry weather which favored harvesting of mature crops.	WWCB
1983	Oct	CMFBA	Vol. 70, No. 43, 10-25-83, p.19 Strong winds and heavy rains from hurricane Tico's abrupt recurring northeastward and slamming into the Pacific coast near Mazatlan destroyed corn, soybeans, rice, beans and other crops totaling about a million acres. People were forced to evacuate and a state of emergency was declared. Tico continued northeastward across the country causing some localized flooding. Much of the rest of the country was generally sunny and dry allowing harvesting and field operations.	WWCB
1983	Oct	ATG	Vol. 70, No. 44, 11-1-83, p. 23 As the seasonal rainy pattern slowly decreased, harvesting was favored across most major agricultural areas. Irrigation supplies for next year's crops continued to increase as scattered showers continued across parts of the northwestern mountain watersheds. The Yucatan Peninsula was hit with heavy rains.	WWCB
1983	Nov	A	Vol. 70, No. 45, 11-8-83, p. 23 Some light showers across the southern plateau and west coast interfered slightly with harvesting and field operations. Most of the northeast was dry enough for citrus, sugarcane and other maturing crops to be harvested.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1983	Nov	AB	Vol. 70, No. 46, 11-15-83, p. 26 In the northeastern part of the southern plateau corn belt and the state of Veracruz, scattered moderate showers interfered with harvesting. Other major agricultural areas generally had weather ideal for field activities, and the rainy season essentially ended over the northwest.	WWCB
1983	Nov	AN	Vol. 70, No. 47, 11-22-83, p. 19 Harvesting and field activities in the northeastern citrus and west coast crop areas especially benefited from warm, dry weather encompassing most areas. Slightly warmer than normal temperatures over northern regions enhanced the growth of winter vegetables, wheat and rangeland vegetation.	WWCB
1983	Nov	BN	Vol. 70, No. 48, 11-29-83, p. 19 Continued excellent harvest weather over most agricultural areas favored the northeast citrus and sugarcane, the southern plateau corn belt and most of the west coast. Northern parts of Baja, California, received moderate rains brought by winter storms.	WWCB
1983	Nov	GABC	Vol. 70, No. 49, 12-6-83, p. 23 About 15 mm of rain fell over parts of the west coast farming area, slowing harvest and field activities and making conditions more favorable for diseases and weeds. Soil moisture generally improved over the area and helped irrigation supplies. Light rains in parts of the southeast probably interfered with sugarcane and coffee harvesting instead of significantly improving soil moisture. Excellent, dry harvest weather persisted over the northeast and extended into the southern plateau corn belt. Cold weather settled over the north-central region with minimum temperatures dropping below freezing, especially at the higher elevations.	WWCB
1983	Dec	BAG	Vol. 70, No. 50, 12-13-83, p. 19 Agriculture over most major production areas was favored by seasonal sunny, dry weather. Crop harvesting was helped in the southern plateau corn belt by abundant sunshine. Rains doused upper Yucatan Peninsula and the Bay of Campeche coast. Remnants of a late season tropical storm, Winnie, temporarily interfered with harvesting and other field activities in areas of the southwestern coast.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1983	Dec	XMA	Vol. 70, No. 52, 12-28-83, p. 15 Freezing air in the Northeast damaged vegetables and some citrus as far south as Cuidad Victoria, about 23° latitude. Generally sunny, mild weather favorable for harvesting and field activities was prevalent over most other major agricultural areas.	WWCB
1983	Dec	XMAB	Vol. 70, No. 53, 1-4-84, p. 17 A major freeze on the 25th and a moderate freeze on the 30th over the northeast resulted from the continued very cold air. As far south as near Ciudad de Valles in eastern San Luis Potasi State, freezing temperatures endangered sugarcane, bananas and other tender vegetation. Along the southeastern coast scattered light rains interfered with some harvesting and field activities. The rest of the country was sunny and dry, favorable for fieldwork.	WWCB
1984	Jan	B	Vol. 71, No. 1, 1-10-84, p. 23 Widespread but mostly light rains were produced when subtropical moisture returned to much of the country. However, 50 mm was received just south of Hermosillo and about 25 mm at Mazatlan. There was generally warm weather over the northeast.	WWCB
1984	Jan	A	Vol. 71, No. 2, 1-17-84, p. 26 Fieldwork in the sugarcane and coffee districts along the east coast was slowed by light rains.	WWCB
1984	Jan		Vol. 71, No. 3 1-24-84, p. 19 There was seasonal sunny weather with mild temperatures from the west coast to the state of Colima but cold air continued over the northeast as temperatures averaged 6 to 10 degrees below normal.	WWCB
1984	Jan	GA	Vol. 71, No. 4 1-31-84, p. 15 Rains that doused the Northeast interfered with field activities but improved soil moisture. Over 75 mm of rain fell around Matamoras, probably eliminating preplant irrigation of grain sorghum and corn. In the south, rains decreased until generally insignificant amounts fell south of Tampico. Ideal sunny, dry weather dominated the west and south.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1984	Jan	GE	Vol. 71, No. 6, 2-14, p. 26 Heavy rains slowed field activities but improved soil moisture and irrigation supplies over the northeast and the southern section of the west coast. Drier than usual weather dominated the extreme northwest and parts of the southeast.	WWCB
1984	Feb	GMAB	Vol. 71, No. 5, 2-7-84, p. 19 Early in the first week moderate to heavy rains moved through the west coast farming areas slowing vegetable harvesting and field activities but improving soil moisture and irrigation supplies before moving eastward where they maintained moist soils across much of the northeast. Heavy rains fell over many of the grain sorghum and maize fields south and east of Matamoras where planting was to start as soon as fields were dry. Early planted fields were eroded and excessively wet in low spots. Seasonal dry, mild weather which favored fieldwork was generally over the remainder of the country.	WWCB
1984	Feb	AB	Vol. 71, No. 6, 2-24-84, p. 26 Spring planting of grain sorghum and corn and harvesting of citrus occurred when dry weather returned to the northeast. Vegetables could be harvested since most west coast farming districts were sunny and mild. The central region and sugarcane and coffee areas in the state of Veracruz had light rains.	WWCB
1984	Feb	BA	Vol. 71, No. 7, 2-22-84, p. 17 Fieldwork and crop development were favored by unsually sunny, dry weather that prevailed across most of the country. In the east, warmer than normal temperatures benefited germination and early growth of grain sorghum and maize. Seasonably warm temperatures benefited vegetables along the west coast farming districts.	WWCB
