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No. 23

(The Geography of the Soils of Colombia)

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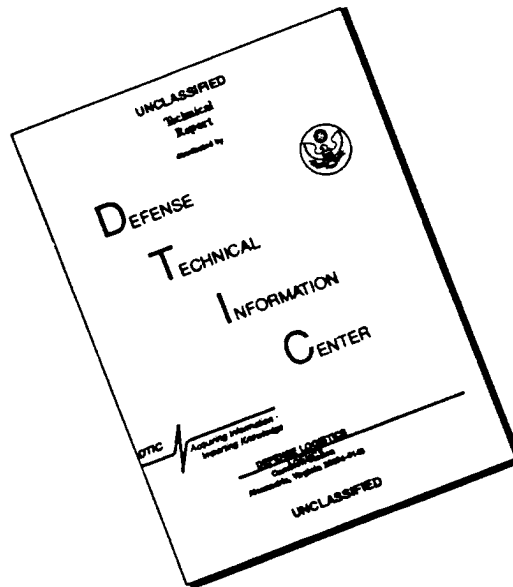
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ECONOMIC AND GEOGRAPHIC TRANSLATIONS
ON LATIN AMERICA

No. 23

COLOMBIA

Geographic

THE GEOGRAPHY OF THE SOILS OF COLOMBIA

[Following is a translation of excerpts from a study by Joaquin Alvarez Lievano and Hernando Suarez Fajardo, Agrologists, entitled "Contribution to the Study of the Geography of the Soils of Colombia," in the Spanish-language periodical Boletin de la Sociedad Geografica de Colombia (Bulletin of the Geographic Society of Colombia), published by the Academy of Geographical Sciences, Vol XXIII, Nos 85 and 86, Bogota, 1st and 2nd quarters of 1965, pages 12-45 and 67-77.]

CHAPTER I

General

Special Comisaria of Vichada - This comisaria has an extension of 102,990 square kilometers and a 1959 population estimated at 14,830 inhabitants, which means a density of 0.149 inhabitants per square kilometer with an annual geometric increase of 23.99%. According to data obtained in this territory this year, the total population of the Comisaria consists of some 40,000 inhabitants, classified as follows: 10,000 civilized and 30,000 natives consisting of the Guajiba, Saliva, Sicuane, Piapoco, Amorua and Cuiba tribes. The result of the census held last year in this country (1964) definitely allocated to the Comisaria 10,130 inhabitants of which 1,449 live in the capital Puerto Carreno.

Its borders are the following: in the North the Republic of Venezuela, consisting of the Rio Meta, State of Tachira; in the South the new Comisaria of Guania; in the East again the Republic of Venezuela, with the Rio Orinoco, Federal Amazonas Territory; and in the west the Department of Meta.

The Comisaria has a total perimeter of 1,512 kilometers which breaks down as follows:

Department of Boyaca	198 kilometers
Department of Meta	246 kilometers
Republic of Venezuela	510 kilometers
Intendencia (District) of Arauca	42 kilometers
Comisaria of Guania	516 kilometers

The following natural regions exist in this territory:

- a) The forest region which is a continuation of the Vaupes forests, and is the largest with respect to the others, being located along the Vaupes river and the Colombian headwaters of the Orinoquia, containing its corresponding affluents.
- b) Transition region, which includes the right-bank affluents of the Vichada river.
- c) The region of the prairie itself, with terraced forests and natural savannas which occupies the largest portion, approximately three quarters of the total area of the Comisaria.

Political Division - Administratively, the Comisaria is divided into the following districts and police precincts:

- 1. Corregimiento of Puerto Carreno.
- 2. Corregimiento of Casuarito.
- 3. Corregimiento of Nueva Antioquia
- 4. Corregimiento of Puerto Narino
- 5. Corregimiento of Amanaben.
- 6. Corregimiento of San Jose of Ocune
- 7. Corregimiento of Puerto Murillo
- 8. Police Precinct of Avispas
- 9. Police Precinct of Santa Rita.
- 10. Police Precinct of Cumaribo.

The present exploratory study of territories includes those of the corregimientos of Puerto Carreno and Casuarito, and the San Rafael de Murillo settlement. Furthermore, data will be provided regarding the marginal zone of Rio Meta since this is the one which offers the greatest opportunities for colonization.

1) Corregimiento of Puerto Carreno. - This is the capital of the Comisaria and it has a population of 1,040 civilized inhabitants. The Corregimiento is frequently invaded by nomad Guajibo Indians who make their incursions especially during the mango harvest.

