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Ulrich Scholz

Identification and Analysis of Agroproduction Zones by the Overlay-Correlation Method

The Case of COSTA RICA

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ACKNOWLEDGEMENTS

The present study is the result of a three month stay at CIAT in Cali, Colombia (August-November 1983) by the author as a Visiting Scientist. The goal was to test the applicability of a method of regional analysis developed by the author in Sumatra/Indonesia (Scholz, 1983) on a region in Latin America. The sample area, Costa Rica, had been chosen by CIAT, and was not known to the author before the assignment started. Naturally, this made the task more difficult, but it demonstrated that the methodology can virtually be applied to any region with relatively moderate inputs in terms of time, personnel and financial means.

At CIAT I found great hospitality and excellent working conditions. I am especially grateful to Dr. Peter Jones for his generous support and that of his team in the Agroecological Studies Unit: Yuviza Barona for typing this report; Walter Hurtado for the cartography; Humberto Becerra and Simon Carter for their manifold assistance.

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Cali, Colombia, November 1983. ULRICH SCHOLZ[a]

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1. CONCEPT AND METHOD

1.1. The need for regional analysis for agricultural research:

In the past, agricultural research has obviously focused its activities on a pure commodity approach and neglected the regional approach to some extent. This has repeatedly resulted in the fact that apparently successful achievements of agricultural research were not accepted or only partially accepted in certain regions because they were not designed either for the specific human needs and potentials or for the natural conditions of the respective area. A series of examples hereof has been the past two decades of agricultural research in SE Asia (which nevertheless have been successful). However, agricultural research can only yield optimal results if an equilibrium between the commodity and regional approach is achieved to adjust agricultural research as precisely as possible to area specific problems and possibilities. Such an approach, of course, requires a basic knowledge of the natural, social, and economic resources of the assigned area, and an insight into the often rather complicated interaction pattern of these resources.

Regional analysis attempts to provide the required information.

1.2. Concepts of regional analysis:

Normally the first step in the analysis of a region, whatever its size, is a division of subregions which are then compared with each other. This subdivision can be performed according to different criteria, e.g. climate, soils, economy, populations, etc., depending upon the specific needs and interests of the respective author or his employer which kind or regionalization he wants to apply. We have chosen a regionalization according to agroproduction criteria to best serve the needs of agricultural research. The aim of any regionalization is to achieve a spatial ordering of a higher level heterogeneous regional system, within which each subordinate regional subunit is characterized by relatively homogeneous conditions in regard to the chosen criterion (e.g. climate). An agroproduction zone thus provides a more or less homogeneous agricultural production pattern while all other factors, such as climate, population density, etc. may differ from each other.

However, the majority of attempts at regional analysis do not exhibit one of the above-mentioned kinds of regionalization, but rather use a subdivision of their assigned region in administrative units. Thus, an analytic report of a country is usually based on a comparative description of its provinces. The explanation is simple: almost universally the statistics (the most important auxiliary means for analysis) are classified according to administrative units which are used as the basis of the reports.

An analysis according to administrative units has significant shortcomings. As a consequence of their historical development (which will not be discussed here in detail) administrative units (even including nations) tend to be expressively heterogeneous with regard to natural, demographic, economic and other factors. Their borders do not conform with those of natural units; rather they run opposite to them. The Central American states provide a good example hereof: while the natural geographical regions are oriented NW-SE along the isthmus, most of the national borders follow the opposite direction from the Pacific to the Atlantic, thus providing each state with a share of the major natural regions of Central America. This heterogeneity also applies to administrative subunits within states. For example, four of seven provinces of Costa Rica (San Jose, Alanjuela, Heredia, Cartago) each contain such different natural regions as the temperate, densely populated and intensively cultivated central highlands

("Meseta Central"), as well as damp and sparsely settled coastal lowlands, and uninhabited forested mountain zones. Statistical mean data- for example, for agriculture- of such administrative units must, therefore, result in totally distorted conclusions, as accurate and scientifically sound as they may be in themselves.

The weakness of administratively classified regional analyses has led to repeated attempts to use other kinds of regionalization. Thus, there exist a variety of partially useful, country reports which follow the natural regions concept. However, up till now, the decisive disadvantage of this approach was the lack of adequate quantitative data for such regional units, and thus the lack of a measurable and verifiable objective basis. Conclusions of such reports must therefore, remain vague; often they reflect the personal impression of the respective author rather than reality. Despite a number of excellent performances such reports have repeatedly been criticized for not being scientifically sound. The same ill fate would necessarily also apply for a regional analysis based on a subdivision into agroproduction zones.

In view of this dilemma a solution is necesary which combines the advantages of the two basically opposite approaches and avoids the disadvantages. It should be possible to find a method to reorder the existing administratively classified data in such a way that they are operative for any other regional classification.

The following "Overlay Correlation Method" is, we hope, an approach to reach that goal. It is so surprisingly simple that it can also be made useful for more practically oriented members of any research discipline and not only for an exclusive circle of specialized scientists. In addition, the method is neither complicated nor expensive.

1.3. The Overlay Correlation Method:

The method consist of four steps:

a) Design of crop production maps by dot-distribution

First, maps must be prepared of all the major crops in the assigned area as well as a set of maps with the most important demographic and ecological features (e.g. distribution of population, climate, relief, soils, etc.). All these maps must be designed at precisely the same scale and should be drawn on transparent paper.

The core of our work consists of designing maps of the crop distribution. For that we have to rely on official statistics although we know how limited they may be, particularly in Third World countries. The easiest and most precise way to map crop distribution is to indicate their location by dots which represent a certain area. The size of the serial unit depends on the size of the total region. In the case of Costa Rica, units of 100 ha per dot proved to be optimal for all crops (1000 ha units were used only for pastures). In larger regions, such as Colombia or certainly Brazil, 1000 ha units would probably be adequate.

To achieve satisfactory results it is essential to place the dots as exactly as possible where the respective acreage of crops exist in nature. Aerial photographs, satellite imagery, and land-use maps can be good auxiliary means to identify the precise location. But even more important is the author's own knowledge of the region. In many cases, he must personally survey the area and visit the staff of local agricultural institutions, e.g. extension workers and place the dots on the maps in their presence. After some training such surveys can be carried out relatively quickly. Their value becomes even more apparent if one considers the great amount of background information obtainable during such surveys- a prerequisite of a good regional analysis.

To a certain extent Costa Rica is a special case, in so far as this country provides an Agricultural Census which splits all data down to such small administrative units as the "distritos" (the country consists of 7 provinces, 79 "cantones" and 406 "distritos"). This made it possible for us to place the dots precisely enough even without previous consultation with local informants. Besides, there exist comparatively good secondary literature and maps, and last but not least, we found among the present CIAT staff several outspoken "Costa Rica specialists" who could provide suggestions as to the possible location of crops. Therefore, a two week survey through Costa Rica proved sufficient to provide the author with the necessary background information on the major agroproduction zones.

Many other Latin American countries are certainly less well equipped with data. In these, more thorough survey activities would be a necessary precondition for a successful application of our methodology.

b) Identification and delineation of the agro-production zones: By overlaying the transparent maps of crop distribution we can now identify and delineate the different agroproduction zones which are named after the respective dominating crop or crop combination.

In Costa Rica we distinguished 32 micro-production regions which could be combined into the following five major production zones (See also Map 13):

1)	rice-based production zones	(5 micro-regions)
2)	coffee-based production zones	(7 micro-regions)
3)	sugar-banana-cacao production zones	(4 micro-regions)
4)	cattle-mixed annuals-production zones	(12 micro-regions)
5)	cattle-based production zones	(4 micro-regions)

NOTE: Our crop distribution maps are based on the Agricultural Census of 1973, i.e. the data are quite old (the new census of Costa Rica is still under preparation). The rapid development of agriculture during the past decade has led to some significant structural changes in certain areas, especially in the cacao- and banana-based production zones where rice cultivation is rapidly expanding. Besides, the census of 1973 does not mention oil palms although many of them existed prior to 1973. Today, oil palms cover an area of more than 13,000 ha. These recent developments could not be considered in our maps; they will, however, be indicated in the analytic profiles of the respective microregions.

c) Transfer of the crop-data from the maps onto a new table:

We now have to overlay our transparent map of the agroproduction zones over each of the different crop distribution maps, then we simply count the number of dots which fall into the respective zones and list the results in a new table. Thus, we have achieved our objective: an agricultural statistic which is no longer classified according to administrative units but to agroproduction units (See the comprehensive Table in Appendix C).

NOTE: The set of crop production maps has been employed only for our specific purpose: an analysis of the agroproduction zones. It should be mentioned that the same maps could also be used for any other approach of regional analysis. Instead of the map with the agroproduction zones one would only have to overlay them with another map of regional units. Thus, for example, an analysis of the agricultural pattern according to soil zones, or to climatic zones might also yield very interesting results.

Besides, the information level of the crop production maps could be augmented. Instead of only providing information of the area (1 dot = 100 ha) each of the dotes could be turned into different symbols indicating additional qualitative aspects of the respective crop, such as cultivation techniques, varieties, yields, cropping intensity, etc. This procedure would, however, definitely require of the author a detailed knowledge of the region.

d) Correlating the agroproduction data with ecological and demographic features; establishing regional profiles:

To carry out this final step we, again, overlay our map with the agroproduction zones over the maps of the population, rainfall, soils (or any other required map) identify the conditions for each of our regions separately and also put the results into the above mentioned table.

We are now in a position to draw from this table comprehensive regional profiles for each of the microproduction zones (Appendix A) which finally serve as the necessary quantitative basis for our regional analysis. It goes without saying that the data base as well as our following regional analysis could be constructed in greater detail or could be tailored differently according to specific needs. This would not, however, affect the methodological procedure, the demonstration of which is the main objective of this report.

2. COSTA RICA - AN OVERVIEW

2.1. Natural Resources

Costa Rica (excluding the Isla del Coco) covers an area of about 50,600 km^2 which is slightly smaller than west Virginia. It's population accounted for 1,872,000 inhabitants in 1973. Among the Central American countries Costa Rica is the next smallest in area (before El Salvador) and in population (before Panama).

The country's natural structure is similar to that of the Central American states: a mountain range of volcanoes and recently folded sections form the central core which encloses several highland basins, e.g. the central highlands or "Meseta Central". The highest elevations reach well above 3,000 msl. To the north, the terrain descends gently toward the flat Caribbean coastal lowlands. Toward the Pacific in the south, coastal plains alternate with hilly zones which reach right to the ocean. The Pacific coast is thus much more differentiated with more beaches, peninsulas, etc. than the straight Caribbean coastline.

Climate

Located between 9° and 11° north of the Equator, Costa Rica exhibits both regions with semihumid tropical features (e.g. its NW section) as well as very humid areas of the equatorial tropical type (e.g. the Caribbean lowlands).

In the coastal lowlands the average temperature ranges around 26° - 27°C and drops to about 20°C at 1000 msl and to 7°-8°C at 3000 msl. Due to the country's location near the Equator the yearly range between the coldest and the warmest month does not exceed 4°C, i.e. there are no thermic seasons. Consequently, agricultural

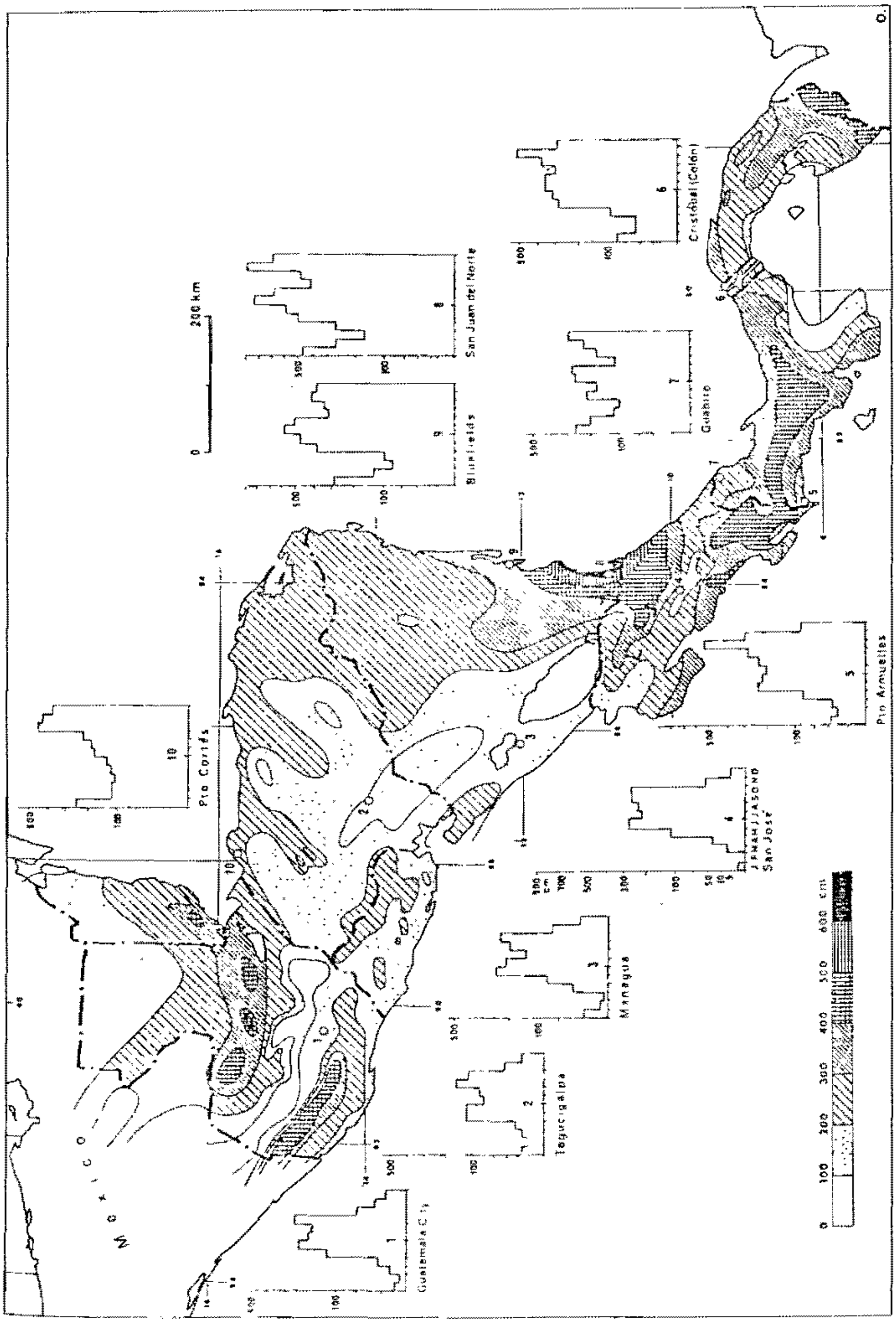

México
200 km
Guatemala City
Tegucigalpa
Managua
San José
Pto Armuelles
Cristóbal (Colón)
Guabito
San Juan del Norte
Bluefields
Pto Cortés
0
100
200
300
400
500
600 cm

FIGURE 1. Mean Annual Rainfall in Central America (Portig, 1965)

activities are ensured the whole year round even up to high altitudes. Only the composition, not the productivity of agriculture changes with increasing height: in the coastal lowlands ("tierra caliente") the dominating crops are rice, bananas, cacao and oil palms. In the temperate zone between 500 msl and 2000 msl ("tierra templada") coffee and sugarcane prevail; and throughout both zones maize, beans, and cattle are found. Above 2000 msl ("tierra fria") we generally find cattle for dairy production, and potatoes.

Altogether, the country receives sufficient rainfall for agricultural requirements (See Map 3). The mean yearly amounts range from 1800 mm in the northwestern section (Pacifico seco), 2000-2500 mm in most of the central highlands ("Meseta Central"), about 4000 mm along the eastern and central sections of the Caribbean coast (Zona Atlantica), up to 4700 mm in the southeastern section of the Pacific lowlands, and finally up to 6000 mm in the northernmost part of the Caribbean coast.

Figure 1 shows Costa Rica's position within the overall rainfall situation of Central America.

By far more important for agricultural problems than the average yearly amounts, in some places, are the striking differences between rainy and dry seasons. For one thing, the yearly distribution of rainfall is determined by the seasonal change of the trade-winds; on the other hand the rather rugged relief of the isthmus causes pronounced microclimatic variations which can result in very different rainfall patterns over short distances. These are of crucial importance for crop production, particularly for rice and beans.

Soil: (Map 4)
Compared with many other tropical countries of the world, Costa Rica has rather favorable soils. Many developed on volcanic ash being generally rich in minerals or were formed on alluvial

substratum originating from volcanic hinterlands. In general, high base status soils with high activity clays prevail (e.g. Vertisols, Mollisols, Entisols and the greater part of the Inceptisols). According to Sanchez and Cochrane (1980) the major problems of these soils are less chemical shortcomings such as nitrogen deficiency but rather drought (as in the NW of Costa Rica) and above all, the threat of erosion. From our observations, the process of erosion is still limited in Costa Rica. Where it occurs it is undoubtedly caused not so much by overcropping as by overgrazing.

Acid infertile soils, (i.e. soils with low activity clays, aluminum toxicity, and pH values below 5.0) are represented by Ultisols and only part of the Inceptisols. Oxisols, "the problem soil" of huge areas of the humid tropics throughout the world, do not occur at all.

A man-made problem restricted to areas of former banana plantations is copper toxicity caused by excessive use of copper-based fungicides.

The share of the different soil-types in the total area of Costa Rica is shown in the following Table 1.

The same table correlates the distribution of the soil types to the distribution of agriculturally used land and of unused land, respectively, each comprising almost exactly 50% of all of Costa Rica.

Of the four major soil types (Ultisols and Inceptisols - Dystropept, -Dystrandept, -Humitropept) which comprise 74% of the country, only Ultisols are clearly concentrated in the sparsely populated areas. The other major soils are more or less evenly distributed over both, used and unused areas.

TABLE 1. The share of the major soil types in the total area of Costa Rica (in %)

		Within agroprod. zones	Within empty zones
Histosols	1 %	4 %	96 %
Vertisols	2 %	100 %	-
Ultisols	19 %	37 %	63 %
Mollisols	4 %	68 %	32 %
Alfisols	< 1	100 %	-
Entisols	7 %	40 %	60 %
Inceptisols - Tropaquept	3 %	47 %	53 %
" - Placandept	2 %	-	100 %
" - Dystrandept	14 %	44 %	56 %
" - Humitropept	12 %	40 %	60 %
" - Ustropept	7 %	88 %	12 %
" - Dystropept	29 %	54 %	46 %
	100 %		

Source: Compiled from Soil Map in Appendix C.

The conclusion is that the different soils did not determine the existing agricultural production pattern of Costa Rica to such an extent as one might have expected. Other factors, such as population density, land tenure, and climate (particularly rainfall distribution) have possibly had as big or bigger an impact on the development of the present land-use pattern as the varying soil conditions.

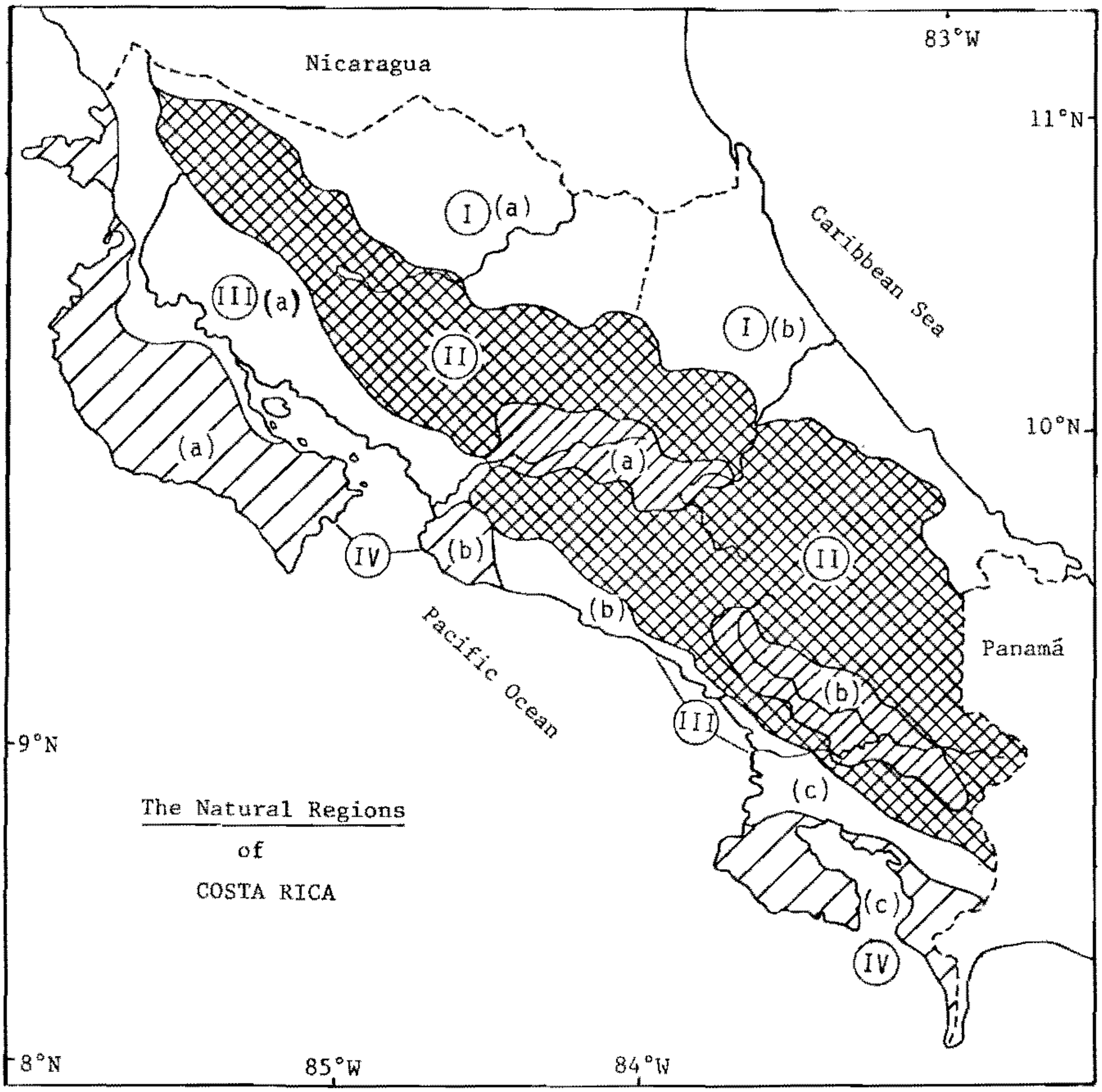

Nicaragua
83°W
11°N
I (a)
Caribbean Sea
III (a)
II
I (b)
10°N
(a)
(a)
IV
(b)
II
Panamá
(b)
Pacific Ocean
III
(b)
9°N
The Natural Regions
of
COSTA RICA
(c)
(c)
IV
8°N
85°W
84°W

FIGURE 2.

I. Caribbean Lowlands
a) Zona Norte
b) Zona Atlantica

II. Mountain Zone
a) Meseta Central
b) Valle General

III. Pacific Lowland Plains
a) Tempisque Lowland
b) Central Section (Quepos-Parrita)
c) SE Section (Diquis - Coto)

IV. Pacific Hilly Zones
a) Peninsula of Nicoya
b) Turrubares Hills
c) Peninsulas of Osa and Burica

Natural Regions (Figure 2)

The combined view of all natural features results in the following classification of natural regional units:

- I) The Caribbean Lowlands
  - a) Northern section ("Zona Norte") including Los Guatusos and San Carlos.
  - b) Eastern section ("Zona Atlantica") including Tortuguero and Limon.
- II) Mountain Zone (Cordilleras) including
  - a) Meseta Central (or: Valle Central)
  - b) Valle General.
- III) Pacific Lowland Plains
  - a) Tempisque-Lowland ("Chorotega"; Guanacaste - prov.)
  - b) Central section (Parrita - Quepos)
  - c) Southeastern section (Diquis - Coto); or "Brunca"
- IV) Pacific Hilly Zones
  - a) Peninsula of Nicoya ("Chorotega"; Guanacaste - prov.)
  - b) Turrubares Hills (Puriscal)
  - c) Peninsulas of Osa and Burica ("Brunca").

2.2. Population

Some 41% of the total population of 1,872,000 (1973 data) live in towns; 59% are spread over the rural areas. Thus, the rural areas exhibit a population density of 22 persons/km^2. Yet, more than half of the rural population is concentrated in the coffee-based production zones of the Central Highlands (this is also particularly true of the urban population) which covers only 7% of Costa Rica's total area. Here, rural districts have population densities of around 150 persons/km^2. On the other hand, slightly more than half the country can still be classified as "uninhabited" with only 1 person/km^2 (Map 5).

Whereas the natural conditions of Costa Rica do not differ substantially from those found in other Central American countries, its population demonstrates some specific differentiating characteristics: the average income per capita is higher and the number of illiterates is lower than in the other Central American countries. Also, Costa Rica is different from the majority of Latin American countries in that the social structure of the rural population is still composed of small holders, although at present the number of haciendas is rapidly increasing. Social conflicts have, therefore, been the exception (Sandner, 1961).

2.3. Agriculture

While agriculture plays a key role within Costa Rica's economy its share of the G.N.P. has recently fallen behind that of industry. Yet, industry is largely concerned with the processing of agricultural products. About half the country's labor force is employed in agriculture. The total value of agricultural exports varied between 70% and 75% during the seventies but has been decreasing to 63% in 1980 (SEPSA, 1982). About 80% of the holdings and more than 90% of the farm land are worked by their owners and the rest by various types of tenants and sharecroppers. Land tenancy is thus relatively satisfactory and there is less impetus for agrarian reforms than in many other Latin American countries (Blutstein et al., 1970).

