This study is part of a larger study to understand the appropriate role of science and technology in the development of a small country like Costa Rica. A preliminary study of the natural resources potential of Limon Province was selected because there exist opportunities for the application of science and technology in the region for the development of Limon Province. A multidisciplinary team of scientists, engineers, economists, and regional developers was organized to conduct the study and make suggestions for in-depth, follow-on studies that would lead to formulation of regional development policies.

The Limon study may be described as a broad brush survey of the natural resources existing in the Province and the potential for utilizing these for regional development.

This region has been neglected for years and consequently its resources have not been fully explored. Although there presently exists a sincere commitment at the national level to develop this region, progress in this direction has been slow because of the history of neglect.

The immediate need is for regional development studies that would lead to development policies and plans to implement such policies.
The Natural Resource Potential for Regional Development of Limon Province: A Preliminary Survey
THE NATURAL RESOURCE POTENTIAL
FOR REGIONAL DEVELOPMENT OF LIMON PROVINCE:
A PRELIMINARY SURVEY

by

The Cornell-Costa Rica Team

Program on Policies for Science
and Technology in Developing Nations (PPSTDN)
180 Uris Hall, Cornell University
Ithaca, New York 14850

October 1973
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I. INTRODUCTION

A. Background

Under a five-year grant from the Office of Science and Technology, AID, Washington, Cornell University is engaged in developing institutional capabilities at Cornell in the area of science and technology policies for accelerating the economic and social development process in less developed countries. Under this Program, opportunities to initiate new research, consistent with the Program objectives, are extended to the Cornell Community. The Program encourages Cornell staff and students to interact with counterparts from developing nations and jointly explore the appropriate role of science and technology in selected areas of LDC development.

This Program is especially relevant to Cornell University since roughly 24 percent of the graduate students enrolled are international students. In administering the Program, a conscious effort is made to include qualified Cornell students from a particular developing country to conduct studies relevant to the Program and of interest to the participating country. This approach offers foreign students at Cornell a unique opportunity to relate their training and education to the development problems in their home countries. It is likely that this focus might demonstrate a means to reduce the "brain drain" that presently robs developing nations of the much-needed professionals and entrepreneurs. The basic premise of this approach is that a young and competent professional from a developing country would prefer to live and work in his native country provided he is offered an attractive and responsible position where he can utilize his talents and training and demonstrate his capability. This Program offers the foreign student the opportunity to demonstrate his capability to his countrymen.

Under a separate add-on contract to the grant Program, a Cornell team recently visited Costa Rica, met with several Costa Rican experts and sought to identify projects that might lead to understanding the role of science and technology in a small developing country like Costa Rica. Because of the many similarities that exist between Costa Rica and member countries of Central American Common Market, the selection of projects favored those that had regional implications and which offered opportunities for cooperation among CACM countries.

After several meetings in Costa Rica, the team proposed a reconnaissance study of the natural resource potential of Limon Province for development of the region. A multidisciplinary group of Costa Rican consultants, Cornell professors, and Cornell students met in June 1973 in San Jose to define the objectives of the study and the strategy to conduct the study.
The "Limon Project" may be described as a broad brush survey of the natural resources existing in the region. This effort comprised gathering data relevant to the Project, evaluating the data, and suggesting studies for formulating policies for regional development.

During their stay at Port Limon, the members of the field team, in close cooperation with the Costa Rican consultants, gathered data on existing natural resources and evaluated their potential for development. Field visits to farms, plantations, agricultural experiment stations, industries, and projects in the region provided added information for the study. The data gathered were evaluated and integrated by the multidisciplinary team. These activities formed the basis for the suggestions for in-depth, follow-on studies.

Although a concerted effort was made to gather all pertinent data, it is quite likely that the team did not have access to all available information because of the short time available to conduct the study. The fact that Costa Rican national elections are fast approaching might have had some influence on the scarcity of data in certain areas.

Therefore, the report on the Limon Project should be viewed with the qualification that the team probably did not have access to all data pertinent to the study.

B. Acknowledgment

Several autonomous institutions, municipalities, ministries, and private citizen groups fully cooperated with the team which greatly facilitated the study.

We are particularly indebted to Lic. Armando Arauz Aguilar, Director, Instituto de Fomento y Asesoría Municipal (IFAM), who evinced keen interest in the Project and assigned a senior IFAM official, Lic. Oscar Padilla, to serve as the Costa Rican coordinator for the Project. IFAM also provided funds of up to 40,000 colones which were used to cover salaries for the Costa Rican students from Cornell and air travel for the entire team to visit Port Limon.

We express our sincere thanks to Hernan Garron Salazar, Gerente General, JAPDEVA, for the many valuable interviews he granted the team and for furnishing useful data on Limon Port activities. Through Sr. Garron, the team learned of JAPDEVA's plans for the economic and social development of the region. He also provided the field team with office space at JAPDEVA's Office for the Regional Development of the Atlantic Zone. JAPDEVA granted members of the team free transportation on the National Railroad and along the canal.
We are especially grateful to Ing. Jorge Manuel Dengo for his excellent presentation of an overview of the natural resource potential of Limon Province and the serious social and economic problems of the region. It provided the team with a broad understanding of the region and convinced the group of the need for a multidisciplinary approach to understand the problems.

The team could not have completed the study without the enthusiastic support and hospitality it received from many officials of the following institutions and ministries, for whose assistance we are indeed grateful:

- Ministry of Planning
- Ministry of Industries and Commerce
- Ministry of Transport and Public Works
- Ministry of Agriculture
- Regional (Limon) Agriculture Extension Agents
- Department of Statistics and Census
- Limon Municipality
- Universidad de Costa Rica, Oficina de Planificacion
- U.S. Agency for International Development
- Instituto Geographico Nacional
- CONICIT
- IFAM
- INVU
- IMAS
- ITCO
- ICT
- ICE
- IICA
- JAPDEVA
- INA
- CODESA
- Tropical Science Center
- Export Promotion Center
- UN Industrial Development Organization in San Jose
- Corporation Financiera de Tortuguero
- Experimental Station at Los Diamantes
- Experimental Station at La Lolla
- Office of Governor, Limon Province
- Civic Committee for Economic Development of Limon
- Office of National Parks

The personal views and concerns of the people we met in Limon Province were extremely valuable inputs to the study. Since development of the region must necessarily involve and relate to citizens of Limon Province, we are indebted to the citizens for their frank views.

F.J. Ahimaz

Principal Investigator
C. The Cornell-Costa Rica Team

1. Costa Rican Consultants

<table>
<thead>
<tr>
<th>Name</th>
<th>Background and Training</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscar Padilla</td>
<td>Economist</td>
<td>Costa Rican Coordinator of Project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>He will be leading IFAM's participation in the regional development of Limon Province.</td>
</tr>
<tr>
<td>Juan Castro Chamberlain</td>
<td>Agricultural Economist</td>
<td>Professor, Department of Agronomy, University of Costa Rica; General Manager, Xerox de Costa Rica, S.A.</td>
</tr>
<tr>
<td>Garrett Britton</td>
<td>Agricultural Engineer</td>
<td>Regional Director for Agriculture, Limon Province, Ministry of Agriculture, Government of Costa Rica</td>
</tr>
<tr>
<td>Felix del Barco</td>
<td>Food Technologist</td>
<td>Professor, Food Technology Department, University of Costa Rica</td>
</tr>
<tr>
<td>Rodolfo G. Madrigal</td>
<td>Geologist</td>
<td>Professor, Department of Geology, University of Costa Rica</td>
</tr>
<tr>
<td>Guido Rodriguez</td>
<td>Transportation and Port Engineer</td>
<td>Department of Ports, Ministry of Transport and Public Works, Government of Costa Rica</td>
</tr>
<tr>
<td>Joseph Tosi</td>
<td>Geographer and Forester</td>
<td>Tropical Science Center, San Jose</td>
</tr>
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</table>
## 2. Cornell Staff and Students

<table>
<thead>
<tr>
<th>Name</th>
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<tr>
<td><strong>Cornell Staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Franklin J. Ahimaz</td>
<td>Assistant Director PPSTDN</td>
<td>Principal Investigator of Project, Assistant Dean of Engineering</td>
</tr>
<tr>
<td>Howard E. Conklin</td>
<td>Agricultural Economist</td>
<td>Professor, Agricultural Economics</td>
</tr>
<tr>
<td>Edmund T. Cranch</td>
<td>Director, PPSTDN</td>
<td>Dean of Engineering</td>
</tr>
<tr>
<td>Ta Liang</td>
<td>Aerial Photograph Interpretation</td>
<td>Professor, Civil and Environmental Engineering</td>
</tr>
<tr>
<td>James A. Liggett</td>
<td>Water Resources</td>
<td>Professor, Civil and Environmental Engineering</td>
</tr>
<tr>
<td><strong>Cornell Students and Graduates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marlene Ahimaz</td>
<td>Business Administration</td>
<td>A Voluntary Participant in the Program. Studied opportunities for an industrial park at Limon City</td>
</tr>
<tr>
<td>(U.S.)</td>
<td></td>
<td>Livestock</td>
</tr>
<tr>
<td>Jose E. Bonilla</td>
<td>Agriculture</td>
<td>Sedimentation in Rivers</td>
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<tr>
<td>(Costa Rican)</td>
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<td>Institutions and Human Resources</td>
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<tr>
<td>Jorge de la Guardia</td>
<td>Water Resources</td>
<td></td>
</tr>
<tr>
<td>(Panama)</td>
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<td></td>
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<tr>
<td>Fernando Nasmyth</td>
<td>Government</td>
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<tr>
<td>(U.S., formerly from Limon)</td>
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<tr>
<td>Martin Raine</td>
<td>Agriculture</td>
<td>Agricultural Crops</td>
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<tr>
<td>(U.S. residing in Costa Rica)</td>
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<td></td>
</tr>
<tr>
<td>Guillermo Ramirez</td>
<td>Food Technology</td>
<td>Agro-Industries</td>
</tr>
<tr>
<td>(Costa Rican)</td>
<td></td>
<td></td>
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<tr>
<td>Federico Rojas</td>
<td>Agricultural Economics</td>
<td>Transportation and Agricultural Economics</td>
</tr>
<tr>
<td>(Costa Rican)</td>
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</tr>
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II. NATURAL RESOURCES POTENTIAL

A. Human Resources

1. History and Background

In 1865 Port Limon was officially declared the port for the Atlantic Zone by President Jose Maria Castro Madriz. Limon was cut off from the rest of the country until 1890, when the railroad connecting Limon to San Jose was completed. In 1900, with the arrival of the United Fruit Company, came the banana boom. This company owned large banana plantations in the rich agricultural zones of the Province. In 1934 the "Panama disease" caused considerable economic loss resulting in United Fruit Company's abandoning the plantations and moving its operations out of the region. After a period of relative inactivity, a new variety that can resist the disease has been planted in several farms and the banana boom is back.

The Province of Limon has an area of 9,300 sq.km., and a population of 97,316. (1972 census). It is divided into 6 counties: Limon, Siquirres, Pococi, Matina, Guacimo, and Talamanca. The city of Limon is the most populated urban area on account of the commercial activity at Port Limon.

The Atlantic region has been in a state of isolation from the rest of the country on account of several factors, one of which was the inaccessible parts of the region. The railroad offered the only communication link between some areas of the province and the rest of the country. With the completion of the gravel road from Siquirres to Limon in 1969, there was a sudden influx of people into the region. The migration to the region is bound to increase appreciably when the paved highway is completed in 1974.

Another factor which contributed to the neglect of the Atlantic region was an apparent lack of interest in the region which had existed for a long time. The ethnic composition of the population and the existence of the foreign companies with large plantations in the region probably contributed to this attitude. The ethnic composition of the Province gives it a unique character that is different from the rest of the country. Presently it is estimated that 49 percent of Limon's population is white, 46 percent black, 3 percent Indian, and 2 percent of Oriental descent. The black population are descendants of the immigrants from the Caribbean and other Central American countries who had worked on the railroad. The immigrants were never really assimilated into the national stream. It was partially their own choosing, and in part due to the lack of interest at the national level. For example, until 1948 blacks were not allowed to freely travel to San Jose and the central part of Costa Rica.
The black population in Limon, however, has managed to preserve its traditions and culture. Most of the blacks still speak an English dialect and their customs, life style, and religion are quite different from those of the rest of the country. However, the third and fourth generation blacks are becoming more and more integrated into the mainstream of the national culture; they have become bilingual and attend public high schools and universities, while retaining their identification with their ancestors' culture.

Another reason for the apparent neglect of the region might have been the presence of the large foreign companies operating in the region. It appears that the development of the region was assumed to be indirectly tied in with the responsibilities of the foreign companies because of their size and importance to the country. This assumption was further strengthened in 1927 when it was estimated that roughly 70 percent of the population of the Province were foreigners brought in by the foreign companies to work on the railroad and the plantations.

2. Population of Limon Province

The 1972 population of the Province of Limon was listed at 97,316, which represented approximately 5.2 percent of the total population of Costa Rica. The population of the Province has been steadily increasing for the past few years. The annual rate of population increase for the region is above the national average. During 1971, the population of the country increased 2.8 percent, while that of the Province showed a 3.9 percent increase. The following chart indicates the annual population increase for Costa Rica and regions of Limon Province:

<table>
<thead>
<tr>
<th>Year</th>
<th>Costa Rica</th>
<th>Province of Limon</th>
<th>Central County (City of Limon)</th>
<th>Pococi County</th>
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</thead>
<tbody>
<tr>
<td>1966</td>
<td>3.4</td>
<td>3.2</td>
<td>3.2</td>
<td>3.6</td>
</tr>
<tr>
<td>1967</td>
<td>3.1</td>
<td>3.2</td>
<td>3.2</td>
<td>3.6</td>
</tr>
<tr>
<td>1968</td>
<td>3.0</td>
<td>3.2</td>
<td>2.9</td>
<td>4.4</td>
</tr>
<tr>
<td>1969</td>
<td>2.7</td>
<td>3.0</td>
<td>2.5</td>
<td>4.0</td>
</tr>
<tr>
<td>1970</td>
<td>3.1</td>
<td>3.8</td>
<td>2.7</td>
<td>5.7</td>
</tr>
<tr>
<td>1971</td>
<td>2.8</td>
<td>3.9</td>
<td>3.1</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Source: Dirección General de Estadística y Censos

The birth rate for Limon Province is also above the national average. For 1971, Costa Rica averaged approximately 31.5 births per 1,000 inhabitants, while Limon registered 44.6.
The mortality rate in the province is also above the national average. The country's mortality rate for 1971 was estimated at 5.9 percent, and that for Limon Province was 9.0 percent.

3. **The Urban Sector**

   a. **General**

   The urban population is estimated at 33 percent of Limon Province population. (However, another source estimates the urban population of the province as closer to 49 percent. The criteria used to define the urban areas might account for the difference in the estimates.)

   The urban population for the province is approximately 32,000 inhabitants, and roughly 25,000 of the urban population are in the city of Limon. The other urban areas of importance are in the counties of Siquirres and Pococi, with urban populations of 3,027 and 2,377, respectively.

   The city of Limon is the main urban center of the region. The country's busiest port and the terminal for the Northern Railway Company are located there. Close by at Moin is the Oil Refinery Plant—RECOPE—the only one of its kind in the country.

   Limon City is served by one hospital with 194 beds and staffed by 13 doctors.

   There is very little in the way of recreational activities for the youth in Limon City. The seriousness of this situation was brought out in the study by the Ministry of Culture, Youth and Sports: "In Limon City the available diversions, classified in order of importance are: drinking (there are 200 bars in the city), gambling (both the national and illegal panamerican lottery), and prostitution." This statement serves to bring out the gravity of existing urban conditions.

   Although there are areas in the province where the soil is rich and suitable for vegetables and fruits, practically all these items are trucked to the city from other parts of the country. The added expense of transportation makes the cost of food in the city of Limon the highest in the country.

   b. **Housing in the Urban Sector**

   The housing problem in the region may be described as acute. There exists a shortage of housing for low income groups. A reasonably high percentage of housing in the cities is in urgent need of repairs.
According to the 1963 census, there were 6,640 houses in the Central County of Limon. Of these, 4,300 were located in the urban sector. Approximately 30 percent of the urban housing was considered to be in reasonably good shape, 39 percent was classed as average but needing repair, and 22 percent in bad condition requiring total replacement.

In 1971, the Ministry of Labor and Social Welfare conducted a socio-economic inventory of the entire Atlantic region. It investigated a total of 5,015 homes in the urban centers of the province, 4,025 of which were located in the city of Limon. Some of the conclusions of this study were:

—The percentage of houses in good condition decreased from 39 percent in 1963 to 28 percent in 1971, while the percentage of houses in average condition increased to 53 percent, and the ones in bad condition decreased from 22 percent to 18 percent.

—The material most commonly used in the construction of houses is wood for the halls and floors and corrugated sheets for roofing.

—Approximately 88 percent of the homes had access to the urban water supply system.

—66 percent shared sanitary facilities with other households.

—About 90 percent of the houses had electricity.

Overcrowding of families in the city is another indication of the housing shortage. It is estimated that 37 families of 10 or more members live in a 1-bedroom house and 133 families of 10 or more live in 2-bedroom houses. Ninety-five percent of the houses have 1 to 4 bedrooms, while 59 percent of the families have 4 to 10 members in each family.

Approximately 42.5 percent of the houses are occupied by owners and 44.8 percent of the remaining are rented out for 200 colones per month or less.

Most of the people who owned homes reported that they had no steady income. The percentage of houses rented dropped from 70.6 percent in 1963 to 57.5 percent in 1971. This decrease can partly be explained by efforts carried out by the National Institute of Housing and Urbanization (INVU) to provide new homes as indicated in Table 1.
Table 1

NUMBER AND TOTAL OF HABITATIONAL SOLUTIONS ACHIEVED BY INVU IN LIMON PROVINCE 1959-1971

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
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<tr>
<td>TOTAL</td>
<td>454</td>
<td>$7,786,928.20</td>
</tr>
<tr>
<td>1971</td>
<td>44</td>
<td>223,200.00</td>
</tr>
<tr>
<td>1970</td>
<td>6</td>
<td>37,000.00</td>
</tr>
<tr>
<td>1969</td>
<td>19</td>
<td>109,600.00</td>
</tr>
<tr>
<td>1967</td>
<td>1</td>
<td>1,133.20</td>
</tr>
<tr>
<td>1966</td>
<td>163</td>
<td>4,019,095.00</td>
</tr>
<tr>
<td>1965</td>
<td>74</td>
<td>1,058,900.00</td>
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<tr>
<td>1964</td>
<td>59</td>
<td>727,000.00</td>
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<td>1962</td>
<td>23</td>
<td>563,000.00</td>
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<td>1961</td>
<td>11</td>
<td>57,000.00</td>
</tr>
<tr>
<td>1960</td>
<td>5</td>
<td>10,000.00</td>
</tr>
<tr>
<td>1959</td>
<td>49</td>
<td>981,000.00</td>
</tr>
</tbody>
</table>

*Includes loans and construction costs

Source: Department of Planning and Finance, INVU
Another matter of great concern is the increasing squatter population. The present squatter population is estimated to be somewhere between 8,000 and 10,000. They are primarily concentrated in Barrio Limoncito and Barrio Cristobal Colon (formerly Cieneguita). Most of the squatters construct their own homes, and therefore are not part of the rent paying population. In some instances, squatters build houses which are rented out to other squatters. Basic services such as water and electricity are supplied to the squatter colony by Limon Municipality.

INVU has carried out several projects in Limon Province. In 1959 it constructed 49 units at a cost of $981,000, which included interest on loans and costs of building and building materials. Presently the INVU is carrying out the construction of another urbanization project called "Los Corales." It involves developing and building houses on 536 lots. The total cost is estimated at $8,280,000.00. This project is scheduled for completion in 1976. There are also plans to construct two apartment building complexes in Barrio Roosevelt to house 32 families. This apartment building concept is relatively new for Limon. INVU was forced to experiment with vertical construction due to the high cost of land in the city of Limon. The estimated cost for this project is $1,785,000.00.

The completion of these projects will undoubtedly help relieve the critical housing shortage. With the completion of the paved highway in 1974, the housing problem will surface again. Long-range urban planning for Limon City is needed in which housing should necessarily receive major consideration. An interdisciplinary approach to evaluating the problem of housing for low-income families, that would include local participation in the studies and in formulating housing policies, is vital for arriving at a satisfactory solution for the housing problem.

c. Labor in Urban Sector

Economically, the Atlantic Zone depends on the regional agricultural activity. Most of the work force in the urban sector is connected with work at Limon Port.

The total employed labor force of the Province is 13,660 and the age bracket of this work force is estimated to be between 15 and 65. The 1971 unemployment rate for the Province was 9.2 percent. Unemployment among males for the Province was estimated at 8.1 percent, while that among females was 12.7 percent. Of the total work force of 13,660, the urban work force is considered to be 7,060 (5,489 males and 1,671 females). Of the 7,060, 4,417 have had some type of primary education. Thus, more than one-half of the urban labor force has some primary
education, but not technical skills. There are 1,914 members of the labor force who have had some type of secondary education and 206 with university training. The unemployed urban labor force is estimated at 6,600. Of this number, 946 are students and 2,500 are women (a majority of women are over 30 years old). Approximately 91.3 percent of the urban employed are involved in some type of non-agricultural activity at the docks or on the railroad.

There is a 10.2 percent underemployment rate in the Province. The underemployed group is made up of people who work roughly 30 hours or less per week. Transport services, which account for 17.4 percent of the economic activity, has the highest percentage of underemployment.

The skilled urban labor force is extremely small. There are very few qualified electricians, construction workers, masons, plumbers, etc. When there is a need for such services in the urban sector, the personnel are generally recruited from the other provinces. Several factors contribute to this condition. The one most commonly cited is the lack of economic incentives on account of the comparatively low salaries that technicians receive. It is unfortunate but true that attractive salaries for laborers at the docks discourage people from pursuing a technician training program. The banana loading jobs at the docks seek unskilled laborers. Working three to four days per week, a banana loader can earn about $1,200 to $1,500 per month. This figure was often quoted during conversations with various high-ranking officials at JAPDEVA. This salary is higher than that of a technician. It is understandable, therefore, why attendance at the INA technician training programs has been poor, and why there is no incentive to go through two to three years of technician training to receive a lower salary than that of an unskilled dock laborer. According to JAPDEVA, there is a waiting list of 2,000 people seeking dock laborer jobs at the port.

The National Institute of Apprenticeship has had to deal with the problems associated with generating skilled laborers in the Province. Its current plan calls for a Regional Center in the city of Limon by 1976 (Table 2) to alleviate the scarcity of skilled labor.

d. Education in Urban Sector

The 1973 school registration for Limon Province was 23,060, of which 6,116 were in the city of Limon. The secondary school enrollment was 3,321. Primary education in Costa Rica is compulsory. However, it is not clear what mechanisms exist to assure compliance.
Table 2
REGIONAL CENTER OF PROFESSIONAL FORMATION OF LIMON: PLAN OF ACTION
1975-1976

<table>
<thead>
<tr>
<th>Denomination</th>
<th>Courses</th>
<th>Groups</th>
<th>Total Dates</th>
<th>Pupils</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL GENERAL</td>
<td>40</td>
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<td></td>
<td>1,616</td>
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<tr>
<td>Total Previous Level</td>
<td>4</td>
<td>16</td>
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<td>240</td>
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</tr>
<tr>
<td>Previous Level A</td>
<td>7</td>
<td>8</td>
<td></td>
<td>120</td>
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</tr>
<tr>
<td>Previous Level B</td>
<td>2</td>
<td>8</td>
<td></td>
<td>120</td>
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</tr>
<tr>
<td>Industrial Courses</td>
<td>8</td>
<td>16</td>
<td></td>
<td>320</td>
<td></td>
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<tr>
<td>Tapistry A</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Tapistry B</td>
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<td>2</td>
<td></td>
<td>40</td>
<td>Compl.</td>
</tr>
<tr>
<td>Bricklayer A</td>
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<td>2</td>
<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Mason B</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Compl.</td>
</tr>
<tr>
<td>Foreman A</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Foreman B</td>
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<td></td>
<td>40</td>
<td>Compl.</td>
</tr>
<tr>
<td>Carpenter A</td>
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<td>2</td>
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<td>Hab.</td>
</tr>
<tr>
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<td></td>
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</tr>
<tr>
<td>Agro-Industry Courses</td>
<td>4</td>
<td>8</td>
<td></td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Commercial Courses</td>
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<td>16</td>
<td></td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>Office Worker A</td>
<td>2</td>
<td>4</td>
<td></td>
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<td>Hab.</td>
</tr>
<tr>
<td>Office Worker B</td>
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<td>4</td>
<td></td>
<td>80</td>
<td>Compl.</td>
</tr>
<tr>
<td>Agricultural Courses</td>
<td>8</td>
<td>16</td>
<td></td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>Banana Cultivator A</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Banana Cultivator B</td>
<td>1</td>
<td>2</td>
<td></td>
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<td>Compl.</td>
</tr>
<tr>
<td>Cattle Farm Admin.A</td>
<td>1</td>
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<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Cattle Farm Admin.B</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Compl.</td>
</tr>
<tr>
<td>Basic Grains Grower A</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Basic Grains Grower B</td>
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<td>2</td>
<td></td>
<td>40</td>
<td>Compl.</td>
</tr>
<tr>
<td>Poultry Raiser A</td>
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<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Poultry Raiser B</td>
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<td>2</td>
<td></td>
<td>40</td>
<td>Compl.</td>
</tr>
<tr>
<td>Women's Courses</td>
<td>8</td>
<td>16</td>
<td></td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>Sewing A</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Sewing B</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Compl.</td>
</tr>
<tr>
<td>Food Preservation A</td>
<td>2</td>
<td>4</td>
<td></td>
<td>80</td>
<td>Hab.</td>
</tr>
<tr>
<td>Food Preservation B</td>
<td>2</td>
<td>4</td>
<td></td>
<td>80</td>
<td>Compl.</td>
</tr>
<tr>
<td>Home Economics A</td>
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<td>2</td>
<td></td>
<td>40</td>
<td>Hab.</td>
</tr>
<tr>
<td>Home Economics B</td>
<td>1</td>
<td>2</td>
<td></td>
<td>40</td>
<td>Compl.</td>
</tr>
</tbody>
</table>

Hab. = Beginners
Compl. = Intermediate or Complementary Training
Presently there are 11 primary and 5 secondary educational centers in the city of Limon. Both Siquirres and Guapiles have an agricultural high school. There are no vocational or technical training centers in the city of Limon. There is a professional high school which offers secretarial, mechanical and accountant training. Its initial enrollment in 1973 was 245 students.

At the present time, the student population from Limon Province attending University of Costa Rica represents only 1.03 percent of the total student enrollment at the University. (See Tables 3 and 4.) Because of the lack of employment opportunities in Limon Province for university graduates, there is a tremendous "brain drain" from the Province. Most of those who have continued their study beyond high school have moved to the Central Valley where better employment opportunities exist.

To encourage higher education for students in the region, the Board of Port Administration and Economic Development of the Atlantic Slope (JAPDEVA) has allocated a scholarship fund of up to $500,000 for direct and indirect scholarships. JAPDEVA has granted over 50 scholarships to students who are attending University of Costa Rica.

For the development of the region it is essential to reduce the "brain drain" that has detracted professionals, managers and skilled laborers from the Province. Prior to granting a scholarship, it might be worthwhile to explore whether a commitment from the student to remain and work in a predetermined job for an agreed upon period and for an attractive salary might provide the needed features to attract native professionals back to Limon. In this manner, local industries, autonomous agencies, and others can draw on the professional and administrative talents from within the region for its development.