The jurisdiction includes two capitánias, one of them in the El Morichal del Avion settlement, some 230 kilometers from Carreno on the road to Villavicencio; the second one is near the other in a place called Carro Quemado at a distance of 250 kilometers from Carreno along the same road.

Borders. - The capital borders in the north on the Meta River; in the south on the Bitá River; in the east on the Orinoco River and in the west on the Cano Juriepe.

Population - The last census recorded 1,040 civilized inhabitants engaged in the following occupations:

- 10% in commerce.
- 15% are employees and workers.
- 20% in domestic occupations.
- 20% in agriculture, livestock farming and fishing.
- 35% are children.

Education - The Corregimiento has an educational plant of the mixed type which provides primary education to 380 students, 25 of whom are natives. Presently a comfortable and large building is being erected to provide a boarding school for approximately 250 students and the influx of Venezuelan students is predicted, especially from Puerto Ayacucho, Caicara, Puerto Paez, etc., population centers where an excellent opinion regarding the education provided by this country prevails.

Public Services - The capital obtains its water from the Rio Orinoco, thanks to a motorized pump and an aqueduct which is insufficient due to the recent population growth. Similarly, there is an electric power plant which generates 60 kilowatts which is insufficient for lighting and the other needs of the population. Furthermore, there is an average-sized hospital, with two doctors and three nurses with a 15-bed capacity and provisions for future expansion.

Markets and Commerce - Not only Puerto Carreno, but also the population centers surrounding the capital purchase Venezuelan products such as imported canned goods, bicycles, outboard motors, radios, typewriters, refrigerators, china, etc., and food such as rice, dough, flour, condensed milk, and other products. These commercial operations are transacted whenever the currency exchange is favorable, i.e., when the bolivar does not reach three Colombian pesos.

Otherwise, all these products are bought in Villavicencio and Bogota. Construction materials such as tile, cement, wire, etc., are brought in from Bogota because they are cheaper and of better quality. Currently a kiln is being adapted to bake tiles which, together with the cement block factory already in existence, will constitute a very important and prosperous industry.

Corregimiento of Casuarito - This corregimiento is 77 kilometers away from Puerto Carreno, and lies on the left bank of the Orinoco River facing Puerto Ayacucho, the capital of the Federal Amazonas Territory, Venezuela.

It houses about 100 inhabitants who live exclusively on trade with Venezuela, which consists of the sale of cloth, cigarettes, leather goods, etc.

Casuarito is located on a rocky formation of pegmatite, whose hardness prevents the construction of roads, sewers, aqueducts, etc. The fact that it is located here is due to the ease with which commercial trade with Puerto Ayacucho is carried on, since its progress depends on it. For the future, it will be necessary to transfer the corregimiento one kilometer toward the prairie where topographic and geological conditions permit the easy installation of various public services.

The corregimiento also has a landing strip which is poorly located, not permitting safe landings, with more adequate locations being some three kilometers away from the population center.

It is not exactly known what the native population of the district is, but it must be quite numerous and they live under conditions of complete abandon.

The only services available in the corregimiento are limited to those provided by one school and one 12-kilowatt electric power plant.

3) San Rafael de Murillo Settlement - This is a small settlement located on the right margin of the Meta River, which had a great farming and livestock-raising activity when it was inhabited by Venezuelan colonists several lustros ago. [One lustro equals five years.] Presently it is only a small population center, beginning again to be colonized.

General Aspects of the Zone Under Study

Location - The zone being studied is lined out on the map which has been included in the present article and includes the triangle formed by Puerto Carreno, Casuarito and San Rafael de Murillo. It should be noted that the maps made by the specialized institutions on this subject are completely in error and contain many faults. Thanks to the cooperation of the Santa Teresita Mission, we were able to prepare a map which, reduced to scale, gives us the basic features, especially those related to hydrography, usable roads, and the most important population centers of the Comisaria.

Puerto Carreno is the capital of the Comisaria and it is separated from the Puerto Paez District by the Meta River. It has an average temperature of 30°C, an elevation above sea level of 95 meters, and it is separated from Bogota by a distance of 1,000 kilometers and from Villavicencio by 880 kilometers by road. The corresponding coordinates are:

6°11'00" Latitude north; and
6°29'00" Longitude east from Bogota.

Casuarito is located on the left margin of the Orinoco River and faces Puerto Ayacucho, the capital of the Federal State of Amazonas, Venezuela. Its coordinates are:

5°39'00" Latitude north; and
6°28'00" Longitude east of Bogota.

San Rafael de Murillo is the most important population center of the region on the right-hand margin of the Meta River. The coordinates are:

6°11'00" Latitude north; and
6°16'00" Longitude east of Bogota.