1984	Feb	MX	Vol. 71, No. 8, 2-28-84, p. 18 Crop development over the northern half of the country and the Bay of Campeche coastal section slowed from cooler than usual temperatures. Spring grasses grew slowly from temperatures of 4°C below normal blanketing the north-central rangeland. Light rains were limited to the east coast and extended across the Yucatan Peninsula. They did little to improve soil moisture. The rest of the country was sunny and dry.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1984	Feb	EMX	Vol. 71, No. 10, 3-13, p. 26 Unusually dry weather over most of the northern half of the country and abnormal coolness in the north-central region caused rangeland grasses and rainfed crops to develop slowly.	WWCB
1984	Mar	XMNB	Vol. 71, No. 9, 3-6, p. 23 Abnormally cool weather continued over the northeast and north-central areas, and expanded southeasward over the remainder of the eastern half of the country. Growth of rangeland grasses was slowed considerably in the north-central region and to a less extent development of crops in the east was limited. Vegetable and early field crops along the west coast were favored by sunny skies that generally dominated the country. Mostly light rain, slightly interfering with field activities but supplying some needed moisture for crops, was primarily limited to the eastern Yucatan Peninsula and along the coastal section of the Bay of Campeche.	WWCB
1984	Mar	NBE	Vol. 71, No. 10, 3-13, p. 26 Weather continued sunny and dry over most of the country. This allowed fieldwork but decreased soil moisture and the rainy season was still a couple of months away. The state of Veracruz and the east coast of the Yucatan Peninsula received very light rain. Sunny, mild weather over the northeast and west coast favored vegetables, corn and other early field crops.	WWCB
1984	Mar	DAM	Vol. 71, No. 11, 3-20, p. 23 Much of the country was sunny and dry and most of northern Mexico experienced unsually warm temperatures that averaged 2° to 4°C above normal. In the west coast Culiacan Valley, some afternoon temperatures soared to a hot 35° to 37°C which was not good for winter vegetables. Droughty rangeland vegetation and rainfed crops were stressed by 30° to 34°C temperatures over the Northeast. Light rains occurred in the higher elevations of the southern plateau corn belt where planting generally begins in April.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1984	Mar	DAT	Vol. 71, No. 12, 3-27-84, p. 19 Over the North, temperatures dropped to near seasonal values, somewhat reducing stress on droughty rangeland grasses and rainfed field crops. About March 20, scattered light showers developed across part of the South but did little to improve soil moisture except in isolated spots. The dryness that generally continued over most of the country benefited harvesting and fieldwork, but increased the need for frequent irrigation.	WWCB
1984	Mar	TM	Vol. 71, No. 13, 4-3-84, p. 19 Rangeland vegetation and rainfed field crops continued to be stressed from the warm sunny weather, and more irrigation was needed for crops since the rainy season usually didn't arrive until mid-May. Temperatures soared in the Northeast, but relief came before crops were damaged.	WWCB
1984	Apr	ET	Vol. 71, No. 14, 4-10-84, p. 23 A needed cooling trend brought near-seasonal temperatures across the North, decreasing some of the stress on crops and livestock. Light rains in some areas of the Northwest did not improve soil moisture or replenish reservoirs. Parts of the east coast sugarcane and coffee areas received only light rains also. The rest of the country was sunny and dry, which helped field activities, but continued to decrease soil moisture and increase irrigation needs.	WWCB
1984	Apr	BN	Vol. 71, No. 16, 4-24-84, p. 18 Sunny, warm weather continued over most areas. Mostly light rains limited to the state of Veracruz aided slightly, coffee, sugarcane and citrus.	WWCB
1984	Apr	XMT	Vol. 71, No. 17, 5-1-84, p. 22 The continuation of abnormally hot, dry weather stressed nonirrigatied crops and rangeland vegetation over much of the nation. Only the states of Veracruz and Chiapas received a few light showers. In the Northeast, temperatures were unsually hot and some districts had weekly extremes of 40-43°C that stressed livestock and immature crops. Greater need for irrigation this spring caused concern about declining water levels in reservoirs, especially since the rainy season that usually begins about mid-May in southern Mexico was expected to be later than usual.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1984	May	XM	Vol. 71, No. 18, 5-8-84, p. 26 Another heat wave that developed over the Northeast with temperatures up to 37-45°C probably critically damaged some nonirrigated corn in the reproductive stage and hastened maturity of grain sorghum and older corn. Southern areas received a few showers as tropical moisture, possibly starting the rainy season, began moving into the area.	WWCB
1984	May	EM	Vol. 71, No. 19, 5-15-84, p. 30 About May 8 the long-awaited rainy season began bringing the first significant showers since late last summer as moist tropical air pushed across the southern mountains into the northwestern mountains. Most rain fell on the mountain peaks but the adjacent valleys received some showers. Light rains should have slightly helped some late corn and grain sorghum in the Northeast, but as a result of no rain in April, most of the country still suffered from dryness that stressed crops and livestock.	WWCB
1984	May	TM	Vol. 71, No. 20, 5-22-84, p. 18 Areas of the eastern half of the nation received as much as 100 mm of precipitation and the late rainy season strongly developed, helping some of the drought-stricken rangeland vegetation and immature crops. Nonirrigated corn and grain sorghum in the Northeast were probably too near maturity to be helped. Water supplies for some west coast crops were expected to improve after showers formed over the northwestern mountain watersheds. Tropical storm Alma formed on the 18th from the very active intertropical covergence zone offshore the southern Mexico coast.	WWCB
1984	May	GNEM	Vol. 71, No. 21, 5-30-84, p. 22 Light rains covered most of the east coast, Yucatan Peninsula and some areas of southern and northwestern mountains, but in some areas of Vercruz State 20 to 40 mm of rain fell benefiting citrus, coffee and sugarcane. Dryness continued hampering corn development in the southern plateau corn belt because rainfall there was very light. Over the northwestern mountain watersheds the rainy season was still not well pronounced.	WWCB