The densely settled Central Highlands form the nucleus from which centrifugically large parts of peripheral outer areas have been colonized during the past decades. Initiators of this colonization process were the small holders searching for new farmland or subsistence cropping. In many cases their cleared areas were taken over in the second generation by hacienda owners who planted pastures for extensive cattle production whereas the pioneering peasant moved on, steadily expanding the frontier toward the periphery (Sandner, 1961). At the same time a third and final step in the colonization process is observed: in which large scale mechanized production of field crops is beginning to replace cattle husbandry around the newly established centers. It should be noted that rice plays a key role in this process. Independent of the indigenous dynamics of agriculture and also isolated in geographical terms, a plantation economy with bananas was imported from abroad around 1875, followed by oil palms after World War II. Primarily, due to the so-called "Panama disease", the banana plantation economy was first transplanted from the former main growing area on the Caribbean coast, to the Pacific side, and later back again to the Atlantic side — this time mainly due to strategic proximity of the Panama Canal, once the Panama disease was under control. Today, along the Pacific coast, most of the former banana plantations have been turned into oil palm estates, whose produce is mostly consumed within the country and is not transported through the Panama Canal.

From the early days of Costa Rica's history as an independent country, coffee has been the major agricultural product, which in 1980 contributed 23% to the overall gross return of Costa Rica's agroproduction (SEPSA, 1982). The country was the first coffee exporter in Central America. The production concentrates almost exclusively in the Central Highlands and the surrounding slopes which are largely volcanic in origin. The typical coffee farmer represents to a large extent the rural middle class of Costa Rican society, and the quality of his product ranks among the best on the world market.

Coffee is followed by bananas and cattle husbandry, each with about 20% of the total gross return on agriculture (Table 2). Cattle husbandry is characterized by two contrasting and geographically independent production systems:

a) Intensive and highly efficient dairy farms. These are concentrated in the higher parts of the central highlands above the coffee belt where they are occasionally found with vegetables and potatoes. Almost all of the specialized dairy farms have improved pastures and average 2.0-2.5 head of cattle per hectare.

b) Extensive cattle holdings for beef production in the lowlands and hilly zones of the vast outer areas. Pastures cover almost one-third of Costa Rica's total area and about four times that of all the plant crops together. The relatively dry NW part (Guanacaste) of Costa Rica is cattle country by tradition; however, in most other parts of the country, extensively used pastures with scattered stands of bushes or trees are characteristic of the rural landscape. The average density ranges around 1 head of cattle/ha. In the transition zones toward the denser populated areas (e.g. in Puriscal) overgrazing and thus, the threat of erosion becomes a problem.

More than half the beef production is exported, mostly to the USA. (CENIA, 1983).

Compared with the three major products - coffee, bananas, and cattle - all other crops rank far below with regard to their gross returns: oil palms probably follow but we do not have precise data available. Next is sugarcane (4.6%), forestry products (4.2%), and rice (4.1%). The once flourishing cacao cultivation has been drastically reduced due to infestation by the "monilia" - disease and repeated collapses of market prices during the past few years. The two important subsistence crops, maize and beans, cover 23% of the cultivated area but do not contribute more than 1.3% (maize) and 0.7% (beans) to the total agricultural gross returns. Cassava plays only a marginal role; although scattered stands can be found in house gardens and on tiny fields throughout the country, cassava does not cover even 1% of the total cultivated area.

The following considerations will focus only on rice and beans.

RICE

Of all the food crops rice has undoubtedly achieved the most remarkable increases during the past few decades. While the area under rice cultivation accounted for less than 30,000 ha in the

TABLE 2. Composition of the agriculturally used area (1973) and division of the total agric. gross returns by commodities in percent (1980).

Rice	65,500 ha	4,1 %
Beans	26,700 ha	0,7 %
Maize	51,900 ha	1,3 %
Cassava	2,200 ha	0,1 %
Sorghum	3,800 ha	0,6 %
Tobacco	1,500 ha	0,4 %
Potato	2,000 ha	1,2 %
Vegetable	1,200 ha	n.a.
Total Annual Crops	154,800 ha	
Coffee	83,400 ha	23,0 %
Cacao	20,300 ha	1,0 %
Bananas	36,100 ha	20,1 %
Plantain + Guineo	9,900 ha	n.a.
Sugarcane	38,800 ha	4,6 %
Oil palms (about 13,700 ha in 1983 but not mentioned in Censos 1973)		
Others (mainly coconuts, pineapple)	2,500 ha	n.a.
Total perennial crops	191,000 ha	n.a.
Pastures (dairy + beef cattle)	1,558,000 ha	20,5 %
Others (pigs, poultry, fish, forestry)	n.a.	11,6 %
Total agricultural used area	1,903,800 ha	

Sources: - Rep. de Costa Rica, Censos Nacionales de 1973, Agropecuario
SEPSA, 1982 (p.112).

early 50's it increased to 50,000 ha in 1963, 65,000 ha in 1973 and at present is around 86,000.

An even more astonishing development has taken place with regard to production: the average yields increased from 1.3 t/ha (1963) to 2.9 t/ha (1979) and are at present probably well above 3.0 t/ha. Thus, the total production has quadrupled since 1963. Based on the assumption of an average per capita consumption of 90 kg unhulled rice per year Costa Rica today produces some surplus for export.

As our rice map (See Map 6) shows, there are pronounced production centers "rice-based production zones" tending to concentrate in the various sections of the Pacific lowlands such as the Tempisque basin in Guanacaste, the Quepos-Parrita area, and in Palmar-Golfito.

During the last few years rice cultivation has been rapidly gaining ground on the Caribbean side too, and is therefore, not yet marked on our respective maps. Here, new production centers are located west of Limon and around Upala (Zona Norte).

More than 90% of the present rice fields are planted with upland rice. But our impression is that much of it grows under similar conditions as "rainfed wet rice" as we know it from SE Asia. This applies to those rice fields which are located on flat alluvial plains where the rainwater does not run off even when the fields are not bounded by dams. This may also explain the somewhat surprising fact that in several places in Costa Rica two crops of upland rice per year are grown. Something which to our knowledge does not occur in the classical rice producing countries of Asia.

According to some rice experts of Costa Rica, the present high level of productivity can only be maintained or increased in the future if rice cultivation gradually shifts from upland techniques to irrigated rice production. Some irrigation schemes have been constructed on the initiative of individual hacienda owners. In addition, a huge government-sponsored irrigation project is under construction near Cañas (Guanacaste province), the first section of which (for 8,000 ha) will begin operation in 1984.

In contrast to Asia's millions of rice peasants with holdings of only 0.5 ha more or less, rice cultivation in Costa Rica is largely carried out on big holdings: almost 60% of the total production is achieved on only 4% of the rice farms, which have an average size of about 50 ha (CENIA, 1983); although some farms have up to 2,000 ha of rice. These big holdings are fully mechanized. Sowing as well as fertilizer application and plant protection is mostly done from airplanes hired for the jobs.

A second farm type consists of middle-sized holdings with an average of 3-4 ha of rice per farm unit. Usually these farms are semi-mechanized and they produce about one-third of the country's total rice production.

A third group are the "minifundios" who own no more than about 1 ha of rice each. Their contribution to the total production amounted to only 6% in 1973 (CENIA, 1983) and is probably decreasing. These minifundios still apply traditional production techniques, namely shifting cultivation with slash and burn practices without any capital input. Consequently, yields are low, generally not more than 1.0 t/ha. Most of the peasants are pioneer settlers in newly cleared forest areas without access to markets, nor do they have any other infrastructure available. They are, therefore, forced to produce their basic subsistence crops themselves.

Presently, the dominating variety is still CR-1113 which produced 85% of the total in 1980. However, this variety reportedly increasingly suffers from blast (Pyricularia orysae), and many rice farmers are considering switching over to CR 201 in the future. A third variety which is planted is CR 5272 (J. Morrillo, MAG).

The cropping calendar is determined by the rainy seasons which differ from one production zone to another, especially between the Pacific and Caribbean lowlands (See: separate regional profiles). Entrepreneurs leasing planes and harvesters are, thus, in a position to distribute their work on a seasonal basis throughout the country over the whole year.

In place of a second rice crop or a seven month fallow period some farmers plant an alternating annual crop on their rice fields, mainly sorghum, sometimes soybeans and in few cases other types of beans. In general, the farmers interviewed were not inclined to rotate their crops principally due to marketing problems.

Among the major constraints of rice cultivation, blast was generally cited first. The No.2 problems were generally weeds, especially "red rice" and "Rotboellia exaltata", in addition to planthoppers (Sogatodes oryzicola). Climatic constraints are another threat - particularly the repeated drought in the NW of Costa Rica (Guanacaste), or too much rain at harvest in the Caribbean lowlands.

BEANS (Map 7)

Apart from rice and maize, beans are the third most important food crop in Costa Rica. Nevertheless, bean production was stagnating through the 70's; and even decreased slightly in area from 26,700 ha (1973) to 24,700 ha (1980). In 1980, 40% of the beans needed for domestic consumption had to be imported from abroad (CENIA, 1983). According to oral information from the Ministry of Agriculture (A. Morales) the government plans to increase the production through guaranteed minimum prices and favorable credit conditions to make beans an attractive cash crop.

At present, beans are regarded as a typical subsistence crop of small holders. Some 80% of the production is cultivated on farms with less than 3.5 ha. Single plots of beans are rarely bigger than 0.5 - 1.0 ha.

Bean cultivation is not as a rule the main crop; farmers usually plant beans only as a substitute for more attractive crops such as coffee, rice, sugarcane or tobacco. Consequently, there are no real bean production centers or "bean-based production zones" as is the case with rice. The cultivation of beans is scattered throughout the country but nowhere is it dominant. Very often the plots are established on rugged highly sloped terrain unsuitable for mechanization. Areas with a relatively fair amount of bean production are the Valle General in SE Costa Rica (CA-MX-6 and CF3 on Map 13), the peninsula of Nicoya (CA-MX-1), the hilly area SW of the Meseta Central (Puriscal), and Upala (Zona Norte).

Both red and black beans are planted. Among the red bean varieties Mexico 80 and Chorotega prevail, while Porillo Sintetico, Talamanca and Ica Pijao are the most common black varieties.

The Costa Rican farmers distinguish between three different cultivation techniques:

a) "Tapado" (or covered bean production)
b) "Espeque" (planting with a planting stick) or "sembrado" (planted)
c) Semi-mechanized.

ad a) The most common production technique is the "tapado" - system which seems to be specific to Central America. In Costa Rica it is used on about 80% of the bean fields.

It is best suited to a sloped terrain covered with secondary shrubs. At the peak of the rainy season, i.e. in October in most parts of Costa Rica, the farmer simply broadcasts ("al voleo") the seed over the area. Then the shrub is cut but not burned and left as mulch in the field. Thus, one can speak of a "slash without burning technique". No further field preparation is done. The beans grow relatively quickly through the mulch and cover the terrain before the weeds come up which makes weed control unnecessary. In general, neither fertilizer nor plant protection is applied. The farmer simply returns to the field three months later for harvest when the dry season starts.

For a sufficiently thick mulch, a long fallow period after harvesting is necessary. Therefore, there is generally only one crop per year. After two or three years of cultivation a longer fallow of at least two years is required. Such extensive practices do, of course, require sufficient land reserves.

In denser populated areas farmers cultivate continuously over a period of years. Farmers with extremely small holdings try to achieve a second crop during the earlier, lighter rainy season (principally in May) hoping that the harvest will coincide with the short interim dry period ("veranillo"). For the secondary crop, the farmers use a slash and burn technique with "espeque" (See below). Instead of beans, maize can also be planted.

With such little inputs of both capital and labor, one cannot expect very high yields which, indeed, are generally below 0.5 t/ha. This, together with the extensive use of land, results in very low land-productivity. In view of the chronic deficit of beans, representatives of the Ministry of Agriculture (MAG) urge the replacement of the "tapado" system by more productive techniques.

Yet, the "tapado" technique also has considerable advantages which should not be overlooked, such as the very efficient protection against erosion and soil degradation by mulch, or the remarkable labor productivity (as has been shown in a detailed study of farming systems in Puriscal/Acosta by v. Platen, Rodriguez, Lagemann, 1982). From oral information given by S. Temple (CIAT staff) the mulch cover also provides good protection against web blight, insofar as it prevents heavy tropical rains from splashing on the bare soil and throwing up particles from below on the bean leaves.

As long as there are still land reserves available, the tapado technique can by all means be regarded as an ecologically tolerable production method and from the farmer's viewpoint economically sensible.

ad b) The "espeque" or "sembrado" technique is used on about 15% - 20% of the bean fields. Compared with "tapado" it is an intensified production method and is, therefore, preferably applied in densely settled areas, such as the Meseta Central or the western section of the Valle General around San Isidro.

This production method requires careful soil preparation, sowing with a planting stick ("espeque"), regular weeding, and application of fertilizer and plant protection. Such treatments make double cropping possible, albeit to a lesser extent with two bean crops. However, rotation with beans and maize is more common whereby the maize is generally planted first in the short rainy season followed by beans in the second, more pronounced season when the rains peak. Beans are often interplanted between the stalks of the harvested maize. Occasionally, maize and beans are also grown in association.

It goes without saying that the "espeque" system results in higher yields of around 0.7-0.8 t/ha than the "tapado" method. Yet, inputs of both labor and capital are considerably higher. In addition, the soil is more exposed to erosion.

ad c) A third technique is the semi-mechanized production method ("frijol semi-mechanizado"), but its contribution to the total production accounts for very little. Some rice farmers apply this technique to double crop beans after rice. Although yields of more than 1.0 t/ha are possible, most rice farmers did not find this rotation attractive enough to incorporate it into their farming system.

When asked for the most serious constraints to bean production, almost all bean farmers in all production zones mentioned the climatic conditions first. It was not lack of rain during the vegetative period but rather the high humidity during the harvest which was considered a major problem. Therefore, the planting date must be determined so that the harvest takes place in the dry period. This usually works well with the second crop from October to January but the first crop from May to August is always a risk because of the short and irregular dry period at harvest time.

Other constraints such as diseases, insects, etc. were reported to be of minor influence as compared with the climatic risks.

3. ANALYSIS OF SELECTED AGROPRODUCTION ZONES

As has been explained in Chapter 1, we divided Costa Rica into 32 different micro-production regions and grouped them into five superimposed agroproduction zones (See also Map 13). For each of the 32 micro-production regions a regional profile is constructed in which the basic data of the respective regions are listed (See Appendix A). However, a detailed interpretation of the data for every region will not be given. Details are given only for a selected number of regions which are of special interest for CIAT research activities. Such regions constitute all the existing rice-based production zones as well as two other zones which are expected to exhibit a rapid increase of rice cultivation in the coming years. In addition, one more zone was selected where bean production plays a relatively important role.

It is evident that, with the database now available such interpretations are possible for all the other regions as well.

3.1. The rice-based production zones

a) The Tempisque Lowlands (RI-1) - (regional profile No.1 in Appendix A)

This zone in Guanacaste province (NW Costa Rica) is presently the "rice bowl" of the country. About one-third of Costa Rica's total rice production occurs here.

The region is located between the Cordillera de Guanacaste in the north and the hilly parts of the Nicoya Peninsula in the south. Large sections consist of flat alluvial plains accumulated by the Rio Tempisque which flows right through the area (Fig. 3).

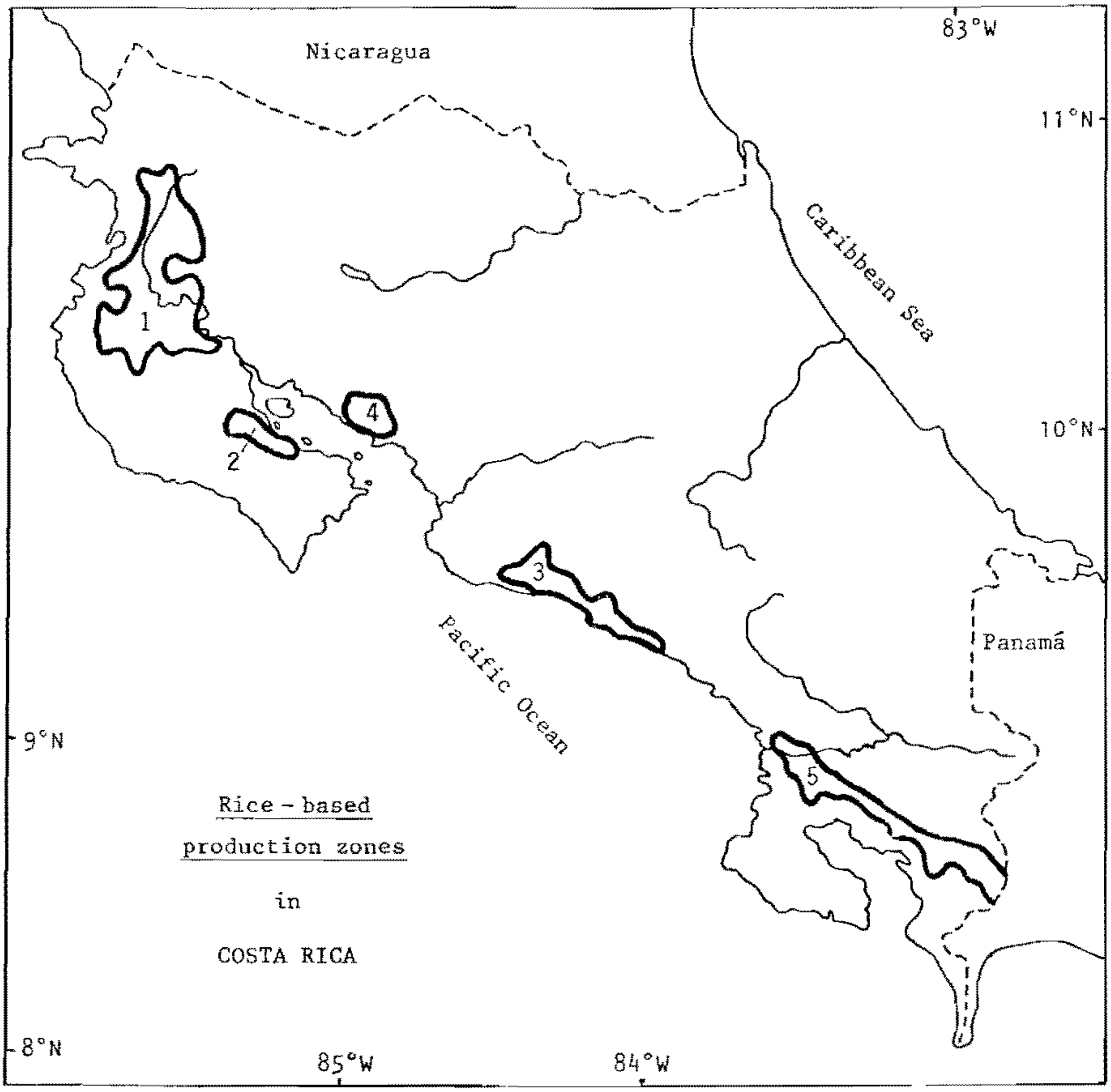

Nicaragua
83°W
11°N
Caribbean Sea
10°N
1
2
3
4
5
Pacific Ocean
Panamá
9°N
Rice - based
production zones
in
COSTA RICA
8°N
85°W
84°W

FIGURE 3.

1-	Tempisque Lowlands	(RI-1)
2-	East Nicoya	(RI-2)
3-	Quepos - Parrita	(RI-3)
4-	Puntarenas	(RI-4)
5-	Palmar - Golfito	(RI-BA)

Due to its location in the rainshadow of two mountain ranges the area is one of the driest parts of Costa Rica, yet, the average figure of 1,900 mm/year is a considerable amount of rain. But far more important for agriculture is the pronounced seasonality of the rainfall distribution. More than anywhere else, this part of Costa Rica exhibits a distinct dry season which lasts from December to April. During this time it may not rain at all for weeks. During July/August ("veranillo") a secondary minimum rainfall occurs which in normal years exhibits average mean values of 170-200 mm/month. Occasionally, however, there are short term droughts with disastrous impact on rice cultivation. The first rainy period in May/June and even more so, the main rainy season in September/ October provide constant and regular rainfall amounts of 250-300 mm, and 350-400 mm/month, respectively.

The described rainfall regime of the Tempisque Lowland is typical of many semi-humid parts of the tropics, such as the monsoon countries of south and southeast Asia which belong to the most important rice areas of the world.

The definite dry season obviously has positive effects on the soils, in so far as the fertility decline is much slower than in the very humid tropics (Sanchez/Cochrane, 1980). The plains are covered with Vertisols and Mollisols of alluvial origin, whereas the undulating and hilly transition zone toward the mountain ranges in the north and south are mainly Inceptisols of the Ustropept and Dystropept type.

For the original, precolumbian Indian population the natural conditions of this area have obviously proved to be more favorable than those of the more humid parts of the country because the traditional "milpa" farming, i.e., slash and burn cultivation could be done more easily in this somewhat drier area. Therefore, it was not by accident that this area in precolumbian times was more densely populated and had reached a higher cultural level than the other parts of Costa Rica (Sandner, 1961).

The present population consists almost exclusively of white colonists from the Central Highlands who have been clearing and colonizing the area for the last 100 years.

Guanacaste is traditionally cattle country and even today pastures cover vast parts of the region. But these pastures are used only extensively and rice production is increasing and has become the dominant enterprise in the area. The area under rice accounts for about 20,700 ha which is almost 75% of the total cultivated area. Most of it is still upland rice although there is a clear trend to expand the irrigated areas.

Of all the rice production zones of Costa Rica, the Tempisque Lowland is generally regarded as having the most favorable soils and the most suitable topographic conditions (flat plains surrounded by mountain ranges) for rice cultivation. Its most serious disadvantage is the climatic risk of unexpected droughts. Because of the long dry season farmers only produce one crop of upland rice per year. Our respondents generally agreed that irrigation would be the best solution over the long run (with simple gravity irrigation works being adequate). However, even with irrigation, in certain parts of the region, particularly to the south on the Nicoya peninsula, double cropping would hardly be feasible because most of the small rivers in these sections carry little or no water during the dry season. Another climatic threat is the heavy winds which blow in from the Pacific from November to January which are detrimental to the existing irrigated rice crops. The farmers in the area have, therefore, started to plant trees as windbreaks.

The planting time for upland rice is June/July (which is uniform for the whole area). There are occasional short term droughts in July/August which must be endured to profit by the principal rainy season in September/October. As the rains gradually abate by the end of October, farmers start harvesting. Rotations with other follow-up crops, e.g. sorghum (altogether 800 ha) or soybeans are only planted sporadically. In most cases the rice fields serve as pastures during the long fallow period from November to June.

Besides rice cultivation and the afore-mentioned cattle husbandry, there are few other agricultural activities of significant importance. There are some big holdings of sugarcane. Cotton cultivation is also in resurgence which, after a boom in 1964-67, had almost entirely disappeared. Maize and beans are the subsistence crops for the smallholders and their plots are scattered across the hilly parts of the area.

b) East Nicoya (RI-2) - (Regional profile No.2 in Appendix A)

This rice-based production zone is located in the eastern half of the Nicoya peninsula along the Gulf of Nicoya.

Representing a continuation of the Tempisque Lowlands, the natural environment and, thus, the conditions for agriculture are very similar to those described above.

The climate is characterized by a pronounced seasonality of the rainfall pattern with a very distinct dry season from December to April. Among the soils, we find mostly Vertisols in the plains and Inceptisols of the Dystropept type in the hilly parts of the area.

After rice (which covers 72% of the total cultivated area) only cattle husbandry plays an important role. All other enterprises are of minor importance.

c) Quepos-Parrita (RI-3) - (Regional profile No.3 in Appendix A)

This former banana region stretches along the central section of the Pacific lowlands. It consists of flat alluvial plains stretching northward at the steeply rising Cordillera de Talamanca.

The area enjoys plentiful but not excessive amounts of rain. With about 3,500 mm/year the area occupies an intermediate position between the relatively dry northern and the very humid southern section of the Pacific coast. As in the Tempisque Lowlands there is also a definite but shorter dry season from January to March (but with an average of 50 mm of rain, these months are not completely dry). The secondary minimum in August is hardly noticeable and has no impact on agriculture. All the months from May to November each have more than 300 mm of rain; April and December have more than 100 mm each.

Soils are generally composed of Mollisols and Entisols in the alluvial plains, and of Ultisols on the upland areas toward the mountains to the north.

The agro-landscape is dominated by extended areas of rice-cultivation (10,000 ha) and oil palm plantations (9,700 ha). As in many parts of Costa Rica, cattle husbandry plays an important role as well.

All other agricultural enterprises are of minor importance. The banana economy which once dominated completely, has disappeared along this section of the Pacific lowlands. In its place are oil palms.

With regard to the natural environment, the Quepos-Parrita zone is probably the most suitable of all in Costa Rica for rice production, at least for upland rice (with the exception of a single farm near Yacco no irrigated rice is cultivated in the area). The high and rather even distribution of rainfall permits two rice crops per year, particularly in low lying terrain with a high ground-water level. In the undulating uplands, the farmers generally produce only one rice crop per year, but rotate with sorghum or maize after rice.

The prevailing Mollisol soils are also favorable for rice cropping (as well as for bananas). However, due to excessive application of copper-based fungicides the former banana soils now suffer from copper toxicity and, thus, are not suitable for rice cultivation. Instead, oil palms have been planted on these soils.