The attractive salaries that laborers earn loading bananas at the docks have enticed the urban population to seek jobs at the docks at an early age. This factor alone has been a main stumbling block to building a stable and on-going educational and training program in the region. New industries may be attracted to the region if a skilled labor force exists in the region. Although the urban population seems to have technical aptitude, technical and vocational training programs are needed to generate skilled technicians. The professional resources at the College of Engineering, University of Costa Rica, the Institute of Technology, Cartago, and INA should be tapped to devise programs that are appropriate for the region and financially attractive to the participants.
Table 3

**LUGAR DE RESIDENCIA PERMANENTE DE LOS ESTUDIANTES DE LA UNIVERSIDAD Y DISTRIBUCION POR PROVINCIAS DE LA POBLACION DE COSTA RICA (1973)**

**Absoluto**

<table>
<thead>
<tr>
<th></th>
<th>Estud.</th>
<th>Poblac.</th>
<th>% Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL</strong></td>
<td>18,908</td>
<td>1,874,372</td>
<td>1.01</td>
</tr>
<tr>
<td>San Jose</td>
<td>12,155</td>
<td>665,215</td>
<td>1.83</td>
</tr>
<tr>
<td>Alajuela</td>
<td>2,209</td>
<td>337,803</td>
<td>0.65</td>
</tr>
<tr>
<td>Cartago</td>
<td>1,452</td>
<td>214,666</td>
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<tr>
<td>Heredia</td>
<td>1,478</td>
<td>118,582</td>
<td>1.25</td>
</tr>
<tr>
<td>Guanacaste</td>
<td>358</td>
<td>209,780</td>
<td>0.17</td>
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<tr>
<td>Puntarenas</td>
<td>565</td>
<td>231,078</td>
<td>0.24</td>
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<tr>
<td>Limon</td>
<td>195</td>
<td>97,248</td>
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</tr>
<tr>
<td>Exterior</td>
<td>418</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Sin indicacion</td>
<td>155</td>
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**Relativo**

<table>
<thead>
<tr>
<th></th>
<th>100.00</th>
<th>100.00</th>
<th>1.01</th>
</tr>
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<tbody>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>1.01</td>
</tr>
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<td>35.6</td>
<td>1.35</td>
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<tr>
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<td>11.68</td>
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<td>7.68</td>
<td>11.5</td>
<td>0.68</td>
</tr>
<tr>
<td>Heredia</td>
<td>7.82</td>
<td>8.1</td>
<td>1.25</td>
</tr>
<tr>
<td>Guanacaste</td>
<td>1.89</td>
<td>11.0</td>
<td>0.17</td>
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<td>Puntarenas</td>
<td>2.99</td>
<td>12.3</td>
<td>0.24</td>
</tr>
<tr>
<td>Limon</td>
<td>1.03</td>
<td>5.2</td>
<td>0.20</td>
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<tr>
<td>Exterior</td>
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<td>--</td>
</tr>
<tr>
<td>Sin indicacion</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

*Source: Estadisticas Universitarias y Dirección General de Estadística y Censos.
Información obtenida en la encuesta realizada por Oscar Torres Padilla en marzo de 1973.*
Table 4

ADMITIDOS EN LA UNIVERSIDAD DE COSTA RICA EN RELACION CON LAS SOLICITUDES DE ADMISION POR PROVINCIA Y AÑO (1973)

<table>
<thead>
<tr>
<th>Provincia</th>
<th>Solicit.</th>
<th>Admit.</th>
<th>% Admit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>8,622</td>
<td>5,045</td>
<td>56.00</td>
</tr>
<tr>
<td>San Jose</td>
<td>4,535</td>
<td>2,725</td>
<td>60.09</td>
</tr>
<tr>
<td>Alajuela</td>
<td>1,237</td>
<td>731</td>
<td>59.09</td>
</tr>
<tr>
<td>Heredia</td>
<td>658</td>
<td>368</td>
<td>55.93</td>
</tr>
<tr>
<td>Cartago</td>
<td>791</td>
<td>474</td>
<td>59.92</td>
</tr>
<tr>
<td>Guanacasta</td>
<td>442</td>
<td>290</td>
<td>65.61</td>
</tr>
<tr>
<td>Limon</td>
<td>131</td>
<td>115</td>
<td>87.79</td>
</tr>
<tr>
<td>Puntarenas</td>
<td>395</td>
<td>192</td>
<td>48.61</td>
</tr>
<tr>
<td>Costarricenses H. School</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Bach. por Madurez</td>
<td>120</td>
<td>42</td>
<td>35.00</td>
</tr>
<tr>
<td>Extranjeros</td>
<td>313</td>
<td>206</td>
<td>65.81</td>
</tr>
<tr>
<td>Sin indicacion</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

4. **The Rural Sector**

a. **Population in the Rural Sector**

The rural population of the Province in 1972 was 65,265, which was roughly 66 percent of the total population of the Province.

Using the county of Pococi as a point of reference, due to its location, size, and importance to the rural sector, the following observations can be made:

—The annual population increase for this area was above the national and the provincial averages.

—The number of births per 1,000 population for this area was almost three times the national average and twice the provincial average.

—The mortality rate for Pococi was also higher than the national and provincial averages.

The high birth rate might be the result of poor and inadequate family planning and counseling centers available to the rural population. The high mortality rate might be related to inadequate medical and hospital care.

b. **Rural Housing**

Based on a subjective survey recently conducted on 1,578 houses in the rural area, it was found that:

—Rural housing conditions have marginally improved since 1963 when the last census was taken.

—The quality of water and services by public utilities have improved.

—The use of water from waterlines has increase appreciably—32.7 percent over that indicated in 1963.

—Installation of bathing facilities has increased from 22.5 percent in 1963 to 59 percent in 1971.

—The electric power lines to houses increased from 9.5 percent to 18 percent.

—The number of electrical appliances also showed a considerable increase. The number of radios went up by 61 percent.
These improvements can be attributed to a conscious effort to better the socio-economic conditions of the rural population. Home ownership showed a decrease of more than 5 percent, and the number of those who rented homes increased 9.3 percent.

Among families with incomes of $500 or less, 47.3 percent owned their homes, 22 percent rented homes and homes were provided for 30 percent. Of those who reported incomes higher than $500, 39 percent owned homes, 24 percent lived in rented homes, and 36 percent were provided free housing, generally by the banana companies.

Of the families which rented homes, roughly 84 percent paid between $50 and $100, 12.7 percent paid between $100 and $200, and 3.3 percent paid rents in excess of $200. As regards income and the rent paid, families with incomes of up to $500 per month paid rents as follows: 89.2 percent paid between $50 and $100, while 10.8 percent paid more than $100. Families with incomes higher than $500 lived in homes for which they paid rents between $50 and $100, and the rest paid rents in excess of $100.

INVU has plans for a housing project to be constructed in the Banana Zone of the Atlantic region. This project is scheduled for 1976-77, at a cost of more than $7,500,000, and will provide a total of 710 units.

c. Rural Labor

Roughly 70 percent of the employed rural labor force in the Province is engaged in some type of agricultural activity. Among the rural labor force there is an unemployment rate of 4.2 percent in the agricultural sector and 6 percent in the non-agricultural sector.

With respect to the economic activity of the zone, the following are some general observations by the Ministry of Labor regarding its socio-economic inventory of the Atlantic region:

—In 1971 farmers, cattlemen, and fishermen represented 57.4 percent of the rural labor force.

—24.6 percent of the rural work force involved in the agricultural sector were self-employed.

—Talamanca showed the highest percentage of farmers and cattlemen (31.1 percent).

—Siquirres showed the highest percentage of self-employed.
Underemployment in the rural zone is largely due to underemployment among the female population. Among the 15 to 19 year-old age group, the unemployment rate was 91 percent. One reason for this higher percentage is the fact that most young people have to combine their studies with part time work to finance their education and to support their families.

As to salary scales, it is estimated that 27.9 percent of the workers earn between €450 and €550 per month. About 74.6 percent earn monthly salaries between €225 and €750. If a median were worked out, it would indicate that 75 percent of the workers received an average salary of €488 per month.

Among the self-employed group roughly 50 percent receive an average monthly salary of €150.

It is estimated that 0.07 percent of the rural labor force have had some university background. Approximately 75 percent of the labor force have only a primary education, and 17 percent are illiterate. The combined strength of these two groups represents approximately 90 percent of the total rural work force. This fact point to two interesting observations:

—The majority of the population which is economically active is made up of people with no or very little educational or technical training. These people are evidently unable to perform jobs which require a certain degree of sophistication.

—A large number of the young people have to work part time while receiving an education. This tends to decrease their efficiency in both activities.

B. Land and Sea Resources

1. Agricultural Crops

a. Introduction

A national problem which has been steadily aggravating with time is Costa Rica's balance of payments deficit. Therefore, National Planning Agencies need to focus on encouraging those development programs which might quickly pay off the foreign debt. Limon Province has great potential for development programs which would help reduce the foreign debt. Import substitution and the development of traditional and new agricultural products for export seem feasible for the region.

For agricultural development, it seems feasible to promote the production of crops and livestock without protracted research by adapting existing knowledge to these activities.
In this section the study focused on:

- encouraging production of commodities such as corn and rice which, through intensification of the culture, can reduce the steadily increasing import of these items;

- the intensification of culture to increase yield and quality of existing crops (cacao, plantains, coconuts), and

- introduction of new crops which will reduce imports (African oil palm) and provide foreign exchange through exports (fruits, vegetables, nuts, spices, and ornamental plants).

b. Traditional Agriculture--General

In assessing present agriculture, it is helpful to study the agronomic history and learn from mistakes of the past. The Atlantic Zone particularly did not benefit from the establishment of monoculture in the region. Bananas came into establishment of monoculture in the region in 1899 with the United Fruit Company and had to be abandoned in the early 1930's after the company had planted 300,000 hectares of bananas. After this, cacao was planted, but in the 1960's many producers went out of business because world cacao prices dropped steadily over a ten-year period.

This bitter experience with monoculture is not particular to Limon. It has been repeated in many parts of the world. Agricultural activities based on monoculture have failed due to epidemics of disease, insects, sudden price drops, and loss of markets. Although there are definite advantages to monoculture with efficient production, the mistake normally made is in having monoculture for an entire region. In diversification there is stability. Directly or indirectly, diversification leads to development of the zone, improvement in transport, greater ease of obtaining credit in the region, and encouragement for other industries to come to the region. By-products of one production which normally would be wasted can be utilized by another. For example, until recently, disposing of banana rejects, which annually amount to 2.5 to 3.0 million pounds, has been a problem. Now, with the introduction of livestock to the region, they are used as supplementary feed supporting hog and cattle raising operations.

Thus to avoid the dangers of monoculture, diversification seems essential for the development of Limon.

Presently, the Atlantic Zone has four main crops--bananas, cacao, plantain, and coconut. The banana grown is the newly introduced Giant Cavendish variety that can resist the "Panama disease." The plantain plantations are growing in
importance and plantains are exported to Nicaragua and the United States. Cacao and coconut are the oldest plantations where very little replanting has been practiced. Cacao plantations are over 40 years old and the coconut trees are over 80 years old.

b. **Traditional Agriculture—Bananas**

The Atlantic Zone of Costa Rica is a region with land that is well-suited to the cultivation of bananas on a commercial scale.

Since the end of the last century, and as a complement to the operations of "Ferrocarril de Costa Rica," Mr. Minor C. Keith started the export of bananas from the Atlantic Zone. In 1899 the United Fruit Company was founded and became one of the largest banana exporters in the world. The Panama Disease forced the United Fruit Company to abandon its plantations in the early 1930's, which brought about a tremendous economic depression in the zone.

Since the beginning of the century, bananas have been next to coffee in national importance as a foreign exchange earner for Costa Rica. Internationally, Costa Rica fares well with the other exporters, as shown in the following table:

<table>
<thead>
<tr>
<th></th>
<th>1971</th>
<th>1972</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecuador</td>
<td>1,350</td>
<td>1,400</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>922</td>
<td>1,075</td>
</tr>
<tr>
<td>Honduras</td>
<td>971</td>
<td>1,010</td>
</tr>
<tr>
<td>Panama</td>
<td>590</td>
<td>700</td>
</tr>
</tbody>
</table>

Standard Fruit Company exports from Limon Province are estimated at 76 million boxes for 1973. In 1962, Standard entered into contracts with independent growers. Presently, under agreements with some 20 independent growers, more than 5,000 hectares are producing bananas with an estimated export of 9 million boxes. (See Table 6)

Banana production is quite labor intensive, estimated at about 1.3 hectares per man with work available the year round at salaries which are two or more times the
### Table 6

**COMPARATIVE TABLE OF EXPORTS, ECONOMIC IMPORTANCE, AREA UNDER CULTIVATION AND LABOR FORCE EMPLOYED IN BANANA PRODUCTION**

Estimate for: 1972

<table>
<thead>
<tr>
<th></th>
<th>Millions of Boxes</th>
<th>Estimated Value (Million $)</th>
<th>Hectares (Thousands)</th>
<th>Number of Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Costa Rican Companies exporting bananas from plantations managed by the companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>29.9</td>
<td>52.8</td>
<td>15.13</td>
<td>12,000</td>
</tr>
<tr>
<td>Cta Bananera de C.R.</td>
<td>18.0</td>
<td>32.0</td>
<td>8.0</td>
<td>7,580</td>
</tr>
<tr>
<td>Standard Fruit Co.</td>
<td>8.7</td>
<td>16.0</td>
<td>4.7</td>
<td>3,750</td>
</tr>
<tr>
<td>BANDECO</td>
<td>3.0</td>
<td>4.5</td>
<td>1.5</td>
<td>630</td>
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<tr>
<td>COBAL</td>
<td>0.2</td>
<td>0.3</td>
<td>0.93</td>
<td>40</td>
</tr>
<tr>
<td><strong>Costa Rican Companies exporting bananas produced under contract with small farmers, sales FOB/CR</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>20.4</td>
<td>26.8</td>
<td>12.5</td>
<td>8,960</td>
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<td>Producers Cta Bananera C.R.</td>
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<td>0.3</td>
<td>160</td>
</tr>
<tr>
<td>Producers Standard Fruit Co.</td>
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<td>10.8</td>
<td>5.0</td>
<td>3,600</td>
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<tr>
<td>Producers BANDECO</td>
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<td>9.0</td>
<td>4.2</td>
<td>2,950</td>
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<tr>
<td>Producers COBAL</td>
<td>4.3*</td>
<td>6.4</td>
<td>3.0</td>
<td>2,250</td>
</tr>
<tr>
<td>TOTAL (GENERAL)</td>
<td>50.3</td>
<td>79.6</td>
<td>27.63</td>
<td>20,960</td>
</tr>
</tbody>
</table>

*These producers must deduct cost of boxes of $.035 (data estimates by Camara Nacional de Bananeros).*
amount paid for other agricultural activities. Banana production has brought with it opportunities for housing for workers and the construction of many roads, especially in the Guapiles area, which greatly contribute to regional development.

Banana plantation operation is not without its negative effects. It has forced many small farmers to abandon their normal cultivation of crops for local and national consumption, in favor of working on banana plantations.

Banks have been ready to extend credit for new banana plantations and the increase in acreage of this crop in the past five years has been spectacular. With increases in the costs and the consequent profit squeeze, independent producers are facing problems. This has dampened plans for planting more acreage. Many independent banana producers are trying to diversify production and are planning on raising cattle instead.

Ten-year contracts were signed between the independent national producers and the large banana exporters. In these contracts, the price that would be paid by the exporters to the producers was fixed, with no qualifying clause to account for possible increases in cost of production. The fixed price for the produce in the face of soaring costs of production and inflation has created a grave situation for the independent national producers presently under contract with the banana exporters. Some of the factors that precipitated the situation are:

—The escalating costs of raw materials and labor at a rate inconsistent with the contract price for the product.

—The contract stipulates that the national independent producer will be paid only after the boxes are placed aboard the ships. On several occasions, due to limited docking facilities for ships, poor storage facilities at the docks, and lack of space aboard the ships, national independent producers have incurred considerable losses due to ripened bananas unsuitable for export.

—Social demands have put more pressure on the national independent producers to provide housing facilities and other social guarantees for their workers.

—The competition among the large companies for the world markets (especially in the United States and Europe) has indirectly placed additional pressure on the national independent producer to pack better quality bananas, thereby further increasing the percentage of bananas rejected.
Recently, the Central Bank decided to permit the national independent banana producers, who do not export, to obtain 39 percent of the foreign exchange of their sales at the free market rate. Producers who have economic ties with exporters would not be eligible for this benefit. This is a first positive step toward helping to solve the critical economic situation of most of the independent producers. Coupled with this step is the requirement to improve housing and social services for the workers. The next logical step is the need for renegotiating the contracts between the exporters and the national independent producers so that the price paid to the producers is consistent with the world market price for bananas. At the present time, prices as high as $3.80 a box are obtained by exporters, while national independent producers receive about $1.05 a box from the exporters, as stipulated in the contract.

The Asociacion Bananera Nacional S.A. (ASBANA) was created in 1971:

- to open new markets by establishing agreements between governments, with guaranteed prices and quotas;
- to form an organization of exporting countries to defend their interests in the international market;
- to eliminate tariff barriers that impede extensive export markets for bananas, and
- to look for opportunities for agricultural diversification and industrialization.

b. Traditional Agriculture--Cacao

The many cacao plantations established in the 1930's made an important contribution to the economy of the region and the country. Their relative importance has decreased, however, because of the decline in prices during the 1960's. However, over the years, the crop has retained its position of fifth place in the country's exports and second major export from Limon. Tables 7, 8, and 9 show cacao's importance in national exports.

Although total production has decreased for the Province, the production per hectare has increased. Between 5,000 and 8,000 hectares have been cleared and replaced by the more profitable banana. The recent price increases for cacao have forced better care by the producers. Thus production of cacao has surged.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee</td>
<td>45.4</td>
<td>44.9</td>
<td>48.4</td>
<td>45.3</td>
<td>48.0</td>
<td>48.6</td>
<td>52.7</td>
<td>54.841</td>
<td>55.264</td>
</tr>
<tr>
<td>Banana</td>
<td>20.3</td>
<td>20.8</td>
<td>26.9</td>
<td>25.8</td>
<td>28.3</td>
<td>28.3</td>
<td>33.3</td>
<td>30.928</td>
<td>42.778</td>
</tr>
<tr>
<td>Cattle &amp; Meat</td>
<td>3.8</td>
<td>4.7</td>
<td>4.1</td>
<td>5.7</td>
<td>7.7</td>
<td>5.2</td>
<td>6.9</td>
<td>9.521</td>
<td>12.281</td>
</tr>
<tr>
<td>Sugar</td>
<td>1.8</td>
<td>3.2</td>
<td>2.8</td>
<td>5.1</td>
<td>5.1</td>
<td>4.6</td>
<td>8.0</td>
<td>8.390</td>
<td>8.710</td>
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<tr>
<td>Cacao</td>
<td>5.8</td>
<td>4.8</td>
<td>4.9</td>
<td>4.3</td>
<td>4.1</td>
<td>2.2</td>
<td>3.1</td>
<td>3.146</td>
<td>2.955</td>
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<tr>
<td>Fertilizer</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>0.6</td>
<td>6.8</td>
<td>3.6</td>
<td>2.4</td>
<td>2.805</td>
<td>4.432</td>
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<tr>
<td>Others</td>
<td>7.7</td>
<td>5.8</td>
<td>5.9</td>
<td>8.2</td>
<td>13.9</td>
<td>21.3</td>
<td>31.6</td>
<td>34.149</td>
<td>44.401</td>
</tr>
<tr>
<td>TOTAL</td>
<td>85.8</td>
<td>84.2</td>
<td>93.0</td>
<td>95.0</td>
<td>113.9</td>
<td>111.8</td>
<td>138.0</td>
<td>143.780</td>
<td>170.821</td>
</tr>
</tbody>
</table>
### Table 8

**CACAO EXPORTS, PRICES AND CREDIT**

<table>
<thead>
<tr>
<th>Year</th>
<th>C.R. Cacao Exports as % of total agricultural exports</th>
<th>C.R. Cacao exports as % of world cacao exports</th>
<th>World Cacao price in cents/pound</th>
<th>% change in world cacao price</th>
<th>Credit outstanding to Cacao from national banks in million €</th>
<th>Cacao Bank Credit as % of total agricultural bank credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>4.6</td>
<td>0.8</td>
<td>27.3</td>
<td></td>
<td>6.0</td>
<td>3.8</td>
</tr>
<tr>
<td>1957</td>
<td>4.9</td>
<td>0.9</td>
<td>30.6</td>
<td>+10.7</td>
<td>6.4</td>
<td>3.0</td>
</tr>
<tr>
<td>1958</td>
<td>6.2</td>
<td>1.2</td>
<td>44.3</td>
<td>+30.9</td>
<td>6.4</td>
<td>3.0</td>
</tr>
<tr>
<td>1959</td>
<td>9.6</td>
<td>1.5</td>
<td>36.6</td>
<td>-21.0</td>
<td>5.4</td>
<td>2.1</td>
</tr>
<tr>
<td>1960</td>
<td>7.0</td>
<td>1.3</td>
<td>28.4</td>
<td>-28.8</td>
<td>6.4</td>
<td>2.2</td>
</tr>
<tr>
<td>1961</td>
<td>5.7</td>
<td>1.0</td>
<td>22.6</td>
<td>-25.6</td>
<td>5.5</td>
<td>1.9</td>
</tr>
<tr>
<td>1962</td>
<td>5.6</td>
<td>1.2</td>
<td>21.0</td>
<td>-7.6</td>
<td>5.5</td>
<td>1.8</td>
</tr>
<tr>
<td>1963</td>
<td>4.9</td>
<td>0.9</td>
<td>25.3</td>
<td>+16.9</td>
<td>4.5</td>
<td>1.5</td>
</tr>
<tr>
<td>1964</td>
<td>4.1</td>
<td>0.9</td>
<td>23.4</td>
<td>-8.1</td>
<td>4.4</td>
<td>1.3</td>
</tr>
<tr>
<td>1965</td>
<td>2.4</td>
<td>0.5</td>
<td>17.3</td>
<td>-35.2</td>
<td>4.0</td>
<td>1.1</td>
</tr>
<tr>
<td>1966</td>
<td>2.9</td>
<td>0.7</td>
<td>24.4</td>
<td>+29.0</td>
<td>4.2</td>
<td>1.1</td>
</tr>
<tr>
<td>1967</td>
<td>2.7</td>
<td>0.6</td>
<td>29.1</td>
<td>+16.1</td>
<td>3.9</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Source: Comercio Exterior, F.A.O. and Banco Central*
Table 9

CACAO EXPORTS

<table>
<thead>
<tr>
<th>Year</th>
<th>Cacao Beans</th>
<th>Cacao Products</th>
<th>Total Cacao</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kilos</td>
<td>Dollars</td>
<td>Kilos</td>
</tr>
<tr>
<td>1956</td>
<td>6,296</td>
<td>2,985</td>
<td>6,296</td>
</tr>
<tr>
<td>1957</td>
<td>7,350</td>
<td>3,923</td>
<td>7,442</td>
</tr>
<tr>
<td>1958</td>
<td>7,685</td>
<td>5,794</td>
<td>7,774</td>
</tr>
<tr>
<td>1959</td>
<td>11,522</td>
<td>7,188</td>
<td>11,626</td>
</tr>
<tr>
<td>1960</td>
<td>11,822</td>
<td>5,854</td>
<td>11,944</td>
</tr>
<tr>
<td>1961</td>
<td>10,214</td>
<td>4,348</td>
<td>10,346</td>
</tr>
<tr>
<td>1962</td>
<td>11,947</td>
<td>4,665</td>
<td>12,079</td>
</tr>
<tr>
<td>1963</td>
<td>9,471</td>
<td>4,247</td>
<td>9,645</td>
</tr>
<tr>
<td>1964</td>
<td>9,225</td>
<td>4,056</td>
<td>9,571</td>
</tr>
<tr>
<td>1965</td>
<td>6,763</td>
<td>2,215</td>
<td>7,210</td>
</tr>
<tr>
<td>1966</td>
<td>7,743</td>
<td>3,103</td>
<td>8,227</td>
</tr>
<tr>
<td>1967</td>
<td>7,194</td>
<td>3,146</td>
<td>7,793</td>
</tr>
</tbody>
</table>

Source: Comercio Exterior.
Note: All figures, both Kilos and Dollars, are in thousands.
Ecological Considerations: Cacao is well adapted to large areas of Limon, but certain areas have proven to be better suited to its production than others. It requires a mean average temperature of 24°C. Total annual precipitation should be between 2,000 and 4,000 mm., well distributed throughout the year, to prevent moisture stress to the plant. Therefore, it should be grown in soils which have both good air and water drainage and high water retention. Most favorable altitudes are below 250 meters, but at 650 meters it is cultivated at Turrialba. Yields over the years have been maintained without additional fertilization because of the nature of the crop—once established, the plantation resembles natural forest conditions. The sun does not reach the ground and shade trees and cacao trees contribute leaf litter which can build up the organic matter and consequent fertility.

Available Labor: When cacao was planted in the areas abandoned by United Fruit Company banana operations, there was unemployed labor since cacao cultivation is not labor intensive. Most cacao farms are run by a family, except on technically advanced farms which use fumigation and drainage. At such farms supplemental labor is hired. When the bananas returned in the 1960's, much of the cacao labor force went back to work on the plantations for higher wages. This has been a motivation for the abandonment of some of the cacao farms. Today labor needs in cacao farms are growing. Hired labor is very expensive and the family work force of the cacao farm owners often migrate to urban centers seeking higher wages.

Principal Natural Pests: Cacao has one principal limiting factor in the Monilia Pod Rot. It infects the pod, turning it black and can also spread to the trunk and limbs. Another fungus is Ceratostomella finbriata, which can destroy the branches or the whole tree. In the old plantations of Limon Province the original shade trees have not been pruned and have grown to great heights, competing with the cacao for nutrients, sunlight, and water.

Cacao production is inefficient because of poor insect control, neglect in tree and farm maintenance, and the age of the trees. (Some are over 40 years old.) Consequently, yields are low—on the order of 300 to 400 kilograms per hectare.

Land Use and Tenure: There are some plantations of more than 200 hectares, but the majority are from 2 to 15 hectares. Existing plantations can be clearly identified in the aerial photographs. Formerly, cacao plantations extended up to Guapiles, but are now concentrated between Siquirres and Matina along the railroad and in the Talamanca region, which is the best suited for cacao in the Province.
Sr. Salazar, in his thesis entitled "Los Recursos Economicos como base para el desarrollo agricola en la zona cacaotera de Cahuita, Limon, Costa Rica," divides land holdings into four sizes in the Cahuita area: Category I = 1 to 3.5 hectares; Category II = 4 to 14 hectares; Category III = 15 to 35 hectares; Category IV = 36 to 100 hectares.

Table 10
DISTRIBUTION OF CACAO FARMS
BY NUMBER AND SIZE IN CAHUITA, COSTA RICA
(1967)

<table>
<thead>
<tr>
<th>Category</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farms</td>
<td>32</td>
<td>113</td>
<td>35</td>
<td>21</td>
<td>201</td>
</tr>
<tr>
<td>Area (hectares)</td>
<td>81.3</td>
<td>863.8</td>
<td>759.1</td>
<td>1,206.9</td>
<td>2,911.0</td>
</tr>
</tbody>
</table>

From the above table it is evident that most landowners are the small farmers. Some 70 percent of the farms are smaller than 14 hectares, which cover 33 percent of the land, while 28 percent of the farms cover 67 percent of the land.

Another aspect of the study was concerned with the form of land tenure for cacao farmers:

Table 11
LAND TENURE BY SIZE OF CACAO FARMS
IN CAHUITA, COSTA RICA (1967)

<table>
<thead>
<tr>
<th>Category</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owners with Title</td>
<td>5</td>
<td>7</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Owners without Title</td>
<td>22</td>
<td>73</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Tenants</td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Tenants are those who rent the land; squatters do not have titles to the land and do not pay rent for its use.

In this area and other cacao-producing areas, there are producers who have rented land from the United Fruit Company since the 1930's. United Fruit has the right to terminate the rent agreement with 90 days advance notice. This uncertainty leaves the farmer with little drive to invest time and money into the farms.

The fact that farmers do not own their farms further handicaps those who approach banks for credit. The banks are reluctant to lend money to farmers who do not have title to their land. The Consejo Nacional de Production (CNP) often provides institutional guarantees on behalf of the farmers. But their help has been limited. In the Cahuita area, 70 percent of the producers do not use credit. Of the 30 percent who do, 17 percent use institutional loans and 13 percent use private funds. Of the loans, 82 percent are for less than one year. Thus, most of the credit is being used for immediate needs, while long-term plans are difficult to initiate under present circumstances.

Marketing: Small producers ferment and dry the cacao themselves, while a few are involved in selling the product in Limon through middlemen. Middlemen usually have diesel dryers. They can receive fresh cacao for drying during unfavorable weather conditions and also from farmers who do not have drying facilities. The products are sold directly to the exporters. Middlemen sometimes supply the farmers with agricultural chemicals, but these are not always available when needed and not to all farmers.

From 1960 to 1969, the international market prices for cacao have been steadily decreasing. The recent price increase might be due to several factors: New markets in Eastern Europe, and perhaps other competing countries have been subject to unstable political conditions. Droughts have severely hurt many plantations, as occurred in Ghana. With the result, cacao exports to international markets have steadily decreased.

