To the Graduate Council:

I am submitting herewith a dissertation written by Hugo C. C. Bodini entitled "Viability of Small-Farmer Communities in the Enriquillo-Cul de Sac Depression of Hispaniola." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Geography.

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VIABILITY OF SMALL-FARMER COMMUNITIES IN THE ENRIQUILLO-CUL DE SAC DEPRESSION OF HISPANIOLA

A Dissertation

Presented for the

Doctor of Philosophy

Degree

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Hugo C. C. Bodini

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ABSTRACT

The viability of rural development in a semiarid environment of Hispaniola has been examined to provide basic knowledge for the improvement of living conditions of small-farmer communities. The viability of these communities in the semiarid Enriquillo-Cul de Sac Depression has been studied within the conceptual framework of appropriate development, desertification control and a small-farmer approach. Priority has been given to the geographical expression of viability and various areal levels of potential and constraint in relation to agriculture.

Relationships between levels of viability, geographical characteristics, and conditions for development in each community were studied in five sectors of the Enriquillo-Cul de Sac Depression where most of the small-farmer communities are located. The technique known as threshold analysis was employed. Natural and spatial factors were used to define thresholds of viability corresponding to levels defined within the model. Economic, legal and socio-anthropological dimensions of analysis were included later to complete the definition of present viability. Areas with high, medium and low levels of viability were located, and their geographical characteristics, potential and constraints identified and measured. Official reports on productivity, costs and prices, plus the results of almost 1000 family interviews facilitated calculation of the approximate population that can be supported within each viability level.

The figures demonstrate that most of the present population, about 60 percent, is located in areas with medium or low viability and that even for the other 40 percent, conditions of family income surplus, social services or physical condition of the rural habitat are inadequate. The area has no potential to support a settlement under present circumstances. On the contrary, there is a real need for investments, new economic activities and better conditions of housing and services. The alternatives to immediate development are very low levels of living and a high rate of emigration, primarily to the capital cities of Haiti and the Dominican Republic.

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CHAPTER I

INTRODUCTION

A striking feature of the world today is the great economic disparity between countries, and among places within countries. These differences and inequalities must be defined, measured and explained before effective action can be taken to solve the related problems of underdevelopment. Regional studies are believed to present the best approach to achieve this goal, and many new concepts, methods and techniques have been proposed in recent years. Among the concepts, three have been accepted as the most promising for applied regional studies. First is the concept of development, second is the concept of desertification and third is the farming system approach.

Development was the first concept to receive worldwide acceptance. It was conceived after the Second World War as the basic goal of programs to rebuild destroyed economies and increase productivity and levels of consumption in countries affected by the conflict. Soon it was transformed into a general measurement of standards of living and economic satisfaction in any society. In recent decades countries and regions have been classified as "developed," "underdeveloped" or "less developed." At the same time, "general development" has been accepted as a fundamental purpose of all political systems.

The concept of development has evolved naturally since its first appearance, when an almost exclusively economic meaning prevailed, to

include an important social dimension. During the 1970's, a new ecological perspective was added, including natural and spatial constraints to be considered in relation to human activity. As a result, this concept is difficult to define, and as a professor of policy analysis wrote recently: "The fact is that no one really knows enough about the rate and pattern of that bundle of changes called development to speak with much authority in this field" (Bird, 1981).

To achieve a realistic approach, new perspectives have been added, such as ecodevelopment, self-management, grass-roots development or appropriate development. The latter is particularly relevant to this study and can be defined as a process of change with the following characteristics:

1. Heavy emphasis on the satisfaction of basic needs, for those who are most needy.
2. Reduced dependency through self reliance at the national, local and collective levels.
3. Reduction of economic, social and political inequalities between the various professions, ethnic groups, sexes and urban-rural residents.
4. Preservation of endogenous cultural patterns.
5. Preservation of the ecological balance.
6. Strengthening of the social identity of individuals.

These assumptions present an ideological minimum to which several other criteria could be added (Samset, 1981).

Grass-roots development is another approach, defined by Ehrlich, Ehrlich and Holdren (1977) as "development planned to help the poorest people, not aimed primarily at massive industrialization and growth of the G.N.P."

At the same time that development was accepted as a basic concept, and many international programs and agencies were created to promote it, UNESCO's Man and the Biosphere Programme launched a Project on Arid Zones. Since 1951, more than thirty volumes have been prepared all over the world, dealing with the Programme. Reviews, seminars and symposia have been organized in relation to major environmental problems of arid and semiarid zones of the various continents.

Optimism was a general characteristic of the post-war reports because most research was based on the simplistic arithmetic that the arid and semiarid lands comprise about one-third of the earth's surface, but support less than one-eighth of its population. Hence, these lands were thought to be untapped resources that might be developed easily through technology transfer.

During the 1970's, and due mostly to the disastrous Sahelian drought of 1968-73, international concern led to a resolution by the United Nations General Assembly calling for a conference on "desertification."

> The latter term is defined as an ecosystematic change that represents diminished biological production, or reduction in biomass, leading to accelerated degradation and eventual instability of the physical environment. In human terms, it is reflected in a lowered livestock-carrying capacity of rangelands, diminished yields, and a loss of productive cropland. Progressive reduction in real income and social well-being occur, and the number of people who can be supported by the region is reduced (Mabbutt, 1979).

A major change of perspective has evolved in studies based on the new approach concerning environmental vulnerability and its relationship to human activities. Most papers prepared for the

"desertification" conference, and for programs and meetings conducted since 1977, refute the view that arid and semiarid lands should be considered underpopulated or as untapped sources of increased production. On the contrary, they are shown to be areas of declining productivity and loss of arable land, of deteriorating human conditions, and of population exodus and settlement retreat where social and environmental degradation call for urgent remedial action (UNESCO, 1977).

The farming system approach and the relevancy of small farms have been promoted in many papers on rural development (Norman, 1980; Badenhop, 1981). Special emphasis has been placed on the idea that the great number of small farms in the developing countries, and their impact on the rest of society, require their active participation in the development effort for national, political and economic stability (Badenhop, 1981).

In most recent international conferences the emphasis on small-farm development has been strong (World Food Conference, 1976; International Conference of Agricultural Economists, 1979; Seminario sobre disparidades regionales y políticas compensatorias en Africa y América Latina, 1982; Conference of Latin Americanist Geographers, 1982). Also, important international organizations, such as the Agency for International Development (A.I.D.), the Inter-American Development Bank (I.A.D.B.), the United Nations Development Programme (U.N.D.P.), the United Nations Environment Programme (U.N.E.P.), the Food and

Agriculture Organization (F.A.O.), the Organization of American States (O.A.S.), the Interamerican Institute for Cooperation in Agriculture (I.I.C.A.), and national agencies for agricultural development or agrarian reform, have defined this small-farmer approach as basic to their future activities. After major controversies about the viability of the "green revolution" in the less developed countries, there is consensus that technological improvement makes the rich richer and the poor poorer, so the goal of social development is not achieved (Heady, 1976; Bhagavan, et al., 1973; Hewitt de Alcántara, 1974; Brown, 1974; Collier, 1975; Innis, 1980; Eckholm, 1980). Hence, research on small-scale farming and related processes of development is today one of the most significant subjects for rural geography and regional studies (Henshall and King, 1966; Henshall, 1967; Chisholm, 1964; Cooke and Johnson, 1969; Whitby, et al., 1974; Lewis, 1979).

Experiences all over the world demonstrate that the concepts of appropriate development, desertification control, and the small-farmer approach interact strongly to define a more specific and realistic scope for regional analysis (Gasser, 1981; Stavis, 1979; Southern Task Force on Rural Development, 1970).

The Problem

The past three decades have been characterized by a major concern for economic and social development. This is especially true in countries of the Third World, where efficient use of the land has been considered basic for proper utilization of natural resources. Many

policies related to settlement have been improved as a result. Colonization projects commonly have been implemented in arid or semiarid environments in conformity with ideas supported by UNESCO, and with emphasis on the development of small-farmer communities. Financial and technical aid has come from some government agency. After decades of experience, the results have been controversial.

Important programs of agricultural colonization have been implemented on the island of Hispaniola during the past fifty years. Although in both countries roots can be traced to the distant past, large-scale Dominican colonization began under the dictatorship of Rafael Trujillo with the passage of the Agricultural Colonization Law of 1934. The number of colonies increased from nine in 1930 to fifty in 1953; and by mid-1959 there was a total of sixty-seven settlements, plus several others in preparation (Augelli, 1962, 1966).

In Haiti, small-farmer settlement began a few years after independence as part of a process to distribute and sell the large French landholdings. It was not until the American occupation, from 1915 to 1934, and mainly in the forties and fifties, that the Haitian government decided to improve the living conditions of small farmers and to promote important programs for the development of small-farm agriculture. Projects were implemented on a modest scale in the principal agricultural areas of the North, the Artibonite Valley, and the Cul de Sac Plain (Tippets, Abbett, McCarthy, Stratton, 1956).

In the Dominican Republic, settlements were spread throughout the country and displayed different characteristics of site, environment,

ethnic composition, and technical and financial assistance. The economic and social results likewise were quite different. While excellent results were obtained in the area of Sosua, on the north coast, and in the Cibao Valley (Augelli, 1962; Antonini, 1971), some communities in the mountains, in the dry South, and in the Enriquillo-Cul de Sac Plain did not prosper. After the fall of Trujillo in 1961, Dominican governments did not support the colonization program, and many colonies suffered economic decadence and an exodus of population. This was particularly the case in some communities of the Enriquillo Basin (Troncoso, 1980).

In Haiti, the government of François Duvalier did not obtain enough financial support to implement projects in agricultural development, and small-farmer communities decayed as a result of natural hazards and the increasing densities of rural population (Moral, 1961; Murray, 1977).

Recently, the Dominican National Office of Planning and the Haitian Secretariat of State for Planning have prepared programs for development in which an important role has been assigned to small-farmer communities, especially in the semiarid Enriquillo-Cul de Sac Depression. Public investments are under consideration to improve settlements in this region (ONAPLAN, 1965, 1976; INDESUR, 1982a; DATPE/SEP, 1981; B.I.D., 1982). Under this new perspective the settlement of small-farmer communities in a semiarid environment must be reviewed to evaluate their viability relative to the prevailing natural, economic and social constraints.

The case of the Enriquillo-Cul de Sac Depression, with almost fifty years of colonization efforts, and the social and economic conditions of small-farmer communities in that area, raise questions to which answers are sought:

1. What are the basic requirements to assure viable, permanent settlement for small-farmer communities in a semi-arid environment, and how do they correspond to the characteristics of the Enriquillo-Cul de Sac Depression?
2. What are the advantages or disadvantages of this dry area compared with other environments and economic regions of the island?
3. How are these communities affected by geopolitical conditions related to the international border and the other human settlements of the Cul de Sac?
4. How can the development of this area be affected by national policies as compared with that of other regions in both countries?
5. What might be the most suitable type of settlement for this dry environment on the island of Hispaniola?

Objectives

According to the ideas presented, the main objectives of this study can be condensed in the following points:

1. To define the basic environmental and socioeconomic requirements for permanent small-farmer settlements within the study area.

2. To compare these requirements with the main ecological and socioeconomic constraints characteristic of the Enriquillo-Cul de Sac Depression.
3. To compare the economic relationships of the study area with other regions of the island, and to analyze the relative advantages or disadvantages of the Enriquillo-Cul de Sac Depression.
4. To analyze the influence of the international border and the dense settlements of the Cul de Sac on the economic prospects for the area.
5. To predict possible effects of government policies for development in the study area.
6. To predict the relative advantages and constraints for other types of settlement in the semiarid environment of the Enriquillo-Cul de Sac Depression.

The Study Area

The island of Hispaniola, also named Santo Domingo in many books and reports, is the second largest of the Greater Antilles in the Caribbean Sea (Fig. 1). Its area of approximately 77,000 square kilometers is shared by two countries: the Dominican Republic (49,000 Km^2) and Haiti (28,000 Km^2). It was the first important land discovered by Columbus and settled by Spaniards in America, and presents an interesting historical evolution. After a promising period of discovery and colonization in the 15th century and first quarter of the 16th, a

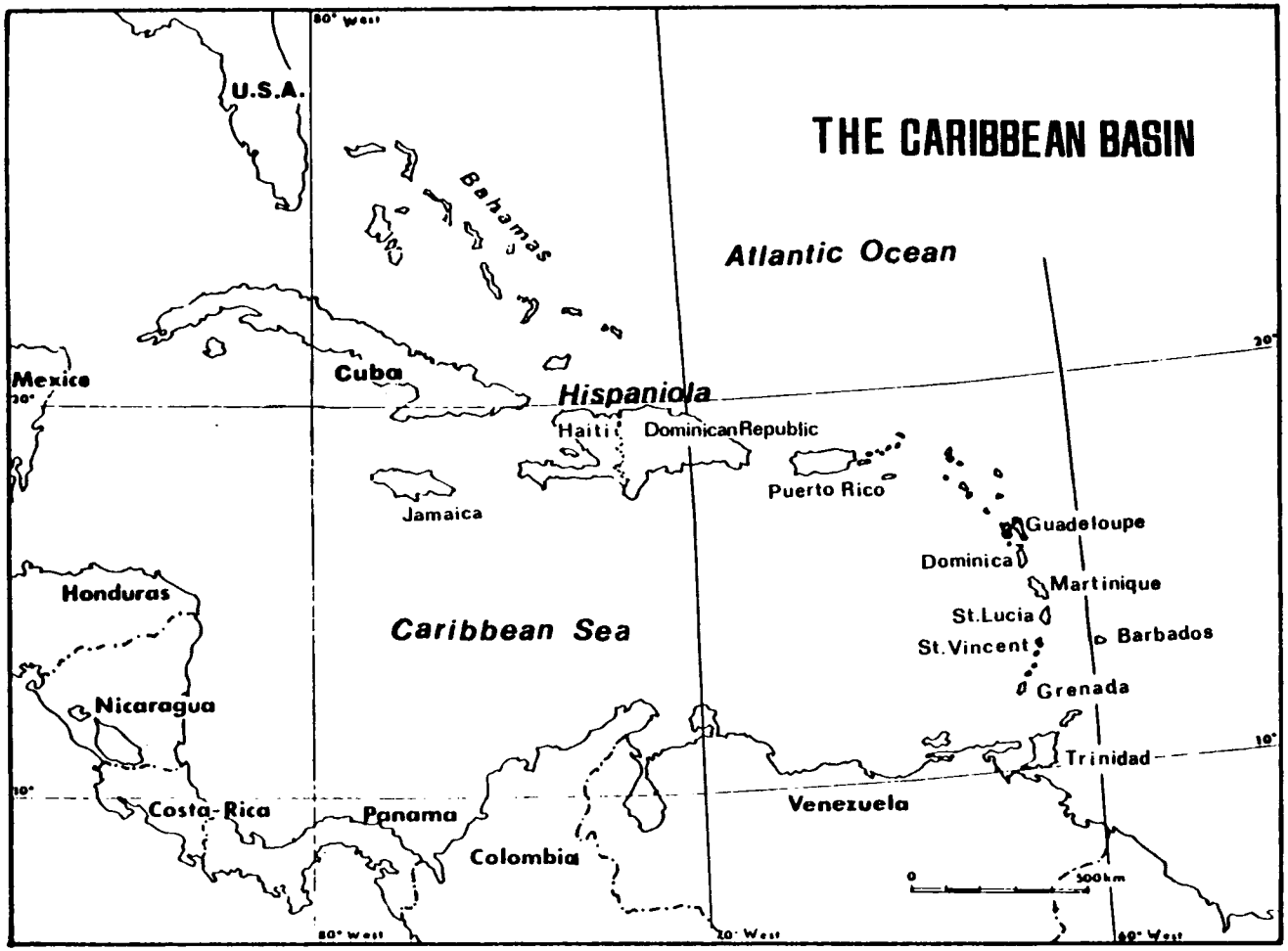

THE CARIBBEAN BASIN
U.S.A.
Bahamas
Atlantic Ocean
Mexico
Cuba
Hispaniola
Haiti
DominicanRepublic
Puerto Rico
Jamaica
Guadeloupe
Dominica
Martinique
St.Lucia
Barbados
St.Vincent
Grenada
Honduras
Caribbean Sea
Nicaragua
Trinidad
Venezuela
Costa Rica
Panama
Colombia
0
300km
80° West
20° West
60° West

Figure 1

decadent colonial period evolved in the Spanish east while the west was developed as a highly successful French colony. Independence, revolutions, wars and dictatorships characterized the 19th century, while American intervention and some trend toward democracy and economic development are products of the 20th century. These social and political changes have deeply affected the pattern of settlement and land use over the island, and major differences can be perceived on the two sides of the international border.

In addition to the contrasts in historical and social evolution, differences in relief and climate are probably the most characteristic features of the island. The terrain is mostly rugged, with more than 60 percent of the total area in mountains. Included is the highest peak in the Antilles, the Pico Duarte in the Dominican Republic, at 3175 meters above sea level.

Three ranges cross the Caribbean Sea from Yucatán, Belize and Nicaragua to form the islands of the Antillean Arc. They converge in Hispaniola and appear as parallel features extending in an east-west direction. Thus, a series of geomorphological regions can be identified, mostly valleys and ranges, from north to south (Cucurullo, 1951, 1968; Guerra, Peña, 1966), as shown in Figure 2. The origin of this relief corresponds to different tectonic uplifts, the oldest being from the Cretaceous, affecting the geology, mineral resources and soils of the island (de la Fuente, 1976; O.E.A., 1967, 1972).

The landform distribution influences climate, and the major differences in altitude are an important factor in the variation of

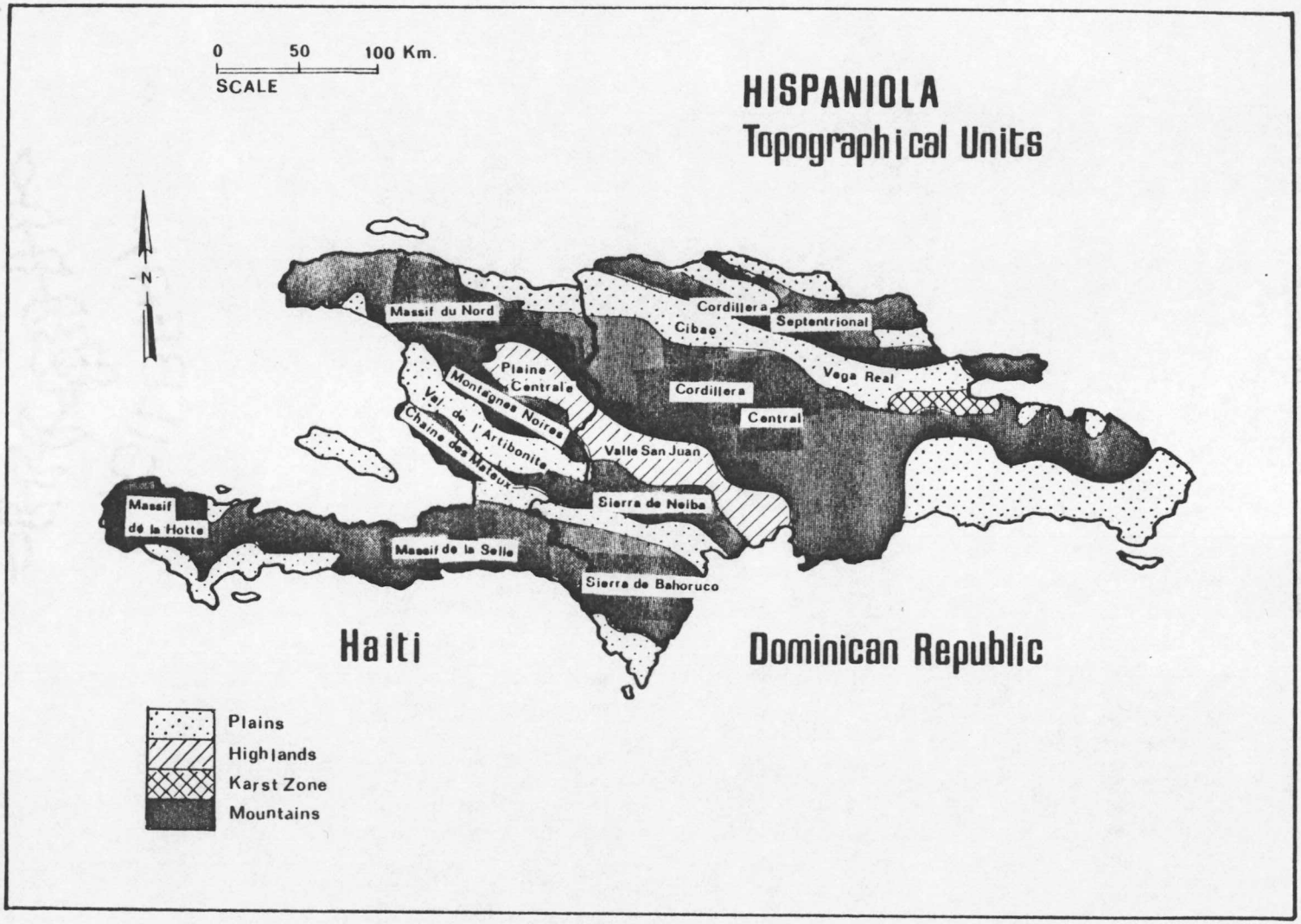

0 50 100 Km.
SCALE
HISPANIOLA
Topographical Units
N
Massif du Nord
Cordillera Septentrional
Cibao
Vega Real
Plaine Centrale
Montagnes Noires
Val de l'Artibonite
Chaine des Mateux
Cordillera Central
Valle San Juan
Sierra de Neiba
Massif de la Hotte
Massif de la Selle
Sierra de Bahoruco
Haiti
Dominican Republic
Plains
Highlands
Karst Zone
Mountains

Figure 2

economic activities and land use that characterize the rural settlement of both countries. Although the island lies wholly within the tropics, temperatures seldom rise above 35°C. because of trade winds and the proximity of large bodies of water. While there is little seasonal contrast in temperature, differences in altitude produce a wide range of climatic conditions. Rainfall varies widely, and its seasonality directly affects agriculture. In the southern part and inland, two-thirds of the rainfall occurs between May and November. On the north coast and in much of the Cibao Valley, the rainy season begins in October. Rainfall is heaviest along the northeastern coast, where an annual average of 2000 millimeters is common. In general, it declines westward, averaging only 600 millimeters in the northwest of the island. In the mostly semiarid western part of the Cibao Valley, irrigation is required for crop production. Much of the Dominican Southwest is arid or semiarid, and in Haiti the Cul de Sac Plain and the Northwest are also dry areas, as shown in Figures 3 and 4 (O.E.A., 1967, 1972; de la Fuente, 1976; Anglade, 1977; Nuñez Molina, 1980). The island is exposed to the vagaries of severe tropical storms, such as Hurricane David which destroyed important areas of both countries in September 1979 (Fig. 5). Major government projects to make land more productive include the rehabilitation of existing irrigation systems, irrigation of new lands, and construction of water storage facilities. Today, in both countries, agriculture is a major concern for future economic and social development.

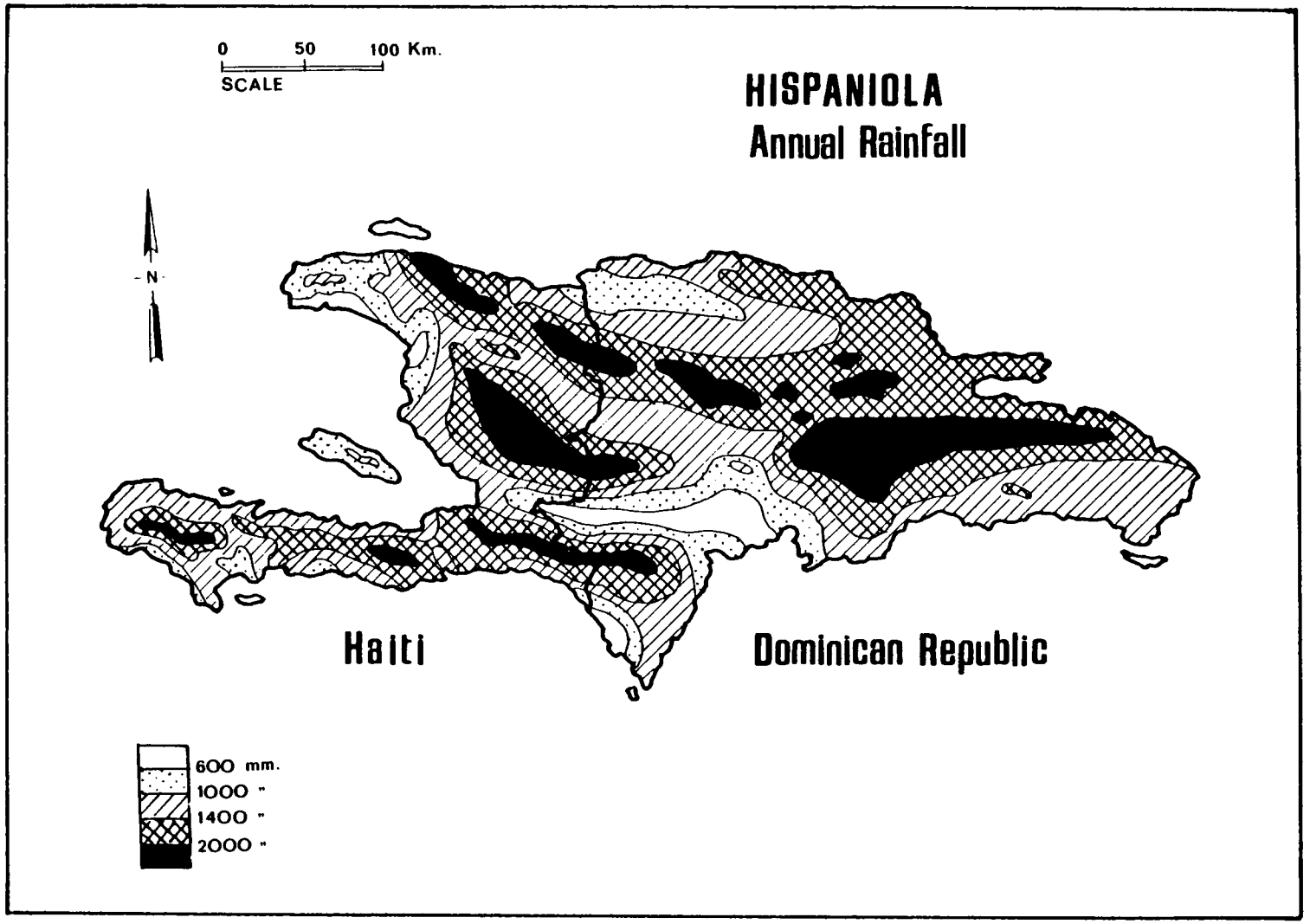

0 50 100 Km.
SCALE
HISPANIOLA
Annual Rainfall
N
Haiti
Dominican Republic
600 mm.
1000 "
1400 "
2000 "

Figure 3

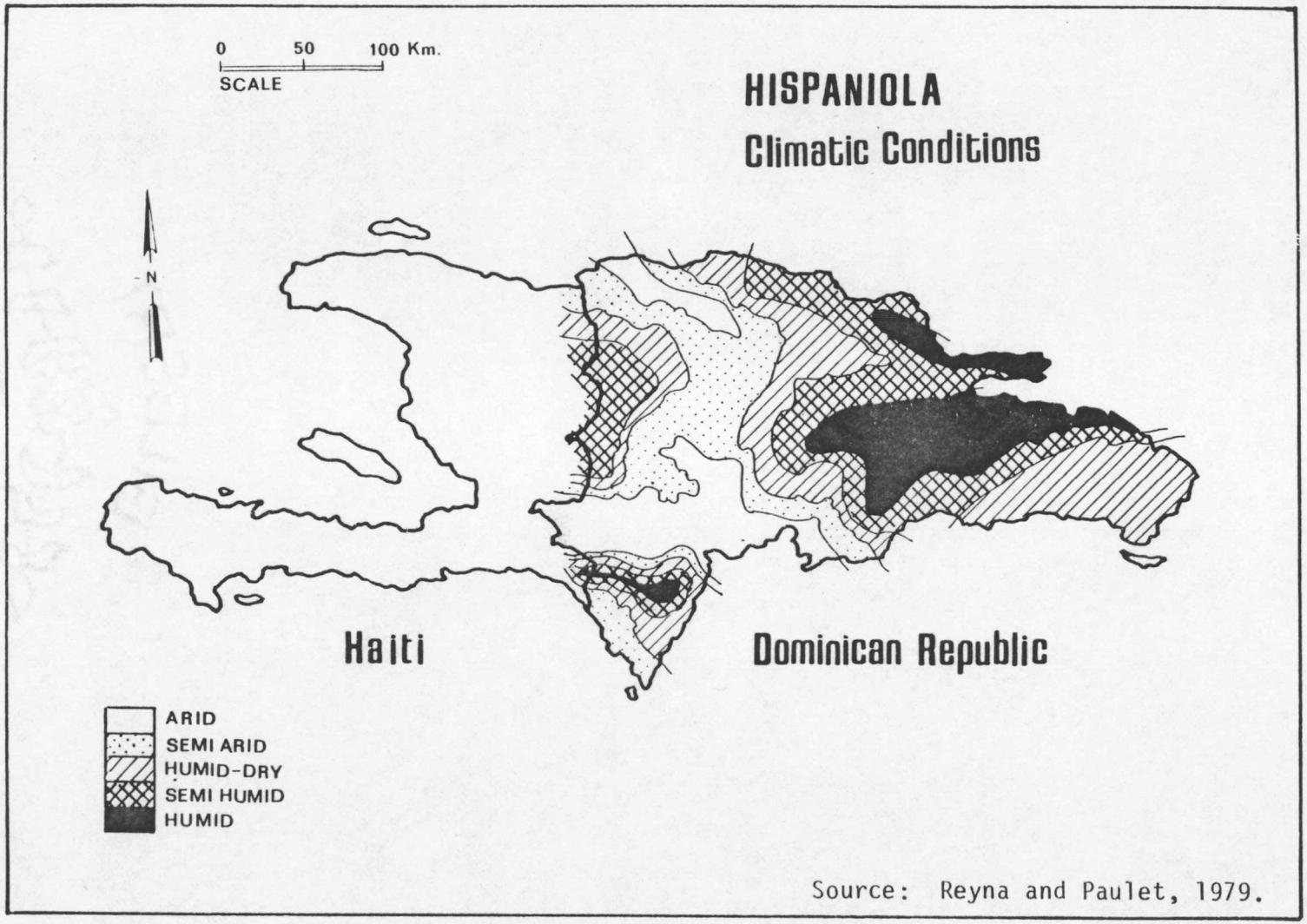

0 50 100 Km.
SCALE
HISPANIOLA
Climatic Conditions
N
Haiti
Dominican Republic
ARID
SEMI ARID
HUMID-DRY
SEMI HUMID
HUMID
Source: Reyna and Paulet, 1979.

Figure 4

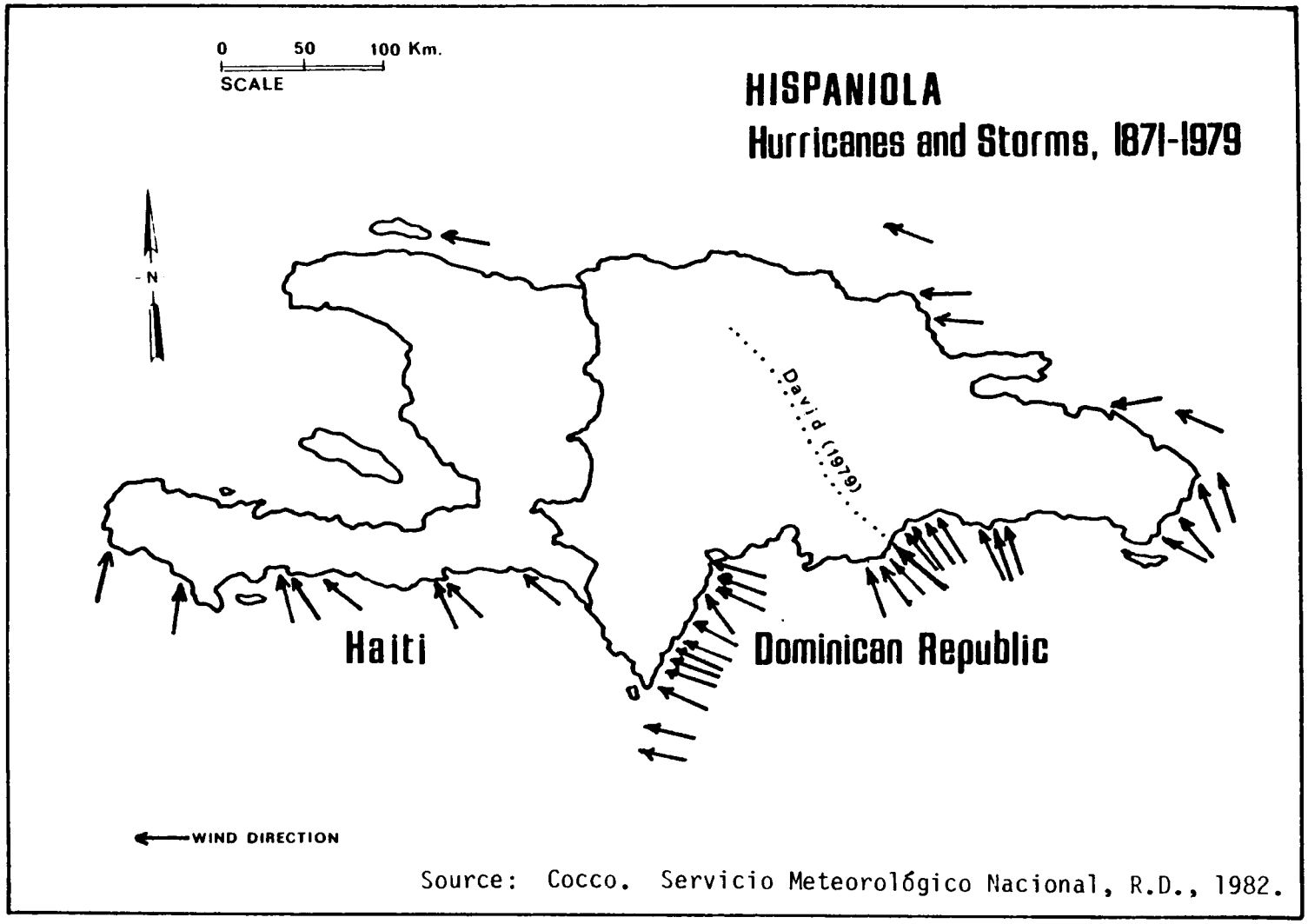

0 50 100 Km.
SCALE
HISPANIOLA
Hurricanes and Storms, 1871-1979
N
David (1979)
Haiti
Dominican Republic
WIND DIRECTION
Source: Cocco. Servicio Meteorológico Nacional, R.D., 1982.

Figure 5

Densities of population are noteworthy throughout the island, but higher absolute values occur in Haiti, while higher rates of increase are found on the Dominican side. In 1982, according to official national censuses, the Dominican population for the first time was higher than the Haitian: 5,647,977 inhabitants in the Dominican Republic (1981), and 5,053,792 inhabitants in Haiti (1982), see Table 1.

The Regional Framework

Any regional study must provide a broad range of analysis since a regional system is influenced by a variety of flows, connections and relationships operating outside of the area under study. At the same time, for some specific analyses the entire country can be significant as a study area. This study was conducted within the Enriquillo-Cul de Sac Depression, but for economic, social, and some physical analyses a broader regional framework was defined to coincide with secondary administrative and planning units. Planning Region No. 3 (Department de l'Ouest) in Haiti, and the Southwestern Planning Region provinces (Barahona, Bahoruco, Independencia, Pedernales, San Juan and Elias Piña) in the Dominican Republic, correspond to this framework (Fig. 6).

The study area covers approximately 25,600 square kilometers, or one-fourth the area of Tennessee, and contains an estimated population of three million. Elevations within this area vary from a depression forty meters below sea level to a maximum of 3175 meters above sea level at Pico Duarte in the Cordillera Central of the Dominican

Table 1

PRELIMINARY CENSUS FIGURES

Dominican Republic 1981 and Haiti 1982

Country	Population	Area(Km^2)	Density(Km^2)
Haiti	5,053,792	28,000	180
Dominican Republic	5,647,977	49,000	115
Total	10,701,769	77,000	139

Planning Regions

Country	Region	Population	Area(Km^2)	Density(Km^2)
Haiti	1	753,575	4,200	180
	2	1,387,933	10,500	132
	3	1,919,703	6,850	280
	4	992,581	6,450	153
Dominican Republic	Cibao	2,242,665	19,500	115
	Southeast	2,685,631	15,000	179
	Southwest	719,681	14,500	50
Total		10,701,769	77,000	139

Study Area in the Cul de Sac Plain (Haiti)

Comunne	Rural Section	Population	Area(Km^2)	Density(Km^2)
Thomazeau	1er Grande Plaine	11,873	97	121
	2eme Grande Plaine	10,299	40	256
Ganthier	Galette Chambon	5,937	26	224
	Balan	9,033	54	167
	Fond Parisien	5,912	60	98
	Pays Pourri	1,751	51	34
	Mare Roseau	4,723	38	124
Total		49,528	366	135

Table 1 (continued)

Study Area in the Enriquillo Basin (Dominican Republic)

Provincia	Municipio	Population	Area(Km^2)	Density(Km^2)
Bahoruco	Neiba	28,049	200	140
	Galván	12,322	300	41
	Los Rios	5,736	150	38
	Tamayo	8,744	100	87
	Uvilla	13,245	350	37
	Villa Jaragua	10,540	150	70
Barahona	Cabral	10,155	100	101
	Las Salinas	5,414	100	54
	Vicente Noble	14,679	250	58
Independencia	Jimani	7,648	600	12
	Duverge	11,515	550	20
	La Descubierta	5,895	200	29
	Mella	2,488	350	7
	Postrer Rio	5,908	150	39
	San Cristobal	5,314	200	26
Total		147,652	3,750	39

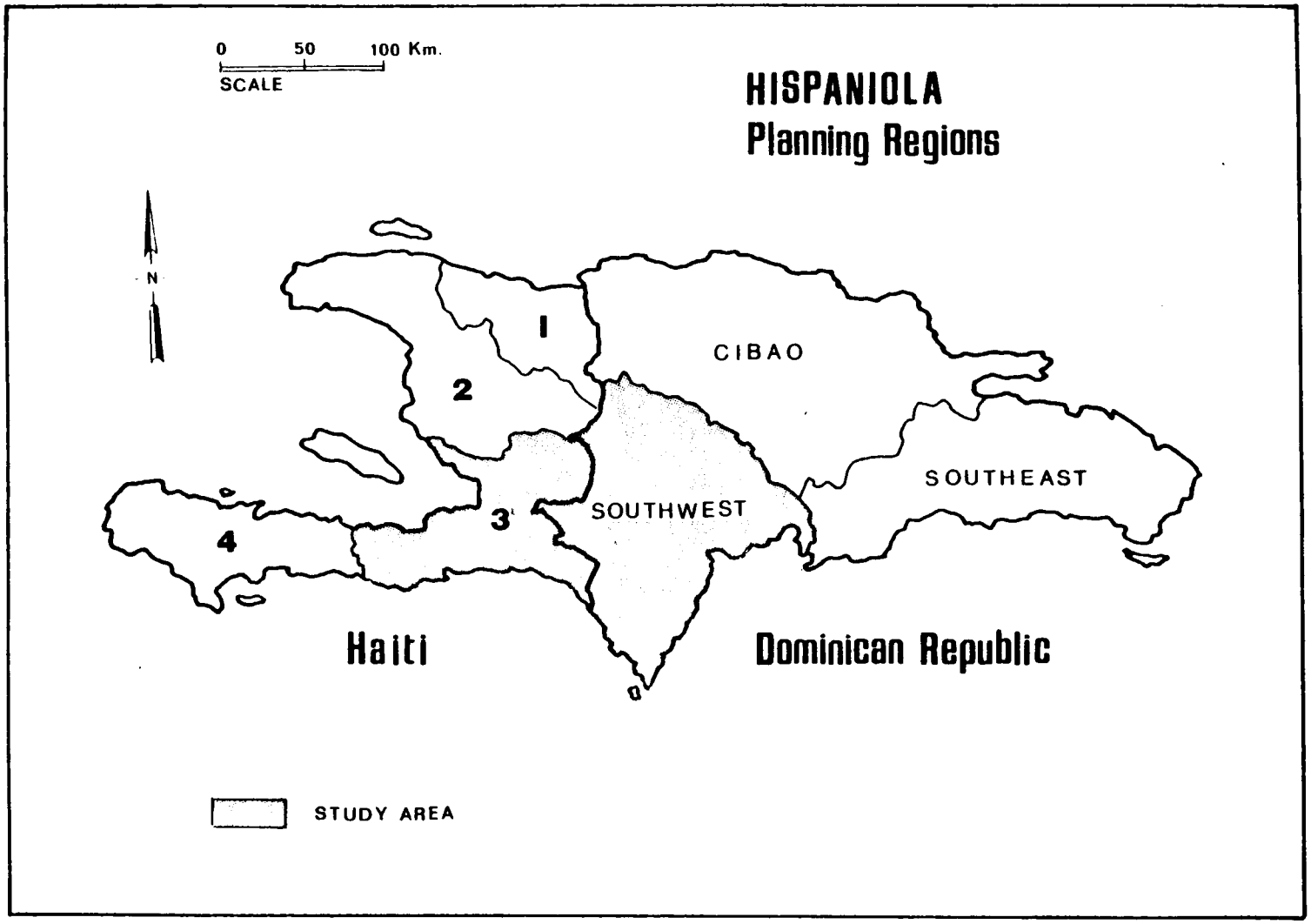

0 50 100 Km.
SCALE
HISPANIOLA
Planning Regions
N
1
2
3
4
CIBAO
SOUTHWEST
SOUTHEAST
Haiti
Dominican Republic
STUDY AREA

Figure 6

Republic. Topography influences both climatic and hydrological features in the area. The climate is generally hot and dry, with rainfall fall reaching no more than 600 millimeters per year in the valleys and depression. In the mountains, annual precipitation usually exceeds 2000 millimeters. Due to the influence of terrain, there are important differences in temperature and rainfall between places that may be in close proximity to each other. Aridity and drought are the most critical features in the valleys and depression because of their importance in water availability, soil salinity, and general influence on human activities.

Water resources are abundant in two major valleys, those of the Artibonite River in Haiti and the San Juan River in the Dominican Republic. Also, in the mountains water is generally plentiful, but not in the plain. Irrigation is limited in the plains, since the only important water supply is from wells. Public investment in irrigation projects has occurred in both countries, but good management is required to distribute the water economically.

Soils are excellent in the San Juan Valley, but other places suited to agriculture have many problems. Among the latter are low soil fertility and high salinity. Thus, soil quality is one of the principal constraints on economic activities and human development in the study area.

Vegetation varies from a dense forest in higher parts of the mountains to a sparse cover in the dry plain and depression. Deforestation has affected the natural ecosystem in both countries, but this phenomenon is more characteristic in the landscape of Haiti.

The Enriquillo-Cul de Sac Depression

In the middle of this regional framework is a plain, that corresponds to a natural depression sometimes called the "Cul de Sac," the "Enriquillo Depression," the "Enriquillo Basin," the "Valle de Neiba," or the "Enriquillo-Cul de Sac Depression." This plain extends from the Dominican city of Barahona to the capital of Haiti, Port-au-Prince, with a length of about 160 kilometers and a width of thirty kilometers (Fig. 7). The semiarid environment covers the entire Dominican side of this depression and the eastern part in Haiti.

The plain corresponds to a faulted syncline, a kind of graben filled with tertiary marine sediments and later filled with continental deposits because of uplift during the Quaternary era. Its relief is almost flat with residual reef terraces on both borders, while the middle is covered with recent alluvium. Residuals of the quaternary marine invasion are some lakes, such as the Étang Saumâtre and Trou Caiman, in Haiti, and the Lago Enriquillo in the Dominican Republic (Fig. 8).

Soils in the area are poor, with a high percentage of salinity. Vegetation is xerophitic, because rainfall in most of the plain is less than 600 millimeters per year. Areas of 300 to 400 millimeters occur and are among the driest areas in the Caribbean.