YEAR	MO	CODE		SOURC
1984	Jun	EMAGN	Vol. 71, No. 22, 6-5-84, p. 26 Some of the early planted corn and beans in the southern plateau corn belt continued to be stressed from very little rain. Grain sorghum and corn that matured early because of prolonged dry, hot conditions in the northeast were harvested. Surgarcane, coffee and other tropical crops benefited from scattered heavy rains in Veracruz State and Yucatan Peninsula. The northwest and west coast were dominated by unusually hot weather that accelerated crop development and water needs of immature crops. Light rains over the southern valleys and a few heavy showers over the adjacent mountains were triggered by tropical storm Boris developing offshore south of Acapulco. Much more rain was needed for southern field crops.	WWCB
1984	Jun	GNDMT	Vol. 71, No. 23, 6-12-84, p. 30 Young corn and beans in most of the southern plateau corn belt benefited from light to moderate showers. Light rains occurred in the major eastern farm areas but more precipitation was needed for sugarcane, coffee, citrus and immature field crops. Northwestern mountain watersheds did not receive their usual precipitation. Maturing corn and grain sorghum in the upper northeast in late May received up to 150 mm of rain but it was little help. The western part of the southern plateau corn belt was unseasonably dry hindering germination and growth of non-irrigated field crops while adequate moisture fell in the eastern districts. In the northwest and parts of the west coast, wheat matured rapidly from very hot temperatures in May. Irrigation requirements were kept very high.	WWCB
1984	Jun	BTNA	Vol. 71, No. 24, 6-19-84, p. 26 The western part of the southern plateau corn belt finally received beneficial rains. Around Guadalajara major corn and bean areas which had been relatively dry in the spring received up to 60 mm of moisture. Germination of late crops and maintenance growth of earlier ones should have been helped with the apparent well established rainy season. Northwestern mountain watersheds that supply irrigation water to west coast farming areas received showers. Sugarcane, coffee and other tropical crops' development was favored by heavy rains on the central east coast to the western Yucatan Peninsula. Sorghum and corn in the Northeast and wheat in the Northwest was harvested since dry weather dominated much of the North.	WWCB