<table>
<thead>
<tr>
<th>Category</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Squatters</td>
<td>5</td>
<td>13</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Others</td>
<td>--</td>
<td>--</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>113</td>
<td>35</td>
<td>21</td>
</tr>
</tbody>
</table>
The rising demand, particularly in the industrialized nations, along with decreasing world reserves, has substantially increased the world market price for cacao. It is likely that the world price might remain high. Costa Rica's production is roughly one percent of the world's supply. Raising or lowering the exports does not adversely affect the world market. On the other hand, world prices make a great deal of difference as to whether or not it is economical to continue to produce or to renovate existing plantations in Limon.

Cooperatives: The rehabilitation project of 4,000 hectares from Penshurst to Puerto Viejo in the Talamanca area, if properly run, could be of great benefit to the region. This area was chosen over other cacao producing areas in the region because the ecological conditions make it ideally suited for growing cacao. The plantations are younger and the farmers more receptive to improved technology. Land use in this area is 67 percent cacao, the rest is pastures and annual crops. Labor is mostly drawn from the farmers' families.

Involved in this project are three national banks (Banco Anglo Costaricano, Banco de Costa Rica and Banco Nacional de Costa Rica), the CNP, MAG, and IICA. The banks give the necessary credit, the CNP offers guarantees to the banks, IICA provides seeds of the improved hybrids and technical aid, and the MAG carries out the extension program. The project is already in operation with an established nursery, and workers are already planting the hybrids. The hybrid is the result of extensive research at IICA's cacao research station at La Lola in Limon. With the variety-- pound 12 x Catango, yields of up to 5,800 pounds per hectare are feasible, compared to 700 to 900 pounds per hectare reported from most farms. This variety is also resistant to Phytophthora and Cercospora, which makes it especially valuable and reduces the cost of maintenance.

Objectives of the project are to increase production in the first four years by improved cultural practices, and to replant some areas with hybrids to increase production from 500 to 2,000 pounds per hectare. Trained personnel are needed at La Lola to produce seed and improve on cultural practices. This project can become a pilot program for other cacao producing areas.

The cacao producers and small producers of other crops in the region need to form an association or cooperative to protect and further their interests. The cacao producers reported disillusionment with two former cooperatives, the more recent being COOPROCAL (Cooperativa de Productores de Cocoa del Atlantico). Several reasons were given for this disappointment:
Table 12
WORLD CACAO SUPPLY & DEMAND IN MILLIONS OF METRIC TONS

<table>
<thead>
<tr>
<th>Year</th>
<th>Reserve (A)</th>
<th>Production (B)</th>
<th>Total Disposable (A+B=C)</th>
<th>Ground (D)</th>
<th>Saldo (C-D)</th>
<th>Variations</th>
<th>Average Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1957/58</td>
<td>224</td>
<td>765</td>
<td>989</td>
<td>849</td>
<td>140</td>
<td>84</td>
<td>$ 99</td>
</tr>
<tr>
<td>1958/59</td>
<td>140</td>
<td>899</td>
<td>1,039</td>
<td>867</td>
<td>172</td>
<td>132</td>
<td>39</td>
</tr>
<tr>
<td>1959/60</td>
<td>172</td>
<td>1,029</td>
<td>1,201</td>
<td>929</td>
<td>272</td>
<td>1,100</td>
<td>34</td>
</tr>
<tr>
<td>1960/61</td>
<td>272</td>
<td>1,163</td>
<td>1,435</td>
<td>1,016</td>
<td>419</td>
<td>1,147</td>
<td>26</td>
</tr>
<tr>
<td>1961/62</td>
<td>419</td>
<td>1,112</td>
<td>1,531</td>
<td>1,109</td>
<td>422</td>
<td>13</td>
<td>21</td>
</tr>
<tr>
<td>1962/63</td>
<td>422</td>
<td>1,146</td>
<td>1,468</td>
<td>1,144</td>
<td>424</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>1963/64</td>
<td>424</td>
<td>1,208</td>
<td>1,632</td>
<td>1,181</td>
<td>451</td>
<td>127</td>
<td>21</td>
</tr>
<tr>
<td>1964/65</td>
<td>451</td>
<td>1,470</td>
<td>1,921</td>
<td>1,322</td>
<td>594</td>
<td>1,143</td>
<td>22</td>
</tr>
<tr>
<td>1965/66</td>
<td>594</td>
<td>1,198</td>
<td>1,792</td>
<td>1,375</td>
<td>417</td>
<td>-177</td>
<td>15</td>
</tr>
<tr>
<td>1966/67</td>
<td>417</td>
<td>1,325</td>
<td>1,742</td>
<td>1,370</td>
<td>372</td>
<td>-45</td>
<td>17</td>
</tr>
<tr>
<td>1967/68</td>
<td>372</td>
<td>1,329</td>
<td>1,701</td>
<td>1,388</td>
<td>313</td>
<td>-59</td>
<td>23</td>
</tr>
<tr>
<td>1968/69</td>
<td>313</td>
<td>1,195</td>
<td>1,508</td>
<td>1,332</td>
<td>176</td>
<td>-139</td>
<td>27</td>
</tr>
</tbody>
</table>
Poor management by people who were not from the cacao producing regions and who were unfamiliar with the local problems. Furthermore, COOPROCAL was so broad in its scope that individual farmers did not get the attention and advice they needed.

Presently there are plans to form a cooperative of the cacao producers which would include the 4,000 hectare rehabilitation area. The plans are being made by some former members of COOPROCAL who have benefited from their earlier experience. This cooperative can be used as a model for farmers in other areas and for other crops.

There are several favorable preconditions that have influenced formation of the new cooperative: the 4,000 hectare project, financing by three banks, new hybrids, and the excellent work that was started on cacao at La Lolla, high world market prices, an assured market, and experienced farmers. Because of the farmers' experience with COOPROCAL, where many lost their investments, a questionnaire was prepared inquiring whether the farmers wanted a cooperative and the type of services they needed. From preliminary returns of the questionnaire, it appears that despite past experiences the farmers still prefer a cooperative to marketing through middlemen. The cooperative is being organized by the MAG.

The cooperative might form committees to inform all growers about the cooperative and expand its membership. Courses might be offered by the Instituto de Fomento de Cooperativas so that there would be a clearer understanding of what is expected of a member of the cooperative. The new cooperative will cover the 4,000 hectare plan but will not include the entire cacao producing area. It will be responsible for gathering, drying and exporting the cacao beans when necessary. This could give a greater return to the farmer while avoiding the role of the middleman. Agricultural chemicals and other supplies might also be available through the cooperative. Thus, it is to be a full-service cooperative, providing technical assistance, credit, inputs, and the collection and exporting of the product.

b. Traditional Agriculture--Plantain

The plantain is an increasingly important crop for many farmers in the area, especially those with small and medium sized farms. It continues to be grown in most farms for local consumption. Lately, with the increasing opportunities for export, plantain production has increased considerably. In 1955, there were 622 farms of 1,139 manzanas, producing 600,000 bunches. In 1963, the production rose to 2,111 manzanas on 853
farms. Since then the most dramatic rise has taken place, as can be seen from the number of 60-pound boxes exported:

<table>
<thead>
<tr>
<th>Year</th>
<th>Boxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>21,716 boxes</td>
</tr>
<tr>
<td>1967</td>
<td>198,434 boxes</td>
</tr>
<tr>
<td>1969</td>
<td>380,380 boxes</td>
</tr>
</tbody>
</table>

In 1971, because of heavy rains, floods in the region wiped out many plantain farms, with the result that production dropped to approximately 20,000 boxes.

The largest market for plantains has been the United States, but recently Nicaragua has been buying in increasing amounts and at prices attractive when compared with those paid by U.S. exporters. Trucks from Nicaragua transport the plantains in the bunch, eliminating the boxing needed for export to the United States. Table 13 shows exports from the entire country and gives an indication of the volume and price paid by each country.

The Atlantic Zone production makes up most of the export; the Sarapiqui and dry Pacific production are mostly for internal consumption.

Principal producing areas in Limon are Estrada, Matina, Barbilla, Bataan, Indiana, La Perla, Bananito, La Bamba, and Talamanca.

Ecological Factors: Plantain grows best in hot humid tropics with a temperature range of 22 to 30°C. Annual rainfall should be greater than 2,000 mm. evenly distributed throughout the year. The greater the number of days the plant is exposed to sunlight the higher will be the yield. Drainage canals are often dug to drain water from areas with high water tables and poor drainage. Currently the best areas for the production of plantain are along the alluvial plains of Matina and Estrada rivers.

Markets: Most plantain farms are from one to ten hectares. Because of the sustained good markets, farmers are now beginning to move into larger farms of over 14 hectares. Credit is a problem for these farmers since most do not have title to their land.

The market has held up because of improved transport facilities both from the farm to the port and from the port to the importing countries. The new road to Limon has brought with it a regular truck service from Nicaragua. Simple packing plants have been set up by the exporters or intermediaries,
<table>
<thead>
<tr>
<th>Country</th>
<th>Kilos</th>
<th>Colones</th>
<th>Colones/Kilo</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>3,810,179</td>
<td>2,937,136</td>
<td>0.770</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>2,126,778</td>
<td>666,051</td>
<td>0.31</td>
</tr>
<tr>
<td>Colombia</td>
<td>8,641</td>
<td>5,037</td>
<td>0.58</td>
</tr>
<tr>
<td>Honduras</td>
<td>40,416</td>
<td>22,832</td>
<td>0.56</td>
</tr>
<tr>
<td>Jamaica</td>
<td>8,594</td>
<td>4,462</td>
<td>0.52</td>
</tr>
<tr>
<td>Holland</td>
<td>16,200</td>
<td>12,035</td>
<td>0.74</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6,010,898</td>
<td>3,647,553</td>
<td>0.61</td>
</tr>
</tbody>
</table>
each plant consisting of a small storage house, a bath for the fruit, and a table for packing.

The shipment to the United States is better organized and, with guaranteed shipping space for plantain, the export has become more reliable.

The farmer, however, is not without his problems. The exporter rarely negotiates contracts with the producers, and seldom provides the farmer with technical aid necessary to produce the high quality needed for export. Technical assistance and information reach only a few producers. The exporters, therefore, are turning to large producers whom they feel are more dependable and capable of meeting standards for export, thus by-passing the small producers who own the greatest number of plantain farms. Standard Fruit Company and Banana Development Corporation (BANDECO) are also interested in the export of plantain and may soon become involved with this product.

Plantain is a crop with great potential for the region because of the many areas of excellent growing conditions and markets to absorb an increased supply. Most of the producers do not use fertilizers or other agricultural chemicals, relying solely on natural fertility and biological pest control. On certain soils which are rejuvenated by occasional floods, fertilizer may not be necessary, but the producer should not rely on this process.

At the present, since world production of plantain is not at a technologically advanced stage, the small producer can still play an important role in the national economy. Now that the large multinational banana companies are moving into plantain production, higher standards for export are inevitable. If the small farmers are provided with technical aid through the MAG extension service, they may be able to increase production and quality of their products.

Local experimental stations or demonstration centers working with improved varieties and better farm management would greatly help the small farmer. A mechanism whereby the farmer would receive disease-free seeds, fertilizer, information on breeding practices, pruning dead leaves, controlling insects and diseases, selecting fruit at the packers and cleaning of fruit for export, would greatly enhance his ability to benefit from the favorable climate that presently exists for plantains.

The fruit is used to make green plantain fried chips, with techniques similar to those used in making potato chips. Several small entrepreneurs are already manufacturing them in the city of Limon. A study should be made of the
possibilities of larger-scale manufacture of this snack. Better packaging of the snack is needed. The fruit can also be manufactured in meal form as a livestock feed.

b. **Traditional Agriculture--Coconut**

Coconut is an important resource which has been exploited to only a minimal degree. Most of the Limon coast-line has planted or natural coconut groves. The total existing area is approximately 3,500 hectares. Like other crops of the area, it has not been cared for or even collected because of the very low price of 0.20 colones per nut. This price structure is the result of a protective law which assures the internal coconut supply for soap manufacture. The extraction plants are very inefficient, using poor quality copra, with the result that coconut oil is imported. The Anuario Estadistico de Costa Rica reports that coconut oil valued at $275,589 was imported in 1972.

The climate in many parts of Limon, especially near the coast, is ideal for the cultivation of the coconut palm. It requires a hot, humid climate, with average temperature between 77 and 86°F (average 25°C). The plant uses considerable water, transpiring 25 liters of water per day. Thus it is best suited to regions where rainfall of 1,500 to 3,000 mm. is evenly distributed through the year.

Once established, the culture is not labor intensive and one family can operate 20 hectares, although most holdings presently are 10 hectares or less. It does not compete with other areas for labor since the coconut groves are generally removed from the banana-producing areas.

The present state of most plantings is quite poor because there has been little incentive to improve them. Many trees are more than 80 years old and in many places fallen coconuts are not even collected. Since many groves occurred naturally, they are not properly spaced for optimum production.

What is basically needed to improve production of coconut is an incentive—a better price and established markets. If rural processing plants were run efficiently with sound technical advice, the growers would be encouraged. The present pricing law needs to be studied and revised.

As far as production is concerned, the first step is replanting the old groves. In many parts of the world, a coconut tree disease has affected hundreds of acres of palms, rendering them unproductive. A means to control lethal yellowing has not been devised. Two steps are recommended: removing the
dead and diseased palms as soon as the symptoms are detected (i.e., premature separation of brown or black coconuts from the tree, yellowing of the leaves beginning with the lower leaves and finally resulting in a stunted bare trunk), and replacing the diseased trees with the Malayan dwarf coconut palm which is resistant to the disease. The following table shows the differences between the two varieties:

Table 14

<table>
<thead>
<tr>
<th></th>
<th>Dwarf</th>
<th>Tall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to disease</td>
<td>High</td>
<td>Susceptible</td>
</tr>
<tr>
<td>Production per plant (nuts)</td>
<td>90-150</td>
<td>30-60</td>
</tr>
<tr>
<td>Plants per hectare</td>
<td>222</td>
<td>118</td>
</tr>
<tr>
<td>Starts to flower</td>
<td>3-4 years</td>
<td>6-7 years</td>
</tr>
<tr>
<td>Days to mature</td>
<td>335</td>
<td>430</td>
</tr>
<tr>
<td>Production/ha/year (nuts)</td>
<td>5000-9000</td>
<td>4000-6000</td>
</tr>
</tbody>
</table>

The dwarf variety is easier to handle and treat for pest control.

It is important to choose the correct seed before establishing a new coconut grove. Because of cross pollination, seeds of known parentage should be used. This information might best be supplied by the MAG. In Jamaica, free seed is distributed to the farmers.

The greatest insect pest of the Limon region is the coconut weevil Phynchophorus Palmarum which burrows in the bud, destroying the tree. The larvae can be controlled (more easily in dwarf coconut plantations) by insecticide treatments.

b. **Traditional Agriculture--Corn**

Self-sufficiency could be achieved for corn only if modern intensive practices are utilized on the 4,000 manzanas of land currently planted with corn.
Corn is one of the basic grains with high potential for the Guapiles-Guacimo and Siquirres area. Without technical aid, the area has produced the highest yields in the country, indicating a zone with favorable soils and climate. The high precipitation (approximately 3,000 mm.) is helpful to the growth of corn once it is established.

Corn should have a high priority among other crops since the country has the potential to become self-sufficient. Currently Costa Rica is importing excessive amounts of corn.

Four farms used improved cultivation practices as shown in the following table:

Table 15
NATIONAL CORN PRODUCTION 1967-1969

<table>
<thead>
<tr>
<th>Year</th>
<th>Area Without Technical Assistance (mz.)</th>
<th>Expected Yields (cwt./mz.)</th>
<th>Production (cwt.)</th>
<th>Area With Technical Assistance (mz.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>73,000</td>
<td>18.4</td>
<td>1,346,585</td>
<td>5,500</td>
</tr>
<tr>
<td>1968</td>
<td>72,500</td>
<td>18.4</td>
<td>1,334,000</td>
<td>6,000</td>
</tr>
<tr>
<td>1969</td>
<td>72,000</td>
<td>18.4</td>
<td>1,324,800</td>
<td>6,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Expected Yields (cwt./mz.)</th>
<th>Production (cwt.)</th>
<th>Total Production (cwt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>56</td>
<td>308,000</td>
<td>1,654,585</td>
</tr>
<tr>
<td>1968</td>
<td>56</td>
<td>336,000</td>
<td>1,670,000</td>
</tr>
<tr>
<td>1969</td>
<td>56</td>
<td>364,000</td>
<td>1,688,800</td>
</tr>
</tbody>
</table>

Based on a study, Professor J. J. Castro estimated that the 200,000 cwt. of corn imported by Costa Rica could be met locally by changing cultivation practices on the 4,000 manzanas, thus increasing yields to 50 cwt. per manzana. Balance of payments effects would have to be carefully assessed since some imports of machinery and chemical products would be needed for a production improvement program. These cultural practices would include
changes in soil tillage methods, improved seed, fertilizer, insecticide, and herbicide.

Limon used to be among the large corn producing regions in Costa Rica because of its favorable ecological conditions. Yields were relatively high because of the high soil fertility immediately after clearing. Corn was also cultivated on a regular basis on many farms. With the return of the banana boom and the high salaries for workers, corn production decreased as farmers became banana workers. Only recently has corn begun to be cultivated on a larger scale again. This is partly due to CNP's price support and a favorable internal market. Production in Limon is approximately seven percent of the national total.

Another reason for low productivity is poor backing by the institutions in the area. In 1971 the Instituto Nacional de Seguros (insurance) had corn harvest insurance for all provinces except Limon. Bank credit for corn farms was minimal until recently (1972) when banks financed 1,101 manzanas of corn. This is probably due to the fact that many farmers do not hold title to the land. Thus the lack of title handicaps local farmers in qualifying for loans.

The CNP, responsible for the purchase, storage and sale of basic grains, has provided an incentive with the building of the largest grain drier in Costa Rica at Guacimo. This is important for the area since marketing a dry product is often a problem in an area with high rainfall. Despite this incentive, the drier was almost shut down in 1971 for lack of volume. During 1972 and for the first half of 1973, the use of the drier has steadily increased.

b. Traditional Agriculture--Rice

Rice in the Atlantic Zone is a crop which has experienced fluctuation in production and interest. Problems in rice production have resulted from variation in rainfall, irrigation systems and climatic conditions during harvest. Consequently, ecological conditions favoring normal rice production have not existed.

Recently at Bataan, over 90 hectares of upland rice were planted and harvested using mechanical methods. The results indicate the need to conduct further trials to determine the best cultural practices appropriate for the area. The Chinese Agricultural Technical Mission has had encouraging results with paddy rice trials using traditional hand transplantation.
The following are the results of the Chinese trials. The first three are long grain varieties, the last are short grain, which appear to be unacceptable for Latin American consumption. Further testing on a commercial scale is planned to assess the feasibility of paddy rice production.

Table 16

<table>
<thead>
<tr>
<th>Rice Variety</th>
<th>Production Kilograms/Hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cica-4</td>
<td>8,600</td>
</tr>
<tr>
<td>IR-22</td>
<td>8,100</td>
</tr>
<tr>
<td>Sinaloa</td>
<td>7,500</td>
</tr>
<tr>
<td>Taiwan 5</td>
<td>8,000</td>
</tr>
<tr>
<td>(Taiwan 5)</td>
<td>5,800 (ledging)</td>
</tr>
</tbody>
</table>

The lack of land development and technical education of the farmers are major barriers to an expansion of rice culture.

b. Traditional Agriculture--Soybeans

The Chinese Agricultural mission seems to have had success with soybean varieties. However, at present their results are inconclusive. The fluctuation of weather conditions during the growing season has produced unreliable results. Experimentation over a longer time period is required to assess whether soybeans can be economically cultivated in the area.

The results of the Chinese experiments are given below. On an average, the production is based on a 100-day cycle.

Table 17

<table>
<thead>
<tr>
<th>Soybean Variety</th>
<th>Production Kilograms/Hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shih-Shih</td>
<td>2,315</td>
</tr>
<tr>
<td>Wakajiuma</td>
<td>2,835</td>
</tr>
<tr>
<td>Tainung 4</td>
<td>3,090</td>
</tr>
<tr>
<td>Tari 66-0-20</td>
<td>3,205</td>
</tr>
<tr>
<td>Palmetto</td>
<td>2,295</td>
</tr>
</tbody>
</table>
c. Crop Diversification--General

The area of Limon has a tropical climate which is ecologically suited for cultivation of many crops such as bananas, plantains, cacao, and coconut. However, the need seems to be for continuing experimentation on different varieties to identify the ones best suited to environmental conditions existing in the region. Besides these main crops, other crops were studied which either had export potential or would help reduce imports into Costa Rica. In this category, African Oil Palm seems a promising possibility since it is labor intensive and might permit a decrease of its import into Costa Rica.

There are also other possibilities in this area, such as fruits and vegetables. However, it would require a great expansion of the present infrastructure, i.e., processing plants, refrigeration chambers, transport facilities, etc., to permit an efficient production and marketing process.

The Limon region is suitable for crop diversification which is an essential ingredient for the steady and sustained growth of an agricultural based economy.

c. Crop Diversification--African Oil Palm

The African Oil Palm is a species which looks promising for the area as a result of the experiments carried out at Los Diamantes. It has proved that it is well suited to the region. Conditions for its optimal growth exist along the Atlantic slopes—from San Carlos and Sarapiqui to the Santa Clara plain, and along a narrow strip from the city of Limon and down to the southern coast of Limon Province.

Under good management, greater than three tons of palm oil and one-half ton of benal oil can be produced per hectare per year. Regions with rains over 1,700 mm., an average temperature of 25°C, and sunlight of more than 2,000 hours per year produce most oil. Since the plant is a heavy extractor of soil nutrients, the soil needs to be kept fertilized with a pH factor of above 5.5.

Oil palm exploitation seems to operate better on large scales (over 100 hectares). These large operations are necessary as a result of the high fixed cost of the infrastructure needed for the oil exploitation. The fruit needs to be processed within 24 hours.

Oil Palm can compete with bananas in the region, as the same soils are usually suited for both. Presently, it uses a large number of laborers at salaries similar to those for
banana workers. The market looks very favorable as the CACM countries presently do not produce enough oils. In 1965 the CACM countries consumed 74,707 metric tons of oil. It is estimated that by 1975 demand will rise to 122,000 metric tons.

The oil palm is a crop which looks quite attractive for the zone because of its adaptability to the zone, its use of a large number of laborers at competitive salaries, and the fact that it is a commodity that has a market in the Central American Common Market countries.

c. Crop Diversification--Fruits and Vegetables

General: Essential to a program involving perishable products such as fruits and vegetables is an efficient network of transportation. This does not presently exist. One way to alleviate this difficulty would be to establish the processing plants near the production areas. Such an approach would provide employment as well as stimulate the rural economy.

The Province has the strategic advantage of a port which can handle refrigerated trailers (roll-on, roll-off). Currently, small amounts of fruits and vegetables are being exported in this manner. Limited space on the banana boats has been made available to a few exporters. Air transportation is possible but has not been fully explored.

Finally, vegetable exports through Port Limon to the United States and the CACM countries is quite attractive. But the production must be carefully timed so that the produce reaches the markets at times when there is low U.S. production. For instance, the U.S. imported 29 million pounds of green peppers valued at $4.36 million. The best season to export appears to be mid-November through June, with San Francisco and Los Angeles the best marketing areas. Approximately 88 million pounds of cucumbers, valued at $7 million, were imported by the U.S. in fiscal year 1967. Major exporters to the U.S. were Mexico and the Bahamas. Pineapple, Papayas, Yucca (cassava) are in low supply in mid-November through spring in most U.S. markets.

A 1973 article in La Nacion pointed out the high foreign demand for fruits and vegetables--namely plantains, cassava, chayote, corriander, celery, tomatoes, papaya, coconuts, name, nampi, hot peppers, and others. However, transportation and infrastructure development in Limon Province continue to limit the exploitation of this foreign market potential.

Vegetables: There is a Chinese technical team working on vegetable production in Bataan. Through experiments, the team has identified certain varieties as not suitable
for the area. These are Chinese cabbage, cauliflower, broccoli, tomatoes, cabbage, and Brussels sprouts. The vegetables that are especially well suited to the region are asparagus, bean, candy bean, cucumber, radish, lettuce, egg plant, green onion, green pepper, hot pepper, and mustard greens.

An efficient system of harvesting and chilling the vegetables immediately after pickup from the field is needed for efficient operation. The possible markets are in CACM countries, the United States, and Europe.

Root Crops: Probably the vegetables best suited to much of Limon are root crops. Best are yucca (cassava), sweet potato, taro, and daskeen. They are an important part of the world's diet, and have a large market in the U.S., especially for the large Latin populations in the cities. Yucca is grown in all tropical countries. Presently there is a program of yucca processing in Turrialba for export. The Guacimo-Guapiles area appears to be ideally suited for yucca production, but other areas could be brought into production as well.

Large scale planting would have to be preceded by establishment of export markets and refrigerated storage facilities. According to the MAG office of planning Preliminary Report dated December 1971, the Guacimo-Guapiles supply justifies a freezing plant for yucca and a processing plant for starch. The by-products of the plants might be liquid glucose, dextrose, alcohols, beer, etc.

The lower quality sweet potatoes produced in the region can be used as swine feed. The leaves and vines that are high in protein can be used as feed for rabbits.

Fruits: Fruits, as well as vegetables, nuts, spices, and others, offer means for initiating crop diversification with opportunities for export. Processing plants for fruits and juices should be developed simultaneously to support year-round production and to seek markets for the processed products as well. The extended rainy season in many areas of the region eliminates many traditional fruit crops, but others particularly well suited to tropical rainforests might be appropriate.

The presence of world-wide competitive fruit industries necessitates large scale investments and sound decisions based on technical and business considerations. This may not be the approach to take for fruit producers in Limon Province. However, small producers who are well trained and operate on a reliable and continual basis have possibilities in the region, especially when working through production and marketing cooperatives.
Certain factors should be borne in mind while considering fruit production:

1. New crops have a risk potential, especially in areas where experience is lacking in large scale plantings. Many well-researched and technically aided programs have failed because of environmental changes, inadequate experience, and ecological differences between the experimental plot and the large plantation.

2. Because of their perennial nature, fruit trees must be adapted to the year round climatic conditions, which do not vary extremely in Limon. The initial decisions about planting will last for many years and initial mistakes can do irreparable harm to the plantations.

3. Fruit trees are usually clonally or vegetatively propagated so that all trees of a given variety are identical. Although this has the advantages of producing better quality and uniform fruit, new strains of pests can quickly propagate to epidemic proportions on the identical host. Also, as better varieties are developed, it should be possible to initiate a system of replacement.

4. The capital investment is high, and the trees do not come into production for several years. Credit should be available to the grower, and creditors should provide for the length of time needed before repayment of the loan can begin.

Passion Fruit: Results from experimental plantings and a few commercial plantings show this to be a very promising crop for the Atlantic Zone. There is a large export market to the United States, especially with a decrease in Hawaiian exports due to urbanization of agricultural lands. The most economical way of establishing a planting is to set up a system of trellises. The crop produces in over a year and yields 30 to 60 tons per hectare per year once it is in full production. Presently, one processor offers to purchase passion fruit at $600 per ton. The income per hectare can range from $18,000 to $36,000 per hectare per year. There are some pests of passion fruit which can be prevented by well-drained soils and by avoiding plantings near cucumbers or melons because of the virus disease they carry. New, high-yielding hybrids have been developed in Brazil, Hawaii and Australia. These seeds should be planted for best results. Cooperatives of producers could be established to provide technical assistance in production, processing and marketing of the fruit.

Grapefruit: Of the citrus fruits, grapefruit appears to be best suited to the area. It is especially adapted to warm climates and low elevations, and does not require low
temperatures for proper coloring when mature. Grapefruit requires nearly twice as many heat units for maturity. Using the summation of daily means above 55°F as an index, grapefruit needs 6,300 units. Higher average temperatures give larger fruit, which may account for the exceptionally large native grapefruits in the area. An abundance of moisture is important for good yields. Popular U.S. varieties—the white and pink—must be propagated by budding on seedlings. From a disease resistant standpoint, the best root stock appears to be the Cleopatra mandarin or sour orange.