To produce two rice crops per year, the first crop must be sown in April so that the second crop can be planted not later than the middle of September in anticipation of the start of the dry season in December. If only one crop of rice is planned, it can be planted at any time from May to August. The best planting date for sorghum, as a follow-up crop of rice, is the end of October, i.e., right after the peak of the main rainy season.

Yields of the first rice crop vary between 3.8 t/ha and 4.6 t/ha in normal years; the result of the second crop is generally somewhat lower-about 3.0 t/ha.

d) The rice-sugar zone of Puntarenas (RI-SU) - (Regional profile No.4)

This zone is located in the coastal lowlands north of the harbor town of Puntarenas. To the north, the area rises toward the Cordillera de Tilaran, and to the south it borders the Gulf of Nicoya.

The region consists mostly of undulating or hilly terrain which encloses some smaller alluvial plains.

Most of the hilly uplands are covered by Inceptisols of the Dystropept type and are principally used for double purpose cattle production. There are also some scattered fields with maize and to a lesser extent, beans. The enclosed plains are mainly Entisols. Here, the cultivation of rice and sugarcane is prevalent. Formerly, farmers also planted cotton but the cultivation of this crop has been almost completely abandoned.

The climatic conditions are similar to those in the Tempisque Lowlands, i.e., there is a very distinct dry season from December to April with extended periods of total drought. But the secondary minimum ("veranillo") in July/August is less pronounced and thus less risky. Nevertheless, upland rice cultivation is only possible once a year. Planting occurs in or around July. From December on, the harvested rice fields serve as pastures.

As in the Tempisque Lowlands some individual farmers have been starting to construct irrigation works which ensure a second yearly rice crop.

Weeds were considered the major constraint for rice cultivation in the area (even more important than blast) whereas insects were under control.

e) Palmar-Golfito (RI-BA) - (Regional profile No.5 in Appendix A).

The rice - banana-based zone of Palmar-Golfito is located to the southeast of Costa Rica (Brunca). It is formed by a long tectonic depression which stretches between the Cordillera Costera in the north and the hilly peninsulas of Osa and Burica in the south, and which continues east into the banana districts of western Panama.

Great parts of the area are completely flat and covered with fertile alluvial Mollisols, which turn into Entisols toward the marshy mangrove coast in the west (near Palmar). In the hilly parts to the north and south, Ultisols and Inceptisols of the Dystrandept type prevail.

The amount of rain along the Pacific coast increases considerably as you go from the northwest (Guanacaste) to the southeast and culminates in the Palmar-Golfito area with a yearly average of 4,000-5,000 mm. The region is, thus, one of the most humid parts of Costa Rica. (Only to the extreme north of the Caribbean lowlands near the Nicaraguan border do we find still wetter areas). With the exception of January to March, all the months of the year have mean precipitation of more than 200 mm. The amount in October (almost 800 mm) is higher than what many stations of the mid-latitude temperate zones register in a whole year. And even during the dry season the average monthly means of 100-120 mm are sufficient to ensure year-round production of a variety of crops.

The agricultural development of the Palmar-Golfito region had been initiated by banana plantations. From 1938 on, the United Fruit Company opened up what was at that time an almost uninhabited area, principally because the previous production center for bananas in the Caribbean lowlands had to be given up due to the Panama disease (Fusarium cubense) and Sigatoka (Area spora musae). Due to the high transport costs of shipping through the Panama canal and after successful breeding of disease resitant varieties, the banana production center has begun to shift back again to the Caribbean side. Of the 9,200 ha of bananas grown in 1973, at least 4,000 ha have been turned into oil palm plantations. Managers of the Compañia Bananera de Costa Rica reckon that by 1988 there will be no more banana plantations on the Pacific coast.

With the decrease in banana production, the cultivation of rice is increasing, although not exactly on the former banana areas due to copper toxicity of the soils; rather, these are reserved for oil palms (See also Quepos - Parrita). The rather evenly distributed and abundant rainfall between April and December normally allows two crops of upland rice (as yet there are no irrigated rice areas). As in Quepos - Parrita, the first crop has to be taken by August to sow the second crop by the middle of September. Some farmers also rotate the crop with sorghum or soybeans instead of a second rice crop.

3.2 The coffee-based production zones

Two out of four coffee production zones (CF-1 and CF-2), the two coffee-sugar production zones (CF-SU-1 and CF-SU-2), as well as the small coffee-potato production zone (CF-PT) together form a complex production area, the center of which is the central highlands from where the area stretches up toward the surrounding mountain slopes. In the following section, the whole area is called "the central coffee area of the highlands".

In addition, there are two more isolated coffee production zones (CF-3 and CF-4) in the western and eastern sections of the Valle General in SE Costa Rica, respectively. These will be called "the eastern coffee areas of the Valle General" (Fig.4).

a) The central coffee area of the Central Highlands - (Regional profiles 6-10).

Almost half the rural population of Costa Rica lives in this highland area, and the major urban settlements are located here.

About 30% of the area is situated between 500 msl and 1,000 msl, 50% between 1,000 msl and 1,500 msl, and 20% above 1,500 msl.

The mean yearly rainfall of the various stations accounts for about 1,800-2,200 mm; the yearly distribution presents a distinct dry season from December to April with average monthly precipitations of less than 50 mm. A secondary minimum exists between July and mid-September but the respective monthly values rarely drop below 200 mm so that one cannot speak of a "real" dry season.

The soil pattern is to a great extent composed of Inceptisols, mainly of the Dystropept - Humitropept - and Dystrandept types. Toward the more humid eastern parts of the area Ultisols gain in importance.

Vast stretches of the rural landscape are clearly marked by coffee, and supplemented by sugarcane in some parts. These two crops predominate.

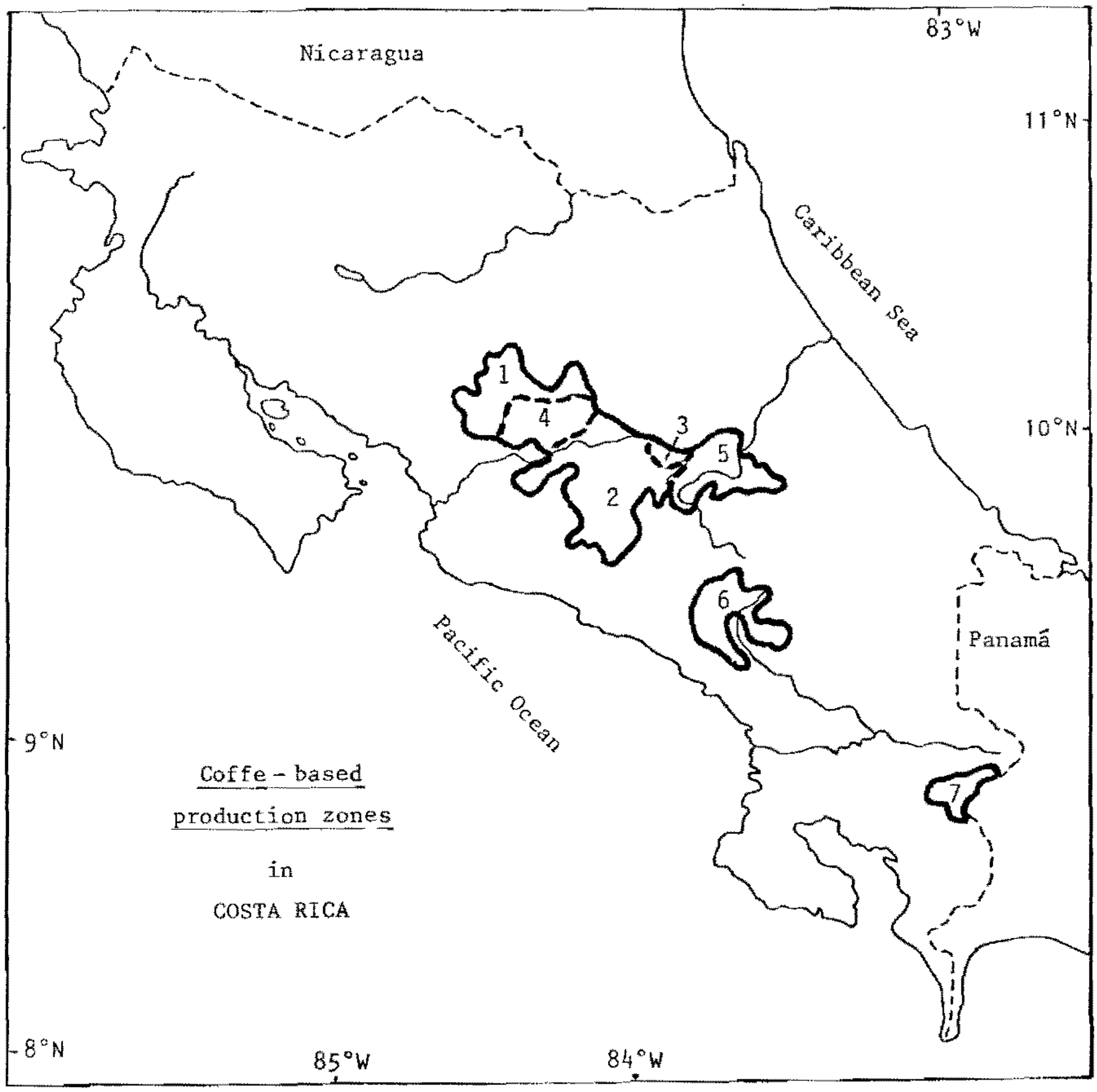

Nicaragua
83°W
11°N
Caribbean Sea
10°N
Panamá
Pacific Ocean
9°N
8°N
85°W
84°W
Coffe - based production zones in COSTA RICA
1
2
3
4
5
6
7

FIGURE 4.

Central Coffee Area

1- Meseta Central, west (CF-1)
2- Meseta Central (CF-2)
3- Cartago (CF-PT)
4- Grecia (CF-SU-1)
5- Meseta Central, east (CF-SU-2)

Eastern Coffee Areas

6- Valle General, west (CF-3)
7- Valle General, east (CF-4)

Whereas sugarcane is usually grown on less sloped terrain which facilitates the use of machinery, coffee cultivation takes place on even steeper slopes. At higher altitudes of about 2,000 msl and above, dairy cattle and vegetable cultivation gain in importance. On the southern slopes of the Irazu volcano (3,432 msl) north of Ciudad Cartago, there is a center for potato cultivation (See regional profile CF-PT; No.8 In Appendix A).

Rice cultivation is non-existent. This is by no means entirely due to natural constraints. Soils, climate and in some parts the geographical relief would undoubtedly permit rice cultivation up to about 1,500 msl. An area such as the Central Highlands if transplanted into a south or southeast Asian country (with their prevailing subsistence-oriented peasantry) would probably be covered with terraced rice fields. Yet, in a farming society with a distinct division of labor, as exists in Costa Rica, the principle of comparative advantage clearly dominates over the subsistence mentality with regard to the spatial organization of agricultural production. Thus, in a densely populated area like the Central Highlands, crops with high land productivity such as coffee and sugarcane are clearly superior to all other crops, even though they do not contribute directly to the subsistence of the producers. The necessary foodstuffs, like rice, are imported from the country's periphery with its extended land reserves.

The same mechanism, although less pronounced than with rice, also applies to two other important food crops, maize and beans. Although the maps of these two crops (Maps No.6 and No.7) show a rather even distribution throughout the country, the picture becomes quite different when the cropping areas are correlated with the density of the rural population (not to speak of the urban population!). For beans, we find that for every 1,000 rural inhabitants there are 40 ha of beans in the outer areas but only 6 ha in the densely settled central area (total for Costa Rica: 24 ha). In the case of maize, the situation is very similar; the respective values are 78 ha/1,000 rural persons in the outer areas, and 11 ha/1,000 rural personas in the central region (47 ha/1,000 rural persons in all of Costa Rica).

When considering these figures, one should, however, take into account that for example, beans are cultivated more intensively in the central region where many bean farmers apply the "espeque" technique, double cropping, and use significant inputs of capital, as compared with the outer areas where generally the extensive "tapado" method is used (See under 2.3).

b) The eastern coffee areas of the Valle General - (Regional profiles 11, 12).

These two isolated coffee zones are located in the western (around San Isidro) and the eastern corners (around San Vito), respectively, of the Valle General in SE Costa Rica (Fig.4).

About 40% of both areas is situated above 1,000 msl, the rest is between 500 and 1,000 msl.

Mean annual precipitation varies around 2,900 mm in the western part and 3,500 mm in the eastern section. The yearly distribution exhibits a clear but not really dry minimum from January to March with average amounts of 20-90 mm/month. Between May and November, each month receives more than 260 mm of rain.

The soils consist primarily of Inceptisols, mainly of the Humitropept type. In the western section Ultisols are also frequent. In contrast to the central coffee area of the Central Highlands there has been no recent volcanic activity in the region leaving ash layers as a basis for fertile soils. The population density is much lower than in the Central Highlands. Coffee predominates. In comparison with the Central Highlands, sugarcane only plays a subordinate role. Rice is almost non-existent as the rather sloping terrain impedes mechanization. However, beans and maize are represented here on a higher than average basis. Together with the rest of the Valle General (Zone CA-MX-6) which is located between the two regions, the whole of the Valle General is one of the major bean producers of Costa Rica. The cultivation of beans in this area is duscussed in Chapter 3.4 (under "Valle General").

3.3. The sugar-, banana-, cacao-based production zones

These are isolated complex zones characterized by monoculture in large holdings or plantations. Of the two sugarcane-based production zones, one is located near Cañas/Guanacaste (SU-1) and the other around Ciudad Quesada in the colonization area of San Carlos/Alajuela (SU-2). Both zones are of only limited interest for our specific purpose; they are, therefore, not analysed in detail (for more detail see Regional profiles 13 and 14 in Appendix A).

The two other zones (BA-CC and CC-BA), predominant in banana and cacao cultivation, together form a continuous plantation belt which runs from the recently opened colonized area of Rio Frio to the west through the Caribbean lowlands via Guapiles, Siquirres to the coastal town of Limon, and from there along the coast to the Panamanian border where this belt merges into the banana zone of NW Panama, Fig.5.

In the more than 100 year history of Costa Rica's banana plantations, the production centers have moved from the Caribbean to the Pacific and back again as has already been noted in a previous chapter (See: 3.1 under "Palmar-Golfito"). At present, the banana plantations are concentrated around Guapiles (Zone BA-CC on Map No.13). With the decrease of cacao cultivation this area has gradually turned into a zone of monocropped bananas with a rapidly improving infrastructure: the old banana railway has recently been extended with new lines and a new asphalt road from Siquirres to Guapiles is presently under construction.

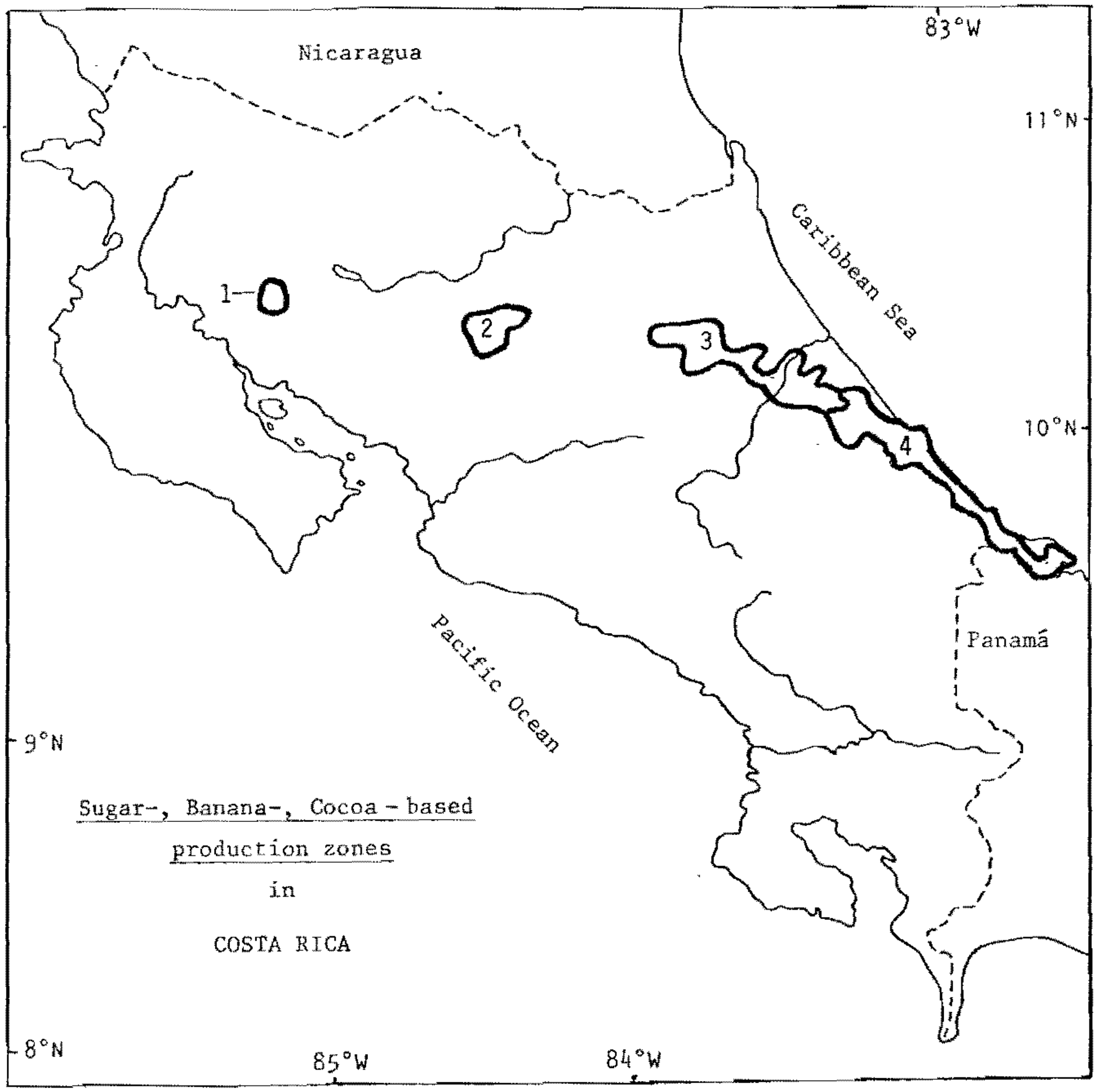

Nicaragua
83°W
11°N
Caribbean Sea
1
2
3
4
10°N
Panamá
Pacific Ocean
9°N
Sugar-, Banana-, Cocoa - based
production zones
in
COSTA RICA
8°N
85°W
84°W

FIGURE 5.

1- Cañas (SU-1)
2- Quesada (SU-2)
3- Guapiles-Siquirres (BA-CC)
4- Limon (CC-BA)

Numerous squatters ("parasitos") are settling along the new road or around the fringes of the plantations. On their small plots, carved out of the forest by slash-and-burn practices they grow some maize, upland rice and cassava for subsistence. Beans are almost non-existent; obviously, the climate is too humid. But with respect to rice, we are currently in a process of considerable expansion, particularly around Matina/Batan (W. of Limon) in agroproduction zone CC-BA. Therefore, this zone will be discussed in more detail in the following section.

LIMON (CC-BA) - (Regional profile 16 in Appendix A)

This zone encompasses the eastern half of the Caribbean plantation belt. From Matina/Batan in the west, it stretches via the hinterland of Ciudad Limon along the Caribbean coast to the Panama border in the east. The denomination "cacao - banana" zone reflects the reality of 1973. Since then the cultivation of cacao has decreased considerably while rice has increased. Today, one would call the area a "rice-banana" zone.

The climate, particularly the rainfall pattern of the Caribbean coast, is fundamentally different from that of the Pacific side. Though the absolute yearly amounts of 3,000-3,200 mm are not spectacularly high, local people consider the Limon area as a region where it always rains. Indeed, precipitation is quite evenly distributed throughout the year. Despite the existence of two yearly minimums there is no real dry season; it rains more than 100 mm per month. Due to the trade winds, the relatively drier period is September/October when the Pacific side receives the heaviest rainfall. Viceversa, the Caribbean stations register their maximum precipitation in December (430 mm) when the major dry season begins along the Pacific. A second, and again only relative, dry season lasts from February to April with monthly mean values of 100-200 mm.

According to topographic and edaphic features, we can divide the area lengthwise into two sections: (a) the alluvial coastal plains where Entisols as well as Inceptisols of the Tropaquept - and the Humitropept - (fluventic) type prevail. The latter two seem to be especially suitable for banana and rice cultivation; and (b) a hilly transition strip toward the southern mountains where Ultisols dominate.

The population density is still rather thin (23 rural persons/km^2). Whereas in most parts of Costa Rica white settlers predominate, there exists a strong minority of negros in the Limon area - descendents of Jamaican negroes who had been brought into the area for railway construction and as plantation workers (Blutstein et al., 1970). Today, many of them are independent small holders.

For centuries, the rural landscape was characterized by cacao plantations. Even in early precolumbian times indian tribesmen were engaged in cacao cultivation which was taken over and systematically expanded by white colonists from the early 17th century on. The center of production was located around Matina. For a long time, cacao served as an official currency (Sandner, 1961). However, poor cultivation techniques, deteriorating market prices and above all the rapid spread of the "monilla" disease resulted in a drastic decrease of cacao production during the last decade. Many former cacao farmers have switched to rice cultivation.

The second most important crop in the area is bananas. Besides the big export oriented plantations of American companies and some Costa Rican cooperatives, there are a number of small holders growing plantain and "guineo" - two other banana varieties which, apart form being used for home consumption, are used as swine feed.

Large scale rice production started around 1978. (By 1965 there had already been some initial trials but due to the lack of extension, marketing facilities and inputs most of the farmers did not continue to cultivate the crop. Today, there are about 5,000 ha of rice (1973: only 200 ha) and it is estimated that the area cutivated will grow to about 20,000 ha in the near future. The present cultivation center is located around Matina/Batan, west of Ciudad Limon.

Small and middle size farms of about 10-20 ha still prevail; but locals fear that in the coming years big holdings of more than 50 ha will become more common as in other rice production zones of Costa Rica. Obviously, the prospective entrepreneurs are waiting to assess the success of the small holders in this new rice area.

Up to now exclusively upland rice has been grown. Thanks to the rains which are evenly distributed throughout the year, farmers are able to produce two crops. The first rice season starts in May/June so that harvesting can be done during the somewhat drier period in September. The second season lasts from mid-October to February. Due to the very humid conditions around December, the second crop is affected by blast and yields are generally lower than those of the first crop.

Favored by the different seasons between the Caribbean and the Pacific sides, the entrepreneurs of the Tempisque "rice bowl" are in a position to lease their harvesters to the rice farmers in the Limon area.

Yields are clearly above Costa Rica's average. Our respondents reported average yields of 4.5-5.0 t/ha for the first crop and about 4.0 t/ha for the second one. These impressive results can obviously attributed to the very young age of most of the rice fields on virgin soils. In the long run, it will be difficult to maintain such high yield levels.

At present, farmers grow almost exclusively the variety CR 1113. The dominant problem is blast; there were fewer complaints about weeds and insects.

3.4. The cattle - mixed annuals production zones - (Regional profiles 17-28).

These zones comprise 40% of the total agriculturally used land, and are thus the largest of all agroproduction zone types. They are particularly characteristic of large parts of the scattered settled peripheral areas of Costa Rica (Fig.6).

Great parts of these zones stretch over the broad, hilly or undulating transition belts between mountain ranges and lowlands, generally between sea level and 500 msl.

With respect to soils, different types of Inceptisols prevail. With increasing humidity, the Ultisols increase to the east and southeast.

Agriculture is clearly dominated by extensive cattle husbandry; 88% of the total area in agriculture is in pastures. Although only 9% of the area in agriculture is in annual food crops, this is nevertheless important for residents because these crops meet their subsistence needs and even occasionally serve as a source of cash. The most common annual food crop is maize, followed by rice and beans. Whereas cattle husbandry is mostly carried out on large farms, maize, beans, and much of the rice is produced by small holders. Perennial crops cover only 3% of the total area in agriculture. Coffee is the most common perennial crop followed by plantains which often serve as shade trees in the small holders' plantations.