The study area contains some of the oldest settlements in America, and agriculture has been conducted here since the 17th century. Large plantations have been important in the development of

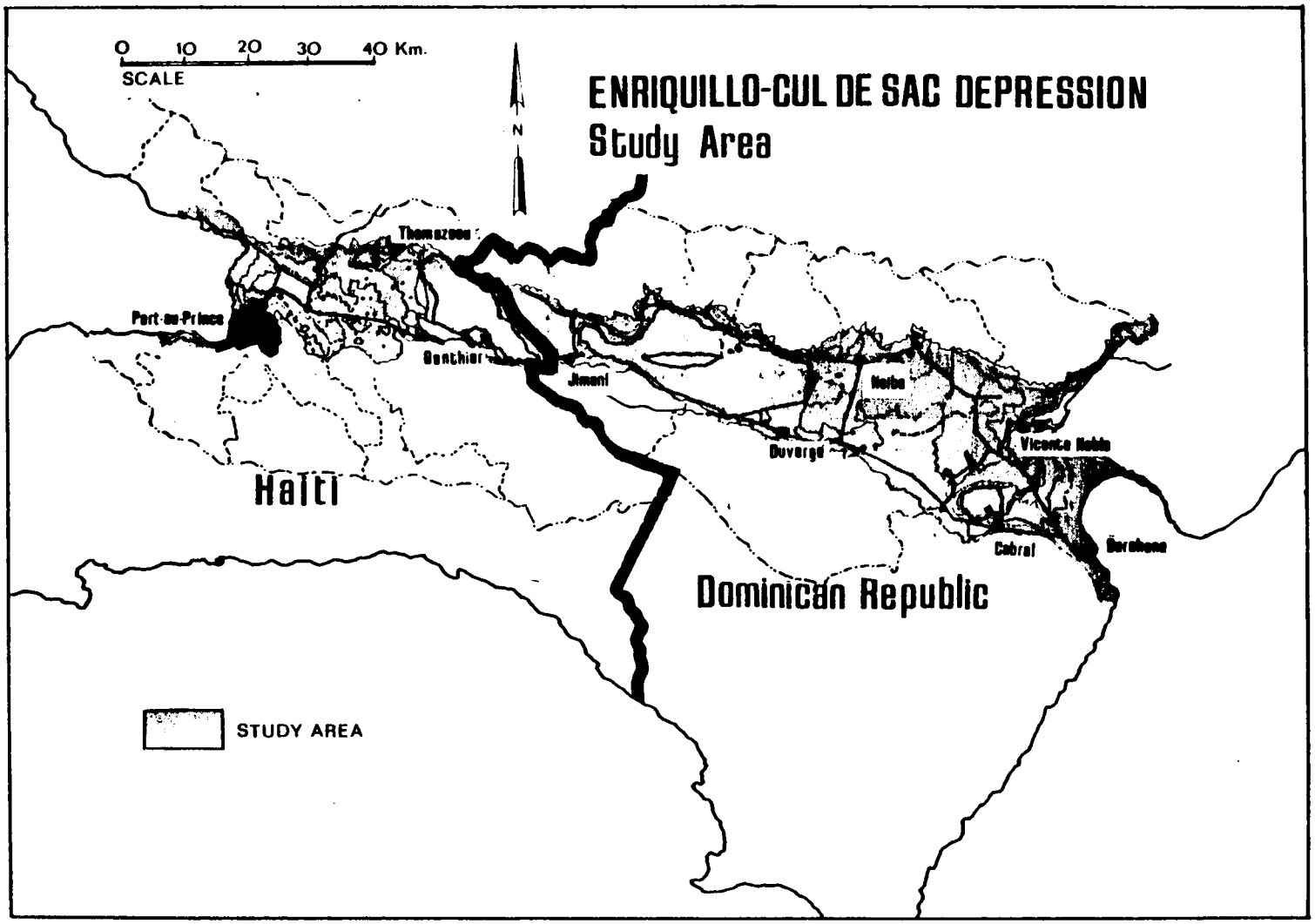
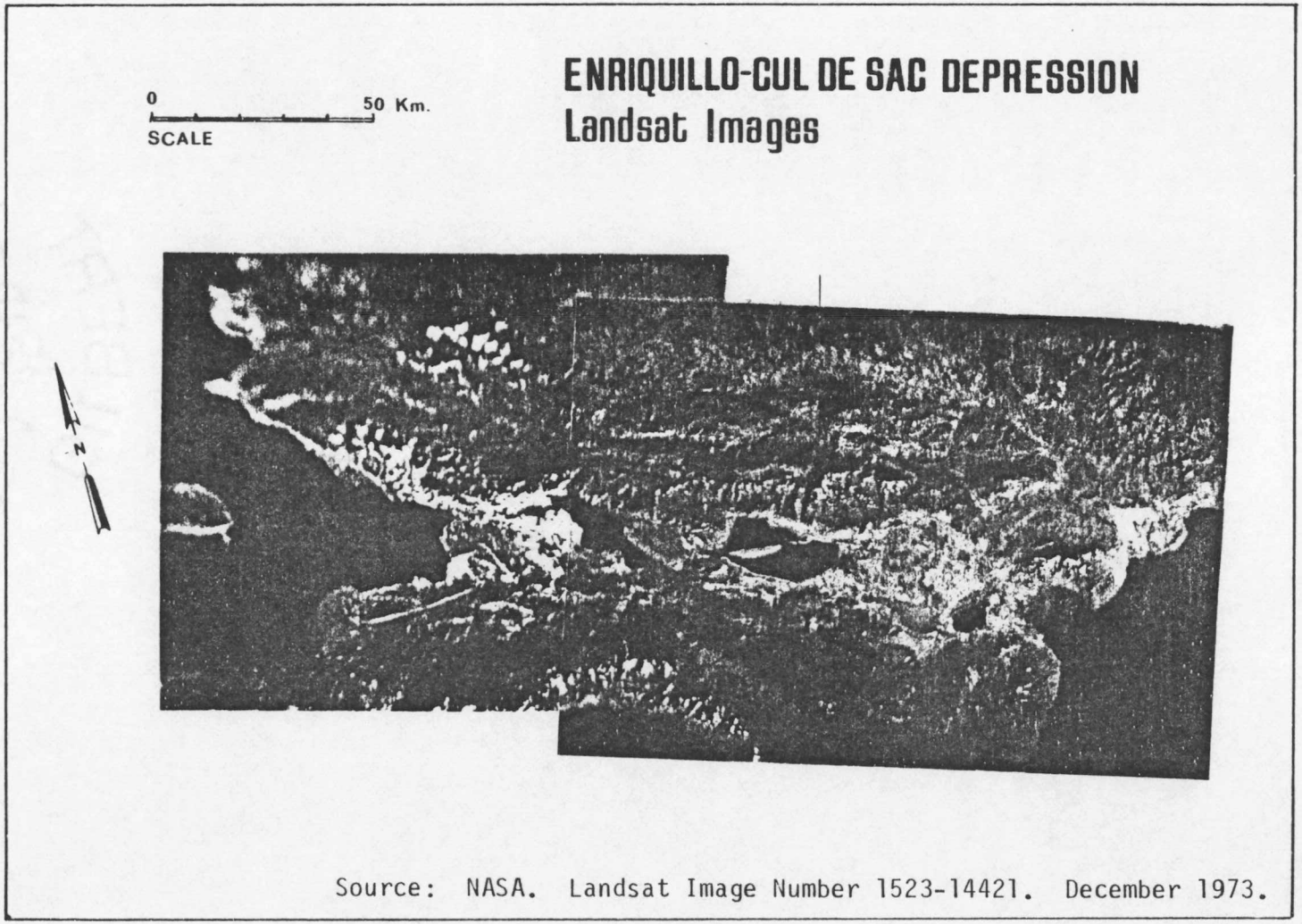

0 10 20 30 40 Km.
SCALE
N
ENRIQUILLO-CUL DE SAC DEPRESSION
Study Area
Port-au-Prince
Thomazeau
Banthier
Jimani
Duverge
Neiba
Vicente Noble
Cabral
Barahona
Haiti
Dominican Republic
STUDY AREA

Figure 7



Source: NASA. Landsat Image Number 1523-14421. December 1973.

Figure 8

the area, mainly in relation to sugarcane cultivation. A few mining activities are found in the region, as well as sporadic tourism development. Small farmers have been here for centuries, but their influence has been more important in the 20th century because of the numerous colonization programs pursued in both countries.

Methods and Techniques

Among the many rural processes worthy of research in the Enriquillo-Cul de Sac Depression, probably the most important is the settlement of small-farmer communities, their low levels of income, and their social development. To prepare a geographical analysis of these communities, the concept of viability was defined spatially in terms of levels of constraint and real possibilities to overcome these constraints. The condition of semiaridity was considered particularly relevant as a constraint on human activities.

The hypotheses defined to focus the methodology were as follows:

1. There are different levels of viability for small-farmer communities in a semiarid environment, and these are related to local ecological and socioeconomic variables.
2. The levels of viability are directly related to conditions of development in each community and its geographical characteristics.
3. Semiarid environments present severe constraints on the settlement of small-farmer communities, and these relate

directly to the maximum population that can be settled with an appropriate type and size of farm.

4. The development of small-farmer communities in a semiarid environment is directly related to the comparative advantages of other regional and economic environments of a country.
5. There are types of settlement other than small-farm agriculture considered more suitable for the colonization of semiarid environments in developing countries.

After preliminary field reconnaisance, a model was designed as a basic heuristic tool to define factors and variables to be collected and measured during the research process. This model of viability was later complemented by field observations. Four dimensions of analysis were selected for small-farmer communities:

1. Ecogeographical, including all natural and spatial factors affecting the study area. Categories of analysis and items to be measured were defined as a principal step of the field research. Primary constraints of this dimension correspond to water availability, soil quality and topographical features, with different items to be measured in each.
2. Juridical, which refers to the distribution and legal management of resources, including the political organization within each territorial unit. Important constraints in this dimension are land tenure, control over water, rural organization,

social authorities, rural agencies and institutions for rural development.

3. Economic, corresponding mainly to agricultural activities, and expressed in terms of productivity, marketing and family income. Natural resources, farm sizes, technology, rural labor and financial support are considered the most relevant factors for agricultural productivity. Prices, markets, costs and consumption are considered basic measurements to determine economic surplus and viability.
4. Socio-anthropological, which refers to social values and goals as significant determinants of human action. Relationships between culture and geography always have been considered important in various approaches to this discipline (Vidal de la Blache, 1922; Sauer, 1925; Brunhes, 1948; Pred, 1969; Harvey, 1969; Bunge, 1969; Tuan, 1971, Taafe, 1974; Chisholm, 1975; Ley and Samuels, 1978; Buttimer and Seamon, 1980, Rushton, 1980; James and Martin, 1981). These dimensions were later defined as constraints to viability, and expressed through geographical indicators within a general system of spatial interactions.

To study the area, collect information, and organize the geographical analysis of the hypotheses, fieldwork was conducted during four stages on the island:

1. From July to August 1981, a visit was made to both countries to define the subject of the research and the specific approach to the study.

2. From May to December 1982, residence was established mainly in the Dominican Republic, with two visits to Haiti, to live in the Enriquillo-Cul de Sac Depression, visit the entire country, and collect necessary historical, economic and geographical information. Interviews were conducted with authorities and small farmers in the study area, including discussions about planning and development policies. Some 800 families were interviewed and more than forty authorities answered questions about viability factors.
3. From January to March 1983, residence was established in Haiti to obtain the same kind of information as had been gathered in the Dominican Republic. Photointerpretation was assisted by the Service de Geodesie, which provided aerial infrared photos, and by the O.A.S. Mission in Haiti.
4. In April 1983, a short return to Knoxville facilitated the acquisition of references with which to revise the model of viability according to the data already collected in the field.
5. From May to July 1983, residence was again established in Haiti, but with a final visit to the Dominican Republic to obtain additional information for the revised model.

Parallel to the fieldwork, and facilitated by reference material, other methodological steps were completed. First, an historical approach was taken to examine the processes of settlement and colonization in both countries with special reference to small-farmer communities

in the Enriquillo-Cul de Sac Depression, their patterns, processes and trends. Studies by Augelli (1962, 1966), Rodríguez Demorizi (1970), Antonini (1971), Lebigre (1974), Palmer (1976), Giralt (1978), and Anglade (1981) provided useful geographical perspectives on the colonization process, but it was necessary to complement their approaches with historical analyses on the political and social development of both countries (Moreau de St. Mery, 1796; Vázquez de Espinosa, 1623; Hazard, 1873; Walker, 1947; Rodman, 1964; Jiménez, 1965; Bosch, 1970; Hoetnik, 1972; Moya Pons, 1974, 1977a, 1977b). Details on the development of the study area were obtained from local historical studies by Robert (1953), Pérez (1978) and Sosa (1981) for the Dominican side, and Murray (1977) for the Haitian Cul de Sac.

A second methodological step corresponded to a geographical framework to understand the general spatial system of the entire island. Systematic general and regional geographical knowledge was obtained from books (de la Fuente, 1976; Nuñez Molina, 1980; Anglade, 1977, 1981); technical reports (O.E.A., 1967, 1972; ONAPLAN, 1965, 1976, 1977; DATPE/SEP, 1981), and other studies on natural and cultural aspects of both countries. A complete field reconnaissance was arranged through the Department of Geographical Sciences of the University of Santo Domingo, in the Dominican Republic, and private assistance in Haiti. A set of maps was collected and consulted during the general geographical analysis of the island.

Another methodological step was the collection of information related to the study area in particular. All types of information

were obtained from books, reports and specific studies on natural legal, economic, social and anthropological characteristics of the Enriquillo-Cul de Sac Depression. Aerial photo interpretation, using images from various dates, facilitated the analysis of dynamic changes of land use and physical features. Most of the information was transferred to maps at a scale 1:50,000 and special tables were prepared on the items defined in the model. At the same time, field observation and interviews with authorities and farmers were used to complete the model and define the significance of elements in the spatial system. As a result, a detailed model of viability was prepared for use in the subsequent geographical analysis of small-farm viability in the area.

In the next methodological step, five sectors were identified within the study area in relation to the settlement of small farmers. An analysis of viability was completed for each of them, according to the model, using a technique known as "threshold analysis" (Kozlowski, Hughes, Brown, 1972; University of Edinburgh, 1973; United Nations, 1977; Goodall and Kirby, 1979) (see Fig. 9).

A grid system with cells corresponding to one square kilometer each was used in every sector. Geographic and economic variables were measured quantitatively, and a set of thresholds was defined for each. The results were compiled on maps of viability, and completed with qualitative analysis for juridical and social factors. Three general levels of viability were differentiated and expressed spatially. Finally, fieldwork was conducted to verify the accuracy of the results.

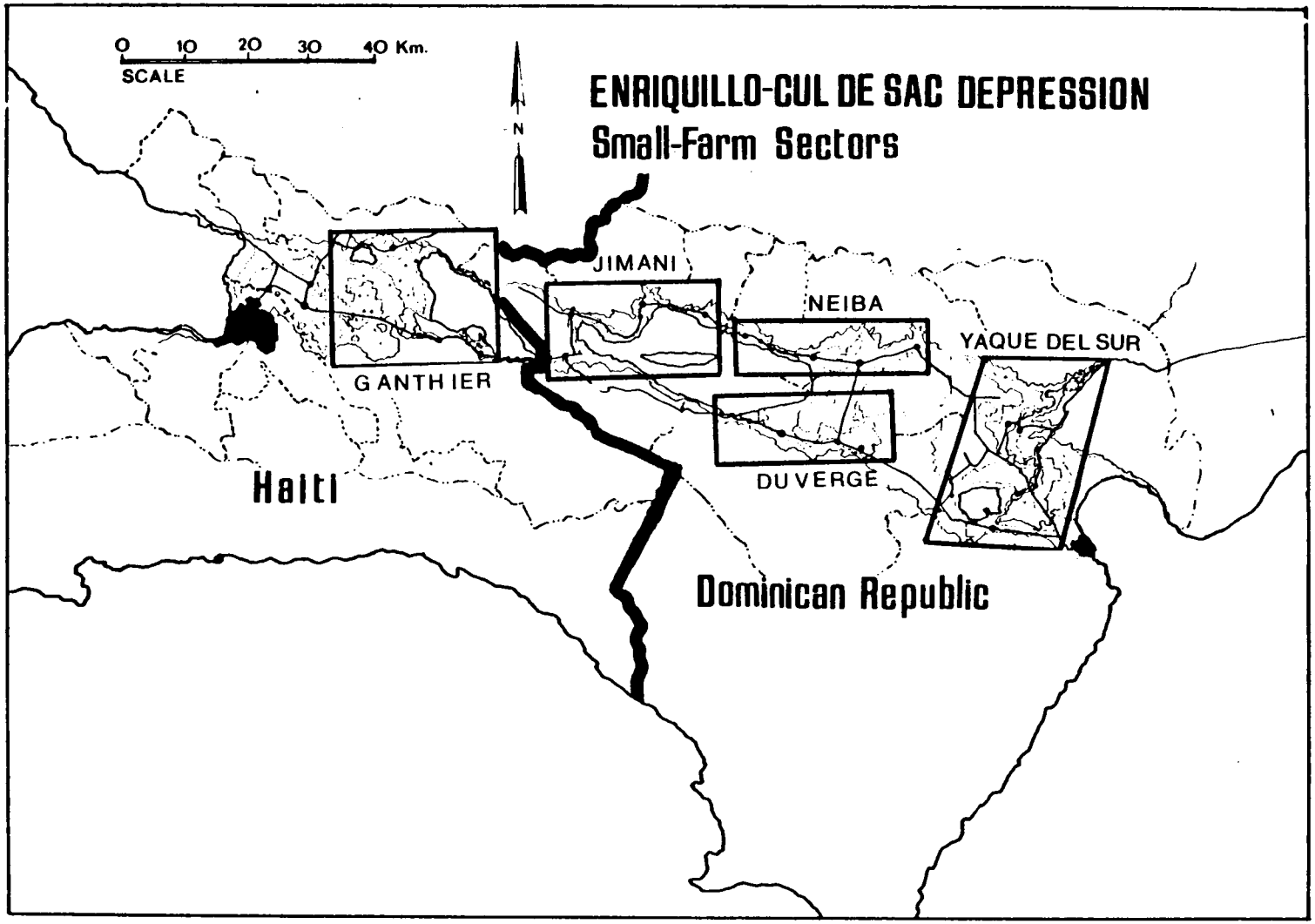

0 10 20 30 40 Km.
SCALE
N
ENRIQUILLO-CUL DE SAC DEPRESSION
Small-Farm Sectors
JIMANI
NEIBA
YAQUE DEL SUR
GANTHIER
DUVERGE
Haiti
Dominican Republic

Figure 9

The most significant step was the definition of thresholds for each factor considered in the model. This part was discussed with authorities and specialists, calibrated, and verified in the field.

With the results of the spatial analysis for each selected sector, the next step was a study of specific sample sites to probe the reliability of the method.

Two sites were selected in each sector by random sampling, and a sample of families was interviewed in each. About one thousand interviews, corresponding to approximately 6000 persons, were conducted during the twelve months of field research. The method to calibrate the model in specific sites was mainly economic, using all reports and studies on costs of production, levels of consumption, prices and markets. The economic data were complemented with social and geographical information obtained during the interviews. Quantitative and qualitative analyses were conducted according to the characteristics of the items to be processed. The model was particularly useful in this stage of the study.

A specific methodological step was defined to study the advantages and disadvantages of the Enriquillo-Cul de Sac Depression. The comparison of the geographical constraints in various regions of each country included an economic analysis of crop types, farm size, levels of productivity, costs, prices and general income. At the same time, a qualitative analysis of public and private investments, plus their location, distribution and relationship to general governmental policies was completed.

The influence of the international border involved another methodological step. An historical analysis was considered fundamental to understand the effects of the international border in the Enriquillo-Cul de Sac Depression. Interviews with authorities and farmers, plus the author's personal experience after several visits to the border, permitted a definition of the main processes and trends for the development of this area. Particularly useful was experience gained during the discussions of programs for research and development of the study area with representatives of the O.A.S. Mission in Haiti and the Dominican Republic. National planning units in both countries are concerned with development of the border area, and they provided useful information for this study.

The final methodological step was an analysis of national policies and alternative types of settlement. Important and frequent contacts with planning authorities at the national and regional levels permitted the projection of future developments in the study area. There are several major projects being implemented and specific regional planning units have been created. Agricultural development, agrarian reform, and irrigation works are the most promising programs for the near future. Help from international experts, representing various agencies operating in both countries, and the personal experience of the author after more than one year on the island, served as a basis for qualitative analysis of various types of development and settlement in the Enriquillo-Cul de Sac Depression.

In general, the methods and techniques used in this research correspond to the basic approach used in regional studies today, with the assistance of quantitative and instrumental techniques whenever possible. A major concern was to acquire a geographical understanding of the area as a whole, and of the locational characteristics and constraints related to human activities over this semiarid portion of the earth's surface.

CHAPTER II

LITERATURE REVIEW

The study of rural communities is a well-defined subject in geography, with both general and specific references in many modern texts. Authors such as Cooke and Johnson (1969), Amedeo and Golledge (1975), or Berry, Conkling and Ray (1976) include a number of references to agricultural activities and rural settlement. For specific references to rural studies in modern geography, the list begins with the classical work by Dunn (1954) on the location of agricultural production, using von Thünen's theory, and a review of the spatial structure of agriculture by Garrison and Marble (1957).

During the sixties, studies incorporated basic elements of quantitative analyses and represented significant steps toward new concepts in rural geography. Important reviews of rural studies with a modern geographical approach were produced in the late sixties by Harvey (1966), Henshall (1967) and Symons (1967).

Recently, new approaches have been proposed in the field of rural resource development (Whitby, et al., 1974), the analysis of rural communities (Lewis, 1979), and the methods and concepts of rural geography (García Ramón, 1981). These references provide a general framework for research in rural geography. It is clear that this field is not fully developed, however, as there are too few studies for such a rich and complex area of investigation. This is particularly

true for small-farm agriculture, which is treated by only a few references in modern geographical literature.

Research on aridity and semiaridity in relation to agricultural development has, in contrast, become abundant during the past decade. In addition to monographs, papers and reports published by UNESCO since the fifties, there are a number of books edited by specialists in dry environments. Two important publications prepared before the United Nations Conference on Desertification are the collection of articles edited by Hills, in 1966, and the book by Dov-Nir, from the Hebrew University of Jerusalem, in 1974. The first covers most aspects relevant to the understanding and development of arid areas. Particularly interesting is the chapter by Whyte on the use of arid and semiarid lands in various parts of the world. Dov-Nir analyzes semiaridity and human settlement on the fringe of the desert. Both studies are thorough and present a well-balanced analysis of the concepts of aridity and semiaridity, methods to measure and define them, and their potentials and constraints in terms of human activities. Both proved very useful for this study.

The United Nations Conference on Desertification, in 1977, resulted in many studies and reports. Papers were prepared for the Conference on aridity and desertification processes in the various regions and continents. Some are related directly to aridity in Latin America (Suárez de Castro, 1977; Naciones Unidas, 1977a). An impressive number of international experts, led by two geographers, Pelissier from France and White from the United States, produced a detailed report on the

development of arid and semiarid lands, including obstacles and prospects, under support of UNESCO in 1977.

One of the most complete studies on agriculture in semiarid environments is that by Hall, Cannell, Lawton, et al., published in Ecological Studies (vol. 34, 1979, "Analysis and Synthesis," Billings, et al., Editors). This collection presents the most useful framework for the study of small-farmer communities on the island of Hispaniola, their potentials and constraints, and their future development.

The concept of development is covered by an extensive bibliography, but few references are useful for a valid geographical analysis of small-farmer communities. The organization of space in developing countries has been well studied by Johnson (1970); Ehrlich (1971); Schumacher (1973); Smith (1976); and Ehrlich, Ehrlich and Holdren (1977).

The interest in small-farmer studies is clearly related to arguments concerning disadvantages of the green revolution in underdeveloped countries (Bhagavan, et al., 1973; Brown, 1974; Collier, 1975; Hewitt de Alcántara, 1975; Poleman, 1976; Innis, 1980). Many articles have been written on this subject, and most emphasize the importance of peasant organization and community development (Adams and Coward, 1972; Stevens, 1974; Stavis, 1979; Cernuda et Maxime, 1979). The concepts of "peasant" and "community" are basic for an understanding of the definition of small farmer, and are used throughout this study.

An impressive number of studies on small-farm characteristics and development can be found in agricultural publications, and many

papers and articles have been written by economists and planners as well. Unfortunately, the field has not been well developed by geographers, hence the spatial perspective is not well defined. New concepts, methods and techniques elaborated from a geographical viewpoint should be added to the social and economic analyses of small-farmer communities by agronomists and rural economists.

Hispaniola

The island of Hispaniola has been studied since its discovery in 1492, and the first references to its geographical conditions are found in letters by Columbus himself. According to Dato Pagán, author of the two best recent bibliographies of the island (1976, 1979), most of the studies are descriptions of resources of the island from the perspective of exploitation, and few are objective and scientifically valid. Important references on Haiti and the Dominican Republic are included in general Caribbean bibliographies (Lambros, 1965, 1975; Baa, 1968; University of Florida, 1959), but geographically the most complete studies are listed in the selected bibliography for the Dominican Republic by Hitt, et al. (1968), and the two general bibliographies by Pagán.

To understand small-farmer communities, their evolution, processes and trends, consideration must be given to the historical, socioeconomic, and political development of both countries. This is especially important for the present study, because the influence of historical processes has deeply affected current characteristics of the economy and population. Native historians provide abundant information on the evolution of both

countries, from the complete collection of documents, reports and graphic material published by Rodríguez Demorizi (1970) to the numerous studies presented by Moya Pons on social and political characteristics of the island (1974, 1977a, 1977b). It is useful to begin the analysis of historical evolution with documents and reports from the Spanish colony of Santo Domingo, and with two descriptions by witnesses in the late 18th and 19th centuries: Moreau de Saint-Mery (1797), and Samuel Hazard (1873). To complete the foreign perspective, there are several condensed histories for both countries (Walker, 1947; Albanell, 1956; Rodman, 1964; Fagg, 1965; Logan, 1968; Wiarda, 1969; Bell, 1970), but most focus on political events and provide few references to social or economic processes.

Spatial processes and trends can be better detected in studies by local historians or in theses concerning anthropological and geographical conditions. Some local historians deal with social evolution (Bosch, 1970; Hoetink, 1972), others are oriented toward economic evolution (Knight, 1939; Boin and Serrullé, 1981), some are interested in the political process (Jiménez, 1965; Franco, 1966), and others present a general analysis of historical evolution (Moya Pons, 1977b). Useful historical analyses also are presented by some theses and other geographical studies (Moral, 1961; Murray, 1977; Lacombe, 1977; Lundahl, 1980; Anglade, 1981), especially concerning land-use changes in Haiti.

Another important factor for small-farm studies on Hispaniola is the economic condition of both countries of the island. Basic economic information is easier to obtain in the Dominican Republic,

where the Banco Central de la República Dominicana and the Oficina Nacional de Estadística provide reliable data on population and economic activities (Oficina Nacional de Estadística, 1955, 1960, 1966, 1976, 1978, 1982a, 1982b; Banco Central de la República Dominicana, 1980, 1982). In Haiti, the Institut Haitien des Statistiques prepared the first complete census in 1950, with technical assistance from the Organization of American States (O.E.A., 1972), updated the figure with sampling and estimates for 1971, and prepared a complete new census in 1982 (Institut Haitien des Statistiques, 1971, 1977, 1983). The population and economic figures are not entirely reliable for 1950 or 1971, and for 1982 they are derived only from preliminary reports. Many authors or agencies prepare their own surveys (Moral, 1961; Murray, 1977; I.A.D.B., 1978; DARNDR, 1982; A.I.D., 1982), especially for regional research when the reliability of national figures is poor (Durán, 1981).

Other sources of economic data include World Bank reports (1978), publications by the national offices for planning (ONAPLAN, 1965, 1981, 1982a, 1982b; DATPE/SEP, 1981), and reports prepared on topics such as unemployment (Trigueros Mejía, 1975), family income (Soto Bello and del Rosario, 1978), economic growth (Fletcher and Graber, 1979), small-scale manufacturing (Haggblade, Defay and Pitman, 1979), external aid (Cecil, 1975), or regionalization and development (Wood, 1968; Antonini, 1979; Aquino, 1980).

In general, economic information is sufficient to provide a framework for the analysis of economic processes on the island, but reliable

information is missing when specific regional processes or sectoral economics must be studied.

Agricultural information is necessary to complement the economic framework. Many technicians and other professionals are involved in agricultural research and development, hence reports are prepared and published regularly on various rural activities. The Dominican Secretaría de Estado de Agricultura and the Haitian Département de l'Agriculture, des Ressources Naturalles et du Développement Rural (DARNDR) have divisions responsible for specific studies, such as natural resources, agricultural economics, planning and social development. Particularly useful are the statistics on production, costs, markets and prices in relation to small-farmer communities. The Instituto Agrario Dominicano (IAD) is also a good source of information on the evolution of agricultural colonies in that country (IAD, 1982a, 1982b).

In addition to government agencies, private institutions have sponsored research on the condition of agriculture in Hispaniola. The Inter-American Development Bank (I.A.D.B., 1968), the Interamerican Institute for Cooperation in Agriculture, of the O.A.S. (Johnson and La Gra, 1975; Clifford, 1981); the Université d'État d'Haiti (1980); the Comisión Económica para América Latina, of the United Nations (Moquete Ortiz, 1983), the Land Tenure Center, of the University of Wisconsin (Dorner, et al., 1967); The University of Tennessee, Knoxville (Badenhop and Rodríguez, 1972); and the United States Department of Agriculture (Buck, 1972) are among the many institutions that have supported research concerning rural conditions on the island. Geographers,

including Augelli (1962, 1966), Wood (1968), Antonini (1971, 1973), Palmer (1976), Giralt (1978) and Anglade (1981), have prepared rural studies from personal perspectives, and it is almost impossible to conceive of geographical analyses without a large number of rural references.

Natural resources research related mainly to climate, soils and water availability is abundant, but geomorphology and biogeography have received little attention. Most of the natural resource studies are prepared by technical institutions and concentrate on a single resource. Hence, the systemic viewpoint is ignored, and often the entire analysis is of limited value due to a lack of relevance for integrated regional development. However, there are a few studies that deserve special attention, such as the national soil survey of the Dominican Republic (SIEDRA, 1980), or the arid zones soils survey of Haiti, under the direction of Hans Guillaume, with support from the O.A.S. Hydrological research is well developed in the Dominican Republic, under the Instituto de Recursos Hidráulicos (INDRHI), and good studies, mainly on underground water resources, have been prepared by the Haitian Département de l'Agriculture (Simonot, 1982). Climate is officially studied by the national services of meteorology, which provide permanent data for atmospheric analysis. The main goal of these services is the detection of atmospheric disturbances so as to predict tropical storms and hurricanes, the greatest natural hazards for the island. The good infrastructure of meteorological services, and the quality of information they provide, facilitate climatic study of the entire island. In addition to official meteorological data, there are

several good reports on climatic characteristics and of the relationship between climate and water requirements in the various regions (Jorge, 1970; Reyna y Paulet, 1979; Paulet, 1982; Frère and Goutier, 1966, 1978).

Geomorphology has not been developed, and only a few references occur in the physical studies by Cucurullo (1951, 1952, 1968), Guerra Peña (1966) and Lanzo (1981). In biogeography, only partial references are found in the various publications (Durland, 1922; Lioger, 1976).

General geographic literature is scarce, but a few useful publications exist. The Organization of American States completed two surveys and published reports, with sets of maps, for the Dominican Republic (1967) and Haiti (1972). These probably still provide the most complete coverage of the territory. Important geography textbooks have been prepared for the Dominican Republic by de la Fuente (1976) and Núñez Molina (1980), and for Haiti by Anglade (1977, 1981), but they describe the countries only from a general perspective. More useful for the regional information needed in this study are reports of the Direction de l'Aménagement du Territoire et Protection de l'Environnement, in Haiti (DATPE/SEP, 1981); regional information provided by the Instituto Geográfico Universitario, in the Dominican Republic; or specific geographical articles (Dyer, 1954; Cecil, 1978; Giralt, 1978).

To compare the geographical characteristics of small-farmer communities in the study area with other areas or regions of the island, many references have been consulted. Particularly useful are several studies of small communities in other areas and their constraints and

potential for development (Murray, 1973; Riaño-Serrano, 1975; Maxime and Cernuda, 1979; Service des Recherches Agricoles, 1979; and Durán, 1981, for Haiti; and Marshall, 1966; Norvell and Nelson, 1966; and Antonini, 1971, for the Dominican Republic). These provide a framework for understanding the model of viability defined in this study and permit the selection of variables and thresholds to quantify the information.

References for the entire island must be considered as fundamental knowledge from which to select the most relevant conditions for viability in the study area and to define the advantages or disadvantages of the Enriquillo-Cul de Sac Depression for settlement.

Regional References

The bibliography for the study area itself is the least abundant on the island. Until recently the Dominican part of the study area was viewed as too dry and too poor to be considered for potential development. On the Haitian side, the Cul de Sac Plain is immediately adjacent to Port-au-Prince, but national activities are so concentrated in the urban area of the capital city that even this plain has not been studied in detail. Thus, there were few regionally oriented publications on this area before the 1960's.

"La Hoya de Enriquillo" by Cucurullo (1949) is the best known publication for the Dominican side and includes mostly geological and climatic information, with a few references to human activities. Robert (1953) wrote on the historical evolution of Barahona from a local viewpoint and with insufficient research. For the Haitian side, a detailed

report on the characteristics and potential of the Cul de Sac Plain was produced in 1956 by Tippets, Abbett, McCarthy and Stratton, on request by the Haitian government, for irrigation, drainage, and flood control development. After these studies, there are only partial references in general works on both countries.

During the sixties, a general interest in regional planning reached the Dominican Republic, and the Oficina Nacional de Planificación (ONAPLAN) was organized under the Technical Secretary of the Presidency. Studies of the national territory were conducted, and the country was divided into three regions. The Southwest was considered to be the region most in need of economic development. During the seventies, groups of concerned citizens of the area asked for special attention, and the government created the Instituto para el Desarrollo del Suroeste (INDESUR) at Azua. Documents were prepared during this period to guide regional development (ONAPLAN, 1976, 1977; SEA, 1978). These reports present some of the best diagnoses on the constraints and potentials of the area. Small-farmer communities are not, however, well analyzed. At the same time, a long drought produced a decline in water resources, and the level of Lake Enriquillo was much lower than usual. Many references were made to this problem, as in the thesis by Peralta, et al. (1970), in which all hydrologic conditions of the area are analyzed. Soil characteristics and salinity were analysed in a seminar organized by the Colegio Dominicano de Ingenieros, Arquitectos y Agrimensores (CODIA), in 1980, in Barahona. Reports on geomorphology (González, 1980), underground water resources (Peguero, 1980), drainage

(Campos, 1980), soil salinity and soil mapping (Tavárez, 1980; Vicioso, 1980) were presented. Several private studies also were produced concerning the region, including a dissertation by Palmer (1976) on land use and landscape changes in the Dominican-Haitian borderlands, in which the author presents an historical comparison of evolution on both sides of the boundary and includes references related to problems and characteristics of small-farmer communities. A highly technical land-use analysis was prepared by Nor (1977) with Landsat imagery in the Enriquillo-Barahona area. Other sources for the Dominican side are a thesis by Krute-George (1978) on small fishing communities in the area of Barahona; some ecological viewpoints by Peña Franjul (1978); and two local histories on Duvergé and Neiba (Pérez, 1978; Sosa, 1981).

At the same time, studies were conducted in the Cul de Sac area. Two important dissertations were written, one dealing with sugarcane production in the Cul de Sac Plain (Lebigre, 1974), the other based on anthropological research dealing with cultural values and agricultural changes in small communities of farmers in the Thomazeau area, near the Étang Saumâtre (Murray, 1977). In the southern part of the plain, another set of studies was prepared by experts from the O.A.S., the Israeli government, the Inter-American Development Bank, and the Département de l'Agriculture, des Ressources Naturelles et du Développement Rural d'Haiti. This research continues and is related to the most important program for rural development in the country: the Blanche River Project. The latter began as a pilot project in the area of Bas-Boen, near the village of Ganthier (Haiti-Israel-OEA, 1972; Gislason,

1978) and later became an important program under the financial support and technical assistance of the Inter-American Development Bank (I.A.D.B., 1978; Marcoux, 1982; DARNDR, 1982; B.I.D./DARNDR, 1982). The experience, methodology and evaluation of this project are fundamental for the study of small-farmer communities, since the project began with one hundred small-farmer families and today includes about 5,000 families.

In the Dominican Republic there have been several efforts to implement a program similar to the Blanche River Project, but without satisfactory results. INDESUR and ONAPLAN have prepared programs for specific areas of development (ONAPLAN, 1981b, 1982a, 1982b; INDESUR, 1981). The Israeli government, through the Centro de Estudios Regionales, Urbano-Rurales (CERUR), prepared a report on potential rural and agricultural development in the Enriquillo Basin (Prion, et al., 1981), but there has not been financial support for the project. At the Universidad Autónoma de Santo Domingo, some reports have been prepared (Troncoso, 1980; Cruz, 1983; Bodini, 1983), and seminars, such as the Second National Conference on Hydrometeorology, have produced a number of scientific reports on the region (Llinás, 1982; Plácido, 1982; Racero, 1982; Sánchez y Féliz, 1982).

In Haiti, the United Nations (Simonot, 1982) and some private agencies (Rahman, 1980; Église des Rachetes d'Haiti, 1983) have prepared studies to implement programs in various areas of the plain, and these provide useful data on living conditions in rural communities.

Finally, statistical information is available from the two national statistical services, especially data from the national censuses

of 1981 and 1982 (Institut Haitien de Statistique et d'Informatique, 1982a, 1982b; Oficina Nacional de Estadística, 1982). Information is also available on climatic and hydrologic conditions from the meteorological services, and from the Instituto Nacional de Recursos Hidráulicos in the Dominican Republic (Ramírez, 1982; INDRHI, 1982).

It is clear that relatively little research has been conducted in the study area, but several good articles and dissertations, and many recent technical reports and statistical bulletins, provide sufficient data to constitute a reliable base for this investigation. Naturally, fieldwork and personal data collection are essential to complement the information from these published regional analyses.

CHAPTER III

SETTLEMENT OF HISPANIOLA

The colonization process on Hispaniola has been continuous for almost five hundred years. It began with the arrival of Columbus, but has varied in form and characteristics according to the economic, social or political conditions of each historical period. The long evolution of settlement on the island included many foreign influences affecting the island's economic and political development. The history of Hispaniola is commonly divided into eight periods, and these are used in this study to distinguish the major settlement characteristics as they have evolved through time.

Columbus and the Indians

The history of the island officially began on December 6, 1492, when Christopher Columbus arrived a short distance from the northwest coast of Haiti. The first settlement was made temporarily on the Bay of St. Thomas, due to the wrecking of one caravel and was called La Navidad (Vázquez de Espinosa, 1629; Hazard, 1873). The natives called the island "Haiti," which means mountainous country, or "Quisqueya," meaning vast country; but Columbus named it "Española" (Spanish). The latter term was transformed by English-speaking people into Hispaniola.

At the time of its discovery, the island was occupied by five large Indian tribes, each ruled by a cacique, or chief, and each holding

land areas subdivided into minor provinces (Hazard, 1873). The five provinces, as shown in Figure 10, included Magua, a realm of the interior plain, its capital being where the old town of Concepción de la Vega was later built. Its chief was Guarionex. Higüey province had its capital on the site of the present village of the same name, under the command of Cacique Cayacoa. The capital of Marien was near the present Cap-Haïtien, and its chief was Guacanarie. Maguana had its capital where San Juan is today, the cacique being the famous Caonabo. The study area was included in the district known as Jaragua, with its capital in the Cul de Sac plain, on the Haitian side of the Enriquillo Basin. Behechio was the Jaraguan cacique.

The Spaniards spread rapidly throughout the island, building forts which became the centers of small mining and farming communities. Gold was of primary interest, and when deposits were found in the Haina River, near the south coast, La Buenaventura was established there. In August 1496, the brother of the Discoverer, Bartolomé Columbus, founded the city of Nueva Isabela (later called Santo Domingo de Guzmán, capital of the Dominican Republic), at the mouth of the Ozama River (Walker, 1947).

The size of the Indian population encountered by the first Spaniards is a matter of dispute, estimates ranging from a high of three million to a minimum of 300,000. A figure of one million seems acceptable. Within a few years, however, the Indiana almost disappeared. Some fled to the high mountains, pursued by hounds. Others were captured and horribly mutilated. Thousands took cassava poison. More

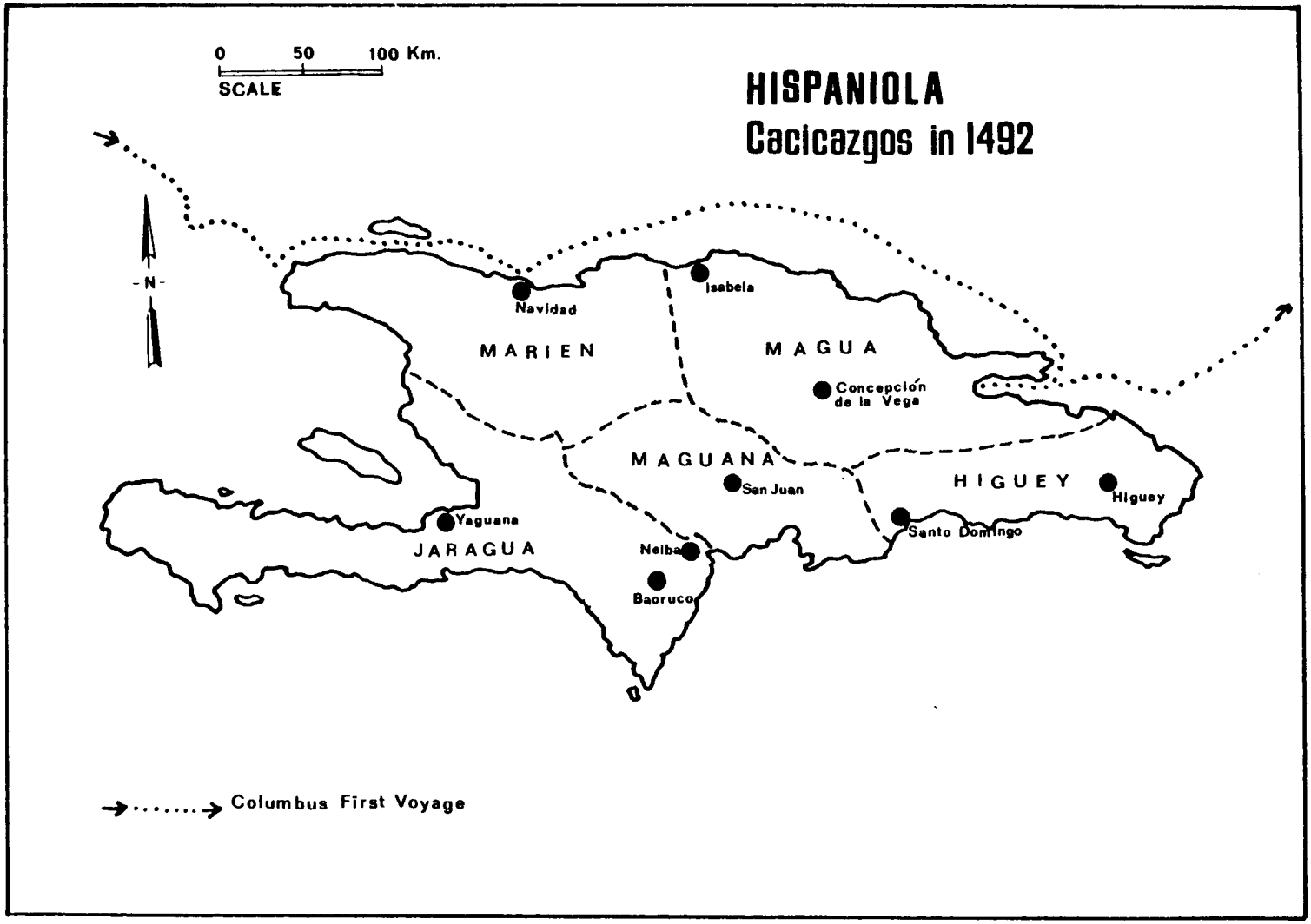

0 50 100 Km.
SCALE
HISPANIOLA
Cacicazgos in 1492
N
Navidad
Isabela
MARIEN
MAGUA
Concepción de la Vega
MAGUANA
San Juan
HIGUEY
Higuey
Yaguana
Santo Domingo
JARAGUA
Neiba
Baoruco
Columbus First Voyage

Figure 10

thousands died of disease and starvation. Of the indigenous population on the island, one-third had been killed by 1496 (Rodman, 1964).

Sauer quotes Pedro Martyr with a figure of 1,200,000 aboriginal inhabitants (Sauer, 1966). More recently, Cook and Borah repeated that estimate, but Moya Pons has presented arguments to consider the number exaggerated, and has proposed an estimate of only 300,000 (Cook and Borah, 1971; Moya Pons, 1977a). General references to the settlement and activities of the aborigines at the time of discovery, and the opinion of historians familiar with the Pre-Columbian period (Professor Francisco Henríquez and R. P. Miguel Rubio, in personal interviews) give validity to the figure of approximately 1,000,000 inhabitants of the island in 1492.