Lines of Communication -

By Land - Puerto Carreno is connected to the interior of the country by the road which connects Puerto Lopez to Villavicencio between the Meta and Bitu Rivers. This road is only in service during the summer months, between December and mid-April. The main interruption occurs in the winter and affects the La Culebra depression which is approximately 27 kilometers long. According to the colonists, this depression could be avoided if the road were to be diverted toward the east of the Muko Canyon. It would be necessary to build a bridge over this canyon, which would permit the road to run

closer to the right bank of the Meta River. Otherwise, and in order to make the road passable during the winter, it would be necessary to fill the entire 27 kilometers of the La Culebra depression, a project which would probably be more costly.

By River - Puerto Carreno is connected to Puerto Lopez and intermediate settlements located on the Meta River by river navigation which is regular and continues during the winter, i.e., from mid-April to early December. During the summer, navigation by launch and "curiaras" (long sailing canoe) is possible only with great difficulty.

Puerto Carreno is connected in the south with corregimientos such as Casuarito, Puerto Narino, Amanaben, and Santa Rita, by way of the Orinoco, Vichada and Tomo Rivers, as follows: Navigation to Casuarito is continuous and uninterrupted throughout the year and proceeds by way of the Orinoco River;

In Amanaben and Puerto Narino it is necessary to avoid the rapids of Atures and Rabi Pelado by means of a paved road which connects Puerto Ayacucho to Sanariapo, entirely built on Venezuelan territory, a fact which for obvious reasons implies a series of borderline difficulties.

Communications with Santa Rita are maintained by way of the Orinoco and Vichada rivers, avoiding the same obstacle presented by the rapids, by way of the same road;

Communications with Cumaribó, Santa Teresita, Guacamayas and other settlements are possible via the Orinoco-Tomo, up to the merger with the central road which connects Santa Rita to Villavicencio. Presently, this is a road which is passable in the summer.

Puerto Carreno communicates with the interior of Venezuela, particularly with the important city of Ciudad Bolivar, by way of the Orinoco River, whose length can be navigated in 30 hours.

It should be noted that the Bitá River, which delivers its water one kilometer from Puerto Carreno, is navigable during the winter, but presently it is not being used since there is no settlement along its banks. Nevertheless, there are some tribes along the banks of this

river who, according to the colonists, are hostile and attack the ships which sometimes travel there, primarily in search of salt.

Airline Service - The Comisaria, in general, and particularly Puerto Carreno, maintains communications with the interior of the country by way of a patriotic and efficient service rendered presently by the SATENA Airline. There are regularly scheduled flights to the various zones which will soon be augmented; this step is due to the fact that the present services are inadequate for the continuous and progressive increase these federal zones have experienced.

Radio Communications - Telegraph service rendered by the Empresa Nacional de Telecomunicaciones (National Telecommunications Company) is available. Furthermore, the government ministry is in direct communications with the authorities of the Comisaria by way of radio-telephone. This service is provided directly from that ministry. Several corregimientos and military outposts use this same means of communications.

CHAPTER II

PHYSIOGRAPHY

TO 11

The most important physiographic characteristic is the prairie proper and it consists of high, medium and low terraces, plains and meadows of alluvial origin.

The existing variations between these units are very slight, especially with respect to the high, medium and low terraces, in contrast with the Eastern Plains, where they are more pronounced and therefore easier recognized.

Some of the characteristics of these physiographic units are the following:

Upper Terrace - Undoubtedly the most sterile, it is covered with natural savannas with grass species such as:

- "Pasto cadillo", *Dichromena ciliata* Vahl
- "Pasto espiga", *Leptocorypheum lanatum*
(H.B.K.) Nees, or "Pasto Saeta",
- "Pasto paja", *Bulbostylis junciformis* (H.B.K.) Kunth.
- "Pasto virola", *Cyperus* species.

These species in general are of a poor quality to raise and fatten cattle.

Middle terrace - the same may be said for the middle terrace as has been said for the preceding unit, because the changes are very imperceptible. This is where the springs are; the grass species of this unit, in addition to those already listed, are:

"Pasto carrizo", indeterminable sterile material.
"Pasto grasa", sterile.

The arboreal vegetation consisting exclusively of evergreen oaks in whose shade various shrub species grow, the majority of which, of the thorny kind, are a manifestation of the microclimate generated by this shade. If it were not for the constant scorching to which the prairies have been subjected, its ecology would be quite distinct. The scorching completely altered all the factors which constitute the habitat.

The texture of the soil of this terrace varies slightly from the clayey sandstone, characteristic of the upper terrace, to the fine sandstone.