The spatial order of the rural landscape exhibits a sequence of concentric belts according to von Thunen's model: in the center is the settlement which is surrounded by a narrow belt of intensively cultivated upland fields with annual crops, mostly rice and a little maize and beans; the latter, being cultivated by the more intensive "espeque" method. Next follows the broad belt of pastures for extensive cattle husbandry. Finally, toward the periphery along the forest clearing there is a second belt of

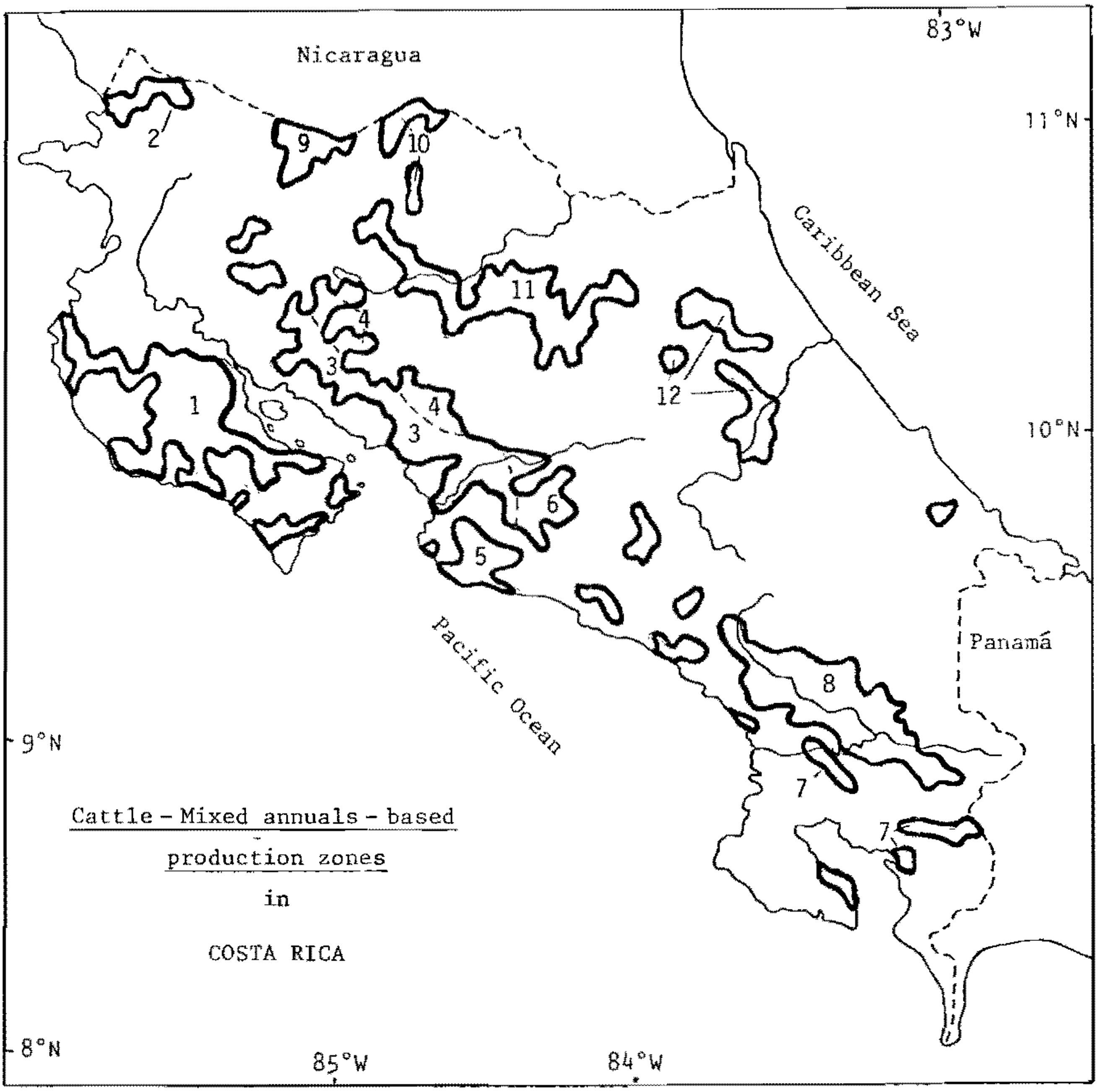

83°W
Nicaragua
11°N
2
9
10
Caribbean Sea
11
4
3
12
1
4
3
10°N
6
5
Pacific Ocean
Panamá
8
9°N
7
Cattle - Mixed annuals - based
production zones
in
COSTA RICA
7
8°N
85°W
84°W

FIGURE 6.

1- Nicoya (CA-MX-1)
2- La Cruz (CA-MX-2)
3- Bagaces-Esparza (CA-MX-3, lowland)
4- Tilaran-Turrubares (CA-MX-3, highland)
5- Yaco (CA-MX-4, lowland)
6- Puriscal-Acosta (CA-MX-4, highland)
7- Osa Burica (CA-MX-5)
8- Valle General (CA-MX-6)
9- Upala (CA-MX-7)
10- Los Chiles (CA-MX-8)
11- San Carlos-Sarapiqui (CA-MX-9)
12- Reventazon (CA-MX-10)

upland fields, composed of scattered plots which are extensively cultivated by the "tapado" method; beans and maize are the major crops of this outer belt which is often several kilometers away from the village. If the village is surrounded by mountain ridges coffee plots may also be scattered within this outer belt.

Because of the widespread occurrence, throughout the country, of the cattle - mixed annuals zones, these were subdivided into as many as 12 micro-regions. In the following sections all of these micro-regions are represented by a regional profile, not all of them had to be interpreted. Only two of them, being of special importance with respect to beans and rice, were chosen for a slightly more detailed analysis; these are:

a) the Valle General (CA-MX-6)
b) Upala (CA-MX-7)

> NOTE: There is a carefully elaborated regional analysis of the "Zona Norte" of Costa Rica elaborated by the University of Hamburg and the "Instituto de Tierras y Colonizacion de Costa Rica" to provide a basis for regional development (Sandner/Nuhn, 1971). This study covers our production zones "Los Chiles" (CA-MX-8) and greater parts of "San Carlos" (CA-MX-9), and it provides abundant information on the natural as well as the human resources of these two regions.
>
> Another study which should be mentioned is the report on farming systems in Acosta-Puriscal by v. Platen/Rodriguez/Lagemann (1982) which represents more or less the situation in the highland sections of our zones CA-MX-3 and CA-MX-4. The study also analyses the economics of the different types of bean production.

a) Valle General (CA-MX-6) - (Regional profile 24 in Appendix A)
This production zone represents only the central low-lying section of the Valle General, whereas the whole Valle General also includes the two "eastern coffee areas" (CF-3 and CF-4) mentioned in Chapter 3.2, in the western part (around San Isidro) and the eastern part (around San Vito) of the Valle General. The whole Valle General is an intermountain basin 110 km long and an average of 20 km wide bordered by the steep wall of the more than 3,000 msl high

Cordillera de Talamanca on the north, and by the 1,000 msl high coastal Cordillera in the South. The central parts of the bottom of this basin are less than 500 msl high but it rises to 750 msl around San Isidro in the west, and to about 1,000 msl in the opposite corner around San Vito to the east.

Although the basin is sheltered by mountain ranges from all sides it receives abundant rain which increases from west to east. The average yearly amount accounts for around 3,000-3,300 mm. The seasonal distribution is similar to that of the Pacific lowlands, i.e. a distinct dry season from December to March with monthly means of less than 100 mm., but seldom below 50 mm. During the wet season from May to November all the months receive more than 300 mm (October more than 500 mm). A secondary minimum which is typical for many parts of Costa Rica is hardly noticeable.

In contrast to the Central Highlands, there has been no recent volcanic activity in the mountains around the Valle General, and thus, no volcanic ash soils with their rich nutrient supply. About three quarters of the whole terrain is covered with Ultisols. The rest is composed of Inceptisols, mostly of the Humitropept type. Nevertheless, the overall natural conditions of the Valle General still offer favorable potential for a variety of possible agricultural activities.

Despite this, the Valle General had been virtually excluded from human settlement for a long time due to its isolation and difficulty of access. Up to the early thirties, the whole valley was nearly completely uninhabited; the present town of San Isidro consisted of only 5-6 huts (Sandner, 1961). This state of isolation ended abruptly when the area was opened by the road from San Jose to San Isidro in 1936 through which thousands of poor squatters from the crowded Meseta Central poured into the western part of the Valle General. After the construction of the Carretera Interamericana in the early sixties, the central section has also

been rapidly colonized. Yet, population density is still relatively low: 34 rural persons/km^2.
Great parts of the basin floor are occupied by haciendas which practice extensive cattle raising. In addition, some rice cultivation takes place in the low-lying plains. Near Buenos Aires, a pineapple plantation has been established (Del Monte). The activities of the small holders have gradually been pushed from the center to the peripheral foothills of the surrounding mountain ranges. In addition coffee, maize and particularly beans are cultivated. The Valle General is one of Costa Rica's major bean producers; around 1/4 of the country's total cultivated area of beans is concentrated here. There are many bean farmers particularly around Pejibaye, south of San Isidro.

Most of the beans are grown in the "tapado" system, particularly the main crop which is planted during the peak of the rainy season in October and is harvested in January in the dry season. Toward the more densely populated western part of the Valle General many farmers plant a second crop of beans from May on wards; for this second crop farmers usually apply the "espeque" technique which is preceeded by clearing with fire.

b) Upala (CA-MX-7) - (Regional profile 25 in Appendix A).
The recent colonization zone of Upala is located in the western part of the Zona Norte close to the Nicaraguan border only a few kilometers south of Lake Nicaragua. Due to its location east of the volcanic range of the Cordillera de Guanacaste the area belongs to the Caribbean lowlands although the Pacific is much nearer than the Atlantic coast.

With regard to climate the area holds an intermediate position between the Pacific and the Caribbean. As in the Pacific lowlands there is a distinct, albeit not completely dry season with an average rainfall of 50-70 mm per month which takes place slightly later (February to April) than along the Pacific coast. Here a phenomenon is found which is different from the Pacific side but similar to the Caribbean lowlands in that the rains are more evenly distributed throughout the year: from May to January there are always more than 200 mm but never more than 350 mm, and there is no secondary minimum. As in other parts of the Caribbean lowlands, Upala has the reputation of being an area where it always rains, although the total average amount (2,600 mm yr) is less than that which the stations of the central and southern Pacific coast receive.

Soils are exclusively Inceptisols, most of them of the Dystrandept type, besides some of the Dystropept and Tropaquept type. Many of the soils are alluvial and originate from the quarternary volcanoes of the Cordillera de Guanacaste. If sufficiently drained these soils should be highly fertile.

Apart from cattle, cacao cultivation has played a key role within Upala's agriculture up until about 10 years ago. Since then, cacao production has been declining significantly, for similar reasons as in Limon (See Chapter 3.3) while at the same time, the cultivation of rice increased.

At first rice was mainly grown by pioneering small holders, among them many people from Nicaragua; but with the completion of the new road from Cañas/Guanacaste the area has become attractive for fully mechanized large scale rice farming, too.

At present, only upland rice is grown; but some individual farmers are planning to construct irrigation works by 1985. Unlike what occurs in Limon (Chapter 3.3) farmers produce only one crop of rice per year; they suggest that a second rice crop might be too risky despite the long rainy season. But there is little risk involved in double cropping with an alternative crop such as maize, soybeans and other beans.

Rice planting usually starts at the beginning of the rainy season around May/June. Because of this harvesting, takes place in early

October when the rainy season is still going on. Obviously, this is not an ideal date for harvesting. Since marketing is not yet functioning very smoothly, due to the peripheral location of Upala, the rice, which is often wet as it is brought from the field, has to be stored too long under poor conditions which affect its quality. On the markets in the Central Highlands rice from Upala is, therefore, classified as inferior and its market price suffers. (When we visited Upala, the local rice farmers were just assembling to discuss measures of how to force the government to negotiate guaranteed prices).

To achieve better quality of their produce, the 15 biggest rice farmers are now jointly constructing the first big rice mill in the area.

Another possibility to improve the quality might be, from our viewpoint, a postponement of the cropping season for about two or three months. Harvest would then take place at the beginning of the dry season (December/January).

However, it would not be possible to plant another crop after rice because of the dry season which follows. But with the present practice of harvesting in October such a crop rotation is highly feasible: November (280 mm), December (210 mm), January (180 mm) still provide sufficient rain for another vegetative period, while (February (70 mm), March (60 mm), and April (50 mm) are good for harvesting. However, not all farmers make use of this possibility. Only one of our respondents does rotate his crops on 100 ha of his 300 ha of rice fields with maize, soybeans and principally with beans. This is one of the few examples in all of Costa Rica of mechanized bean cultivation (with the exception of the harvest).

With the help of fertilizer and plant protection, yields of beans range around 1.1-1.2 t/ha which result in a gross revenue almost as high as for rice. If we bear in mind the labor intensive harvest for beans, the farmers' interest is clearly focused on rice

production. Therefore, they are establishing irrigation works to achieve a second rice crop rather than cultivate beans or other annual food crops.
Here the prevailing variety is no longer CR 1113 (by contrast to other rice production zones) because the losses caused by blast had become too great. At present, CR 201 prevails but now weeds (particularly Rotboellia exaltata) are the No.1 problems.

3.5. Cattle-based production zones (CA-1 - CA-4)

These zones comprise 25% of the total area under agriculture but only 4% of the rural population. Some 99% of the area is in pastures; field cultivation is only practiced by a few scattered squatters. Like the cattle-mixed annuals zones, the purely cattle-based production regions are also spread throughout Costa Rica (Fig.7).

With the exception of small but intensively used areas for dairy cattle in the Central Highlands most of the cattle-based production zones are located in the poorly populated outer areas of Costa Rica. However, it is not these zones, as one might expect, but rather a small belt of extensive field cultivation by squatters which represents the actual clearing front spreading toward the primary forest areas (See Chapter 3.4). Only after the fields of these squatters are abandoned due to soil exhaustion and invading weeds as a result of the prevailing shifting cultivation techniques, are the areas turned into pastures.

The total area has been subdivided into four subzones according to the ecological aspects involved. The respective regional profiles are listed in Appendix A (No.29-32). Because these areas are of relatively little interest to us, no further interpretation of the profiles has been added.

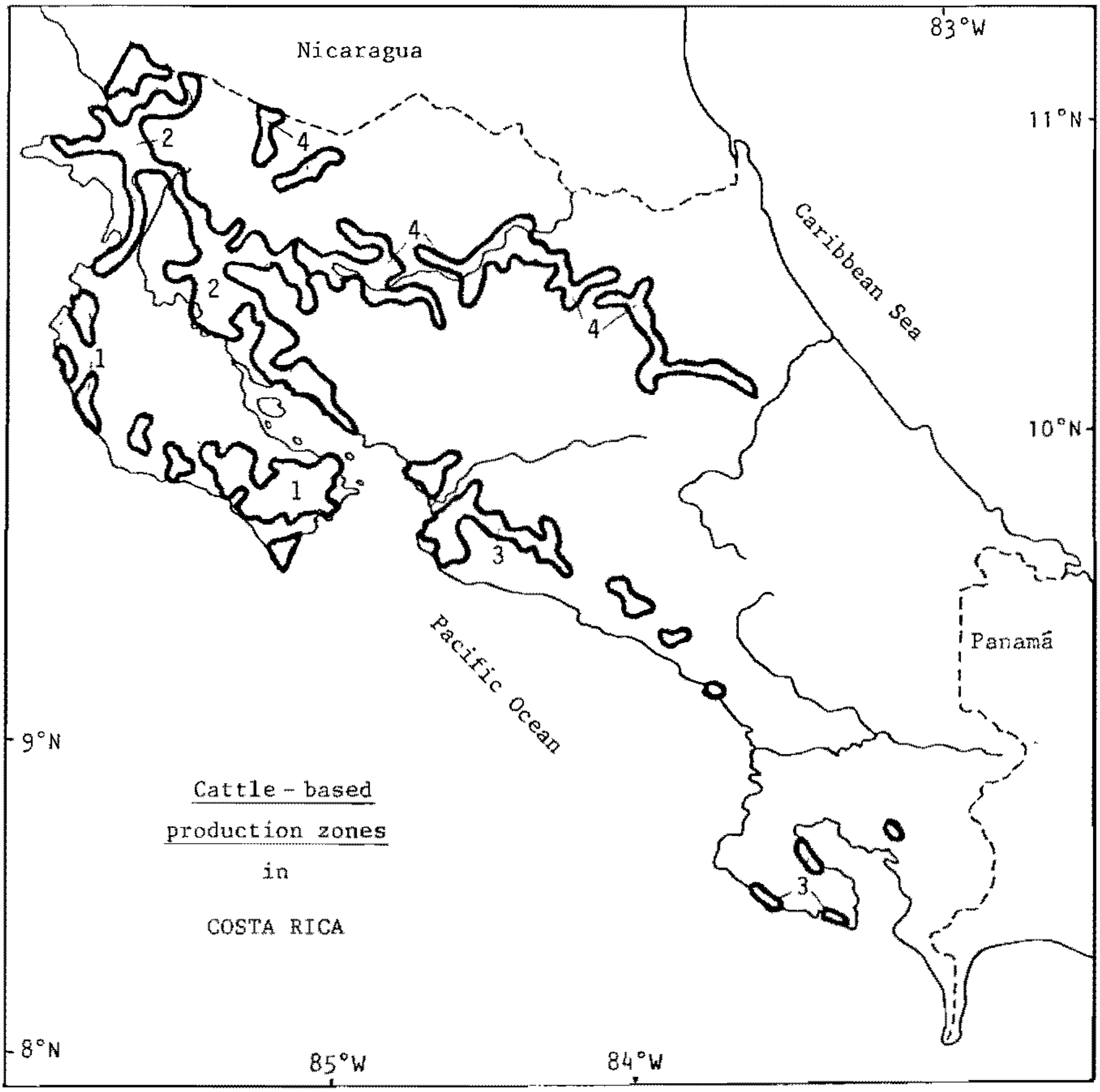

Nicaragua
83°W
11°N
10°N
9°N
8°N
85°W
84°W
Caribbean Sea
Pacific Ocean
Panamá
1
2
3
4
Cattle - based production zones in COSTA RICA

FIGURE 7.

1- Nicoya (CA-1)

2- Guanacaste (CA-2)

3- Puntarenas (CA-3)

4- Zona Norte (CA-4)

SUMMARY

The present study is the result of a three month visit to CIAT from August 13 - November 13, 1983. It attempts to demonstrate a methodology for regional analysis which should provide a basis for area-specific agricultural research and serve as a guideline for future implementation of research results into special micro-regions.

Costa Rica was chosen as a test case.

Regional analysis basically consists of a comparative analysis of regional subunits. In general, administrative units (e.g. provinces in a country) are used as subunits because the existing statistics are classified accordingly to them.

The results, however, are of little relevance to the needs of agricultural research because the borderlines of agroproduction are not determined by administrative borders. Often they run quite opposite to them. What is needed is an analysis of a region according to its agroproduction zones.

To achieve the necessary quantitative base for such an approach it is necessary to rearrange the existing administratively ordered data according to the agroproduction zones. For this purpose, we apply the overlay-correlation-method which is carried out in four steps:

a) Mapping separately by dot distribution the spatial distribution of all important agricultural commodities. (In the case of Costa Rica, we chose 100 ha units per dot).

b) Identifying and delineating the agroproduction zones by overlaying the transparent commodity maps and the design of a transparent map of the agroproduction zones.

c) Transferring the commodity data from the maps onto a new table by overlaying the agroproduction zones over commodity maps and counting the respective commodity figures for each agroproduction zone.

d) Correlating the agroproduction data with ecological and demographic features by overlaying the agroproduction map over respective thematic maps, e.g. rainfall, soils, relief, population maps and establishing regional profiles of each agroproduction zone.

In the case of Costa Rica, five major agroproduction zones were identified and named after the dominating crop or crop combination. These zones were again subdivided into a total of 32 micro-production regions. For all 32 micro-regions a regional profile was constructed. According to the specific needs of CIAT, eight of them were selected for more detailed interpretation.

References:

Banco Central de Costa Rica. (Sección Técnica Agropecuaria). Cálculo de producción por hectárea para cultivos más importantes de Costa Rica. San José, 1983.

BLUTSTEIN, H.I., et al. Area Handbook for Costa Rica. American University, Washington, D.C. 1970.

Centro Nacional de Información Agropecuaria (CENIA). Diagnóstico del Sector Agropecuario. San José, 1983.

CIAT - Agroecological Studies Unit. SAMMDATA-South American Monthly Meteorological Database. Cali-Colombia.

HOLDRIGE, L.R. and J.A. Tosi. The ecological adaptability of selected economic plants for small production in six regions of Costa Rica. San José, 1977.

Instituto Geográfico de Costa Rica. Mapa Físico-Político de Costa Rica 1:500,000. San José, 1974.

NASA: Landsat - satellite imagery. 1974-79.

Oficina de Planificación Sectorial Agropecuaria (OPSA). Mapa Asociación de sub-grupos de suelos de Costa Rica; 1:200,000. San José, 1978.

Oficina de Planificación Sectorial Agropecuaria (OPSA). Manual Descriptivo del Mapa de Asociaciones de Sub-grupos de Suelos de Costa Rica. San José, 1979.

Partido Liberación Nacional (PLN). "Volvamos a la Tierra"; Programa de Gobierno 1982-1986. San José, 1981.

PLATEN, v.H., G. Rodriguez, I. Lagemann. Farming Systems in Acosta - Puriscal, Costa Rica. Publ. of CATIE, Turrialba-Costa Rica, 1982.

PORTIG, W.H. Central American Rainfall. In: Geogr. Review, 55 (p.68-90), 1965.

República de Costa Rica. Censos Nacionales de 1973; Agropecuario. Dirección Gen. de Estadística y Censos, San José 1974.

SANCHEZ, P.A. and T.T. Cochrane. Soil constraints in relation to major farming systems of tropical America. In: "Soil-related constraints to food-production in the tropics"; (p.107-139) IRRI, Los Baños, 1980.

SALAS, W., I. León, I. Aguilar, C. Barbuza. El sector agropecuario costarricense - un análisis dinámico 1950-1980. Univ. de Costa Rica, Fac. de Agronomía, San José, 1983.

SANDNER, G. Agrarkolonisation in Costa Rica. Kiel/W. Germany, 1961.

SANDNER, G., H. Nuhn. Das nördliche Tiefland von Costa Rica. Berlin/New York, 1971. (In Spanish: Estudio Geográfico Regional de la Zona Norte de Costa Rica). Instituto de Tierras y Colonización (ed.). San José, 1969.

SCHOLZ, U. The natural regions of Sumatra and their agricultural production pattern - a regional analysis. Balittan Sukarami (ed.) Padang/Indonesia, 1983.

Secretaría Ejecutiva de Planificción Agropecuaria y de Recursos Naturales Renovables (SEPSA). "Información básica del sector agropecuario de Costa Rica", No.2. San José, 1982.

TOSI, J.A. Jr. Mapa Ecológico de Costa Rica - según la clasificación de L.R. Holdridge. San José, 1969.

APPENDIX A

REGIONAL PROFILES

No. 1: Regional Profile of Production Zone RI - 1 "Tempisque Lowlands"

Location : Guanacaste - providence (Chorrotega; Pacífico Seco)
Population : 38,000 rural inhabitants
Size of the area : 1,569 km^2
Population density : 24 persons/km^2

Altitude 0-500m: 100%, 500-1000m: -, 1000-1500m: -, >1500m: -
(% of total area)

Rainfall : average precipitation per year: 1,885 mm.

J	F	M	A	M	J	J	A	S	O	N	D
10	5	10	20	240	320	190	180	370	390	110	40

Soils : Histosols - Vertisols 24% Ultisols -
(% of total area) Mollisols 4% Alfisols - Entisols -
Inceptisols-tropaquept 3% -placandept - -dystrand -
-humitrop - -ustropept 46% -dystrop 20%

Agriculturally used area : 1,529 km^2

- Annual crops (harvested area in km^2): 262 km^2
  rice: 207 beans: 10 maize: 37 cassava: -
  sorghum: 8 tobacco: - potato: - vegetables: -

- Perennial crops (area planted in km^2): 279 km^2
  coffee: - cacao: - bananas: - plantain + guineo : -
  sugar: 17 others: -

- Pastures: 1,250 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 2: Regional Profile of Production Zone RI-2 "East - Nicoya"

Location : Guanacaste/Puntarena (Chorotega; Pacífico Seco)
Population : 6,000 rural inhabitants
Size of the area : 119 km^2
Population density : 50 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, >1500m: -

Rainfall : average precipitation per year: 2,335 mm.

J	F	M	A	M	J	J	A	S	O	N	D
10	15	30	60	290	320	280	330	400	450	120	30

Soils (% of total area) :

Histosols	-	Vertisols	58%	Ultisols	-
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	-	-placandept	-	-dystrand	-
-humitrop.	-	-ustropept	-	-dystrop	42 %

Agriculturally used area : 105 km^2

- Annual crops (harvested area in km^2) : 25 km^2

rice : 18	beans : 2	maize : 3	cassava : -
sorghum: 2	tobacco: -	potato : -	vegetables: -

- Perennial crops (area planted in km^2): - km^2

coffee : -	cacao : -	bananas: -	plantain + guineo : -
sugar : -	others : -		

- Pastures: 80 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 3: Regional Profile of Production Zone RI-3 "Quepos - Parrita"

Location : Centr. Puntarenas (Pacífico Central)
Population : 17,000 rural inhabitants
Size of the area : 406 km^2
Population density : 42 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 3,570

J	F	M	A	M	J	J	A	S	O	N	D
70	30	50	150	360	430	440	420	440	650	370	160

Soils : (% of total area)

Histosols	-	Vertisols	-	Ultisols	31 %
Mollisols	48%	Alfisols	-	Entisols	17 %
Inceptisols-tropaquept	-	-placandept	-	-dystrand	-
-humitrop.	-	-ustropept	-	-dystrop.	4 %

Agriculturally used area : 355 km^2

- Annual crops (harvested area in km^2) : 126 km^2

  rice :101 beans : 5 maize : 11 cassava : 1
  sorghum: 8 tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 9 km^2

  coffee : - cacao : - bananas: 1 plantain + guineo : 2
  sugar : 6 others : -*/

- Pastures: 220 km^2

*/ There are 97 km^2 of oil palms in the area not mentioned in the Censos Nacionales of 1973.