EPISODIC EVENTS FOR MEXICO

YEAR	MO	CODE		SOURCE
1984	Jun	GNT	Vol. 71, No. 25, 6-26-84, p. 22 Over much of the nation, especially in the South, the rainy season was well established. Heavy rains fell when a tropical depression formed in the southwestern Gulf of Mexico and moved inland at Tampico. Rain also resulted from rejuvenated tropical storm Boris and hurricane Cristina although these systems remained well offshore the southern coast of Mexico. Development of corn and beans in the southern plateau corn belt, sugarcane and coffee along the central east coast and improved irrigation supplies for west coast field crops were aided by the rains. Grain sorghum and corn harvest in the upper Northeast and the development of cotton in North central and Northwest areas were benefited by abundant sunshine.	WWCB
1984	Jun	GNTEM	Vol. 71, No. 26, 7-3-84, p. 22 Over much of the South and Northwest, crops benefited from seasonal moderate to heavy rains. Corn and bean areas in most of the southern plateau received moisture adequate for crop development. There were dry spots in the northeastern section, but rains that extended across the northwestern mountain wastersheds were expected to increase irrigation supplies for west coast soybeans, cotton and other summer crops. Most of the north-central and northern areas were dry which aided harvesting, but stressed non-irrigated, immature crops.	WWCB