Guava: Guavas are native to the Atlantic Zone and grow quite well there. The plant grows on a wide variety of soils in pH's of 4.56 to 8.2 if properly fertilized. For optimum growth the guava needs a constant supply of moisture flooding and will grow on water-logged soils. Commercial plantings in the tropics exist under 1,000 meters with annual precipitations from 40 to 150 inches. It is suitable in the regions of lower rainfall in Limon Province. Several products can be produced from the fruit—guava jelly, paste, and canned shells. The vitamin C content is five times that of the orange. Pest control is important.

c. Crop Diversification—Nuts

Macadamia: In a study by Benavides et al., a large section in Limon was found to be suitable in terms of the ecological qualifications for Macadamia nuts. The section extends from the Cartago Province border to Limon city and south to the Talamanca region. Because of unsatisfied markets and the high price the crop commands, macadamia nuts seem to be a good possibility for the region. However, experimental programs have to be initiated before any determination can be made. Some of the other nuts suited to the ecological conditions of the region are pili fruit, jack fruit, water chestnut, cola nut, and Brazil nut.

c. Crop Diversification—Spices

There are several spices well suited to the hot, humid climate of Limon:

Black Pepper: Pepper is the most promising of all spices for the zone, as experiments at Los Diamantes have indicated. Results of laboratory tests at McCormick Spices Company rate the pepper as very large in size and of good quality. The variety is one that was brought to Costa Rica ten years ago and has since evolved, adapting to local conditions.
The pepper vine thrives in a moist, hot climate, from sea level to 1,500 feet of elevation with a well-distributed rainfall of 100 inches or more, and produces best growth on fertile flat or gently sloping land with good drainage. For the Atlantic Zone, wood posts to support the vine would be best if the wood were properly treated to last more than ten years. If not, other posts could be used.

The present black pepper production can easily be doubled. Each plant will produce more than 4.5 pounds of black pepper. A recent study using a two pounds per plant per year production of black pepper has estimated a gross return could be €45,420 per hectare.

This spice offers a great possibility for both the large and small producer. Harvest is once every week, which provides continued employment on large plantings and, for small backyard plantings. It also provides a constant source of income. Although good drying of black pepper is possible with two days in the sun, machine drying might be advisable to maintain the quality.

Nutmeg and Mace: Nutmeg exists in Limon in isolated trees. Tests at McCormick Company show that it is of good quality. The reason for the failure of one of the plantations is that 60 percent of the trees were male. Unfortunately, one must wait until the tree flowers (6 to 7 years) to discover its sex.

Ginger: Small isolated plantings of ginger exist in the Atlantic Zone. This is another potential crop, being well suited to the area. It produces better under high intensity of sunlight and heavy rainfall (2,000 to 3,000 mm). It is reproduced in arable, well-drained soils. It uses a great deal of nutrients and responds well to heavy fertilization and crop rotation. Experiments at Los Diamantes have been quite favorable and existing markets in the U.S. offer prospects for ginger in the Atlantic Zone quite attractive. In the U.S. supermarkets, prices for fresh ginger reach $1.20 per pound. Dried ginger fetches a higher price.

c. Crop Diversification--Essential Oil Extracts

Oil of citronella, oil of vetiver, lemon grass oil, and ginger grass oils are all essential oils of grass plants which grow quite well in the Atlantic Zone. Several attempts were made to develop some of these crops, but adverse market conditions forced developers to abandon the effort.
c. **Crop Diversification--Flowers and Ornamental Plants**

The Atlantic region has a greater potential for ornamental plants than for flowers, although there are some native flower species which could be grown as well. Presently, ornamental plants are exported from the Atlantic Zone and the results have been quite encouraging. One grower in the region exported 100,000 plants to the U.S. at $1.00 per plant.

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**2. Livestock**

The Limon Province is favorable for the production of livestock because of its ecological features, fast pasture growth, and year round fresh water supply. This zone, until a few years ago, had been dormant as far as livestock programs are concerned. The government, institutions, and private enterprise have realized the livestock potential of the region. Consequently, there has been a sudden surge of livestock activity.

In Costa Rica, agriculture furnishes about 23.1 percent of the gross domestic product, and provides work for about 63 percent of the labor force. This represents nearly 30 percent of the total population, earning about 74 percent of foreign exchange.
a. Beef Cattle

There is a current boom in cattle production in the Province. One of the reasons for this boom in beef cattle is the climatic condition. The almost constant rainfall gives a consistent supply of water from streams and rivers. Pasture grows very fast in this area and has a high rate of recuperation, due in part to good soils and to the abundant and uniform supply of water. The topography of the region is suitable for livestock. However, for certain areas, livestock may not be appropriate since other crops can be raised with greater economic advantage and less damage to the soils.

In Limon Province, the area that has been active in cattle production is the Pococi-Guacimo region. This is due to the favorable agricultural conditions for pasture that exist in the region and the citizens drive to exploit the increased market for beef cattle.

The export quotas for beef are steadily increasing. Due to uncertain market forces, the local producers in the Province are unable to meet the local demand. Many distributors go out of Limon Province to buy cattle for the market in Limon.

The poor returns for traditional crops have turned farmers to beef cattle operations.

The main type of cattle in the area belong to the Zebu crossbreed. The criollo type is almost nonexistent in the Province. Several other breeds have been introduced into the area during the past decade: the Charalais, Gir, and Brangus. The main benefit obtained from the introduction of different breeds is hybrid vigor.

The cattle population in Costa Rica in 1969 was 1,493,475 head, out of which 144,410 were from Limon Province. The average per capita consumption in Limon Province was 19 kilograms during 1971, while the national per capital consumption according to the Central Bank was 15.65 kilograms. The estimated national consumption for 1975 is 18 kilograms.

Pasture: In Limon in 1970, a total of 144,410 head of cattle grazed within an area of 299,142 hectares of pasture, which gives a capacity of 0.71 head per hectare. The national average is approximately 0.9 head per hectare. The pastures of this region recuperate very fast. For this reason, the pastures need to be well managed, and rotation of cattle grazing in pastures has to be coordinated with the pasture rejuvenation cycle. Otherwise, nutritive value of the pasture will be lost. Weeds which might dominate the pasture land are
another problem. Weed growth might be due to poor preparation of the land, overgrazing, and planting of species not adapted to the region.

As many farmers established new pastures, they needed to choose the best grass for their particular area. The more common grasses of the area are: Para, Guinea, Natural, Janeiro, Surinan, Estrella (Stargrass), Aleman, Guinea rastrera, and Gamalote.

The commonly found natural grass in the farms has a low capacity per hectare. Farmers are now planting pastures with such grasses as Aleman for the wet areas and Star for the drier areas. Also, they are using Para, Guinea, Janeiro, and others that grow well in the Limon region. Two legumes have been recommended for the region: Kudzo tropical and Centro, which add nutritive value to the forrage and improve the physio-chemical properties of the soil.

A large part of the Limon Province virgin forest lands are being converted into pasture. A period of 2 to 3 months is necessary for the grass to get established. After the cattle feed for a few days, the grass is cut for establishing an even and dense grass growth. The practice of using rotation and herbicides should be increased in the region.

Feed and Mineral Supplements: Besides pasture, the area has good opportunities to develop supplementary feed for cattle such as banana rejects, copra meal, and molasses. Two experiments were planned and coordinated by IICA to obtain information on the usefulness of banana supplements for fattening steers in the Atlantic region. The conclusions from the first study were that banana can be effectively used as a substitute for grass in areas where there is a lack of pasture without a detrimental effect on the weight of the steers. The second experiment established that small quantities of banana had a definite weight-increasing effect on the steers. After a specific quantity of banana intake there seemed to be a saturation state beyond which no additive weight effect was noticed. The most satisfactory limit was found to be 5 kilos of banana supplement per day. Bananas in greater quantities offer a means of substituting for grass, which increases the number of cattle that can be raised per hectare of pasture.

Bananas, as the bulk feed for cattle and technically supplemented with protein and minerals, offer a good opportunity to develop feed lots in Limon. There are approximately 3 million pounds of bananas that are rejected annually because they do not meet the high standards for export. Supplementing beef cattle feed with banana rejects is a means of utilizing the wastes from the plantations for the economic benefit of the region.
Molasses from the sugar cane refinery can also be used more productively as a supplement to cattle feed. Two experiments were conducted by IICA to find out more about the value of molasses as a supplement for beef cattle production. Results from these tests indicate that molasses offers an additive effect as well as a substitute effect for beef cattle. Consequently, it can improve the utilization of pasture and increase the capacity of beef cattle production per hectare in areas where there is a lack of pasture. In regions where grass has a high protein content, energetic supplementation with molasses provides an additive effect, thereby increasing production.

This approach of using molasses as a feed supplement is relevant to the region because there are approximately 50,000 hectares in the Pococi-Siquirres area which are ecologically suitable for sugar cane farms. This region is between 100 and 1,000 meters above sea level. For every 10 tons of sugar cane processed, the by-products include 1 ton of molasses and 5 tons of bagasse. An area of the size of the Pococi-Siquirres would be able to produce 2,000,000 tons of pure sugar annually and 500,000 tons of molasses. The planting of sugar cane has already begun in Siquirres. A production of 15,000 tons of sugar cane is anticipated in 1975. No plans exist for an integrated agro-industry, although the opportunity for one in this region seems quite attractive.

Another feed supplement might be the wastes from the separation of oil from the African Oil Palm. This meal contains approximately 18 to 20 percent protein and is appropriate as a livestock feed. Since African Oil Palm is particularly suited for the region, it could be the basis for an integrated agro-industry.

Only a few ranchers in the area have a controlled breeding season. The bulls are on pasture with the cows all year round. There is no control of age or weight of calves. The Charolais breed was introduced in the area during the last decade. Some of the problems presented by this breed are Piroplasmosis, Anaplasmosis, and foot problems, but there are no pronounced calving or fertility problems. According to several ranchers, the Charolais breed has not adapted itself as well as the Zebu crossbreeds. However, the Charolais give good results when crossed to make use of the hybrid vigor.

Some ranchers are introducing Brangus bulls in their commercial calf-cow operations. The bulls have presented problems with external parasites. The Brangus bulls have to be sprayed every 15 days to be kept free of external parasites such as screwworms and ticks.
Diseases: Most of the diseases of the area can be easily controlled with better management. Some of the main diseases observed in the region are of nutritional, reproductive, and parasitic origins. It is not a common practice in the region to vaccinate the animals or to drench them to kill parasites. Some farmers do not spray frequently, which causes the ticks to become a problem, especially during the drier months. In most cases, salt and mineral supplements are not fed to the cattle.

Market: To meet the local demand for beef, butchers bring cattle from other regions, like Alajuela. They slaughter some 250 cattle per month for the city of Limon.

The Guapiles-Guacimo-Siquirres area had a total production of 10,750 head for 1971. With a local consumption of 6,581 head, 4,169 head of cattle were available for shipment to other regions. Listed below is the production and slaughter house capacity in the different zones of Costa Rica:

Table 18

<table>
<thead>
<tr>
<th>Zones</th>
<th>Annual Slaughter Capacity</th>
<th>Annual Production 1969</th>
<th>Projected Annual Production 1974</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Pacific</td>
<td>44,800</td>
<td>108,802</td>
<td>138,405</td>
</tr>
<tr>
<td>South Pacific</td>
<td>-</td>
<td>10,128</td>
<td>12,810</td>
</tr>
<tr>
<td>Atlantic</td>
<td>-</td>
<td>8,171</td>
<td>10,304</td>
</tr>
<tr>
<td>North</td>
<td>-</td>
<td>43,271</td>
<td>55,139</td>
</tr>
<tr>
<td>Central</td>
<td>203,200</td>
<td>48,439</td>
<td>61,822</td>
</tr>
</tbody>
</table>


During 1970-71, the beef cattle quota for export was shared by the different regions as follows: Guanacaste exported 67 percent, Puntarenas 15 percent, Alajuela 11 percent, Limon 3 percent, San Jose 2 percent, Heredia 1 percent and Cartago 1 percent.

There is a need for a network of roads in the region linking the beef cattle production regions to slaughterhouses and the markets. With this road network, cattle production could be substantially improved in the region. Another aspect to be considered is that beef cattle, when transported
over a long distance from the pasture area to the slaughterhouse, invariably lose weight during transit. For the farmer this means a loss in the profit per head of cattle. Since the cattle population of the Guapiles-Guacimo-Siquirres area is more than 100,000 head, this area merits consideration for a slaughterhouse both to benefit the producers and to meet the need to decentralize beef cattle operations in the country.

Geographically, Siquirres is the center of the Province and has the advantage that existing roads pass through it. It is the closest to all areas of beef cattle production in the area. The cattle can be transported by train or truck. With a slaughterhouse at Siquirres and facilities for storage, the product would be easily accessible to local markets or for export through Port Limon. The presence of a slaughterhouse also opens up opportunities for industries based on the by-products such as bloodmeal, bonemeal, hides, etc.

Presently, there is no organized market in the region. The producers generally sell their cattle for local consumption or transport them to be sold in other markets. Most farmers have a commercial operation (production of feeders), but recently there seems to be a movement to move from production of feeders into fattening operations.

Among the other problems that the cattle industry faces in the region are poor management and the lack of dissemination of sound technical information in cattle raising practices or on-going experimental programs in animal husbandry and animal diseases. Beef cattle production is a relatively new enterprise for the region, and the producers need considerable and continuing guidance and technical support. On account of the high salaries paid for laborers in the banana plantations, it is difficult to attract workers for the industry without paying them high salaries. Since beef cattle production is not a labor-intensive operation, the increasing number of farms being converted to pasture might create considerable rural unemployment in the Province.

Intensive dairy production based on feed lot system can be established on the highlands of Siquirres. Pasture dairy production does not seem feasible for that area.

b. Swine

Swine production is unevenly distributed throughout the country. The regions of Alajuela, San Jose, and dry Pacific account for approximately 90 percent of the swine production, although Limon Province appears better suited for swine production. At the moment, swine production seems to be heavily controlled by the prices of feed concentrates, which are steadily increasing.
CAN reports that swine production for 1972 was 9,089,000 kilograms and that the per capita consumption was 4.74 kilograms, while the potential per capital consumption based on imports is 7.30 kilograms. This would require a swine production of 13,745,000 kilograms per year.

Table 19
SWINE PRODUCTION AND CONSUMPTION DATA FOR COSTA RICA
(THOUSAND KILOS)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production in C.R.</th>
<th>Consumption actual per capita</th>
<th>Consumption potential per capita</th>
<th>Total Production</th>
<th>Production Needed per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>7,369</td>
<td>5.03</td>
<td>8.49</td>
<td>12,435</td>
<td>5,066</td>
</tr>
<tr>
<td>1965</td>
<td>8,548</td>
<td>5.58</td>
<td>8.19</td>
<td>12,450</td>
<td>3,902</td>
</tr>
<tr>
<td>1966</td>
<td>8,731</td>
<td>5.55</td>
<td>8.68</td>
<td>13,642</td>
<td>4,911</td>
</tr>
<tr>
<td>1967</td>
<td>6,978</td>
<td>9.32</td>
<td>8.46</td>
<td>10,436</td>
<td>3,458</td>
</tr>
<tr>
<td>1968</td>
<td>6,992</td>
<td>4.20</td>
<td>6.76</td>
<td>11,260</td>
<td>4,268</td>
</tr>
<tr>
<td>1969</td>
<td>8,372</td>
<td>4.79</td>
<td>7.30</td>
<td>12,541</td>
<td>4,169</td>
</tr>
<tr>
<td>1970</td>
<td>8,611</td>
<td>4.76</td>
<td>7.28</td>
<td>12,895</td>
<td>4,284</td>
</tr>
<tr>
<td>1971</td>
<td>8,850</td>
<td>5.76</td>
<td>7.29</td>
<td>13,312</td>
<td>4,462</td>
</tr>
<tr>
<td>1972</td>
<td>9,089</td>
<td>4.74</td>
<td>7.30</td>
<td>13,739</td>
<td>4,650</td>
</tr>
</tbody>
</table>

Source: Tecnica Ag. SRL and Banco Central de Costa Rica

Table 19 indicates the added swine production needed in the country to fully satisfy domestic demand.

The two aspects that need to be considered in swine production are the fact that swine are monogastric, which limits the number of feeds suitable for them, and the steadily increasing price of feed concentrates. There are some swine production enterprises in Limon Province, but many of them are poorly managed. There is a good swine demonstration barn in Los Diamantes which could be used as a model for the Province to assist farmers and to increase swine production. Dissemination of the demonstration program needs to be strengthened. Limon Province has a good potential for swine production since the Atlantic Zone is suitable for the production of such roots as malanga, yucca, and musaceas (banana), which are suitable for swine feed supplements. It is estimated that annually 3 million pounds of banana production in Limon Province do not meet export standards and are hence rejected. According to local technical experts, these rejects can feed from 40,000 to 80,000 swine per year.
It has been found from two experiments conducted in the tropics that green banana meal without the skin can be used as a substitute for 60 percent of the corn requirement for swine. Also, it was found that banana green meal without the skin could replace 45 percent of the corn diet for baby swine. The potential use of green banana meal suggest additional research to optimize the use of banana rejects and green banana for possible use as substitutes in livestock feeds.

c. Poultry

Poultry production is a fairly new operation in the Limon region. In 1972 there were 26 farms, which delivered 60,000 pounds of meat every 8 weeks. Eight weeks is the normal period required to raise poultry for the market. But the 26 projects supplied only 16 percent of the meat consumed in the Province.

The amount of poultry meat imported to the Province during June 1972 was 35,010 pounds. During the same month, the municipal market sold 100,000 pounds and other sources sold 15,000 pounds, indicating that the market for poultry in the region during June was 150,000 pounds.

On the average, each farm in the zone needs a daily supply of 15 pounds of concentrate. The chickens are prepared for the market when they are 8 to 9 weeks old. The producers in the region are seriously handicapped from want of storage and freezing facilities in the region. Presently, the poultry meat is temporarily kept in iced water until it is delivered to the market the next morning.

The 8 to 9 week old chickens have an average weight of 3 pounds and fetch a price of 4.50 colones per pound. Some farms sell between 200 and 300 pounds at the market per day.

Currently, the high cost of concentrates is hurting poultry operations in the region. A study of alternative sources for feed concentrates would be valuable to the region.

d. Green Turtle

The green turtle returns to the Atlantic coast near Tortuguero during the nesting season to lay about 300 to 500 eggs per season. According to Mariculture, S.A., no more than 2 out of 1,000 survive to return to Tortuguero beach for nesting. The green turtle is one of the few animals that lives on sea vegetation found in abundance near the waters of Nicaragua and Panama. Green turtles offer an opportunity for development of a potential source of food for local needs and for export.
Plants in Port Limon process the turtles slaughtered during June, July, and August. During the remaining months, the plants are used to process lobster, shrimp, and beef cattle. At the turtle processing plants in Limon, the hard undercover (stomach) is used for glue production. The "carey" (turtle scale) is exported to Japan. Meat scraps, fats, and tendons are industrial wastes that are not fully utilized. If processed, the wastes can be used as a protein supplement for livestock feeding. The turtle meat is cut up in pieces and packaged in five-pound boxes and exported to Europe. Turtle eggs are sold locally.

Each turtle produces about 50 pounds of meat. Frigorificos del Atlantico has freezing facilities to store and handle 1,500 boxes of turtle meat, weighing 50 pounds each. The plant has the capacity to slaughter and pack 30 to 50 turtles per day. In 1972, Frigorificos del Atlantico slaughtered 620 turtles and Mariscos del Caribe slaughtered 320 turtles. Approximately 1,000 green turtles were slaughtered by poachers and fishermen in Limon.

As pointed out in the summary section, although the green turtles offer a unique opportunity for cooperation among Nicaragua, Costa Rica, and Panama for planned management and exploitation, so far this opportunity has been missed. If the present indiscriminate killing of the turtles at their nesting grounds is allowed to continue, this precious resource will be quickly depleted. It is imperative that the efforts initiated in 1968 to bring about the cooperation of the three countries to formulate regional policies for the rational development be ratified and implemented. The approach might also include considerations for modern hatching and rearing of the green turtles until they have a better chance to survive and grow in the sea.

e. Institutional Assistance for Livestock Enterprises

There are few institutions that are active in the Limon region assisting local farmers and entrepreneurs to plan and develop livestock enterprises in Limon.

Assistance from the Ministry of Agriculture is often sought to provide advice and offer incentives to promote livestock enterprise appropriate to the region, regardless of the scale of operation. With proper advice and assistance, it is likely that such enterprises can become profitable. Within the Ministry of Agriculture there are several "Direcciones Generales" for Research, Cattle Raising, Extension, Forestry, Planning, Administration, Operations, etc. These functions are
further divided into subgroups such as animal health, wildlife, fisheries, etc. The Director of the Extension Service believes that an interior road network is needed in Limon Province to encourage cattle production and to link meat markets with the production centers. The National Agricultural Extension Service is subdivided into Regional Centers, with a regional director for each section who coordinates the extension agents under his jurisdiction. Ing. Garrett Britton is the director of the Regional Center for Limon Province, which is composed of six extension agencies. Not all of these extension agencies have an extension agent.

The extension service of Limon Province needs additional technical personnel to carry out demonstration programs and to assure that appropriate information reaches the users. There are areas in Limon Province which the extension agents have not been able to visit due to shortage of manpower and the consequent pressure of work. Some of the personnel assigned to Limon have been transferred to other areas of the country.

The country needs more veterinary service and closer interaction between agricultural extension agents and the producers. In some areas, Los Diamantes for example, there is a high degree of coordination between extension staff and experimental personnel.

Greater interaction between the pilot (demonstration) program personnel and extension agents, and through them the local farmers and producers, should become a continuing program for the region. Currently Los Diamantes is carrying out several useful experiments and information on the results of these experiments appears to be reaching the users.

Los Diamantes is conducting several experiments on African Oil Palm, passion fruit, macadamia nut, rice, maize, pineapple, cinamon, citrics, plantains, banana (commercially), sweet potatoes, cassava, achiote, and cuadrado (pelipita). The experimental station also has purebred herds of Bhraman and Charolais which are being used for several experiments in animal husbandry involving Chianina semen. The station holds a sale of stock of purebred bulls and swine each year so as to introduce better stock to the region. Its good swine barn has Yorkshire, Hampshire, and Duroc breeds. It would benefit the region if the station could conduct roving experimental seminars to demonstrate its findings directly to the local farmers. The short courses on cattle and swine presently under preparation at Los Diamantes could be coupled with a roving experimental seminar for even greater value to the farmers.
There are several projects in which the regional center of Limon is involved. One of them, called "Plan Pococi," was developed in 1972 and is concerned with the development of farms through improvement of the herd and pastures. Another project is studying the problem of obtaining credit in the region for farmers who do not hold titles to the farms. The effort here is to plan and assist in the integrated development of the farm.

A new method of financing and repayment of loans is under consideration, whereby a farmer will be eligible for a "package loan" that would cover all of his farm needs rather than particular requirements such as fertilizer, seeds, fences, etc. This will enable the farmer to negotiate a single loan instead of several individual ones. The mechanism for repayment will enable the farmer to increase his savings so that he might not remain continually at the subsistence level.

The experimental station in Turrialba can be of great assistance to the region. Unfortunately, the location and the ecological conditions that exist at Turrialba are not typical of the region.

The other institutions involved directly with livestock production in the region are the banks. There has been no real difficulty in financing beef cattle enterprises since the cattle usually serve as guarantee for the loan. But with other livestock enterprises, such as swine, farmers do find difficulty trying to obtain loans. This is mainly due to the banks' concern over collateral and project feasibility. The regional banks should closely interact with the regional center of the Ministry of Agriculture to assure proper use of the land for the benefit of the region.

CNP has no programs for livestock production.

f. Rabbits

Rabbit meat for local consumption and for export markets in Europe seems to have possibilities for the region. The leaves of the sweet potato plant particular to the region have been found to be an excellent rabbit feed. The national drive to increase the intake of proteins might encourage production of rabbit meat for domestic consumption. The protein content of rabbit meat is compared with other meats in Table 20. JAPDEVA has an experimental program for rabbit production in the region. Technical support for this program is needed from experimental stations like Los Diamantes and the Ministry of Agriculture.
Table 20

<table>
<thead>
<tr>
<th>Animal</th>
<th>Percent Protein</th>
<th>Percent Fat</th>
<th>Percent Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabbit</td>
<td>21.05</td>
<td>9.7</td>
<td>67</td>
</tr>
<tr>
<td>Chicken</td>
<td>22.65</td>
<td>3.1</td>
<td>72</td>
</tr>
<tr>
<td>Ox</td>
<td>19.00</td>
<td>10.0</td>
<td>71</td>
</tr>
<tr>
<td>Veal</td>
<td>18.86</td>
<td>6.0</td>
<td>75</td>
</tr>
<tr>
<td>Pork</td>
<td>12.54</td>
<td>37.3</td>
<td>49</td>
</tr>
</tbody>
</table>

g. Sheep

Several tropical ovine breeds, including Persa Cabeza Negra (Persian Black Head), West African, Barbados Barriga Negra (Barbados Black Belly), and Criolla, were investigated for production opportunities in tropical regions. The results show that the Barbados Black Belly seems especially suited for the region, particularly on account of its ability to sustain attractive weight levels.

A market study is needed to ascertain the opportunities for export. It would also be useful to establish a Barbados Black Belly experimental farm in the Limon region to explore production possibilities with this breed.

h. Water Buffalo

There are certain sparsely populated areas in the Atlantic region that are swampy with canals and lagoons and green vegetation. Such swampy, humid areas are ideally suited for water buffalo production. This opportunity has not been explored, although there are large water buffalo herds in the Caribbean countries.

Here, too, an experimental farm in the region for a few herds of buffalo with a parallel market study for buffalo might be useful.

3. Forest and Forestland Development Potential in the Limon Region

Costa Rica has extensive forestlands and standing timber resources, but these lie essentially latent and unused in modern economic sense. They do not contribute substantially to
the country's foreign exchange earnings nor do they provide industrial or labor opportunities anywhere near their high potential. A very large part of the unused forestland and unharvested natural forest growth lies on the Atlantic slope and adjacent coastal plain of Costa Rica in Limon, Heredia, and Alajuela Provinces. At least 40 percent lies within Limon Province.

A distinction must be made here between forestland and forest or timber resources. Forestland constitutes all land areas upon which ecological conditions are unsuited to permanent agricultural or grazing use. It may be divided into production and protection subcategories; it may exist under a wide range of actual vegetational cover conditions from virgin forest to naked or cultivated soil, depending upon land use history. Forest or timber resources are forest vegetation as a standing crop suitable for immediate or near future exploitation. Forest resources occur both on and off land which would be classified as forestland. These distinctions are not generally made in either public discourse on the forestry problem or by land economists and planners. In planning for regional development, however, this distinction is critical.

Within the context of institutional and cultural circumstances which contribute to forestry and underdevelopment in Costa Rica, the resource in forestlands and in forest resources has not been evaluated formally by competent professionals. Neither public nor private support yet exists for a technical commitment in this field. In view of the short time period available for the study and the vast resource in forestland and forest resources, very little precise data can be presented. The following comments and recommendations, therefore, are both approximate and tentative.

The area, extent, and location of forestland resources in Limon Province require evaluation. Such evaluation might be forthcoming, in a very indirect way, from the land use map that accompanies this report. The map was prepared with major land use capability being assessed from climate, terrain, drainage, and soils parameters, employing techniques adopted from the 1968 Northern Zone Study by the Tropical Science Center. At this stage, therefore, only the roughest guess can be made as to the total area of lands in the production forestry and protection forestry categories.

The protection category will probably include almost all of the land in steep mountainous terrain in the Canton of Talamanca (more than 50 percent of the entire Province) plus two smaller areas in the southwestern, mountainous sections of the other two cantons. Here, timber cutting and agrarian uses are excluded because of the very high rainfall-runoff and the steep to precipitous terrain. These lands do, however, have exceptional
importance for the production of certain social values. They could provide a regulated flow of clear water for generating hydroelectric energy for regional industrial development. They also provide protection of lowland farms and communication infrastructure from periodic damaging floods and landslides. These areas should be demarcated as soon as possible. Legislation insuring their inviolability from clearing and logging should be promulgated and enforced.