Data compiled from:
- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 4: Regional Profile of Production Zone RI-SU "Puntarenas"

Location : West-Puntarenas (Pacífico Seco)
Population : 4,000 rural inhabitants
Size of the area : 213 km^2
Population density : 19 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 2,305 mm

J	F	M	A	M	J	J	A	S	O	N	D
10	10	15	60	260	360	270	280	350	470	170	50

Soils :						
(% of total area)	Histosols	-	Vertisols	-	Ultisols	-
	Mollisols	-	Alfisols	-	Entisols	9 %
Inceptisols	-tropaquept	-	-placandept	-	-dystrand	-
	-humitrop.	-	-ustropept	-	-dystrop.	91 %

Agriculturally used area : 196 km^2

- Annual crops (harvested area in km^2) : 26 km^2

rice : 17 beans : 1 maize : 5 cassava : -
sorghum: 3 tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 20 km^2

coffee : - cacao : - bananas: - plantain + guineo : 1
sugar : 18 others : 1

- Pastures: 150 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 5: Regional Profile of Production Zone RI-BA "Palmar - Golfito"

Location : East-Puntarenas (Pacífico Sur; Brunca)
Population : 31,000 rural inhabitants
Size of the area : 688 km^2
Population density : 45 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 4,640 mm.

J	F	M	A	M	J	J	A	S	O	N	D
110	90	140	260	470	490	520	540	540	770	490	220

Soils (% of total area) :

Histosols	-	Vertisols	-	Ultisols	13 %
Mollisols	69%	Alfisols	-	Entisols	7 %
Inceptisols-tropaquept	-	-placandept	-	-dystrand	11 %
-humitrop	-	-ustropept	-	-dystrop.	-

Agriculturally used area : 549 km^2

- Annual crops (harvested area in km^2) : 149 km^2

rice : 111 beans : 12 maize : 23 cassava :
sorghum: 3 tobacco: - potato : - vegetables:

- Perennial crops (area planted in km^2): 120 km^2

coffee : - cacao : 3 bananas: 92*/ plantain + guineo : 23
sugar : 1 others : 1*/

- Pastures: 280 km^2

*/ About 40 km^2 of banana estates have been turned into palm oil - plantations.

Data compiled from:
- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 6: Regional Profile of Production Zone CP-1 "Meseta Central, West"

Location : Alajuela-province (Region Central)

Population : 51,000 rural inhabitants

Size of the area : 619 km^2

Population density : 82 persons/km^2

Altitude (% of total area) 0-500m: -, 500-1000m: 10%, 1000-1500m: 70%, >1500m: 20%

Rainfall : average precipitation per year: 2,045 mm.

J	F	M	A	M	J	J	A	S	O	N	D
15	10	10	20	260	300	250	270	380	360	120	50

Soils :	Histosols	-	Vertisols	-	Ultisols	9 %
(% of total area)	Mollisols	-	Alfisols	-	Entisols	22 %
	Inceptisols-tropaquept	-	-placandept	-	-dystrand	66 %
	-humitrop.	3%	-ustropept.	-	-dystrop.	-

Agriculturally used area : 489 km^2

- Annual crops (harvested area in km^2) : 19 km^2

  rice : - beans : 5 maize : 11 cassava : -

  sorghum: - tobacco: 1 potato : 2 vegetables: -

- Perennial crops (area planted in km^2): 140 km^2

  coffee : 116 cacao : - bananas: - plantain + guineo : -

  sugar : 24 others : -

- Pastures: 330 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 7: Regional Profile of Production Zone CF-2 "Meseta Central"

Location : San José/Heredia/Cartago (Región Central)
Population : 275,000 rural inhabitants
Size of the area : 1,331 km^2
Population density : 207 persons/km^2

Altitude 0-500m -, 500-1000m: 10%, 1000-1500m: 60% > 1500m: 30%
(% of total area)

Rainfall : average precipitation per year: 2,060 mm.

J	F	M	A	M	J	J	A	S	O	N	D
30	30	30	70	260	290	210	230	180	330	330	70

Soils : Histosols - Vertisols <1% Ultisols -
(% of total area) Mollisols - Alfisols - Entisols -
Inceptisols-tropaquept - -placandept - -dystrand 12 %
-humitrop. 15% -ustropept - -dystrop. 73 %

Agriculturally used area : 921 km^2

- Annual crops (harvested area in km^2) : 65 km^2
  rice : - beans : 16 maize : 35 cassava : -
  sorghum: - tobacco: 10 potato : - vegetables: 4

- Perennial crops (area planted in km^2): 276 km^2
  coffee : 265 cacao : - bananas: plantain + guineo : -
  sugar : 11 others : -

- Pastures: 580 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 8: Regional Profile of Production Zone CF-PT "Cartago"

Location : Cartago-province (Region Central; Valle Centr.Or.)
Population : 15,000 rural inhabitants
Size of the area : 79 km^2
Population density : 190 persons/km^2

Altitude (% of total area) 0-500m: - 500-1000m: - 1000-1500m: - > 1500m: 100%

Rainfall : average precipitation per year: 2,560 mm.

J	F	M	A	M	J	J	A	S	O	N	D
100	60	50	70	270	310	280	220	320	350	230	200

Soils :
(% of total area)

Histosols	-	Vertisols	-	Ultisols	-
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	-	-placandept	-	-dystrand.	67 %
-humitrop.	33%	-ustropept	-	-dystrop.	-

Agriculturally used area : 70 km^2

- Annual crops (harvested area in km^2) : 22 km^2

  rice : - beans : 2 maize : 1 cassava : -
  sorghum: - tobacco: - potato : 17 vegetables: 2

- Perennial crops (area planted in km^2): 18 km^2

  coffee : 18 cacao : - bananas: - plantain + guineo : -
  sugar : - others : -

- Pastures: (for dairy cattle) 30 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 9: Regional Profile of Production Zone CF-SU-1 "Grecia"

Location : Alajuela-prov. (Region Central; Valle Centr. Occ.)
Population : 120,000 rural inhabitants
Size of the area : 475 km^2
Population density : 253 $persons/km^2$

Altitude (% of total area) 0-500m: - 500-1000m: 70% 1000-1500m: 20% > 1500m: 10%

Rainfall : average precipitation per year: 1,895 mm.

J	F	M	A	M	J	J	A	S	O	N	D
10	10	15	50	270	290	200	210	310	350	140	40

Soils : (% of total area)

Histosols	-	Vertisols	19%	Ultisols	-
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	-	-placandept	-	-dystrand.	25%
-humitrop	42%	-ustropept	-	-dystrop.	14%

Agriculturally used area : 469 km^2

- Annual crops (harvested area in km^2) : 19 km^2

rice : - beans : 6 maize : 5 cassava :
sorghum: - tobacco: 3 potato : vegetables: 5

- Perennial crops (area planted in km^2): 230 km^2

coffee :123 cacao : - bananas: plantain + guineo :
sugar :104 others : 3 (oranges/ pineapple).

- Pastures: 220 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 10: Regional Profile of Production Zone CF-SU-2 "Meseta Central, East"

Location : Cartago-prov. (Region Central; Valle Centr. Orient.)
Population : 56,000 rural inhabitants
Size of the area : 588 km^2
Population density : 95 persons/km^2

Altitude (% of total area) 0-500m: 5%, 500-1000m: 60%, 1000-1500m: 30%, > 1500m: 5%

Rainfall : average precipitation per year: 2,480 mm.

J	F	M	A	M	J	J	A	S	O	N	D
140	100	90	110	230	270	290	230	230	270	260	260

Soils (% of total area) :

Histosols -	Vertisols -	Ultisols 56 %
Mollisols -	Alfisols -	Entisols -
Inceptisols-tropaquept -	-placandept -	-dystrand. 15 %
-humitrop. 27%	-ustropept -	-dystrop. 2 %

Agriculturally used area : 518 km^2

- Annual crops (harvested area in km^2) : 9 km^2
  rice : - beans : 2 maize : 6 cassava : -
  sorghum: - tobacco: - potato : - vegetables: 1

- Perennial crops (area planted in km^2): 179 km^2
  coffee : 92 cacao : - bananas: - plantain + guineo : -
  sugar : 87 others : -

- Pastures: 330 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 11: Regional Profile of Production Zone CF-3 "Valle General, West"

Location : East-S. José (Valle General/Pacífico Sur; Brunca)
Population : 23,000 rural inhabitants
Size of the area : 494 km^2
Population density : 47 persons/km^2

Altitude (% of total area) 0-500m: -, 500-1000m: 50%, 1000-1500m: 40%, > 1500m: 10%

Rainfall : average precipitation per year: 2,900 mm.

J	F	M	A	M	J	J	A	S	O	N	D
40	20	30	110	370	360	290	360	420	530	270	100

Soils : (% of total area)

Histosols	-	Vertisols	-	Ultisols	39 %
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	-	-placandept	-	-dystrand.	-
-humitrop.	47%	-ustropept	-	-dystrop.	14 %

Agriculturally used area : 382 km^2

- Annual crops (harvested area in km^2) : 43 km^2

rice : -	beans : 16	maize : 27	cassava : -
sorghum: -	tobacco: -	potato : -	vegetables: -

- Perennial crops (area planted in km^2): 79 km^2

coffee : 68	cacao : -	bananas: 1	plantain + guineo : 1
sugar : 9	others : -		

- Pastures: 260 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 12: Regional Profile of Production Zone CF-4 "Valle General, East"

Location : East-Puntarenas (Valle General/Pacifico Sur; Brunca)
Population : 19,000 rural inhabitants
Size of the area : 212 km^2
Population density : 90 persons/km^2

Altitude (% of total area) 0-500m: -, 500-1000m: 60%, 1000-1500m: 40%, >1500m: -

Rainfall : average precipitation per year: 3,550

J	F	M	A	M	J	J	A	S	O	N	D
80	60	90	170	450	390	340	380	400	630	400	160

Soils : (% of total area)

Histosols	-	Vertisols	-	Ultisols	-
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	-	-placandept	-	-dystrand.	33 %
-humitrop.	58%	-ustropept	-	-dystrop.	9 %

Agriculturally used area : 192 km^2

- Annual crops (harvested area in km^2) : 22 km^2
  rice : 2 beans : 8 maize : 12 cassava : -
  sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 40 km^2
  coffee : 38 cacao : - bananas: - plantain + guineo : -
  sugar : 2 others : -

- Pastures: 130 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 13: Regional Profile of Production Zone SU-1 (Sugar) "Cañas"

Location : Guanacaste-prov. (Pacífico Seco; Chorotega)
Population : 1,000 rural inhabitants
Size of the area : 113 km^2
Population density : 9 persons/km^2

Altitude 0-500m: 100%, 500-1000m: -, 1000-1500m: -, >1500m: -
(% of total area)

Rainfall : average precipitation per year: 1,760 mm.

J	F	M	A	M	J	J	A	S	O	N	D
10	5	10	30	230	300	160	190	350	370	90	15

Soils :	Histosols	-	Vertisols	17%	Ultisols	-
(% of total area)	Mollisols	27%	Alfisols	17%	Entisols	-
	Inceptisols-tropaquept	-	-placandept	-	-dystrand.	-
	-humitrop.	-	-ustropept	39%	-dystrop.	-

Agriculturally used area : 106 km^2

- Annual crops (harvested area in km^2) : 1 km^2
  rice : 1 beans : - maize : - cassava : -
  sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 25 km^2
  coffee : - cacao : - bananas: - plantain + guineo : -
  sugar : 25 others : -

- Pastures: 80 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 14: Regional Profile of Production Zone SU-2 (Sugar) "Quesada"

Location : Alajuela-prov. (Zona Norte)
Population : 15,000 rural inhabitants
Size of the area : 231 km^2
Population density : 65 persons/km^2

Altitude (% of total area) 0-500m: 30%, 500-1000m: 50%, 1000-1500m: 20%, > 1500m: -

Rainfall : average precipitation per year: 4,520 mm.

J	F	M	A	M	J	J	A	S	O	N	D
290	190	110	100	320	470	510	490	500	490	490	560

Soils : (% of total area)

Histosols	-	Vertisols	-	Ultisols	24 %
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	-	-placandept	-	-dystrand.	65 %
-humitrop.	8%	-ustropept	-	-dystrop.	3 %

Agriculturally used area : 212 km^2

- Annual crops (harvested area in km^2) : 6 km^2

rice :	-	beans :	2	maize :	2	cassava :	2
sorghum:	-	tobacco:	-	potato :	-	vegetables:	-

- Perennial crops (area planted in km^2): 66 km^2

coffee :	12	cacao :	-	bananas:	-	plantain + guineo :	4
sugar :	50	others :	-				

- Pastures: 140 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 15: Regional Profile of Production Zone BA-CC "Guapiles - Siquirres"

Location : Limon - prov. (Zona Atlãntico)
Population : 29,000 rural inhabitants
Size of the area : 700 km^2
Population density : 41 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, >1500m: -

Rainfall : average precipitation per year: 3,910 mm.

J	F	M	A	M	J	J	A	S	O	N	D
280	190	170	220	380	400	430	300	240	350	450	500

Soils : (% of total area)

Histosols	-	Vertisols	-	Ultisols	17%
Mollisols	-	Alfisols	-	Entisols	11%
Inceptisols-tropaquept	16%	-placandept	-	-dystrand.	40%
-humitrop.	16%	-ustropept	-	-dystrop.	-

Agriculturally used area : 583 km^2

- Annual crops (harvested area in km^2) : 30 km^2

rice : 4 beans : 1 maize : 22 cassava : 3
sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 243 km^2

coffee : - cacao : 41 bananas: 197 plantain + guineo : 4
sugar : 1 others : -

- Pastures: 310 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- Repũblica de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 16: Regional Profile of Production Zone CC-BA "Limon"

Location : Limon-prov. (Zona Atlântico)
Population : 19,000 rural inhabitants
Size of the area : 838 km^2
Population density : 23 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 3,090 mm.

J	F	M	A	M	J	J	A	S	O	N	D
280	190	190	200	270	260	340	260	110	200	360	430

Soils :	Histosols	-	Vertisols	-	Ultisols	34%
(% of total area)	Mollisols	-	Alfisols	-	Entisols	5%
	Inceptisols-tropaquept	32%	-placandept	-	-dystrand	-
	-humitrop.	29%	-ustropept	-	-dystrop.	-

Agriculturally used area : 319 km^2

- Annual crops (harvested area in km^2) : 9 km^2
  rice : 2*/ beans : - maize : 5 cassava : 2
  sorghum: - tobacco: - potato : - vegetables: -
- Perennial crops (area planted in km^2): 190 km^2
  coffee : - cacao :131*/ bananas: 36 plantain + guineo : 13
  sugar : - others : 10 (mainly coconuts)
- Pastures: 120 km^2

*/ At present there exist about 50 km^2 of rice in the area, mainly replacing cacao.

Data compiled from:
- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 17: Regional Profile of Production Zone CA-MX-1 "Nicoya"

Location : Guanacaste/Puntarenas (Pacífico Seco; Chorotega)
Population : 55,000 rural inhabitants
Size of the area : 1,850 km^2
Population density : 30 persons/km^2

Altitude (% of total area) 0-500m: 95%, 500-1000m: 5%, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 2,180 mm.

J	F	M	A	M	J	J	A	S	O	N	D
10	10	15	40	300	320	270	240	390	470	90	25

Soils (% of total area) :

Histosols	-	Vertisols	7%	Ultisols	-
Mollisols	1%	Alfisols	-	Entisols	3%
Inceptisols-tropaquept	-	-placandept	-	-dystrand	-
-humitrop.	-	-ustropept.	13%	-dystrop.	76%

Agriculturally used area : 1,552 km^2

- Annual crops (harvested area in km^2) : 152 km^2

  rice : 21 beans : 50 maize : 75 cassava : 1
  sorghum: 5 tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 20 km^2

  coffee : 12 cacao : - bananas: - plantain + guineo : 4
  sugar : 4 others : -

- Pastures: 1,380 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 18: Regional Profile of Production Zone CA-MX-2 "La Cruz"

Location : Guanacaste-prov. (Pacífico Seco; Chorotoga)
Population : 4,000 rural inhabitants
Size of the area : 181 km^2
Population density : 22 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, >1500m: -

Rainfall : average precipitation per year: 1,940 mm.

J	F	M	A	M	J	J	A	S	O	N	D
30	10	20	30	170	370	180	240	340	310	150	90

Soils :	Histosols	-	Vertisols	7%	Ultisols	-
(% of total area)	Mollisols	-	Alfisols	-	Entisols	-
	Inceptisols-tropaquept	-	-placandept	-	-dystrand	-
	-humitrop.	-	-ustropept	41%	-dystrop.	52%

Agriculturally used area : 170 km^2

- Annual crops (harvested area in km^2) : 9 km^2

rice : 3 beans : 3 maize : 3 cassava : -
sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 1 km^2

coffee : - cacao : - bananas: - plantain + guineo : 1
sugar : - others : -

- Pastures: 160 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 19: Regional Profile of Production Zone CA-MX-3 - Lowland "Bagaces - Esparza"

Location : Guanacaste/Punt./Alaj./S.José (Pacífico Seco, Central)
Population : 51,000 rural inhabitants
Size of the area : 1,444 km^2
Population density : 35 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: - 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 2,040 mm.

J	F	M	A	M	J	J	A	S	O	N	D
10	10	10	50	250	350	190	230	360	440	120	20

Soils :	Histosols	-	Vertisols	3%	Ultisols	-
(% of total area)	Mollisols	4%	Alfisols	3%	Entisols	5%
	Inceptisols-tropaquept	-	-placandept	-	-dystrand	1%
	-humitrop.	16%	-ustropept	22%	-dystrop.	46%

Agriculturally used area : 1,366 km^2

- Annual crops (harvested area in km^2) : 63 km^2

rice : 25 beans : 12 maize : 19 cassava : 3
sorghum: 4 tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 13 km^2

coffee : - cacao : - bananas: - plantain + guineo : 3
sugar : 8 others : 2

- Pastures: 1,290 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 20: Regional Profile of Production Zone CA-MX-3 - highland "Tilaran - Turrubares"

Location : Guan./Punt./Alaj./S. José (Pacífico Seco, Central)
Population : 21,000 rural inhabitants
Size of the area : 625 km^2
Population density : 34 persons/km^2

Altitude (% of total area) 0-500m: -, 500-1000m: 70%, 1000-1500m: 30%, >1500m: -

Rainfall : average precipitation per year: 2,170 mm.

J	F	M	A	M	J	J	A	S	O	N	D
70	30	40	100	240	300	220	240	310	310	160	150

Soils (% of total area) :

Histosols	-	Vertisols	2%	Ultisols	-
Mollisols	-	Alfisols	-	Entisols	29%
Inceptisols-tropaquept	-	-placandept	-	-dystrand	28%
-humitrop	17%	-ustropept	-	-dystrop.	24%

Agriculturally used area : 446 km^2

- Annual crops (harvested area in km^2) : 25 km^2

rice : -	beans : 10	maize : 14	cassava : -
sorghum: -	tobacco: 1	potato : -	vegetables: -

- Perennial crops (area planted in km^2): 21 km^2

coffee : 19	cacao : -	bananas: -	plantain + guineo : 1
sugar : 1	others : -		

- Pastures: 400 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 21: Regional Profile of Production Zone CA-MX-4 - Lowland "Yaco"

Location : Puntarenas/S. José (Pacífico Central)
Population : 15,000 rural inhabitants
Size of the area : 750 km^2
Population density : 20 persons/km

Altitude (% of total area) 0-500m: 100%, 500-1000m:-, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 3,570

J	F	M	A	M	J	J	A	S	O	N	D
70	30	50	150	360	430	440	420	440	650	370	160

Soils (% of total area) :

Histosols	-	Vertisols	-	Ultisols	54 %
Mollisols	13%	Alfisols	-	Entisols	7 %
Inceptisols-tropaquept	-	-placandept	-	-dystrand.	-
-humitrop.	-	-ustropept	-	-dystrop.	26 %

Agriculturally used area : 365 km^2

- Annual crops (harvested area in km^2) : 44 km^2

  rice : 29 beans : 4 maize : 7 cassava : -
  sorghum: 4 tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 1 km^2

  coffee : 1 cacao : - bananas: plantain + guineo : -
  sugar : - others : -

- Pastures: 320 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 22: Regional Profile of Production Zone CA-MX-4 - Highland "Puriscal - Acosta"

Location : Puntarenas/San José (Pacífico Central)
Population : 24,000 rural inhabitants
Size of the area : 481 km^2
Population density : 50 persons/km^2

Altitude (% of total area) 0-500m: -, 500-1000m: 50%, 1000-1500m: 30%, > 1500m: 20%

Rainfall : average precipitation per year: 2,440 mm.

J	F	M	A	M	J	J	A	S	O	N	D
40	30	40	80	250	330	240	310	390	450	220	60

Soils : (% of total area)

Histosols	-	Vertisols	-	Ultisols	-
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	-	-placandept	-	-dystrand	-
-humitrop	18%	-ustropept	-	-dystrop.	82%

Agriculturally used area : 215 km^2

- Annual crops (harvested area in km^2) : 39 km^2

rice	-	beans	16	maize	22	cassava	-
sorghum	-	tobacco	-	potato	1	vegetables	-

- Perennial crops (area planted in km^2): 26 km^2

coffee	20	cacao	-	bananas	-	plantain + guineo	1
sugar	5	others	-				

- Pastures: 150 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 23: Regional Profile of Production Zone CA-MX-5 "Osa - Burica"

Location : East. Puntarenas (Pacífico Sur; Brunca)
Population : 15,000 rural inhabitants
Size of the area : 375 km^2
Population density : 40 persons/km^2

Altitude (% of total area) 0-500m: 90%, 500-1000m: 10%, 1000-1500m: -, >1500m: -

Rainfall : average precipitation per year: 4,640 mm.

J	F	M	A	M	J	J	A	S	O	N	D
110	90	140	260	470	490	520	540	540	770	490	220

Soils (% of total area) :

Histosols	-	Vertisols	-	Ultisols	53%
Mollisols	12%	Alfisols	-	Entisols	22%
Inceptisols-tropaquept	-	-placandept	-	-dystrand.	-
-humitrop	-	-ustropept	-	-dystrop.	13%

Agriculturally used area : 248 km^2

- Annual crops (harvested area in km^2) : 22 km^2
  rice : 4 beans : 5 maize : 12 cassava : 1
  sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 16 km^2
  coffee : - cacao : 1 bananas: 4 plantain + guineo : 11
  sugar : - others : -

- Pastures: 210 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 24: Regional Profile of Production Zone CA-MX-6 "Valle General"

Location : San José/Puntarenas (Valle General; Pacífico Sur)
Population : 53,000 rural inhabitants
Size of the area : 1,569 km^2
Population density : 34 persons/km^2

Altitude (% of total area) 0-500m: 60%, 500-1000m: 40%, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 3,140 mm.

J	F	M	A	M	J	J	A	S	O	N	D
50	40	50	170	380	380	330	410	420	510	310	90

Soils : (% of total area)

Histosols	-	Vertisols	-	Ultisols	73%
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	-	-placandept	-	-dystrand	2%
-humitrop.	18%	-ustropept	2%	-dystrop.	5%

Agriculturally used area : 1,034 km^2

- Annual crops (harvested area in km^2) : 160 km^2

rice : 45 beans : 45 maize : 70 cassava : -
sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 44 km^2

coffee : 21 cacao : - bananas: 10 plantain + guineo : 5
sugar : 4 others : 4

- Pastures: 830 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 25: Regional Profile of Production Zone CA-MX-7 "Upala"

Location : NW - Alajuela (Upala; Zona Norte)
Population : 15,000 rural inhabitants
Size of the area : 338 km^2
Population density : 44 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, >1500m: -

Rainfall : average precipitation per year: 2,610 mm.

J	F	M	A	M	J	J	A	S	O	N	D
180	70	60	50	190	300	320	320	330	300	280	210

Soils (% of total area) :

Histosols	-	Vertisols	-	Ultisols	-
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	15%	-placandept	-	-dystrand.	52%
-humitrop	-	-ustropept	-	-dystrop.	33%

Agriculturally used area : 288 km^2

- Annual crops (harvested area in km^2) : 51 km^2

rice :	19	beans :	21	maize :	11	cassava :	-
sorghum:	-	tobacco:	-	potato :	-	vegetables:	-

- Perennial crops (area planted in km^2): 27 km^2

coffee :	1	cacao :	22	bananas:	2	plantain + guineo :	2
sugar :	-	others :	-				

- Pastures: 210 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 26: Regional Profile of Production Zone CA-MX-8 "Los Chiles"

Location : N - Alajuela (Guatusos; Zona Norte)
Population : 6,000 rural inhabitants
Size of the area : 244 km^2
Population density : 25 persons/km^2

Altitude 0-500m: 100%, 500-1000m: -, 1000-1500m: -, > 1500m: -
(% of total area)

Rainfall : average precipitation per year: 2,610 mm.

J	F	M	A	M	J	J	A	S	O	N	D
180	70	60	50	190	300	320	320	330	300	280	210

Soils :
(% of total area)

Histosols	8%	Vertisols	-	Ultisols	-
Mollisols	-	Alfisols	-	Entisols	-
Inceptisols-tropaquept	39%	-placandept	-	-dystrand	-
-humitrop.	-	-ustropept	-	-dystrop.	53%

Agriculturally used area : 169 km^2

- Annual crops (harvested area in km^2) : 18 km^2

rice	7	beans	2	maize	9	cassava	-
sorghum	-	tobacco	-	potato	-	vegetables	-

- Perennial crops (area planted in km^2): 1 km^2

coffee	-	cacao	-	bananas	1	plantain + guineo	-
sugar	-	others	-				

- Pastures: 150 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 27: Regional Profile of Production Zone CA-MX-9. "San Carlos - Sarapiqui"

Location : Alajuela/Heredia (S. Carlos/Tortuguera; Zona Norte)
Population : 48,000 rural inhabitants
Size of the area : 1,281 km^2
Population density : 37 persons/km^2

Altitude (% of total area) 0-500m: 90%, 500-1000m: 10%, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 4,150 mm.