EPISODIC EVENTS FOR PARAGUAY

YEAR	MO	CODE		SOURCE
1971		XM	353.8 D101.22, 550-156, Area Handbook for Paraguay, p. 189. Bad weather reduced corn production.	MISC
1971		F	353.8 D101.22, 550-156, Area Handbook for Paraguay, p. 186. The flooding of the Paraguay River early in the year wiped out several hundred farms near Asuncion.	MISC
1971		GMHN	HD1411.U5, 328-339, ERS-FOR 334, p. 23 Heavy rains in late 1970 and early 1971 adversely affected corn production which decreased 1 percent although the area planted increased 17 percent. Cotton production dropped 54 percent. Although there were increases in production of wheat, which had been rapidly increasing since 1967; rice, sugarcane and soybean total agricultural production was down almost 5 percent.	TWHAGS
1972		NDMXP	HD1411.U5, 341-355, ERS-FOR 351, p. 17 There was a large increase in agricultural production, especially of cassava, soybeans and rice: both soybeans and rice increased more than 50 percent which represented new gains. Although corn planted area increased, drought conditions reduced production almost 25 percent. An unusually hot and damp winter caused a severe outbreak of wheat rust that reduced production by 65 percent below 1971.	TWHAGS
1973		NM	HD1411.U5, 356-365, ERS-FOR 360, p. 23 Corn production recovered from a poor crop last year and output was up to 250,000 tons. Continuing a 2 or 3 year upward trend, cotton, sugarcane and soybean production also increased substantially. Wheat production improved only slightly from the poor 1972 crop. Largely because of competition from other crops, particularly soybeans, production of the most important food crop, cassava was apparently down somewhat.	TWHAGS
1974	Jan	FM	353.8, A93.29/2, U.S. ERS, WAS 1-12, 5, Sept 74, p. 5. In parts of the country during the first half of the year abnormally heavy rain fell and even flooding began as early as January and continued through April, damaging some of the early crops.	WAS

EPISODIC EVENTS FOR PARAGUAY

YEAR	MO	CODE		SOURCE
1974	Mar	GN	5-30-74, 31/3, p. 4 The weather was wet and crop conditions were normal.	FAO
1974	Sep	BN	10-28-74, 30/9, p. 4 Weather and crop conditions were normal. Wheat imports of 80,000 tons were planned.	FAO
1975	Apr	EN	4-30-75, 24/4, p. 11 Although the weather was dry; crop conditions were normal.	FAO
1975	May	NB	5-30-75, 6/5, p. 9 Normal crop conditions and normal weather prevailed.	FAO
1977	Jan	F	2-8-77, 18/1, p. 13 The Parana and Paraguay Rivers caused localized floodings in southwestern and northern regions after heavy rains fell in the areas bordering Brazil.	FAO
1978	Apr	N	5-11-78, 17/4, p. 18 1977 wheat production was estimated higher than the 29,300 tons in 1976.	FAO
1979	Jun	FRM	6-15-79, 1/6, p. 21 The districts of Bahia Negra, Fuerte Olimpo and other localized areas were flooded resulting in the loss of crops and property when persistent torrential rains in the Brazilian Amazon region of Mato Grosso state caused the Paraguay River in the department of Alto Paraguay to overflow. The government and FAO/WFP gave relief to the flood victims.	FAO
1981	Nov	ANB	1-22-82, 25/11, p. 21 Harvest of 1981 wheat, completed in December, was expected to be 10,000 tons above the 1980 production. This was due to favorable weather throughout most of the growing cycle.	FAO
1982	Jun	FR	7-16-82, 24/6, p. 19 During the second ten days of June torrential rains caused extensive floods that inundated areas from the northern border with Bolivia to the capital city Acuncion. About 31,000 people were affected and the Government as well as voluntary relief organizations were aiding them. Continued wet weather aggravated the situation.	FAO