The area of lands not suited to agriculture or grazing use but satisfactory for the sustained production of timber crops (production forestry) cannot be as clearly delineated as the foregoing. It is a large area. The land is characterized by residual soils with poor drainage—moderately steep slope. The climate is perihumid and superhumid (tropical wet, premontane wet, and rain forest life zones) in the foothills and upon the coastal plain throughout the Province. It includes important areas of timber resources highly suitable for industrial development (Cativo forests, Cedromacho forests, and Gavilan forests), which are the product of poor drainage conditions under high rainfall. It also includes very extended areas of palm swamps from which cellulose products might be derived (as for a paper industry) and well-drained upland mixed forests suitable for intensive management on a sustained yield basis. The last of these forest types is currently endangered by the overextension of agriculture, especially the pasturing of beef cattle. Such lands are subjected to ruthless deforestation (without significant use of the timber) followed by pasture establishment. There is strong evidence to the effect that this intervention cannot be lasting, due to soil degradation problems which inevitably accompany grazing on lands of this quality. It is, therefore, important that production forestry lands be delineated by a formal, objective process on the basis of long-term sustainable productivity and that the planning process include measures to insure the maintenance of all such lands as permanent natural forest cover. This step will be necessary if intensive management for a continuous timber production is to be stimulated so that a high-level, modern, integrated industrial forestry program can be developed within the region.

Forest or standing timber resources must be evaluated within this region through formal timber stand inventory procedures. The form and intensity of the inventory will differ substantially between forestlands and lands suitable for agriculture or grazing use. Every effort should be made to evaluate first the standing merchantable timber resource on all non-forestry lands and to achieve utilization of this material by the timber industry when lands are cleared for other uses. Such utilization should take precedence over cutting on lands classified for permanent production forestry, until such time as all timber on non-forestry lands has been utilized by the industry.
The inventory on non-forestry lands should be integrated with a survey of present and potential industrial uses of all timbers present. The inventory should cover the Province and adjacent parts of the country which have timber-using industries and are near enough for timbers to be shipped economically by rail, canal, or road. At present there is no link between the industry itself and the timber supply from private farms engaged in land clearing for agriculture. Most of the harvestable timber on private farmlands, being on the very best sites for forest growth, is of high quality. At present these forests are generally the most accessible to transport and markets. But the bulk of this raw material is felled and allowed to rot on the ground or is sawn up locally into rough lumber or banana-props.

Inventory on lands suitable for agriculture and grazing use will usually ascertain sizes and volumes by species of trees generally acceptable to the existing industry, comprising veneer mills and sawmills. Smaller sizes may be desirable in laurel (Cordia alliadora).

Inventory on forestlands as delineated by the survey should be designed to evaluate yields under management. Current standing merchantable volume should also be estimated. If pulp, chipboard, and chemical wood industries are to become realities, the inventory must ascertain cubic volumes obtainable from secondary species in small or postwood sizes.

A further recommendation would be the establishment of permanent study plots for growth of secondary species, mixed-aged selectively cut old-growth stands, and possibly other types, especially laurel in mixture with cacao and with pasture. For all such purposes, a regional forestry office with competent professional technicians should be established in Limon and be provided with sufficient budget and equipment to begin the task of forestland and timber resources inventory and related research tasks.

The timber and wood-using industry in Limon region is small, inefficient, poorly equipped, and lacking direct and permanent ties with the forestland and timber resources there. In Limon there is an American-owned veneer mill peeling cativo logs. This mill buys logs from small private entrepreneurs who obtain concessions on government-owned riverside cativo stands and deliver the logs at Moin, mostly via the canal. This mill ships dried veneer sheets to the U.S. where it is used as core stock for plywood and panels. The finished product is not made in Costa Rica. Several factors make the expansion of the present mill into a full-scale plywood and panel operation with added facilities for the peeling of surface veneers and plywood bonding and finishing desirable. The actual supply of cativo is very limited, although the date of exhaustion is unknown since no
timber survey has been done. Current cutting practices are uncontrolled and do not provide for the regeneration of the cativo. The current operation leaves little profit in Costa Rica and employs very few people. If such expansion cannot be undertaken, the mill should be shut down to conserve the remaining supply of cativo until a more efficient and nation-serving industry can be established. Under either circumstance, it would be wise to integrate the present cut with present growth and to determine what specific cutting practices, if any, will provide for adequate natural regeneration of cativo. This would be a further task for the suggested regional forestry research office.

It is rumored that a large North American firm has acquired a very large acreage of virgin forest (some of which is probably too steep to be placed in the production forest category) near Siquirres. The firm is currently setting up a modern mill for the processing of furniture parts from a wide range of species. (Grupo Pozuelo Marin, S.A., Apartado 4535, San Jose). These materials are for export. If this company is interested in placing its lands and cutting operation under the supervision of competent professional tropical foresters, the firm could provide the first effective demonstration of the use of modern technology for the sustained-yield management of natural forests in Costa Rica.

Elsewhere, the Province includes a small number of mostly old-fashioned sawmills. Some are circular mills; others are band mills. Few, if any, have the necessary accessory equipment, as, for instance, edgers, trimmers, or dry kilns, for the efficient production of high quality lumber. None of the mill owners are land owners. Rather, they buy logs from anyone willing to sell, mostly delivered to the mill itself. Such mills are found in Limon, Siquirres, and a few places along the Old Line. Southeast of Limon there appear to be no sawmills except for one at Estrella, which is the property of Standard Fruit Company and cuts for company needs only.

A considerable but undetermined quantity of logs from the Province finds its way to the Valle Central (Turrialba, Cartago, San Jose) via the railroad and the highway. Apparently, much of this timber is second-growth laurel, which is a product of natural regrowth on pastures and in cacao plantations and is an important but unrecognized source of ancillary farm income throughout much of the region. The growth of laurel should probably be encouraged as it is much prized as a wood nationally and has a large potential export market. This timber is sold both to plywood plants in San Jose and to the many sawmills located in the mentioned cities.

Obviously, the present sawmilling industry in the Limon Province is too small and poorly organized to provide an outlet for locally grown and produced timbers, even under the
present "no-management" and "no-utilization" conditions on forestlands and farm woodlands, respectively. The result is expensive transportation of a bulky and heavy raw material out of the region with resultant losses both to the region and to the consuming public. Therefore, upgrading and expansion of the sawmilling industry in Limon Province should be a priority and major objective. A very considerable labor and earnings opportunity is now being wasted by this neglect.

Any upgrading of the sawmilling industry should be accompanied by relevant laboratory timber quality and potential use studies. Every effort should be made in the mills to produce quality lumber, in terms of dimension, drying, and wood preservation. The first involves technological improvements in mill equipment, organization, and operation, including retraining of workers and sawyers. The second involves the establishment of dry kilns and air-drying yards at each mill and the experimental development of correct kiln schedules for each new species, by dimension. The third calls for the installation of proper equipment for the impregnation of all nondurable woods with insect and fungus preventing chemicals. With respect to this last, there appears to be an excellent opportunity for the central establishment of a large wood-treating plant within the region, preferably along the railroad. Such a plant might treat up to hundreds of thousands of railroad crossties per year. These ties could be produced from heavy, coarse textured timber species now unused but present in substantial quantities in the upland forests. Such timbers are generally mechanically apt for ties but non-durable when exposed to the ground and weather. Foreign and local markets exist for treated crossties. Such a plant could also process general construction lumber and bridge timbers.

An integrated forest industries project, involving both vertically and horizontally integrated primary and secondary processing industries and tied directly to a single large block of virgin forestland, might provide the hub for the development of the northeastern sections which have generally high rainfall and imperfect-to-poor drainage. Such a development would include a new industrial town linked by the Tortuguero Canal to the ports at Moin and Limon, and provide for regional decentralization of population and industry. It is presumed that the northeast will be determined to be mostly "forestland" rather than agricultural or pasture land.

4. **Fish Resources**

Due to a serious lack of data, it was difficult to identify the types and size of fish resource based activities that had existed in the region. Therefore, most of the information obtained was through interviews with fishermen and local
small-scale fishing and drying industries located near the coastal region. Although there seems to be a potential for developing the inland water and sea fish resources and a domestic market for fish, it would be difficult to make suggestions without further studies.

Corporacion Financiera de Tortuguero, which is actively involved in investment opportunities in the region, has a plan to organize fishing in the Atlantic sea near the mouths of the many rivers that flow in the region. The fish will be iced and transported to Port Limon and distributed to local markets in the region. There are two small shark fishing and sun drying industries at Bocca Colorado, each with about eight small mechanized boats. With the abundance of sharks in the area, it was possible to fish sharks out of the Colorado River. Now it is necessary to move out to the sea for the catch. With technical advice provided by a Mexican fishing company operating in Puntarenas, shark skin is being treated and processed for export to Japan. Since the only transporation to Bocca Colorado is through the inland canal, the shark and fishing industry has been localized and relatively isolated.

Oysters could be a very valuable resource since they can be farmed. The Atlantic area appears to offer many ideal areas for the establishment of good size oyster beds. Oyster beds existed at the Moin River delta and main canal, but were destroyed after Recope was established, possibly due to pollution of the Moin canal and river waters.

Tilapia, a fresh water fish, is native to Africa. This fish has been introduced in several parts of the world on account of its rapid rate of growth and good taste. It takes about five months for a fish to achieve market size. Tilapia grows very well in fresh water ponds and can be farmed. A pilot project on Tilapia conducted near Turrialba has been successful. Some of the farmers who participated in developing the Tilapia farms have not been able to achieve the success of the initial demonstration program. Most of these farms are located in areas of higher altitude. Tilapia's suitability for the Limon region must be demonstrated before its farming can be encouraged.

According to Landes [H.C. Landes, 1965, "Oportunidades de Desarrollo de la Industria Costarricense de Productos Alimenticios"], tuna banks can be found on the Atlantic coast close to the Limon shores. No other report of this was found in the literature survey and no reference was made by the local fishermen. This is another fish whose activity and presence in a commercial basis needs to be determined.
5. Minerals and Energy

Minerals: Explorations covering most of Costa Rica's territory in search of minerals have not been sufficient for predicting the mineral potential of the region or the economic feasibility for exploiting it. Geologic and geomining research, both governmental and private, has been limited to locating attractive areas which justify larger investments to determine the true potential of the deposits.

One of the zones of greatest mineral potential, the Talamanca Mountain Range, has received very little attention. It remains a virgin area full of possibilities for interested companies anxious to carry out mineral exploitations in this region. Samples of barite, copper, gold, and sulphur have been reported from the Talamanca region.

Costa Rica's mining legislation suffers because it does not have under its control the buying and selling of mining rights. All the areas of the country showing mining potential have been claimed by persons whose principal interest might be more of speculation than systematic exploration or exploitation for minerals. Very little can be done to alter the situation. It would be beneficial to the country and the region if claimants to such lands were required to geologically explore their holdings.

The most important iron ore deposits in Costa Rica are of secondary origin in the beds of black sand formed by magnetic accumulations. Exploration indicates that black sand reserves are in sufficient quantities for exploitation. The Geology Office of the Ministry of Industries and Commerce has reported on the analysis of the Atlantic Coast samples. These samples show:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Magnetic content</td>
<td>94.75%</td>
</tr>
<tr>
<td>Nonmagnetic content</td>
<td>5.50%</td>
</tr>
<tr>
<td>Total Oxides:</td>
<td></td>
</tr>
<tr>
<td>Iron Oxides</td>
<td>86.75%</td>
</tr>
<tr>
<td>Titanium Oxides</td>
<td>8.08%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Metallic Content:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron (Fe)</td>
</tr>
<tr>
<td>Titanium (Ti)</td>
</tr>
</tbody>
</table>

During the nineteenth century, explorations in the region revealed "Lloraderos" or natural springs containing petroleum and hydrocarbon gas in the lower Talamanca region south of Port Limon. In 1916, the Costa Rica Oil Corporation, a company controlled by Sinclair Central American Corporation, drilled the
first five wells in Costa Rica. The deepest (1,240 meters) well was drilled at Cahuita. Gas was found at a depth of 260 meters. Unfortunately, due to fire accidents, this hole was abandoned. The test hole Uscuri No. 1 also identified gases at a depth of 257 meters. The other test holes proved negative.

In 1951, a new contract was signed between the Government of Costa Rica and the Compania Petrolera de Costa Rica, a subsidiary of Union Oil Company. A total of 14 wells were drilled. The deepest (3,192 meters) well at Victoria produced oil and gas but not in quantities necessary for commercial exploitation. Cocoles No. 2 had a good initial production of API Grade 45 oil which soon declined to 12 barrels per day polluted by salt water. While drilling this set of 14 wells, several mechanical and geological problems were encountered. This made the investigation difficult and, in some cases, impossible. For instance, the Watsi structure was never investigated due to plastic flow of the clays into the drill pipe.

Presently, a French company is conducting offshore explorations of the ocean shelf. Preliminary reports of this investigation are encouraging.

Energy: Since Costa Rica has no oil or coal reserves, the domestic energy production consists of electrical energy. Indeed, the hydroelectric potential of Costa Rica is probably its greatest natural resource. This resource is presently being managed by the Instituto Costarricense de Electricidad (ICE). By 1975, the Costa Rican electrical network will be interconnected into a single system that serves the entire country.

With energy reserves, especially electrical energy, a single region cannot be isolated from the remainder of the country. In fact, electrical networks are almost universally being analyzed by the techniques of systems analysis. Thus the planning, distribution, and scheduling of electricity is governed for economic reasons by the mathematical laws which minimize costs--or maximize benefits--for an entire network. However, the construction of generating facilities, like any large construction project, can have a large economic impact on a region through expenditure of capital, use of local labor, provision of housing for labor, use of local markets, etc.

The installed capacity of electrical energy in Costa Rica is presently (1973) 320 mw. This amount proved inadequate in early 1973 due to a rather severe drought. Thus ICE plans the installation of 40 mw early in 1974 in the form of gas turbines to prevent a recurrence of the shortage. Through steady additions of thermal and hydro plants, the installed capacity will increase to 926 mw in the year 1987. Projects now planned for the Atlantic region include:
Late 1975: two gas turbines at Moin  
Late 1976: hydroelectric turbines at Rio Macho  
Late 1984: hydroelectric turbines at Angostura  
Late 1986: thermal turbines at Moin

In addition, there are a number of potential projects under study by ICE for the Atlantic Region:

Table 21

<table>
<thead>
<tr>
<th>Date</th>
<th>Electrical Projections</th>
<th>Total Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>40 mw gas turbines, Cartago</td>
<td>360</td>
</tr>
<tr>
<td>1977</td>
<td>135 mw Arenal</td>
<td>561</td>
</tr>
<tr>
<td>1980</td>
<td>45 mw Arenal</td>
<td>606</td>
</tr>
<tr>
<td>1981</td>
<td>45 mw Santa Rosa</td>
<td>651</td>
</tr>
<tr>
<td>1982</td>
<td>90 mw Santa Rosa</td>
<td>741</td>
</tr>
<tr>
<td>1985</td>
<td>45 mw Angostura</td>
<td>921</td>
</tr>
</tbody>
</table>

Several factors argue in favor of the continued development of Costa Rica's hydroelectric resources. These stem primarily from the fact that oil, gas, and coal are not available in the country. Costa Rica has, in the past few years, had difficulty with its balance of payments. Thus, the hydro potential is the only source available which does not deplete funds for foreign exchange. Also, hydro power still proves to be the least expensive form of electricity. Future world shortages of fossil fuel will undoubtedly increase the price advantages. The demand scale is such that nuclear energy will not become economical in the foreseeable future unless Costa Rica integrates its system with the other Central American countries. (Even in that case, nuclear power would probably not be economic. Note that most nuclear units in the United States are of the order of 1,000 mw, more than Costa Rica's 1987 projection.) However, the present capacity in the dry season is about 57 percent of the wet season capacity. The dry season occupies approximately 3 months of the year. Thus the provision of dry season capacity, which is used about 1/4th of the time, becomes expensive in terms of capital cost. Thus the thermal and gas turbine types of generator become feasible. Alternately, the government might consider subsidizing industry which would refrain from the use of power, or at least curtail power uses, during the dry season.
A complete economic analysis of the system should include the annual scheduling of power to provide reserve for the dry season. As an example, the larger reservoirs could be saved at capacity until the need developed for their use. The overall systems analysis would reveal the relative economics of such measures compared to the installation of additional capacity.

In general, Costa Rica should continue to have sufficient electrical power at reasonable rates to provide for expected economic growth of the country in general and of the Atlantic Region in particular. However, shortages have occurred in the past and only careful planning will prevent their recurrence in the future.

III. REGIONAL DEVELOPMENT OF LIMON PROVINCE

A. Ministries and Autonomous Institutions

There is a growing desire among citizens in Limon Province for greater participation and involvement in affairs affecting the Atlantic Zone. Programs that were planned and implemented from San Jose seem to have benefited neither the Center nor Limon Province. Despite the resource potential and the need for economic and social development, the region seems to have been overlooked at the national level as regards allocation of funds and programs for regional development. Most of what has been done seems to be fragmented with no overall policy for development.

Discussions on regional development of the Atlantic Zone posed an important question—whether or not there should be a national plan for development of the country, which incorporates the coordinated development of various regions. In spite of several meetings with officials at the Ministry of Planning, the team was unable to identify the existence of a long range policy or plan for national development. Without a national policy and plan, separate plans for development of different regions could be counterproductive and even wasteful. The present approach is to focus on developing one region at a time. This approach might miss opportunities for coordination among regions. Some regions in dire need of development programs might have to wait their turn. It is not clear whether the series approach to regional development might be to the regional and national interests.

It must be remembered, therefore, that the reconnaissance of the national resource potential of Limon Province for regional development had insufficient information on national priorities, national industrial policy, national goals, and fund
allocations for regional development. In the absence of such information, the team considered development of Limon Province as a rational approach to utilize the existing resources to benefit the urban and rural population of the region; and to identify how such an approach might contribute to regional and national development.

Presently, the central government is supporting the concept of decentralized planning. The Institute to Promote and Advise Municipalities (IFAM) was created for that purpose. This institution is conducting a regional development project in Valle de el General with the cooperation of the municipalities and local institutions of the region.

In order to derive maximum benefit from the regional developmental programs, it is essential that coordination of efforts exist between institutions. It appears that each institution, in keeping with its individual goals and authority, plans and executes programs quite independently of other institutions. This has resulted in several discrete efforts with no overview of the needs or coordination of the programs. Some confusion and misunderstanding among institutions has also resulted from these independent efforts. Inter-institutional cooperation is vital to the rapid and efficient development of the region.

The decentralization of institutions might begin with the establishment of regional offices for relevant institutions in the Province. The municipalities and Office of the Governor for the region might actively participate with the regional institutions to plan and implement regional development programs.

At present, very few institutions and ministries are closely identified with the region. Some institutions have at most one representative, while, in other instances, a part time official is the regional representative for an autonomous institution.

The municipalities, as the institutions most closely in touch with the needs of each county, might be the source most frequently consulted when an institution is planning a program for a particular area. The municipalities and their influence have been greatly limited due to the lack of sufficient funds and qualified administrative and technical personnel. IFAM was created to assist municipalities to play their proper role. IFAM offers municipalities technical advice, provides loans, and opportunities to cooperate with other municipalities in the region.
The Office of the Governor might represent at the national level the needs of the region and seek budget allocations and institutional cooperation. However, if this office is to efficiently perform its duties, the number of competent staff needs to be increased.

To summarize, the need exists for regionalization in development policies and planning. Institutions need to decentralize their operations and establish regional offices with adequate staff and budget. The local offices should represent the institutions in discussions to coordinate regional institutional effort and maximize benefits to the region from the institutional programs.

Implicit in this approach is the understanding that the regional development plan, jointly developed by institutions and with active local participation, fits in with national goals for development of the country as a whole. Also implicit is the assumption that funds to implement the development plan would be forthcoming.

With the creation of institutions to meet specific needs, the number of institutions operating in a small country like Costa Rica has increased substantially. As a result, there are grey areas of overlap in institutional functions. An attempt will be made in the following pages to bring out these areas of overlap and to stress the need for greater coordination among institutions.

Listed below are some of the sectors considered vital for regional development of Limon Province along with the institutions responsible for planning and conducting development projects in each sector.

1. Transportation

A carefully planned transportation network is indispensable for the maximum exploitation of the natural resources of the region. Easy accessibility to markets is essential, as is greater mobility for people and goods to different sectors of the region and to different parts of the country. Over the years, the transportation and communication networks of the region have been neglected. However, ambitious plans and programs are being discussed to correct this situation. Plans are being made to integrate the canal system, the road network, and the railroad lines.

Presently the canal which extends 112 kilometers from Moin to Barra del Colorado is in a state of underdevelopment. Judging from the traffic on the canal at the present time, a large expenditure of funds to develop and maintain the canal might not be justified.
The institutions that are primarily responsible for the development of the canal are the following:

—The Board for Port Administration and Economic Development of the Atlantic Slope (JAPDEVA). The charter of this autonomous institution grants it the responsibility for construction, administration, and maintenance of the canals of the North Atlantic zone. Within JAPDEVA, development of canals falls under the jurisdiction of the Department of Regional Development of the Atlantic Zone.

—The Ministry of Transport and Public Works (MTOP). MTOP is also enjoined with the planning, construction, and improvement of the inland waterways and interior navigation terminals (Constitutional Charter of the MTOP dated July 1971).

—The Institute of Lands and Colonization (ITCO). ITCO is another autonomous institution that apparently has certain rights over the canal. It has jurisdiction over lands located 50 meters from the shoreline. Several sections of the canal fall within ITCO's jurisdiction.

Clearly, there are areas where these institutions are jointly involved in the development of the canal.

Roads: The importance of feeder and secondary roads connecting otherwise isolated areas has already been stressed. The Ministry of Transport is the institution directly responsible for the development of this area. It is charged with the responsibility to "plan, construct, and improve the highways and secondary roads". It is also required to maintain these roads in collaboration with the municipalities.

On various occasions, JAPDEVA has assumed some of this responsibility for the region. The Department of Regional Development, JAPDEVA, in its budget for 1973, has an allocation of approximately 1,351,720 colones for road construction and maintenance. Most of this allocation goes to the Ministry of Transport and to municipalities in the various counties. This expenditure is justified by JAPDEVA on the grounds that it falls within the scope of regional development.

The municipalities are responsible for the construction, maintenance, and cleanliness of the streets within their jurisdiction. However, the municipalities lack the necessary funds, technicians, and equipment to carry out this function. Thus, they rely on other institutions, mainly the Ministry of Transport and, in some instances, JAPDEVA.
Railroad: The railroad was for a long time the only mode of transportation and communication between the region and the rest of the country. In some cases, it is still the only communication link between various areas of the Province. It is presently under the administration of JAPDEVA.

Improvement of this service must be coordinated with other projects which would complement the overall improvement of the transportation network of the Province.

Presently, there is a drive by JAPDEVA to improve the services offered by the railroad. More modern equipment is on order which will improve the cargo transport and passenger services. The banana producers largely depend on this service for the fast and efficient transportation of the fruit from the plantation to the port for export. This is just one indication of the important role that the railroad can play in the economic development of the region and the nation as a whole.

Port: The port of Limon is the busiest port in the nation. Approximately 40 percent of the total exports and imports of the country pass through this port.

Again, the institutions responsible for the administration and operation of the port are JAPDEVA and the Ministry of Transport. The former is in charge of the administration, planning, maintenance, and operation of the actual Port of Limon and its extension in Cieneguita.

The constitutional charter of the Ministry of Transport dated July 10, 1971 gives this institution the right to plan, construct, improve, and maintain the ports and the movement of shipping.

For the development of the port facilities, cooperation between these institutions is essential to jointly plan and implement port projects. The Limon Municipality can stimulate and offer incentives to encourage greater volume of import and export through Port Limon.

2. Agricultural Development

Much of the efforts for the development of the region have been concentrated in the agricultural sector. This focus seems logical when two-thirds of the population is rural and the potential for agriculture is attractive.

The area primarily depends on banana production. This reality, combined with the present abandonment of large cacao plantations, may result in the dependence of the region on a monoculture economy. The possible dangers of this trend
are commonly known. Therefore, the appropriate institutions should attempt to come up with alternatives to this situation and inform the farmers of viable and economically feasible diversification opportunities that exist in the agricultural sector.

The institutions responsible for the development of the agricultural sector are:

Ministry of Agriculture and Livestock (MAG). This institution is responsible for:

a) Orientation and promotion of agricultural development through research, control, planning, and coordination of agrarian and fishing activities;

b) Promotion of conservation and better use of natural resources;

c) Supplying technical assistance to farmers and information on developments in agriculture to the general public;

d) Formulating and executing government policy in agriculture, and

e) Controlling and supervising entries and exits of animals and plants into the country.

Institute of Lands and Colonization (ITCO). This institution was created to:

a) Promote a fair distribution of land in order to increase productivity;

b) Raise the farmer's social status in order to incorporate him into the national socio-economic development process, and

c) Avoid concentration of land in the hands of a few who may use it for speculation or exploitation detrimental to the nation's interests.

National Production Council (CNP). The responsibilities of this autonomous institution include:

a) The promotion of the development of both agricultural and industrial production;

b) Stabilization of prices of food and raw materials;
c) Collaboration with credit institutions, extension agencies of MAG, and all other organizations in promoting the increment of production, and

d) Maintaining equilibrium between consumption and export quotas under its control.

—National Agricultural Council (CAN). This is a department within MAC. It is composed of 12 members from several institutions. Among the members are the Minister of Agriculture, a representative from ITCO, the National Banking Systems, the University, and private sector. The purpose of this council is to coordinate the agricultural plan for the nation and to evaluate agricultural programs.


—JAPDEVA. As the institution charged to oversee and achieve the rapid and efficient socio-economic development of the region, JAPDEVA is also responsible for the development of this sector.

Briefly, the major institutions concerned with the development of Limon Province have been listed. Also, an attempt was made to point out the areas of overlap in the institutional functions which, if not properly coordinated, could lead to inaction among institutions. There are indications that some programs have suffered in Limon Province on account of poor coordination and vague definition of overall goals.

Autonomous institutions and semi-government agencies were created to get around bureaucratic delays and inaction, and to focus funds and talents to carry out discrete tasks. Over time and with the diversity in national needs, the number of such institutions has steadily increased. It is inevitable that, with the many institutions involved in national development, there are bound to be unresolved grey areas of overlap in institutional objectives. If not properly coordinated, the operation of a collection of such institutions to fulfill a common goal can slow down the achievement of the stated goal.
A national look at the many institutions might be a worthwhile study. The study might attempt to explore the optimum number of institutions appropriate for a small developing country like Costa Rica. The study might also comment on the viable degree of functional overlap in institutional objectives and a mechanism to coordinate them for the smooth operation of the development process.

Institutional cooperation and action is needed in several areas of the agricultural sector in Limon Province:

Agricultural Credit: The National Banking System and its regional banks have provided about two-thirds of the agricultural credit for the country. The National Banking System functions under the "tope" system, whereby the Central Bank apportions the economic activity of the country into sectors and establishes limits (topes) on the amount of credit that each bank can extend for a particular sector. The main criteria used by the Central Bank to establish the topes is based on the balance of payments, thus favoring export products such as bananas, beef cattle, etc.

Agricultural credit evaluation and approval processes seem to assure against any possibility of risk on the part of the banks. Without adequate guarantees, it may not be possible for a small farmer, who may not have title to his land, to receive loans for nontraditional agricultural crops. One of the functions of the National Production Council (CNP) is to give guarantees to the banks so that farmers who do not have land titles may be eligible for agricultural credit. During the years 1971, 1972, and 1973, through CNP's efforts, it was possible for 798 agricultural activities in the Limon region to receive credit totaling 1,720,366 colones. AID has made three loans to the regional branches of national banks so that credit might be available to small farmers.

In 1970, a National Agricultural Plan was drawn up with funds from the Costa Rican government and a loan from AID. Under this plan, the extension service of the Ministry of Agriculture was expanded to give the small farmer access to and information on modern agricultural practices. It was intended to make it easier for the small farmer to receive credit when he showed willingness to adopt improved agricultural practices on his farm.

Agricultural credit to small farmers must necessarily be accompanied by technical assistance from the extension agencies. The small farmer also needs assistance in the preparation and analysis of costs when he approaches the banks for credit. This calls for an integration of the efforts by the regional banks, CNP, and the agricultural extension services.
The distribution of credit seems to be in favor of export products such as bananas and beef cattle. Agricultural credit should be earmarked so as to encourage crop diversification for local and national consumption. Rationale for approving credit might be based more on the criteria of economic analysis relating to productivity, employment, greater returns, and quick payoffs, rather than traditional agricultural products.

A study of the regional distribution of credit might indicate that the small farmer in Limon Province has benefited least from this national program. Indirectly, this factor has helped the monoculture economy in the Province, to the detriment of the region. Credit that encourages crop diversification will benefit the region. Also, greater consideration must be given to broader aspects of regional development in evaluating credit applications. It might be worthwhile to consider top allocation on a regional basis.