Concerning the Enriquillo-Cul de Sac Depression, local historians (Robert, 1953; Pérez, 1978; Sosa, 1981) have indicated that Bartolomé Columbus, Nicolás de Ovando, and Gonzalo Fernández de Oviedo visited the area of Jaragua and were impressed by the excellent condition of the Indian tribes, probably the best anywhere on the island. At the same time, the Jaraguan chief Behechio was the most prominent of all the Indian authorities. Columbus himself made reference to the number of Indian villages he saw from his ship when he traveled near the southwest coast.

Most efforts to colonize the island were concentrated along the north coast, in the Cibao valley area known as the Vega Real, and in the area between the Ozama River (Santo Domingo) and the Haina River on the south coast. The southwest area was not much affected. However,

when the Spaniards founded Azua, and a year later San Juan de la Maguana in the beautiful Maguana Valley, they quickly dominated the Indians of the region. The cacique Caonabo was sent to be imprisoned in Spain but died during the trip. His wife, sister of Behechio, cacique of the Jaragua Valley, was captured and killed by Ovando.

Within the study area, the first settlement was Azua de Compostela, about eighty-three miles west of Santo Domingo. It was founded by Diego Velásquez, in 1504, four miles southwest of its present location. Another village, La Verapaz, was founded by Velásquez in the Jaragua Valley in 1503, but soon was abandoned.

When Diego Colón, son of the Admiral, returned to Hispaniola as governor in 1520, he found the Indians being abused by the Spaniards to whom they had been assigned for religious instruction. The planters and mineowners were using Indian workers along with the Negro slaves whose importation had been accepted by the Spanish Crown. It was Bartolomé de las Casas, protector of the Indians, who suggested to Charles V that every Spanish resident in the Americas be given the right to import twelve Negro slaves. Simultaneously, the last and most effective Indian insurrection in Hispaniola began. Its leader, Enriquillo, cousin of Anacaona, had been educated by the Spaniards but was re-enslaved under the system of repartimiento. He escaped to the Bahoruco Mountains, near present-day Barahona. Soon, his forces became formidable because of their military organization. The Spaniards could not defeat them, so a treaty finally was signed on the island of Cabritos in Lake Jaragua, or what is now Lake Enriquillo. The Indians,

no more than 600 in number, were settled in a village (Boyá), and land was given to them to cultivate for their own use. This treaty, in 1533, ended conflict with the aborigines, and as Hazard notes, "Of this race, not one single pure-blooded descendant exists today" (Hazard, 1873). A census conducted in 1508 reports only 60,000 Indian survivors, and the colonial historian Fernández de Oviedo doubted that 500 Tainos remained in 1548 (Schoenrich, 1918; Rodman, 1964).

The Decadence

During the first half century of Spanish government, the island flourished because it served as an administrative center and as a base for expeditions to the rest of the New World. Unfortunately for Santo Domingo, the more lucrative conquests of Mexico and Peru soon turned it into a poor way-station. By 1550, Hispaniola was almost abandoned. There was relatively little silver or gold to be found, and hence the colony was of nominal value to the Spanish Crown. For almost three centuries under colonial rule, it remained a neglected, poverty-ridden corner of the vast Spanish Empire.

The chronicler López de Velasco, in 1574, wrote the following commentary about Azua, in the study area: "Founded by Nicolás de Ovando, in 1504, it was big, today there are in it no more than fifteen neighbors and many sugar mills." The area west of Azua was soon occupied by Maroons, or runaway Negroes, and was known as the territory of Maniel. There, they organized many small communities and copied the

social institutions of their former Spanish masters (Schoenrich, 1918; Rodman, 1964).

In the Cul de Sac of Haiti, the settlement of Santa María de la Verapaz was first founded adjacent to Lake Jaragua. Later, it was abandoned, then refounded on the present site of Port-au-Prince. It did not become immediately important, however, because of an unhealthful natural environment.

Conditions in the study area changed little during the 16th century, and only in the 17th were some repartimientos organized and the village of Neiba settled on the Lake Enriquillo plain. According to Andrés Nuñez de Torra, who wrote a report about the island, there were no more than sixty neighbors (heads of families) in Azua, and one-third that number in Neiba. Sugar, timber and cattle were the main economic resources of the area extending from Azua to the Enriquillo plain. Beyond the plain, in the Bahoruco Mountains, and in the area of Pedernales, was the Maniel refuge for runaway Negroes (Rodríguez Demorizi, 1970).

Cattle raising became the only important activity in the Spanish colony during the 16th and 17th centuries. Sugarcane cultivation, which was important at the beginning of the 16th century, suffered a complete decadence as a result of the restrictive commercial system imposed by Spain. Cattle ranches, or hatos, became the typical rural settlement of the island, and the base of social organization and political life in the colony. These forms marked the development of Dominican life and remained almost unchanged until the end of the 19th

century, when capitalistic activities began to appear. The study area suffered the same process, and hateros were the first settlers of most present-day rural communities (Bosch, 1970; Moya Pons, 1977b; Boin and Serrullé, 1981).

The Buccaneers

New conditions of economic development occurred on the island during the 18th century as the immediate effect of processes that began in the previous era. The most important change in the pattern of settlement on Hispaniola corresponded to the influence of French colonization in the western part of the island.

At the beginning of the 17th century, the Spanish Governor Osorio decided to concentrate the sparse population of the colony in the east and south, and all settlers in the northern and western areas were forced to migrate. Their houses were destroyed, and many of their cattle and belongings were lost in the move. In Spanish, these processes are well known as "Las devastaciones de Osorio" because the land was literally devastated, burned and abandoned. Small settlements in the area, such as La Verapaz, La Yaguana and Neiba, disappeared. At the same time, the French became interested in that part of the island. In 1641, Le Vasseur took possession of the island La Tortue, off the northern coast of Haiti, which became definitively French after 1659. From there, the French occupied the mainland, hunting cattle that remained from the abandoned Spanish hatos (Lacombe, 1977).

This was the origin of the term buccaneer, applied in that time to men who hunted cattle and tanned the hides. In 1697, the treaty of Ryswick recognized the French right to colonize that part of the island.

During the 18th century, the French colony became the most prosperous in the world. From an estimated population of 13,500 at the time of the treaty of Ryswick, it reached 500,000 in 1789. Most former buccaneers became farmers, and many new colonists arrived from France. Women were invited to migrate to form new families, and thousands of slaves were imported to develop large agricultural operations. Indigo, first, and then sugar and coffee were so important that, at the end of the century, three-quarters of the world's production of sugar was produced in Sain-Domingue, the ancient name of the French colony (Lacombe, 1977). Cap Haitien, founded in 1670 with the name of Cap Français, was a kind of Paris in the Antilles during the entire 18th century, and its fame remains today.

During the same century, the Spanish colony experienced a resurgence of prosperity. Sugar and coffee plantations, and cattle ranches, stimulated foreign trade and commerce. Landowners and merchants prospered, more Negro slaves were imported, and a new wave of Spaniards immigrated from the Canary Islands to strengthen the Crown's hold. Despite some improvements, Hispaniola remained poor in comparison with Spain's other colonies. By 1789, its population was still only 125,000 (of whom about 15,000 were slaves), while that of the far more prosperous French colony numbered half a million. There were

still few roads and little internal trade, and in the rural areas even the wealthy went barefoot (Wiarda, 1969).

Moreau de St. Mery, who visited the island and wrote "A Topographical and Political Description of the Spanish Part of Santo Domingo," in 1797, mentions two forms of recreation in Eastern Hispaniola: "sleeping and dancing." At the same time, he explains that there were only twenty-two small mills to process sugarcane, with about 600 slaves, to produce only syrup. There was no export. Coffee was imported from the French colony on the west. Cotton, cacao and tobacco were produced almost entirely for domestic consumption, but beef from the vast Spanish hatos supplied the French colony and was the sole commercial export of Spanish Hispaniola. Spain concerned itself only with the residence of the Governor, the Real Audiencia, the seat of the Archbishop, and the twelve companies of Spanish veterans in the capital, letting the rest of the colony shift for itself. This was the condition of Spanish Hispaniola when Spain, defeated in Europe, ceded its eastern two-thirds of the island to France, in 1795.

The Cul de Sac plain, on the French side, was developed a few years later than the northern area of Cap Français. In 1713, the population in the plain of Leogane included only 480 white settlers, but within a few years the entire Cul de Sac was irrigated and well populated, as shown in Figure 11. The first irrigation works were initiated in 1730, and by 1773 the watershed of the Rivière Grise was completely covered by the irrigation system. Table 2 shows the economic evolution of this plain.

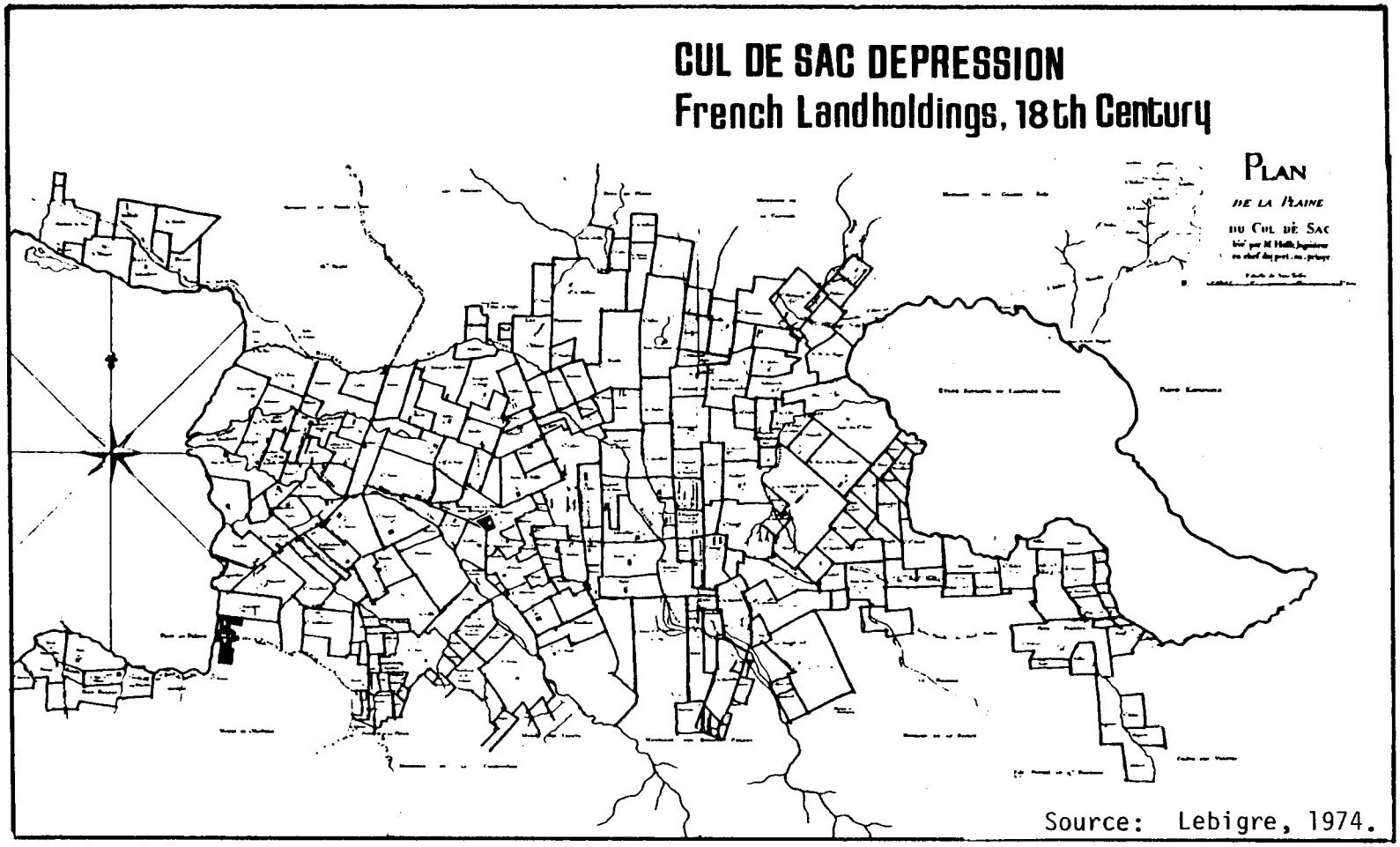

CUL DE SAC DEPRESSION
French Landholdings, 18th Century
PLAN
DE LA PLAINE
DU CUL DE SAC
Source: Lebigre, 1974.

Figure 11

Table 2

ECONOMIC EVOLUTION OF THE PARISH OF CROIX DES BOUQUETS

Haitian Cul de Sac, 18th Century

Year	Slaves	Sugar Mills	Indigo Mills	Cattle
1713	--	3	298	12,000
1723	3,097	--	--	--
1730	5,354	20	191	16,000
1739	8,024	35	210	19,000
1788	30,000	94	--	--

Source: Moreau de St. Mery, cited by Lebigre, 1974.

The city of Port-au-Prince was officially founded in June 1749, near the site of the old Indian capital of Jaragua, to promote the development of the southern part of the French colony (Lebigre, 1974). On the Spanish side, Neiba was founded in 1735 on the same site as the abandoned 16th century village of the same name. However, the Spanish settlements were far from equal to the French in level of economic activity, and their main source of income was from the sale of leather and meat to the big plantations of Saint-Domingue.

The 18th century appears to have been the most prosperous period in the economic history of Haiti until the present, and the Cul de Sac was one of the main areas of economic activity. Its seventy-five sugar mills produced approximately 25,000 tons of brut sugar, while sixty-five mills produced 35,000 tons of white sugar. In total, according to Moreau de St. Mery, there were 142 sugar mills in the two parishes of Croix-des-Bouquets and Port-au-Prince. In general, as shown in Figure 12, population was well distributed in the French colony, and the Cul de Sac presented a high rural density.

On the Spanish side, the development of the western colony influenced commerce, and some improvement of economic activity, but the Enriquillo Depression, known as the Valle de Neiba, supported only a few hatos. In neither country were small-farmer communities developed at this time.

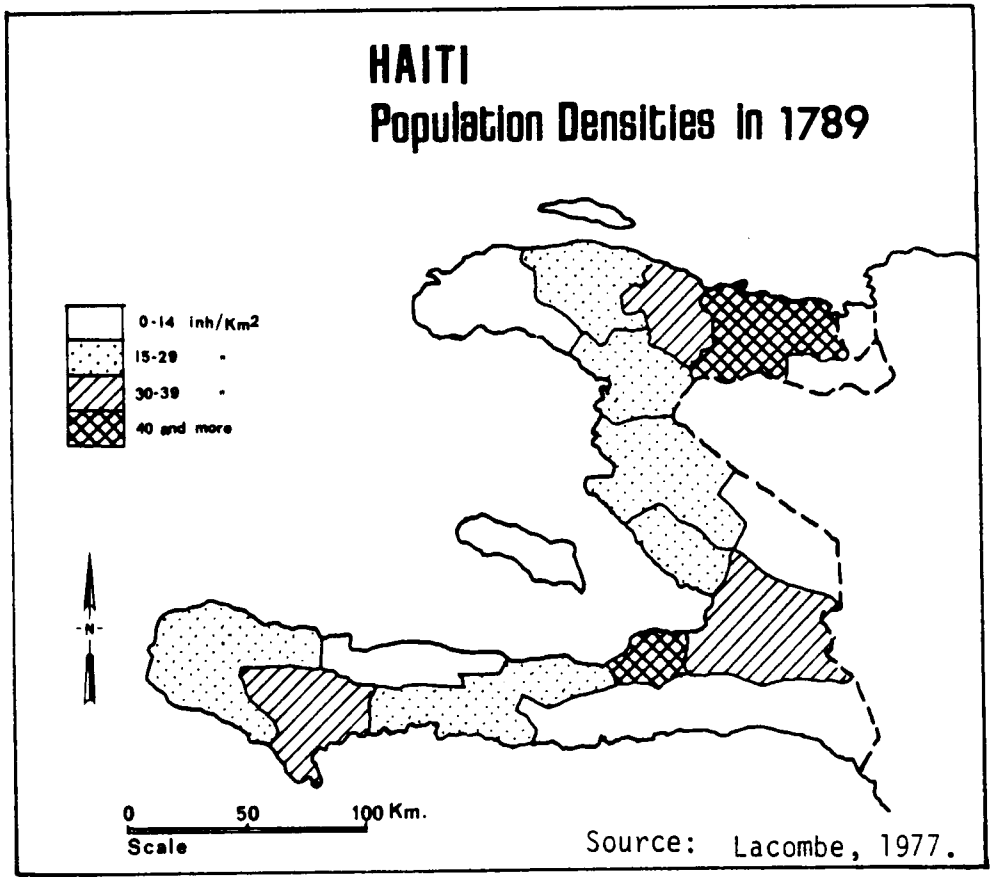

HAITI
Population Densities in 1789
0-14 inh/Km2
15-29 "
30-39 "
40 and more
N
0
50
100 Km.
Scale
Source: Lacombe, 1977.

Figure 12

Predominance of Haiti

Major changes occurred in the social, political and cultural development of the island between the last decade of the 18th century and the first half of the 19th. Events of the French Revolution and European wars made France unable to control the island. Led by former slaves Toussaint L'Overture and Jean-Jacques Dessalines, the colony rose up in bloody revolt, obtained independence from Napoleonic rule, and destroyed the European elite and plantations. In 1805, they invaded the Spanish side of the island, installing terror in the white ruling class. In 1809, aided by the English fleet, Dominicans drove the Haitians from the eastern side, and the former colony was reunited with Spain.

The new Spanish government in Santo Domingo was a failure. In 1821, José Núñez de Cáceres proclaimed the independence of Spanish Haiti, and asked for help from Simón Bolívar. After only nine weeks, Haitian columns under the mulatto general Jean Pierre Boyer again overran the newly independent nation and declared the union of the island. The Haitian occupation, 1822-1844, disrupted the economy, forced out the traditional ruling class, and almost exterminated the white population.

The entire island was affected during these years, especially the areas near the border where combat caused great destruction. Settlements in the Enriquillo-Cul de Sac Depression were destroyed and plantations were abandoned by landowners. Only a few settlements,

mostly military, survived during this period. Port-au-Prince became increasingly important as the new capital of Haiti, but the Cul de Sac plain was divided into small units of land and never again saw the productivity of the old French plantations. A positive action for the area was the founding of Barahona, ordered by Toussaint, as a military settlement. This condition lasted until 1858, when it became a común of the province of Azua (Rojas, 1944).

This period was important for the development of small-scale agriculture in Haiti. Studies by Moral (1961), Anglade (1981) and especially the anthropological thesis of Murray (1977) explain the origin of land distribution in Haiti in relation to the financial problems of the government at that time. To pay salaries to the army and government employees, large areas of public land, including old landholdings of the French colonists, were distributed to soldiers and civil servants. Most of them were not interested in being farmers. A prohibition against the sale of land to foreigners created a large offering for a small demand, and prices of land were so low that almost every farmer was able to buy his own piece of property (Murray, 1977).

First, the government distributed the best land, corresponding to old plantations in the valleys. Then, it distributed all land in the plains and, finally, on the hills and mountains. Thus, the entire country was converted to small holdings which, after a few generations of subdivision, became insufficient to support the large Haitian rural family (Moral, 1961). Conditions of small-farmer communities in the

Cul de Sac are well described by Murray (1977), who explains how complex social and economic systems have been developed locally to facilitate survival in such an unsuitable environment.

Caudillismo

In 1844, the Spanish part of Hispaniola became independent under the name Dominican Republic, and since then relationships between the two countries on the island have been difficult. In Santo Domingo, the capital of the new republic, the idealistic leaders of the independence movement were soon replaced by two caudillos, Pedro Santana, from the province of Seibo, and Buenaventura Báez, from the province of Azua. The latter controlled the country in several alternate periods. These caudillos promoted the idea of a protectorate status for the Dominican Republic and sought annexation to the United States at one time, and a return to Spanish rule at another (Rodman, 1964). Many political events occurred during this period: revolutions, dictatorships, invasions, civil wars, and a short dependence on the Spanish Crown, from 1861 to 1865, known as "Foolish Spain" (Wiarda, 1969). In general, the country did not progress, and only for short periods of relative peace were agriculture and other economic activities improved by the new Dominican leaders.

In Haiti, coffee grew wild, and the organized cultivation of sugarcane, cocoa and cotton for export ceased altogether. The French buildings, factories and irrigation works that survived the revolution and were rebuilt under Dessalines and Christophe fell into disrepair.

Earthquakes leveled major structures. Neat coastal cities gave way to villages of jerry-built one-story wooden houses, while African-type thatched huts of wattle and mud began to dot the countryside. A mulatto attempt to rule Haiti on behalf of an elite caste, while making economically disastrous efforts to appease a predominantly Negro population, failed. Between 1844 and 1915, only three light-skinned presidents held power, for a period totaling only nine years (Rodman, 1954).

In the Dominican Republic, the most negative personality in this period is Ulises Heureux, who governed the country between 1882 and 1899. His rule has been described as "perhaps the most pitiless tyranny in the history of Latin America." He bought out many of his rivals and subjected most of the others to vilification, exile or murder. He employed an army of spies, sent assasins abroad and enriched himself, his friends and relatives at the expense of the nation (Wiarda, 1969). Under these conditions, the study area experienced little change, except for the establishment of some large hatos in the valley of Neiba and a growing number of small farms in the Haitian Cul de Sac. A simple description was given by Otto Schoenrich, at the beginning of the 20th century:

> Barahona, 126 miles west of Santo Domingo City, became capital of the Barahona District when a provincial government was established there in 1881. It is a small town, which began to be settled in the beginning of the nineteenth century, and suffered greatly during the Haitian wars and the revolutions following them. At present its fame is its fine coffee. Other towns are Enriquillo, formerly called Petitrú, on the coast, 22 miles south of Barahona; Neiba, 32 miles northwest of Barahona, founded a century ago and prevented from developing by the damages it sustained first by the Haitians, then in the

> civil wars; and Duvergé, formerly called Las Damas, which commands a fine view of Lake Enriquillo with Cabras Island in the distance. In the northwest corner of the province is the small collection of huts called Tierra Nueva, and a few miles beyond, isolated in a wild region in the frontier, the inland custom-house of Las Lajas (Schoenrich, 1918).

At the same time, Azua, the most important settlement west of Santo Domingo, had no more than 1,500 inhabitants.

American Influence

Due to bad management of public finances during the previous period, the national debt in both countries became a serious problem by 1900. European countries were involved in the economic crisis, and many were interested in a military occupation of the island. The United States maintained a clear policy against any kind of European intervention in America and, by various means, began to participate more actively in the internal affairs of both countries on Hispaniola. Although the official United States military intervention was during the period 1916-1924 in the Dominican Republic, and 1915-1934 in Haiti, American influence began much earlier and lasted much longer.

Political characteristics of the intervention are complex and do not correspond to this study, but at the same time many improvements were made that affected everyday life. Public works were completed, and the educational system was improved. Sanitation and health measures were introduced. Internal improvements were made in the organization of the government, including salutary changes in the police system. The method of land registration was reformed. Roads and bridges were

built, and ports were made more easily accessible (Walker, 1947; Knight, 1939).

All of these changes influenced the study area, but probably the most important change for the Enriquillo Basin was the development of a sugar industry near Barahona. The Barahona Sugar Company was organized in 1916, and major investments were required before it could process sugar (Knight, 1939). Large areas of land were irrigated to control soil salinity, railroad systems were built, and a network of small settlements, called bateys, were established to house temporary workers for the harvest period, or zafra. Thus, a large area in the eastern part of the basin was organized geographically and new population came from all over the island.

This economic development produced changes in services and social activities in the area. Efforts were made to exploit timber, coffee and tobacco in the region, and even tourist accommodations were improved. Small farmers settled the area next to the Yaque del Sur River, producing mostly bananas and sugarcane.

In Haiti, a similar process was begun by the Haitian-American Sugar Company (HASCO) in the Cul de Sac plain, with irrigation programs, improved accessibility and exports. This economic development deeply affected the small communities of farmers established in the plain. The new system of roads replaced the small railroad of the region, and changed the size of regional markets. Port-au-Prince became more important, and many local markets disappeared. At the same

time, many farmers decided to produce mostly sugarcane, instead of other crops, depending directly on HASCO as their consumer. These changes increased the importance of Port-au-Prince, while the rest of the country remained mostly unaffected, in a marginal condition of dependence (Murray, 1977).

Finally, the American intervention made possible, for the first time, access to reliable cartography and census information. In 1920, the first census in the Dominican Republic recorded a total population of 894,665, with less than 17 percent urban and a general density of about 18 inhabitants per square kilometer. Only three settlements within the study area were considered urban: Azua, with 4,707 inhabitants; Barahona, with 3,826; and San Juan de la Maguana, with 1,817. More than 83 percent of the total population was rural and in the study area the percentage was even greater (Oficina Nacional de Estadística, 1978).

The Trujillo Era

Political history was quite different between the two countries of the island after the American intervention. While the Dominican Republic was dominated by Rafael Leonidas Trujillo, President and Protector of the Republic, in Haiti four black presidents organized a well-developed political democracy, with all the irregularities and economic tensions typical of any underdeveloped nation. For the Dominicans, the American intervention ended in 1924, for Haiti, in 1934.

The "Trujillo Era" lasted until 1961, when the dictator was assassinated, and during three decades the country was economically developed as a modern nation. Public works, as well as social services, enjoyed an exceptional period of improvement. One of the most significant programs of Trujillo's government involved colonization of the borderlands and it affected the study area. In 1927, a few experimental colonies, composed exclusively of Dominican nationals, were established on the frontier. By 1930, the year of Trujillo's rise to power, nine such colonies, with a total assigned area of 46,333 acres of farmland, were in existence. Two of them, Pedernales and Banano, were in the study area. With passage of the agricultural colonization law of 1934, the farm settlement program was placed on a more sound footing and a rapid expansion occurred. The number of colonies increased from nine in 1930 to fifty in 1953, and by 1959 there were sixty-seven settlements in the country that had originated as agricultural colonies (Augelli, 1962; Aragón, 1979).

At the same time, the government implemented a program of technical and economic assistance to the farmers, so the colonies made impressive gains. Administrative units were reorganized in relationship to the settlement program, and within the study area the new provinces of Bahoruco and Independencia were created in 1948. New roles were given to places such as Jimaní, Duvergé and Neiba, where many new colonies had been established. The area was also affected because the sugarcane industry of Barahona fell under control of the Trujillo family and many developments were ordered to improve the

income of the dictator. Roads and harbor facilities were built, as well as hotels, and tourism infrastructure. In general, the area enjoyed an exceptional period of development. Places such as Jimaní and Duvergé were provided with new buildings, schools, hospitals and public services. Investment from the public sector was especially important.

In Haiti, the good organization of the American period did not last long. Only the large sugar plantations were maintained in the Cul de Sac, while roads, houses and services in general deteriorated until recently.

In 1960, the main settlements in the study area had grown so much that Barahona had 20,270 inhabitants; San Juan de la Maguana, 21,630; Azua, 12,600; Neiba, 8,640; and Port-au-Prince, in Haiti, had 209,000 inhabitants.

Present Trends

Present trends are quite distinct in each country. In the Dominican Republic, the assassination of Trujillo improved the climate for modern democracy, but political conflicts generated an American intervention in 1965. Since the Americans left the country, the most democratic government in the history of the Dominican Republic has made great efforts to develop the economy and general standard of living.

In Haiti, the government has been controlled by the Duvalier family since 1957, when Dr. François Duvalier was elected democratically.

Later, he became President for Life, and after his death his son became President for Life, also. These dictatorships have been oppressive, and especially during the government of "Papa Doc," the country ceased progressing. Social and economic problems are the worst in the Western Hemisphere.

Under these conditions, the study area became the least developed area in the Dominican Republic and one of the areas with greatest problems in Haiti. The rapid growth of population and the environmental and economic constraints are conditions that affect the success of any program for this area. The sugar industry is today under government control, and roads and housing are basic responsibilities of national agencies. Yet, general deterioration can be observed in comparison with the system organized during the American intervention or that of the Trujillo government, which provided important economic and technical aid.

Problems are greater today, and the needs of the people must be met. This area must be studied and analyzed to determine its priority for improvements relative to other parts of the island. From an analysis of the history of this region and its social and economic development, it appears that the study area has yet to be organized according to its environmental characteristics and the abilities of its inhabitants.

CHAPTER IV

THE GEOGRAPHICAL FRAMEWORK

The viability of small-farm communities in the Enriquillo-Cul de Sac Depression depends basically on the geographical characteristics of the area. Natural, spatial, legal and socioeconomic conditions interact in a place and define a system of relationships within which small-scale farming is conducted which, in turn, generates income and services to provide a livelihood to the inhabitants. The geographical framework for this analysis is complex, so a model has been designed to simplify the number of factors and variables to be considered. However, it is necessary to present a general perspective of the various geographical characteristics that affect the region, and the reasons why some of them are considered more relevant.

Natural Conditions

The Enriquillo-Cul de Sac Depression has been strongly influenced by its geological history. Like many other Caribbean islands, Hispaniola is an area of extreme geologic complexity. Many periods of crustal deformation, with repeated cycles of submergence and emergence, have been associated with folding and faulting. The result is that the Depression has possibly been subjected to greater tectonic forces than any other portion of the island. Today, the Enriquillo-Cul de Sac Depression is part of the recent subsidence of a well-defined trough

which extends from the Bay of Port-au-Prince eastward to the Bay of Neiba in the Dominican Republic. The oldest known rocks in the area are volcanic. These form the basement on which were deposited the sedimentary series which comprise both the rocks underlying the trough and the mountains that form its northern and southern borders. The sedimentaries, largely Eocene and Oligocene limestone, have been folded and uplifted into the Trou d'Eau Mountains and the Sierra de Neiba north of the plain, and the Massif de la Selle and the Sierra de Bahoruco to the south. Crustal movements depressed the area of the present plain and elevated the marginal mountains, producing a trough that was invaded by the sea during the Miocene. An extended period of erosion and deposition followed, during which the land masses of the borders furnished detrital material for shallow water deposition of sandstones and conglomerates in the margins of the sea, while finer material was carried into the deeper portions of the trough to form limestones and claystones. After new tectonic activity, the trough was once again partially submerged during the late Pliocene and Pleistocene epochs. Climatic conditions were apparently conducive to active erosion, and streams draining the mountains deposited fine and course sediments along the borders of the trough in the shallow sea, where they were cemented with a calcareous matrix. Final emergence occurred at the end of the Pleistocene epoch, and the marginal deposits were dissected by erosion to form the east-west trending knobs and ridges that are prominent features on the south side of the plain today.

As erosion continued, extensive alluvial deposition completely or partially buried the Pleistocene ridges and formed the present active fans over the valley floor. Upon final emergence, those depressions not filled by recent alluvial deposition remained as lakes forming the present Étang Saumâtre, in Haiti, and the deeper Lake Enriquillo in the Dominican Republic. Sea water captured in the basins has remained and accounts in part for the salinity of the lake waters at the present time (Cucurullo, 1949, 1951; Tippets, et al., 1956; Lanzo, 1981) (Figure 13).

The general topography of the plain reflects the geological processes by which it was formed. The bordering limestone mountains rise sharply to an elevation of 2279 meters on the north (Sierra de Neiba) and 2674 meters on the south (Massif de la Selle). Swift-flowing rivers draining the steep mountain slopes have deposited alluvium over most of the valley floor. In Haiti, since greater flows originate on the Massif de la Selle, the alluvium on the south side of the valley is considerably more extensive than that on the north. The result is a general northward slope extending across the valley toward the base of the Trou d'Eau range. Most of the alluvial fan material on the surface of the plain has been deposited by two major rivers, the Rivière Grisse and the Rivière Blanche. These streams enter the valley through deep gorges in the southern mountain border, and during periods of heavy rainfall carry large quantities of silt, sand and gravel to be deposited on their alluvial fans. The rate of

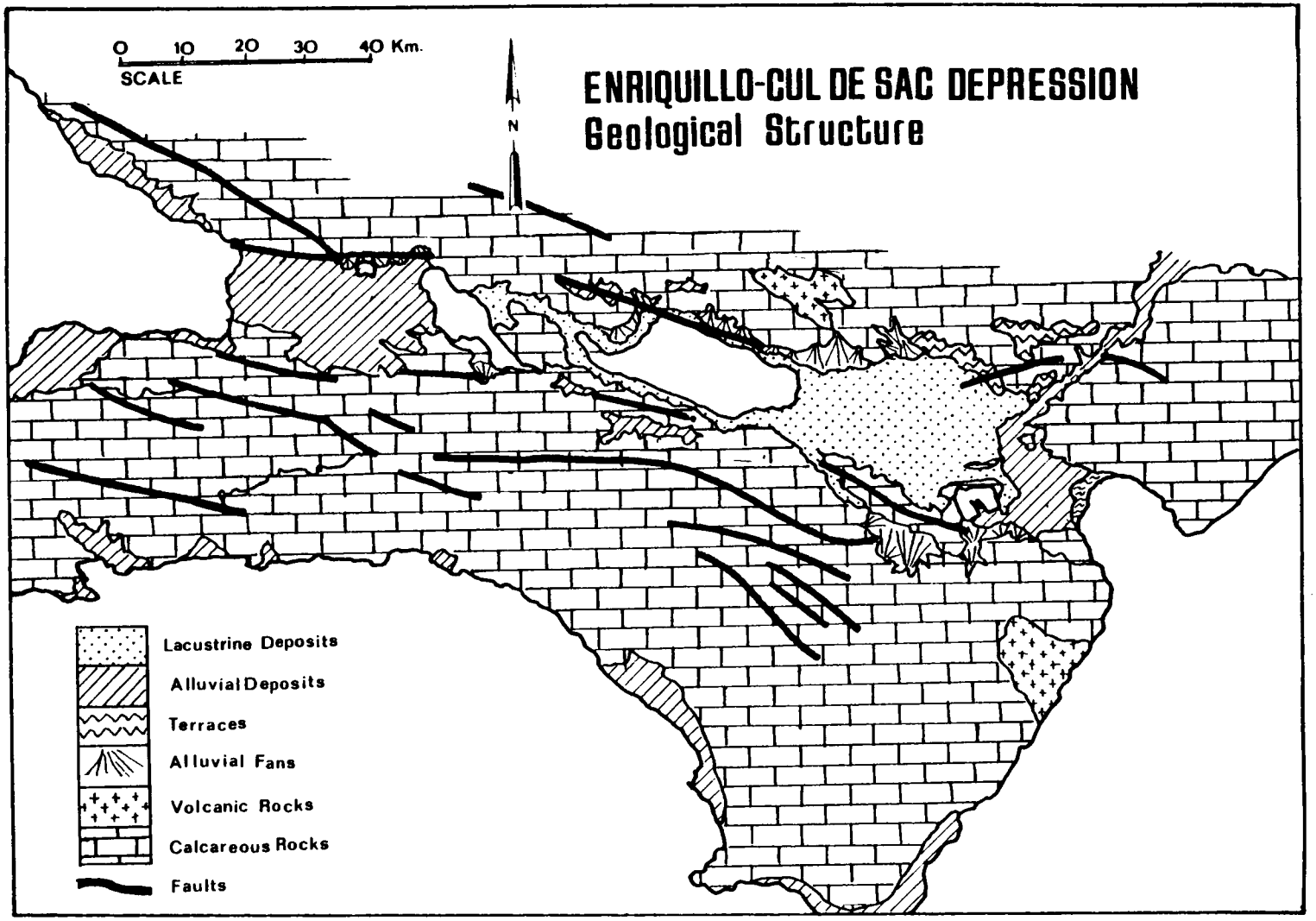

0 10 20 30 40 Km.
SCALE
N
ENRIQUILLO-CUL DE SAC DEPRESSION
Geological Structure
Lacustrine Deposits
Alluvial Deposits
Terraces
Alluvial Fans
Volcanic Rocks
Calcareous Rocks
Faults

Figure 13

erosion of the soil mantle has increased in recent times because the inhabitants have removed most of the natural vegetation and have planted row crops on steep slopes without building terraces. The channels of the rivers have meandered during their history, adding to the heterogenity of fan material. Other streams entering the plain from the south and all of those entering from the north are seasonally dry and have deposited only limited fans (O.E.A., 1972).

In the Dominican Republic, the geomorphology of the study area is similar to that in Haiti. The central part of the plain is covered by sediments of lake claystones while low hills and ridges are formed by folded limestones from the Miocene and Pliocene epochs, plus conglomerates and volcanic sediments. Also noteworthy are the alluvial deposits and terraces of the Yaque del Sur River at the eastern extremity of the basin. On the foothills of the Sierra de Neiba and Sierra de Bahoruco there are large alluvial fans, such as those named Caballero, Granado, Neiba and Galván, and some small basin deposits. Terraces with coarse sediments and coraline material extend on the northeastern side of the plain. Finally, beach sediments, sandstones and coastal limestones cover the area near Barahona (O.E.A., 1967; Lanzo, 1981).

A prominent feature on the Dominican side is Lake Enriquillo, the surface of which was 44 meters below sea level in 1982. Due to uneven deposition in the sea which previously occupied the area, along with tectonic uplift and regression of the ocean, the depression remained as a large salt water lake with no natural outlet. The amount

of runoff from tributary streams, some springs and surface precipitation has been insufficient over the years to provide the dilution required to reduce the lake's salinity. Unfortunately, the complex geomorphological processes related to this basin have not been studied, and there is a real need to understand them within the near future if agriculture programs are to be implemented successfully.

Geomorphological and geological processes are particularly related to soil conditions in the area. The parent materials from which the alluvial soils are derived consist principally of limestone and, to a minor extent, basalt. The Enriquillo-Cul de Sac soils are azonal, pedocalic and of alluvial deposition (Tippets, et al., 1956). Large quantities of calcium carbonate are present, mostly in a concretionary state. Some pronounced zones of accumulation are detectable. The limestone mountains surrounding the plain have been deforested and cultivated for a long time. Consequently, most of the drainage area is seriously eroded and large quantities of water-borne material, from clay to boulders, have been deposited on the plain below. Fine-textured surface soils generally are underlain by subsoils of coarser texture, or gravel, resulting in greater permeability with depth. The surface condition has been accentuated in some areas by the added deposition of suspended silt and clay particles delivered by irrigation water (O.E.A., 1967, 1972).

The origin and evolution of soils in the Enriquillo-Cul de Sac Depression are important considerations for an understanding of the factors most critical to agricultural development: salinity and

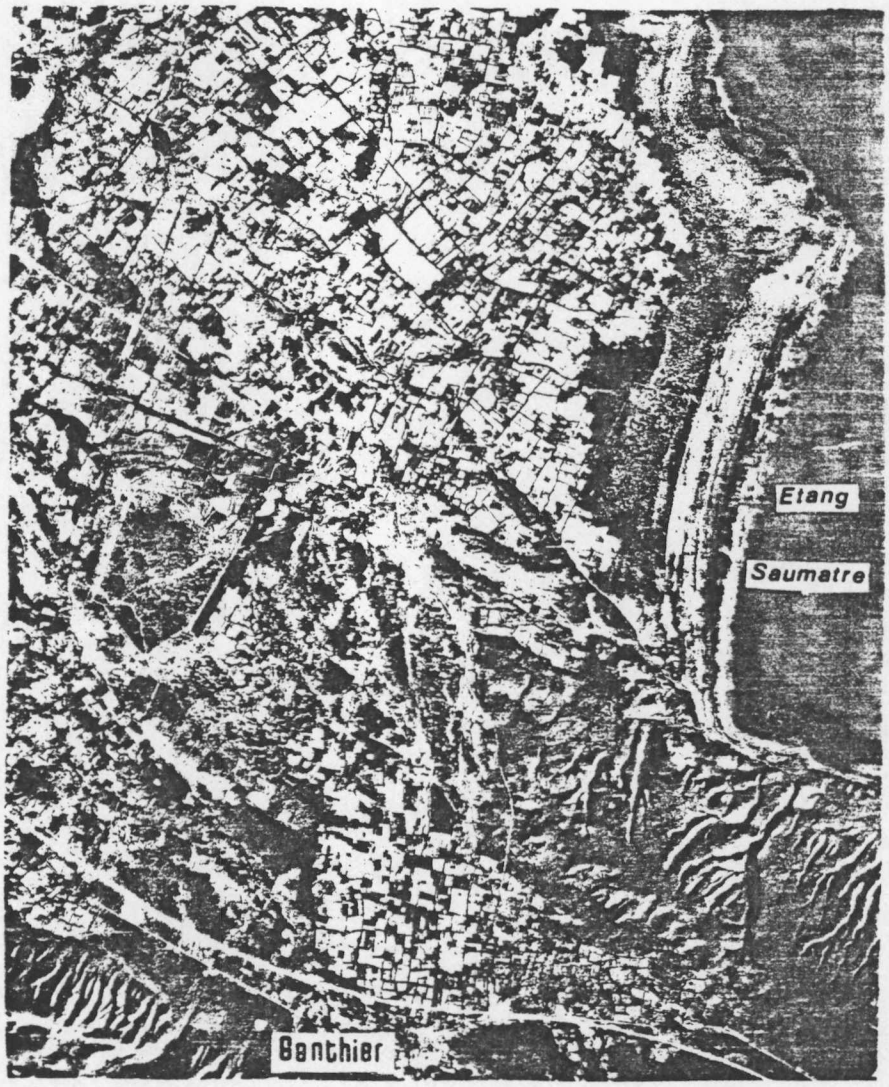
alkalinity. The salts resulted originally from primary mineral break-breakdown. Weathering caused them to form, and they were carried as solutes in irrigation water, and in the absence of adequate soil drainage, they accumulated in the soil profile. Low areas of flat topography were impregnated with salts from below by a rising water table induced by irrigation or by rainfall in adjacent higher land. The Enriquillo-Cul de Sac Depression, with its semiarid climate, is not an area where sufficient natural leaching occurs because the evaporation potential is much greater than the normal precipitation.

In both countries, agricultural utilization of the plain is seriously limited by the salt content of the soils. In Haiti, neither the intensive agricultural exploitation during the period of colonial plantations nor the poor technical characteristics of the rural scene since independence have resulted in any special treatment to avoid the process of salinization. Excessive irrigation, poor drainage, and the effects of natural hazards have produced a general deterioration of soils in the eastern part of the Cul de Sac, bordering the Étang Saumâtre, where most of the small-farmer communities are located (Fig. 14).

In the Dominican Republic, with less intensive agricultural occupance, small farmers are settled mostly on alluvial fans or in parts of the plain where problems of salinity are not so great, such as on the alluvial soils near the Río Yaque del Sur. However, salinization affects the large sugarcane plantations (Tavárez, 1980; Vicioso,

HAITI

ETANG SAUMATRE AREA
Small Farms



Source: Aerial Photography, 1957.

Figure 14

1980; González, 1980), some small farms in the area of Duvergé, and small settlements of the central plain. According to Israeli experts (Prion, et al., 1981), the central part of the plain in the Dominican Republic presents the greatest salinity, but could be rehabilitated for agriculture with modern techniques of leaching. Fernando Campos, of the Dominican Secretariat for Agriculture, offered the same opinion, in a personal interview, concerning the need for modern technology to implement improved agriculture in the study area. Much needed are evaluations of the constraints of soil salinity for future expansion of arable land. Similar conditions may be detected on the Haitian side, where a survey on soil salinity is being conducted by the Laboratory of Soil Chemistry in the Department of Agriculture, supported by the O.A.S. (Fig. 15).

Climate in the area is another significant constraint on agriculture because of the low rainfall and high evaporation resulting from high temperatures throughout the year. Various methods have been used to establish aridity indexes for the study area (Féliz, 1964) and in all of them the results correspond to a desert or semidesert. Table 3 presents climatic data and Figure 16 depicts isohyets for the study area. Yet, the real climatic constraint is related to erratic rainfall and the disastrous effects of natural hazards, such as tropical storms or hurricanes. For example, the highest intensities of rainfall for one day have been recorded in Tamayo, 574 millimeters on 16 June 1972; in Barahona, 563 millimeters on 6 May 1974; in Cabral, 453 millimeters on 24 August 1964; and in El Peñón, 390 millimeters on 16 June 1972.