Lower Terrace - This is the third physiographic unit present in this zone and it offers two important aspects:

a) Greater density and succulence of natural pasture lands consisting of some of these species already listed under the previous units and those characteristic of this unit:

"Pasto alpara", unclassified.
"Pasto negro", unclassified.
"Pasto Mono", unclassified.
"Pasto gustoso", *Azonopus purpusi* (Mez) Chase.

Some shrubbery, among which,

"El Acato", Flacourtiaceae.
"Cafeto", *Connarus* species.
"Mirtillo", Flacourtiaceae, etc.

begin to manifest themselves in the lower terrace.

b) The presence of a superficial crust of ferruginous material in the form of small grains formed by dissolution which has consolidated around a sand or pollen nucleus.

The soils are similar to the previous unit with a greater loam content.

Plain - Well-defined by its vegetation, texture and the structure of its soil, it has a potential fertility much more suitable for agriculture and livestock farming than the units already listed. The normal river beds are not only flooded, but are also susceptible to abnormal

swellings which appear with regularity every seven years. This is where the most solid forest with reed and climbing plants develops. Its grazing lands are also different since they are of better quality for the cattle and have more substance.

The soil texture of this unit varies between frankly loamy and frankly sandy and a horizontal sedimentation is noted in its profile, generated by the river floods which indicates to us that this unit was submersed under the river waters until relatively recent times. The same terraces indicate the various development periods of the river beds.

This unit extends and is parallel to the rivers and streams along a narrow strip.

Swamp - This is the last physiographic unit whose level is slightly above that of the streams and river and consequently may be flooded by any type of swelling.

Its vegetation, due to being frequently flooded, is limited to weeds and some shrubs. The main pasture is the "gramalote," the favorite food of the capybara. The soil texture is quite loamy, exceeding 1.50 meters in depth.

CHAPTER III

CLIMATE

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The climate is one of the most important factors in agriculture, since it provides us with a very valuable set of data which allow us to derive and understand aspects of vital importance to determine the planned development of the land.

In this report we were unable to obtain data with the accuracy required by this sort of work, due to the fact that in the region under study there is no meteorological station collecting pluviometric data, distribution of daylight, etc., so necessary to be able to calculate the needs of the various crops in accordance with the planned development program.

Nevertheless, thanks to data collected in the City of Puerto Ayacucho and thanks to the information furnished by the inhabitants of the region, certain estimates were derived which are probably close to reality.

Precipitation - There are two well-defined seasons regarding the distribution of precipitation:

a) The rainy season which begins in mid-April and extends to late November.

b) The summer season which begins in December and ends in mid-April.

July is the transition month between the seasons.

In the meteorological station in Puerto Ayacucho, some 77 kilometers from Puerto Carreno and 140 kilometers from San Rafael de Murillo, the following annual precipitation data were obtained:

2,200 millimeters.

The situation of Casuarito with respect to Puerto Ayacucho permits us to assign to this zone a precipitation equal to that recorded earlier, since both are located on one of the vertices of the triangle under study. The other two vertices, due to being relatively close to Puerto Ayacucho, have a precipitation which closely approaches that of Puerto Ayacucho.

Temperature - There are two definite seasons, the summer, whose maximum temperature reaches 43°C and whose minimum temperature is 32°C . Winter has a maximum of 35°C and a minimum of 25°C .

There are no abrupt changes in temperature, it varies slowly, which permits this region to enjoy a dry and excellent climate.

Winds - By direct and continuous observations made during the period when this study was being prepared, it can be stated that the winds during this period -- December to March -- come from the north and are trade winds. These deductions may be established by means of arranging certain devices located at the airport and by the displacement and direction taken by the smoke, very abundant during this season, which results from the burning activities.

Winds are constant and do not change greatly in intensity, velocity and direction.

Since temperature, clouds, the amount of solar radiation, the geomorphology, and winds are intimately related to the physiological and metabolic processes in plants, and since throughout the zone of Carreno, Ventanas, Casuarito, San Rafael and la Pinzonera, the presence of clouds is absolutely nil during this season, providing for a direct and very high radiation rate which totally or partially dehydrates the vegetation, we are led to believe that the potential evaporation is much higher than annual precipitation.

Evaporation-Transpiration - For the reasons given above and other external factors, such as vapor pressure, relative humidity, CO₂ saturation and its balance with oxygen, we are led to conclude safely that the transpiration gradient of the zone under study is extremely high.