EPISODIC EVENTS FOR PARAGUAY

YEAR	MO	CODE		SOURCE
1983	Mar	FMR	4-15-83, 23/3, p. 20 Extensive floods which damaged crops and made 3,000 people homeless came about when the rivers Parana and Paraguay overflowed. The Government was providing emergency food assistance.	FAO
1983	May	FM	5-20-83, 5/5, p. 20 The Parana River and its affluents again overflowed in the southern region after heavy rains were received. New damage to crops and property occurred at San Juan Bautista city and large surrounding agricultural areas.	FAO
1983	Jun	FM	6-17-83, 4/6, p. 21 The flood situation in both upper and lower areas was aggravated by continued heavy rains and serious crop and livestock damage were reported. Thousands of people had to be evacuated. Food supplies were still adequate.	FAO
1983	Jun	FM	7-18-83, 1/7, p. 21 The rise in the levels of the Parana and Iguazo Rivers from June rains in the eastern region could have aggravated the flood situation in the southern areas bordering Argentina and could have interrupted the slow decrease of the level of the Paraguay River. The food supply was still adequate in the flooded areas and according to UNDRO the crop damage was expected to be less serious than originally thought.	FAO
1983	Jul	R	8-12-83, 20/7, p. 22 The food supply was still adequate and the flood levels were stationary or slowly descending except the Parana River which rose suddenly. A FAO/TCP project was being implemented to provide seed potatoes and fertilizers.	FAO
1983	Oct	FEN	11-18-83, 1/11, p. 22 The overall situation in southern flooded areas beside the Parana and Paraguay Rivers improved since there was dry weather in October. The food situation was satisfactory since newly harvested crops were available.	FAO
1984	May	G	Vol. 71, No. 19, 5-15-84, p. 31 Persistent showers occurred over the extreme southern portion of the country.	WWCB
1984	Jun	G	Vol. 71. No. 23, 6-12-84, p. 31 Southeastern Paraguay was hit by a band of heavy rain (50 to 220 mm) during the week of June 3-9.	WWCB

EPISODIC EVENTS FOR URUGUAY

YEAR	MO	CODE		SOURCE
1969		N	HD1411.U5, 269-281, ERS-FOR 279, p. 7 With recovery from last year's adverse weather, total agricultural output for 1969 was expected to be significantly above the previous year.	TWHAGS
1969		HBNM	HD1411.U5, 282-301, ERS-FOR 294, p. 12 A sharp expansion in plantings of 1970 feedgrains occurred as a result of attractive prices and good weather after the 1967/68 drought. The 1969 corn harvest was nearly double the 1968 low, rice reached a new record, rapid expansion in sorghum grain continued and sunflower seed registered a significant recovery as moisture levels improved. Wheat plantings for 1969/70 were severely cut back because of dissatisfaction with prices, and depressed prices contributed to a 54 percent decline in sugar beet production. Barley and oat crops were smaller.	TWHAGS
1970		HGN	HD1411.U5, 302-327, ERS-FOR 312, p. 12 A reduction in planted wheat area resulted from heavy rains during the planting season while rice production was a record for the second straight year.	TWHAGS
1971		NM	HD1411.U5, 328-339, ERS-FOR 334, p. 25 Grain production continued steady with increases in corn, sorghum and barley: sugarcane production was also steady, but there were decreases in wheat, rice and oats. The total agricultural situation deteriorated significantly with production falling 10 percent.	TWHAGS
1972		MGN	HD1411.U5, 341-355, ERS-FOR 351, p. 18 This second straight year of decline, the agricultural production fall of about 3 percent was caused mainly by poor wheat, corn and potato crops. Low prices relative to other commodities and excessive rains brought down wheat production 50 percent below the 1967-71 average. Lower corn and sorghum production resulted from poor weather and total feed grain production was down 12 percent while total grain production was down 21 percent. Rice production was up about 3 percent, but sugarcane gained sharply.	TWHAGS