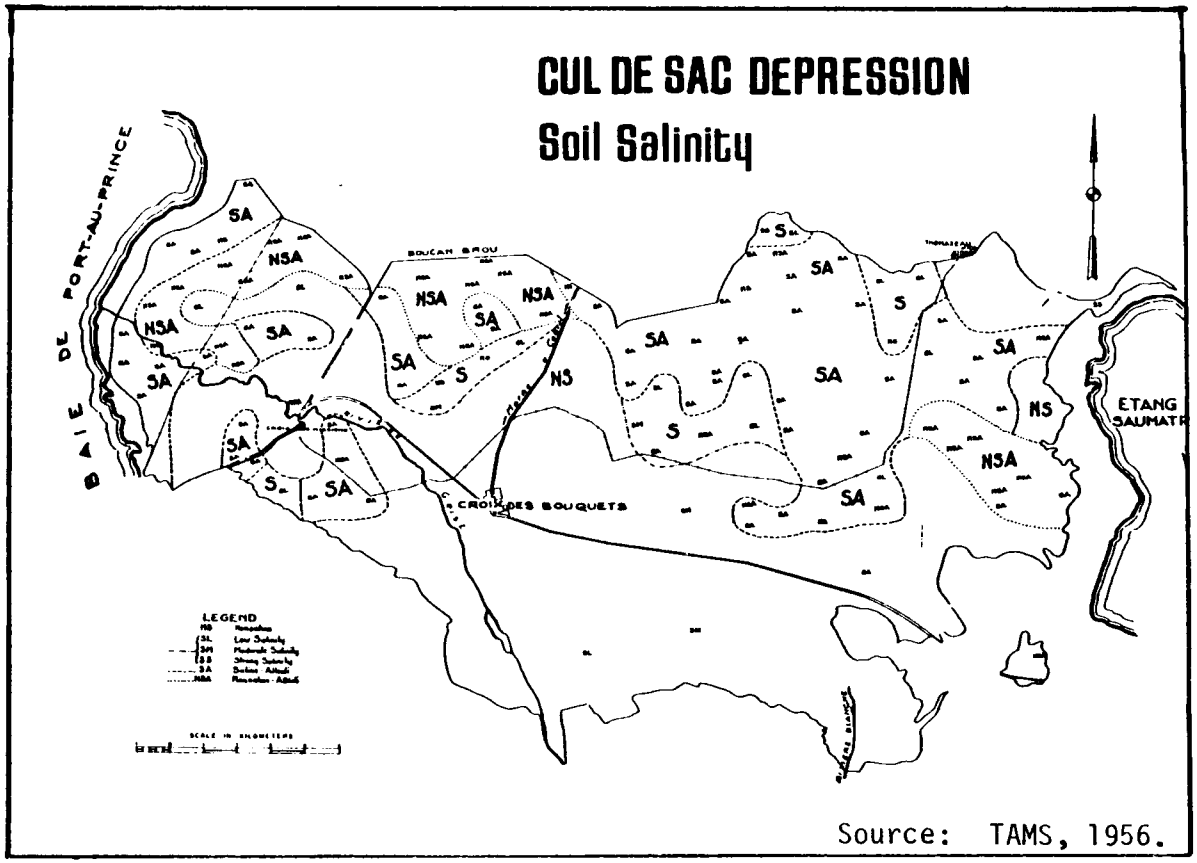

CUL DE SAC DEPRESSION
Soil Salinity
BAIE DE PORT-AU-PRINCE
SA
NSA
S
NS
ETANG SAUMATR
CROIX DES BOUQUETS
LEGEND
Source: TAMS, 1956.

Figure 15

Table 3

CLIMATIC DATA FOR THE ENRIQUILLO-CUL DE SAC DEPRESSION

Station	Elevation in Meters	Annual Rainfall (mm.)	Average Temperature (C°)	Potential Evaporation (mm.)
Haiti:				
Damien	18	1073	27.1	1794
Croix des Bouquets	--	941	--	--
Rivière Blanche	--	1115	--	--
Ganthier	80	710	26.0	--
Despuzeau	--	807	--	--
Thomazeau	--	897	--	--
Fond Parisien	50	908	25.8	--
Dominican Republic:				
Barahona	35	1001	--	2721
Neiba	30	510	26.8	2442
La Descubierta	20	646	28.3	1890
Jimaní	20	735	27.4	--
Duvergé	0	482	28.1	2083
El Peñón	4	658	26.1	2156
Cabral	19	871	26.8	1727
Tamayo	21	533	26.8	1681

Sources: Haiti: Service Meteorologique National, 1983; OEA, 1972. Dominican Republic: Secretaría de Estado de Agricultura, División de Climatología y Agroclimatología, 1982; INDRHI, 1983.

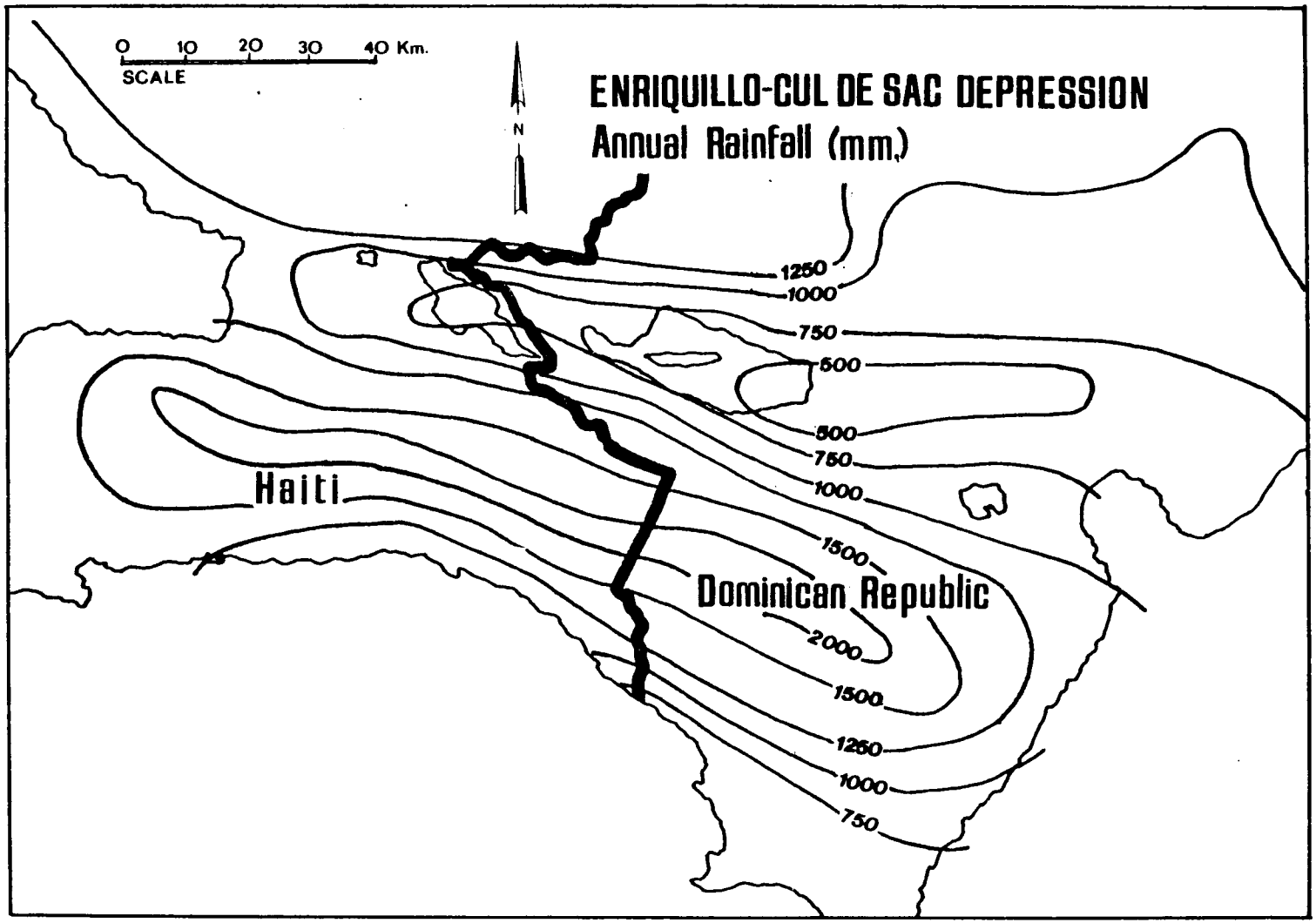

0 10 20 30 40 Km.
SCALE
N
ENRIQUILLO-CUL DE SAC DEPRESSION
Annual Rainfall (mm.)
1250
1000
750
500
500
750
1000
1500
Haiti
Dominican Republic
2000
1500
1250
1000
750

Figure 16

Such rainfall is enough to produce floods and destroy irrigation infrastructure. The period of greatest rainfall is between May and October, and the month with the highest frequency of rain is May. However, there are often periods of drought, and living conditions of farmers are difficult during the dry periods. In general, semiaridity is the main challenge to be overcome if settlements are to prosper in this depression. Availability of water constitutes the only significant answer to the drought, and water management has become a fundamental technique for survival of small-farmer communities.

Topographic and geological conditions in the area are favorable to provide water in various ways. High rainfall in the Sierra de Neiba and Sierra de Bahoruco generates runoff to the valleys and depression, and water infiltrates and accumulates in underground water reserves (Peguero, 1980; Simonot, 1982). A comprehensive report was published recently by the United Nations Development Programme on the underground water resources of the Haitian Cul de Sac. For the Dominican Republic there are no reliable studies on this topic. Engineer Sinecio Ramírez, of the Instituto Nacional de Recursos Hidráulicos, stressed the importance of these resources in the Dominican Republic, in personal interview, and proposed studies for the use of underground water in the alluvial fans and in the plain.

Surface water resources are well known in both countries, but there are deficiencies in infrastructure to use them properly. In Haiti, drainage is a major problem of water management in the arid eastern side of the Cul de Sac, while other sectors of the plain can

only be irrigated by wells. A complete survey of surface water resources on the Dominican side is maintained by the Instituto de Recursos Hidráulicos, and a list for the study area is presented in Table 4. In general, these resources are insufficient to assure permanent agricultural activity to the farmers, hence an underground supply is essential if new communities are to be settled, or if greater productivity is sought for this area.

The ability of the natural landscape to support permanent agriculture is under review. The most useful reports relative to the viability of small-farmer communities are a study by Reyna and Paulet (1979) on water requirements for agriculture in the Dominican Republic; a series of papers and articles by the Section on Agrometeorology in the Secretaría de Estado de Agricultura; and a thorough analysis of land potential prepared by the Departmento de Inventario, Evaluación y Ordenamiento de los Recursos Naturales (SIEDRA, 1980) (Figs. 17 and 18).

Spatial Organization

Population distribution in the region under study is very different between the two countries. In the Dominican Southwest, with a total population of 719,681 inhabitants in the census of 1981, 41 percent of the population was urban, and 59 percent rural. In Planning Region No. 3, in Haiti, with a total population of 1,919,703 according to the official census of 1982, 42 percent of the population was considered urban and 58 percent rural. These figures seem to represent

Table 4

YAQUE DEL SUR IRRIGATION DISTRICT

No.	Canal	Flow (m^3/s)	Area (Ha.)	Length (Km.)	Source
1	Monte Grande	--	67.68	3.0	Río Yaque del Sur
2	Fondo Negro (Bomba)	--	319.00	4.0	"
3	Fondo Negro No. 1	--	143.75	3.5	"
4	Fondo Negro No. 2	--	--	2.0	"
5	El Montazo	--	57.40	3.5	"
6	San Ramón (Bomba)	--	1265.61	8.5	"
7	San Ramón	--	276.00	11.0	"
8	Arroyo Grande	--	251.57	2.0	"
9	Las Lajitas	1.00	175.80	5.0	"
10	Santana	--	10924.28	24.0	"
11	Los Habitantes	--	420.19	3.5	"
12	Tamayo	--	113.80	3.5	"
13	Vicente Noble	2.27	1616.35	13.0	"
14	El Jobo	--	530.60	4.0	"
15	La Azucarera	--	630.00	5.0	"
16	Peñon No. 1 (Bomba)	--	--	3.5	"
17	Jaquimeyes (Bomba)	--	377.36	3.5	"
18	Palo Alto (Bomba)	--	125.79	3.5	"
19	Peñon No. 2 (Bomba)	--	420.19	1.5	"
20	Fundación (Bomba)	--	327.04	--	"
21	Pescaderia (Bomba)	--	105.00	3.5	"
22	La Guinea	--	188.68	1.5	"
23	Caballero	--	467.04	1.0	"
24	Sistema Majagual	--	503.14	--	Cachones
25	Cachones de Cabral	--	205.40	--	"
26	Colector Cabral (La Lista)	--	200.00	3.0	"
27	La Lista-Salina	--	1580.00	11.0	"
28	El Naranjo	--	75.47	3.0	A° el Naranjo
29	Los Saladillos	--	377.36	4.0	Río Lemba
30	Salinas	2.00	73.90	1.0	"
31	Cristóbal	15.00	1197.04	--	Laguna Rincón
32	Las Lajitas	1.00	432.33	5.0	Río Majagual
33	Cambronal	2.00	933.46	7.0	"
34	Granado-Guanarate	--	150.00	4.5	Bomba de Pozo
35	Cabeza de Toro	--	250.00	4.0	Cañada Naranjal
36	Panzo	1.00	843.07	9.0	Río Panzo
37	Plaza Cacique	--	634.47	6.0	El Manguito
38	Sonador (Bomba)	--	146.00	5.0	Cachones
39	Las Marias	0.0025	264.00	5.0	"
40	Las Cañitas	--	88.00	--	"
41	La Isleta	--	43.00	1.0	Río Don Juan
42	las Marias	--	25.00	9.0	"

Table 4 (continued)

No.	Canal	Flow (m^3/s)	Area (Ha.)	Length (Km.)	Source
43	Pitajaya	--	90.00	5.0	Río Bermesí
44	Los Cerros	--	98.40	3.0	"
45	Los Mancebos	--	104.75	1.0	"
46	Los Pérez	--	24.00	2.0	"
47	Mamonal	--	86.25	1.5	"
48	Los Cocos	--	10.40	1.5	"
49	Olivar	0.33	193.00	9.0	Río Pedernales
50	Altamizar	--	40.87	--	Aº Ojo de Agua
51	Los Méndez	--	33.59	1.0	"
52	Los Fones	--	--	2.0	"
53	Palmar Dulce	--	251.57	7.0	Río Las Damas
54	Vengan a Ver	--	94.34	5.0	"
55	Clavellinas	--	415.28	10.0	Río Barrero
56	La Resaca	--	117.90	1.0	Aº Bayahonda
57	Bayahondal	--	266.12	4.0	"
58	Las Barías	--	720.13	16.0	Cachón
59	Boca de Cachón No. 1	--	25.00	4.0	"
60	Boca de Cachón No. 2	--	20.00	2.5	"
61	Canal Jimaní	--	1864.07	6.0	Aº Blanco
62	La Esperanza	--	140.88	--	"

Source: INDRHI, 1983.

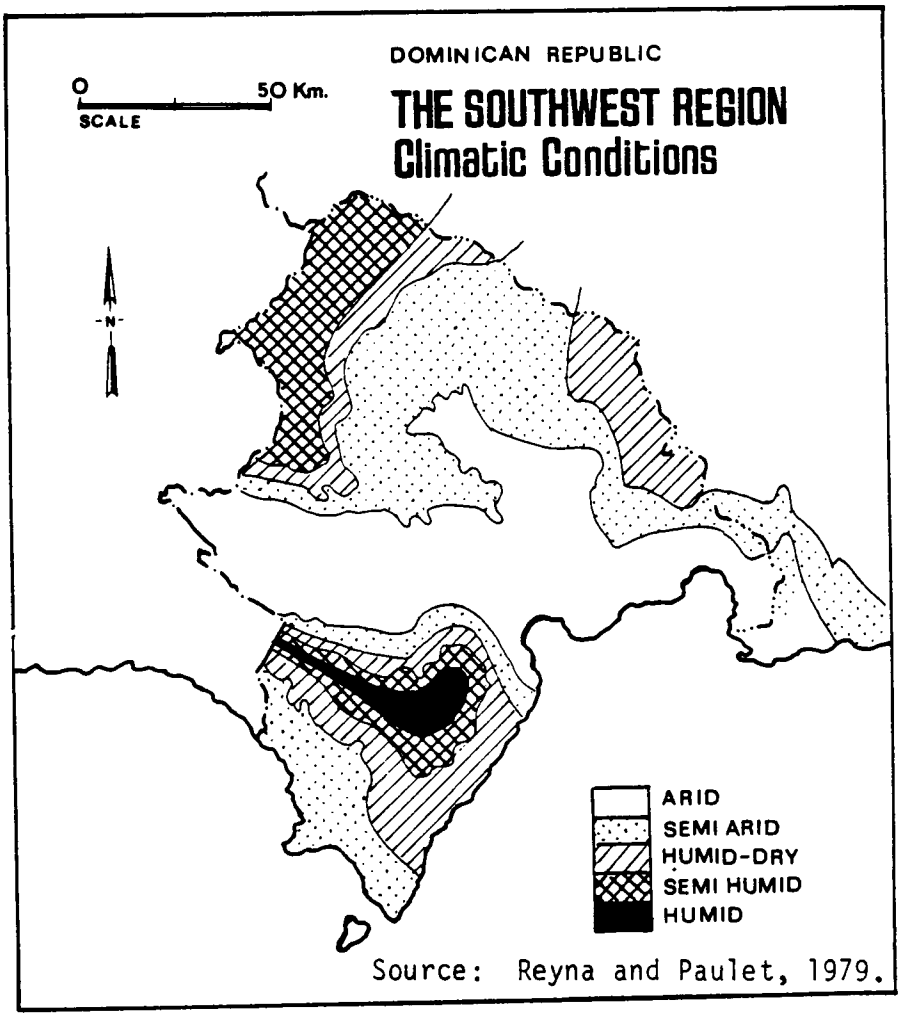

DOMINICAN REPUBLIC
0
50 Km.
SCALE
THE SOUTHWEST REGION
Climatic Conditions
-N-
ARID
SEMI ARID
HUMID-DRY
SEMI HUMID
HUMID
Source: Reyna and Paulet, 1979.

Figure 17

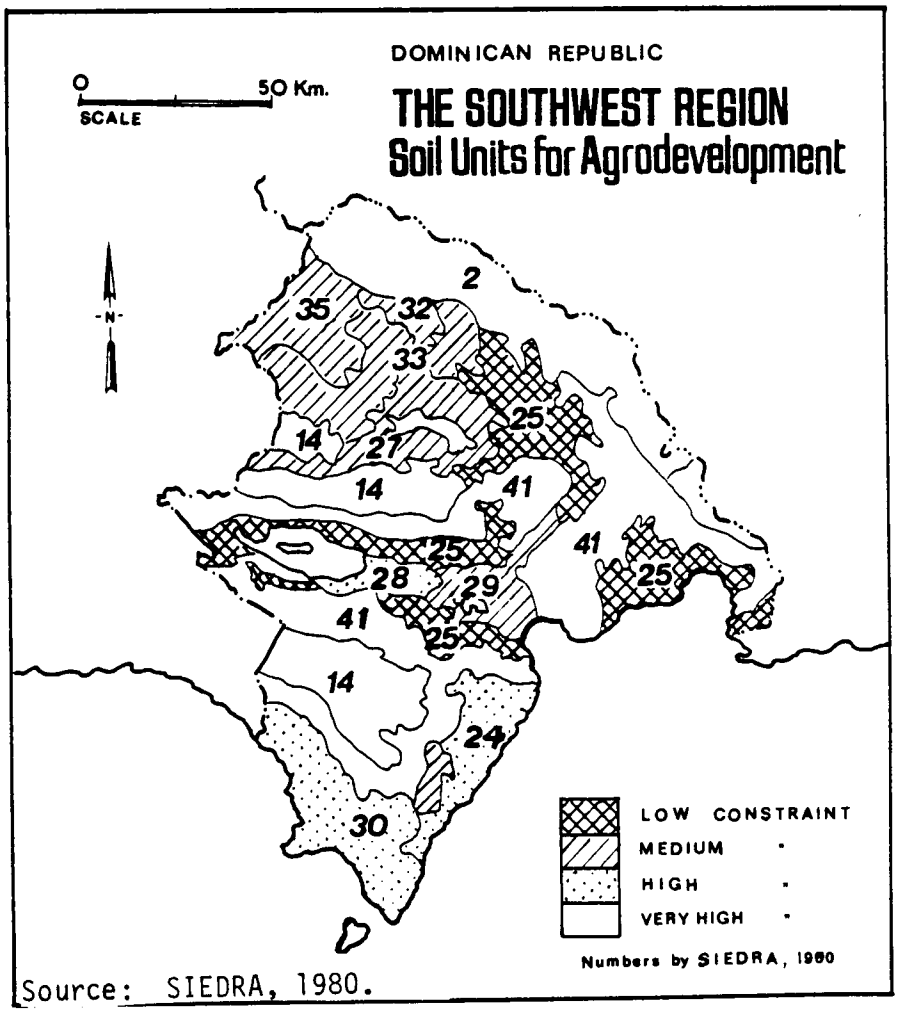

DOMINICAN REPUBLIC
0
50 Km.
SCALE
THE SOUTHWEST REGION
Soil Units for Agrodevelopment
N
2
35
32
33
25
14
21
14
41
25
41
28
29
25
41
14
24
30
LOW CONSTRAINT
MEDIUM
HIGH
VERY HIGH
Numbers by SIEDRA, 1980
Source: SIEDRA, 1980.

Figure 18

an almost identical reality, but the distribution and number of urban centers and the total volume of rural population are quite different on each side of the border. The best parameter by which to visualize these differences is the distribution of absolute densities, as shown in Figure 19.

The highest density on the Dominican side is in the municipio of El Cercado, with 272 inhabitants per square kilometer, and only six municipios have more than 100 inhabitants per square kilometer in a total of forty municipios. In Haiti, the highest density corresponds to the commune of Port-au-Prince, mostly urban, with 1674 inhabitants per square kilometer. In a total of twenty-one communes, two have densities exceeding 400, six have from 200 to 400 and eight have between 100 and 200 inhabitants per square kilometer. Comparing densities of contiguous municipios and communes, those on the Haitian side are about four times greater.

A fundamental measure of population distribution is the level of rural population as a percentage of the total population in each municipio or commune. This measure is expressed as levels of rurality in Figure 20. A low level of rurality corresponds to the Enriquillo-Cul de Sac Depression, in direct relation to poor conditions for agriculture. It is a general rule that population in arid environments tends to be concentrated in settlements of medium size, usually considered as urban in the census. Even the Yaque del Sur alluvial plain has a low percentage of rural population, and the lowest is in mining sectors of the Dominican side and in the urban area of Port-au-Prince,

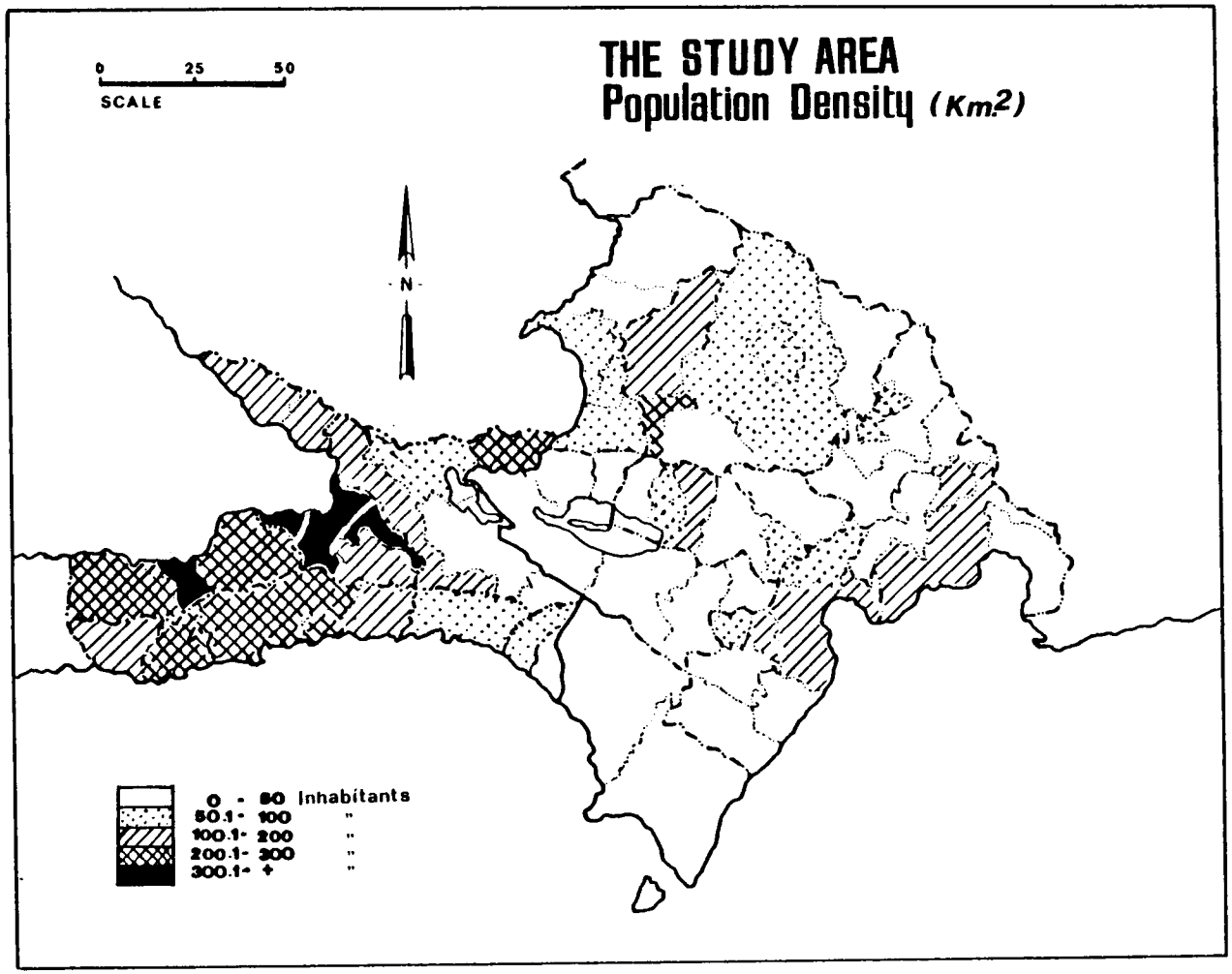

THE STUDY AREA
Population Density (Km.2)
0 25 50
SCALE
N
0 - 50 Inhabitants
50.1- 100 "
100.1- 200 "
200.1- 300 "
300.1- + "

Figure 19

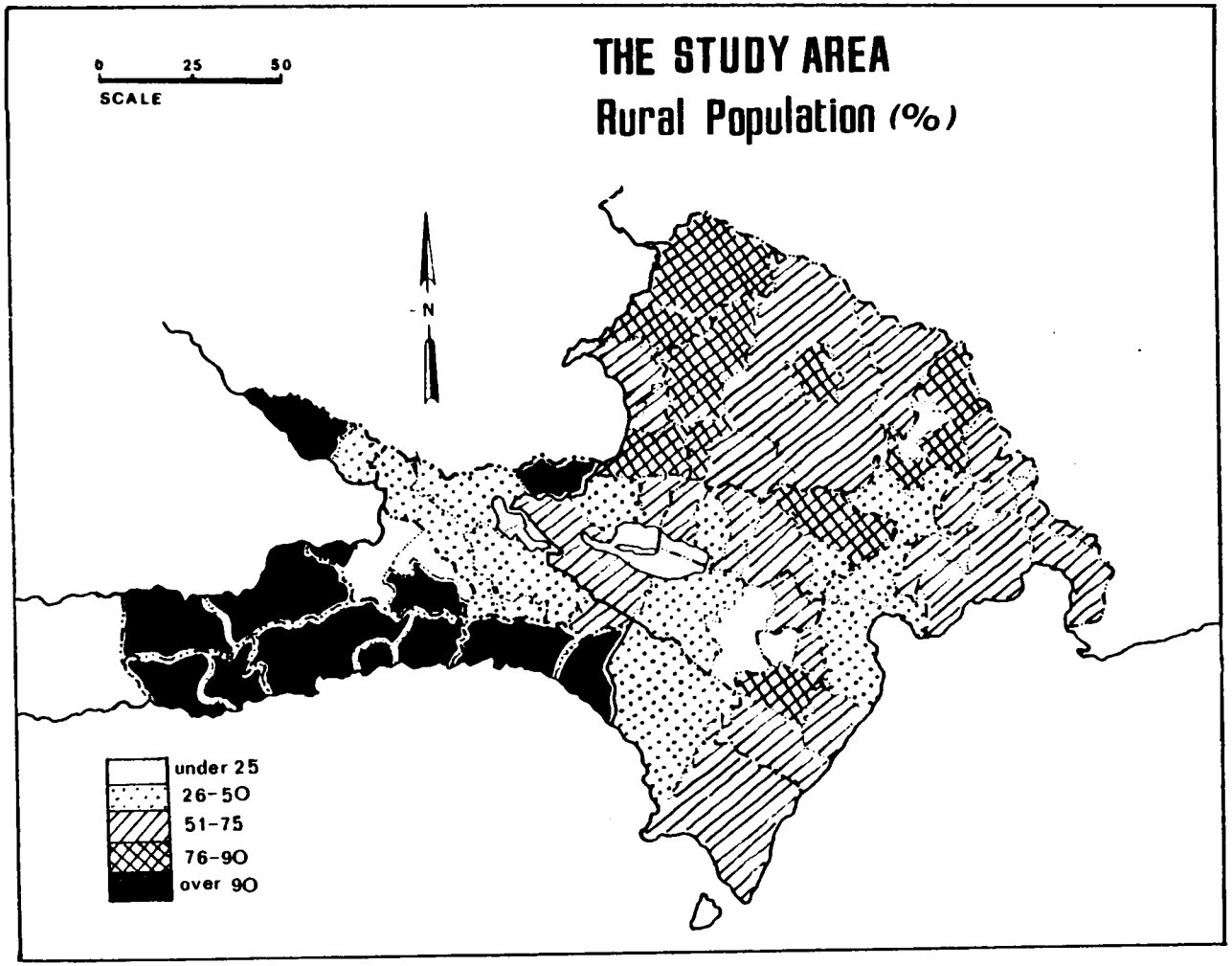

THE STUDY AREA
Rural Population (%)
0 25 50
SCALE
N
under 25
26-50
51-75
76-90
over 90

Figure 20

Haiti. The highest rural densities are in the area of the Massif de la Selle, in Haiti, with occupance over 90 percent rural.

Urban settlements in the region under study must be analyzed differently for each country. In the Dominican Republic, the Southwest includes two urban networks. One is in the San Juan Valley, with its main center the city of San Juan, with about 50,000 inhabitants. Its principal subcenters are Comendador, the capital of Elías Piña Province; las Matas de Farfán; and El Cercado, all foci of important rural activities. The other Dominican network corresponds to the Enriquillo Basin and the Pedernales Plain. The main settlement is Barahona, with a population similar to that of San Juan, and the subcenters are Neiba, the Capital of Bahoruco Province; Jimaní, capital of Independencia Province; and Pedernales, capital city of the province with the same name. Other important centers of rural activities are Duvergé, Tamayo, Vicente Noble, Cabral and Oviedo.

The two networks converge to the east in the city of Azua, a regional administrative center, headquarters of the Instituto para el Desarrollo del Suroeste (INDESUR), and capital of the province of Azua (Fig. 21). In general, the San Juan area has better conditions for agriculture and other economic activities.

In Haiti, the capital of the country, Port-au-Prince, dominates completely the regional network of settlements. In 1971, the ten largest settlements in Planning Region No. 3, each with more than 1500 inhabitants, had a total urban population of 533,813 and Port-au-Prince alone accounted for 93 percent of that figure. The

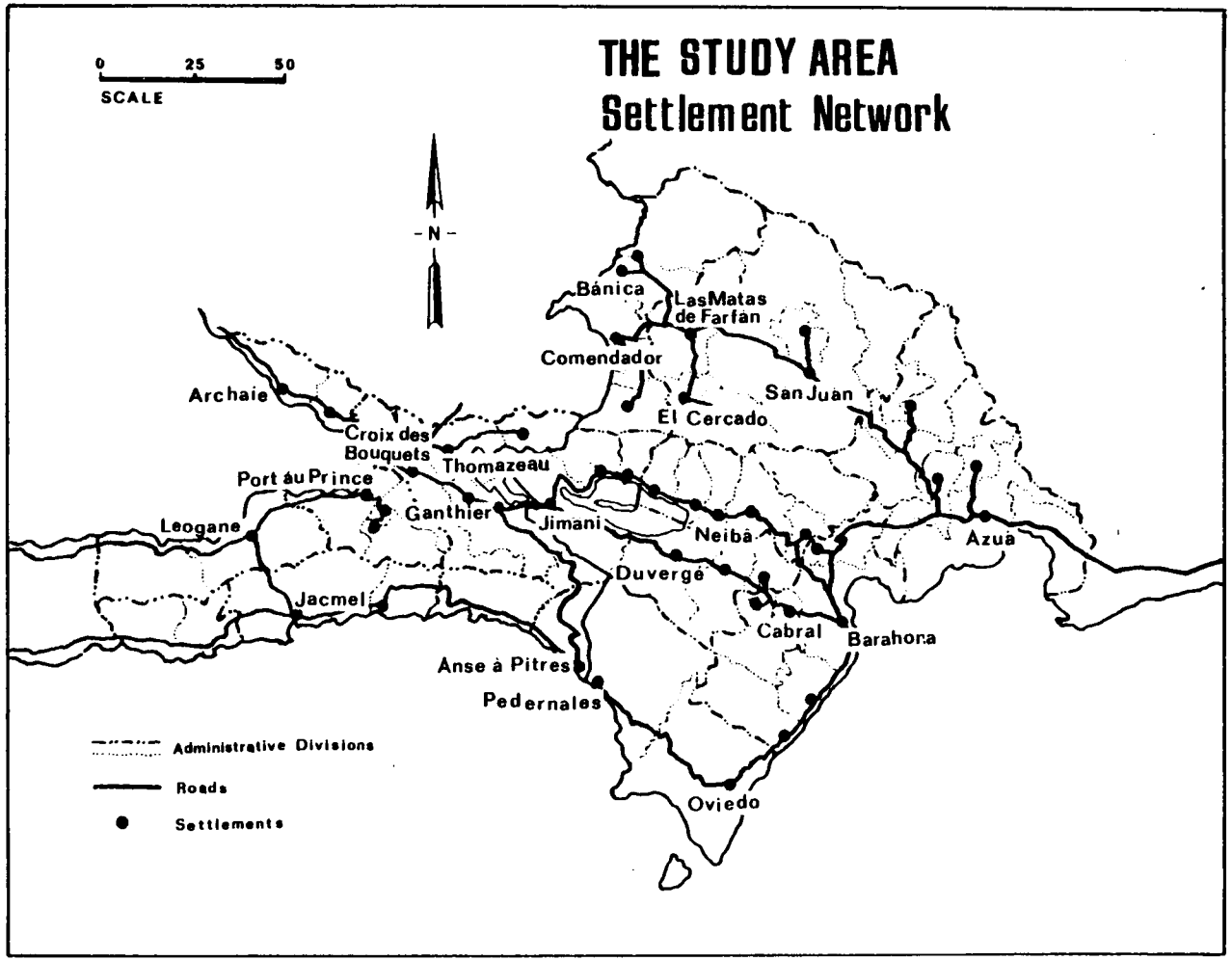

THE STUDY AREA
Settlement Network
0 25 50
SCALE
N
Bánica
LasMatas de Farfán
Comendador
San Juan
El Cercado
Archaie
Croix des Bouquets
Thomazeau
Port au Prince
Ganthier
Jimani
Leogane
Neibà
Azua
Duvergé
Jacmel
Cabral
Barahona
Anse à Pitres
Pedernales
Oviedo
Administrative Divisions
Roads
Settlements

Figure 21

second-ranked urban center of the region in Haiti is Jacmel, and the third is Petit-Goâve. Data from the census of 1982 are not yet available, but it is probable that the influence of the capital city is even greater. However, the historical development of Port-au-Prince has not much affected its countryside. A few kilometers from the big city, rural activities are of the same traditional and non-productive forms as in the rest of the country.

Land use corresponding to these characteristics of population distribution is simple. Rural activities totally predominate in most of the region, with some variation relative to natural conditions of soils and climate, and especially with water availability. Different kinds of crops reflect these natural constraints. Sugarcane has been developed on two large plantations. On the Dominican side, the Barahona Sugar Company was created by Americans in 1916. It is now owned by the Dominican government, under the name Central Barahona, and has affected considerably the development of the city of Barahona. In Haiti, the Haitian-American Sugar Company (HASCO) is owned by private interests that control most rural activity in the Cul de Sac plain because it constitutes the most secure market for small farmers. The remaining land is generally in small farms, and large areas are not cultivated at all because of severe natural constraints. This is particularly true in the Dominican Republic due to lower population densities.

Mining is not important in the region. The main mining settlement is located near Pedernales, and is based on bauxite exported by

the Alcoa Company to be processed abroad. Today, this activity has declined as a result of low international prices for aluminum. In the Sierra de Bahoruco there are large salt and gypsum deposits that were profitably exploited under the government of Trujillo but are abandoned today. Finally, near Vicente Noble, at a place called Canoa, there is a type of marble (travertino) that is widely used for construction in Santo Domingo. Other activities such as fishing, lumbering and tourism are also developed, but their influence on the economy of the region is slight and can only be considered as a potential.

Tertiary activities and services are concentrated in the principal urban centers, while rural settlements have great need for better schools, health services and particularly technical and financial aid. Good facilities for recreation are in short supply. This lack of social amenities was mentioned as one of the main reasons to emigrate from the region by families interviewed during the field research.

Finally, the inadequacy of transportation and communication is a basic constraint in the area. The Dominican side has the poorest system of roads in the entire country, and many farmers complain that road conditions hinder the commercialization of their products. There are few buses in the rural areas, and it is common to wait several hours to obtain a ride if anybody needs to visit a village. In Haiti, road conditions are better because of the proximity to Port-au-Prince, but transportation means are scarce and usually women take their goods to the city market by foot. Because distances are short, it is easy to reach most places, but mental distances are enormous, due to the

cultural differences and lack of communication between the big city and rural communities. In general, the organization of space is unsatisfactory and presents a number of constraints that adversely affect the viability of small-farmer communities.

Economic, Legal and Social Constraints

Natural and spatial conditions, technology, farm size, the social system of labor and financial support are the basic economic constraints in the region under study. Besides the scarce natural resources and major constraints of climate and soils, the area is characterized by low levels of technology. Agriculture, in both countries is conducted without fertilizer, pruning or grafting. Productivity is low, and the small size of farm units results in very low income per family. Farms on the Dominican side average about 30 tareas, or less than two hectares, in size. In Haiti, they are of similar dimensions, expressed in carreaux, the Haitian unit of land measurement. Average family size is between 7 and 8 persons on the Dominican side, and between 5 and 6 on the Haitian side.

The system of labor is a significant criterion by which to evaluate the economic productivity of farms. Because the entire family participates in the economic process, rural salaries are not considered in the evaluation. At the same time, this system is a partial solution to the huge problem of rural unemployment. As labor is not considered in the calculation of agricultural costs, low market prices do not affect the competitiveness of farmers who manage to survive with the low income

they obtain by trading their products. Markets and prices for regional production are minimal. There are great differences between the price farmers receive in the local market and the commercial prices in Santo Domingo. Usually, producers depend on one or two middlemen who come to the villages to buy and transport the products in their own trucks. The prices are imposed on the producers, who are paid in goods acquired from the urban markets. In general, this system of interchange is damaging to the rural economy.

As a result of the economic constraints, income per family is low. In the Dominican Republic, the average annual income of small farmers is no more than 1000 dollars per family, and many earn much less. In Haiti, where conditions are worse, it is common for a family income to be 100 dollars per year or less. In fact, the figure of 300 dollars annually per rural family has been considered a goal for rural development in some programs of the United Nations in the Artibonite Valley (Durán, 1981).

Political and legal systems become relatively important when there are severe natural and economic constraints. The region under study is divided into provinces and municipios or communes. The latter are more important because of their immediate influence at the local level. Figure 21 shows sixty-one municipios and communes in the region under study. Unfortunately, many are too small and too poor to provide any help. At the same time, rural population densities and the lack of services present huge problems at the local level. These political disadvantages are usually ameliorated by social organization.

In Haiti, voodoo is not only a religion, but an entire social system. It provides authorities and social values, organizes living conditions, and inhibits crime and other local problems. On the Dominican side, there is some voodoo influence, but most Dominican communities are organized in a more modern form.

Significant legal constraints relate to land tenure and control over water resources. Cadastral systems have not been organized in these communities, and land ownership corresponds more to tradition than to legal status. Control over water resources is organized from the capital city of each country, the Département de l'Agriculture, des Ressources Naturelles et du Développement Rural in Haiti, and the Instituto Nacional de Recursos Hidráulicos, in the Dominican Republic. In both cases, there are many difficulties and some irregularities in the provision of water to small-farmer communities.

Finally, social constraints in the area are very important because local communities maintain many customs and traditions that affect popular values and goals. In the Dominican Republic, men are in charge of families and decide almost everything, including how to use the family income, which often goes for alcohol, rum, gambling and prostitution. These constitute important social constraints on the improvement of income and family living conditions. In Haiti, social problems are not so great, but the influence of voodoo creates values and a system of social authority that makes it difficult to introduce new conditions of health, rural labor or economic organization.

General references to human constraints must be considered in greater detail for the model of viability and for specific analyses of each sector of small-farmer communities.