Not all the water absorbed by the roots for metabolic action in the plants is retained by them, but the exposed organs do their part, such as leaves, through which it passes into the atmosphere. This process is the result of an infinity of factors both internal and external, the former being the anatomic characteristics of the plant and the latter due to the physical characteristics mentioned earlier.

The amount of water absorbed from the soil by a vegetable is very large if it is compared to what the plant contains at any instant, and the ratio of this absorbed amount to that retained by the plant varies according to the species and internal and external factors. When this ratio exceeds the decay coefficient, the plant dies, i.e., if the rate at which the leaves deliver water to the atmosphere > the rate at which the roots absorb it from the soil. The leaves gradually lose their fullness and consistency until death occurs.

In the Vichada plains, where evaporation is especially intense during the summer season, factors which lead to a drying out of natural pastures and crops appear to combine as we note in the Photograph number 4. Dehydration of the grazing land is one of the reasons why the colonists subject savannas to regular burning to obtain tender, digestible and protein-rich pasture land. This pasture land does not dry out so readily, among others, due to the small foliage surface exposed to sunrays. As we know, the leaf is the exposed part, specializing in the photosynthetic process and its anatomy is designed accordingly, so that its cells occupy a greater surface to absorb light and maintain contact with CO₂ and oxygen; this anatomic configuration, so useful to the processing of carbohydrates, is absolutely harmful in the case of transpiration, permitting a maximum of evaporation and transpiration.

One of the other important factors which have led us to confirm the high gradient of evaporation-transpiration in this zone, is the low concentration of dissolved material;

in view of the nature of the soil, very poor in colloidal substance, it is reasonable to assume that this situation must prevail. The low saturation of dissolved material enhances the transpiration rate; nevertheless, the few dissolved substances continue to concentrate in the protoplasm to cooperate in the acceleration of the drying process of the plant.

It would be very interesting to investigate if the concentration of the substances is one of the primary impediments causing the cattle not to like the grazing land under these conditions. This is the case of the evergreen oak leaves which have such a concentration of substances that it results in a roughness similar to sandpaper and which is therefore used to clean dishes. This same fact may affect the accelerated wear of cattle dentures.

For future irrigation plans, this evaporation-transpiration phenomenon will play a role of vital importance in the calculations, due to the consequences which may result if it is not taken into account.

CHAPTER IV

GEOLOGY

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Due to the fact that in our country knowledge regarding geology and geomorphology, useful in the agrological field, are extremely limited, since we only have general geological maps on scales varying from 1:200,000 to 1:1,000,000, a geological description of this zone is very difficult for us. For the reasons given above, we are unable to give an accurate geological description, especially since this region is not represented on the geological charts of the country.

Nevertheless, based on the drainage system which predominates, we are able to note that this zone corresponds to an orognosy which, due to its complete uniformity, leads to the unrelated belief that the geology on which it is based is also rigorously uniform. On this homogeneous geology the finer sediments coming from the Cordillera Oriental were deposited, having been brought here by the rivers.

The erosion of the cordillera (mountain chain) has been the result of the rise of the tertiary and the quaternary. This erosive process of the ter iari formed the pleistocene deposits of the prairies which consist of finer or heavier materials depending on the distance they are located from the cordillera. The fact that the soil of the zone under study is of a general sandstone texture is due to the fact that the fine material dragged here from the cordillera has been lixiviated and is found in the lower layers.

The water streams called channels ["Caños"] originate in the same plain, but are found at a greater distance than in the middle of the plains.

The terraces mentioned in the chapter on Physiography consist of a fine sandy gravel base and their gradient is

very mild and uniform, ranging from zero to one percent. The soil fertility is a function of the level of the terraces, which are less fertile, the higher up they are located.

Similar to drainage, the upper terraces are better drained than the lower ones.

One of the more interesting aspects of the geology of this zone is the formation of arrecife (reef). This is characteristic of tropical regions with definite dry and humid seasons, such as Puerto Carreno, Casuarito, San Rafael and La Pinzonera. This arrecife, which has a concretionary aspect and occurs in large deposits, originates according to the following chemical process:

a) During the dry season, the humidity of the soil concentrates and rises to the surface in order to evaporate;

b) There occurs the precipitation of the materials in solution, which remain on the surface;

c) The chemical reaction which generally follows is of an irreversible order, which permits the accumulation of this concretionary material forming the arrecife.

In a study regarding Venezuelan plains, performed by Augusto Bonazzi, in order to determine the origin of the various red soils present in the prairie, he arrived at the conclusion that "Many of them rest on consolidated ferruginous horizontal stretches known in the region under the designation of 'arrecife'." Bonazzi also determined that "Elsewhere where strong rainy seasons alternate with extremely dry seasons, this structure appears to be in the process of formation."