The Bank of Costa Rica has established a mobile credit unit to speed up credit evaluation and distribution for the dry Pacific Zone. This effort has nearly tripled the amount of credit approved for this zone in one year. Such a program for Limon Province should be initiated as soon as possible.

Cooperatives: As of September 1969, there were 237 cooperatives functioning in Costa Rica. Of these, 43 were agricultural cooperatives. The cooperative movement has become an important factor in the economy of the country. Serving about 65,000 families in the agricultural sector, cooperatives represent approximately 19 percent of the national production.

Given the background of failures by large cooperatives and the understandable skepticism that is prevalent among many farmers towards cooperatives, the cooperative movement in the province of Limon is staging a comeback.

The National Cooperative Development Program was started in 1972. It attempts to strengthen the cooperative movement in Costa Rica so that the small farmer who does not qualify for credit can obtain the needed capital to purchase modern inputs. Through a cooperative, he has the benefit of an organized structure for group action on individual as well as group problems.

To promote cooperatives, AID provided funds for improving the operation and institutional structure of the Cooperative Department of the National Bank. Funds were allocated for agricultural credit and for improving cooperative production, as well as for marketing facilities. Recently, the Instituto de Fomento de Cooperativos (INFOCOOP) was created,
eliminating the Cooperative Department within the National Bank. This approach is aimed at promoting rather widely independent cooperatives in the country.

Land Tenure and Land Titling Program: According to the 1963 census, 52.6 percent of the farmers in Costa Rica were on farms of less than 10 hectares, which accounted for only 4.8 percent of all farm land in the country. At the other extreme, 0.7 percent of the farmers had farms exceeding 700 hectares, accounting for 31.3 percent of all farm land. The number of farms without title in the Atlantic Zone in 1969 was estimated at 9,000.

The Institute of Land and Colonization (ITCO) was created to try to solve land tenure problems. It is an autonomous institution with three main purposes: 1) to promote a fair distribution of land in order to increase productivity; 2) to raise the farmer's social and economic status and incorporate him into the national socio-economic development process, and 3) to avoid concentration of land in the hands of a few who may use it for speculation to the detriment of national interests.

The difficulties facing ITCO in carrying out its responsibilities are due to limitations of its authority and a serious lack of financial resources. In 1972, ITCO had a budget of 4 million colones, which was 0.3 percent of the national budget.

ITCO has two major projects for the distribution of land titles to small farmers in Limon Province—the Carieari and the Bataan Projects.

The Bataan project was started in 1966 for the purpose of providing land to 600 families at a total cost of 19,783,863 colones. The Compania Bananera, a subsidiary of the United Fruit Company, had abandoned the banana plantations in 1930. In 1959, the plantations of abaca were abandoned by their owners. Portions of the abandoned land (more than 10,000 hectares), were bought by ITCO, together with housing and other installations that existed on the land. Each family was provided with 8 to 10 hectares of this farmland.

Another important aspect of land tenure in the Province of Limon is the large number of farmers who rent land from the Compania Bananera de Costa Rica. These tenant farmers were former workers for the United Fruit Company and are reported to have incurred large debts. They seem unwilling to borrow and invest in their land since, under the terms of the agreement, the land is rented out for a year and renewed each year. This agreement can be ended with a three-month notice. To a large measure, the uncertainty over renting the land for longer periods has resulted in poor agricultural activity on these farms.
B. Transportation

One reason for the present state of underdevelopment of the region might be the inaccessibility and the consequent isolation of several parts of the region. Poor communication links exist between areas of the region and the rest of the country. This lack of communication links is a major handicap to the speedy development of the region.

At present, there are four modes of communication within the region and to parts outside it: railroad, roads, rivers and canals, and civil aviation.

1. Railroad

Limon Province and its main city and port on the Atlantic Coast, Port Limon, have been linked by railroad to the Central Valley since the end of the 19th century. Under a 99-year contract, the British-owned Northern Railway Company administered the Atlantic Railroad. It was nationalized by the present government in November 1972. On account of the widely fluctuating industrial and agricultural activity of the region, the administration and maintenance of the railroad has suffered. When the government of Costa Rica nationalized the railroad it also inherited a very important tool for integrating the country, but in sad need of repair.

The railroad has a 100-mile main line connecting Port Limon to San Jose, plus more than 350 miles of branch lines. Presently, JAPDEVA is responsible for the administration of the railroad and all its allied functions. A considerable percentage of the income from the railroad operation for this year has been earmarked for repairs and purchase of more boxcars and diesel locomotive engines. It has been estimated that 680,000 railway sleepers are to be replaced, as well as a large number of railroad sections.

Besides the main route to San Jose, the railroad connects towns in other important agricultural sectors. There is a railroad route that connects Port Limon to Penshurst and links up the Valley of Estrella. There is also an independent railroad that links Watsi and Bribri near the Valley of Talamanca to the Sixaola River near the Panama border. This route is operated infrequently, and JAPDEVA is negotiating with the owner, the Chiriqui Company, to discontinue part of that railroad and replace it with a road which would link the Limon road system with Panama’s. Panama has an excellent road system leading to the border near the Sixaola River. The distance from Bribri to the Sixaola River at Guabito is 30 kilometers.
JAPDEVA is considering extending the railroad from Guapiles along Rio Frio to Los Chiles, which is located close to the Nicaraguan border. From there a ferry system could be used to travel along the navigable length of Rio Frio, to Lake Nicaragua. Through this link, the agricultural products of Guapiles area can be transported to Granada, one of the important cities of Nicaragua. Granada is only 46 kilometers from Managua by road. If and when such a project were implemented, it would open up markets for the agricultural activities of the northern region and provide opportunities for greater interaction between Nicaragua and Limon Province.

2. Roads

Port Limon will soon be connected by a paved highway to San Jose. Saopin, a Mexican road contractor for the World Bank, is constructing the road. Saopin expects to complete the project by 1974. Discussions with two engineers from Saopin revealed that the road, excluding full use of some bridges, will be ready in early 1974 and the bridges completed soon after. Construction on the Siquirres-Limon section of the highway started in July 1971 at a cost of 121 million colones. A gravel road linking Siquirres and Limon has been in operation for quite some time. The new highway will replace this road.

Saopin is also constructing the road from Westfalia to Penshurst (south of Limon), a distance of 21 kilometers at a cost of 14 million colones. A bridge will connect this road with the existing road on the other side of Estrella River. This road, when completed, will link Cahuita and open up travel to the Talamanca Valley. At the present time, the Ministry of Transport and Public Works is completing work on a stretch of road that will end at Teline in the Talamanca Valley. With the completion of the road to Teline and the Saopin road to Penshurst, the southern part of the Province will be linked by road to Port Limon and the Central Valley, opening up market opportunities and development of the region.

Another road project that is almost ready for implementation is the Guacimo-Florida highway. A bridge crossing the Reventazon River will connect Florida with Siquirres-Turrialba road, thus linking the Linea Vieja region to the Central Valley.

There are other projects under study. With funds from the World Bank, a feasibility study is being carried out for a road to link Guapiles with San Jose. The road will pass through the Cordillera Central for a distance of about 50 kilometers. At present, the road from Guapiles to San Jose is about 150 kilometers long. The proposed highway will substantially
reduce the distance and time. More importantly, the variety of agricultural products from the Guapiles area can be transported quickly to the San Jose area. Another road under study will link Tilaria on the Pacific side of the country with the valleys of the San Carlos River, and Santa Clara to Guapiles. Yet another road will link Guapiles to Puerto Viejo on the Sarapiqui River.

In addition to the plans of the Ministry of Transport, JAPDEVA projects include roads that run parallel to the railroad lines. These plans are aimed at connecting important regions to each other by road and railroad.

3. Rivers and Canals

The Atlantic slope can be subdivided into two parts: the northern part which drains into Lake Nicaragua and the San Juan River, and the southern part which drains directly into the Caribbean Sea.

In the northern portion, the most important rivers are the Rio Frio and the Rio San Carlos in Alajuela Province, and the Rio Sarapiqui and the Rio Chirripo in Heredia Province. The Rio Chirripo is the border line between Heredia and Limon Provinces.

The most important rivers in the southern section are the Chirripo (north), the Tortuguero, the Reventazon-Parismina, the Pacuare, the Chirripo (south), Matina, and the Sixaola. The latter is an international boundary between Costa Rica and Panama. These are the rivers considered important to this study. All of them originate in the Central Ridge and flow through Limon Province into the Atlantic Ocean, with the exception of the Chirripo (north), which flows into the Rio Colorado.

All the main rivers in Limon Province exhibit more or less the same hydrologic characteristics. They originate in the Central Ridge and flow through the mountain area where they have a very well defined channel and a steep slope. From the mountain area they flow into the plains where the slope decreases considerably. In this area, the channels of the rivers are badly defined and the velocity of flow decreases considerably, causing heavy sedimentation which, in turn, causes the high instability of the river courses in the plains.

In the coastal areas the streams meander considerably. Abandoned meanders, either dry or in the form of lakes and pools, are observed along most of the major stream beds. The river mouths are very small compared to the size of the river courses, and large alluvial deposits called "barras" are observed along the coast.
In the upper plains area the drainage is good, but in the lower plains it is poor. From a drainage point of view, the lower plains could be divided into three categories: one which has swamps all year, with no drainage; another with swamps part of the year which drain in the drier months, and another that has relatively good drainage. There is no clear geographic delineation. Some of these areas have been drained by means of drainage channels, but other areas may require land filling.

Deforestation is being undertaken in the Central and Talamanca Ridges. Uncontrolled deforestation will affect they hydrologic regime of an area, mainly causing lower base flows during the dry periods and floods with faster and higher peak flows. Deforestation decreases the water retention, creating a faster and greater amount of surface runoff. Rainfall could increase due to the greater convective heat or it could decrease due to the lack of condensation which normally takes place under the forest cover.

As observed from stream flow records, the lower flows generally occur during the month of March through the middle of April. The floods can be divided into two types: those due to local rainfall that are relatively low and occur during the rainy season, and those caused by storms due to the cold fronts from the north. These cold fronts do not reach Costa Rica, but they cause severe storms in the area. During storms, the highest flows on record for the Reventazon River were 4,200 cubic meters/second at Pascua. Such floods usually occur from October to December, coinciding with the wet season for the region when the soil has less retention because it is saturated.

Very little is known about groundwater in the plains area aside from the fact that the water table is very close to the surface. In the months of October and November, the phreatic level in several places is about 50 cms. above the ground surface. These areas are called "swampos" by the inhabitants of the region.

In most of the plains area, ground water is used for local consumption, as in Port Limon, where the average demand is approximately 150 liters per second. Individual wells are widely used. Wells will perform satisfactorily in the coastal areas as long as drawdown is kept to a minimum so as to avoid the possibility of saline intrusion. This poses a problem in using wells to supply large volumes of water for mass consumption.

Sedimentation in Rivers: The rivers in the mountain areas of the Atlantic Coast of Costa Rica drain volcanic formations which provide highly erodible material on their banks and beds. They run in well defined channels with very
steep slopes; they have a high velocity of flow which increases the rivers' capacity to erode. Therefore, the rivers carry a large amount of sediment. Deforestation and land use for pasture also increase sediment transport.

The Reventazon River carries the largest amount of sediment because it drains the southern part of the Irazu Volcano. The eruption of Irazu provided highly erodible material which the stream is transporting. The Chirripo (N) and the Tortuguero drain the northern slope of the Irazu Volcano. Pacuare and Chirripo (S)-Matina are not directly in contact with the volcano so their sediment transport is expected to be smaller than that of the others.

Sedimentation causes deposition in the alluvial fan, river instability, and meandering in the lower areas. At the junction of the rivers with the canal, heavy deposition of the sediment causes navigational problems.

As the river beds fill, the rivers are diverted, resulting in instability of the river course. The Reventazon and Pacuare Rivers and the Chirripo (N), the Tortuguero, and the Sarapiqui Rivers exhibit such instability. This is a continuous process. A river that has a high potential to erode its banks and bed generally tends to change its course often.

The origin of meandering in rivers is still a subject of discussion. Essentially, it is a process by which scouring on a concave bank of the stream is transported and deposited on a convex bank. In other words, it is a trade of sediment from the banks to the bars in a stream.

The canal which runs parallel to the Atlantic Coast from Moin to Barra del Colorado is made up of natural lagoons connected by dredged sections. At present, this canal is experiencing strong sedimentation at the points where it links with rivers. The points of stronger sedimentation are at the Matina, Pacuare, and Reventazon junctions.

At the junction of the Matina River, a small part of the dredged canal has been abandoned, and navigation is now proceeding along an arm of the river delta. Along the junction of the Reventazon and Pacuare, dredging is in progress to keep the canal open. Areas as far as 800 meters from the junctions of the rivers and canal are experiencing sedimentation bars.

The strong sediment deposition in these areas of the canal is due to the very low velocity of the river and the canal linking the rivers. Variation in the levels (30 cm.) due to tides is not large enough to generate velocities to transport sediment deposits in the canal.
There also appears to be a very mild southward current in the sea which creates a small sand transport along the shoreline. As the river flows to the sea, it encounters this current. Thus, what could be considered a balance of the forces transporting sediment occurs, creating a strong sedimentation at the junctions where the rivers meet the sea. This might be the reason for the small river mouths and the formation of the large alluvial deposits.

The sediment transport was calculated for the Reventazon and Pacuare Rivers. With these data, estimates of the transport of the Chirripo (N) and Chirripo (S)-Matina Rivers were made. These estimates required considerable hydrological insight into the basins of the rivers mentioned. It should be pointed out that the methods actually available for the calculation of sediment transport are by no means exact. Several of these methods are generally accepted, but are to be used only under conditions very similar to those for which they were derived. For this reason, sediment transport was calculated in an indirect way: the bedload transport was calculated by means of Einstein's bedload method, and the suspended load was obtained from the UN-WMO which uses the suspended sediment rating curve, a curve relating the amount of suspended solids in the stream to the water discharge. Einstein's modified method for calculating total transport (including washload) was not used due to the lack of data necessary for its application.

From the calculations based on the data gathered, it is now possible to provide equations for the sediment transport for each river:

(a) Bedload Transport: \( y = 1,090x^{0.74} \)

(b) Total Sediment Transport:

- Rio Matina \( y = 700x^{0.78} \)
- Rio Pacuare \( y = 650x^{0.77} \)
- Rio Tortuguero \( y = 605x^{0.79} \)
- Rio Chirripo (N) \( y = 550x^{0.81} \)
- Rio Reventazon \( y = 458x^{0.83} \)

Where: \( y \) = drainage area

\( x \) = the sediment transport in MCM. The specific gravity of the particles transported was assumed to be 2.65
The normal procedure to study riverworks for the control of sediment transport and the stability of a river is by the use of river models. This is both expensive and time consuming and might not be justified at this time. A trial and error method to be carried out in the field might be more appropriate.

To control or stabilize the river courses, one has to control the sediment deposition that occurs in the part of the basins under consideration. A scheme that will decrease the actual sediment deposition has to be devised to stabilize these rivers. Thus, the variation of river courses will take effect over a considerably longer period of time. To achieve this objective, sediment must be removed from the river at strategic locations.

The amount of sediment removed is important, since too much removal will increase the amount of scouring done by the river. The amount depends mainly upon the availability of material, the velocity of flow, and the amount of sediment in the flow. If a stream is flowing under an equilibrium situation and there is a reduction of the amount of sediment that is actually in the flow, the stream will try to achieve the previous equilibrium by scouring. On the other hand, if too little is removed, the deposition will continue and so will the instability of the river. In other words, a fine balance must be obtained between achieving the minimum of scouring and the withdrawal of sediment that will maximize the stability of the river course.

The approach might be a pervious dam made out of concrete blocks or natural stone held together by steel wires. It should be located at the beginning of the plains areas, where the deposition of sediment begins. (See figures 1 to 5.)

These dams have given satisfactory results when used in low slopes and low velocity streams. Since this is a trial and error procedure, the dams should be observed once installed, so that their height can be varied depending on the amount of scour and deposition they are causing. Also, the material deposited has to be dredged periodically since it is expected to be at least the total bedload transport. This deposition will amount to 0.35 MCM/year in the Chirripo (N) River, 2.0 MCM/year in the Reventazon, 0.56 MCM/year in the Pacuare, and 0.75 MCM/year in the Matina. This material could be utilized for construction or landfilling in the area. An economic study is needed to evaluate the costs and benefits of such a scheme.

Control of meandering is obtained by protecting the river banks. Several methods may be used for this purpose:
FIGURE 3

PROFILE

Rio Chirripo (N)

Elevation (m)

Distance (km)

Proposed location of previous dam

Rio Suco
laying blankets of stone or wood, employing steel jacks which will cause deposition of sediment instead of scouring, providing a cut-off channel for the stream, or a combination of all these.

An economic study is needed to evaluate the benefits derived from the protection against meandering in the areas where the river banks are being utilized by agriculture or urbanization.

**Sedimentation in Canals:** The best solution for the control of sedimentation which takes place in the junctions of the canals and rivers is through use of models. Again, such an approach cannot be justified at this stage. A simple trial and error procedure with the use of bottom or surface guide vanes might be a cheaper approach. The purpose of the guide vanes is to divert the bottom water, with its heavy load of sediment, away from the canal intake and into the point of maximum velocity of the stream. The sediment will then continue to be carried by the stream while the top water, with its light sediment load, is diverted to the canal intake. These vanes can be made out of metal. Once installed, the deposition of sediment should be observed so that any necessary variations can be made for a satisfactory performance.

The variable parameters of these guide vanes are their length, number, distance from centers, height, angle to the direction of flow, and distance to the canal intake. The vanes need to be so located that they will not pose a hazard to navigation.

The Ministry of Transport and Public Works has been responsible for linking the rivers, canals, and lagoons in the region to facilitate travel along the waterway from Moin up to the San Juan River along the Nicaraguan border. The parts of the canals and rivers that are navigable and that form a network for inland navigation are:

<table>
<thead>
<tr>
<th>Route</th>
<th>Length (kms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Moin to Barra del Colorado (canal)</td>
<td>112</td>
</tr>
<tr>
<td>Along Matina River</td>
<td>16</td>
</tr>
<tr>
<td>Along Pacuare River</td>
<td>38</td>
</tr>
<tr>
<td>Along Parismina River</td>
<td>34</td>
</tr>
<tr>
<td>Along Tortuguero River</td>
<td>30</td>
</tr>
<tr>
<td>Along Colorado River—mouth of San Carlos</td>
<td>86</td>
</tr>
<tr>
<td>Along Sarapiqui River</td>
<td>41</td>
</tr>
<tr>
<td>Along San Carlos River</td>
<td>86</td>
</tr>
<tr>
<td>Total length of navigable rivers and canals</td>
<td>443</td>
</tr>
</tbody>
</table>

The above does not include the San Juan River, which is navigable all the way to Lake Nicaragua.
The efforts of the Ministry of Transport to develop the waterways in the Atlantic Zone are aimed at linking inaccessible and isolated regions and bringing agricultural and possibly industrial activities to the region. Several areas in the region have agricultural potential. This has not been tapped because of the lack of a permanent and effective means of transportation for passengers and products.

The canals linking the rivers and lagoons in the zone have made it possible to travel from Moin to Barra de Colorado, a distance of 112 kilometers, in about 4 hours. When completed, the canals will have a minimum width of 30 meters and a minimum depth of 2 meters.

A passenger and cargo terminal at Moin will soon be ready. It will have 171 meters of marginal loading dock space, plus buildings for storage, repairs, and administration. There will be 3 auxiliary docks in Pacuare, Matina, and Barra del Colorado, which are about 40 percent complete.

The Ministry of Transport conducted a study to determine the economic justification for developing the canal. A zone of influence was used as a base to analyze the economic benefits resulting from development of the canal. The centerline for the zone of influence was the navigable waterway from the Colorado River to San Juan River, the navigable sections of the rivers that flow to the San Juan and those linked by the canal itself. The zone of influence was defined as the area 10 kilometers on either side of this centerline.

For industrial activities, the report considers wood and timber products as having good prospects in this zone of influence. An annual increase of 7 percent was indicated as the national demand for wood that can be produced in this area. The many varieties of wood available in the area might make the rational exploitation of the forests for timber difficult. Therefore, exploitation of the forests for timber, according to the report, should be directed toward exploring industrial operations for plywood and veneer.

Another activity indicated in this report was the production of paper by using the pulp of the swamp palm tree called "yolillo" as raw material. Still other activities mentioned as possibilities were fishing, processing of coconut oils, and rubber production.

4. Civil Aviation

The important airport for the region is located at Port Limon. LACSA, the Costa Rican National Airways, has 5 daily flights to and from San Jose. The passenger traffic on
this route is heavy, but the facilities at the airport are poor. Although it rains at Port Limon, the airport is located in an area that is slightly above sea level and it can easily serve as an alternate airport to the Juan Santamaria airport at San Jose. It is estimated that during the rainy season roughly 60 percent of the flights to San Jose are presently routed to Panama. Using Port Limon as an alternate national airport might provide added revenues to the region and savings to the nation.

Naturally, an alternate national airport at Port Limon calls for improving and adding facilities at the airport, including the runway, and building a modern control tower. New hotel facilities for passengers in transit would also be needed. An industrial estate for Port Limon will become more attractive with a modern airport at Port Limon, and the tourist trade in the region is bound to pick up immediately.

The other airport that serves the region is the one at Guapiles. Cariari Airlines has a flight each day to and from San Jose. Public airports for small planes are located at Barra del Colorado, Tortuguero, Parismina, and Puerto Viejo. There is also a considerable number of airports in the banana plantations for small private planes.

5. Linkages of Different Modes of Transportation

No study has yet been made to ascertain the economic feasibility of linking the different modes of transportation in the region so that no part is isolated and transportation within is quick and regular.

With construction of the canal terminal at Moin, the city will become a focus for the linkage between national roads, railroad, and canal systems. At Parismina, Tortuguero, and Barra del Colorado, there will be linkages between airports and the canal system.

At a point on the river Sarapiqui near Puerto Viejo there is an opportunity to link with the national road network of the country. Presently, the main drawback in canal and river navigation is the fact that only small boats can be used to transport passengers and cargo. This communication by canals and roads with the Central Valley is important since Puerto Viejo is connected to San Jose by a 100 kilometer regional highway.

The canal and road link is cited as one of the possibilities if all modes of transport in the region were interconnected to encourage greater movement of people and agricultural products.
C. Limon-Cienaguina Port

Port Limon is the principal port on the Atlantic Coast. Located on the leeward side of Uvita Island it has a water approach to the port that varies from a depth of 14.5 to 18 meters. The port has 3 wharves:

Metallic Pier--This is a T-shaped structure with 3 berths with varying depths of 8.8, 7.9, and 6.7 meters. Constructed in stages between 1899 and 1904, the pier has a wooden dock supported on wrought iron pilings. The T-pier head is 23.9 meters wide and 320 meters long. A private pipeline for petroleum products and a waterline serve the pier.

National Pier--A smaller wharf located next to the Metallic Pier was constructed around 1902 which can accommodate only small vessels in its single berth. It is 152 meters long and 15.8 meters wide. The pier is served by a single railroad track which branches into three tracks on the pier. It is functionally obsolete for the larger ships that now call at the port.

The Provisional (Banana) Pier--This Pier has 3 berths of 9, 9, and 6 meters depth, respectively.

The existing piers are owned by the Government of Costa Rica and operated by JAPDEVA. Most of the waterborne commerce is handled at the Metallic Pier. Delays in cargo handling are experienced due to lack of transit storage facilities and the need to moor ships a short distance away to prevent damage from swells in the harbor area.

During 1971, operating on a 24 hour basis for 365 days of the year, approximately 1,303,000 metric tons of cargo were handled, including 562,400 metric tons of banana. The commerce projections indicate that banana shipments through Limon will increase to 950,000 metric tons in 1975.

The October 1970 report on "Port Feasibility Studies and Preliminary Design by TAMS Ingenieria and Disenos y Proyectos" conducted for the World Bank recommended:

...development of a port at Cienaguina... (which) would include a sheltered harbor and 3 general cargo berths. The cost of design and construction is estimated to be U.S. $30 million, excluding import duties. It is recommended that the design of these facilities be started no later than March 1971 which would permit their completion by the end of 1974. Our analysis indicates that the recommended facilities are feasible from an economic standpoint and that they would be financially viable.
TAMS recommendation for the Limon-Cieneguita harbor would include a primary breakwater 730 meters long near Cieneguita river and an island breakwater of 200 meters off Limon Point. Three general cargo berths would be constructed in Stage I with capability of handling container operations. Subsequent stages would provide 2 additional general cargo berths and various other port facilities.

The study evaluated Moin and Cieneguita as potential sites for development of the new port and recommended Cieneguita for the following reasons:

—Because of the sediment flow in Moin and Cieneguita Rivers and the direction and volume of the littoral drift. The volume of annual dredging and maintenance required at Moin would be more than twice that at Cieneguita.

—A permissible orientation of the harbor entrance would result in better navigational characteristics at Cieneguita than at Limon.

—Developing port facilities at Cieneguita would include the cost of new housing for families required to move from the site who now live in substandard dwellings. Port development at Cieneguita would help solve a local problem of marginal housing.

—A port at Cieneguita would be better coordinated with available functions and services at Limon. Duplication of investments might be necessary if new port facilities were developed at Moin.

—The additional cost of transporting cargo to and from the Central Plateau, resulting from the greater distance to Cieneguita from Moin, is insufficient to alter the relative overall cost advantage of Cieneguita.

—A port at Cieneguita would provide a calm inner harbor, better naturally sheltered anchorage, preferred navigational approaches, and more convenient access to existing facilities in Limon—labor, utilities, and related infrastructure.

The report warned that failure to carry out Stage I improvement would mean that cargo in excess of the present port capacity would be either diverted or unrealized.

In April 1969, the International Bank for Reconstruction Development concurred with TAMS-DYPSA's choice of the Limon-Cieneguita site for the new port installation on the Atlantic Coast. It is not clear why no action was taken on this study and its recommendations.
The report brings out additional reasons for developing the Limon-Cieneguita site, including the saving in import costs should Costa Rica decide to import wheat through Limon instead of Puntarenas. The strong preference of Costa Ricans for wheat flour products is indicated by the increase in wheat imports:

Table 22

<table>
<thead>
<tr>
<th>Year</th>
<th>Metric Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1959</td>
<td>46,100</td>
</tr>
<tr>
<td>1967</td>
<td>74,700</td>
</tr>
<tr>
<td>1971</td>
<td>132,000</td>
</tr>
</tbody>
</table>

Under the contractual agreement with the major supplier in the United States, wheat is imported from Portland, Oregon, through Puntarenas to the flour mill at Alajuela. Agricultural experts estimate that Gulf Coast wheat will generally have a price advantage. In addition, it will have the cheaper ocean freight if exported through New Orleans to Limon. The saving estimated in 1970 was $4.00 per ton of grain imported through Limon and delivered to the mill at Alajuela.

It is not clear what led to the Engineering Study of Port Limon breakwater by engineering consultant B. Sellhorn of Hamburg, Germany. The Sellhorn recommendations were based on a 41 million Deutsche Mark Model Study of the breakwater at Limon Point that was conducted at the Franzius Institute for Civil Engineering, Technical University of Hanover. In his report, dated 27 April 1971, Sellhorn proposes extending the Island breakwater of the TAMS-DYPSA study for an additional length of 210 meters at an angle of 25° to the initial direction of the breakwater. This would reduce the swells within the harbor to levels that would permit 100 percent utilization of the berths throughout the year. The Sellhorn recommendation for the breakwater does not interfere with the water approach to the Limon-Cieneguita port as proposed in the TAMS-DYPSA report. Thus, the Sellhorn recommendation might be considered as a refinement of the TAMS-DYPSA study. Sellhorn further recommends removal of the national pier and providing additional berth space within the protected area of the breakwater.

According to Ing. Rogelio Pardo Jochs, Diputado por la Provincia de Limon, if the Sellhorn suggestions are carried out independent of the TAMS-DYPSA recommendations, there will be only one additional berth with no flexibility to increase dock spaces when needed. Furthermore, one additional berth would not be adequate for the varied types of loading and unloading facilities—roll-on, roll-off and containerized cargo—that might be needed in the future.
Ing. Rogelio Pardo supports development of the Cie­
eguita Port since it would relieve urban pressures and problems of Limon Port, provide employment opportunities in the Industrial Zone, bring about 55 hectares of unproductive swampland into use for new industries, and divert the land cargo truck route that presently goes through the heart of the city. Also, through acquisition of land for the Cieneguita project, it would be possible to remove substandard housing (squatters) in the area and provide better housing with improved sanitation facili­ties.