Small-Farm Sectors

Study of the general geographical framework was supplemented by the selection of some specific sectors in the Enriquillo-Cul de Sac Depression for more detailed analysis. These sectors comprise the areas where most of the small-farmer communities are located. From west to east they are:

1. Ganthier, in Haiti, covering the plains area of the communes of Thomazeau and Ganthier (Fig. 22). This sector includes 414 square kilometers, but one-fourth of it corresponds to water bodies and another fourth is comprised of hills and mountains with slopes greater than 20°. Soil salinity and drainage are the most serious problems, and indices of aridity are among the highest in Haiti. The southern half of the sector includes the Blanche River Basin, where an important rural development program is being prepared by the Inter-American Development Bank (I.A.D.B., 1978).
2. Jimaní, in the border area of the Dominican Republic (Fig. 23). This sector includes small oases adjacent to Lake Enriquillo. The main oases are Postrer Río, La Descubierta, Boca de Cachón and Jimaní, the capital of the Independencia Province. Most of the farms are located on large alluvial

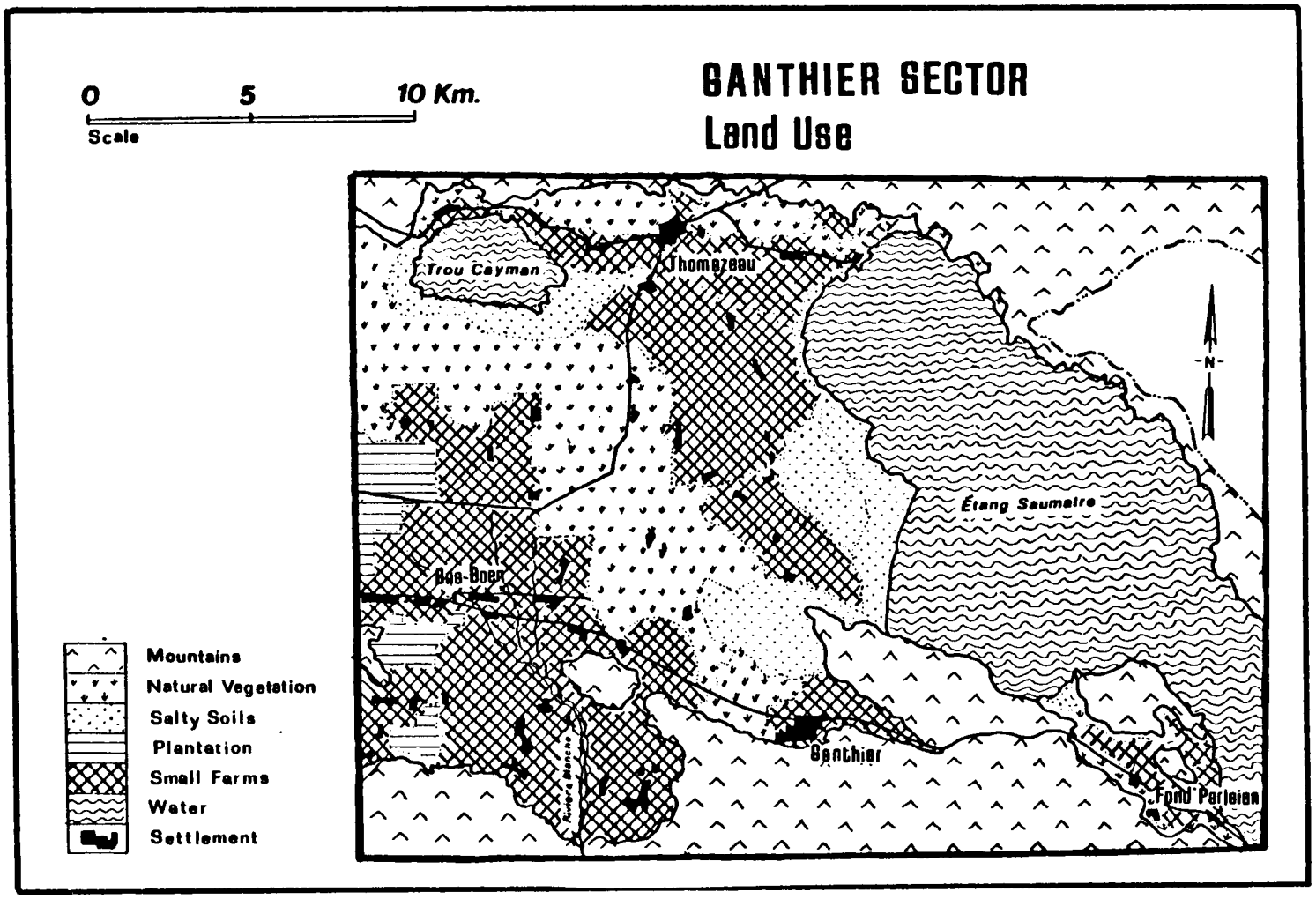

0
5
10 Km.
Scale
GANTHIER SECTOR
Land Use
Trou Cayman
Thomazeau
Étang Saumatre
Bas-Boen
Ganthier
Fond Parisien
N
Mountains
Natural Vegetation
Salty Soils
Plantation
Small Farms
Water
Settlement

Figure 22

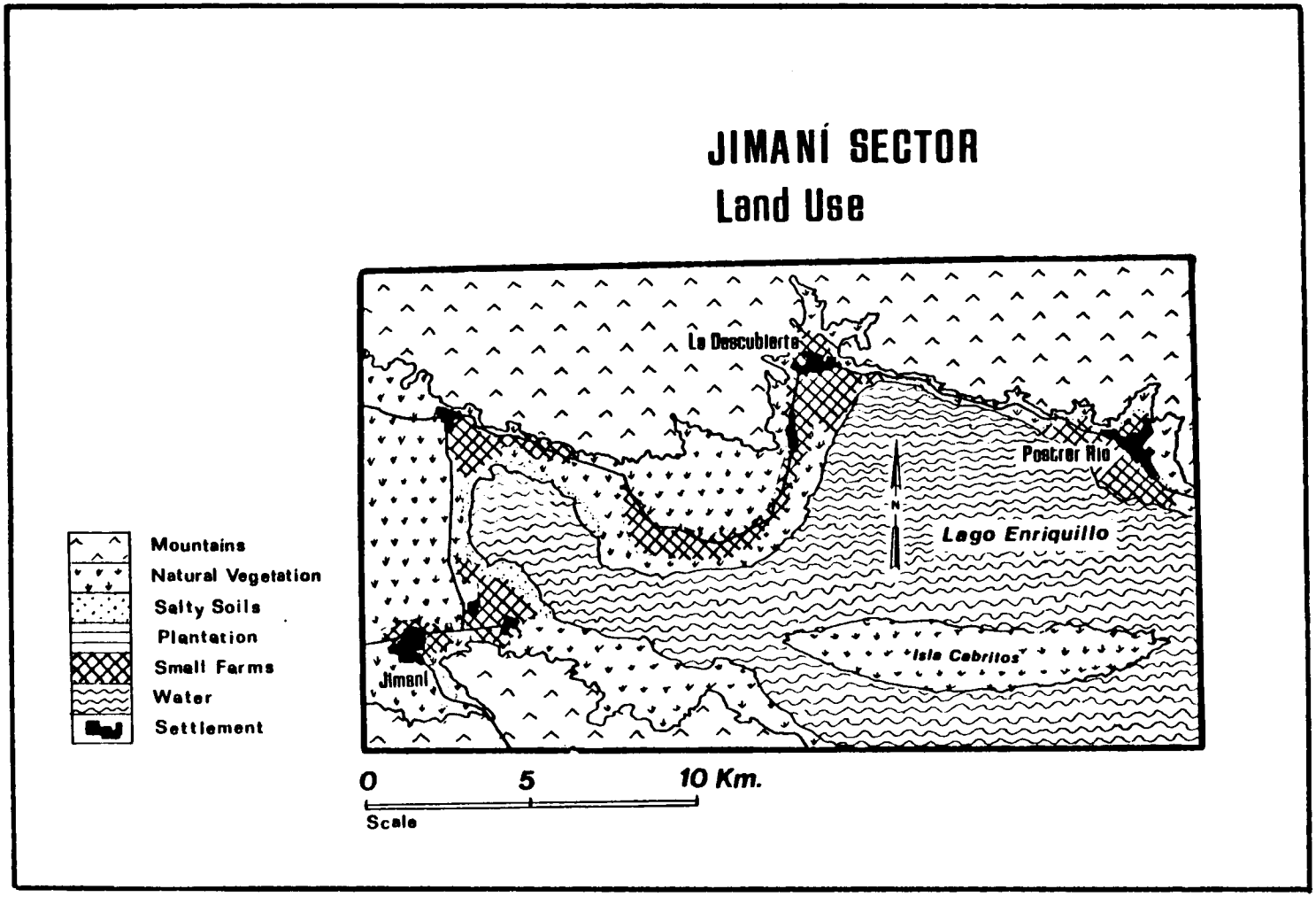

JIMANÍ SECTOR
Land Use
La Descubierta
Postrer Rio
Lago Enriquillo
Isla Cabritos
Jimani
N
Mountains
Natural Vegetation
Salty Soils
Plantation
Small Farms
Water
Settlement
0
5
10 Km.
Scale

Figure 23

fans, with stony soils but with much less salinity than the plain. Water is obtained mainly from wells and small rivers. Springs are numerous, but the quality of water is a constraint in terms of agricultural use. This area is probably the most isolated of those in the Depression, with many problems of communication and services.

3. Neiba, corresponding to the northern alluvial fans in the Enriquillo Basin (Fig. 24). Three large oases with substantial agricultural production support the oldest settlements in this depression: Neiba, Galván and Villa Jaragua. Neiba is the second-largest settlement in the Enriquillo Basin and, with 12,000 inhabitants, is the capital of Bahoruco Province. This city constitutes an important local market and provides the best services for small-farm communities. Galván and Villa Jaragua are also well-developed settlements famous for their agriculture.
4. Duvergé, on the south side of Lake Enriquillo (Fig. 25). The settlement of Duvergé dates from the late decades of the 19th century (Sosa, 1981), but the town became well known as a center for agricultural colonization during the government of Trujillo. Duvergé is a local market within the Depression and provides services and recreation for nearby rural communities. Two other settlements of this sector, Mella and Colonia, originated as part of Trujillo's program of agricultural colonization. Soils in the area

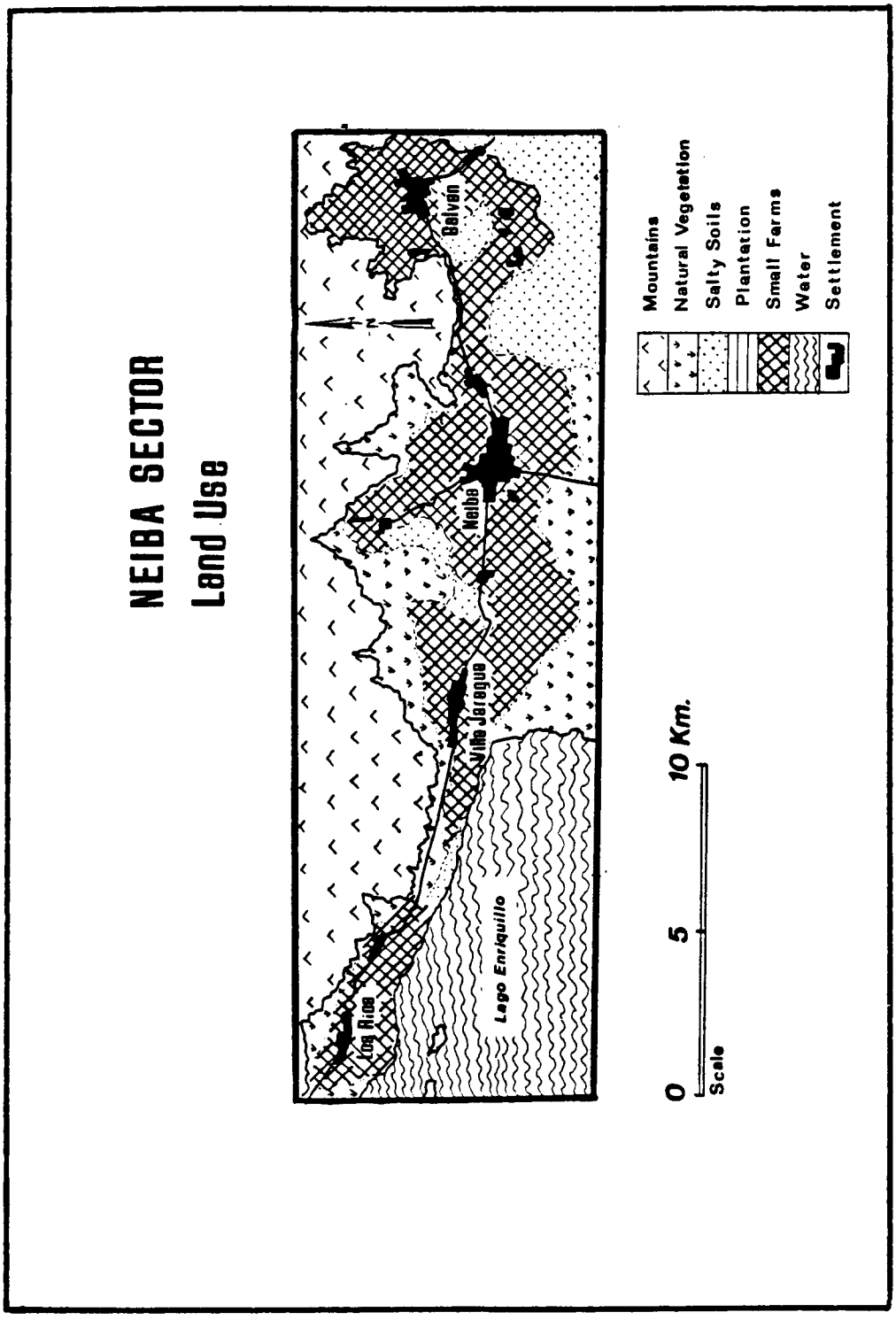

NEIBA SECTOR
Land Use
Baiyen
Neiba
Villa Jaragua
Lago Enriquillo
Los Rios
N
Mountains
Natural Vegetation
Salty Soils
Plantation
Small Farms
Water
Settlement
0
5
10 Km.
Scale

Figure 24

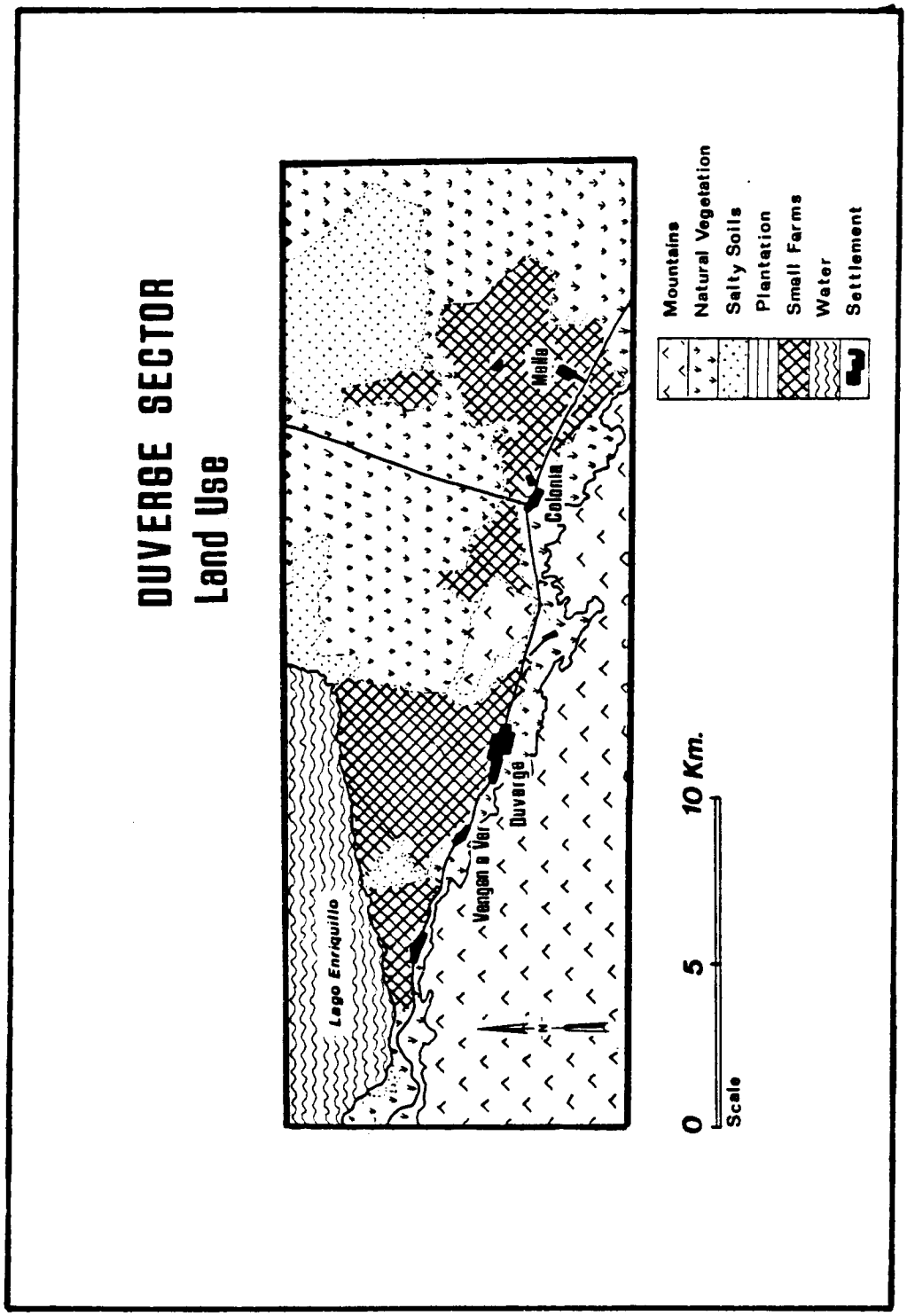

DUVERGE SECTOR
Land Use
Lago Enriquillo
Vengan a Ver
Duverge
Colonia
Mella
Mountains
Natural Vegetation
Salty Soils
Plantation
Small Farms
Water
Settlement
0
5
10 Km.
Scale

Figure 25

are poor, but water resources provided by the Río Las Damas make them arable.

5. Yaque del Sur (Fig. 26). The Yaque del Sur sector is exceptional for the quality of its soils. It is topographically a plain, with alluvial deposits by the Yaque del Sur River, and has an abundance of water. Transport and communication also are much better than in other sectors. The main settlements are Tamayo and Vicente Noble, in the middle of the agricultural zone. Cabral, south of the Laguna del Rincón, is another local center, but with less potential. At least thirty other small settlements are dispersed throughout the plain. This sector possesses the most promising conditions for future development, but until recently the same low level of living has prevailed here as in the other sectors of the Depression.

It is the viability of these sectors for the support of small-farmer communities that is the main focus of this research.

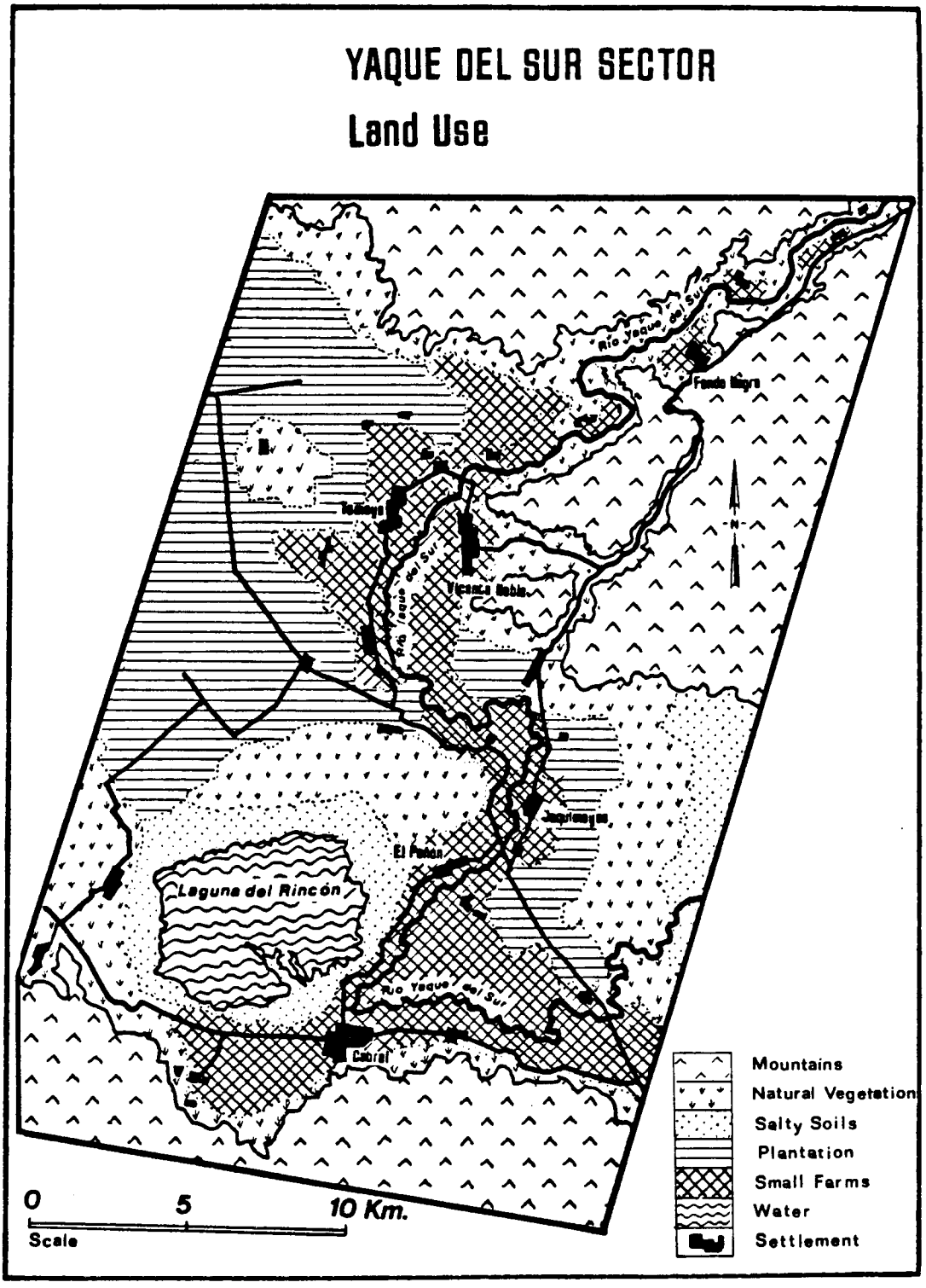

YAQUE DEL SUR SECTOR
Land Use
Río Yaque del Sur
Fondo Negro
Yerba Buena
Jaquimeyes
El Pinar
Laguna del Rincón
Río Yaque del Sur
Cabral
N
0
5
10 Km.
Scale
Mountains
Natural Vegetation
Salty Soils
Plantation
Small Farms
Water
Settlement

Figure 26

CHAPTER V

VIABILITY FACTORS

In August 1982 the new President of the Dominican Republic, Salvador Jorge Blanco, in his inaugural speech, said: "We must go back to the countryside. In the countryside is the salvation of the Dominican Republic." In January 1983 the President for Life of Haiti, Jean-Claude Duvalier, addressed an important speech to personnel of the Haitian Département de l'Agriculture, des Ressources Naturelles et du Développement Rural urging them to go to the rural areas, to live there and to be more involved in agricultural development, because this is the only solution for the future of the country. Thus, almost at the same time, both governments on the island seemed to realize the importance of agricultural settlement for the development of their countries.

Presidential appeals for more rural concern and a return to the countryside raise an immediate question about the capacity of the land to support more population or new economic activities. Rural inhabitants of Haiti constitute 75 percent of the total population (Institut Haitien des Statistiques et d'Informatique, 1983), and in the Dominican Republic 48 percent of the total population is considered rural (Oficina Nacional de Estadística, 1982). This high degree of rurality is especially critical in the semiarid environment of the study area, where population densities are lower than the national figures but where there

are notable natural and spatial constraints on human settlement. An analysis of the viability and potential of this area to support new colonies, or new rural activities, is of special relevance and requires the use of modern geographical approaches.

Geographical Viability

The concept of viability has been used in rural analysis by McCown, Haaland and de Haan in a study of the interaction between cultivation and livestock production in semiarid Africa. For them, "absolute viability is that production threshold where costs are equal to returns" (McCown, et al., 1979). This economic approach, considered as a requirement for the maintenance of any specific rural practice, has been supplemented with concepts of political and ecological viability. According to these authors, the natural, economic and political environment, plus the "pool of technological skills, organizational principles and preferences held in common by a given group" form the basis for behavioral solutions to rural problems.

Similar concepts and factors are mentioned by Castillo (1976) in an analysis of the farmer and the food problem, by Chandler (1976) in his study of physical and biological potentials and constraints in meeting world food needs, by Burton (1976) in a study on overcoming constraints and realizing potentials in the physical and biological aspects of rural activities, and by Ensminger (1976) studying constraints on millions of small farmers in developing countries who risk changes in farming practices and family living patterns.

For a geographical approach to the concept of viability, these potentials and constraints must be measured and expressed to establish where constraints exist and where potentials can be expected. This spatial expression of viability must include sufficient explanation of why certain locations are more viable than others, and which constraints are more easily overcome. Hence, geographical viability must be defined within a multidimensional framework, constructed upon the natural and spatial conditions of a place, and refers to the suitability of that place to support a specific human activity. At the same time, levels of geographical viability may be defined according to potentials and constraints identified in relation to a minimum condition of development. For human settlement, supported by a specific economic activity, the identification of levels of viability requires the previous definition of a corresponding desired minimum standard of development.

Samset, in 1981, defined a minimum condition of development for small communities according to the appropriate development approach, and summarized it as follows:

1. Satisfaction of basic needs.
2. Reduced dependency.
3. Reduced economic, social and political inequalities.
4. Preservation of endogenous cultural patterns.
5. Preservation of the ecological balance.
6. Social identity of individuals.

These conditions have been related to the geographical characteristics of the Enriquillo-Cul de Sac Depression and to the recommendations of general studies on agricultural development in semiarid areas (Naciones Unidas, 1977a, 1977b; Hall, et al., 1979). Special attention has been given to the basic requirements of small-farm agriculture in developing countries mentioned in international meetings (International Conference of Agricultural Economists, 1979), or by specialists in the subject (Castillo, 1976; Chandler, 1976; Ensminger, 1976).

For small-farmer communities in the study area, a minimum desirable level of development may be defined, consisting basically of the following three conditions:

1. Agriculture must produce a surplus of family income sufficient to improve present living conditions.
2. The quality of services provided in rural settlements must assure an acceptable level of satisfaction for some social indicators, such as health, education, recreation and social organization.
3. The physical characteristics of the rural habitat must assure sufficient protection for the families and their possessions and provide adequate space to perform social and economic activities.

As these conditions are defined to improve present characteristics of small communities and assure better standards of living for future generations, it is necessary to supplement them with two other

requirements. First, it is essential to consider preservation of the ecological balance within the area, and second, the system of goals and values in these communities must coincide with the real possibilities of proper development and assure that the farmers will remain in the area and permanently improve their living conditions.

The Model

To define factors that may affect small-farmer viability in the study area, a model has been constructed as an heuristic tool useful in determining methodological steps for this study. Nevertheless, a previous definition to be considered for the design of the model is the subject for which viability is to be measured. For this purpose the subject has been generally defined as "small-farmer communities within the Enriquillo-Cul de Sac Depression," but the term must be more clearly specified. The following assumptions have been established to define these communities:

1. They are constituted by farmers, and their main economic activity is agriculture.
2. Families in each community are relatively poor because they cultivate small plots of land. According to Dominican standards, between 8 and 80 tareas, from 0.5 to 5.0 hectares per family, is considered the typical landholding for a small farmer.
3. Social organization is community oriented, with strong interrelationships between families and individuals.

4. Agriculture is conducted at low technological levels.
5. A predominance of family labor prevails, without any system of salaries within families.
6. Economic activities are only partially market-oriented, with a large part of the production consumed within the family or bartered within the community.
7. These communities are in need of development. They require economic surplus for savings and to improve present living conditions.

These assumptions have been defined according to the basic characteristics of the small farmers in the Enriquillo-Cul de Sac Depression, but are considered general enough to construct a model useful for other communities in similar environments.

The assumptions for these communities relate to the semiarid environment of the study area. Natural potentials and constraints, costs for the development of economic activities, and an acceptable quality level in human settlements are basic considerations to be added to these assumptions.

Natural factors, such as topography, climate, soil, or water availability, are essential in this concept. Spatial arrangements of population, trends in demographic growth and population movements, settlement quality, and networks of transportation and communication constitute another basic group of geographical factors related to viability. This spatial framework also includes local influence of

some other factors that are not essentially geographic, but that interact strongly in the spatial system that constitutes a place.

According to these characteristics and the opinion of authorities and specialists interviewed during the research, the factors that influence potentials and constraints of an area to support any specific human activity have been classified into four groups:

1. Ecogeographical,
2. Economic,
3. Socio-Anthropological,
4. Legal.

These constitute the basic dimensions of analysis in the model.

This model which presents factors of viability used for the analysis of small-farmer communities in the study area is the result of assumptions already defined and the relationships between factors selected as most relevant. The model has been designed to define the main group of factors which must be considered in a geographical analysis (Fig. 27), but also presents the primary interactions in the rural system under study.

To measure the influence of each factor that affects geographical viability, it is necessary to differentiate between three types:

1. Factors with spatial expression. These are basic to a definition of areas with natural and spatial potential and constraints for the settlement of small farmers.
2. Factors with economic expression. These are non-spatial, but their characteristics may be applied to areas already

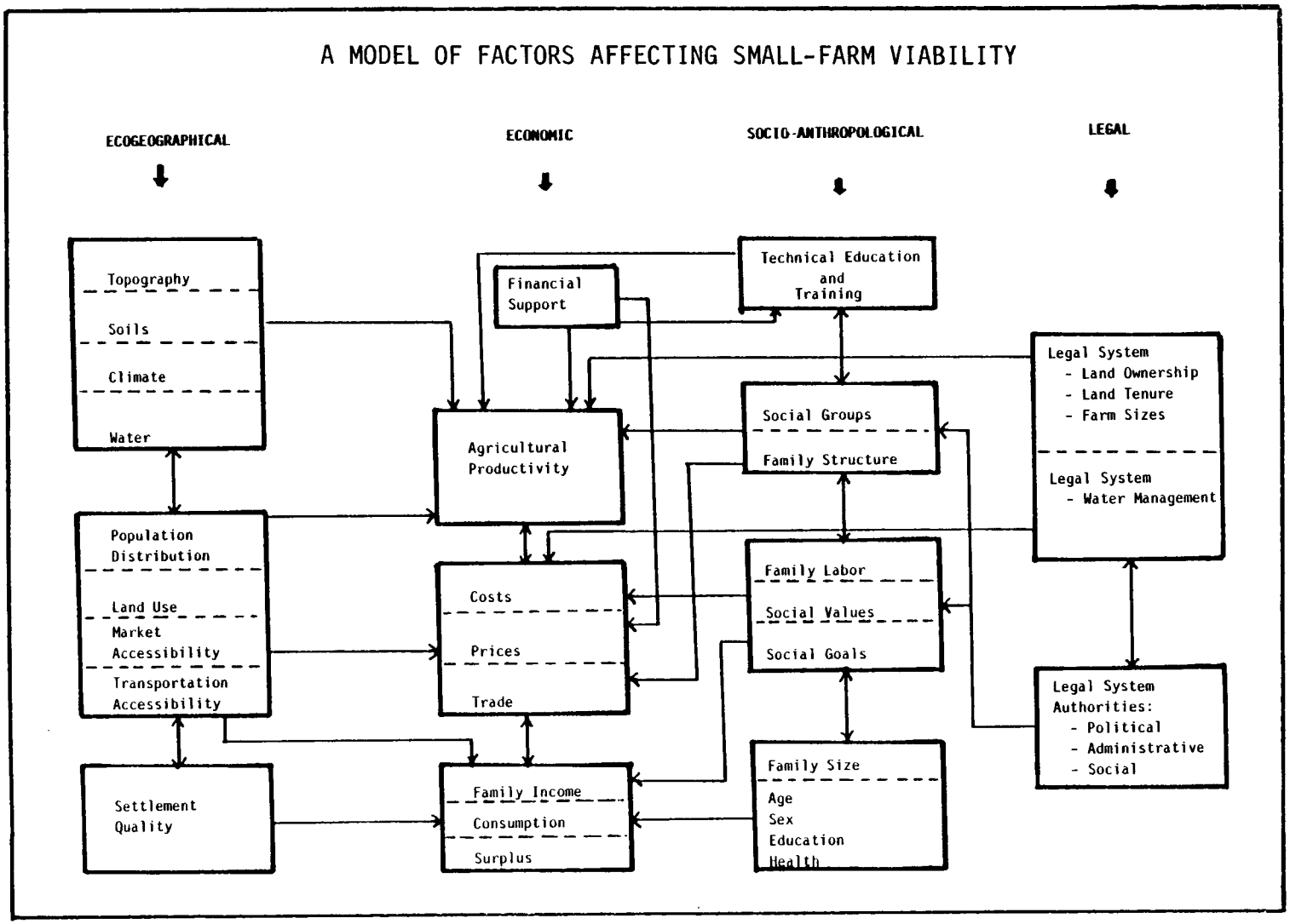

A MODEL OF FACTORS AFFECTING SMALL-FARM VIABILITY
ECOGEOGRAPHICAL
ECONOMIC
SOCIO-ANTHROPOLOGICAL
LEGAL
Topography
Soils
Climate
Water
Financial Support
Technical Education and Training
Agricultural Productivity
Social Groups
Family Structure
Legal System
- Land Ownership
- Land Tenure
- Farm Sizes
Legal System
- Water Management
Population Distribution
Land Use
Market Accessibility
Transportation Accessibility
Costs
Prices
Trade
Family Labor
Social Values
Social Goals
Legal System Authorities:
- Political
- Administrative
- Social
Settlement Quality
Family Income
Consumption
Surplus
Family Size
Age
Sex
Education
Health

Figure 27

defined and provide an important new dimension for the spatial analysis of viability.

3. Subjective factors. These are difficult to measure, but their influence may be decisive for the adoption of new techniques or for the process of development in general. They may be assigned to certain locations in relation to cultural patterns of the inhabitants. These factors are defined in the model as socio-anthropological and legal.

These three types of factors correspond to different methodological approaches that must be used in the final evaluation of geographical viability.

Threshold Analysis

The method for measurement of potentials and constraints in the study area in relation to factors that affect viability is based on threshold analysis, a technique originated and pioneered by Professor Boleslaw Malisz in 1963, and developed in Scotland in 1965 by J. Kozlowski when cooperating in the Grangemouth-Falkirk Regional Survey (United Nations, 1977). Threshold analysis has been used mostly in studies for urban planning, and the technique has a good reputation in that field. However, it can be useful also in regional analysis, as shown by research on fishing potential in Ireland and tourist development in the South Adriatic region of Yugoslavia (Kozlowski, Hughes and Brown, 1972).

Threshold analysis is basically a location-oriented technique that introduces some economic considerations into the physical planning approach. For a study of geographical viability it seems quite appropriate, because the problem is also location-oriented, and there are some economic considerations involved. However, the model of viability also includes juridical, social and political considerations that cannot be analyzed with this technique. A qualitative analysis has been adopted for these social dimensions.

The concept of thresholds as discontinuity points in the range of potentials and constraints in a region permits a differentiation of areas with similar characteristics in relation to specific activities. To obtain this result, it is essential to define the main factors that influence the process under study, a threshold within each of them, or other types of measurement useful for the analysis.

The different levels of constraint for each factor and their respective costs to be overcome are represented in a grid system and are totaled to define areas with similar conditions of potentials and constraints and similar levels of development cost.

For the area under study, a grid with cells of one square kilometer has been used, and the levels of viability within each factor have been reduced to three: high, medium and low, according to conventional thresholds defined after consultation with authorities and specialists interviewed during the research.

At the same time, the predominantly economic approach of the method has been replaced by the concept of potential support for

agriculture, so the final result of the sum of factors represents areal levels of viability for agriculture that, complemented with the dimensions of economic, social and legal factors, express the potential to support small-farm activities. The basis of the method is quantitative, but the main analysis and interpretation of factors and the final result are mostly qualitative.

The method could be used with a more quantitative approach, and with specific references to economic costs for development, if the case under study related to a well-defined project to be implemented in the area. For a general definition of viability of small-farmer communities in the entire Enriquillo-Cul de Sac Depression, however, a qualitative analysis seems more appropriate.

Ecological Factors

Ecological or natural factors for geographical viability involve conditions of land form, soil, climate and water availability. From a land-form perspective, the two main factors that affect agriculture are elevation and slope. For the Enriquillo-Cul de Sac Depression, differences in elevation are not significant, hence slope is the main consideration. Thresholds of slope for agriculture can be established at 10° and 20°. Areas with less than 10° are already irrigated or considered to have high potential to be irrigated according to specialists of the Secretaría de Agricultura.

The physical properties of soils, including texture and structure, are essential to a definition of agricultural potential and to determine the type of soil management most suitable to a given area. However, chemical properties, such as salinity, pH, organic matter, nutrients and fertilizers, are critical to the selection of crops and the best cropping system. For the definition of soil thresholds within the study area complete reports on the Dominican side have been prepared by the Sistema de Evaluación de Recursos Agrícolas (SIEDRA), a program supported by the Dominican Secretariat of Agriculture and Michigan State University. Soil properties have been carefully mapped and described in relation to various levels of constraints for agricultural development. In Haiti, a report by Tippets, Abbett, McCarthy and Stratton (1956) and recent reports from the Laboratory of Soil Chemistry facilitated the design of areal thresholds of soil quality. Stoniness, salinity, drainage and dryness were the main factors to be considered in defining high, medium and low levels of soil viability on the Haitian side.

Climate in the study area is semiarid, with low rainfall and high evaporation, but conditions are not uniform throughout the plain. Water balance is the principal climatic factor to be considered, and climatic thresholds correspond mainly to isohyets, since evaporation is generally high throughout the plain. Areas with high, medium or low rainfall have been mapped as levels of viability for this analysis.

Water availability is the fourth natural factor to be considered in the model. Surface runoff and groundwater resources are important

hydrologic factors, but thresholds of water availability are better defined in relation to present conditions of irrigation. Thresholds have been defined to distinguish areas irrigated, areas irrigated with constraints, areas in need of irrigation works (canals, wells or special works) and areas without feasibility for irrigation.

The sum of these natural thresholds separates numerous different areas with varied levels of natural viability. To simplify the analysis, these levels have been transformed into three categories: areas with high, medium or low level of natural viability to support agriculture and settlement.

Spatial Factors

Population is distributed through space according to historical processes, economic activities and other natural and social factors. Present distribution of absolute and relative densities is an important consideration in establishing the types of services needed for a region. Spatial distribution, and its dynamic expression, growth, and migrational movements, are basic factors to be considered in the model of viability. However, population thresholds have been defined according to absolute densities at the levels of 5, 50, and 250 inhabitants per square kilometer. It is assumed that areas with higher densities correspond to higher levels of viability. Dynamic characteristics of population were considered as social or anthropological factors.

Types of land use constitute a particular economic system with spatial expression. Differences in land use correspond to differences in resource accessibility. They represent relationships between natural potential or constraints and human activities through space. Types of land use can be considered as spatial levels themselves. By detailed analysis with photointerpretation, prepared by the author, areas with low, medium and high levels of land-use viability were differentiated.

Areas with less than one kilometer, from one to three, and from three to five kilometers from the local markets are also defined as spatial levels. Due to the lack of a secondary road network, only areas less than one kilometer from a main road are considered to have good transportation viability.

The system of human settlement, including size, activities, services and structure is considered fundamental to define quality-of-life levels within the study area. However, its analysis was made mostly qualitatively, without a sharp definition of viability thresholds.

Economic Factors

Economic viability was defined earlier as a basic element in the concept of geographical viability. Applied in the case of small-farmer communities, economic viability corresponds to the capacity of agriculture to produce surplus family income. This surplus could be saved and become the basis for improved services and living conditions for rural communities.

Agricultural productivity, costs, prices, trade, family consumption and financial support are economic factors that must be considered in the model, but their thresholds are not as significant in the spatial dimension as they are in an economic sense. Hence, economic analyses with levels of productivity, levels of cost, prices, trade and consumption are included in the model of geographical viability, but in a non-spatial dimension.

For each sector of small-farmer communities economic productivity has been studied and measured according to official data and information gathered through interviews. Hence, the areal thresholds defined by natural and spatial characteristics in each sector have acquired a new economic dimension. The combination of both dimensions, and their respective levels, permits the definition of areas more suitable for investment and indicates the general costs involved in overcoming the constraints. Because this process may generate a large number of different cost levels, only the most relevant levels should be selected for specific projects. The economic analysis of productivity conducted in this study was based on present land use.

Social and Anthropological Characteristics

Four categories of analysis have been defined within the socio-anthropological dimension of the model of viability: demographic, social, moral and technical. Demography provides data on family size, age, sex, education and health, which are the main social factors in the model. It is difficult to express the relative influence of each

factor in a quantitative way. Hence, qualitative considerations are required to establish their individual relevance.

Social groups and authorities, family structure, family authority and family labor are the main social factors included in the model. These are closely related to moral factors: social values and social goals. Together, they represent important subjective conditions that have been disregarded in most analyses related to development, although the influence of these factors on the outcome of any program cannot be dismissed. Peasant attitudes are normally defined in these terms: a system of social values and goals, rural and family oriented, without much concern for markets or modern sophisticated techniques. Development in such peasant communities requires cultural change that may constitute a major obstacle for the implementation of economic or social policies.

Finally, technical factors are related to educational levels, training in modern methods, and social skills with which to overcome rural constraints. These factors can be identified with specific practices in agriculture, such as pruning, fertilization or crop selection, and skills in cost analysis, marketing or financial management.

This group of social and anthropological factors has special relevance on both sides of the Haitian-Dominican border and was found to be a general constraint for development in the area under study.

Legal Conditions

A final group of factors included in the model are political and juridicial characteristics that may affect processes of development in rural settlement. Land ownership, land tenure, water management, the political system and administrative authorities are the main factors in this dimension.

Land tenure and water management are specially relevant in the Enriquillo-Cul de Sac Depression. Land ownership is difficult to define because there are few accurate cadastral records for the area. The small size of plots and lack of official titles to property create financial constraints on agricultural activity. At the same time, water management is generally controlled by administrative authorities in the capital of each country. This results in the neglect of local problems and interferes with a proper utilization of water resources.

CHAPTER VI

VIABILITY IN THE STUDY AREA

In this research, priority has been assigned to the spatial expression of viability. This decision was adopted to determine the real influence of natural and spatial factors for the settlement of small-farmer communities in an arid environment. These dimensions of analysis give prior attention to ecological preservation because an arid environment is a particularly fragile milieu, and because the ecosystem must be able to support rural settlements without any process of deterioration which could affect future generations. But ecological preservation cannot be the only geographical concern in this case. Natural dimensions also determine areas with special conditions of vulnerability, such as soils, climate or vegetation. These important natural constraints may influence the prospect of an economic surplus in agricultural activities.

Agricultural productivity also depends on spatial factors. The relationship between the costs-prices-trade system and the income-consumption-surplus system, for example, may depend upon the spatial characteristics of population distribution, land-use, accessibility to markets and transportation, or settlement quality. Hence, geographic and economic conditions are strongly interrelated and influence achievement of the first condition for rural development in the area: a family income surplus.

According to a thorough study prepared by the Banco Central de la República Dominicana in 1977, and updated by the Oficina Nacional de Planificación (ONAPLAN, 1982b), family levels of income per month have been classified into seven groups: from 50 to 100 Dominican pesos, from 101 to 200, from 201 to 300, from 301 to 400, from 401 to 600, from 601 to 800, and more than 800. These studies show that levels of expenses in rural areas were higher than income for the first group, were similar to income for the second, and were lower than income for the remainder. However, expenses considered were the actual expenses of families in each group, excluding any consideration of desired levels of satisfaction for basic needs. Complementary studies by ONAPLAN consider a level of 200 Dominican pesos of monthly family income as the minimum for acceptable satisfaction of basic needs. This represents an income of about US$1500 per year for an average family of seven persons. These economic studies, and the level of 200 Dominican pesos, have been considered as basic references concerning the question of viability in the Dominican portion of the study area.

For the Haitian rural family there are no similar studies, but useful references have been found in some economic analyses of viability for rural development in the Artibonite Valley (Durán, 1981), and in reports on rural productivity in the Bas-Boen area of the Cul de Sac, near Ganthier (Projét Integré de Bas-Boen, 1972; Gislason, 1978) (Fig. 28). In the Artibonite study, information collected during the second stage of the program shows that the minimum budget for a rural family of five persons was approximately US$300 per year. References to

HAITI

BAS BOEN AREA
Small Farms



Source: Aerial Photography, 1957.

Figure 28

previous studies by González and Viaud (1978), Maxime et Cernuda (1979), and the Haitian Secretairerie d'État du Plan (1980) verify the validity of Table 5, prepared in 1973 by the Institut Haitien des Statistiques et d'Informatique. Considering these figures and the savings necessary to improve present living conditions, Durán established a minimum of US$350 as a desirable annual income per rural family in the Artibonite Valley.

Rural conditions in the Cul de Sac area are little different from those elsewhere in the country. In the Bas-Boen Project, annual family income before the program was initiated, in 1973, was estimated between US$80 and 100. In 1974 the average income per farmer was estimated at US$600. In 1978, using rural monitors, average per family income was calculated as between US$1300 and 1400 annually.

For this study, the figure of US$350 has been accepted as a minimum indicator of viability for rural development in Haiti, but US$1000 of annual income per rural family seems more appropriate as a goal for future development policies.

Geographical levels of potential and constraint must be defined according to these figures and the thresholds of costs they represent. Agricultural productivity may be affected by constraints of slope, soils or water availability. Costs of production may be affected by the system of labor, technology and distance to markets. Rural income and consumption may be affected by farm size, family size, services provided, social needs and financial assistance. As a result, surplus income can only be assured if the productivity-costs-income-consumption

Table 5

HAITI: AVERAGE RURAL INCOME, 1973

Income Level	Average Annual Income per Family (US $)	Total Families	Percent
Low	45	615,653	82
Medium	300	103,154	14
High	1000	31,087	4
Total		749,894	100

Source: Institut Haitien des Statistiques et d'Informatique.

relationship is correlated positively with the geographical characteristics of an area.

A second indicator to define conditions of viability is the quality of social services provided in rural settlements. According to standards defined by F.A.O. (1949) and UNESCO (Chiva, 1959), the services can be summarized in four categories: health, education, recreation and social security. In the Enriquillo-Cul de Sac Depression these categories are represented as services provided by the central governments without charge to the farmers. There are no private institutions of health or education, except for a few in some Haitian villages. Recreation is represented only by sports, a few movie theaters, places for drinking and dancing, and some sites for swimming in the lakes or natural springs. Levels for this indicator can be defined according to the existence of each service, the quality of services provided, and the accessibility of rural settlements to the service location. In the study area, the levels for this indicator are extremely low. Information collected by ONAPLAN (1981a) in a detailed study of social indicators for the Dominican Republic, and results of the interviews conducted by the author, demonstrate that the study area has the lowest levels of social services, and they constitute a substantial constraint. The analysis of viability by sectors assumes that this indicator represents a constraint that should be overcome as soon as possible.

The third indicator of viability has been defined as the physical characteristics of the rural habitat. According to the international

standards previously mentioned, housing, infrastructure and accessibility are the basic categories to be analyzed. These are typically spatial indicators. The distribution of dwellings, their structure, materials and elements, and their size and functions are basic information for this study. Data were obtained from the official censuses of both countries, but required supplementation by personal interviews and field analysis. In general, conditions of housing within the study area are highly inadequate. Hence, specific characteristics and levels are considered in the respective analysis of each sector.

Infrastructure relates mainly to the provision of water, energy, sanitation and some public buildings for community use. The levels of these services, like those of the social services, are defined according to the existence of each service, the quality of services provided and accessibility of rural settlements to the service. Accessibility includes conditions of transportation and communication. Communication is relatively well-developed within the study area, but deficiencies in transportation remain in some rural districts. This affects accessibility to markets and, as a result, rural income in several communities is restricted.

The geographical analysis of viability for each of the five sectors selected in the study area has been prepared according to the method and indicators previously cited. First, is the definition of areas with different thresholds of natural constraint and ecological vulnerability; second, is the definition of areas with spatial thresholds in relation to conditions of population, land use, markets and

transportation. Third, is the definition of ecogeographical areas with different levels of viability to support rural settlements; fourth, is the analysis of economic dimensions of productivity, costs and income in relation to the levels of constraint in each area. Fifth, is a complementary analysis of socio-anthropological dimensions of each area to define precisely the viability of small-farmer communities in each place. The quality of social services provided in rural settlements and the physical characteristics of the rural habitat are closely related to the qualitative analyses of socio-anthropological dimensions of viability. In general, they are considered highly unsatisfactory in the study area. Hence, they are specifically mentioned only in cases where their conditions have special relevance for the development of farming communities.