J	F	M	A	M	J	J	A	S	O	N	D
300	170	150	100	310	480	540	410	360	450	450	430

Soils :	Histosols	-	Vertisols	-	Ultisols	9%
(% of total area)	Mollisols	-	Alfisols	-	Entisols	-
	Inceptisols-tropaquept	-	-placandept	-	-dystrand	24%
	-humitrop.	27%	-ustropept	-	-dystrop.	40%

Agriculturally used area : 1,224 km^2

- Annual crops (harvested area in km^2) : 65 km^2
  rice : 23 beans : 8 maize : 26 cassava : 7
  sorghum: 1 tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 69 km^2
  coffee : 18 cacao : - bananas: 13 plantain + guineo : 22
  sugar : 11 others : 3 (mostly pineapple)

- Pastures: 1,090 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 28: Regional Profile of Production Zone CA-MX-10 "Reventazon"

Location : Limon-province (Atlántico)
Population : 27,000 rural inhabitants
Size of the area : 631 km^2
Population density : 43 persons/km^2

Altitude (% of total area) 0-500m: 90%, 500-1000m: 10%, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 3,920 mm.

J	F	M	A	M	J	J	A	S	O	N	D
280	190	170	210	380	400	440	300	240	350	450	510

Soils :	Histosols	-	Vertisols	-	Ultisols	42%
(% of total area)	Mollisols	-	Alfisols	-	Entisols	-
	Inceptisols-tropaquept	31%	-placandept	-	-dystrand.	26%
	-humitrop.	1%	-ustropept	-	-dystrop.	-

Agriculturally used area : 264 km^2

- Annual crops (harvested area in km^2) : 22 km^2

rice : 1 beans : - maize : 20 cassava : 1
sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 12 km^2

coffee : 5 cacao : 2 bananas: 4 plantain + guineo : 1
sugar : - others : -

- Pastures: 230 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 29: Regional Profile of Production Zone CA-1 (Cattle) "Nicoya"

Location : Guanacaste/Puntarenas (Pacífico Seco; Chorotega)

Population : 15,000 rural inhabitants

Size of the area : 1,363 km^2

Population density : 11 persons/km^2

Altitude (% of total area) 0-500m: 95%, 500-1000m: 5%, 1000-1500m: -, >1500m: -

Rainfall : average precipitation per year: 2,145 mm.

J	F	M	A	M	J	J	A	S	O	N	D
10	5	10	40	300	320	250	240	390	470	90	20

Soils :	Histosols	-	Vertisols	1%	Ultisols	-
(% of total area)	Mollisols	-	Alfisols	-	Entisols	31%
	Inceptisols-tropaquept	-	-placandept	-	-dystrand	-
	-humitrop	-	-ustropept	17%	-dystrop.	51%

Agriculturally used area : 818 km^2

- Annual crops (harvested area in km^2) : 7 km^2
  rice : 1 beans : 1 maize : 5 cassava : -
  sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): 1 km^2
  coffee : 1 cacao : - bananas: - plantain + guineo : -
  sugar : - others : -

- Pastures: 810 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 30: Regional Profile of Production Zone CA-2 (Cattle) "Guanacaste"

Location : Guanacaste/Puntarenas (Pacífico Seco; Chorotega)
Population : 13,000 rural inhabitants
Size of the area : 2,563 km^2
Population density : 5 persons/km^2

Altitude (% of total area) 0-500m: 100%, 500-1000m: -, 1000-1500m: -, > 1500m: -

Rainfall : average precipitation per year: 2,255 mm.

J	F	M	A	M	J	J	A	S	O	N	D
10	5	10	30	260	300	190	200	350	380	120	40

Soils : (% of total area)

	Histosols	-	Vertisols	4%	Ultisols	-
	Mollisols	5%	Alfisols	-	Entisols	4%
Inceptisols	-tropaquept	-	-placandept	-	-dystrand	6%
	-humitrop	-	-ustropept	53%	-dystrop.	28%

Agriculturally used area : 2,430 km^2

- Annual crops (harvested area in km^2) : 10 km^2

rice : 7 beans : - maize : 3 cassava : -
sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): - km^2

coffee : - cacao : - bananas: - plantain + guineo : -
sugar : - others : -

- Pastures: 2,420 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 31: Regional Profile of Production Zone CA-3 (Cattle) "Puntarenas"

Location : Puntarenas (Pacífico Central, - Sur)
Population : 7,000 rural inhabitants
Size of the area : 582 km^2
Population density : 12 persons/km^2

Altitude 0-500m: 90%, 500-1000m: 10%, 1000-1500m: -, > 1500m: -
(% of total area)

Rainfall : average precipitation per year: 4,530 mm.

J	F	M	A	M	J	J	A	S	O	N	D
90	60	90	200	410	460	480	480	490	710	430	190

Soils :	Histosols	-	Vertisols	-	Ultisols	35%
(% of total area)	Mollisols	18%	Alfisols	-	Entisols	4%
	Inceptisols-tropaquept	-	-placandept	-	-dystrand	1%
	-humitrop.	-	-ustropept	-	-dystrop.	42%

Agriculturally used area : 277 km^2

- Annual crops (harvested area in km^2) : 7 km^2
  rice : 1 beans : - maize : 6 cassava : -
  sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): - km^2
  coffee : - cacao : - bananas: - plantain + guineo : -
  sugar : - others : -

- Pastures: 270 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

No. 32: Regional Profile of Production Zone CA-4 (Cattle) "Zona Norte"

Location : Alaj./Heredia/Limon (Zona Norte; Atlãntico)
Population : 9,000 rural inhabitants
Size of the area : 1,526 km^2
Population density : 6 persons/km^2

Altitude (% of total area) 0-500m: 80%, 500-1000m: 20%, 1000-1500m: -, >1500m: -

Rainfall : average precipitation per year: 3,410 mm.

J	F	M	A	M	J	J	A	S	O	N	D
220	120	110	110	290	400	410	330	320	380	370	350

Soils :	Histosols	-	Vertisols	-	Ultisols	-
(% of total area)	Mollisols	-	Alfisols	-	Entisols	1%
	Inceptisols-tropaquept	-	-placandept	-	-dystrand	37%
	-humitrop	9%	-ustropept	2%	-dystrop.	51%

Agriculturally used area : 1,127 km^2

- Annual crops (harvested area in km^2) : 7 km^2

rice : - beans : 2 maize : 4 cassava : 1
sorghum: - tobacco: - potato : - vegetables: -

- Perennial crops (area planted in km^2): - km^2

coffee : - cacao : - bananas: - plantain + guineo : -
sugar : - others : -

- Pastures: 1,120 km^2

Data compiled from:

- CIAT-Agroecolog.Studies Unit,SAMMDATA(South Amer.Monthly Meteorol. Database)
- Mapa Físico-Político de Costa Rica, 1:500,000, 1974
- Mapa Asoc. de Sub-Grupos de Suelos de Costa Rica, 1:200,000; 1978
- República de Costa Rica, Censos Nacionales de 1973, Agropecuarios.

APPENDIX B

PHOTO ILLUSTRATION

Photo 1: Newly opened rice area near Upala/Zona Norte (29/9/83)

Photo 2: Smallholder (from Nicaragua) threshing rice in Upala (29/9/83)

Photo 3: Irrigated rice fields in the Tempisque Lowlands (30/9/83)

Photo 4: Irrigation project near Cañas/Guanacaste (29/9/83)

Photo 5: Preparing airplane for fertilization of rice fields in Guanacaste (30/9/83)

Photo 6: Former cacao farmer, now growing rice, near Limon (4/10/83)

Photo 7: Coffee cultivation near Atenas/Meseta Central (1/10/83)

Photo 8: Coffee-pickers near Cartago/Meseta Central (5/10/83)

Photo 9: Potato fields on the slopes of Irazu volcano/Cartago (2/10/83)

Photo 10: Vegetable cultivation on the slopes of Irazu (2/10/83)

Photo 11:
Sugarcane fields near Grecia/Meseta Central
(3/10/83).

Photo 12:
Banana - harvest in the Caribbean Lowlands
(4/10/83)

Photo 13: Pioneer settler in the Caribbean Lowlands (3/10/83)

Photo 14: Typical menu ("casado") with rice, beans, meat, vegetable, and tortilla.

Photo 15: Pastures plus maize/beans cultivation in Turrubares (1/10/83)

Photo 16: Pastures plus maize/beans cultivation in Turrubares (1/10/83)

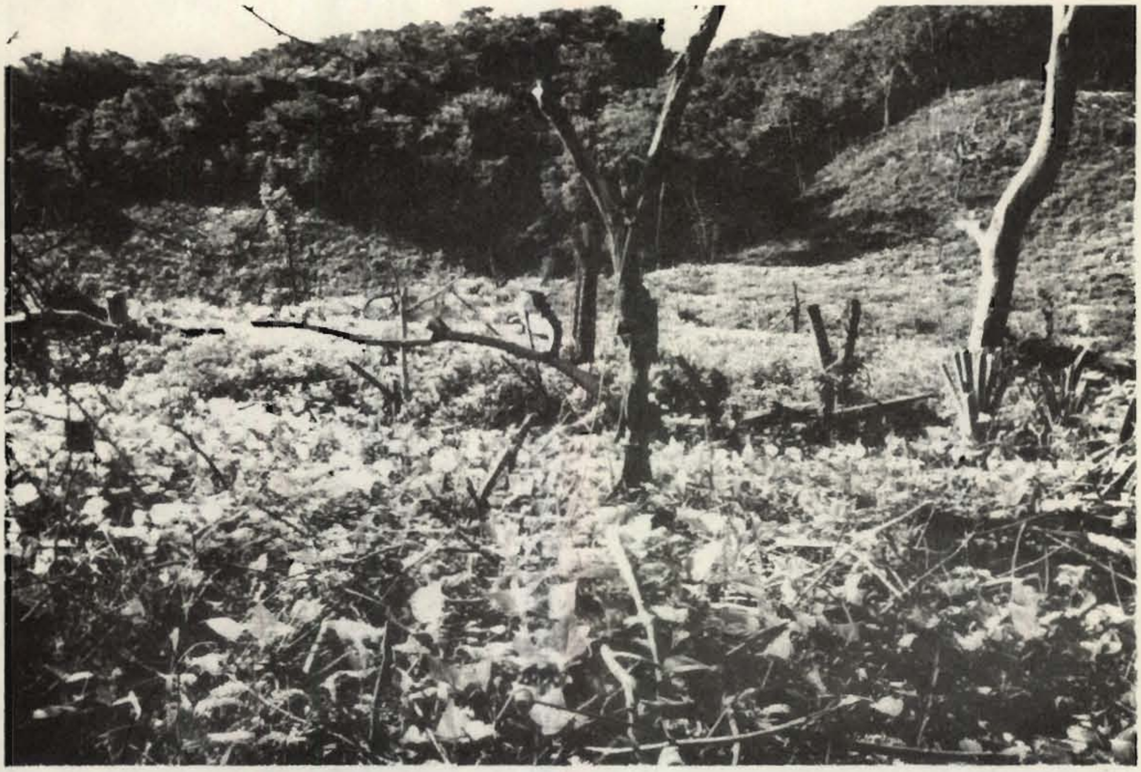


Photo 17:
Cultivation of
"covered" beans
("frijol tapado")
in Guanacaste

(1/10/83)

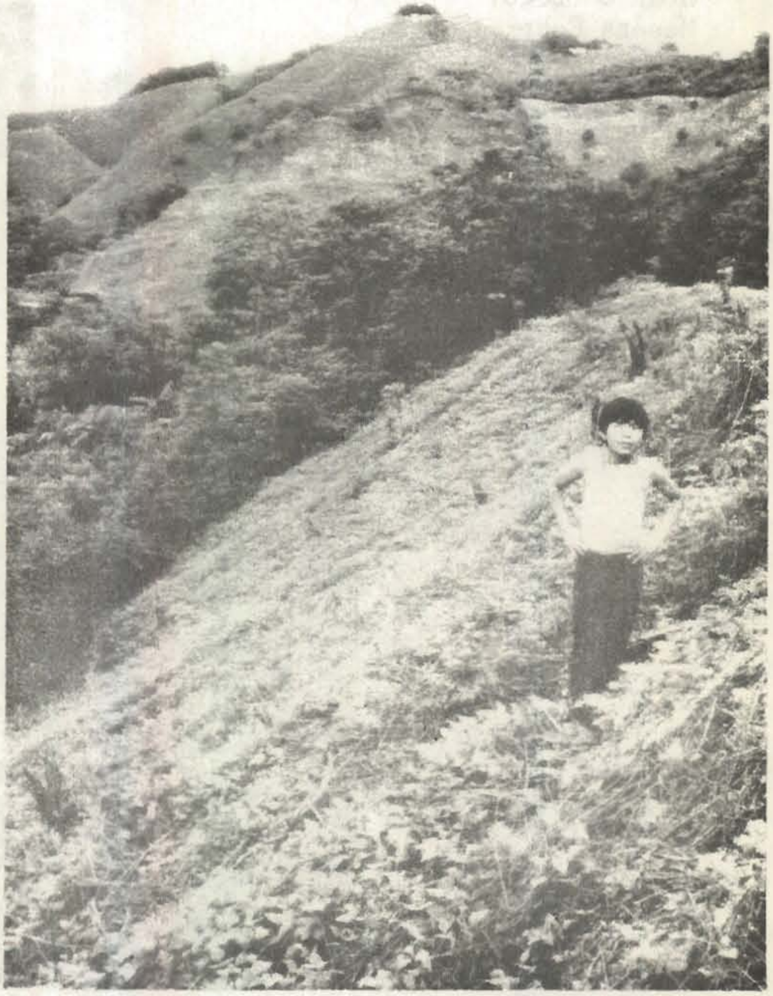


Photo 18:
"Frijol tapado" in
Puriscal

(6/10/83)

Photo 19:
Planted beans
("frijol espeque")
near Cartago,
Meseta Central

(2/10/83)

Photo 20:
"Frijol espeque"
near San José,
Meseta Central

(28/9/83)

Photo 21:
Shifting cultivation
with maize;
South of Upala

(29/9/83)

Photo 22:
Extensively used
pastures near
Cañas/Guanacaste

(29/9/83)

Photo 23:
Cattle breeding
in Guanacaste

(30/9/83)

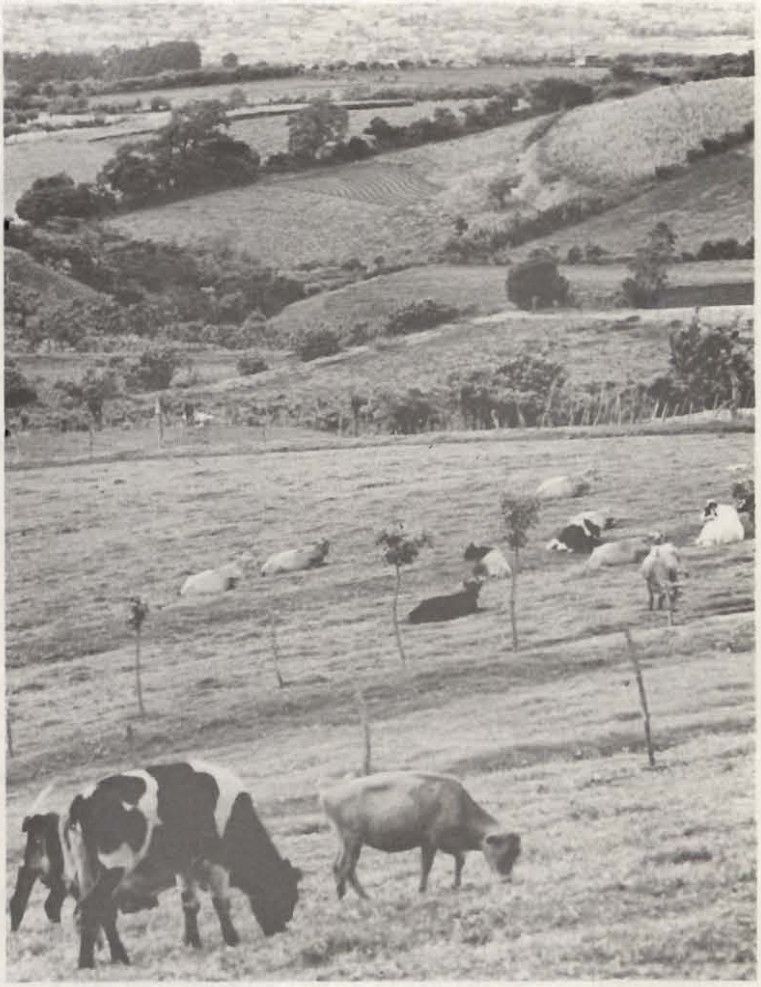
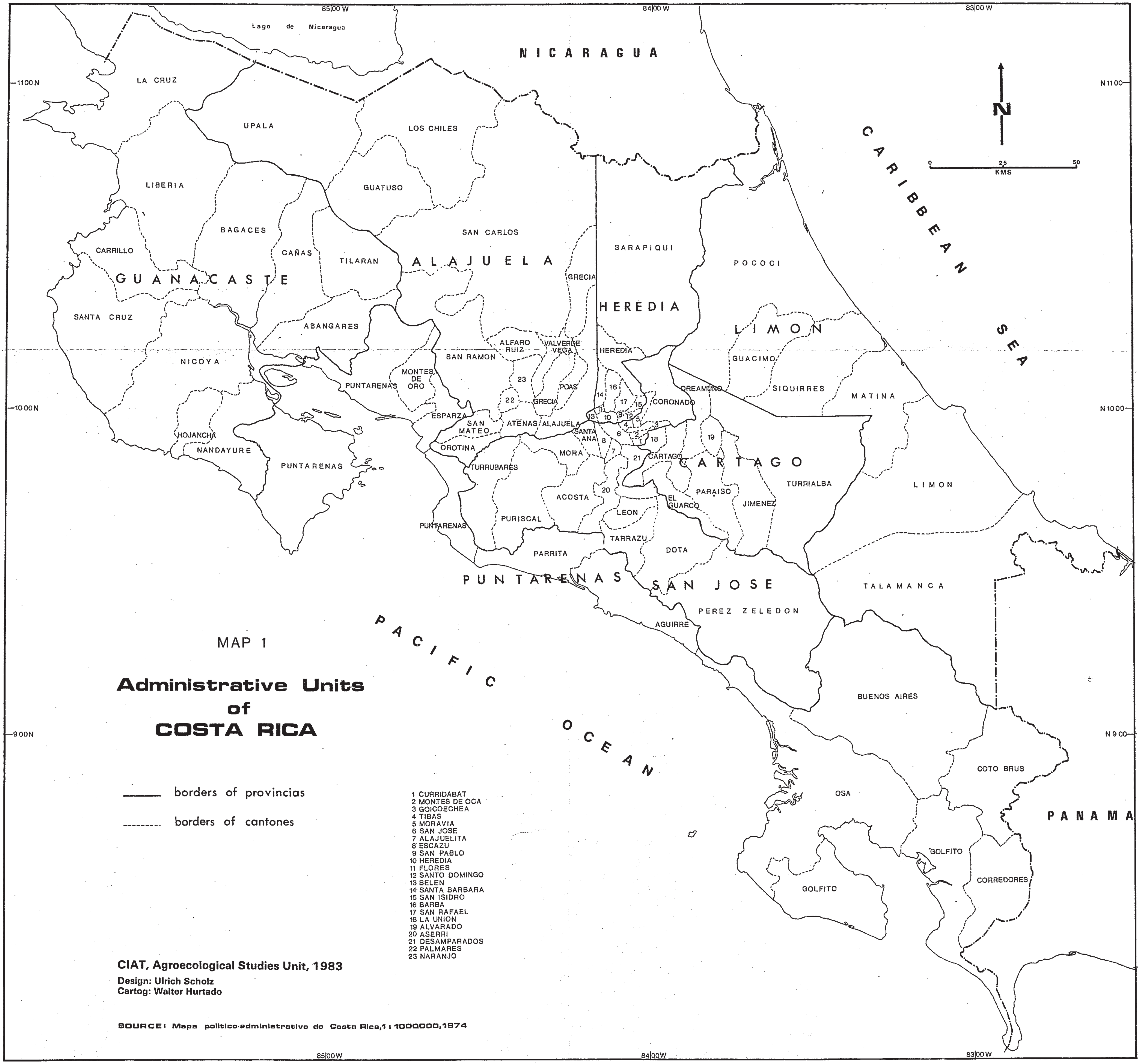


Photo 24:
Intensive breeding
of dairy cattle
near Cartago,
Meseta Central

(2/10/83)


85|00 W
84|00 W
83|00 W
1100 N
1000 N
900 N
N1100
N1000
N900
Lago de Nicaragua
NICARAGUA
CARIBBEAN SEA
PACIFIC OCEAN
PANAMA
N
0
25
50
KMS
GUANACASTE
ALAJUELA
HEREDIA
LIMON
CARTAGO
SAN JOSE
PUNTARENAS
LA CRUZ
UPALA
LOS CHILES
GUATUSO
LIBERIA
BAGACES
CAÑAS
TILARAN
SAN CARLOS
CARRILLO
SANTA CRUZ
NICOYA
ABANGARES
HOJANCHA
NANDAYURE
PUNTARENAS
SARAPIQUI
POCOCI
GUACIMO
SIQUIRRES
MATINA
GRECIA
ALFARO RUIZ
VALVERDE VEGA
SAN RAMON
MONTES DE ORO
ESPARZA
SAN MATEO
OROTINA
ATENAS
ALAJUELA
POAS
HEREDIA
OREAMUNO
CORONADO
SANTA ANA
MORA
TURRUBARES
PURISCAL
ACOSTA
LEON
TARRAZU
DOTA
PARRITA
CARTAGO
PARAISO
EL GUARCO
JIMENEZ
TURRIALBA
LIMON
TALAMANCA
PEREZ ZELEDON
AGUIRRE
BUENOS AIRES
COTO BRUS
OSA
GOLFITO
CORREDORES
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

MAP 1

Administrative Units of COSTA RICA

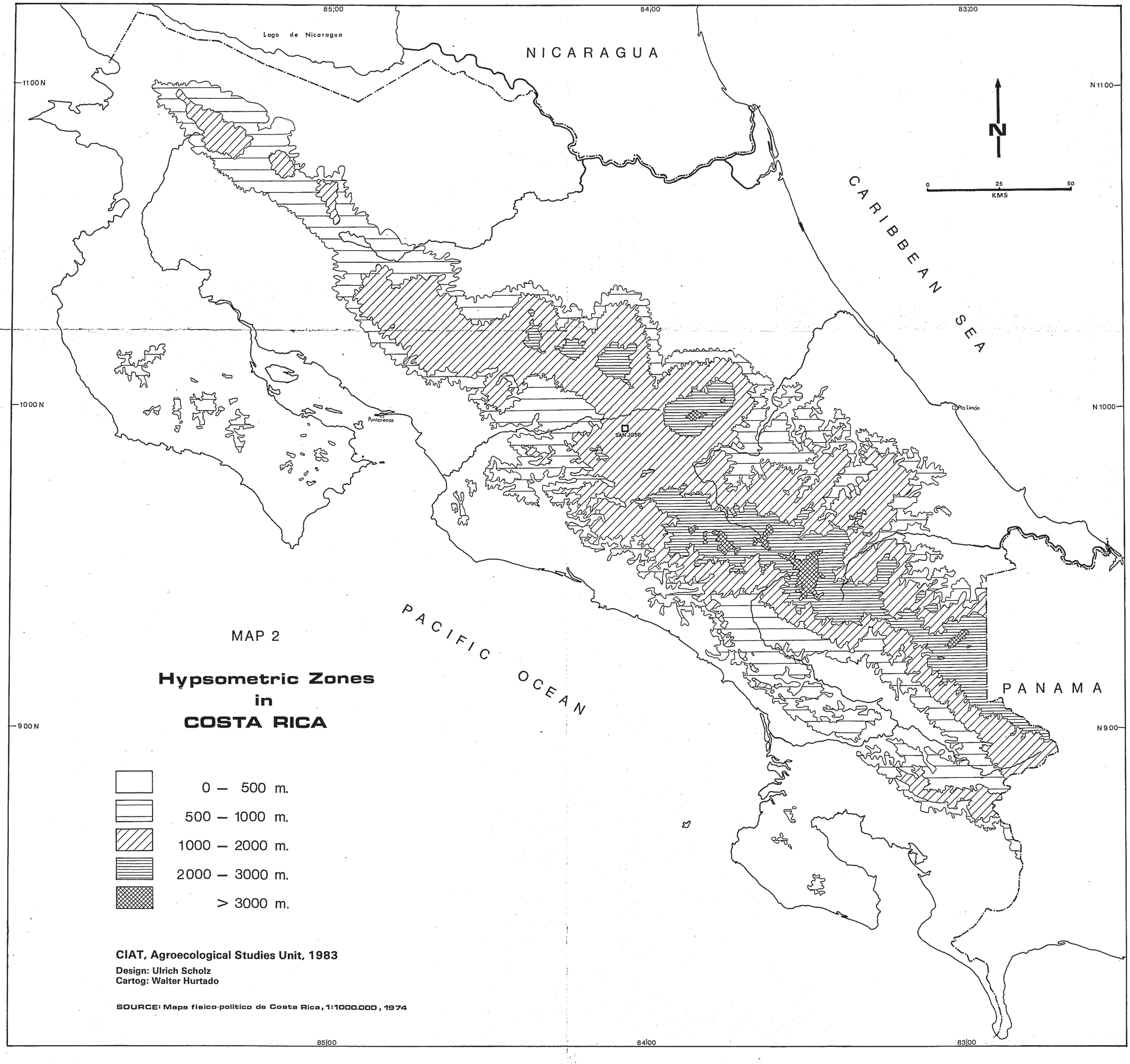
borders of provincias

borders of cantones

1 CURRIDABAT
2 MONTES DE OCA
3 GOICOECHEA
4 TIBAS
5 MORAVIA
6 SAN JOSE
7 ALAJUELITA
8 ESCAZU
9 SAN PABLO
10 HEREDIA
11 FLORES
12 SANTO DOMINGO
13 BELEN
14 SANTA BARBARA
15 SAN ISIDRO
16 BARBA
17 SAN RAFAEL
18 LA UNION
19 ALVARADO
20 ASERRI
21 DESAMPARADOS
22 PALMARES
23 NARANJO

CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado

SOURCE: Mapa politico-administrativo de Costa Rica,1 : 1000000,1974


85 00
84 00
83 00
Lago de Nicaragua
NICARAGUA
1100 N
N 1100
N
0
25
50
KMS
CARIBBEAN SEA
Puntarenas
SAN JOSE
Pto Limón
1000 N
N 1000
PACIFIC OCEAN
PANAMA
900 N
N 900
0 – 500 m.
500 – 1000 m.
1000 – 2000 m.
2000 – 3000 m.
> 3000 m.
85 00
84 00
83 00

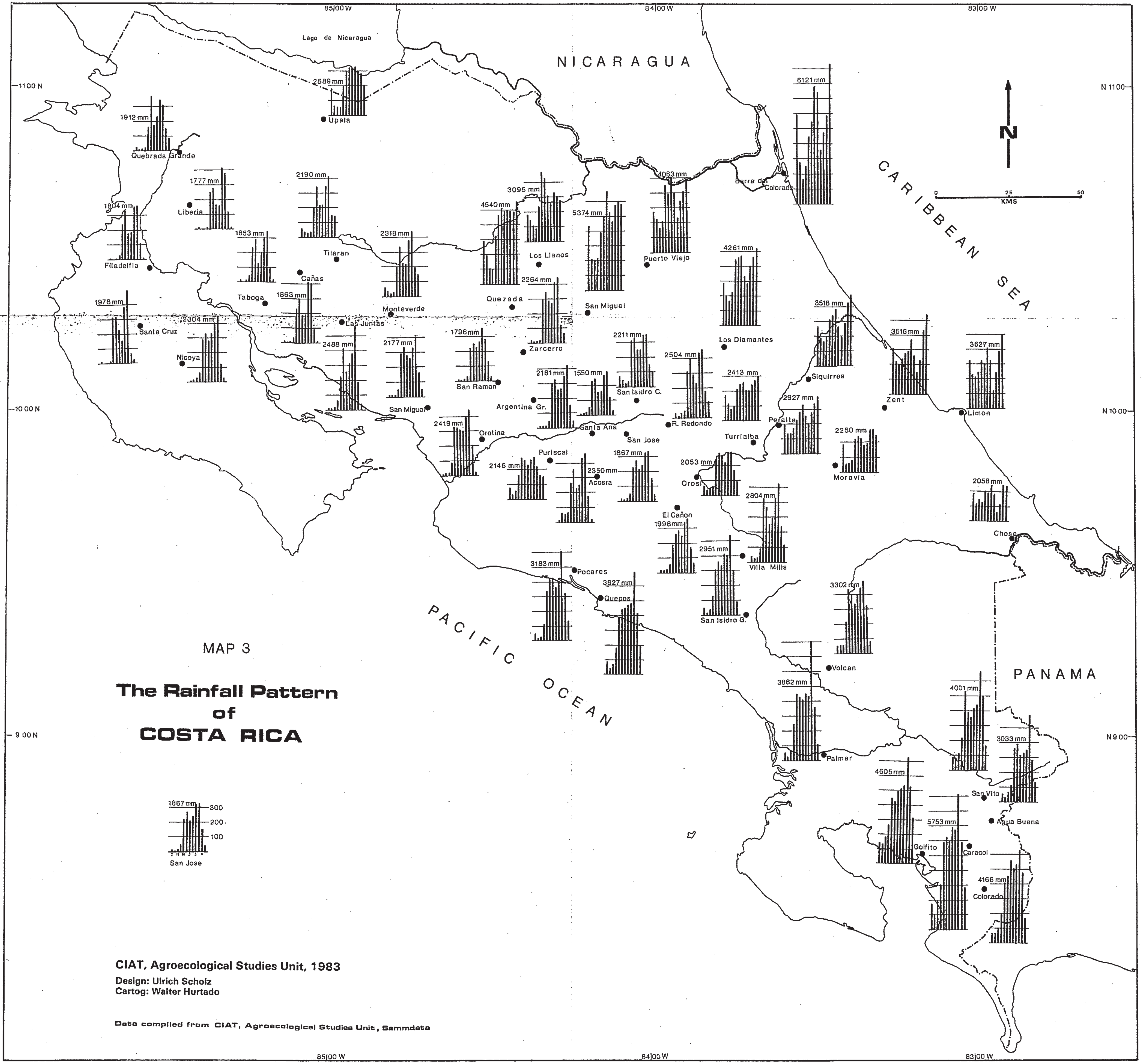
MAP 2

Hypsometric Zones in COSTA RICA

CIAT, Agroecological Studies Unit, 1983

Design: Ulrich Scholz
Cartog: Walter Hurtado

SOURCE: Mapa fisico-politico de Costa Rica, 1:1000.000, 1974

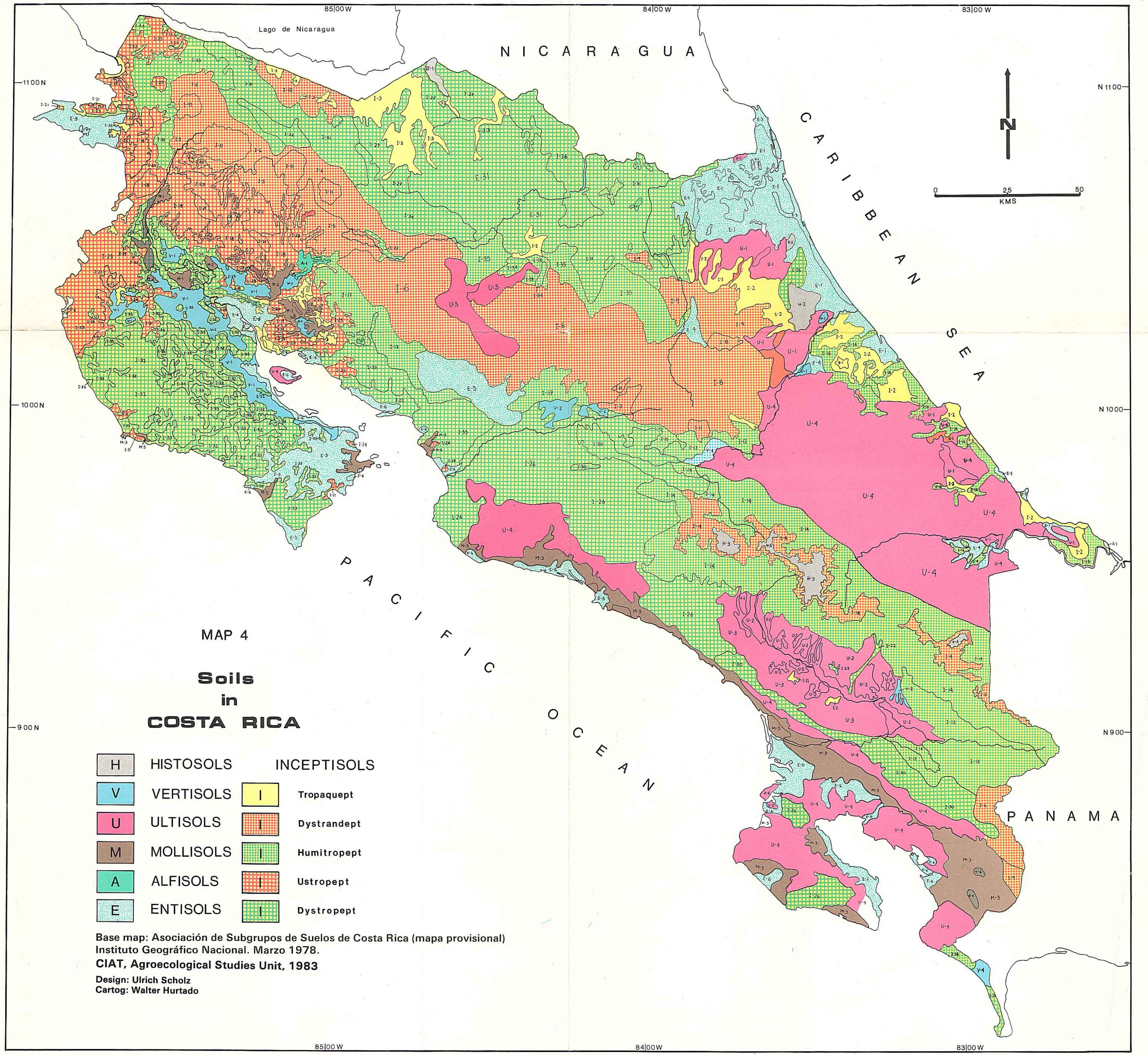

85|00 W
84|00 W
83|00 W
11 00 N
N 11 00
10 00 N
N 10 00
9 00 N
N 9 00
Lago de Nicaragua
NICARAGUA
CARIBBEAN SEA
PACIFIC OCEAN
PANAMA
N
0
25
50
KMS
2589 mm
Upala
1912 mm
Quebrada Grande
6121 mm
Barra del Colorado
1777 mm
Liberia
2190 mm
3095 mm
4063 mm
1804 mm
4540 mm
5374 mm
Puerto Viejo
1653 mm
2318 mm
Tilaran
Los Llanos
Filadelfia
Cañas
4261 mm
2264 mm
Taboga
1863 mm
Quezada
Monteverde
San Miguel
1978 mm
2304 mm
Las Juntas
3518 mm
Santa Cruz
1796 mm
2488 mm
2177 mm
Zarcerro
2211 mm
Los Diamantes
3516 mm
3627 mm
Nicoya
2504 mm
2181 mm
1550 mm
2413 mm
Siquirros
San Ramon
San Isidro C.
2927 mm
Zent
Argentina Gr.
San Miguel
Limon
2419 mm
R. Redondo
Peralta
Santa Ana
Orotina
2250 mm
San Jose
Turrialba
Puriscal
1867 mm
2146 mm
2350 mm
2053 mm
Moravia
Acosta
Orosi
2058 mm
2804 mm
El Cañon
1998 mm
Chose
2951 mm
3183 mm
Villa Mills
Pocares
3827 mm
Quepos
3302 mm
San Isidro G.
Volcan
3862 mm
4001 mm
Palmar
3033 mm
4605 mm
San Vito
Agua Buena
5753 mm
Golfito
Caracol
4166 mm
Colorado
1867 mm
300
200
100
J M M J S N
San Jose

MAP 3

The Rainfall Pattern of COSTA RICA

CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado

Data compiled from CIAT, Agroecological Studies Unit, Sammdata


85|00 W
84|00 W
83|00 W
Lago de Nicaragua
NICARAGUA
CARIBBEAN SEA
PACIFIC OCEAN
PANAMA
N
0
25
50
KMS
1100 N
N 1100
1000 N
N 1000
900 N
N 900
85|00 W
84|00 W
83|00 W

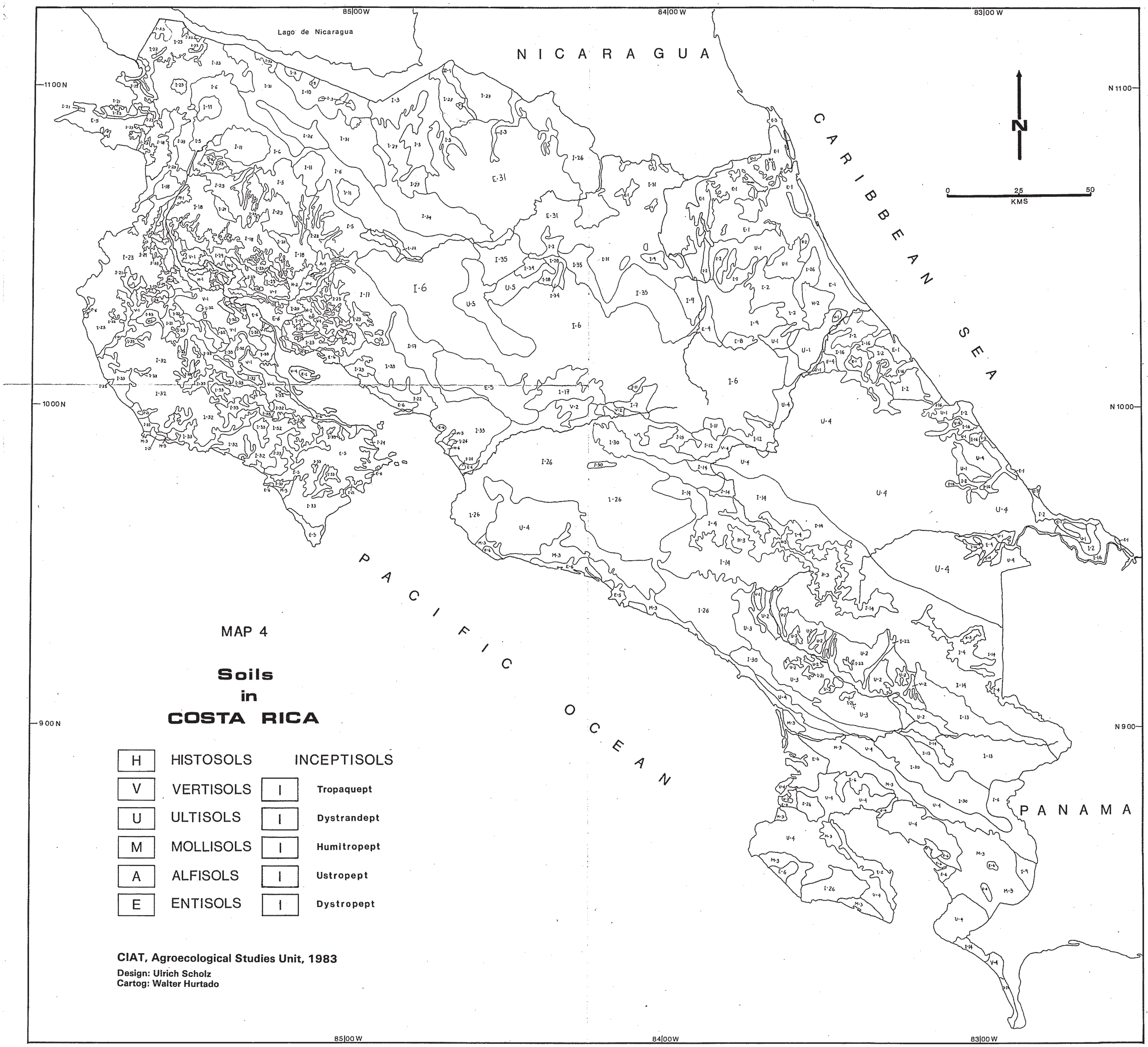
MAP 4

Soils in COSTA RICA

H HISTOSOLS
V VERTISOLS
U ULTISOLS
M MOLLISOLS
A ALFISOLS
E ENTISOLS

INCEPTISOLS
I Tropaquept
I Dystrandept
I Humitropept
I Ustropept
I Dystropept

Base map: Asociación de Subgrupos de Suelos de Costa Rica (mapa provisional)
Instituto Geográfico Nacional. Marzo 1978.
CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado



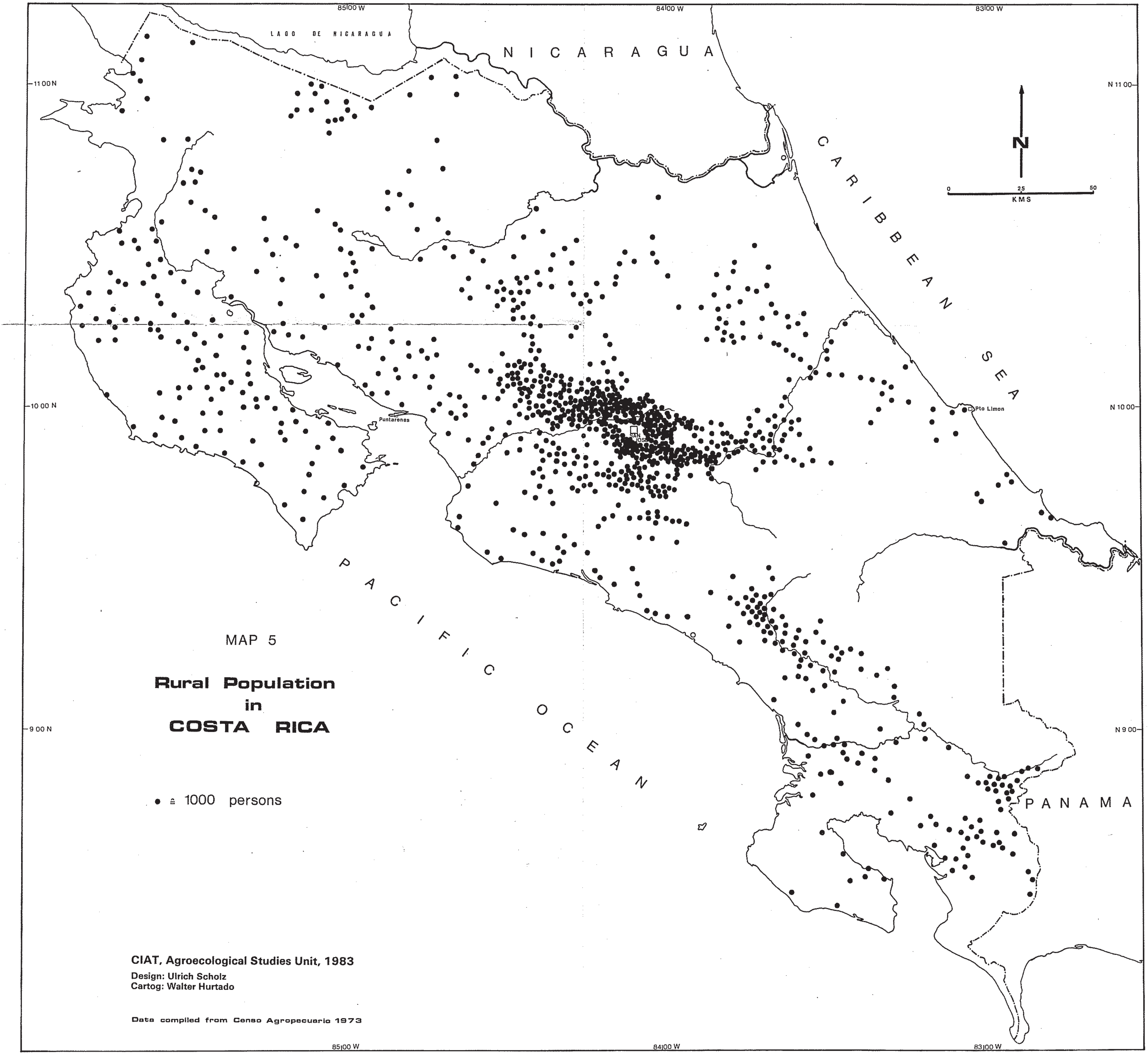
85|00W
84|00W
83|00W
Lago de Nicaragua
NICARAGUA
CARIBBEAN SEA
PACIFIC OCEAN
PANAMA
N
0
25
50
KMS
1100N
N1100
1000N
N1000
900N
N900

MAP 4

Soils in COSTA RICA

H	HISTOSOLS		INCEPTISOLS
V	VERTISOLS	I	Tropaquept
U	ULTISOLS	I	Dystrandept
M	MOLLISOLS	I	Humitropept
A	ALFISOLS	I	Ustropept
E	ENTISOLS	I	Dystropept

CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado



MAP 5

Rural Population in COSTA RICA

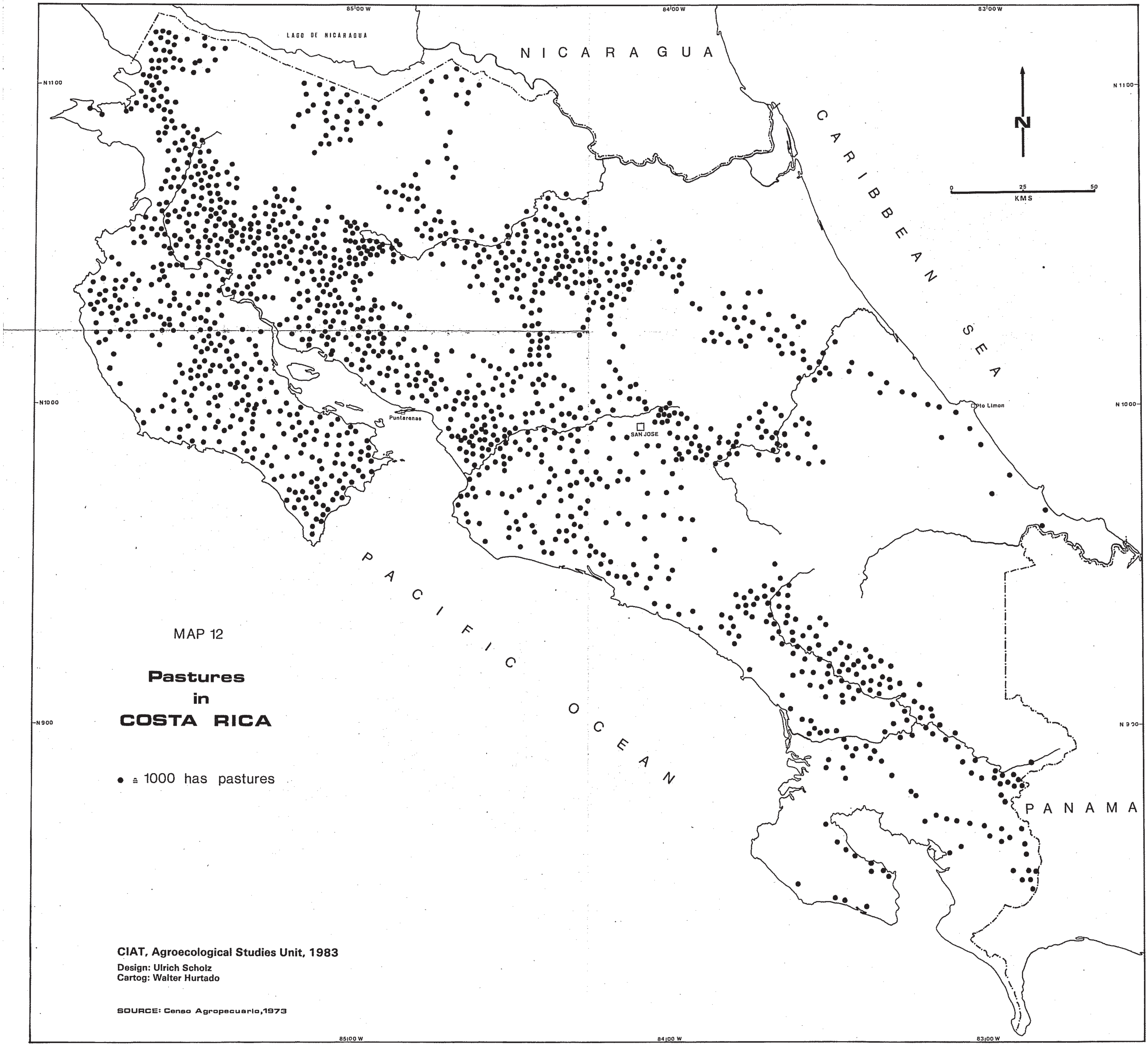
● ≙ 1000 persons

CIAT, Agroecological Studies Unit, 1983

Design: Ulrich Scholz
Cartog: Walter Hurtado

Data compiled from Censo Agropecuario 1973

85|00 W
84|00 W
83|00 W
11 00 N
N 11 00
10 00 N
N 10 00
9 00 N
N 9 00
LAGO DE NICARAGUA
NICARAGUA
CARIBBEAN SEA
N
0
25
50
KMS
Pto Limon
Puntarenas
SAN JOSE
PACIFIC OCEAN
PANAMA


85°00 W
84°00 W
83°00 W
LAGO DE NICARAGUA
NICARAGUA
CARIBBEAN SEA
N
0
25
50
KMS
N1100
N1000
N900
Pto Limon
SAN JOSE
Puntarenas
PACIFIC OCEAN
PANAMA
85°00 W
84°00 W
83°00 W