In the zone under study, as we noted before, this formation is present and it emerges occasionally. In some limestone areas it reached a depth of 1.2 and 2.50 meters, as shown by profile number 12, on a ranch called "La Cabana," and on number 18, near Casuarito, on the "Tanumana" ranch.

It may be anticipated that this same arrecife is present in the savannas of the Tomo and Tuparro rivers and Bonazzi defines them as "A concretionary vesicular mass of the pleistocene." The climatological conditions found by this author near Calabozo are very similar to those found in Puerto Carreno, Casuarito, San Rafael, i.e., well-defined

intensive rainy seasons and extreme droughts. According to that study, these conglomerates "are formed by silicon fragments rounded by their water movement, adhering to each other due to an iron oxide cement which was allegedly deposited in successive layers on the surface of this gravel" and he added that this is "a ferruginous which may have several origins, among which the most frequent ones are:

a) A reddening of the soil due to superficial lixiviation;

b) The 'in situ' ferretization in hydromorphous profiles which leads to concrete-like neoformations in the profile mass;

c) Subaerial lateritic alterations in their more restricted sense."

The author makes some scientific evaluations in his search for other possibilities and adds "due to observations and analyses made on the Calabozo arrecife which proves the presence of abundant spores, grains of pollen, fragments of leaf residues, all exposed organs of the plants, and within the ferruginous mass, without taking into account the numerous root fragments, indicate that the Calabozo arrecife was formed under conditions under which ferruginous accumulation was able to trap and imprison these exposed vegetable fragments, because it proceeded continuously on a surface susceptible of receiving these residues. The ultimate consolidation occurred when the successive layers of aggregate deposited on top of the earlier aggregates. The very nature of the pollen, of the leaf residues (cryptogam foilage) and of the abundant spores tends to indicate that this arrecife formed under underwater marshy conditions during which probably the bacterial flora of the iron age was active."

Along these ideas, Dr. Bonazzi arrived at the conclusion that "The arrecife is not a laterite 'sensu strictu,' but a succession of more or less thick cemented layers and that each one of them formed above the previous one due to the dissolved iron precipitation on the marshy acid waters, thanks to biochemical action, which soon caught the aerial vegetal spores and tissues which had fallen from the plants into the water during the process of iron deposit." He added that by "impregnation with the recently precipitated iron oxide, this vegetal tissue becomes an integral part of

the arrecife forming on the bottom of the marsh. "Many grains of pollen and tissue fragments permitted him to state that they were impregnated with iron, even after the treatment administered to isolate them."

He also added that "The black or dark blue small granules found abundantly in the flooded soil of the plain, lend support to the hypothesis and so does the presence of small amounts of phosphorus (P_2O_5) which is distributed irregularly on this arrecife: a phosphorus very likely derived from the cellular content of bacteria, fungus, pollen and hidden leaf residue.

Other formations of this arrecife are Fe_2O_3 , ferric oxide; Al_2O_3 , aluminum oxide; SiO_2 , silicon; CaO , calcium oxide; and K_2O , potassium oxide." Finally, the author says, upon concluding his interesting study, that "future statistical studies will clarify the climate and ecology during the formation period of the 'arrecife.'"

In addition to the formation mentioned above, there is a 'sienite' and granite rock formation along the Orinoco River.

CHAPTER V

SOIL

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There existed a need to make a very quick analysis of the zone, leading to an exploratory survey of the soil of the area enclosed by the triangle which is the object of this study. During this work, special attention was given to delimiting "grosso modo" the zones which offer the best possibilities and which, due to special qualities, may have a magnificent future. Furthermore, this effort, once all the information has been collected, may be a guide for future more detailed studies.

It should be kept in mind that when carrying out specific agricultural programs, this requires the study of soils of a preliminary and general nature, with special attention given to those zones which, due to their agricultural and economic qualities, may be potentially productive.

This exploratory survey, as we may have assumed, undoubtedly requires and justifies formulating approximate judgments regarding the agricultural potential of the zone, and in our opinion these regions will within a short period of time play a role of vital importance in the country's economy. These are terrains which are undergoing the same development process which the plains of the present department of Meta experienced no more than 15 to 20 years ago. This same process will occur in Vichada, but evidently it will develop more rapidly because the present socioeconomic conditions of the country are demanding this. Furthermore, the progress achieved in agricultural technology may accelerate this process.

Based on the seventh approximation, we have tried to suggest the classes of soil found there, which is approximate, especially since tropical and sub-tropical soils were investigated. This is the case of the oxisoils which were studied only up to more or less the third approximation.