Ganthier Sector

The Ganthier Sector (Fig. 29) covers the eastern part of the Haitian Cul de Sac and includes most small-farmer communities in the semiarid part of the plain. It has an area of 414 square kilometers, but approximately 100 square kilometers are water bodies, the Étang Saumâtre and Trou Cayman. The alluvial fan landscape of the plain is modified in this sector by an east-west range of Pleistocene deposits. Where Pleistocene hills have been only partially covered by fan sediments they extend above the general surface as prominent ridges or domes, especially noticeable because of the lack of cultivation due to the poor quality of their soil.

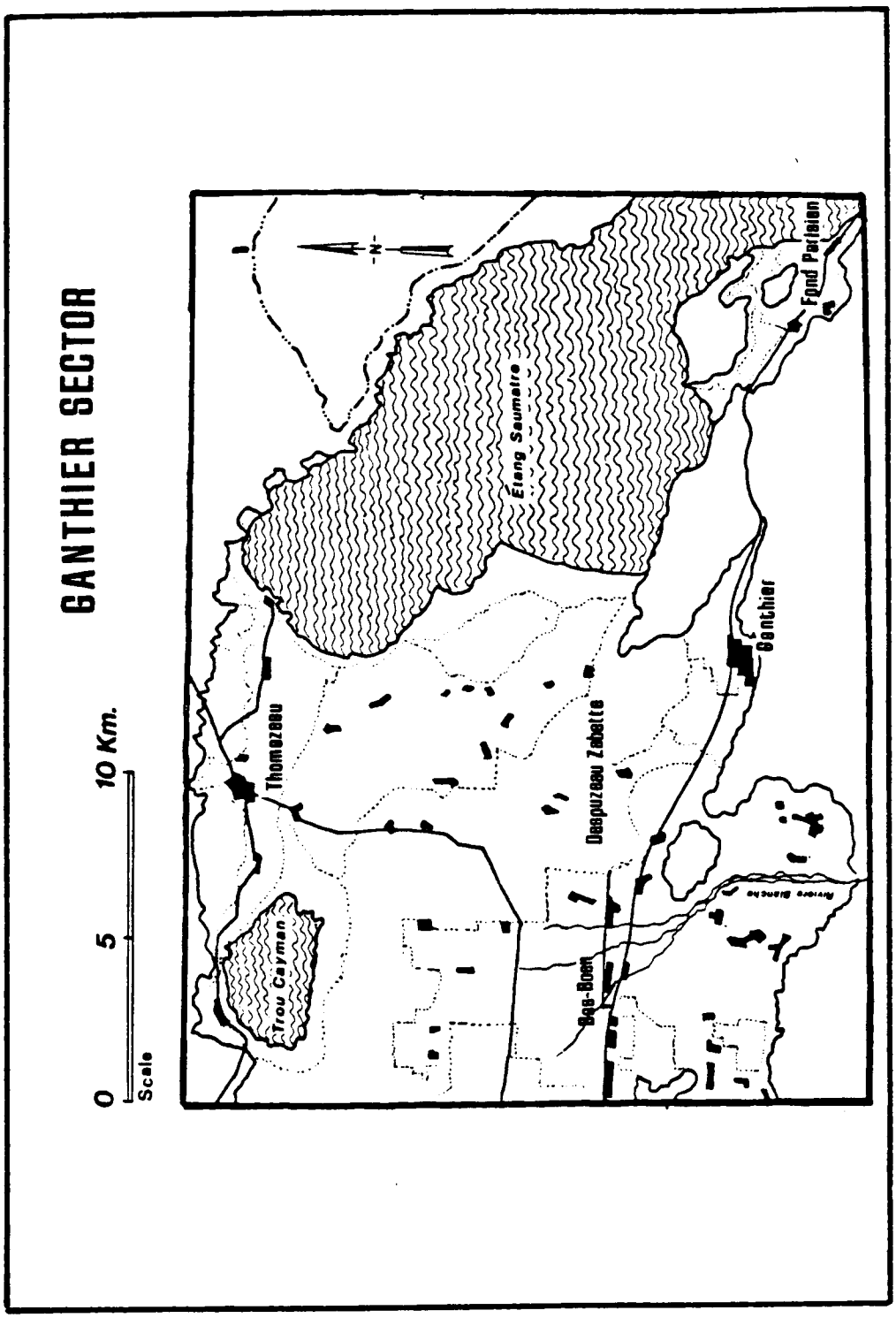

GANTHIER SECTOR
0
5
10 Km.
Scale
N
Thomazeau
Trou Cayman
Etang Saumatre
Desguzeau Zabette
Bas-Boen
Ganthier
Fond Parisien

Figure 29

The most significant land for agricultural development in this sector is near the Blanche River. It covers the southwestern part of the sector and has good alluvial soils. During low flows of this river, the water spreads out over the plain and seeps into the gravel before reaching the shallow fresh-water lake known as Trou Cayman. It is believed that some of this water reappears at the Despuzeau-Zabette group of springs, whose natural discharge is into Étang Saumâtre. The Trou Cayman is surrounded by a poorly drained area of high ground water, and its level and the degree of saturation of the surrounding area vary according to seasonal rainfall.

On the northern border of this sector of the plain, there are several alluvial fans upon which some agricultural activity is possible due to runoff from the Chaîne des Matheux, some natural springs, and better soil quality. Another small area useful for agriculture is Fond Parisien, at the southern end of the Étang Saumâtre, adjacent to the international border with the Dominican Republic. A large alluvial fan and surface and groundwater resources are positive factors in these rural communities.

Climate in the Ganthier sector is semiarid, the rainfall averaging 810 mm. per year. Potential evaporation is estimated at between 1500 and 2000 mm. There are two rainy seasons, peaks occurring in May and September. The driest months are December and January, with another dry period in June-July (Rahman, 1980). Table 6 shows the figures for rainfall at different places on the plain.

Table 6

RAINFALL IN THE HAITIAN CUL DE SAC (mm.)

Station	Years	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Ganthier	1896-1955	8	21	36	87	141	44	34	67	93	102	55	15	710
Fond Parisien	1949-1956	7	25	48	108	122	43	51	116	93	166	76	48	908
Despuzeau	1940-1964	10	23	30	78	129	57	48	95	99	155	56	21	807
Rivière Blanche	1928-1956	15	34	60	121	207	81	61	132	135	164	77	23	1115
Thomazeau	1905-1955	96	19	34	86	143	58	57	93	116	123	55	12	897
Croix-des-Bouquets	1923-1960	17	31	50	102	176	71	58	123	122	116	49	21	941

Source: Service Météorologique National d'Haiti.

In general, soil and water resources are the basic constraints for agricultural development in this sector. There are large areas of saline soils, and drainage is a problem in the middle part of the plain, bordering Trou Cayman. Water is necessary to compensate for high evaporation, but the Blanche River and scant runoff from the northern mountains are not sufficient. Rainfall is low, with frequent periods of drought. Groundwater is a potential solution, but would require larger expenditures for drilling and pumping than the peasants can afford.

Population densities are lower here than in other rural areas of Haiti. However, they are high in relation to the severe environmental constraints. A study prepared by the author, based on original data of the 1982 census, shows densities exceeding 1000 inhabitants per square kilometer in many habitations, the Haitian political divisions for rural areas. Land use in this sector is similar to that of many other rural areas of Haiti, with a predominance of sugarcane and corn as basic crops, but without advanced technology and with very low yields. Yields in this sector are one-third or one-fourth those typical of other Caribbean countries. Local markets, namely the small villages of Thomazeau (1914 inhabitants in 1982) and Ganthier (1387 inhabitants in 1982), are not important for regional trade. Port-au-Prince, only twenty kilometers away, influences most economic aspects of agriculture. Transportation is a basic constraint, because there is only one good road in the sector, the international road in the southern part of the plain. However, this constraint is only relative

because for decades women, the typical merchants in the country, have walked several miles to market their goods.

Under these spatial conditions, areal thresholds have been defined as shown in Figures 30, 31 and 32. The area with relatively higher natural and spatial viability corresponds to the plain irrigated by the Blanche River in the western part of the sector. Other areas with medium levels of viability are located on the northern border, near the alluvial fans, around Fond Parisien, and in the central plain adjacent to the Blanche River basin.

The economic dimensions of viability for areal thresholds may be defined using data collected for the Bas-Boen area, which provide the threshold with the highest spatial viability. A pilot project conducted there from 1968 to 1976 demonstrated that family income might be increased from an average of US$100 per year before the program was initiated, to US$1300 five years later, and that there was a potential to reach US$2500 with future assistance. These results were used by the Inter-American Development Bank to implement a larger program in the area, covering about 6000 families instead of the 100 families of the pilot project developed by O.A.S. and the governments of Israel and Haiti. The Final Report of I.A.D.B. presents all the analyses of productivity, costs, prices and benefits, and the social conditions to be improved for the rural communities within the project (BID-DARNDR, 1982). The higher viability of the Blanche River area is confirmed by the conclusions and recommendations of these reports.

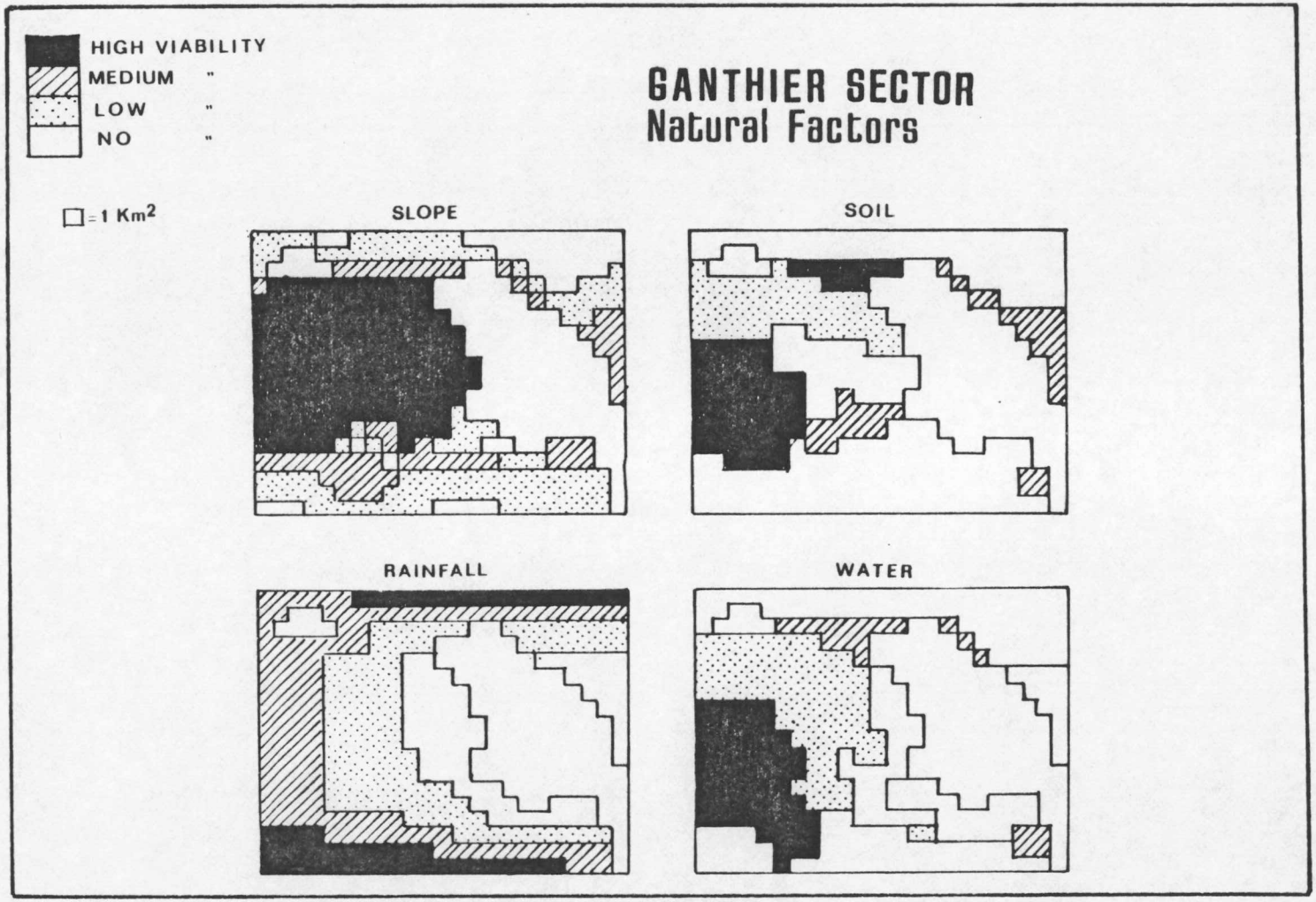

HIGH VIABILITY
MEDIUM "
LOW "
NO "
□ = 1 Km²
GANTHIER SECTOR
Natural Factors
SLOPE
SOIL
RAINFALL
WATER

Figure 30

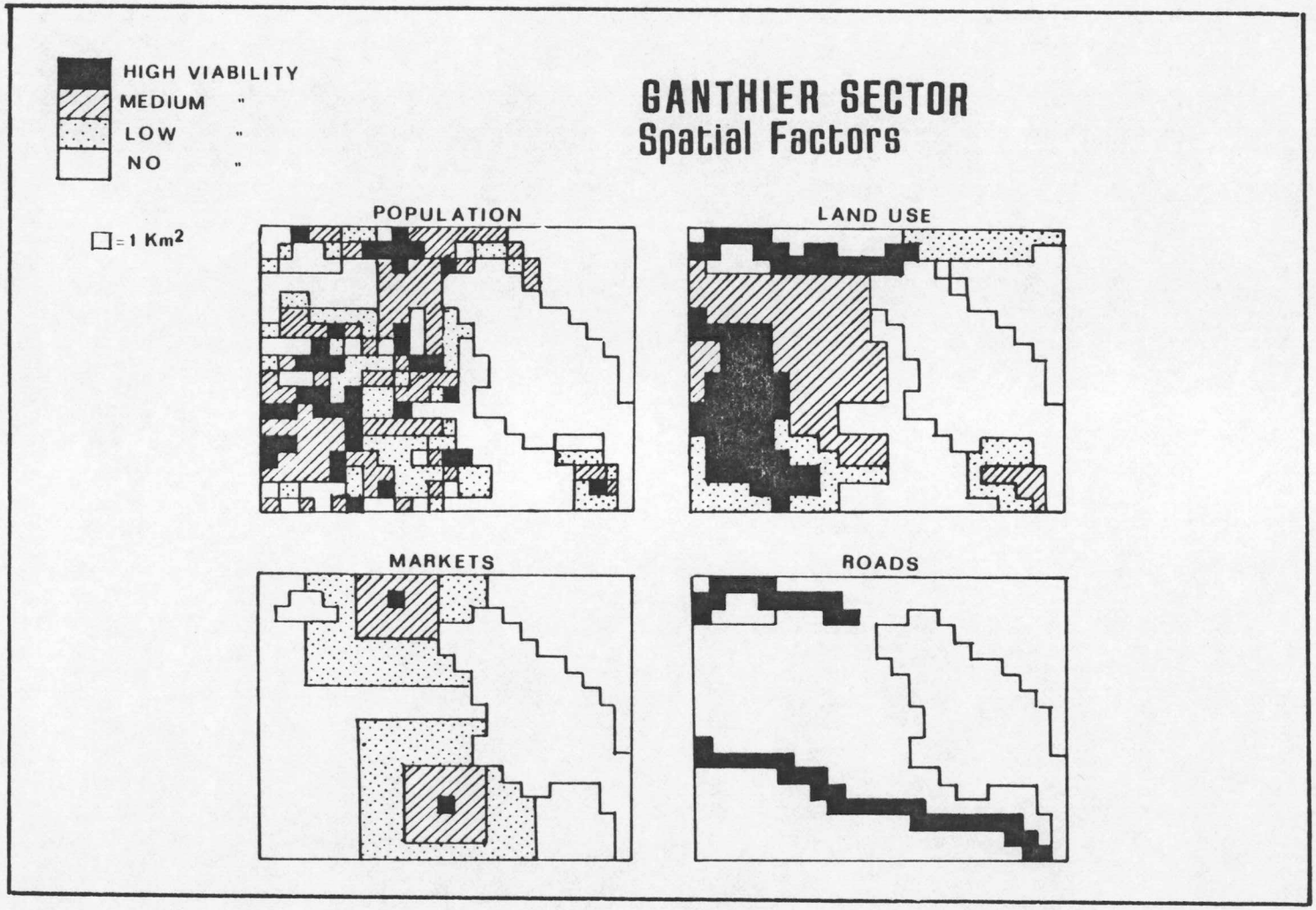

HIGH VIABILITY
MEDIUM "
LOW "
NO "
□ = 1 Km²
GANTHIER SECTOR
Spatial Factors
POPULATION
LAND USE
MARKETS
ROADS

Figure 31

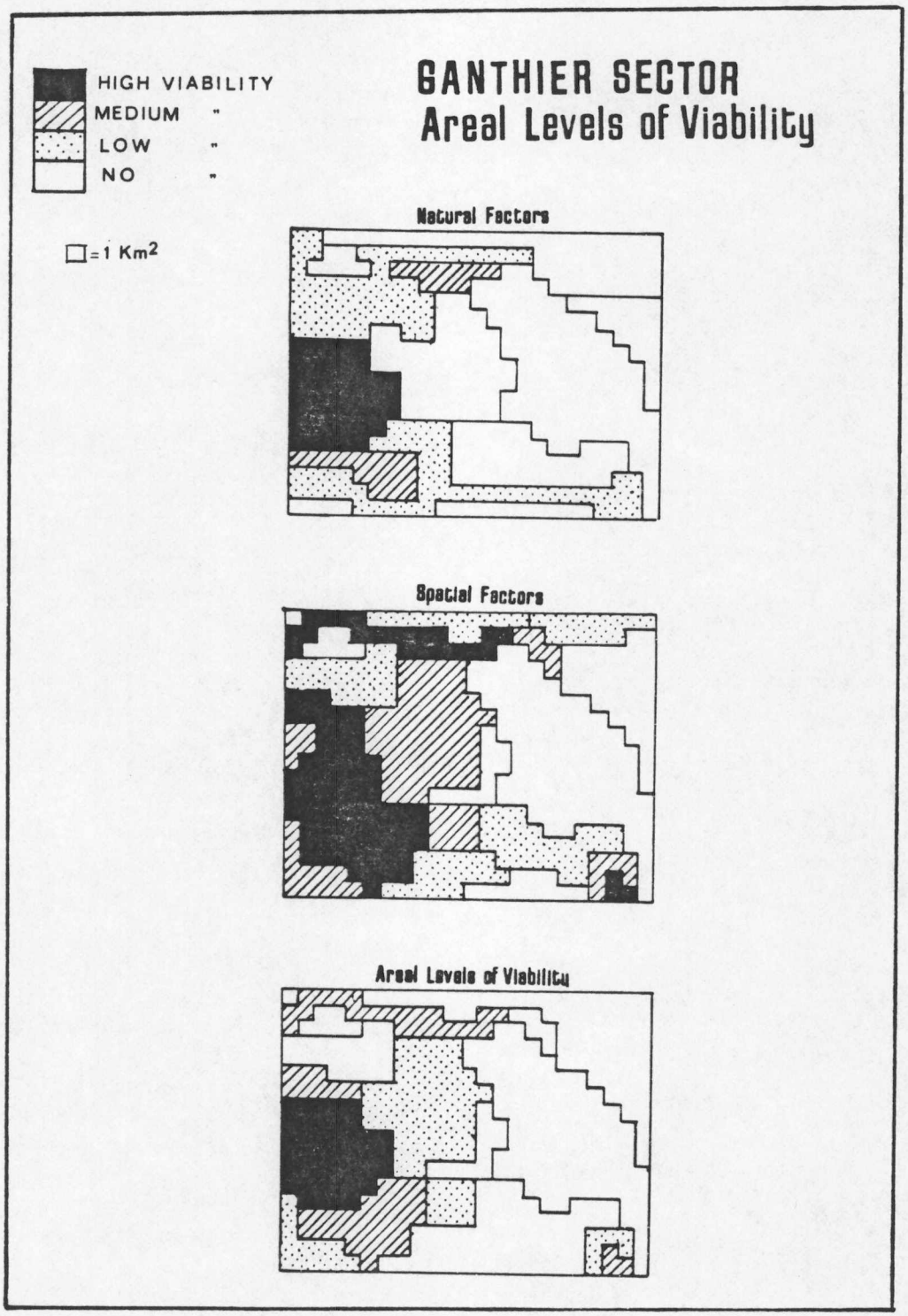

HIGH VIABILITY
MEDIUM "
LOW "
NO "
□=1 Km²
GANTHIER SECTOR
Areal Levels of Viability
Natural Factors
Spatial Factors
Areal Levels of Viability

Figure 32

For other parts of this sector, with medium or low spatial viability, the economic thresholds pertain mainly to costs of overcoming constraints related to agriculture. The medium viability areal threshold on the northern border of this sector has been well studied by Murray (1977) and Rahman (1980). According to them, the fringe of alluvial fans from Trou Cayman to Étang Saumâtre, better known as the Thomazeau area, has some potential in soils, but surface water resources must be supplemented by wells and natural springs. Better techniques to deal with soil salinity and drainage are necessary, as well as better technical support for agriculture in general. The cost of implementing these techniques is high and cannot be supported by the poor farmers of the area. The case of Fond Parisien is similar to that of Thomazeau. A large alluvial fan provides useful soils, but with constraints of slope and water availability. Natural hazards have destroyed good irrigation systems, and present rural communities are poor. The major positive factor in this area is the international road. Interviews by the author and a report of the Église des Rachetes d'Haiti (1983) confirm the medium level of viability of the area, with some important constraints to be overcome prior to any rural development.

The remainder of this sector, the areas of low viability, is land with numerous constraints. Basically, soils and slope constitute severe limitations. Only very specific rural activities can be supported by these ecosystems, and they demand costly investments. However, some rural communities are located in these areas and their only

expectation for development is in massive migration to better lands or through special programs for rural investment.

Major factors to be considered beyond spatial and economic thresholds in this sector are legal and social conditions. Land ownership and farm size present complex characteristics because of historical and political processes and the influence of voodoo on social and economic relationships within communities. Farm size is especially important. Murray (1977) prepared Table 7, which shows that only 5 percent of the individual plots have more than 0.5 carreaux, or 0.62 hectares. The author prepared Table 8, showing the average size of landholdings per rural habitation in a sample of approximately one-fourth of the entire sector. The landholdings usually are comprised of many plots. According to Murray, as shown in Table 9, more than 60 percent of all cultivators have five or more plots in their holdings. Beyond this perspective, the present study cannot produce detailed analyses of specific viability because they depend on the kind of project to be implemented and the specific thresholds of costs that must be overcome. The method provided in this study has the potential, however, to be specified and expressed more quantitatively according to the specific project under analysis.

In summary, only 13 percent of the Ganthier sector, or 41 square kilometers, has a high level of viability for small-farmer communities. An area of 58 square kilometers, or 18 percent of the total, has a medium level of viability. The remaining 69 percent,

Table 7

THOMAZEAU AREA: DISTRIBUTION BY SIZE OF PLOTS

Size (Has.)	Number	Percent
Less than 0.04	304	25
0.04 to 0.15	315	26
0.16 to 0.32	341	28
0.33 to 0.65	191	16
Over 0.65	74	5
Total	1225	100

1 Ha: 2.47 acres.

1 acre: 0.4047 Has.

Source: Murray, 1977, page 218, Table 5.8.

Table 8

FARM SIZE BY AGRICULTURAL LANDHOLDING: SAMPLE OF RURAL HABITATION IN EASTERN CUL DE SAC

Habitation	Total Area of Farms (Has.)	Number of Farms	Average Size (Has.)
Dutil Durand Terre Ronde	46	69	0.7
Chambrun	77	57	1.3
Dimulsseau	337	248	1.3
Bois Gorman	147	92	1.6
Source Salle Grande Place Leroy	44	37	1.2
Chapotin Savane Cabrit	124	60	2.1
Grand Acul Pain Ganot	434	217	2.0
Ganthier Pont Kenete Bois Gallette Terre Contree Balisaille Bois l'Autrebord	364	144	2.5
Boucandrice Grande Ravine	450	233	1.9
Total	2023	1157	1.7

Source: 1982 National Census of Haiti.

Table 9

THOMAZEAU AREA: PLOTS PER LANDHOLDING

Number of Plots in Cultivator's Holding	Number of Cultivators
1 plot	7
2 plots	12
3 "	26
4 "	36
5 "	38
6 "	47
7 to 11 plots	40
12 or more plots	17
Total	223

Source: Murray, 1977, page 210, Fig. 5.2.

omitting water bodies, has a low level of viability or no viability at all. The potential for economic surplus corresponds to these levels of viability, but conditions of social services and rural habitat are uniformly inadequate throughout the sector. Political and social factors are also extremely significant and must be considered in any program for rural development in Haiti.

Jimaní Sector

The Jimaní sector (Fig. 33) corresponds to the northwestern shore of Lake Enriquillo. Water covers most of the tectonic depression, and mountains reach the lakeshore in many places. Only a few narrow plains, mostly alluvial fans, have developed adjacent to the lake. La Descubierta, Postrer Río, and Boca de Cachón are the main settlements established on alluvial fans north of the lake. Hato Nuevo and Jimaní are rural settlements to the west. The latter was transformed into an important political center when Trujillo decided to develop the border areas, created the Province of Independencia, designated Jimaní as the new capital, and established many new services there. Unfortunately, after Trujillo's assassination the area received little public investment. Recently, the new President, Salvador Jorge Blanco, has expressed personal concern for the development of these border areas.

Natural constraints are important in this sector. Most of the area is mountainous, and even the few narrow plains present some degree of slope. Soils are dry and stony, and the climate is the most arid

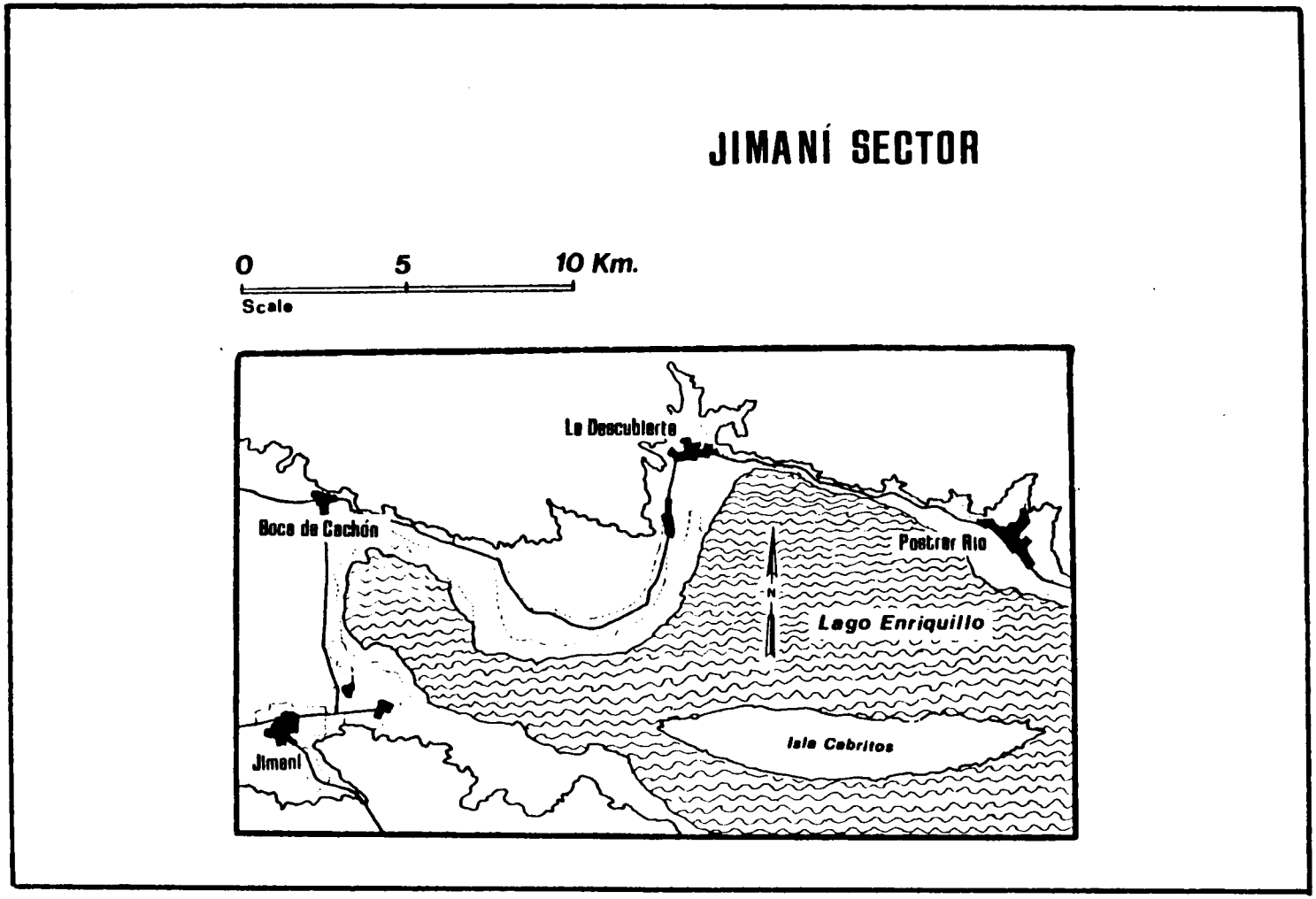

JIMANÍ SECTOR
0
5
10 Km.
Scale
La Descubierta
Boca de Cachón
Postrer Rio
N
Lago Enriquillo
Isla Cabritos
Jimaní

Figure 33

in the entire island. Water resources are scarce. A few natural springs could be used for irrigation, but the only present sources of water are some small rivers from the Sierra de Neiba. Postrer Río uses water from the Guayabal and Barrero Rivers; La Descubierta is supplied with water from the Yerba Buena and Las Barías Rivers; and Jimaní uses water from the Arroyo Blanco and Jimaní. According to information from the Instituto Nacional de Recursos Hidráulicos (INDRHI), these water resources are used to irrigate eight square kilometers near Postrer Río, fifteen square kilometers around La Descubierta, twenty-two square kilometers in the area known as Boca de Cachón, and fourteen square kilometers near Jimaní and Hato Nuevo.

Population distribution is closely related to natural conditions. The only important rural settlements are located in the areas now under irrigation. Postrer Río, with a population of 2279 in 1981, and La Descubierta, with a population of 3634 in the same year, are the two main urban centers on the northern margin of the lake and are developed on large alluvial fans with good agricultural soils. Jimaní, with 3327 inhabitants in 1981, is the administrative center, and there is some agriculture in the rural area known as Hato Nuevo. Jimaní has an important international role as the Dominican gateway to Haiti and its principal market, Port-au-Prince.

Land use is reduced to the small narrow plains, comprising only 18 percent of the total area of the sector. Small-farm agriculture covers approximately one-fourth of this 18 percent, while the remainder is in grassland or extensive agriculture. Commerce is

constrained in a major way, since only two small rural markets are in operation, La Descubierta and Jimaní, and local roads are in very poor condition. Transportation is difficult because there are no secondary roads and farmers must transport their products by horse or mule. Traffic is light because there are no local means of transportation. It is not unusual to wait several hours along the road to catch a ride.

Areal levels of viability, according to local characteristics of natural and spatial factors are presented in Figures 34, 35 and 36. Only eight square kilometers have a high measure of viability, twenty-three have a medium level, and forty-five have a low level of viability for small-farmer communities.

Economic dimensions within these areal levels may be analyzed in relation to the studies of productivity and costs prepared by the National Office of Planning and the Secretariat of Agriculture, as well as data collected by the author through sample interviews in the settlements of Postrer Río and La Descubierta (Table 10). Figures on productivity, costs and net income per tarea, a Dominican land unit equivalent to .06 hectares, are presented in Table 11. In relation to the three main crops cultivated in the sector of Jimaní, namely bananas, red beans and guandul, a kind of Dominican pea, net income in the irrigated areas varies from 27 to 58 Dominican pesos per tarea. Interviews demonstrated that the average size of property held by small farmers is 33 tareas near La Descubierta and 22 tareas near Postrer Río, with a general average for the sector of 26 tareas. This

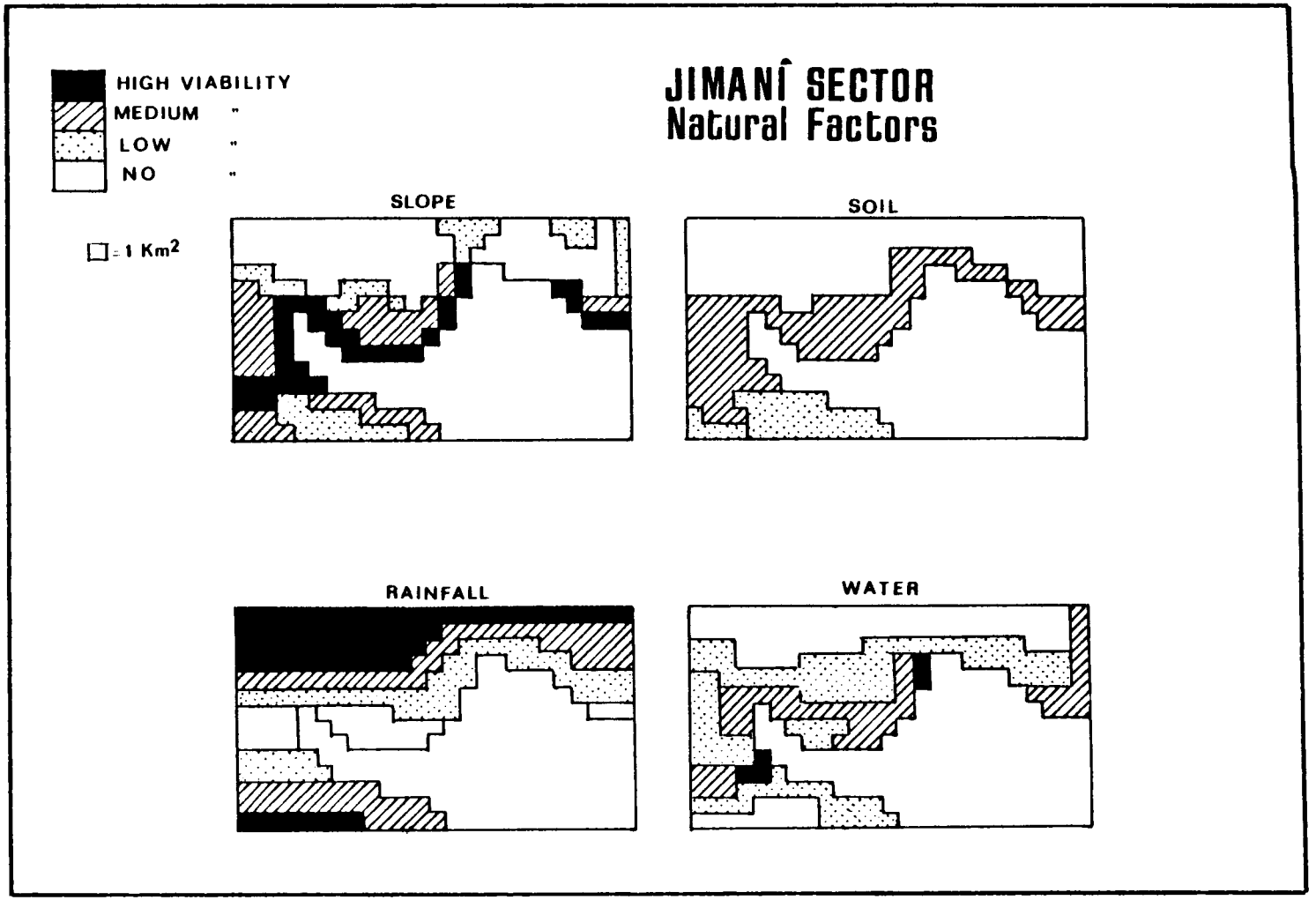

HIGH VIABILITY
MEDIUM "
LOW "
NO "
□ = 1 Km²
JIMANÎ SECTOR
Natural Factors
SLOPE
SOIL
RAINFALL
WATER

Figure 34

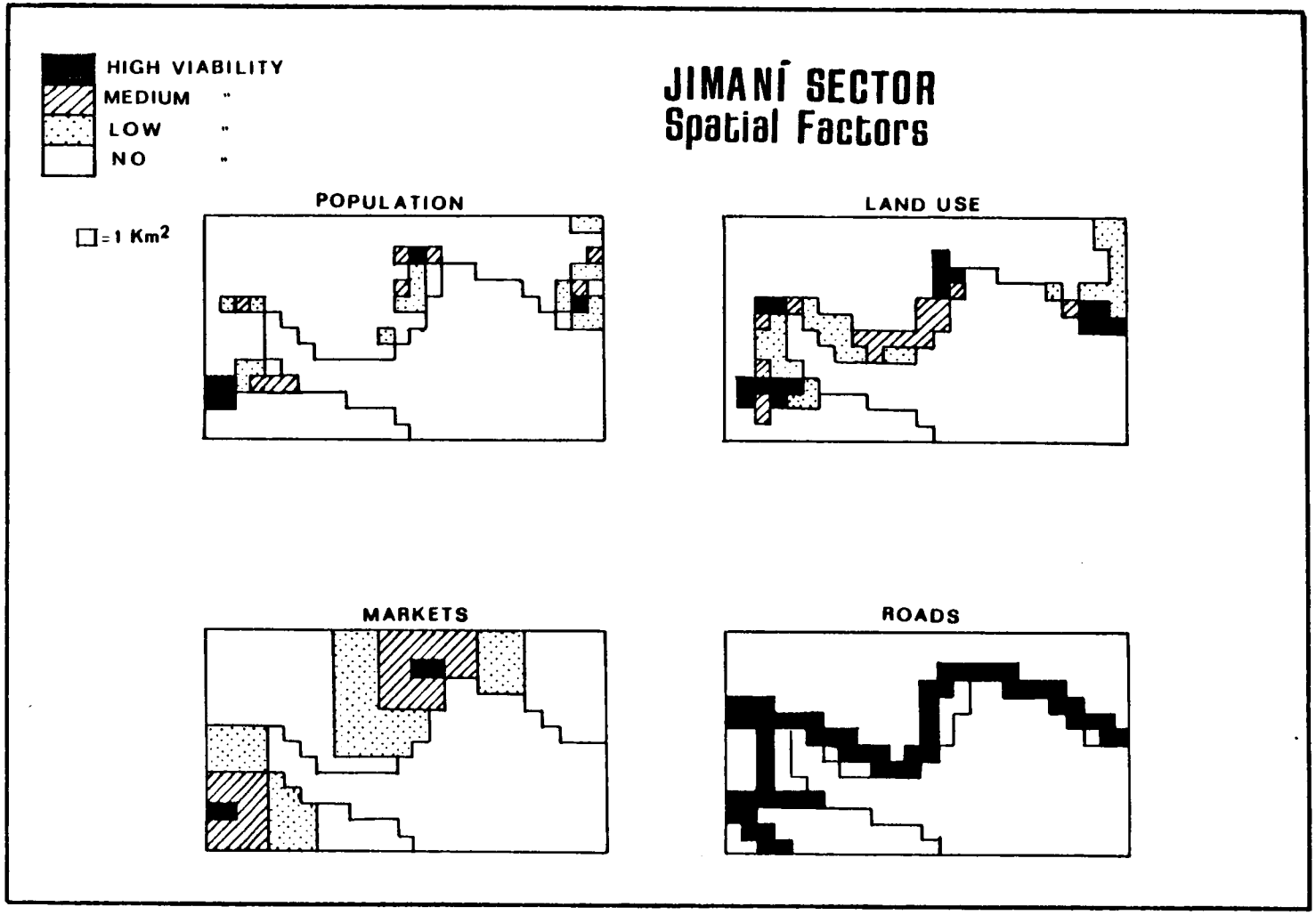

HIGH VIABILITY
MEDIUM "
LOW "
NO "
JIMANÍ SECTOR
Spatial Factors
POPULATION
□=1 Km²
LAND USE
MARKETS
ROADS

Figure 35

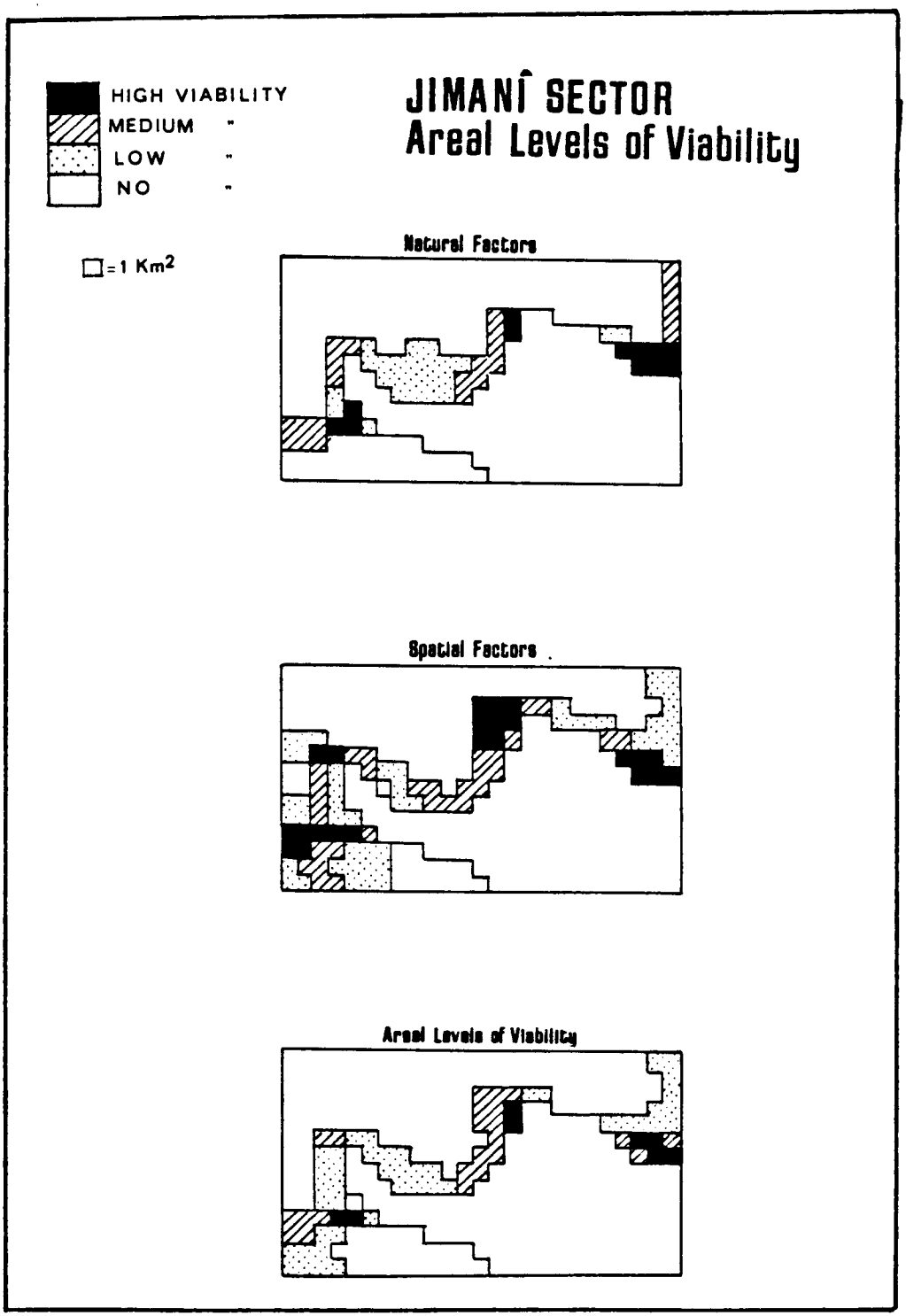

HIGH VIABILITY
MEDIUM "
LOW "
NO "
JIMANÎ SECTOR
Areal Levels of Viability
□=1 Km²
Natural Factors
Spatial Factors
Areal Levels of Viability

Figure 36

Table 10

DOMINICAN REPUBLIC: CHARACTERISTICS OF SAMPLE SITES

Site	La Descubierta	Postrer Río	Los Rios	Las Clavellinas	Villa Jaragua	Vengan A Ver	Duvergé	El Peñón	Jaquimeyes	Vincente Noble	Total
Families Interviewed:	60	70	65	55	94	85	97	97	93	100	816
Small Farmers in Sample:	57	63	54	55	89	34	39	42	48	39	520
Percent:	95	90	83	100	95	40	40	45	46	39	63
Farmers with less than 9 tareas:	0	3	0	0	0	20	4	12	11	18	68
Farmers with more than 80 tareas:	2	3	8	0	5	0	10	11	4	5	48
Families without land:	1	1	3	0	0	31	44	32	30	38	180
Members per family:	7.5	7.9	8.5	8.3	7.9	8	7.6	7.3	5.5	6.5	7.5
Population under 15 years (%):	31.5	42.6	31.4	35.4	34.5	49.1	32.6	40.1	35	38	37
Education Head of Family (years):	3.3	2.4	2.4	2.6	2.5	2.6	4.1	3	2.7	3.2	2.9
Size of House (m^2):	62	45	54	48	63	53	58	50	76	55	56
Size of Farm (Tareas):	33	23	30	27	39	25	33	27	33	34	30
Area Cultivated:	29	18	20	22	30	20	26	25	27	32	25
Percent:	86	80	68	79	76	80	78	92	81	94	80
Families considering Migration:	34	31	21	36	43	17	14	16	10	15	237
Percent:	60	50	39	65	48	50	36	38	20	38	45
Preferred Place to Migrate:	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD

SD: Santo Domingo.