JAPDEVA, with a 20 million colones appropriation, is presently supervising the construction of the first leg of the breakwater. The initial length of 200 meters is nearly completed and has considerably increased the cargo-handling capacity of the port.

Tables 23 and 24 provide details of the volume of imports and exports to Costa Rica through Limon for the period of 1958 to 1971. Table 25 compares the volume of commerce through Limon and Puntarenas for the period 1963 to 1971. The commerce projections for 1975 to 1995 are shown in Table 26. Current projections indicate that export tonnage from Port Limon will increase from 704,000 metric tons in 1971 to 1,440,000 metric tons in 1995; bananas will represent 80 per­cent of the total export. Export through Limon is nearly double that of the rest of the country.

There are indications that added benefits to the region can be gained if improvements and modernization of the Limon-Cieneguita port can be initiated along the lines suggested by the TAMS-DYPSA report.

The Coordinated Caribbean Transport (CCT) owns more than ten ships that ply between the Guatamala port on the Caribbean side and Miami, carrying meats, vegetables, and fruits to markets in the U.S. Since March 1973, one CCT ship has started calling once a week at Limon Port. But the bulk of the export from Costa Rica to the United States is still trucked along the Pan American Highway to Guatamala and then shipped via CCT lines to Miami. With the San Jose-Limon high­way scheduled for completion in 1974, Costa Rica might want to evaluate the benefits of shipping all Costa Rican exports to Miami through Port Limon provided there are facilities at the port for roll-on, roll-off service and cold storage facilities at the docks.

The Sealand Company of Panama offers sea cargo transport from Panama to New York City. CCT lines do not touch at ports near the New York area. If Limon port is developed and the export volume from Costa Rica to the Northern U.S. is attractive, Sealand Company might schedule regular stops at Port Limon.
Table 23
COSTA RICAN IMPORT THROUGH PORT LIMON (1958-1971)
Thousands of Metric Tons

<table>
<thead>
<tr>
<th>Year</th>
<th>Costa Rican Import</th>
<th>Import through Puerto Limon</th>
<th>Import through Puerto Limon as a % of Costa Rican Import</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Excluding Crude Oil</td>
<td>Total</td>
</tr>
<tr>
<td>1958</td>
<td>433</td>
<td>433</td>
<td>172</td>
</tr>
<tr>
<td>1959</td>
<td>442</td>
<td>442</td>
<td>207</td>
</tr>
<tr>
<td>1960</td>
<td>510</td>
<td>510</td>
<td>210</td>
</tr>
<tr>
<td>1961</td>
<td>496</td>
<td>496</td>
<td>235</td>
</tr>
<tr>
<td>1962</td>
<td>537</td>
<td>537</td>
<td>261</td>
</tr>
<tr>
<td>1963</td>
<td>584</td>
<td>584</td>
<td>268</td>
</tr>
<tr>
<td>1964</td>
<td>608</td>
<td>608</td>
<td>248</td>
</tr>
<tr>
<td>1965</td>
<td>804</td>
<td>804</td>
<td>303</td>
</tr>
<tr>
<td>1966</td>
<td>711</td>
<td>693</td>
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</tr>
<tr>
<td>1967</td>
<td>745</td>
<td>638</td>
<td>293</td>
</tr>
<tr>
<td>1968</td>
<td>889</td>
<td>631</td>
<td>443</td>
</tr>
<tr>
<td>1969</td>
<td>1004</td>
<td>734</td>
<td>498</td>
</tr>
<tr>
<td>1970</td>
<td>1261</td>
<td>962</td>
<td>570</td>
</tr>
<tr>
<td>1971</td>
<td>1322</td>
<td>935</td>
<td>599</td>
</tr>
</tbody>
</table>

Table 24

VOLUME OF COSTA RICAN EXPORT* THROUGH PORT LIMON

(Thousands of Metric Tons)

* The Banana Export is indicated within the brackets.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Export Tonnage to Costa Rica</th>
<th>Export Tonnage through Puerto Limon</th>
<th>Tonnage through Puerto Limon as a % of the Total Export</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958</td>
<td>395 (201.6)</td>
<td>65 (3.7)</td>
<td>16.5 (1.2)</td>
</tr>
<tr>
<td>1959</td>
<td>300 (213.2)</td>
<td>86 (19.8)</td>
<td>28.7 (9.3)</td>
</tr>
<tr>
<td>1960</td>
<td>398 (272.7)</td>
<td>111 (34.4)</td>
<td>27.9 (12.6)</td>
</tr>
<tr>
<td>1961</td>
<td>347 (230.1)</td>
<td>139 (49.6)</td>
<td>40.1 (21.6)</td>
</tr>
<tr>
<td>1962</td>
<td>419 (291.9)</td>
<td>163 (65.4)</td>
<td>38.9 (22.4)</td>
</tr>
<tr>
<td>1963</td>
<td>409 (261.1)</td>
<td>181 (69.8)</td>
<td>44.3 (26.7)</td>
</tr>
<tr>
<td>1964</td>
<td>533 (292.9)</td>
<td>178 (85.3)</td>
<td>33.4 (29.1)</td>
</tr>
<tr>
<td>1965</td>
<td>512 (316.0)</td>
<td>206 (108.4)</td>
<td>40.2 (34.3)</td>
</tr>
<tr>
<td>1966</td>
<td>603 (358.7)</td>
<td>251 (136.2)</td>
<td>41.6 (38.0)</td>
</tr>
<tr>
<td>1967</td>
<td>629 (371.0)</td>
<td>243 (137.1)</td>
<td>38.6 (37.0)</td>
</tr>
<tr>
<td>1968</td>
<td>898 (553.3)</td>
<td>367 (230.0)</td>
<td>40.9 (41.6)</td>
</tr>
<tr>
<td>1969</td>
<td>1022 (694.6)</td>
<td>491 (372.8)</td>
<td>48.0 (53.7)</td>
</tr>
<tr>
<td>1970</td>
<td>1198 (856.0)</td>
<td>616 (515.6)</td>
<td>51.4 (60.2)</td>
</tr>
<tr>
<td>1971</td>
<td>1356 (922.2)</td>
<td>704 (562.4)</td>
<td>51.9 (61.0)</td>
</tr>
</tbody>
</table>

Ref: Comercio Exterior de Costa Rica.
Table 25

VALUE OF IMPORT/EXPORT FROM COSTA RICA*
(Million $)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Limon</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Export</td>
<td>57</td>
<td>63</td>
<td>53</td>
<td>63</td>
<td>61</td>
<td>68</td>
<td>70</td>
<td>65</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Import</td>
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<td>53</td>
<td>60</td>
<td>52</td>
<td>51</td>
<td>59</td>
<td>59</td>
<td>68</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
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<td>116</td>
<td>113</td>
<td>115</td>
<td>112</td>
<td>127</td>
<td>129</td>
<td>133</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>Puntarenas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>10</td>
<td>17</td>
<td>20</td>
<td>26</td>
<td>30</td>
<td>34</td>
<td>48</td>
<td>74</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Import</td>
<td>48</td>
<td>59</td>
<td>91</td>
<td>70</td>
<td>65</td>
<td>65</td>
<td>84</td>
<td>114</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>58</td>
<td>76</td>
<td>111</td>
<td>96</td>
<td>95</td>
<td>99</td>
<td>132</td>
<td>188</td>
<td>158</td>
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</tr>
<tr>
<td>Costa Rica</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>93</td>
<td>114</td>
<td>112</td>
<td>136</td>
<td>144</td>
<td>171</td>
<td>191</td>
<td>232</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>Import</td>
<td>124</td>
<td>139</td>
<td>178</td>
<td>178</td>
<td>191</td>
<td>213</td>
<td>245</td>
<td>316</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>217</td>
<td>253</td>
<td>290</td>
<td>314</td>
<td>335</td>
<td>384</td>
<td>436</td>
<td>548</td>
<td>575</td>
<td></td>
</tr>
</tbody>
</table>

*Direccion General de Estadistica Y Censor
### Table 26

**COSTA RICA COMMERCE PROJECTION 1975-1995**

In Thousand Metric Tons

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Limon</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>969</td>
<td>1270</td>
<td>1414</td>
<td>1534</td>
<td>1641</td>
</tr>
<tr>
<td>Import</td>
<td>378</td>
<td>479</td>
<td>583</td>
<td>707</td>
<td>859</td>
</tr>
<tr>
<td>Total</td>
<td>1374</td>
<td>1749</td>
<td>1997</td>
<td>2241</td>
<td>2500</td>
</tr>
<tr>
<td><strong>Puntarenas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>150</td>
<td>130</td>
<td>145</td>
<td>162</td>
<td>78</td>
</tr>
<tr>
<td>Import</td>
<td>420</td>
<td>400</td>
<td>430</td>
<td>460</td>
<td>488</td>
</tr>
<tr>
<td>Total</td>
<td>570</td>
<td>530</td>
<td>575</td>
<td>622</td>
<td>666</td>
</tr>
<tr>
<td><strong>Costa Rica</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3456</td>
<td>4212</td>
<td>4917</td>
<td>5668</td>
<td>6456</td>
</tr>
</tbody>
</table>

*Direccion General de Estadistica Y Censor*
According to recent information published in local papers, land worth 15 million colones has been reclaimed on the inside of the island breakwater at Limon Point. This space will be utilized for building transit storage facilities near the dock. With funds furnished by the West German government, construction might soon begin to provide additional berths on the inside of the island breakwater as per recommendations in the Sellhorn report.

JAPDEVA has recently established a new Department of Hydraulic Studies in Limon, staffed by two Costa Rican engineers.

D. Industrial Development

1. Urban Sector

Roughly 20 percent of the population of Costa Rica lives in metropolitan San Jose. The 1972 population density of the metropolitan area of San Jose was 1,307 people per square kilometer, while that for Costa Rica as a whole was only 36.2. This tremendous difference in population density between the metropolitan center and the country as a whole reflects the tendency for populations and industries to polarize around capital cities where better opportunities for employment and marketing exist. Thus the outlying regions of the country remain sparsely populated with little opportunity for development of their human and natural resources.

Table 27 shows the 1968 to 1972 populations of the seven urban areas of Costa Rica, and Table 28 shows the population densities of the same areas in 1972. As is indicated in Table 27, the average yearly increase in population in metropolitan area of San Jose was 11,355, while that for other areas was considerably less. At this rate of growth, the population of metropolitan San Jose could reach 462,000 by 1975, further aggravating problems of density, polarization of industry, and inequitable regional distribution of benefits derived from national development programs.

In many developing countries, such as India, Mexico, and Puerto Rico, industrial estates have played a role in government policies aimed at diverting industries from relatively overpopulated or over-industrialized centers and directing them towards depressed or less developed areas. Such policies have helped promote a geographically balanced development. They served as important national tools in solving the urbanization problems through decentralization of industrial activities and development of the estates as nuclei for further growth in the outlying depressed areas.
### Table 27

**POPULATION OF URBAN AREAS OF COSTA RICA**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>San Jose</td>
<td>383,219</td>
<td>395,401</td>
<td>406,990</td>
<td>417,502</td>
<td>428,718</td>
</tr>
<tr>
<td>Alajuela</td>
<td>28,600</td>
<td>29,171</td>
<td>29,820</td>
<td>30,525</td>
<td>31,212</td>
</tr>
<tr>
<td>Cartago</td>
<td>22,421</td>
<td>22,397</td>
<td>22,931</td>
<td>23,472</td>
<td>24,018</td>
</tr>
<tr>
<td>Heredia</td>
<td>23,513</td>
<td>24,021</td>
<td>24,675</td>
<td>25,197</td>
<td>25,806</td>
</tr>
<tr>
<td>Liberia</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>14,621</td>
<td>15,435</td>
</tr>
<tr>
<td>Puntarenas</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>31,880</td>
<td>33,200</td>
</tr>
<tr>
<td>Limon</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>37,514</td>
<td>39,837</td>
</tr>
</tbody>
</table>

**Source:**
Direccion General de Estatistica y Censos
<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>Population</th>
<th>Area</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Jose</td>
<td>428,718</td>
<td>328</td>
<td>1307.0</td>
</tr>
<tr>
<td>Alajuela</td>
<td>31,212</td>
<td>327</td>
<td>132.0</td>
</tr>
<tr>
<td>Cartago</td>
<td>24,018</td>
<td>143</td>
<td>168.0</td>
</tr>
<tr>
<td>Heredia</td>
<td>25,806</td>
<td>520</td>
<td>49.6</td>
</tr>
<tr>
<td>Puntarenas</td>
<td>31,880</td>
<td>2146</td>
<td>9.8</td>
</tr>
<tr>
<td>Limon</td>
<td>39,837</td>
<td>1756</td>
<td>15.5</td>
</tr>
<tr>
<td>Liberia</td>
<td>15,435</td>
<td>1567</td>
<td>22.7</td>
</tr>
</tbody>
</table>
A policy of this type would help alleviate some of the population pressures now facing metropolitan San Jose.

A likely area for the location of a new industrial estate would be near Port Limon. The industries located there may not be fully market oriented at the start. It might include industries that are agro-based, such as wood, paper manufacturing, fruit processing, and those requiring heavy imported inputs so that there could be cost saving from manufacturing near the sea port. Opportunities might also exist for certain drawback industries and storage and freezing facilities.

The industries selected for the industrial estate should be interrelated in order to obtain some type of vertical integration which can result in a reduction of production costs. The appropriateness of the industries would be determined after an in-depth study of the needs and potentialities particular to the area.

Port Limon possesses many facilities which would be advantageous to industrial development: Its proximity to an airport, railroad service, warehouse facilities at the port, ocean transport, a labor force with an aptitude for technical skills, an unemployment of 12 percent for Port Limon, a new highway to be completed in 1974 which will connect Limon to San Jose, and an adequate population size that would support the industrial estate. (India established an industrial estate in a city of 20,000 people.)

The TAMS-DYPSA report on Limon-Cienguita Port recommends that:

Provision should be made for development for shipping and storage of bulk commodities and for industries requiring waterfront space. Studies have not been made as to the type of industrial facilities that might be developed at the port. Based on experience at other ports, however, the availability of sheltered and suitable waterways permitting economic development of shipping terminals is likely to encourage industrial development by private interests. The requirements of individual industries are unique and overall planning for such facilities must be generalized until specific needs are determined. Space is an essential requirement for most water oriented industries and consequently suitable areas must be made available and reserved for industrial development from the outset. Approximately 100 hectares
(250 acres) should be set aside adjacent to the Cieneguita port site on the Atlantic Coast for receipt of dredged material and for future potential development.

Without detailed economic and market studies, it would be premature to suggest the type of industries appropriate for the industrial estate. Sr. Garron Salazar, General Manager of JAPDEVA, during one of his many discussions with the group, indicated that he had received several proposals from established businesses to start new industries at Port Limon. The types of industries that have evinced such interest in the urban sector should be evaluated to find out whether the city of Limon can capitalize on the expressed interest and develop an industrial estate to house these industries and offer incentives, cheap energy, and services to attract others.

Based on preliminary evidence, the following industries are suggested for further study as potential industries for the urban sector:

a. **Paper and Paper Products**

Recently two plans for establishing plants in Costa Rica for the manufacture of paper were proposed. Both received the approval of the Ministry of Industries, but because of economic difficulties in the use of necessary raw materials, prospects of advancement of these plans did not materialize. One mill with a planned capacity of 50,000 metric tons was proposed for the Province of Limon where wood would be used as the raw material.

In 1961, the fruit companies began shipping bananas in boxes instead of on the stem, with the result that large quantities of boxes had to be imported. In 1964, the companies began manufacturing boxes in Costa Rica, so that imports of the boxes fell sharply and import of cardboard for their manufacture became important. During the 3-year period from 1965 to 1967, while an annual average of 349,000 metric tons of bananas were being exported, an average of 22,700 metric tons of miscellaneous cardboard and paper were imported, nearly all for the manufacture of boxes. Approximately 65 kilograms of cardboard is needed to pack a metric ton of banana.

Imports of newsprint grew fairly steadily from 3,200 metric tons in 1957 to 7,603 metric tons in 1968. The volumes imported correlate reasonably well with the growth of Costa Rica's population. Increased circulation and new newspaper publications might account for the steady upswing in recent years. Imports of all other paper, cardboard, and related manufactured products averaged 24,900 metric tons per
year during 1965 to 1967. Based on projected gross domestic product (since the volume of these imports remains about the same proportion of GDP), it is estimated that a total of 50,000 metric tons of paper and cardboard products, other than newsprint and material for banana boxes, will be imported in 1980.

The following table gives the value of paper, and carton and paper products that were imported during 1967 to 1971.

Table 29

CIF VALUE IN MILLIONS OF COLONES

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper and Cartons</td>
<td>60.2</td>
<td>81.6</td>
<td>91.1</td>
<td>131.0</td>
<td>132.0</td>
</tr>
<tr>
<td>Paper products</td>
<td>14.5</td>
<td>19.3</td>
<td>16.7</td>
<td>25.3</td>
<td>20.7</td>
</tr>
</tbody>
</table>

Source: Comercio Exterior de Costa Rica 1971
Direccion General de Estradistica y Census

During discussions in Costa Rica, statements were often made regarding the potential for using the swamp palm tree "yolillo" for manufacturing paper. The team was unable to discover whether research has been conducted on yolillo to determine its suitability for manufacturing paper. The large yolillo groves in the region serve a very important function in the low lands. Through transpiration, the tree drains the region of large amounts of water. Cutting down the trees might disturb the balance and inundate greater areas. However, the large number of yolillo leaf stems that are each more than 15 feet in length might be trimmed on a rotational basis, thus assuring that the tree itself would not be cut down. Another aspect to be considered is the fact that yolillo groves are in marshlands that are not easily accessible and transport of yolillo leaf stems might be a difficult and expensive operation.

There was a cardboard and paper manufacturing company, the Reconvertidors de Papel S.A., based on cabuya derived from the abaca plant. According to Mr. Jorge Land of that company, several factors contributed to the failure of the venture. He indicated, among other reasons, the inexperienced technica.s operating the plant and a change in policy of the abaca suppliers—the United Fruit Company. Further studies into the causes for the failure of this industry will be valuable to the detailed study for paper and paper product industries in Limon Province.
To satisfy requirements for economies of scale, paper industries can be approached on a regional basis since the Atlantic coastal regions of Panama and Nicaragua are endowed with similar vegetation and forestlands. A pulp and paper industry, in view of the paper and pulp shortage in the developed world, has potential for consideration as an "integration industry" for CACM countries, provided fair distribution of benefits is worked out and agreed upon by the participating countries.

b. **Drawback Industries**

The unemployed urban labor force is estimated at 6,600. Of this number, 946 are students and 2,500 are women. The majority of the women are over 30 years old. Recently there was an interest in learning to sew and many housewives organized small sewing clubs. As a result of the local interest, a Corte y Confeccion Program was initiated to improve the skills and capabilities of women in dressmaking and tailoring. In 1969, the National Apprenticeship Institute conducted training programs for 2 groups. Of the 29 who attended the program, 17 graduated. In 1971, 25 of the 26 who enrolled graduated. There are plans for an expansion of the program and enrollment in sewing is expected to rise to more than 100 students.

Thus there exist excellent possibilities for the establishment of certain drawback industries such as apparel manufacturing. These labor-intensive industries might help alleviate the critical problem of unemployment among women in the region and offer tremendous incentive to the businessman in terms of skilled and low cost labor.

c. **Wood Industries**

A good part of the region consists of lands suited only for permanent use in forestry. Such lands are almost totally under virgin or only lightly logged natural forest cover today. Moreover, lands suitable for agriculture and grazing are, in substantial part, still occupied by heavy stands of mature timber or by second-growth stands of fast-growing laurel and balsa trees. Little of the timber felled in land-clearing operations is utilized at all, being left to rot upon the ground. Thus, there is in the region a great but as yet unavailed opportunity for the development of major wood-using industries and the supplying of national demands for timber, currently increasing at about a 7 percent annual rate.

Given increasing world demand for forest products in all categories, and the current sharp increase in world prices for wood, the species-complexity of the Limon Province forests should no longer be an obstacle to their
integral utilization under modern systems of sustained yield forest management. Their species-complexity may be turned into an asset, in fact, by the development of a complex of major, integrated industrial processing plants producing everything from lumber to chemical by-products and the secondary manufacturing of semi-finished and finished products of high value for both internal and external markets. These industries should be linked directly to managed forest units and to secondary farm production of some fast-growing species, such as laurel, by a regional forestry office for survey, research, and professional forest management.

If and when it is found necessary to establish an industrial estate near the city of Limon, the planning of the estate must take into account the experience in metropolitan San Jose, where clusters of industrial activity had encouraged migration of the rural population to the metropolitan areas. Therefore, it might be appropriate to consider simultaneous promotion of industries in the rural areas while planning an industrial estate for the urban sector.

2. Rural Sector

Since more than two-thirds of the regional population is involved in agricultural activities, the team tried to identify the types of industries that exist in areas outside the city of Limon.

The 1963 Agricultural Census reported several industries operating in the rural areas of Limon Province. Only a few of the industries reported in the 1963 census were found to be operating in 1973. Some of the industries that had failed were:

—A marmalade, guava, and fruit jelly making plant in Siquirres that had failed for want of working capital and a lack of regular supply of fruits;

—Three yucca starch (almidon) operations in the Siquirres-Guapiles area went out of business because of competition from other CACM countries that were able to sell the same product cheaper in this area, and

—A corn milling and cacao dehydration plant had failed because of a lack of cheap transportation, need for a stable and reliable supply of raw materials, and insufficient technical knowledge and advice.

Only a few of the industries reported in the 1963 census were found to be in operation in 1973. These were 6 municipal slaughterhouses, the cacao drying and processing
plants, the sawmills, and the banana packing operations. In most of these operations, the technology used is quite primitive and inefficient. Without further technical and financial supports, these will remain marginal operations.

Among the new industries that have started since 1963, are two turtle and lobster processing plants--the Frigorificos del Atlantico and Mariscos del Caribbe.

Frigorificos del Atlantico is located in a fairly big and modern building where the turtle meat is processed and frozen for export. For greater use of the freezer space, cuts of beef are also processed and stored in the plant. Occasionally, local fishermen are granted freezing and storage space for short periods. This company recently acquired a beef cattle fattening operation near the city of Limon and intends to establish a vertically integrated modern slaughterhouse and beef packing plant. It plans to diversify its operation into such areas as a fine quality of copra called "coconut snow," mainly for export. There is an existing law in Costa Rica that prohibits export of coconuts and copra. This law has seriously limited opportunities for exploitation of coconuts in Costa Rica.

Mariscos de Caribbe, S.A. is also involved in processing turtle meat and lobsters. This plant extracts turtle oil for export to the U.S. and Europe. For maximum utilization of plant facilities, pork is processed for export and stored for local markets. Port sausages are manufactured for the domestic market.

On account of the declining number of turtles and lobsters, both firms are forced to reduce normal operations and seek other opportunities such as freezing of fresh fillets, etc. to maximize utilization of plant facilities.

In the Siquirres area there is a small plant for roasting and grinding corn. Corn powder is mixed with ground peanut and cacao and used in preparing the local beverages, Orchata and Pinolillo. This industry, although it is producing good quality mixes that are readily bought by wholesalers, seems unable to expand to meet the demand because of lack of capital and lines of credit.

In Guacimo, a corn drying plant owned by CNP has provided the opportunity for a diversified set of industries producing feed for cattle, pigs, and fish (Tilapia). The corn flower, along with the locally available bagasse, cacao pods, copra, banana, and potato flour and bone meal from the slaughterhouse at Siquirres offer opportunity for manufacturing feed for raising or fattening livestock.
The opportunities for agro-industries located in the rural sector appear quite attractive, but several factors need consideration before such ventures can be encouraged. Technical information and advice, credit, freezing and storage facilities, steady and reliable supply of raw materials, domestic and export market information, and agricultural and food research capabilities, are some of the types of information needed for industries located in the rural sector.

E. Tourism

During 1969, 122,000 tourists spent an estimated $19 million in Costa Rica. More than 52 percent of the tourists came from outside Central America, including 25 percent from the United States.

Limon Province attracts only a small number of tourists who trickle into the Province at Port Limon, Cahuita, and Boco Tortuguero. The adventurous tourists who visited these spots were willing to overlook inconvenient travel schedules, poor accommodations, and limited services. From conversations with the tourists, organized tours to the region are few and most of them have been disappointing. For instance, the organized tour for 60 elderly North Americans, who were promised a trip up the canal, was reported by the tourists as a bitter experience. The tourists arrived at Moin on a rainy day after a jogging bus ride from Limon to find that the boat for the tour was under repair in San Jose.

The general comment from the tourists was that they found too little to do in San Jose, while what the Atlantic Zone had to offer was different and more exciting. Although the Atlantic Zone has several attractive tourist spots, this opportunity has not been fully explored.

The Instituto Costarricense de Turism (ICT) has plans to develop tourist spots along a 14 mile stretch of the canal between Moin and Swamp Mouth. The plan includes building cabins on the strip between the shoreline and the canal so that tourists will have easy access to both the sea and the canal.

Members of the team visited different areas of the region and agreed that the potential for tourism in the region is much greater than what the present plans might indicate. The white sand beaches, the localized coral reef, and the shallow waters near Cahuita Point are a tourist's paradise. The variety and abundance of citrus fruit trees, the cacao plantations, and opportunities for deep sea fishing at Cahuita are added attractions.
Tourists from the industrialized countries seem to be looking for an opportunity to escape the hustle and bustle of everyday living in crowded cities and seek temporary refuge in an unspoiled natural environment that offers relaxation and change. The lowlands of the Atlantic Zone offer the unique opportunity to see nature in her grandeur and to witness one of the few remaining scenes in nature's world—the green turtles returning to their nesting grounds along the beaches at Tortuguero.

The National Parks in Kenya, Uganda and Tanzania offer opportunities to witness wildlife in its natural habitat. Tourists flock to these parks in such large numbers that travel plans and reservations for rooms at the parks must be made several months in advance. Camera safaris to East Africa are quite popular among European and American tourists. Travel costs to East Africa and hotel expenses at the national parks do not permit the average citizen from the developed world to visit these sanctuaries.

Several enterprising wildlife development organizations have suddenly sprung up in the United States and have been successful in exploiting this need. As a result, there are wild game reserves in Miami, Los Angeles, and Houston. Most of the wildlife in these reserves has been imported from Africa. The success of these projects has encouraged the developers to start similar projects in Canada and Japan.

The natural tropical forests, lagoons, and canals in the Atlantic Zone offer an ideal setting for establishing similar wildlife sanctuaries in Costa Rica. If a suitable area is declared a National Reserve, then wildlife suited to the area and common to the Central American Region might be protected by law and allowed to live in this restricted area. Camera safaris to such parks could become an attraction to CACM and foreign tourists.

Tortuguero offers an attractive opportunity to develop tourism in the region. The Atlantic green turtles' nesting ground was on its way to oblivion. Archie Carr, in the March 1972 issue of Audubon reported that:

There was organized exploitation along the entire nesting beach. The turtles were turned for the market as soon as they came out of reach of the surf and despite the rapid spread of anxiety over its decline...the position of the green turtle is clearly degenerating.
Since then, the Government of Costa Rica has initiated steps to protect the green turtles' nesting grounds along Tortuguero beach by declaring this stretch of beach a National Park. Park guards are posted to prevent poachers from operating in this area. On a clear night, it is not uncommon to witness several turtles lumbering from the sea to dig holes and lay 300 to 500 eggs at spots along this stretch of Tortuguero beach.

A tourist package that includes a visit to Cahuita, a short boat ride on the natural canal to a camera safari at a wildlife park, a trip to Tortuguero to observe the green turtles at night and to fish in the Atlantic, might offer the needed variety to attract tourists and the increasing number of back-to-nature fans.

Opportunities to develop tourism within the region must be evaluated against a background of several other programs that are planned for the region. For instance, the Ministry of Transport and Public Works has been successful in its efforts to link navigable rivers and lagoons so that it is now possible to travel by boat from Moin to Barra Colorado and on up to the San Juan River. The Department of Planning Ministry of Transport, in the April 1968 report, "Estudio de Factibilidad Economica de la Canalizacion de las Lagunas del Atlantico," has justified developing the canal as a means of transportation based on:

- Projected passenger traffic along the canal,
- Projected transport of agricultural products from areas close to the canal, and
- Potential for industries, fishing, and tourism in the region.