EPISODIC EVENTS FOR URUGUAY

YEAR	MO	CODE		SOUR(
1973		DNXM	HD1411.U5, 356-365, ERS-FOR 360, p. 25 The several crops that recovered from the drought conditions of 1972 increased production by 26 percent. Corn production increased 62 percent and sorghum threefold while wheat reached only one-half the 1961-70 average since the weather at planting time was poor and producer prices were low. However, it did increase 10 percent from the low 1972 crop.	TWHA(
1974	May	NEM	5-30-74, 3/5, p. 4 Crop conditions and plantings were normal, weather was dry, but harvests were below average or delayed.	FAO
1974	Jun	EN	7-24-74, 28/6, p. 4 The weather was dry, but crop conditions, plantings and harvests were normal.	FAO
1974	Sep	NG	10-28-74, 30/9, p. 4 Crop conditions were normal and the weather wet.	FAO
1975	Jan	EMN	1-31-75, 2-25-75, 31/1, p. 5 The weather continued dry, crop conditions were below normal, plantings and harvests were normal. Wheat production was expected to be above last year's.	FAO
1975	Apr	M	4-30-75, 11/4, p. 11 Corn, sunflower and other minor crops were below average, but the shortfall wasn't serious.	FAO
1976	Jan	N	3-3-76, 27/1, p. 11 Weather, crop conditions and plantings were all normal.	FAO
1976	Apr	NM	5-6-76, 12/4, p. 11 All major summer crops, rice, corn, sorghum and sunflower seed were expected to increase in production. Grain was expected to increase enough for exporting but wheat output was expected to fall short of last year's.	FAO
1976	May	N	6-14-76, 25/5, p. 11 1976 overall summer grains production was higher than last year's.	FAO
1976	Jun	EN	7-28-76, 6/6, p. 11 The weather was dry and crop conditions were normal.	FAO

EPISODIC EVENTS FOR URUGUAY

YEAR	MO	CODE		SOURC
1976	Sep	NH	9-27-76, 14/9, p. 12 The increase expected in rice production was due to better yields and increased area.	FAO
1976	Oct	NBE	10-29-76, 12-7-76, 5/10, 4/11, p. 13 The October information stated crop conditions and weather were normal. The first of November was wet and crop conditions were above normal.	FAO
1976	Nov	EMBN	1-11-77, 15/11, p. 14 Heavy rains damaged crops in the south while favorable weather benefited grain crops in the north. The 1976 wheat crop was expected to be larger than that for 1975.	FAO
1977	Apr	EM	4-14-77, 5/4, p. 15 Excessive rains delayed the harvest of the grain crop.	FAO
1977	Apr	EM	5-11-77, 15/4, p. 17 The 1976/77 wheat output was still expected to be larger than last year's, but the quality was thought to be much below average due to excessive rains. The sorhgum and corn harvests were delayed.	FAO
1977	Oct	EXM	11-14-77, 17/10, p. 21 Very wet weather prevailing from July through September hampered wheat sowing operations and a violent hailstorm striking in northeastern Paysandu area October 15 caused heavy damages to crops and properties and killed much livestock. 1977 wheat area was expected to be less.	FAO
1977	Dec	AMPG	1-12-79, 21/12, p. 18 The estimate for the 1977/78 wheat crop being harvested was reduced due to pest attacks and excessive rains causing a sharp decline in yields. 1976/77 wheat production was 504,000 tons.	FAO
1978	Mar	GPM	4-7-78, 5-11-78, 16/3, p. 18 Persistent rains and pest attacks sharply reduced wheat yields and the production estimate was reduced to 160,000 tons for 1978. Imports of wheat would have to be made. There were no imports in 1977.	FAO

EPISODIC EVENTS FOR URUGUAY

YEAR	MO	CODE		SOUR
1978	May	MG	6-9-78, 18/5, p. 17 Most of the crops in the grain areas were seriously damaged by end-March rains.	FAO
1978	Aug	AGN	9-15-78, 14/8, p. 19 Wheat sowings were delayed by excessive rains in June-July, however, production was expected to be somewhat higher than last year's.	FAO
1979	Feb	XMAH	3-9-79, 16/2, p. 18 Adverse weather affected the wheat crop throughout the growing cycle; and the 1978 crop, harvested December-January, was estimated to be lower than that for 1977 which was 173,000 tons. Lower production and reduced stocks meant wheat imports would more than double the 112,000 tons imported during 1978. Area sown to 1979 corn and sorghum crops, due for harvest in April-June, was greater than in 1978.	FAO
1979	Mar	DGAN	5-11-79, 26/3, p. 20 The drought which had affected the entire country for about three months was interrupted during the first half of March by heavy rain. Sorghum and corn crops due for harvest in May-June benefited especially from the rain.	FAO
1980	Apr	H	4-18-80, 8/4, p. 21 Larger sown area and better yields should push wheat production to about 120 percent above the previous year to 380,000 tons. Corn should reach 162,000 tons or 130 percent more than in the last year.	FAO
1980	May	EAG	6-13-80, 27/5, p. 23 Reduced soil moisture at planting time and excessive rains during the recent harvest decreased yields for the corn crop probably by 60,000 tons, but the yield was still much above the 70,000 tons harvested in 1979.	FAO
1980	Jul	GAH	7-11-80, 8/7, p. 23 Since early May; abundant rains provided adequate soil moisture but delayed wheat field work. However, sowings should exceed those for 1979.	FAO