1 tarea: 0.063 Ha.; 1 Ha: 15.9 tareas.

Source: Personal Interviews, 1982.

Table 11

ENRIQUILLO BASIN: RURAL PRODUCTIVITY, COSTS AND INCOME

Area	Product	Production per tarea	Price ($Dom)	Brut Income per tarea	Cost of Production per tarea	Net Income per tarea	Tareas per family	Income per Family
Jimaní	Bananas	2000	50/1000	100	41.38	58.62	27	1582
	Beans	1.5 qq	35/qq	52.50	25.37	27.13	27	732
	Guandul	3 qq	14/qq	42	13.60	28.40	27	766
Tamayo	Bananas	2500	50/1000	125	56.38	68.62	34	2333
	Beans	1.5/qq	36/qq	54	33.68	20.32	34	690
	Tomato	--	--	78	63.05	14.95	34	508
Vincente Noble	Bananas	2500	50/1000	125	58.41	66.59	34	2264
	Tomato (Industrial)	45 qq	2/qq	90	60.85	29.15	34	991
	Tomato (Salad)	40 qq	12/qq	480	135.73	344.27	34	11,704
Jaquimeyes	Bananas	2500	50/1000	125	53.56	71.44	33	2357
	Rice	3 qq	26/qq	78	45.71	32.29	33	1065
	Chili	12 qq	10/qq	120	43	77	33	2541

Source: Secretaría de Estado de Agricultura, 1982.

is equivalent to 1.75 hectares per family. Hence, income per family of small farmers varies from 732 to 1582 Dominican pesos a year. For non-irrigated areas, such figures are much lower. In areas of low or medium levels of viability, costs to overcome constraints affect net income and make difficult any program of development for small-farmer communities.

Other social factors, such as family size, farm size or age and education, also affect the economy. Interviews by the author in this sector demonstrated the importance of these factors for future development. Other indicators of viability, such as housing, services or legal and political conditions, were likewise recognized as constraints to be overcome to promote better living conditions in the rural settlements.

In general, this sector appears to have the poorest conditions of development, and the highest levels of constraint. Therefore, it also has the lowest relative viability within the study area. At the same time, rural settlements in this sector are urgently in need of public efforts to ameliorate current conditions of poverty and underdevelopment.

Neiba Sector

The Neiba sector (Fig. 37) is an area of large alluvial fans in the northern part of the Enriquillo Basin, in the Dominican Republic. It is characterized by two dominant features: first, the series of alluvial fans bordering the Sierra de Neiba; second, a dry and salty

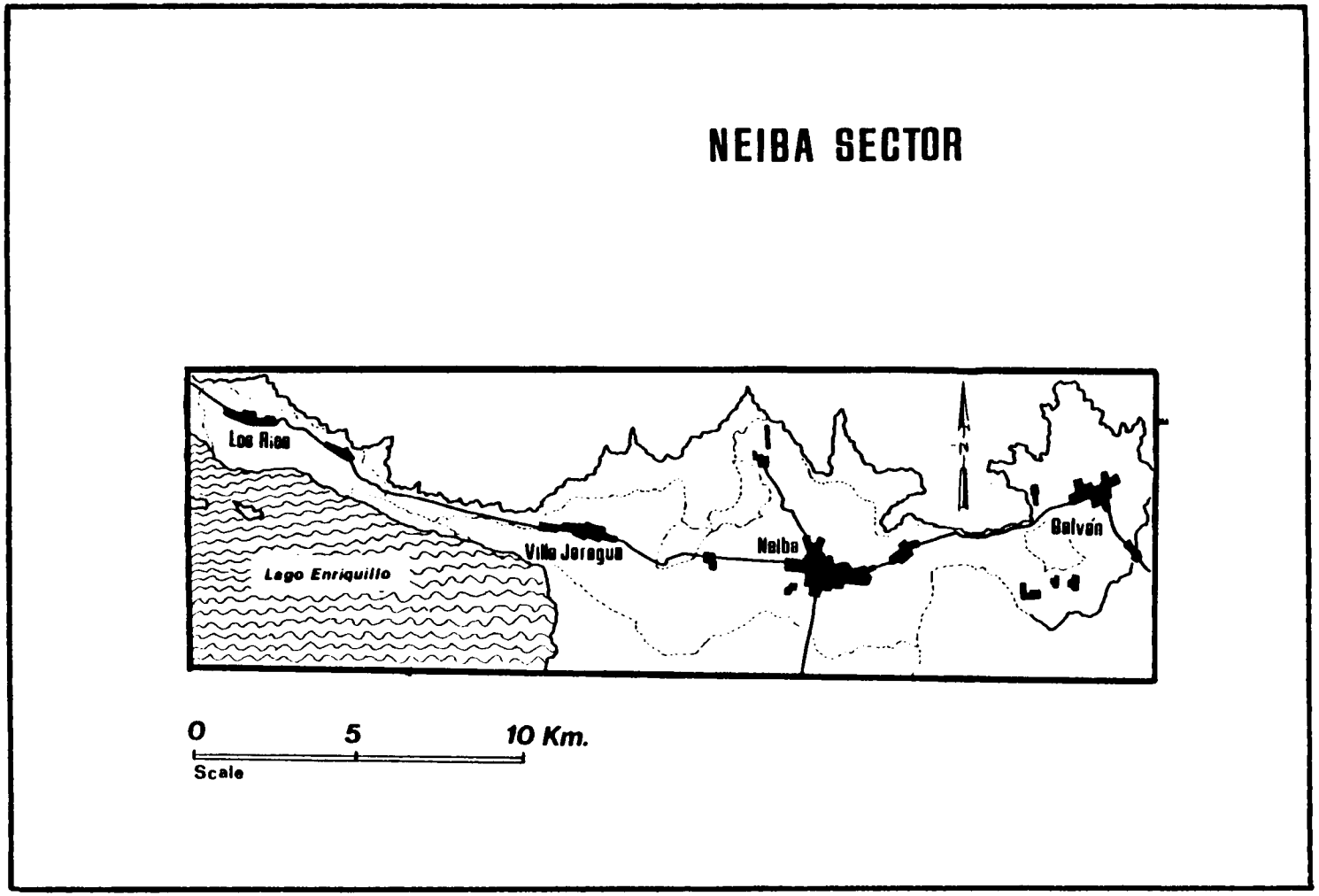

NEIBA SECTOR
Los Ríos
Villa Jeragua
Neiba
Galván
Lago Enriquillo
0
5
10 Km.
Scale

Figure 37

plain that extends through the entire central part of the Enriquillo Basin. Many important contrasts exist between these two areas. Rural settlements have been established since the 16th century on the alluvial fans, while the desert plain has been abandoned for centuries without any kind of human activity. This contrast relates to differences in soils, climate and water availability that present major limitations in the plain.

The largest settlement in the interior of the entire depression is in this sector: the city of Neiba, capital of the Bahoruco Province, with 12,590 inhabitants in 1981, and a regional center for services and economic activities. Other important settlements are Galván, with 4833 inhabitants; Villa Jaragua, with 7179 inhabitants; and Los Ríos, with 2891 inhabitants in 1981. Rural population is spread over the alluvial fans and some small areas of the dry plain. Conditions of land use, markets and transportation exceed those of other sectors. Hence, levels of natural and spatial viability are relatively higher, as are economic and social potentials for development.

Areal levels of viability, as shown in Figures 38, 39 and 40, indicate that thirty-three square kilometers, or 14 percent of the sector correspond to land with high viability. Some 64 square kilometers, or 27 percent of the sector, are areas with a medium level; and 80 square kilometers, or 34 percent, have a low level of viability. Only 60 square kilometers are not viable for small-farmer settlement.

A total of 214 families were interviewed in this sector, of whom 198 were small farmers with an average farm size of 32 tareas, or

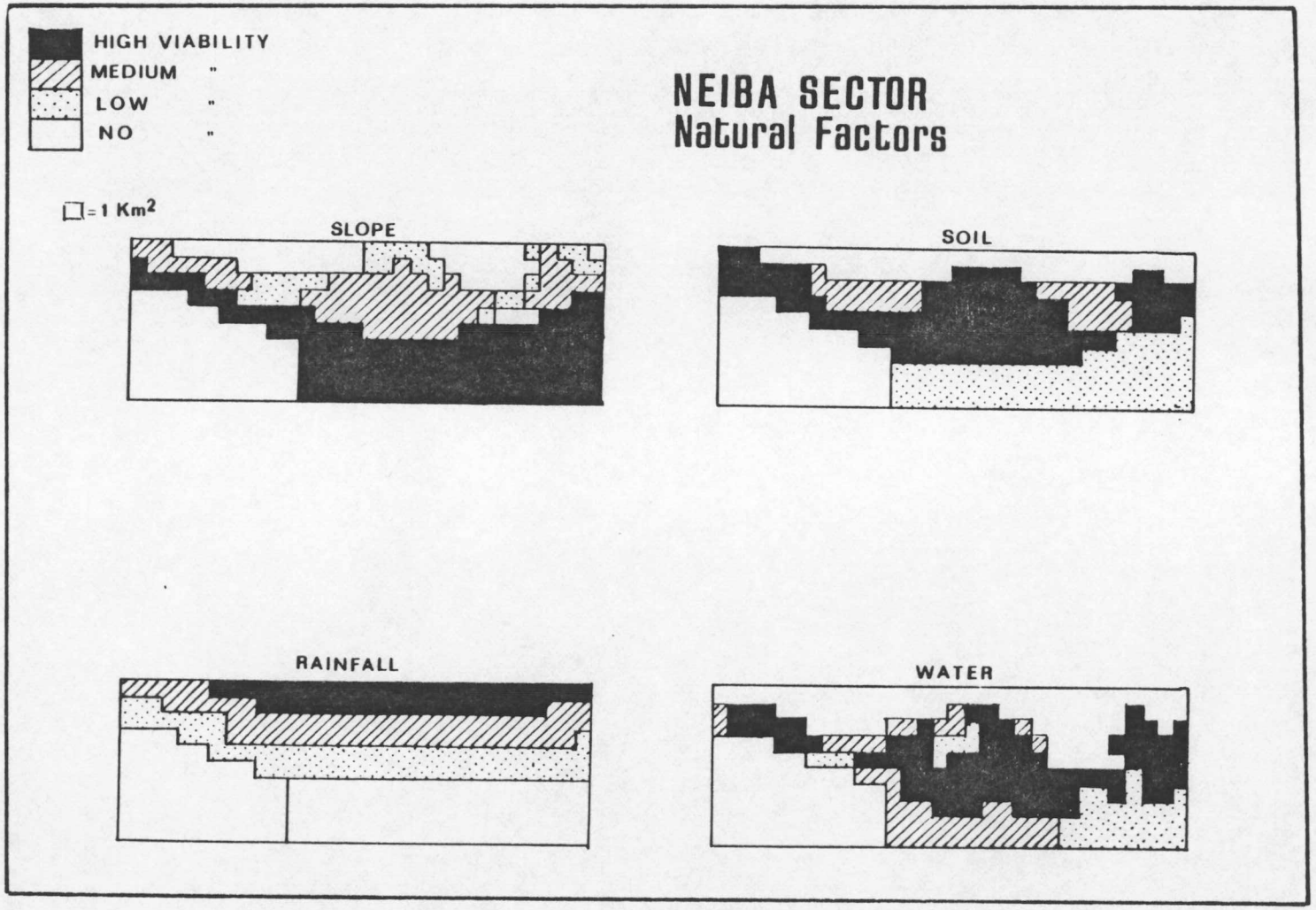

HIGH VIABILITY
MEDIUM "
LOW "
NO "
NEIBA SECTOR
Natural Factors
□= 1 Km²
SLOPE
SOIL
RAINFALL
WATER

Figure 38

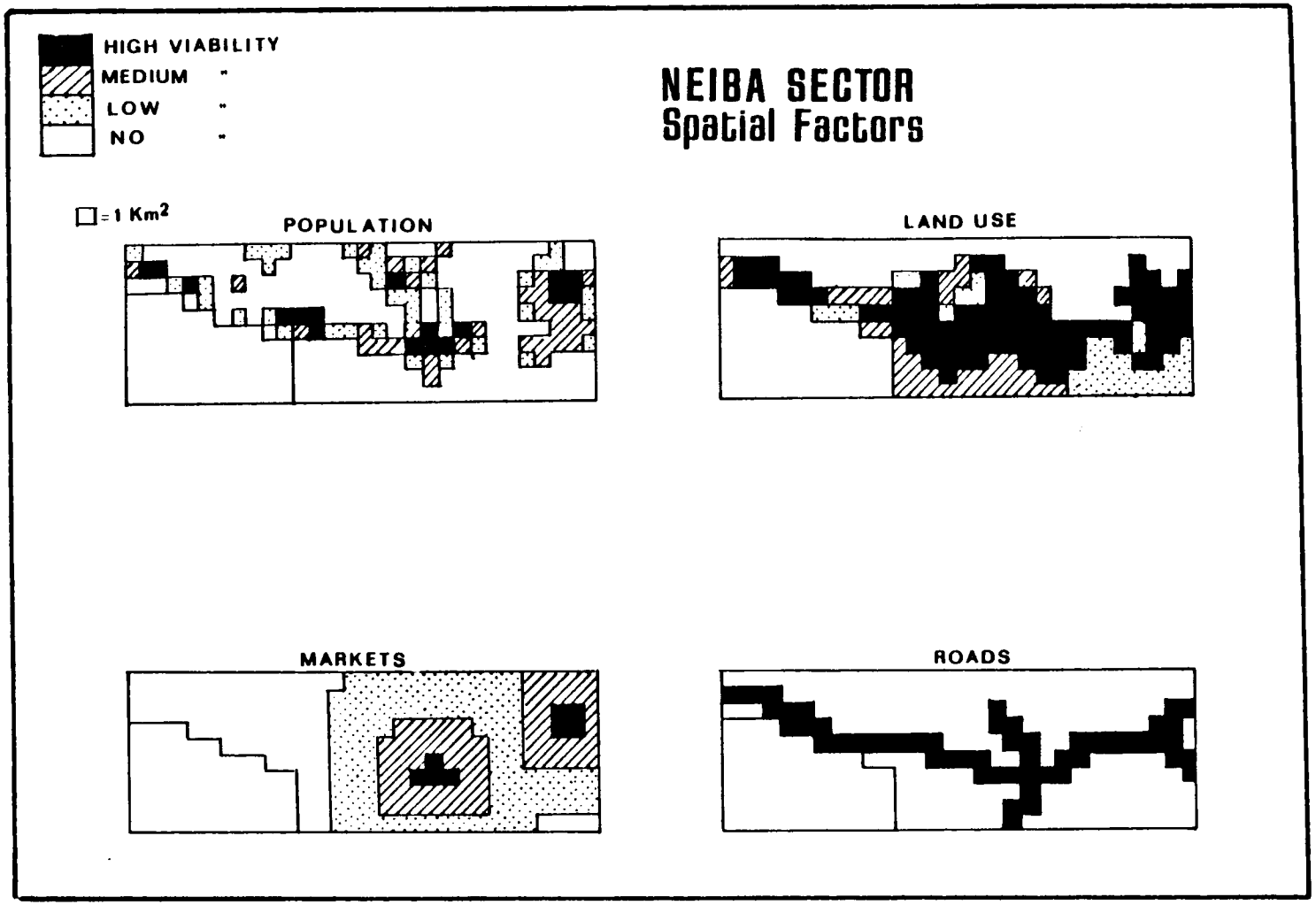

HIGH VIABILITY
MEDIUM "
LOW "
NO "
NEIBA SECTOR
Spatial Factors
□ = 1 Km²
POPULATION
LAND USE
MARKETS
ROADS

Figure 39

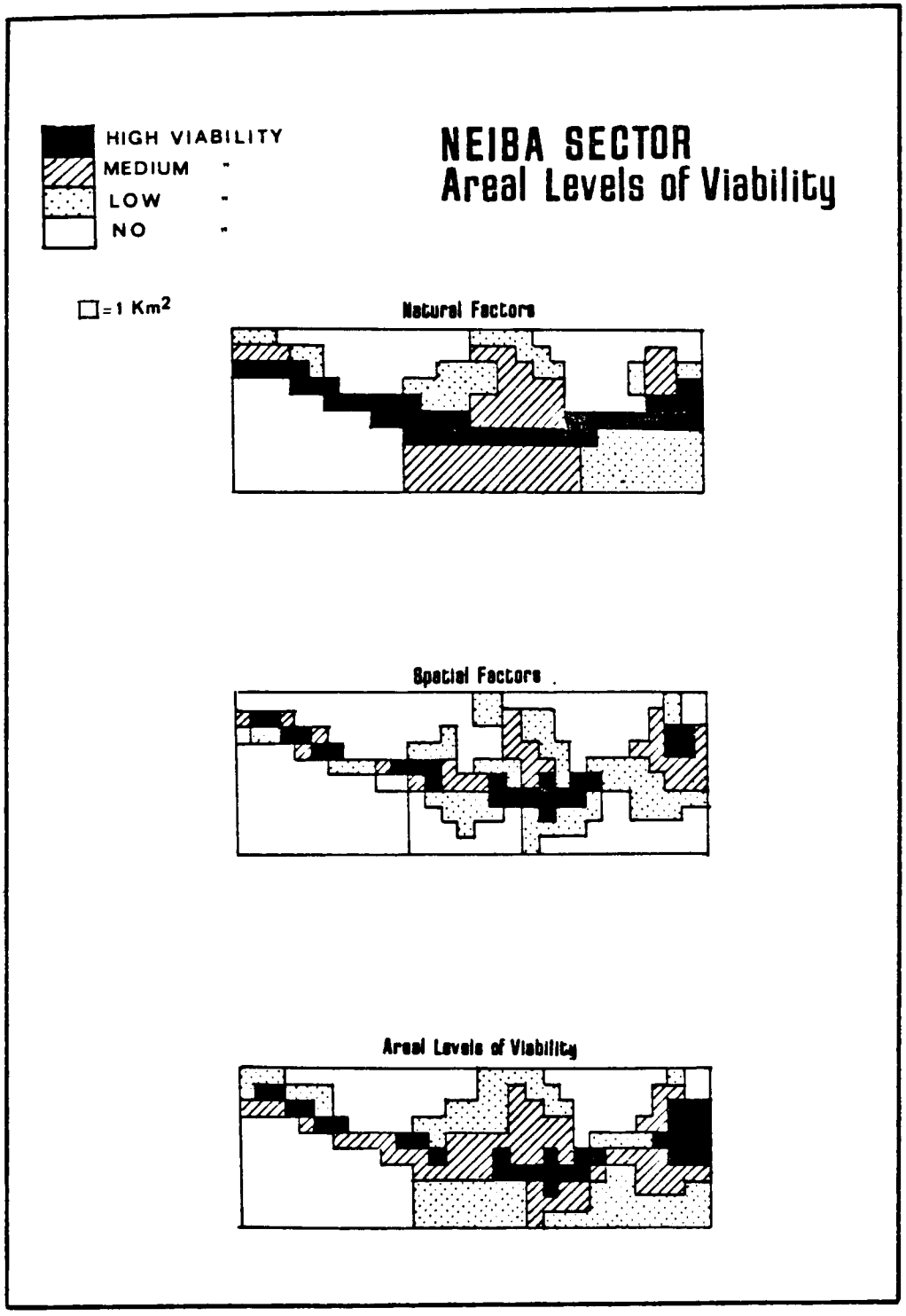

HIGH VIABILITY
MEDIUM
LOW
NO
NEIBA SECTOR
Areal Levels of Viability
□=1 Km²
Natural Factors
Spatial Factors
Areal Levels of Viability

Figure 40

2.0 hectares. These farmers are from the settlements of Villa Jaragua, Los Rios and Las Clavellinas, a small village near Los Rios.

Productivity, costs and family income have been studied by the National Office of Planning and the Secretariat of Agriculture for areas with a higher level of viability within the sector. Depending on the crops cultivated, family income may be established between 500 and 2500 Dominican pesos per year.

Viability for the area of the dry plain was specifically evaluated by a group of Israeli experts in 1981 (Prion, et al.) which recommended a set of technical and economic decisions to settle the plain with small farmers. Experts of the Secretariat of Agriculture (Campos, 1980) concur with this study. However, the improvement of water resources, using groundwater, and a good soil management and soil leaching program, is considered essential to the development of agriculture in the dry plain of this sector.

Tables 10, page 154, and 11, page 155, present data on the sector and indicate the economic and social characteristics that may affect the development of new rural settlements in the vicinity of Neiba. In general, physical conditions and services of the local settlements are poor. Fieldwork with experts from UNICEF, the Secretariat of Health and the Instituto para el Desarrollo del Suroeste facilitated discussions with local authorities and verified the need for public investment to support rural settlements within the study area.

Duvergé Sector

The Duvergé sector (Fig. 41) is part of the narrow plain along the southeastern edge of Lake Enriquillo. This sector was first settled at the end of the 19th century and was developed mainly as a result of the Trujillo program for rural colonization (Augelli, 1966).

The southern shore of Lake Enriquillo is the driest part of the Depression, with an annual rainfall at Duvergé of 482 millimeters. Soils are salty, with some drainage problems due to influences of the lake. Water availability, mainly from Las Damas River, permitted the settlement of a few families during the past century and the development of small-farmer communities in the present. However, major natural constraints will limit future development. Today, most of the farmers own some land in the nearby valleys of the Sierra de Bahoruco, with better irrigation potential and a temperate climate. At the same time, commerce and services offer a good source of employment.

Population is concentrated in the town of Duvergé, the principal settlement in the entire Province of Independencia, with 7971 inhabitants in 1981. Mella, with 1935 inhabitants in 1981; Vengan a Ver, with 1306; and Colonia, with 1133 are the only rural settlements that show a significant level of development. The importance of these settlements reflects the predominance of a concentrated rural habitat. There are no farmers living in the countryside. A sample of small farmers was interviewed in Duvergé and Vengan a Ver, as indicated in Table 10, page 154. The percentage of small farmers in relation to

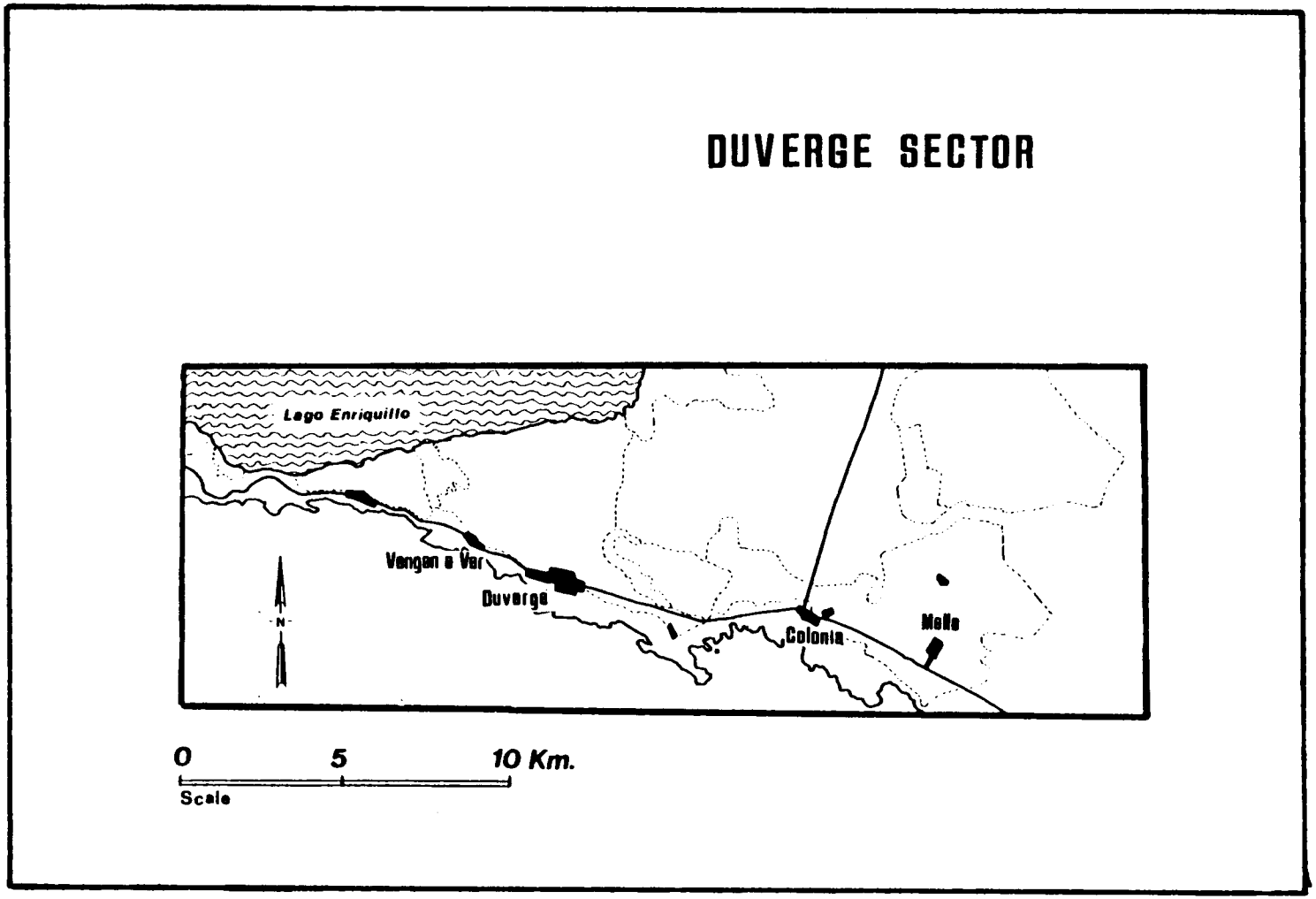

DUVERGE SECTOR
Lago Enriquillo
Vengan a Ver
Duverge
Colonia
Mella
N
0
5
10 Km.
Scale

Figure 41

the total population in the sample was the lowest in the entire study area. Only 40 percent of the families interviewed operate farms between 8 and 80 tareas in size, and two-thirds of the farms are smaller than 32 tareas, or 2.0 hectares (see Table 12). One-third of the family-heads are illiterate. The Secretariat of Agriculture has not published studies on productivity and costs for this area, but detailed personal interviews and preliminary reports from the National Office of Planning (ONAPLAN, 1982) show very low levels of technology and productivity.

Figures 42, 43 and 44, on areal levels of viability, have been prepared with reference to natural and spatial constraints in the sector. Spatial conditions of markets and transportation are relatively better than in Jimaní and Neiba, but natural and technical constraints are severe. Only two areas with a total of 36 square kilometers, or 16 percent of the land in the sector, display a high level of viability. The more important is between Duvergé and the lake, with irrigation from Las Damas River; the other is a fringe along the Sierra de Bahoruco, where small alluvial fans provide good soils and minor sources of water. Soils are a significant limitation in the plain, with problems of salinity and drainage. Areas with medium levels of viability correspond to land with severe constraints in soil, slope or water availability, where it is necessary to develop special programs; while areas with low viability present several constraints simultaneously and very high costs to develop agriculture.

Table 12

ENRIQUILLO BASIN: SIZE OF FARMS

Sample Sites	Size in Hectares 0.5-1	1.1-2	2.1-3	3.1-4	4.1-5	Total
Jimaní Sector:						
La Descubierta	22	13	4	8	10	57
Postrer Río	34	16	6	5	2	63
Sub Total	56	29	10	13	12	120
Percent	47	24	8	11	10	100
Duvergé Sector:						
Duvergé	12	11	5	6	4	38
Vengan a Ver	12	11	8	3	0	34
Sub Total	24	22	13	9	4	72
Percent	33	31	18	12	6	100

Source: Personal Interviews, 1982.

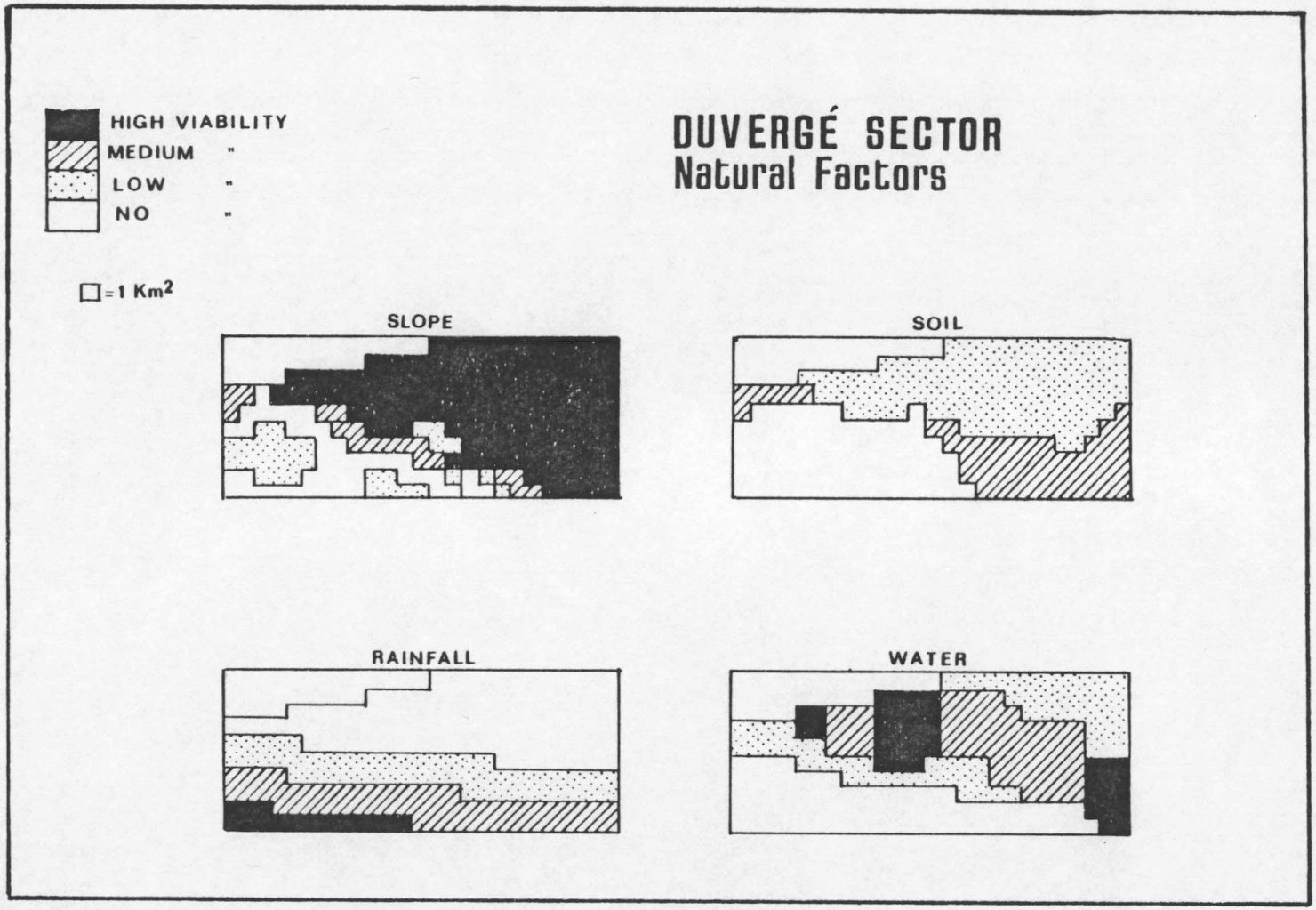

HIGH VIABILITY
MEDIUM "
LOW "
NO "
□ = 1 Km²
DUVERGÉ SECTOR
Natural Factors
SLOPE
SOIL
RAINFALL
WATER

Figure 42

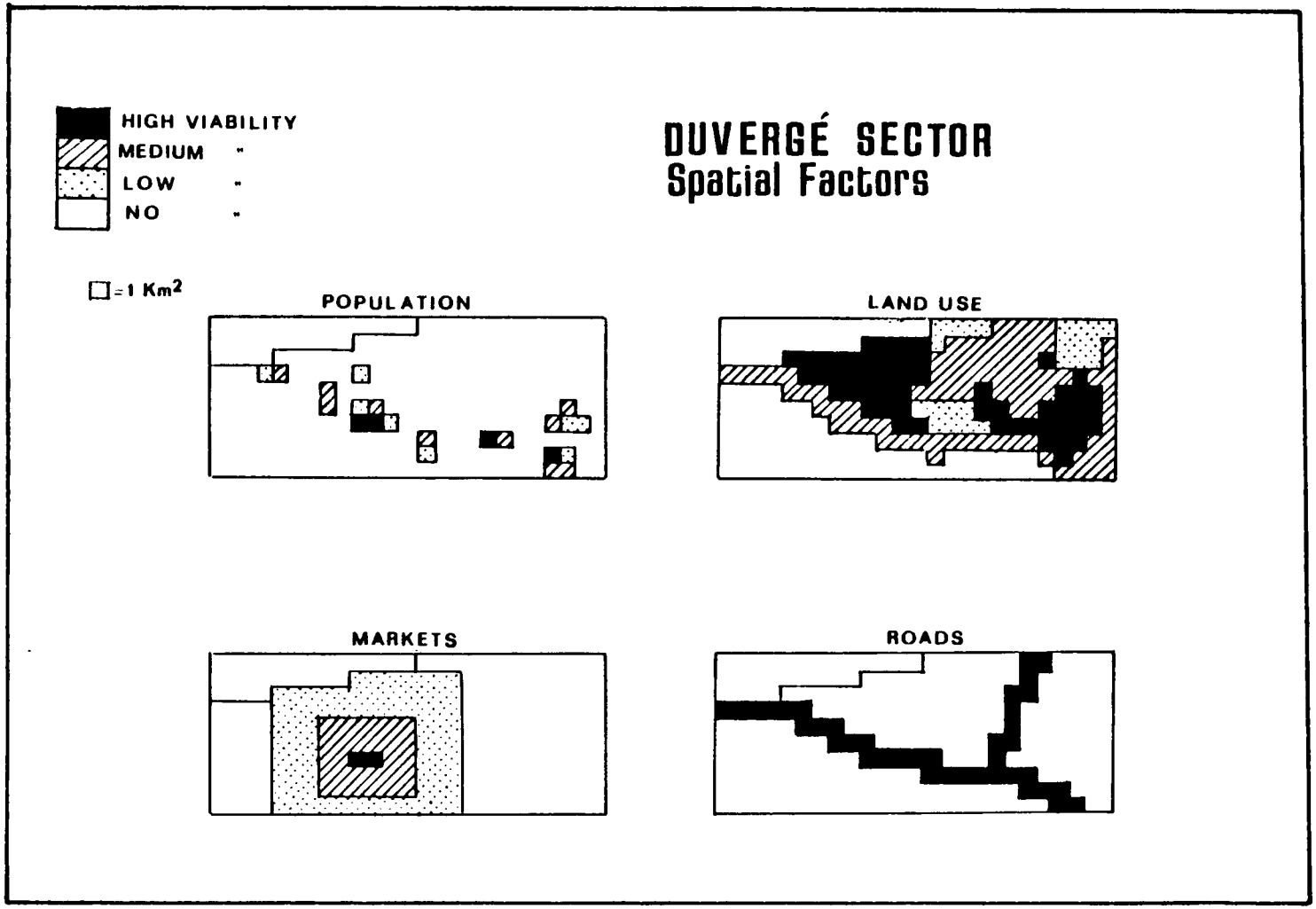

HIGH VIABILITY
MEDIUM "
LOW "
NO "
□=1 Km2
DUVERGÉ SECTOR
Spatial Factors
POPULATION
LAND USE
MARKETS
ROADS

Figure 43

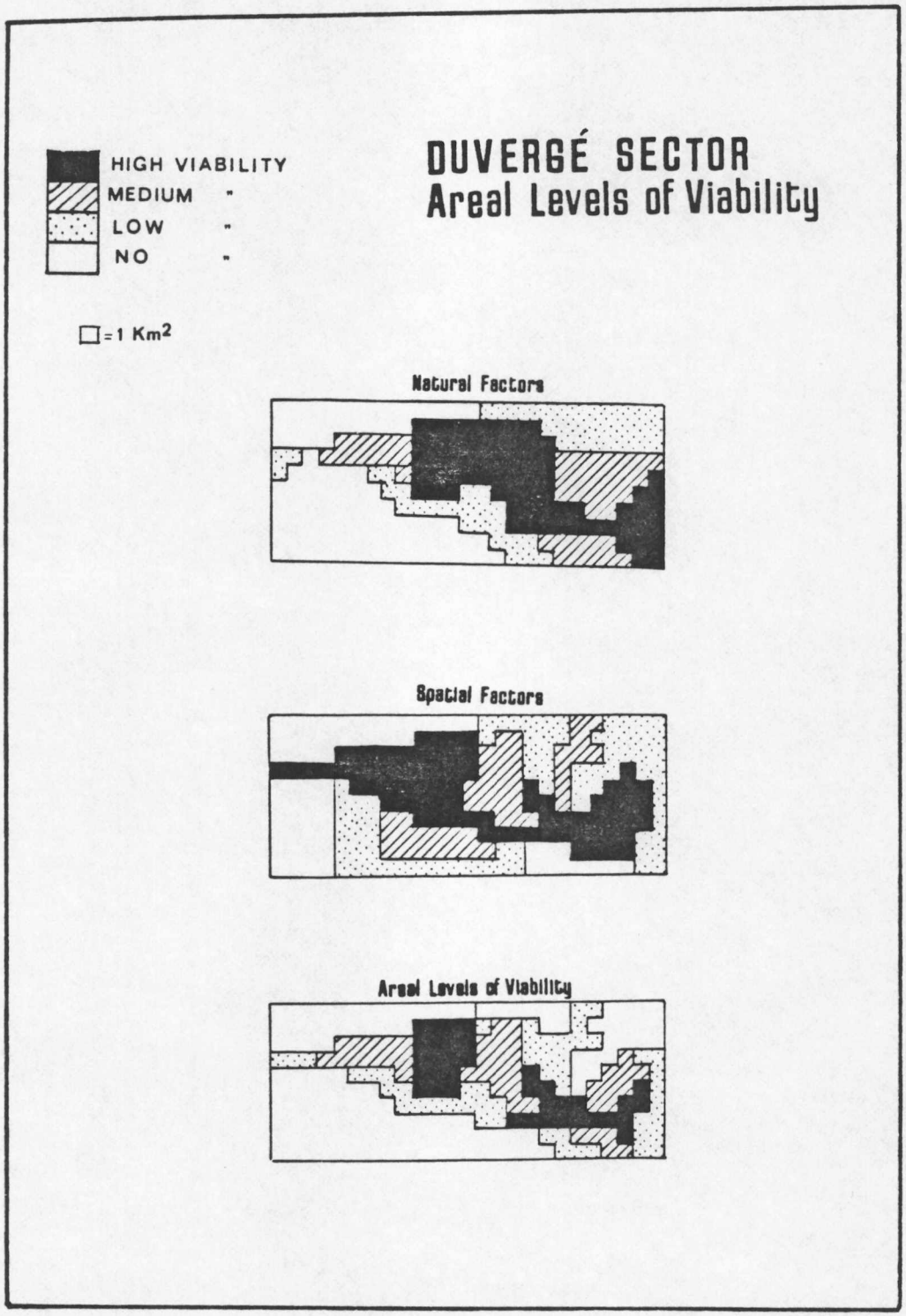

HIGH VIABILITY
MEDIUM -
LOW -
NO -
DUVERGÉ SECTOR
Areal Levels of Viability
□=1 Km2
Natural Factors
Spatial Factors
Areal Levels of Viability

Figure 44

Technical, social and anthropological factors also present many deficiencies. Levels of education, health, recreation and social organization are low. Physical conditions of the rural habitat need improvement. In general, this sector has severe problems of viability for small-farmer communities. However, services and commerce offer some possibilities as a source of alternative family income within the area.

Yaque del Sur Sector

The extreme eastern margin of the Enriquillo-Cul de Sac Depression is an alluvial plain formed by the Río Yaque del Sur (Fig. 45). The river originates at the Cordillera Central and, after crossing the Azua Plain, enters the Enriquillo Basin through a narrow gorge between the Sierra de Neiba and the Sierra Martín García. Some small rural communities, such as Quita Coraza and Fondo Negro, are located there. Then the river, in a meandering course, covers the plain with alluvial sediments and serves as the main source of irrigation water for numerous small-farmer communities. The slope is low, alluvial soils are predominant, and water resources are available from the river. Consequently, natural constraints are not too severe in this sector. However, salinity has been a problem in the eastern part (Tavárez, 1980; Vicioso, 1980), while river floods and other natural hazards create special natural constraints.

Spatial conditions are particularly important for the development of rural settlements in this sector. Easy accessibility to

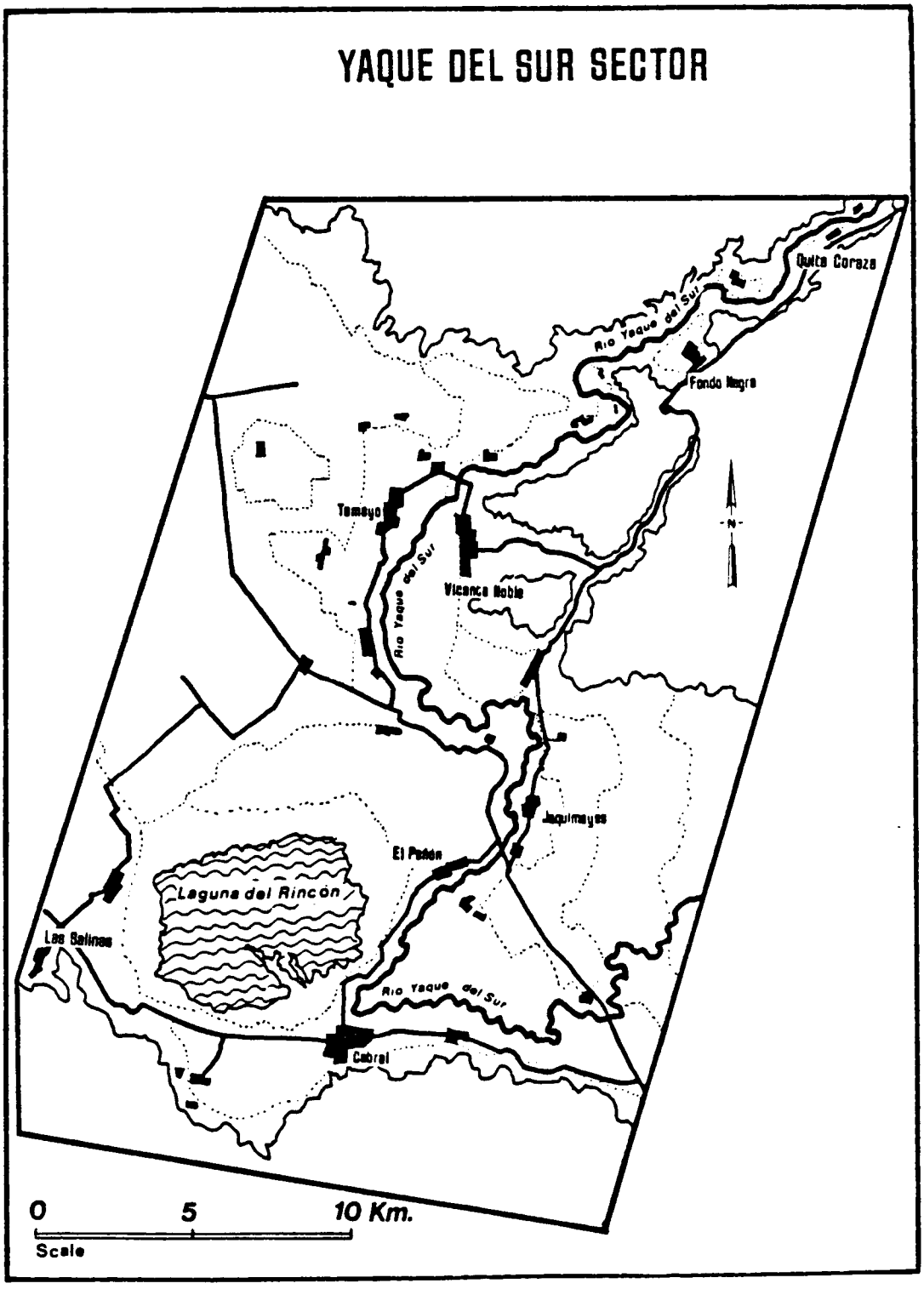

YAQUE DEL SUR SECTOR
Quita Coraza
Río Yaque del Sur
Fondo Negro
Tamayo
Río Yaque del Sur
Vicente Noble
Jaquimeyes
El Peñón
Laguna del Rincón
Las Salinas
Río Yaque del Sur
Cabral
0
5
10 Km.
Scale

Figure 45

coastal centers and to the main concentrations of Dominican population influences the economy of the area. Barahona, outside the sector, but only ten kilometers distant and with almost 50,000 inhabitants in 1981, provides a wide range of services and constitutes an important regional market. An impressive new highway has been completed recently from Barahona to Santo Domingo, crossing this sector and affecting the relative distances for all of its rural settlements. Rural population is abundant and is concentrated in more than thirty small towns. Main settlements in the sector are Tamayo, with 5174 inhabitants; Vicente Noble, with 8879 inhabitants; Cabral, with 10,155 inhabitants; and Las Salinas, with 5414, in 1981. Other relatively active rural settlements are Fondo Negro, El Peñón, and Jaquimeyes.