It is the opinion of the team that broader studies assessing different opportunities are needed before a policy for development of the canal can be formulated.

There are fast growing hyacinth groves on either side of the canal. It is reported that the banana packing chemical wastes dumped into the rivers and carried to the canals have quickened the growth of the hyacinth. The manatee, a tropical aquatic herbivorous mammal that lives in the lagoons, had helped to keep the hyacinth growth in check. The indiscriminate harpooning has made the manatee an almost extinct species in Costa Rica. The killing of the manatee and the phosphate in the wastes have contributed to the abundance of hyacinth groves along the canals and lagoons. The tides, currents, and waves created by boats separate hyacinth patches from the groves and set them adrift along the canal. Often, the brush and trees on the banks of the canal are cleared and dumped into the canal. Aground trees, floating branches, and drifting hyacinths are hazards to navigation.
The sedimentation in the canals is another important factor that needs consideration. The sediment transported by the rivers is deposited in certain sections of the canal. The present cost of dredging operations, which operate continuously, 24 hours a day, is estimated at 500 colones per hour. This operation is considered inadequate to keep the canal open for continuous use. Riverworks at appropriate locations on the rivers that link with the canal is an approach to reduce the sediment in the canal. Economic justification for such works would require quantification of the increased benefits from agricultural, industrial, and tourist activities that might result if the canal is properly maintained.

Of the many approaches to developing the region, one approach might be to encourage only agricultural and industrial activities in the region. On the other extreme, since the soils in certain areas of the region are constantly washed of nutrients, it might be better to promote only tourist trade, with no industrial or agricultural activity, thus leaving a major part of the region largely underdeveloped. Yet another alternative might be to promote a fair mix of agricultural and industrial activity with tourism. In this case there must be adequate guarantees so that one activity would not imperil the other. This approach might also assure that the environmental quality of the region is maintained.

If the main thrust of development is to take place in the agricultural and industrial sectors only, then the passenger and cargo traffic along the canal will be heavy. It must be remembered that there is negligible flow in the canals since the region is relatively flat and the total volume of water in the canals and lagoons is relatively small. The lagoon waters are almost stagnant. The combination of the small amount of relatively still water and the high degree of economic activity might quickly pollute the inland waters, destroying the attractiveness the region holds for tourism. Problems of pollution are already evident despite the low industrial and agricultural activity in the region. The wastes and oil spills, probably from the refining operation at Moin, have coated the banks of the canal at Moin with a black slimy spread which extends for several kilometers up the canal. Shrimp and oyster beds that were once thriving in Moin river and canal have been destroyed. The annual tarpon fishing contest that used to be held in Moin river and canal has been discontinued.

Among the three approaches, it seems rational to declare certain areas of the Atlantic Zone as national parks and develop them for tourism; and at the same time, explore opportunities in the remaining areas for agricultural and agro-industrial activities. For this approach, it is necessary to establish adequate safeguards against pollution before implementing this approach.
An environmental impact study of the region is necessary to identify the areas for tourism and set guidelines for agricultural and industrial activities so that opportunities for tourism may not be destroyed. Such a study might be a sound approach for the optimum use of the land in the region since the analysis would be concerned with the broad development potential of the region. The guidelines recommended by the study might also guard against over-exploitation and the consequent degradation of the region.

IV. SUMMARY AND SUGGESTIONS

This study is part of a larger study to understand the appropriate role of science and technology in the development of a small country like Costa Rica. A preliminary study of the natural resources potential of Limon Province was selected because there exist opportunities for the application of science and technology in the region for the development of Limon Province. A multidisciplinary team of scientists, engineers, economists, and regional developers was organized to conduct the study and make suggestions for in-depth, follow-on studies that would lead to formulation of regional development policies.

The team comprised Costa Rican consultants and Cornell professors and students. Among the Cornell students there were several Costa Rican citizens. Such a deliberate attempt to select qualified Costa Rican students had two distinct advantages. The students being quite familiar with the region and its problems were able to ask probing questions which helped the data gathering process. Equally as important, the students had a unique opportunity to relate their education and training at Cornell to the particular needs of their home country. The enthusiasm and commitment they showed suggest a direction for U.S. universities to follow in the education of international students. The approach might allow the international student to select for his graduate thesis or research, a project in his home country. Thus, the educational training at a U.S. university takes on greater relevance to an international student. This approach might also reduce the chance of a student becoming a brain drain candidate.

The multidisciplinary approach used in the study may be unique in that scientists and engineers participated with economists and regional development planners as members of a team from the initial stages of the study. Consequently, it is unlikely that the same suggestions in this report would be arrived at if a highly discipline-oriented group had conducted the same study.
The Limon study may be described as a broad brush survey of the natural resources existing in the Province and the potential for utilizing these for regional development.

This region has been neglected for years and consequently its resources have not been fully explored. Although there presently exists a sincere commitment at the national level to develop this region, progress in this direction has been slow because of the history of neglect.

The immediate need is for regional development studies that would lead to development policies and plans to implement such policies.

Very few studies of substance have been conducted on aspects relevant to the overall development of Limon Province. Therefore, the team was handicapped by a lack of data. During the two and one-half months that the team was in Costa Rica, the breadth and mandate of the study did not permit the type of in-depth studies necessary to set priorities or to clarify policy choices for the region.

Thus, the study and the suggestions made in this report are based on the information that was available to the team and the data it was able to collect in Costa Rica. There is evidence that certain topics need further study to enable formulation of regional development policies. These topics are suggested in this section for in-depth, follow-on studies.

The team was unable to identify existence of a long-range national development policy or plan for the country. Without the broad guidelines of national goals, independent development policies for each region might not receive the national commitment needed to implement such policies. Also, sources of funds at the national level for regional development could not be identified. (JAPDEVA is seeking approval to transfer income from the railroad operation to finance regional development of Limon Province.)

Independent development programs for different regions of the country can be counterproductive and even wasteful on a national basis. The current approach of developing one region at a time might overlook opportunities for coordination and cooperation among regions of the country. Under the present approach, regions like Limon Province that are in dire need of development might have to wait their turn. It is not clear whether this "series" approach to regional development serves the interest of the region and the country.

Neither was the team able to identify an industrial policy for the country. Such a policy might provide incentives for certain indigenous industries that are considered essential for
national interests. During the initial stages of operation of such industries, the policy might be to restrict import of similar products.

In the absence of such information as national priorities, national goals, and national industrial policy, etc., the team viewed the objectives of the study as a rational approach to utilize the natural resources of the region for the benefit of its urban and rural population, and to indicate how such an approach might contribute to national development.

According to the new constitution approved by the Legislative Assembly on September 11, 1973, JAPDEVA will provide the rapid and efficient development of the Atlantic slope of Costa Rica. It can lease, sell, adjudicate or exploit lands which the law confers on it but should previously consult with ITCO; it will be in charge of administering the canals in the Atlantic Zone.

In the past, development programs in the region were handicapped by several institutions' claiming jurisdiction over such programs. The overlap in functions had led to misunderstanding among institutions, characterized by a lack of coordination of institutional efforts. The resulting inaction forced JAPDEVA to seek technical advise from abroad to carry out programs urgently needed in the region.

Now that JAPDEVA is responsible for the regional development of the Atlantic Zone, it is seeking the rapid and efficient approach to carry out its functions. One approach might be for JAPDEVA to rely on the technical competence in some areas of development which already exists within several national institutions. There would be savings in time and money if JAPDEVA looked to the autonomous institutions within the country to provide this support. JAPDEVA could take on the administrative role, seeking the assistance of appropriate institutions within the country to carry out specific tasks.

The Central Government is emphasizing the concept of decentralized planning. Aggressive regional offices of autonomous institutions are essential in support of this drive. The regional offices would need adequate funds, full time personnel, and programs. Except for the Ministry of Agriculture, the group was unable to identify enterprising regional offices of autonomous institutions. In the case of the MAG regional office, part of the funds a number of extension agents assigned to the region were transferred to activities outside the region. Active regional offices are essential if JAPDEVA is to carry out its mandate rapidly and efficiently.

The municipalities in the region need to articulate local views and concerns regarding development, but they have been
relatively passive in this respect. IFAM's commitment to strengthen municipalities in the region to play this vital role is essential to active local participation in the regional development process.

The important first step is to organize and coordinate efforts so that an infrastructure exists to carry out plans for regional development of Limon Province.

The next step is an environmental study of the region to locate national parks and establish safeguards for protecting and developing the parks for tourism. At the same time, the study would identify the areas for agricultural and industrial activities in the region. Such a study might point to the optimum use of land for development and set guidelines against over-exploitation and the consequent degradation of the region.

This is a broad study utilizing current methods and technologies for the rational development of the region. The natural tropical forests, lagoons, and canals in the Atlantic Zone offer an ideal setting for establishing wildlife sanctuaries in Costa Rica. Modeled after the parks in Kenya and Uganda, the wildlife sanctuaries would protect wildlife common to the Central American Common Market countries. If properly developed, Costa Rica could become a center for camera safaris to the region. Tortuguero and the green turtles offer another attraction for tourism. The white sandy beaches, the localized coral reefs, and the shallow waters off Cahuita Point might be considered a tourist's paradise. The variety that this region offers for tourism and back-to-nature fans has not been fully explored.

But the agricultural activities in the region, the uncontrolled destruction of the forests, the indiscriminate killing of wildlife and the pollution of the streams and rivers threaten to quickly destroy its natural beauty and its potential for tourism. Since the region is relatively flat and the water in the canals and lagoons almost stagnant, there are already signs of pollution and environmental decay. The shrimp and oyster beds that once thrived in Moin river and canal beds have been destroyed and the annual Tarpon fishing contest in Moin river discontinued. The industrial wastes and oil spills at Moin have covered the banks of the canal near Moin with a black, slimy coating for lengths along the canal.

Regional development will be difficult unless the environmental study is initiated soon, to delineate regions for suitable activities.

Investigations of the development and modernization of facilities at Limon-Cieneguita Port, an industrial estate for the city of Limon, and a low-cost housing program for the
squatters in Cieneguita would form a set of studies quite important for the urban sector of Limon Province.

The Limon-Cieneguita Port and the industrial estate for the city of Limon have been discussed at length in sections III C and D of this report.

The low-cost housing program for the squatters of Cieneguita calls for an urgent study before any further houses are built. The social, economic, cultural, and technological aspects of the problem should be considered simultaneously to evolve a housing policy for the low-income group in the region. INVU is currently engaged in building five different models under the Los Corales project to evaluate the urban population's preference for a particular model. This approach tends to overlook the main problem of how to factor in local talents and seek the participation of the squatters in the project. The cost of the houses is another concern. The team was informed that the 23,000-colones houses were built for people earning at least 500 colones per month, and the buyers would have to pay 200 colones per month for 30 years. At this moment, local participation in the planning and construction of this project seems minimal.

The group had the opportunity to visit the Los Corales site and inspect a 23,000-colones, INVU-built house and compare it with a similar but far better built 10,000-colones house in the squatter colony. The contrast exemplified the need to study and plan the project with full participation of the squatters and to utilize their talents to construct the houses.

As far as the agricultural sector is concerned, this summary will proceed in three parts: first, a short agricultural history of the region; second, an indication of agricultural enterprises which were found to possess growth potential, and third, recommendations concerning the nature of future investigations and the institutional forms for work. The summary will conclude with a synthesis of proposals for additional study aimed at clarifying how future work in this area might proceed.

The Atlantic Coast Region of Costa Rica has traditionally been an agricultural area. Its tropical climate and topography have made it an ideal place for plantation crops, especially bananas. However, these conditions have not always contributed to the sustained economic growth and social progress of the zone. In the absence of a regional economy based on diversified tropical enterprise, the area has been subjected to the vicissitudes of a banana monoculture. Since 1880, the area has been dependent upon banana production and the large foreign fruit companies with their extensive plantings and marketing channels.
Banana production peaked in the Limon area in 1913, when United Fruit Company had 19,000 hectares of its own plantings. From 1913 to 1943, the production rate and the number of hectares of banana plantations declined until no bananas were exported from the region. This decline was a direct consequence of the planted variety's susceptibility to Panama disease. Consequently, United Fruit Company abandoned its plantation operations in the region and moved to other parts of the country.

Cacao, abaca, pineapple, and rubber have all existed as alternative enterprises to bananas. However, with the exception of cacao, these commodities have all suffered a cycle of expanded production and rapid decline similar to the case of bananas. By 1960, the war-created production of abaca collapsed. In the case of rubber, the Goodyear production facilities were phased out in 1968. Pineapple, which existed as a side activity of United Fruit Company, was closed down in 1915.

As banana production began declining, United Fruit and private landowners started planting cacao on abandoned banana lands. This practice was initiated in 1913, and by 1963, with the collapse of the banana industry and abaca production, there were 31,000 hectares of cacao. This was privately operated, either through private land ownership or the leasing of United Fruit lands.

This dependency on banana production, with shortlived large-scale production activity in abaca and rubber, prevented the development of a stable agrarian economy capable of supporting growth in the region. It has also had disastrous effects on capital formation, and has prevented the establishment of dependable sources of regional employment. This loss of revenue and employment forced many farmers, squatters, and hacendados into other agricultural activities, namely cacao and, recently, cattle.

During the period of cacao and emerging cattle production, the regional economy became tied to the world cacao prices. Thus, due to the volatile nature of the world cacao market, the zone was not able to establish a regional economy dedicated to long-term growth and stability. This state of affairs continued until the mid-1960's, when bananas again became a viable alternative for the area.

As the Atlantic Region begins a new agricultural developmental thrust, it would seem prudent to investigate the manner in which land resources and socio-economic factors have shaped the present pattern of agricultural enterprise. The present study was directed toward the investigation of avenues of diversification which could balance increasing banana production and stabilize the economy while imparting a growth element to it.
In addition, such analysis could point out potential bottle-necks in developmental schemes for the region, as well as indicate possible strategies for implementing change.

The study found several factors which have contributed to the present slow rate of agricultural growth in Limon Province. The most significant of these were:

— The lack of coordinating agent or institution to oversee the planning and implementation of agricultural developmental projects and schemes in the area;

— The absence of support for and coordination between regional development strategies and national plans for agriculture;

— The existence of an agricultural pricing structure which did not provide an adequate return to the farmer;

— The presence of an inadequate marketing structure for agricultural produce;

— The development over time of an infrastructure incapable of handling the dissemination of information, technical inputs, and output;

— The lack of technical information necessary for innovation and change in production and marketing. This lack has been compounded by the absence of an extension service of sufficient size and by the failure to conduct local experimentation and demonstration programs appropriate to the region;

— The failure to carry out a detailed potential land use and soil map with an agricultural orientation;

— The common practice of growing crops in unsuitable ecological areas;

— The development of a wage scale which makes it more profitable for a land holder to work as a day laborer than exploit his own land, and

— The presence of a large proportion of farmers who lack title to the land they operate.

These problems cannot all be overcome immediately. However, the realization of their existence and an appreciation of their impact upon any development strategy is imperative.
The Atlantic Zone possesses tremendous possibilities for agriculture if development is carried out in an organized manner. The climate, soil, and topography prohibit the cultivation of many crops and the husbandry of many animals, but there are great possibilities for ecologically suited enterprises. In order to realize this potential, many of the barriers mentioned above need to be overcome.

Conclusions from the detailed report indicate six areas of agricultural activity with potential for expansion. These warrant additional investigation to assess the degree of their apparent potential, their future impact upon the economy, and the feasibility of new investment in them. These activities are cacao, plantain, passion fruit, beef cattle, swine, and sea turtles. Activities of minor importance include coconut, black pepper, African Oil Palm, and sheep.

Cacao, as shown, has enjoyed an important place in the Limon economy. However, in the 1960's it lost its place of importance as a consequence of depressed world cacao prices. The low prices resulted in the abandonment of large tracts of cacao plantings. In turn, this hindered research into new cacao varieties, the use of improved agricultural practices, and management skills. It slowed the research and training in appropriate cacao culture. As a result, when world cacao prices increased during 1971 to 1973, the Limon cacao farmers were unable to capitalize on the opportunity. Thus, the majority of cacao producers faced a market in August 1973 paying $400/cwt. with trees capable of producing only 7 to 9 cwt./hectare, while a well-cared for, high yielding planting could have produced 30 cwt. per hectare. The income difference of $3,600 to $12,000 is significant to both the producer and the Limon economy. The price of $400/cwt. is not expected to remain stable over a long period of time; a more realistic level might be $200/cwt. However, even at this level, the yield differences between poorly maintained old plantings and adequately cared for improved varieties is significant.

Plantain, like cacao, is an important crop for many small and medium sized farms. Present cultural practices are primitive. Few producers use fertilizers or required cultural practices on a regular basis. Consequently, limited quantities of high quality fruit are produced. Local extension personnel estimated that improved technology could bring yields of 1,000 to 1,200 bunches per hectare. Thus, with a normal price of $3.50/bunch, returns would range from $3,500 to $4,200 per hectare. The normal fluctuation of plantain prices is from $2.50 to $6.00 per bunch. Currently, the only market for the plantain is domestic. However, during the study parties from Florida and New York were making enquiries into the possibilities of Limon's producing for these foreign markets.
According to results of experimental plantings and the experience of a few small producers, passion fruit could be a very promising commodity for the region. The current supplier for the U.S. market, Hawaii, is forced to reduce its acreage due to urban and residential expansion, thus indicating a potential market for Limon production. Yields from experimental plots have been the basis for projections of 30 to 60 tons per hectare per year, once the plant is in full production (1 to 1.5 years). The current local market price is $600 per ton, indicating a gross return of $18,000 to $36,000 per hectare per year.

Until recently, Limon Province was not considered a livestock area. However, with expansion of cattle into areas of the region that are similar to San Carlos, the government and private enterprises are hurriedly moving into Limon Province to exploit this opportunity. The region is capable of supplying adequate pasture and water for an expanding cattle industry. In addition, the presence of agricultural by-products, i.e., banana rejects, molasses, and corn meal, which can be used as feed supplements, can support such expansion.

Presently, there is a very low ratio of 0.48 head of cattle per hectare in Limon Province. The national average is 0.6 head per hectare. The presence of pasture with the ability to quickly recuperate after cattle grazing further indicates the opportunity for expansion of this activity.

The national swine production in 1972 was 9,089,000 kilograms. An estimate of a fair per capita consumption is 7.3 kilograms, which would require a national production of 13,739,000 kilograms. This figure is 4,650,000 kilograms more than the 1972 production. These figures indicate the need for Costa Rica to expand pork production. The Atlantic region appears to be an area capable of making a large contribution to expanded production of swine, especially with the availability of banana rejects, molasses, and corn meal as feed supplements.

The actual selection of these enterprises possessing growth potential demands further detailed study. In addition, it calls for the collection of further data, some of which are not presently available. An analytical framework might be used to delineate projected areas, also requiring additional investigation. The analyzed data would then provide the basis for the formulation of criteria to be used in policy decisions and priorities for an agricultural development plan.

Decisions among the competing enterprises would need inputs from the existing economic and social structure in the region. If the policy decisions called for changes in specific aspects of the socio-economic matrix, then a willingness to deal with the consequences must be evident. The social matrix decisions
will necessarily involve government policy regarding land tenancy and ownership, carry over of regional discrimination at the national level, and the structure and control of the labor market in terms of employment opportunity and wage rates.

The formulation of regional agricultural policy must proceed in a logical order. It will be possible to use the detailed study as a source of base information for the decision process. The actual policy decision should be made after analysis has been carried out in the following sequence:

—Evidence should be cited indicating the production possibilities of alternative programs. Such information is contained in the present report. It gives data reflecting the present state of agricultural efforts involving the specified crop and livestock enterprises and their potential for growth.

—Justification for selection among alternative activities would require independently developing data for each prospective agricultural development enterprise. The collected and analyzed information would form the basis for generating policy choices, planning, and implementation.

Justification for selection among alternatives would include:

a) Experimentation to assess the feasibility of physical production. This criterion implies the decision to establish local experiment stations. An alternative is to use data developed in other regions or counties under similar conditions, with local specific testing and verification of results. This work would involve decisions with respect to the size, scope, and nature of physical production research.

b) Economic research concerning the production unit, its size, and organization. Important considerations would be labor and capital requirements and their availability, as well as the availability of technical inputs and supportive service, relevant management skills, credit availability, profit potential, and potential impact of the activity on the regional economy.

c) Market research, involving detailed analysis of past and present market trends for the commodity involved for future projections. Central to marketing studies would be the selection of possible internal and/or export markets, plus a realistic evaluation of the time and resources required to develop and exploit the potential. The markets would have to be studied with respect
to location, size, reliability of demand, price fluctuation over time, and growth potential. The market demands upon the producing units in terms of supply and quantity would also require study.

d) Evaluation of the infrastructure prerequisites before the enterprise to efficiently develop, or facilities which must be created concomitantly as the enterprise moves from inception to maturity. These infrastructure requirements would reflect the needs of the producing units, the processing activities, and the markets.

e) Realistic evaluation of time horizon from inception to project realization.

The framework demands that this kind of information be collected for each potential development activity. Once the data are compiled, comparative analysis should lead to policy choices.

Another major area of policy decision is the institutional form or arrangement through which the above kinds of data will be collected, analyzed, and formulated into development strategies. The different forms of information require dissimilar investigating agents. The orientation of an experiment station or the expansion of current facilities in Limon Province to study production possibilities is imperative. The scope and nature of the station's investigations must be determined: is it to duplicate work being done elsewhere, be concerned with theoretical research, or have an applied orientation? Since the country lacks an adequate experimental facility in the humid tropics, such an investment appears to be justified. Some alternatives include 1) expansion of Los Diamantes, 2) modernization and expansion of the IICA La Lolla station, or 3) creation of a new institution. Regardless of the alternative(s) chosen, the government must make an effort to have a coordinated experimental program between the various branches of the Ministry of Agriculture, the agriculture faculty of the university, and the needs of the private agricultural sector.

Marketing and economic research are of critical importance in the formulation of development policy. These kinds of research must be done independent of outside forces and must be directed toward detailed analysis of markets and production economies. Vital to the growth of Costa Rica's economy is the development of a national capability for potential markets and the required forms of production and infrastructure. Thus, it is strongly urged that the government set up a semi-autonomous research institute to carry out such functions. This institute ideally could be linked with the national university. However, it must be manned by full-time professional staff, not part-time professors. An agency so formed must be concerned with
market and economic research for the agricultural products appropriate for the region, not product promotion and market development. The two kinds of activity are separate and need to be treated independent of each other.

The investigation of the activities or commodities should be regulated by those who have demonstrated capability in experimental work or in actual farm production. There must be close cooperation between the people directing physical investigations, market and economic research, and the extension service.

In conclusion, the Limon study has produced evidence for various agricultural enterprise possibilities. The next step is the allocation of time, money, and personnel to

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- study the existing socio-economic matrix of the region to determine the social, economic, and land tenancy base upon which the enterprise will be implemented;

- collect the kinds of data needed on the crops and livestock this study has identified to provide the background for policy formulation;

- evaluate the alternatives for an agricultural experimental facility focusing on testing and demonstrating agricultural opportunities typical for the region, and

- explore the alternatives for establishing an agricultural market and economic research facility, possibly linked with the University of Costa Rica but manned by a full-time professional staff. Professors and students might work part-time at this facility, thereby providing the opportunity to orient the study program to the particular needs of the country.

As far as opportunities for regional cooperation among CACM countries for mutual development, the green turtle population along the Atlantic Coast offers a unique opportunity. Further action at the regional and national level is needed to reopen discussion on this issue.

Until recently, there was organized poaching of the green turtle and its eggs along the nesting grounds at the beaches of Tortuguero. The turtles were caught and brought to market as soon as they came to the beach to nest. Roughly two-thirds of the Tortuguero nesting colony was derived from the extensive turtle grass pastures off the coasts of Nicaragua and Panama. Alarmed by the poachers operating in Tortuguero and the poor nesting seasons, a group of high level delegates from Panama, Costa Rica, and Nicaragua met in 1969. The three countries
working together, it was believed, could insure survival of the species by giving Costa Rica custody of the nesting ground and a fair share of a controlled yearly harvest. The agreement drawn up at the meeting was not ratified by the governments. Instead, Nicaragua built two big, modern turtle processing plants.

The vogue of the existing turtle steak menu in the sea food restaurants of Florida has practically wiped out the Florida green turtle population. This has created a market for green turtle meat in the United States. Outside the United States, the biggest market for turtle is West Germany.

The life cycle of the Tortuguero nesting colony is the best known of any population. Costa Rica has the only green turtle breeding ground remaining in the Western Caribbean; and the Nicaraguan pastures are populated by turtles that hatched on the Costa Rican shore. Through the failure of the three countries to ratify the agreement, the uncontrolled exploitation is bound to be reflected in a decline of the available resource. Nicaragua and Costa Rica are depriving their coastal populations of the turtles they desperately need, while at the same time promoting an export industry that is bound to exhaust the resource.
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APPENDIX: POTENTIAL AND ACTUAL LAND USE MAPS

A very useful tool for studying the types of land-use in a region is an actual land use map. Such a map will provide a quick overview of what exists in the region and suggest trends in land-use activities. For plans to develop the region optimally, a potential land-use map is necessary. It marks out areas best suited for a particular crop based on the soil, climate, temperature, and rainfall data. Potential land-use maps can be used for other purposes, such as urban planning on lands not suited for agriculture, transportation planning, etc.

A tentative actual land-use map and a potential land-use map were prepared to assist the team in its efforts to broadly study the development potential in the region. This was necessary because the available maps were either outdated or incomplete. The maps prepared by the team were to meet a particular need in the study. In view of the short time available to prepare the maps and the fact that soil data for large sections of the region are still not available, the maps should be considered as tentative. Although the maps were adequate for the study, a detailed potential land-use map, which might take more than a year to complete, should be prepared as soon as possible.

There were two sets of aerial photographs of the region taken by the Instituto Geographico Nacional about 10 years apart. These photographs provided valuable information to prepare the actual land-use map. The first set of aerial photographs was taken in 1960 to a scale of 1:60,000; the second set, taken during 1970 to 1973, covered most of the same region and was on a scale of 1:20,000. Using the two sets of photographs, it was possible to determine the trends in agricultural activities over a 10-year span. Identifying cacao plantations from the photographs was particularly difficult since the forest shades formed a complete cover, especially in the case of abandoned plantations. In such cases, the team visited the sites, talked to the farmers and the agricultural extension agents of the Ministry of Agriculture, and jointly delineated areas that were in doubt. Aerial photographs were not available for the entire region, forcing the team to rely solely on field data in some cases.

On the map, areas delineated with solid black lines are areas for which aerial photographs were available and which were confirmed by visits to sites. The dotted lines indicate regions for which aerial photographs were not available, where the team had to rely on information from the farmers and extension agents at the sites. During this study it was possible to gather information on particular crops that were tried in certain areas and later abandoned due to a host of different reasons, among them the unsuitability of the land for the particular crop. If a potential land-use map were available, it would have been
possible to predict failures if crops unsuited to a particular area were planted in that area.

The potential land-use map was prepared by superimposing three maps for the region: a relief map, a soils map, and an ecological life zone map prepared by Tosi and Holdridge. The potential land use map was first drawn on maps of 1:50,000 scale and then reduced to 1:200,000 scale. The specific maps used were:

1. Nuhn and Perez--Estudio Geographico Regional ITCO, Map 11, a Soils Map (1967)


The potential land-use map was useful in identifying areas best suited for the production of a particular type of agriculture, production forest, pastures, perennial, or annual crops. An area classified as annual crop on the map signifies clean tillage and the most intensive use of the land without ecological damage to the area. Once the agronomic potential of the region is evaluated, it will be necessary to assess economic factors to justify selection of a particular crop for a given area so that the agricultural activity and the consequent benefit to the region would be optimal.

It should be noted that the Talamanca area is left blank, because no soils data are available for this region.

A copy of the actual land-use map and the potential land-use map are furnished with this report.
POTENTIAL LAND USE MAP
LIMON PROVINCE, COSTA RICA
OCTOBER, 1973

(1) Annual crops
(2) Perennial crops
(f) Production forest
(s) Production forest or unstable land
(A) Appropriate for pasture
(*) Maximum use potential with the introduction of new techniques or intensification of culture & management
(+) Highly technical water control works necessary on minor scale
(++) Highly technical water control works necessary on major scale
(Listings with two figures (e.g. - aA, A) signify the area contains predominantly the first figure with smaller areas of the second)

Area delineated with information from soil maps
--- Area delineated without information from soil map