EPISODIC EVENTS FOR URUGUAY

YEAR	MO	CODE		SOURCE
1980	Aug	AGHM	9-19-80, 22/8, p. 21 Field work and sowing of 1980 wheat, hampered by abundant rains since early May resulted in an estimated 210,000 fewer planted hectares and below average output.	FAO
1980	Nov	AXH	11-14-80, 6/11, p. 18 The wheat crop harvested December-January was expected to be half that harvested in 1979, since the weather was unfavorable during most of the growing season. However, stocks left over from 1979 should prevent importing wheat. An increase in recently sown maize, harvested next April/May, was expected since there was an increase in planted area. The greater area planted to corn replaced less remunerative crops such as sunflower, soya and sorghum.	FAO
1981	Jan	A	2-17-81, 6/1, p. 21 Harvest of 1980 wheat crop, completed January, 1981, yielded only 230,000 tons against 500,000 tons in 1979.	FAO
1981	Jul	H	8-7-81, 9/7, p. 22 The Government used price incentives to try to stimulate domestic grain production and increase exports. Wheat area was expected to increase.	FAO
1982	Jan	AMX	2-12-82, 12/1, p. 21 Downward revision of the yield of the 1981 wheat crop just harvested, resulted from lower yields per hectare following less favorable weather during the last part of the growing season.	FAO
1982	Aug	A	9-10-82, 20/8, p. 19 The Government lowered support prices to farmers so wheat production was expected to be less at next harvest. The 1982 wheat crop sowings of 280,000 hectares were just completed mid-August.	FAO
1983	Sep	G	Vol. 70, No. 40, 10-4-83, p. 24 Southwestern Uruguay received heavy rain as a storm system intensified.	WWCB
1984	Feb	G	Vol. 71, No. 9, 3-6-84, p. 23 Heavy rains that were greater than 50 mm spread into the country from Argentina.	WWCB
1984	Apr	G	Vol. 71, No. 14, 4-10-84, p. 23 Most of Uruguay received precipitation of more than 50 mm during the first week of April.	WWCB

EPISODIC EVENTS FOR URUGUAY

YEAR	MO	CODE		SOURCE
1969		N	HD1411.U5, 269-281, ERS-FOR 279, p. 7 With recovery from last year's adverse weather, total agricultural output for 1969 was expected to be significantly above the previous year.	TWHAGS
1969		HBNM	HD1411.U5, 282-301, ERS-FOR 294, p. 12 A sharp expansion in plantings of 1970 feedgrains occurred as a result of attractive prices and good weather after the 1967/68 drought. The 1969 corn harvest was nearly double the 1968 low, rice reached a new record, rapid expansion in sorghum grain continued and sunflower seed registered a significant recovery as moisture levels improved. Wheat plantings for 1969/70 were severely cutback because of dissatisfaction with prices and depressed prices contributed to a 54 percent decline in sugarbeet production. Barley and date crops were smaller.	TWHAGS
1970		HGN	HD1411.U5, 302-327, ERS-FOR 312, p. 12 A reduction in planted wheat area resulted from heavy rains during the planting season while rice production was a record for the second straight year.	TWHAGS
1971		NM	HD1411.U5, 328-339, ERS-FOR 334, p. 25 Grain production continued steady with increases in corn, sorghum and barley: sugarcane production was also steady, but there were decreases in wheat, rice and oats. The total agricultural stituation deteriorated significantly with production falling 10 percent.	TWHAGS