MAP 12

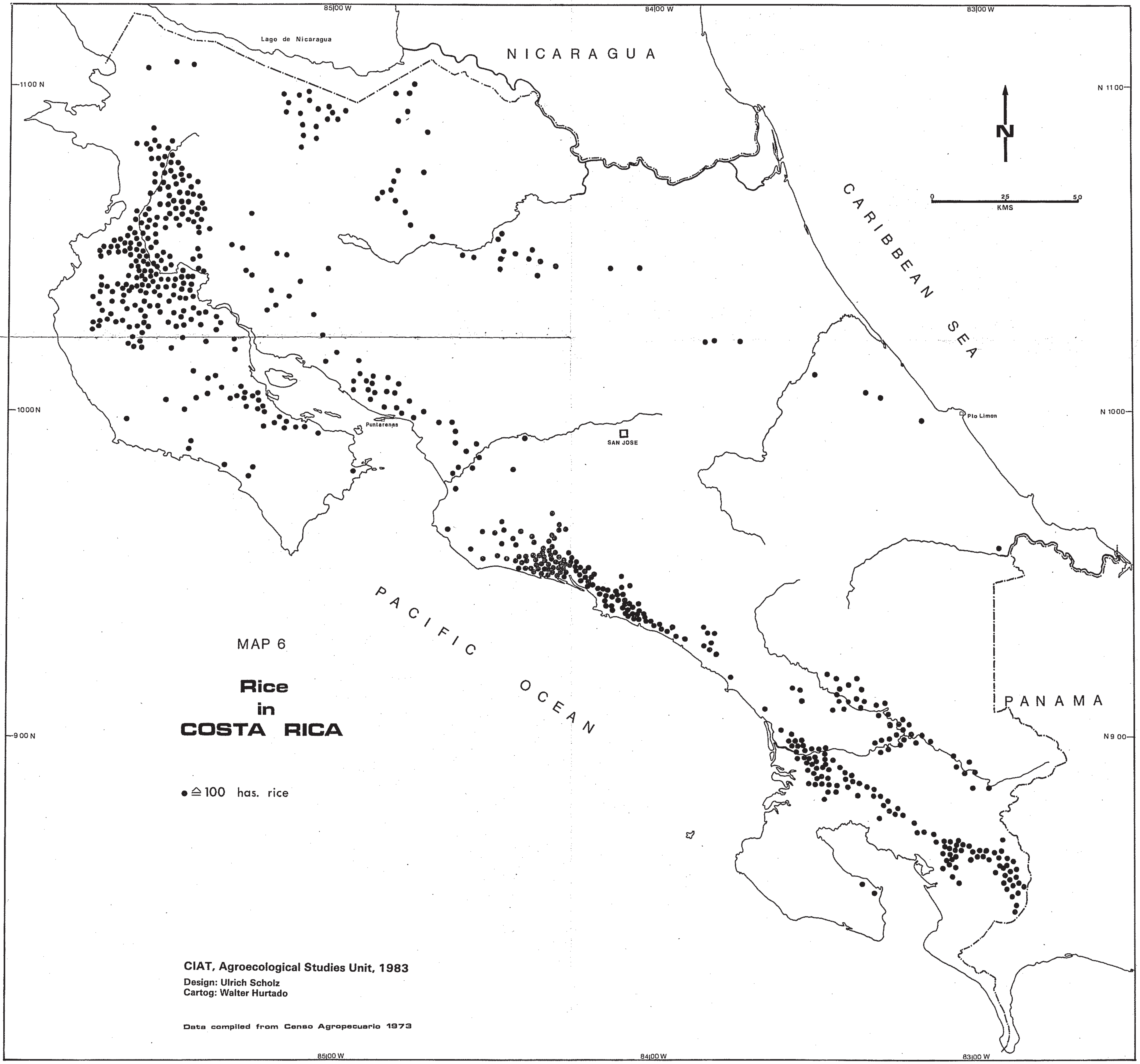
Pastures in COSTA RICA

● ≙ 1000 has pastures

CIAT, Agroecological Studies Unit, 1983

Design: Ulrich Scholz
Cartog: Walter Hurtado

SOURCE: Censo Agropecuario, 1973


85|00 W
84|00 W
83|00 W
Lago de Nicaragua
NICARAGUA
11 00 N
N 11 00
N
0
25
50
KMS
CARIBBEAN SEA
Pto Limon
10 00 N
N 10 00
SAN JOSE
Puntarenas
PACIFIC OCEAN
PANAMA
9 00 N
N 9 00
85|00 W
84|00 W
83|00 W

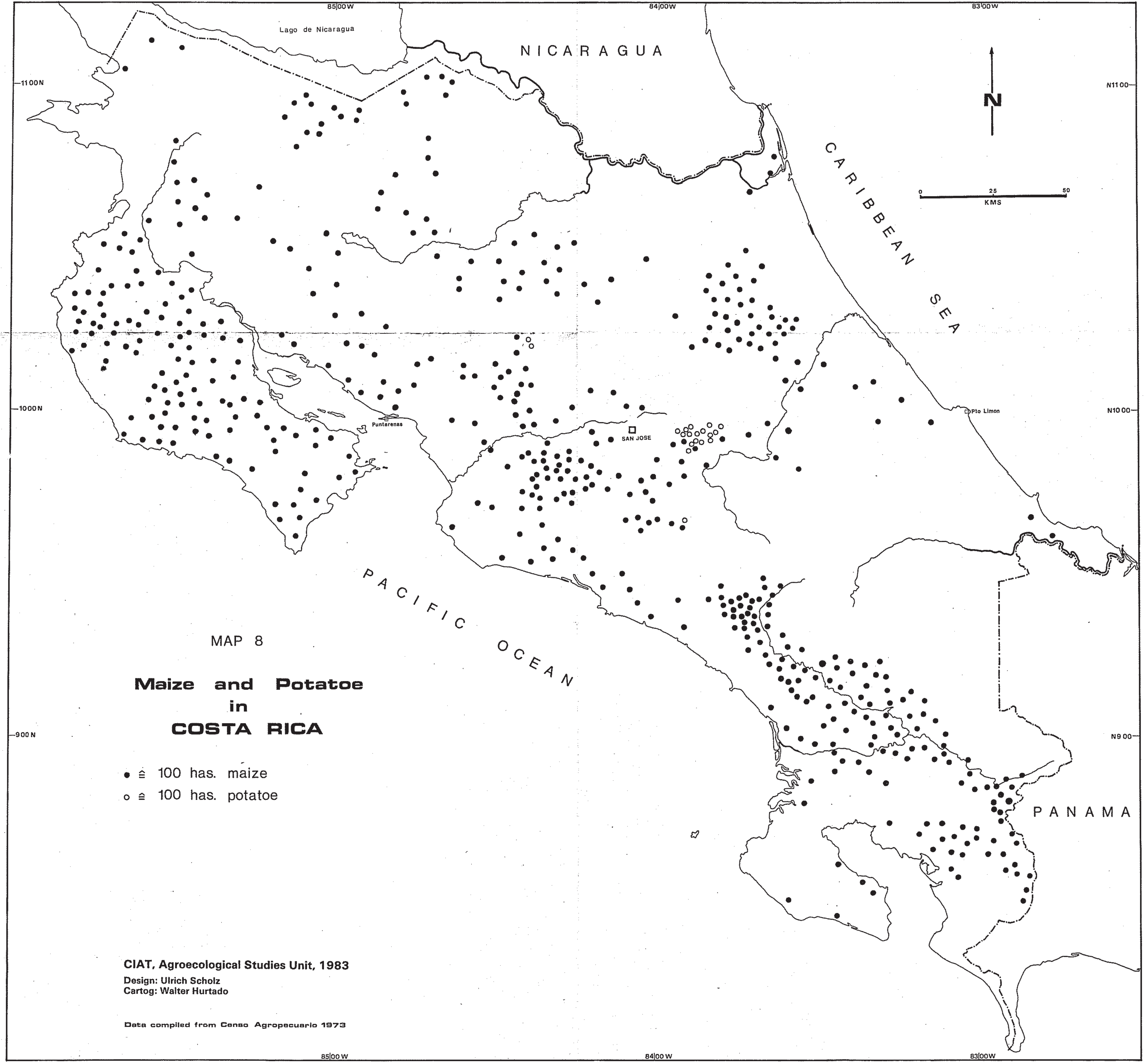
MAP 6

Rice in COSTA RICA

● ≙ 100 has. rice

CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado

Data compiled from Censo Agropecuario 1973

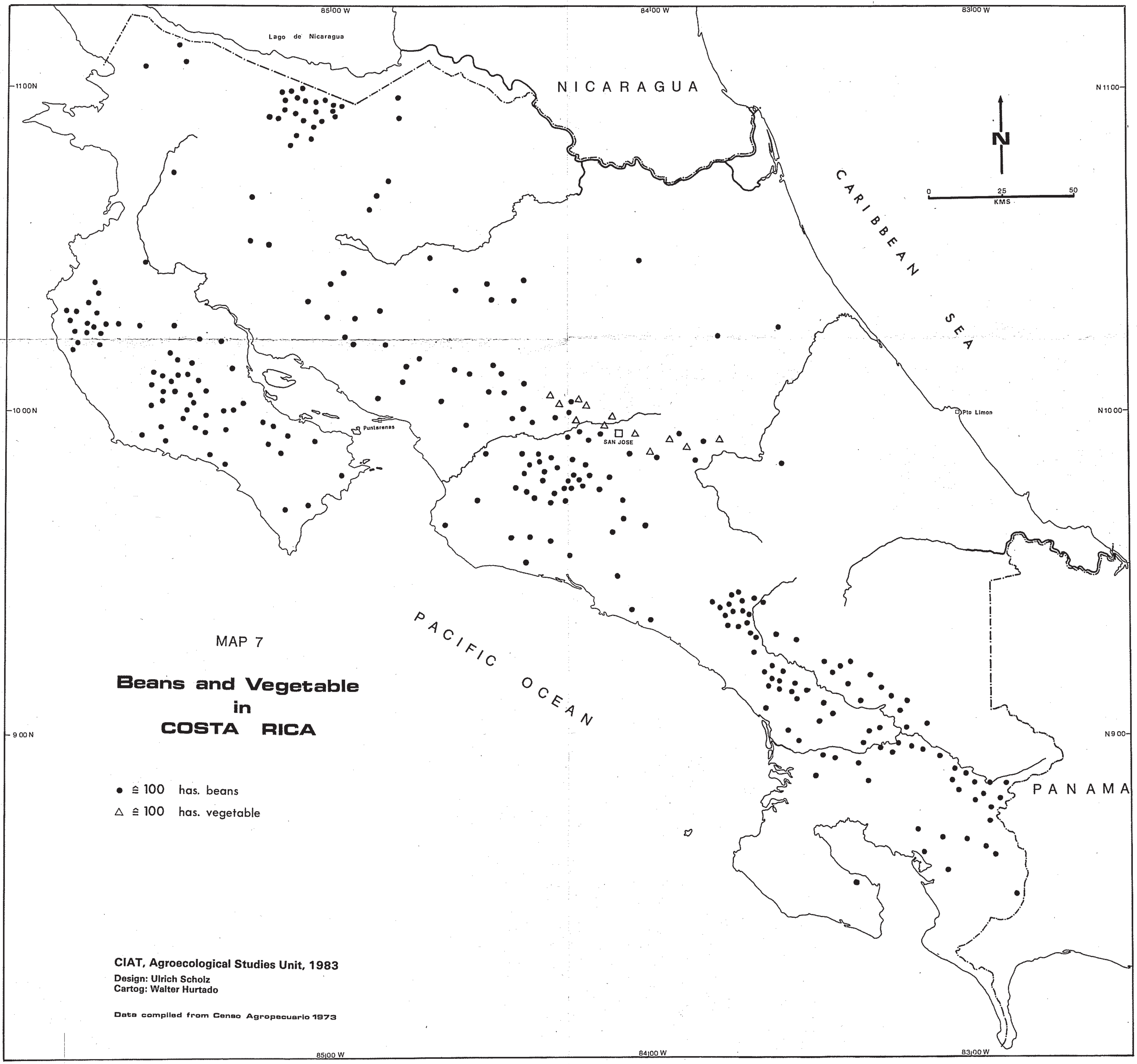

85|00W
84|00W
83|00W
11 00N
N11 00
10 00N
N10 00
9 00N
N9 00
Lago de Nicaragua
NICARAGUA
CARIBBEAN SEA
PACIFIC OCEAN
PANAMA
N
0
25
50
KMS
Puntarenas
SAN JOSE
Pto Limon
● ≙ 100 has. maize
○ ≙ 100 has. potatoe

MAP 8

Maize and Potatoe in COSTA RICA

CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado

Data compiled from Censo Agropecuario 1973


85|00 W
84|00 W
83|00 W
Lago de Nicaragua
NICARAGUA
N
0
25
50
KMS
CARIBBEAN SEA
11 00 N
N 11 00
10 00 N
N 10 00
9 00 N
N 9 00
Puntarenas
SAN JOSE
Pto Limon
PACIFIC OCEAN
PANAMA
85|00 W
84|00 W
83|00 W

MAP 7

Beans and Vegetable in COSTA RICA

● ≙ 100 has. beans

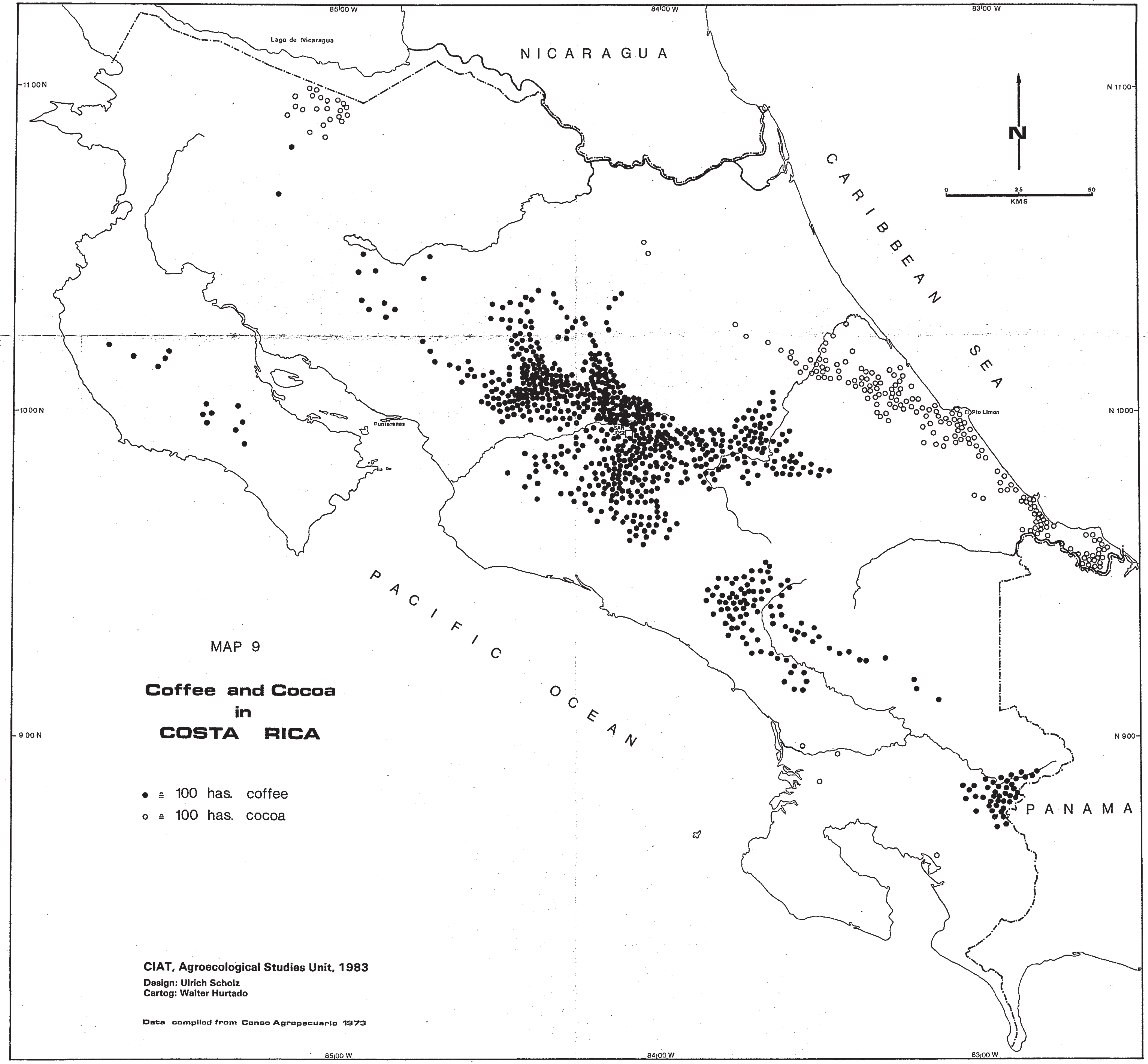
△ ≙ 100 has. vegetable

CIAT, Agroecological Studies Unit, 1983

Design: Ulrich Scholz

Cartog: Walter Hurtado

Data compiled from Censo Agropecuario 1973


85°00 W
84°00 W
83°00 W
11°00 N
N 11°00
10°00 N
N 10°00
9°00 N
N 9°00
Lago de Nicaragua
NICARAGUA
N
0
25
50
KMS
CARIBBEAN SEA
Puntarenas
SAN JOSE
Pto Limon
PACIFIC OCEAN
PANAMA

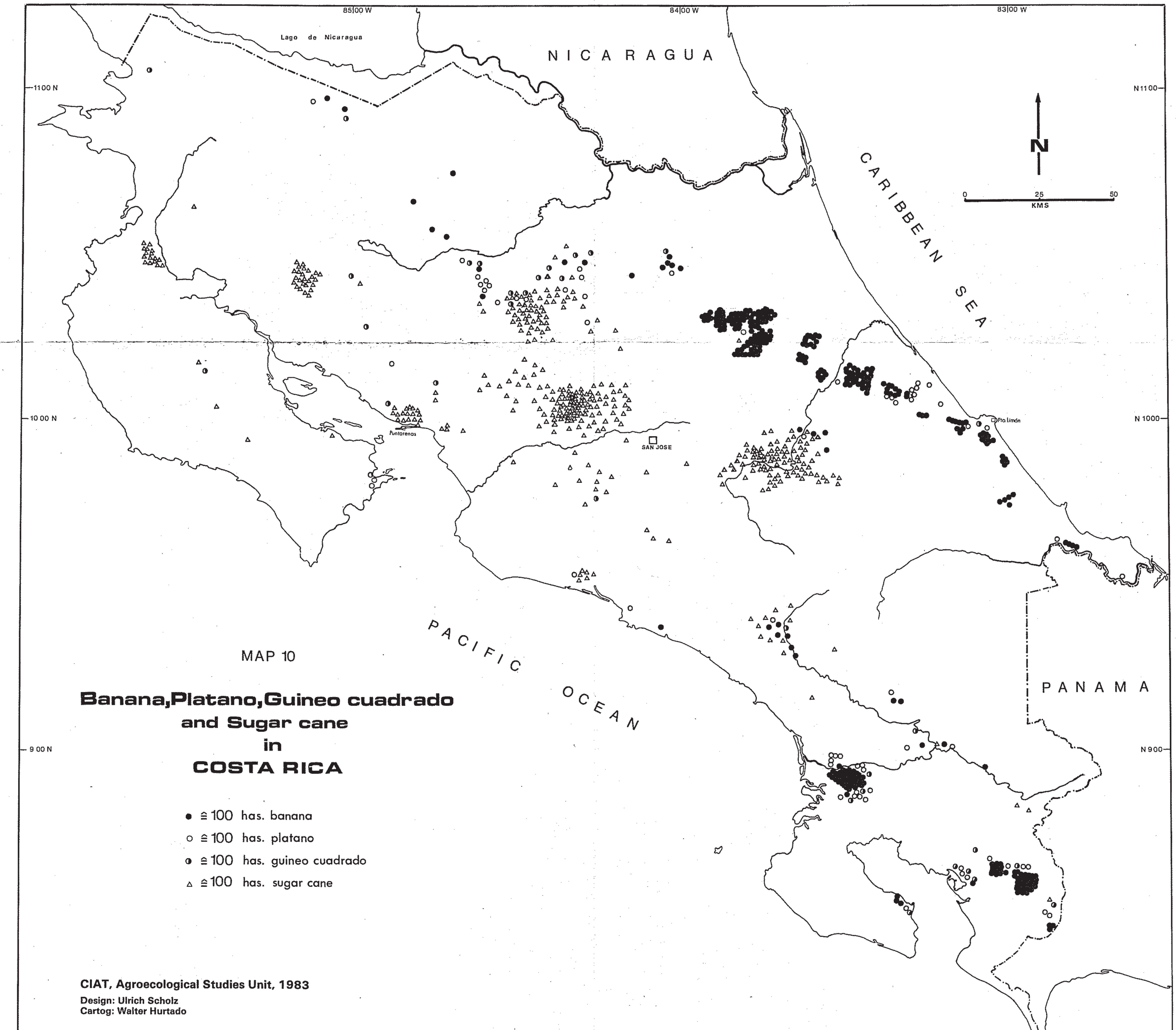
MAP 9

Coffee and Cocoa in COSTA RICA

● ≙ 100 has. coffee
○ ≙ 100 has. cocoa

CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado

Data compiled from Censo Agropecuario 1973


85|00 W
84|00 W
83|00 W
Lago de Nicaragua
NICARAGUA
CARIBBEAN SEA
N
0
25
50
KMS
1100 N
N1100
10 00 N
N 1000
9 00 N
N 900
Puntarenas
SAN JOSE
Pto. Limón
PACIFIC OCEAN
PANAMA

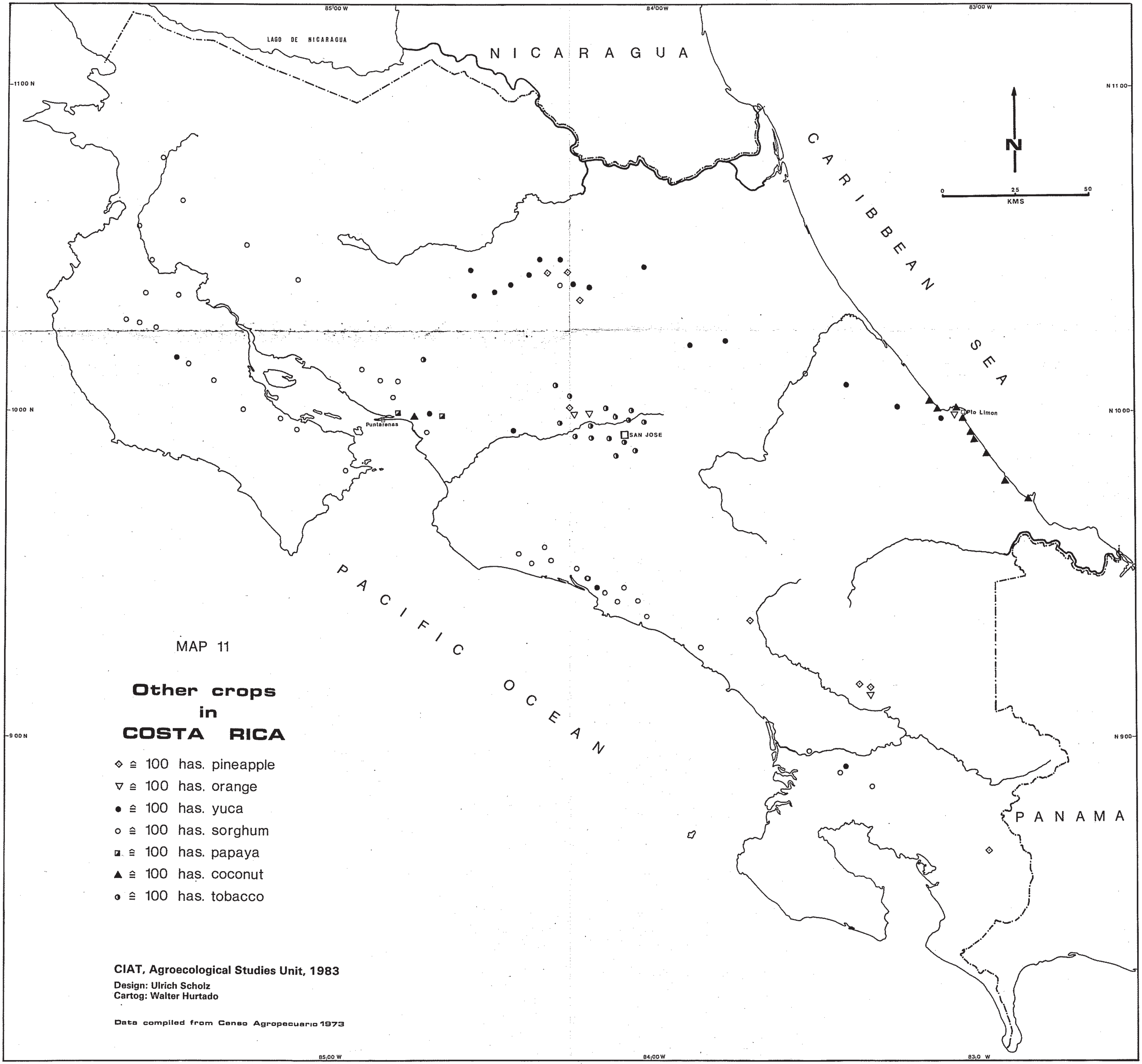
MAP 10

Banana, Platano, Guineo cuadrado and Sugar cane in COSTA RICA

● ≙ 100 has. banana
○ ≙ 100 has. platano
◐ ≙ 100 has. guineo cuadrado
△ ≙ 100 has. sugar cane

CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado

Data compiled from Censo Agropecuario 1973


85°00 W
84°00 W
83°00 W
11°00 N
N 11°00
10°00 N
N 10°00
9°00 N
N 9°00
LAGO DE NICARAGUA
NICARAGUA
N
0
25
50
KMS
CARIBBEAN SEA
Pto Limon
Puntarenas
SAN JOSE
PACIFIC OCEAN
PANAMA
85°00 W
84°00 W
83°0 W

MAP 11

Other crops in COSTA RICA

- ◇ ≙ 100 has. pineapple
- ▽ ≙ 100 has. orange
- ● ≙ 100 has. yuca
- ○ ≙ 100 has. sorghum
- ◪ ≙ 100 has. papaya
- ▲ ≙ 100 has. coconut
- ◐ ≙ 100 has. tobacco

CIAT, Agroecological Studies Unit, 1983
Design: Ulrich Scholz
Cartog: Walter Hurtado

Data compiled from Censo Agropecuario 1973