Due to the characteristics of the soils and their corresponding exploration, we believe that three types exist in the Puerto Carreno-Casuarito-San Rafael zone:

1. Ultisoils.
2. Oxisoils.
3. Entisoils.

Next, let us give the characteristics of each of these soils, which have led us to make the following statement:

Ultisoils - This soil is shown in profile number 4 -- El Meroy settlement -- whose general characteristics are that it has a slightly argile horizon, characterized by the removal of the upper and lower horizon clay by way of a process called illuviation: It also has an umbric epipedon characterized by its dark color, very likely due to the organic carbon. These soils contain no indications of meteorizable minerals in the loam and clay fractions. With respect to the base saturation, it was not feasible to obtain laboratory data necessary to confirm this arrangement. This soil, in general, is found on the lower terraces at some distance from the rivers.

Oxisoils - This type includes soils designated as lato soils of the recent classifications but preceding the seventh approximation. They appear to be the most abundant ones in the region and are characterized by an ocric epipedon, i.e., light colors, containing very little organic matter, which includes the superficial horizon. The clay horizon which is one of the characteristics of the oxisoils, is not represented but, in turn, the hardened plintite is abundant on the surface and it is soft whenever it is found at lower depths.

We will make reference to some theories proposed by several authors with respect to these soils, whose references permit us to make very important comparisons.

"H. Harrassowitz gave a description of a typical laterite profile and presents some of the principal characteristics of this group of soils. According to this author,

the profile consists of four horizons:

"Mother rock, which is followed by a horizon which represents the primary meteorization material of a kaolinitic nature, followed by a third lateritic horizon which becomes a superficial horizon characterized by crusts and ferruginous concretions. The decomposition may be a very thin film or it may reach a thickness of one meter or more. The superficial ferruginous crust may develop so much that it may prevent vegetation growth."

The ferruginous crust to which this author refers can be found in many places and is found with abundant details on the Tanumana farm.

"G. C. Stephens, studying the edafogenesis in the laterite formation felt that the laterites developed during the tertiari." See the chapter on geology of the present study.

Other authors, such as Hardy and R. R. Follett-Smith, describing a profile in British Guayana, found the following four horizons:

1. Frequently, vesicular superficial laterite and fiderite, which breaks up into blocks on the surface.
2. Surface soil. Grayish red humus clay; 20 centimeters.
3. Tawny brittle red earth, with gravel, especially on the top part. The gravel consists of pieces of laterite, large lentils of fiderite, and fragments of quartz; they are 3 to 6 meters thick.
4. Hard and crusty primary red laterite, 7 centimeters thick, on a surface of broken rock."

The descriptions provided by the authors above and contained in the Robinson Book on Soils correspond to the tropics and combine in general the same characteristics of a climatological and quite possibly of a geomorphological order of the Colombian Orinoco region.

Hardy's description, for example, covers an area approximately 800 kilometers from Puerto Carreno; Bonazzi's studies on the Calabozo prairies were made only 300 kilometers from that city; the richest iron ore deposits in the Orinoco hydrographic basin, at Imataca, are located 650 kilometers from Carreno; the San Felipe deposits, which are

located only 450 kilometers from Carreno, permitted us to ask some questions which lead us to believe that the Orinoco plains may contain incalculable deposits of this ore (iron), since these characteristics were noted in this triangle; it has been well documented that this zone belongs to the same hydrographic basin of the Imataca and the Calabozo plains are a continuation of the Colombian prairie. What has been said about iron may also be said about industrial diamonds which are being exploited by Venezuela.

Now then, the profiles described by Hardy and Follet-Smith are very similar to those described near Casuarito, Puerto Carreno, San Rafael and Pinzonera, which are included in this report. Furthermore, the ferrolitic concretions described by Hardy, Follet-Smith and Bonazzi are characteristic of this entire zone.

Entisoils - The plagic horizon which is so representative in this class, was not found, but in turn we found a whitish horizon which is the one from which the clay and the free iron oxides have been lixiviated, it being represented primarily by sand particles and primary limestone. This characteristic is found well defined in the soils. This whitish (albic) horizon is found on the surface primarily on top of a mineral soil. Furthermore, it is possible that the wind has acted on this horizon, a detail which is very characteristic of entisoils.

In these soils, during the winter, (April to November), we find a rock washed by infiltration water, which causes an impoverishment of the foundations and which acidifies even more the profile, which leads to an instability of the clay complex. This does not occur during the summer, because due to the high temperature evaporation is so strong that the soil dries down to a considerable depth.