Levels of viability shown in Figures 46, 47 and 48 defined the area with higher viability as 151 square kilometers, or 24 percent of the sector. This area is in the lower part of the Yaque Valley, where soils and water resources are better. However, areas with a medium level of viability corresponding to the remainder of the district irrigated by the Yaque River, cover 141 square kilometers, or 22 percent of the sector. These two levels account for 46 percent of the total, indicating that the viability of this sector is the highest within the five sectors under study. Table 11, page 155, with figures for productivity and income in Tamayo, Vicente Noble and Jaquimeyes, shows that depending on the kind of crops cultivated, some small-farmer families in this sector can obtain incomes of 2000 to 11,700 Dominican pesos annually. The condition of viability in this sector is confirmed

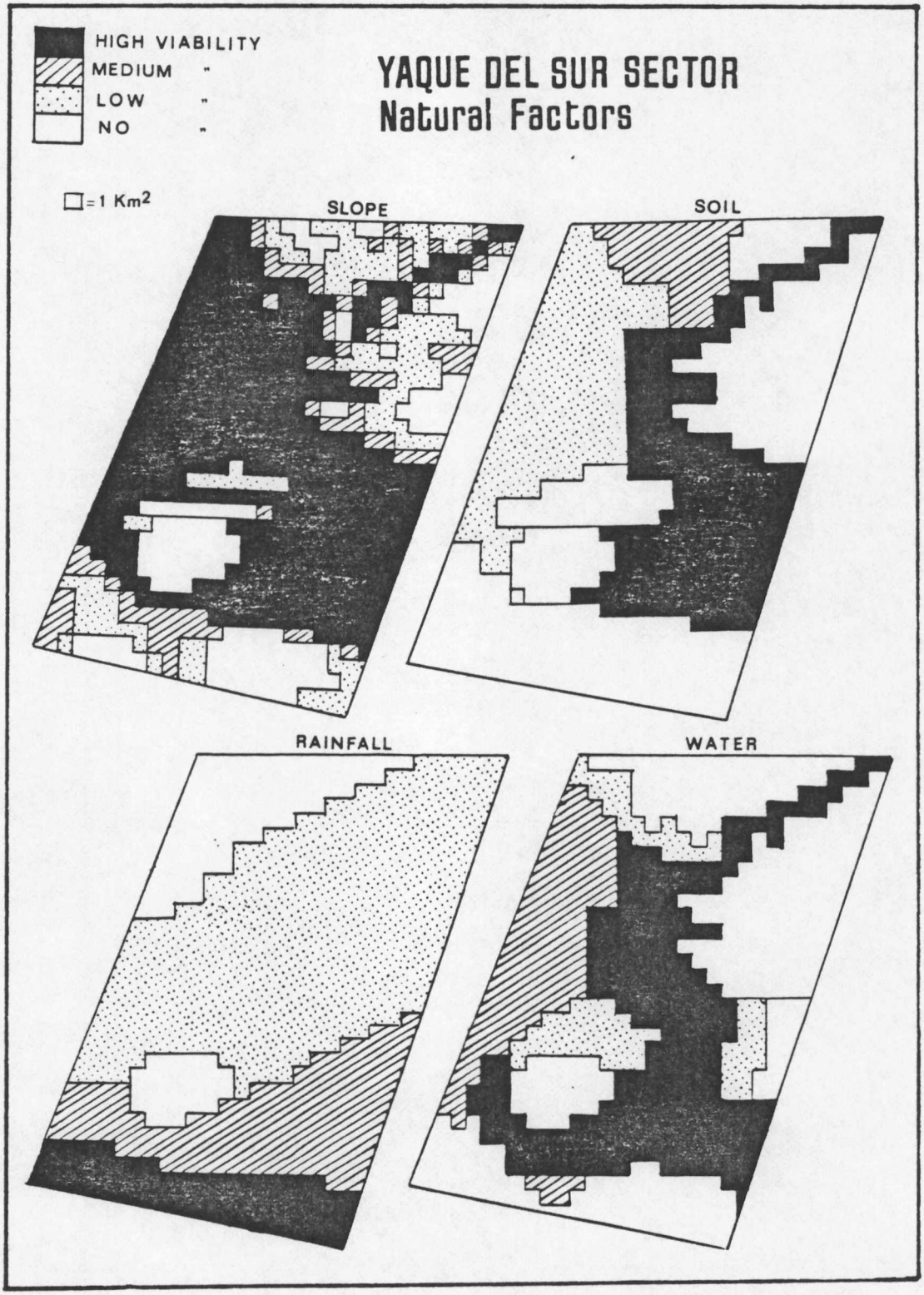

HIGH VIABILITY
MEDIUM "
LOW "
NO "
YAQUE DEL SUR SECTOR
Natural Factors
□=1 Km2
SLOPE
SOIL
RAINFALL
WATER

Figure 46

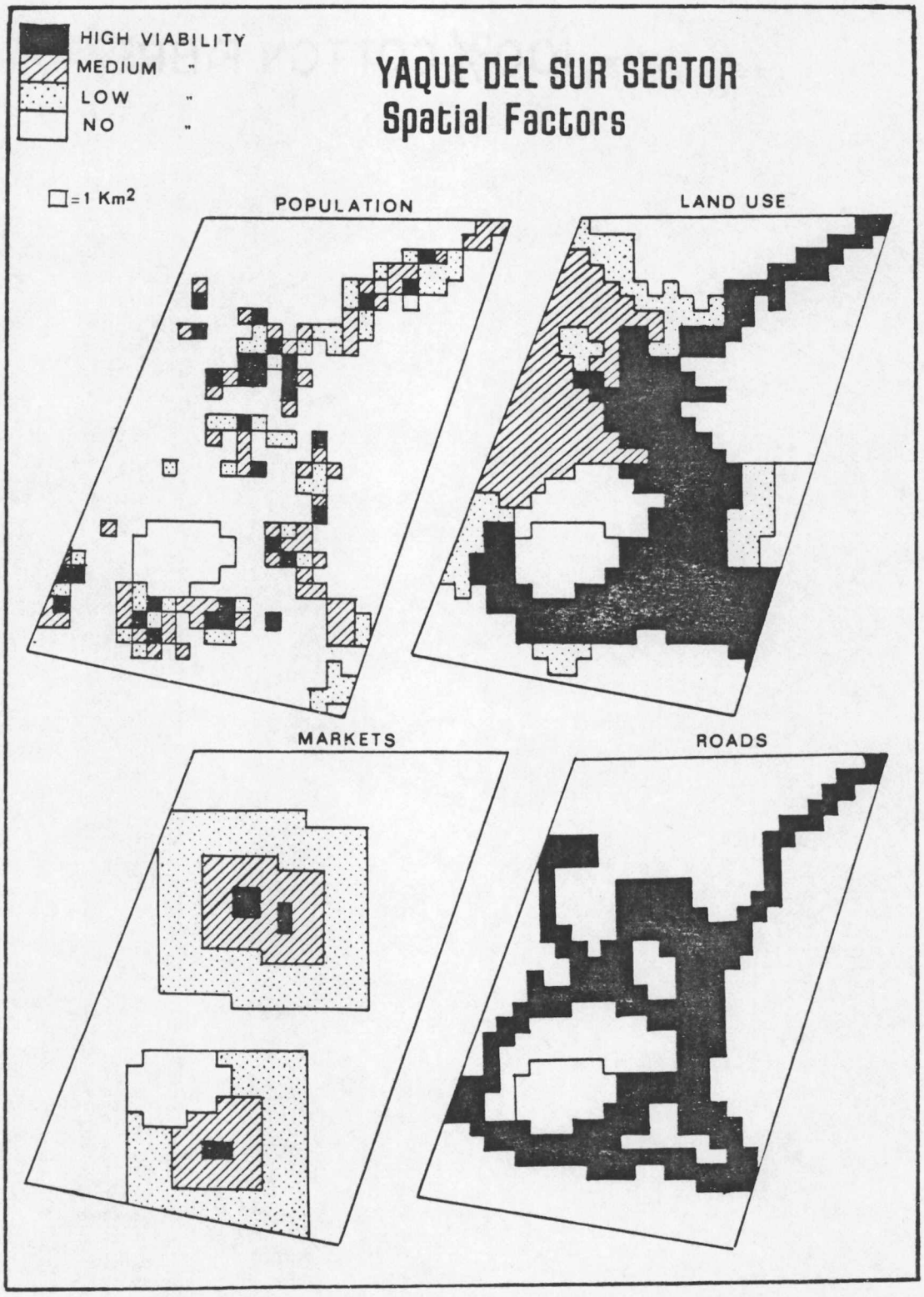

HIGH VIABILITY
MEDIUM "
LOW "
NO "
YAQUE DEL SUR SECTOR
Spatial Factors
□=1 Km2
POPULATION
LAND USE
MARKETS
ROADS

Figure 47

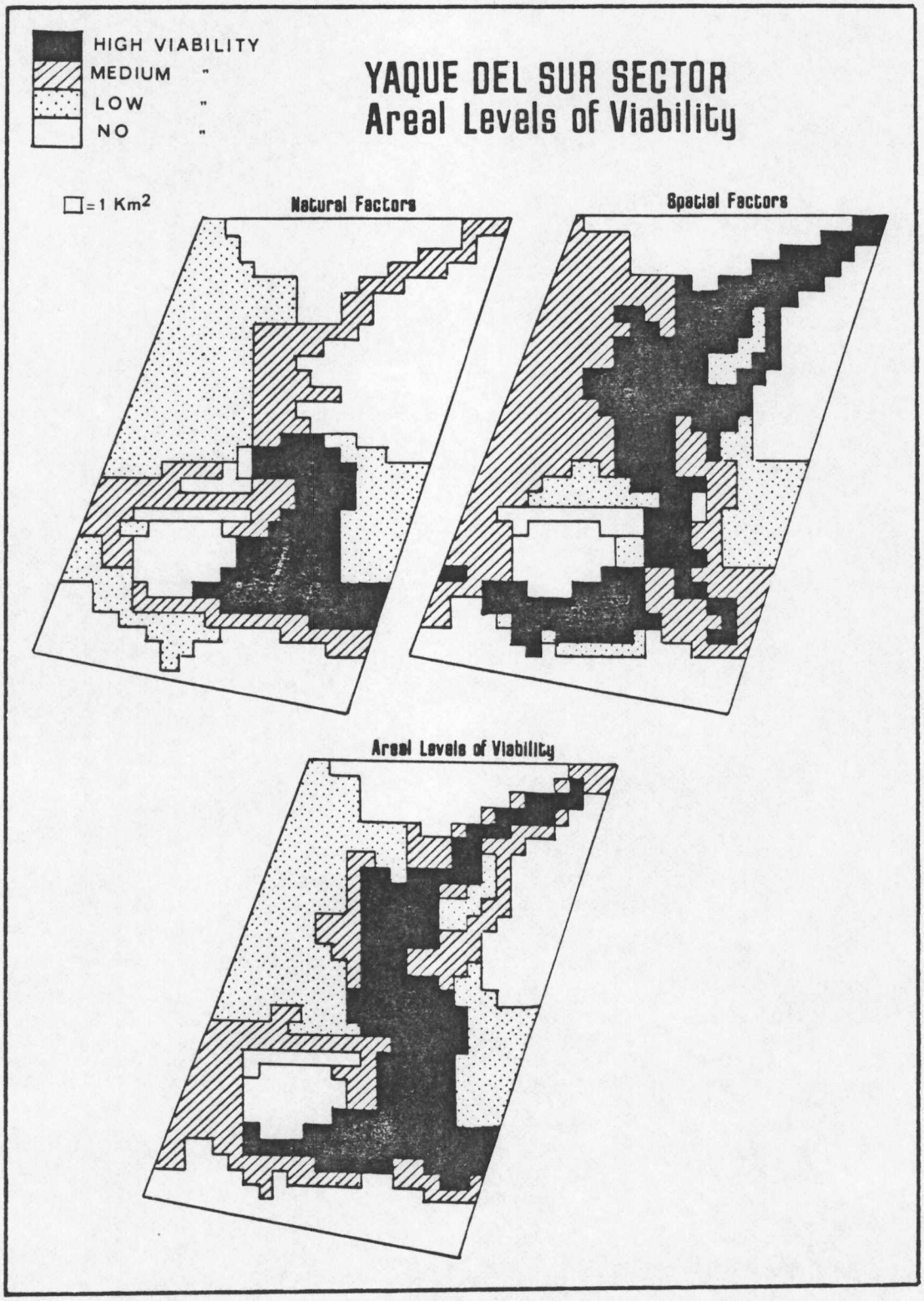

HIGH VIABILITY
MEDIUM "
LOW "
NO "
YAQUE DEL SUR SECTOR
Areal Levels of Viability
□=1 Km2
Natural Factors
Spatial Factors
Areal Levels of Viability

Figure 48

by the level of services and the general conditions of infrastructure and rural habitat. However, among the 290 families interviewed in the sample, only 129 were associated with small-scale farming. The other 55 percent of the sample included 141 families without land and twenty families with more than 80 tareas (see Table 10, page 154).

This generally better condition of small farmers has exceptions in some communities in the northeastern part of the sector, where the valley is narrow and soils are thin. Quita Coraza and Fondo Negro (Troncoso, 1980) are special cases of communities with a very low standard of living. Another small rural community with different circumstances is Las Salinas, formerly the center of an important mining district.

In general, the Yaque del Sur sector offers good conditions of viability for small-farmer communities, with some constraints in terms of soil management and social and anthropological factors. Services, commerce, infrastructure and accessibility are positive conditions, although improvements are still needed to enhance the status of small-farm agriculture and rural living conditions.

CHAPTER VII

SMALL FARMERS IN THE NATIONAL CONTEXT

In addition to local conditions of viability, there are important national circumstances that may influence the development of small-farmer activities in a region. The case of Hispaniola is particularly interesting because Haiti and the Dominican Republic present different national contexts for small-farm development. At the same time, the variety of landscapes and differences in spatial and social characteristics influence standards of living. Regional contrasts, economic interrelationships, and a well-defined international border are the main factors to be analyzed for a better understanding of the national framework that affects small-farmer communities within the study area.

Regional Differences

Physiography is a major factor of regional differentiation. Various types of valleys, alluvial and coastal plains, and high mountain ranges constitute a contrasting physiographic base for human settlement in both countries. Soils and climate also help to create numerous distinct environments on this relatively small island. Differences in population, land use or social characteristics of the rural communities usually correspond to environmental circumstances. The ability of these communities to use and develop natural and spatial potential is generally related to present living conditions.

Historical, political and geographical differences have affected the political and administrative division of each country, resulting in a large number of provinces. Today, the Dominican Republic is divided into twenty-nine provinces, the two most recent created in 1983. Haiti is divided into nine provinces, or départements. These political and administrative units do not represent major regional differences per se, but more often reflect local influences and political conditions.

Traditionally, both countries have developed a clear distinction between northern and southern areas. In both cases, specific cities represent these trends. In Haiti, the capital of the north is Cap-Haïtien, the old capital of the French colony known as Cap Français. The main settlement of southern Haiti is the present capital, Port-au-Prince. In the Dominican Republic, the traditional capital of the north is Santiago de los Caballeros, political and economic center of a fertile region known as the Cibao. In the south, the main settlement is the present capital, Santo Domingo. Within this framework, the study area, as a region, may be clearly identified with the area of direct influence of Port-au-Prince, in the core of southern Haiti. The Dominican side of the study area, to the contrary, is not included in the traditional division of the country, and has not been considered an important territory until recently. Agriculture has been well developed in the Cibao and in the southeastern coastal plain of the Dominican Republic, based on large plantations of economic significance

to the Gross National Product. In Haiti, the Cul de Sac plain was important in colonial times, but aridity and natural hazards, as well as the distribution of landholdings into small-size plots have affected productivity. Hence, today this is a secondary area for Haitian agriculture. The Artibonite valley and northern plains near Cap-Haïtien are the main agricultural regions of the country. In the Cul de Sac, only a few plantations near Port-au-Prince and sugarcane cultivation by HASCO are significant in the Haitian economy.

A new approach to regional differences has been developed recently within the framework of national planning. In the Dominican Republic, a long process to define planning regions was completed in 1980, with the division of the national territory into three large regions: the Cibao, the Southeast and the Southwest (Wood, 1968; Aquino, 1980). The Cibao region, with 40 percent of the Dominican territory and 2,250,000 inhabitants, is the richest in the country. The Cibao valley accounts for more than half of the total agricultural production, with coffee, cacao, tobacco, rice and bananas as the main crops. Soils and climate are particularly favorable in this region that traditionally has been considered the most productive part of the country. The Southeast includes an extensive coastal plain and low elevations of the eastern Cordillera Central. Heavy rainfall and high temperatures provide good conditions for raising cattle and sugarcane, the main economic activities of this area. The capital city, Santo Domingo, is located here and has a strong influence on many economic activities. Statistical data on commerce, industrial

development and public investment are more impressive in this region because of the presence of Santo Domingo. Today, other settlements such as San Cristóbal, La Romana or San Pedro de Marcorís have developed important secondary economic activities influenced by their proximity to the large market of the national capital. With an area of 15,000 square kilometers and a population of 2,685,631 in 1981, this region has the highest absolute density and most rapid population growth in the country.

The Southwest region, which includes the study area, has 14,500 square kilometers, almost one-third of the national territory. The population of 1981 was only 719,681, however, or 13 percent of the total population of the Dominican Republic. Table 13 shows the present condition of the region in relation to the total national territory (INDESUR, 1982a). This region includes only 10 percent of the cultivated area, produces only 6.6 percent of the Internal National Product, and received only 1.7 percent of all industrial investment during the period 1968-1978. Natural resources in this region are much more limited than in the other two regions, and climatic conditions are predominantly arid or semiarid. There are clear comparative advantages in the Cibao region or in the Southeast.

In Haiti, regional differences are not as marked as on the Dominican side of the border. The Département d'Aménagement de Territoire et Protection de l'Environement has adopted a division of the country into four planning regions, numbered from 1 to 4. Region 1 corresponds to the northeastern part of the country, with Cap-Haïtien

Table 13

SOUTHWEST REGION: SOCIOECONOMIC INDICATORS

Indicator	Units	National Total	Southwest	Percent
Territory	Km^2	48,442	14,511	30.0
Population 1981	Inhabitants	5,627,582	719,681	12.7
Population Growh 1980-1981	Rate	2.9	2.4	--
Internal Brut Product (1979)	Millions	5,520.6	364.1	6.6
Industrial Investment (1968-1978)	RD$ Thousands	336,353	5,720	1.7
Per Capita Product (1979)	RD$	1,046	526	--
Loans from Development Fund (FIDE, 1979-1980)	RD$ Thousands	334,753	17,409	5.2
Loans from Banco Agricola	RD$ Millions	186.6	29.5	15.8
Unemployment	%	23	23	--
Illiteracy	%	32	41	--
Cultivated Land	Thousands Tareas	25,920	2,799	10.7
Infant Mortality Rate		31.2/1000	43.6/1000	--
Infant Malnutrition	%	65	61	

Sources: ONAPLAN, 1981; INDESUR, 1982.

as its center. This region has the second-best soils in Haiti, but characteristics of semiaridity and topographical constraints make irrigation and considerable human effort necessary for the conduct of agriculture. Nevertheless, this region has been under cultivation since the beginning of the French colony and is still one of the most important agricultural areas of the country. With 4180 square kilometers, or 15 percent of the national territory, it is the least populated of the four planning units. From 539,000 inhabitants in 1950 and 685,000 in 1971, it reached 753,575 in the 1982 census. The annual growth rate has been 1.1 percent, yet since 1950 there is a relative demographic loss, from 17 to 15 percent of the national population. The region's population is 23 percent urban, including some active centers such as Cap-Haïtien, the second-largest city in the country; Limbé; Grande Rivière du Nord and Ouanaminthe.

Region 2 is the largest planning unit, with 10,500 square kilometers. It includes three provinces: the départements du Nord-Ouest, de Centre and de l'Artibonite. The principal constraints for agricultural development in this region are soils and aridity. Most of the region has relatively low population densities, especially in the northeast and the central mountains. The principal regional center is Gonaïves, on the coast, and the interior subcenter is Hinche. Population in this region totalled 1,387,933 in 1982, about 85 percent rural. The region contains 28 percent of the total population of the country, in very poor conditions due to serious environmental, social and

economic problems. Many international programs for development have been established in this region.

Region 3 is the most important in Haiti. It comprises the départements de l'Ouest and du Sud-Est, with 6850 square kilometers and a population of 1,919,703 in 1982. It may be defined as the region of Port-au-Prince, because this city includes 40 percent of the regional population and dominates all economic and cultural activities. Three large plains comprise almost all of the cultivated land in this region: Archaie, along the coast north of Port-au-Prince, with a regional subcenter in Saint Marc; Léogane, a rich and long settled plain southwest of Port-au-Prince; and the Cul de Sac plain, the study area for this research, which extends east of Port-au-Prince for fifty kilometers to the Dominican border. A good transportation network facilitates the regional organization of this territory, but in rural areas, levels of underdevelopment are the same as elsewhere in Haiti.

Finally, region 4 corresponds to the western part of the southern peninsula, namely the départements du Sud and la Grande Anse. It included 992,581 inhabitants in 1982, about 90 percent rural, on 6450 square kilometers of land area. The two main urban centers are Les Cayes and Jérémie, which serve as markets for a largely self-sufficient economy. Good soils and climate generate important agricultural activities and, despite its isolation, this region has the best prospects for development.

Considering regional differences in both countries, the study area presents many comparative disadvantages for private and public

investment. These disadvantages are particularly acute in the Dominican Republic, where the only significant source of economic development would be through special government programs. In Haiti, the eastern Cul de Sac also presents severe limitations for development, but proximity to the large urban market of Port-au-Prince could provide an incentive to private and public investors.

Economic Interrelationships

Regional differences are particularly important in terms of economic interrelationships. In both countries, economic interchange is strongly influenced by the large markets provided by the capital cities. There is, however, a major difference in the relative location of the study area on each side of the border. In Haiti, the Ganthier sector is no more than thirty kilometers from Port-au-Prince, a large market and center of services and job opportunities. This location constitutes a favorable condition for marketing products and for potential improvement in small-farmer living conditions. In the Dominican Republic, the Enriquillo Basin is one of the most distant areas from Santo Domingo. This is true not only physically but also in terms of communication, ecological conditions and cultural patterns. These distances affect transport costs, market prices, productivity and financial support.

There are other important differences between rural conditions in the two countries. In Haiti, general underdevelopment affects all rural activities and there are no privileged areas. Prices, costs and

income levels are equally bad throughout the country. It is therefore difficult to define comparative advantages or disadvantages vis-a-vis economic interrelationships. Most goods are traded in traditional local markets, some of them relatively large. An interesting system of rotating markets has been established in many rural areas to maintain a permanent demand for products. This system is particularly important in areas far from the large markets of Port-au-Prince or Cap-Haïtien (Moral, 1961; Palmer, 1976). These two centers of economic activity control the international trade, the financial system, the national distribution of services and public investment. They also constitute, by themselves, important economic units with their own sources of supply.

In the Dominican Republic, economic interrelationship are much affected by the market of Santo Domingo, but there are several important regional markets, and rural communities are better integrated into the national economic network. The influence of Santo Domingo has been clearly defined in a study of the national Secretariat of Agriculture (S.E.A., 1977). According to that study, 15,309 tons of food reach the capital every week, and 5154 tons, or almost exactly one-third, are redistributed to the rest of the country. In many cases, products are sent to the same area where they were produced, with prices that include new costs of transportation and processing. Within the study area, bananas from Barahona or Neiba, tomatoes from Duvergé, and beans from Jimaní or Cabral are affected by this process of trade.

An important aspect of economic interrelationships in both countries is the affect of small-farmer crop-production in maintaining low food prices in the urban areas. Studies have been conducted (Moquete, 1983) to demonstrate how difficult it is to raise present levels of income for small farmers without creating severe economic problems in the urban areas. Most workers in large cities, with low levels of salary and large families, can survive only because of the low prices and food produced by small-farmer communities. This economic constraint is a major handicap on governmental policies favoring improved conditions of trade for small farmers in both countries.

Finally, economic interrelationships within each country, and in the study area, are much influenced by the types of production. In the Dominican Republic, agriculture is concentrated in the Cibao, with the best levels of productivity, good conditions of soils and climate, and a variety of crops. Coffee, bananas, cacao, tobacco, rice, peanuts and sugarcane predominate. Tourism and mining are also of some importance. The Southeast, with its fertile plain and abundant rainfall, is well-known as the region of sugarcane and cattle. Coffee, cacao and many fruits are also produced. Industrial development in towns such as La Romana and San Pedro de Macoris contributes to the regional economy. In contrast with these two regions, the Southwest is an underdeveloped area with many natural constraints and few significant economic activities. The valley of the Río San Juan is the only area of the region in which agriculture is prosperous and productivity is comparable to that of other regions of the country. The

Enriquillo Basin, or the plains of Azua and Pedernales, are arid environments with too many constraints to attract public or private investment. Most of the crops here yield less than in other regions.

In Haiti, regional differences in agriculture and other economic activities are less clear, but there are environments with different suitability for crops. Coastal plains and valleys, mountains or arid environments are clearly different in potential for human settlement. Under these circumstances, the greater productivity is in the coastal plains and valleys, such as near Leogane, Limbé, Les Cayes or in the Artibonite valley. Settlements in the mountains have severe problems of erosion, but some areas are suitable for coffee and vegetables. Aridity is the principal constraint in the least developed areas of the country. The northwest and the eastern part of the Cul de Sac suffer from this condition.

In summary, economic interrelationships are not significant for the study area and present a number of disadvantages in comparison with those of other areas. Consequently, private and public investment will be required on a relatively large scale to achieve economic development and regional integration.

Influence of the Boundary

In addition to natural and spatial differences on both sides of the boundary, historical and political factors have considerable influence on present living conditions within the study area. Since colonial times, when Spaniards and French shared the island, the border

has been sharply defined and well protected to avoid conflict between the two territories. Only for a short period, between 1822 and 1844, did the boundary disappear, because the entire island was under Haitian rule. Independence of the Dominican Republic from Haiti increased the cultural and political distance between these two countries. Until recently, almost every Dominican government has adopted special policies to protect the border and avoid Haitian influence. The culmination of this attitude was the decision by Trujillo's government to expel all Haitians from Dominican territory, which caused thousands of deaths in the process. Recently, relationships are more peaceful and there are several cooperative programs between the two governments. Hostility is more prevalent on the Dominican side, but through the years both countries have developed reciprocal sentiments of distrust.

In the study area, which suffered destruction during the Haitian wars of the 19th century, the border constitues a strong barrier to inter-regional relationships. For many years, the transit of people or goods across the boundary was strictly forbidden. Even today, border crossing is constrained by the requirements of extensive documentation and by bureaucratic delays. Many times authorization is simply rejected. Haitian workers are allowed to enter the Dominican Republic to harvest sugarcane, but the Dominican government requires that they return promptly to Haiti. However, it is impossible to maintain control over the entire border, and many illegal immigrants enter the Dominican territory every year. Officially, international relationships are friendly, but economic or cultural relationships are rare.

The Enriquillo Basin, only sixty kilometers from the market of Port-au-Prince, could be an important supplier for Haitian needs, but restrictions at the border inhibit any efforts toward economic cooperation. The reciprocal cultural influence can be easily detected in the rural areas near the border, because many Haitian farmers understand Spanish and many Dominicans speak Creole, the popular language of Haiti. Nevertheless, economic and personal relationships are discouraged, and farmers on either side must turn to their respective political capitals to receive economic support or technical aid. The study area comprises a semiarid environment in both Haiti and the Dominican Republic, and small farmers on either side of the boundary face almost identical problems. The contrasting historical, political and economic conditions of these countries makes it impossible to think of integrated programs for their mutual benefit.

CHAPTER VIII

FUTURE DEVELOPMENT

The analyses of viability acquire particular relevance when related to prospects for future development. Both governments on the island show especially great concern for rural development, and several international agencies are interested in the improvement of living conditions for small-farmer communities. However, many programs lack adequate compatibility with the potentials and constraints of the study area. Most lack any consideration for geographical and ecological characteristics of the semiarid environment. Others are more concerned with the political effects of a decision than with its regional implications. It seems appropriate to revise the most significant national policies for development and to compare their assumptions and objectives with levels of viability. Another question raised as a result of the study of viability for small-farmer communities is the suitability of other types of settlements in a semiarid environment, such as the Enriquillo-Cul de Sac Depression.

National Policies for Regional Development

Official national agencies concerned with regional development are the Oficina Nacional de Planificación (ONAPLAN), in the Dominican Republic, and the Secretairerie d'Etat du Plan (SEP), in Haiti. Both agencies are relatively new, and the determination of regional

development policies is still in process. However, in the Dominican Republic, ONAPLAN has supported some important decisions related to regional development. First, it promoted creation of the Instituto para el Desarrollo del Suroeste (INDESUR), a regional branch of ONAPLAN concerned with the improvement of living conditions in the Southwest through better coordination of the sectoral programs prepared by other governmental agencies. INDESUR also prepares and funds a few programs on its own initiative, but the pragmatic approach of this institution and its weak executive authority deter any real possibility of policy definition. Another regional action of ONAPLAN has been a complete survey of resources and potential for development in the Cibao region, completed in 1983 with support from the Organization of American States and involving all national technical agencies. A third regional program supported by ONAPLAN is the national system of human settlements (Aquino, 1980), with emphasis on development of the urban area of Santo Domingo. Today, the most important program for ONAPLAN is the development of border areas, specifically mentioned by President Salvador Jorge Blanco as a high priority for his government. The study area is totally within what have been defined as border areas. Hence, there are good prospects for a massive program of development, although these are often based mostly on political declarations and lack technical or economic support.

In Haiti, the Secretairerie d'Etat du Plan participates as technical advisor in the discussion of all programs that might affect

Haitian development. However, the lack of reliable data and the primitive state of many departments within the Secretairerie, hinder any attempt to define a general policy for regional development. The idea of regional planning offices is being implemented, and the first one has been organized in the Artibonite Valley. The study area, in the Cul de Sac Depression, has no priority in these regional efforts. National policies for development in Haiti are more concerned with the arid northwest, with traditional agriculture in the north, with the fertile Artibonite Valley, or with new potentials of the southern peninsula. The proximity of Port-au-Prince is a strong argument against specific regional programs for the Cul de Sac.

In addition to those of specific agencies for regional development, other important programs also affect rural life in the study area. The Instituto Agrario Dominicano is in charge of an extensive agrarian reform program. Since Trujillo's death, agrarian reform has been a priority of all national governments. By August 1982, more than 55,000 families were placed in asentamientos of the Instituto Agrario Dominicano (IAD). Some 8540 families had been settled in the Southwest, and 2929 in the Enriquillo Basin. Rural settlements begun as IAD projects are supported with technical and financial assistance. Natural and economic constraints are better overcome by these rural settlements, although in many cases soil conditions, water availability or farm size are unsatisfactory. Eleven asentamientos are spread over the Enriquillo Basin, but they affect mainly the Jimaní and Duvergé

sectors. According to authorities of the IAD, there are no projects for new rural settlement in the Enriquillo Basin.

Specific sectoral agencies, such as those pertaining to health, education, agriculture or public works, define their own regional projects, which often do not correspond to national priorities for development. In education, the main program at present is to eliminate illiteracy in the Dominican Republic. This problem affects the entire country, yet there are no specific regional programs. A study by the author concerning conditions of teachers and schools in the area found that in many settlements there are no classrooms, and for years there have been no teachers. However, no specific projects to improve education in the region were detected.

Health is another basic concern for better living conditions in the region. Official reports (ONAPLAN, 1981a), define the Southwest as the region with the lowest indices of health. Specific programs for rural health, nutrition and environmental sanitation have been initiated in recent years. The Instituto Nacional de la Vivienda (INVI) has shown particular interest in the improvement of rural settlements, and there is some research being conducted in the study area. However, the implementation of effective programs for rural communities may take some time. INVI studies are the only ones with an integrated approach to rural living conditions. Agriculture and Public Works maintain regional offices in Barahona and are permanently involved in support for some rural activities. Such programs are concerned with

specific responsibilities, however, and generally refer to small communities or areas. No regional projects sponsored by these agencies were identified.

International agencies and technical assistance from specific countries are also important in the Dominican Republic. However, international aid must be channeled through national agencies. Hence, there are no decisive policies for future regional development in this country, but numerous sectoral projects are being supported by national and international efforts. The only really important program for the study area in the near future is a project for development of border areas, but it is in the first stage of consideration.

In Haiti, conditions are similar to those of the Dominican Republic, because the Secretairerie d'Etat du Plan is just beginning to discuss regional development. Today, most efforts are concentrated on the economic development of urban areas, such as Port-au-Prince and Cap-Haïtien, while rural development is focused on the Artibonite Valley and some areas of the southern peninsula. However, there is one important program for development in the study area: the Project Rivière Blanche, supported by the Inter-American Development Bank. The area covered by this project coincides with the area having higher viability for small farmers in the Ganthier sector, and most of the basic assumptions and objectives are well related to the needs of rural communities in that environment. Unfortunately, there are no plans to exploit the agricultural potential of areas such as nearby Thomazeau or Fond Parisien.

Alternative Types of Settlement

An alternative approach to development in the Enriquillo-Cul de Sac Depression is to consider non-agricultural types of settlement that may be more suited to the environmental characteristics of this area. During fieldwork, and particularly in discussions with authorities and planners, this approach was frequently mentioned. Nevertheless, thorough studies on the conditions of fishermen (Krute-George, 1978), the coffee trade (Giralt, 1978), reports prepared in ONAPLAN, and the personal experience of authorities in the region, indicate that agriculture must be the basic economic activity for regional improvement in the Enriquillo-Cul de Sac Depression.

Fishing is conducted near Barahona, but the quantity and quality of fish are inadequate to support any significant industrial exploitation. Also, in many areas of Lake Enriquillo, farmers supplement their income by fishing. Tilapia is particularly in demand, but there is only limited potential. Farming plus fishing in the salty waters of Lake Enriquillo could be important, but experimental programs must be developed prior to any public investment in this activity.

Tourism and mining are other economic activities generally mentioned as possibilities to give future support to settlements within the study area. There is some mining potential, but local ore deposits are too small to affect any large segment of the population. Tourism is the greater possibility. However, the entire island of Hispaniola has tourism potential, and many other regions are more attractive, have better infrastructure, and offer easier accessibility.

Among rural activities there are possibilities for several types of economic development in this region. Plantations of sugarcane, or some other extensive exploitation, could be a solution for areas with low or medium levels of viability if financial support is available. Cattle raising also could be an important new activity for this semi-arid environment. However, considerable research and experimentation are needed to evaluate these prospects.

ONAPLAN and SEP, the official planning agencies in the respective countries, concur that agriculture offers the greatest potential for economic improvement in small rural communities. Agro-industry is the only clear way to increase the added value of agricultureal production in the study area but, again, large investments are needed.

Concerning prospects for future development, the Enriquillo-Cul de Sac Depression appears to be an underdeveloped area with many geographical constraints and little possibility for immediate improvement in living conditions. Some small projects are being implemented, but they are clearly insufficient to achieve appropriate development of the region's small-farmer communities.

CHAPTER IX

CONCLUSION

The viability of rural development in a semiarid environment of Hispaniola has been examined to provide basic knowledge for the improvement of living conditions of small-farmer communities. The viability of these communities in the semiarid environment of the Enriquillo-Cul de Sac Depression has been studied within the conceptual framework of appropriate development, desertification control and small-farmer conditions. Priority has been given to the geographical expression of viability and various areal levels of potential and constraint in relation to agriculture.

Questions defined at the beginning of the study and the hypotheses formulated as a basic methodological approach have been answered and tested during more than twelve months of field research and a similar period for processing the data gathered. The first question involved the definition of basic environmental and socioeconomic requirements for permanent small-farmer settlement within the study area and their correspondence with present characteristics of the Enriquillo-Cul de Sac Depression. This question was considered essential to the research, and methodologically was related to three main hypotheses. The first hypothesis concerns the existence of levels of viability and their relationship to local ecological and socioeconomic variables. The second concerns the relationship between levels of viability,

geographical characteristics, and conditions of development in each community. The third hypothesis pertains to relationships between levels of constraint in a semiarid environment and the amount of population that can be settled, given an appropriate type and size of farm.

The definition of levels of viability and their respective requirements were derived from reports on rural development and confirmed by interviews with specialists and with officials in the study area. A model incorporating the main factors that affect rural development was prepared and summarized in three levels of general viability. However, the method also demonstrated the possibility of differentiating additional levels and of quantifying inputs and outputs when applied to specific development projects. After the model was discussed thoroughly and tested during the analysis of several rural sectors, it was retained for its validity as an heuristic tool in this type of research. Local factors that affect levels of viability were found to be of four types: ecogeographical, economic, legal and socio-anthropological. Various specific items were considered within each of these types.

Relationships between levels of viability, geographical characteristics and conditions for development in each community were studied in five sectors of the Enriquillo-Cul de Sac Depression, where most of the small-farmer communities are located. The technique known as threshold analysis was employed. Natural and spatial factors were used to define threshold of viability corresponding to levels defined

within the model. Economic, legal and socio-anthropological dimensions of analysis were included later to complete the definition of present viability for rural development in each group of communities. Areas with high, medium and low levels of viability were located, and their geographical characteristics, potential and constraints for development clearly identified as shown in Table 14. According to these figures, certain geographical characteristics were essential to define the levels of viability corresponding to specific development needs.

The third hypothesis required an analysis of potential to support population. Threshold analysis was especially useful to define the number of square kilometers which correspond to each level of viability. Official reports on productivity, costs and prices, plus the result of almost 1000 family interviews facilitated calculation of the approximate population that can be supported within each level. Considering the average size of small farms on each side of the border to be approximately two hectares, each square kilometer can be divided into fifty small farms. The average size of family for both countries may be estimated as six persons, hence each square kilometer can support 300 persons in small-farm families. Table 14 shows a total of 269 square kilometers with high viability, which indicates a support capacity of 80,700 persons. The areas with a medium level of viability comprise 328 square kilometers, which could support 98,400 inhabitants, but only with considerable improvement. The areas with low viability total 405 square kilometers, which could support a potential population of 121,500. Recent official censuses report a

Table 14

LEVELS OF VIABILITY IN THE SECTORS UNDER STUDY

Sectors	Total Area (Km^2)	Water Bodies (Km^2)	Net Land (Km^2)	High Viability (Km^2)	(%)	Medium Viability (Km^2)	(%)	Low Viability (Km^2)	(%)
Ganthier	414	93	321	41	13	58	18	74	23
Jimaní	350	133	217	8	4	23	11	45	21
Neiba	300	63	237	33	14	64	27	80	34
Duvergé	250	26	224	36	16	42	19	51	23
Yaque del Sur	660	28	632	151	24	141	22	155	25
Total	1974	343	1631	269	16	328	20	405	25

Source: Personal Research, 1983.

total population in the sectors under study of 197,180 or two-thirds of the maximum potential support, including high, medium and low viability potentials. These figures demonstrate that most of the present population, about 60 percent, is located in areas with medium or low viability and that even for the other 40 percent, conditions of family income surplus, social services, or physical condition of the rural habitat are inadequate. The area has no potential to support more settlements under present circumstances. On the contrary, there is a real need for investment, new economic activities, and better conditions of housing and services. The alternatives to immediate development are very low levels of living and a high rate of emigration.

A second question defined at the beginning of the study is related to the advantages or disadvantages of this dry area compared with other regions of the island. An analysis of regional differences and economic interrelationships on the island demonstrates that the area under study presents many restrictions for economic activities. Comparative advantages historically have favored the northern regions and some fertile valleys. A particular condition of the study area is the strong influence of the international boundary which interrupts regional interchange and transforms relative distances, creating a dependence on the respective capitals. The area traditionally has been neglected on both sides of the border, except for a short period in the 18th century when the Cul de Sac was developed with French plantations. Given the paucity of public investment, other regions seem more appropriate for future development.

The final questions refer to future policies for regional development and the possibility for other types of settlement. Most national and regional authorities concerned with the study area were interviewed, and official reports on future policies for development in both countries were consulted. However, no significant programs of regional development were detected for the near future. In Haiti, a project for the development of rural communities in the Rivière Blanche area is in its initial stage, and constitutes the most important investment in the entire arid environment of the Enriquillo-Cul de Sac Depression. In the Dominican Republic, the new President is interested in development of the border areas. Specific studies are not available, however, and regional surveys, basic problems and new projects are only now being discussed to determine potential implementation with international support from the Organization of American States.

At present, regional development consists of small programs of INDESUR and sectoral activities by national agencies in charge of education, health, public works or agriculture. Appropriate integrated development is lacking on both sides of the border.

The question of settlement types more suitable for the environmental and social conditions of the study area has no ready answer. Agriculture is now the basic economic activity. Fishing and mining present additional resources, but are of little commercial importance. Tourism offers some possibilities, but there are much better alternatives in other regions of both countries. Hence, agriculture remains

the sole economic activity that offers some potential for future development. To improve agriculture, it is necessary to provide technology, commercialization and financial aid. At the same time, new types of agrarian settlement might be tried, such as extensive agriculture or cattle raising. Finally, to increase the value of agricultural products and family income for small-farmer communities, it is necessary to develop agro-industry on a larger scale.

In general, there is urgent need to improve the conditions of small-farmer communities. According to this study, there are four actions that should be implemented within the near future:

1. Public investment to improve social services, infrastructure and housing in the rural areas.
2. Programs to improve present conditions of agricultural technology, commercialization and financial aid.
3. Policies to encourage emigration from rural areas to reduce high densities in the semiarid zones.
4. New national investment programs to develop economic activities, such as agro-industry, cattle raising or tourism.

These actions themselves face constraints, because of comparative advantages of other regions and the limited financial resources of both governments. In Haiti, financial conditions are worse, yet the Inter-American Development Bank program for the Rivière Blanche area will provide economic development in a district of small farmers and should be supplemented with a few public investments to assure an integrated development of the Ganthier sector.

Conclusions based on this research may be summarized as follows:

1. The concept of geographical viability was confirmed as a useful tool to evaluate potential for the development of specific human activities in areas with environmental constraints or diverse spatial characteristics. The heuristic model of factors that affect viability and the method of threshold analysis likewise proved useful. These concepts and methods can be applied in similar studies of other areas with geographical constraints.
2. Arid and semiarid regions present special constraints that must be analyzed with a geographical approach. This is particularly true for the new perspective on arid zones developed by the United Nations Conference on Desertification. The potential for population support in these areas should be examined from an ecological perspective, considering all the natural limitations and spatial characteristics of each individual region. Economic activities and social development must be clearly related to these geographical considerations.
3. The concept of appropriate development and the small-farm approach should be further investigated in relation to the potentials and constraints of arid and semiarid areas. There is need for better geographical knowledge to define the type of development appropriate for specific arid regions, such as the Enriquillo-Cul de Sac Depression. This

appears to be a fruitful field that could be developed with new studies in applied geography. The small-farmer approach, considered as a valid alternative for the Green Revolution, presents special limitations when applied to arid or semi-arid environments, and much research is needed to determine the viability of small-farmer communities in dry areas of other underdeveloped countries.

4. The viability of small-farmer communities in the Enriquillo-Cul de Sac Depression is generally low, and specific small areas of high viability are not sufficient to support their present densities of rural population. As a result, living conditions are poor, and there are no prospects for future development at the scale necessary to overcome the natural or spatial constraints. Policies for improvement of social services, technical support and financial aid are urgently needed. The immediate alternative is a massive emigration from rural areas to the respective capitals. This process may alleviate present necessities in rural areas, but would create increased social tension and economic needs in the oversized urban centers.

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