Just as plintite was found in the oxisoils of the zone, the entisoil was found, however, in smaller amounts.

Another one of the characteristics found was that the parental material of the representative locations lies at a great depth.

CHAPTER VI

HYDROGRAPHY

All the data related to the hydrography of the plains play an important role since due to their special characteristics of a physiographic, geomorphological, etc., order, they cause these zones to be subject to periodic flooding.

Since no river gauge data are available, it is impossible to correlate the maximum and minimum water levels of the rivers crossing this zone.

To obtain indirect control of the hydrological regime of the rivers originating in the Cordillera Oriental, and those which originate in the plain, it would be necessary to begin to perform and extend the studies to all the tributaries of each one of these major rivers, thus establishing adequate flood and erosion control. These hydrological studies are very extensive, covering aspects such as level readings, evaporation, infiltration, calculations, pluviometric data, quality and amounts available for irrigation, reforestation of the slopes, etc.; this by no means says that all these tests cannot be made. Let us hope that very soon the governments and specialized private companies carry out these large-scale projects for the benefit of the plains of Vichada and, in general, of the Oriental plains.

The zone covered by this study is crossed by large rivers such as the Orinoco and the Meta rivers. It is also crossed by the most beautiful Rio Bitá and many rivers of great water content, such as the Cano Guaripa, the Cano La Meseta, the Cano Negro, the Cano Umirica and others. Some 15 kilometers from the mouth of the Rio Bitá there are the Tres Matas and Coco de Mono lakes, whose principal characteristics are that they contain enormous amounts of water

and a great ichthyological wealth. These lakes are an indication of the depth of this phreatic level which for the upper terrace is some eight meters deep during the season of greatest drought.

CHAPTER VII

IRRIGATION

TO 23

In general, the Vichada plains, but especially the zone of the present study have enormous amounts of water at all times which can be used for irrigation, as substantiated by analyses of the Bitá and Orinoco rivers which cross and touch upon the Vichada plain. One irrigation district of this zone soon will become indispensable and its charges will be less than those usually made for this type of work, in view of the completely level topography and the relative closeness of the rivers to each other.

The most appropriate method will be provided by a more specific study of this region. Nevertheless, under the function of the physical-chemical analysis aimed at agriculture and livestock raising, it may be anticipated that an aspersion-type irrigation will be the most suitable due to the general sandstone structure; another system that has occurred to us might wash away the fertilizer and basic constituents, which by themselves are very scarce in this soil.

Next we will show the result of an analysis of the Rio Bitá water made by the National Chemical Laboratory:

SiO ₂ Turbidity	7.00 mg/liter
Potentiometric pH at 20°C	7.20
Specific conductivity at 25°C	25 micromhos cm ⁻¹
Total hardness, E.D.T.A. in CaCO ₃	10.44 mg/liter
Orange Methyl alkalinity in CaCO ₃	15.00 mg/liter
Phenophtalein alkalinity	negative
Carbonates	negative
Bicarbonate in HCO ₃	16.30 mg/liter
Chloride in Cl	traces

Sulfides	negative
Sulfates in SO ₄	0.50 mg/liter
Nitrites	negative
NO ₃ nitrates	1.00 mg/liter
Silicon in SiO ₂ solution	13.50 mg/liter
Total iron content in Fe	0.75 mg/liter
Iron in Fe solution	0.30 mg/liter
Calcium in Ca	1.93 mg/liter
Magnesium in Mg	1.37 mg/liter
Ammonium	negative
Sodium in Na	0.92 mg/liter
Potassium	negative
Free CO ₂	2.00 mg/liter
Free Chloride	negative
Absorption ratio of RAS sodium	0.12
Classification for irrigation	Co-S1
Total solid evaporation at 105°C	50.00 mg/liter
Solids in solution, evaporation at 105°C	40.00 mg/liter
Solids in suspension (difference).	10.00 mg/liter

NOTE: Chemical potability of this water is lowered by the turbidity (limit 5 mg/liter) and by the iron content in suspension (total iron less iron in solution, limit 0.30 mg/liter).

These drawbacks may be eliminated easily by means of careful filtration.

Regarding its hardness, the water is classified as soft; for irrigation purposes, it is classified within the Co-S₁ group of low salinity and sodization risk to the soils.

We recommend bacteriological control prior to human consumption.

NATIONAL CHEMICAL LABORATORY
/s/ Alvaro Mondragon Gutierrez
Chief Chemist

DRAINAGE

The zone under study in general has good natural drainage; nevertheless, there are small strips which are flooded during the winter. If these zones are to be integrated in the country's economy, a drainage system should

be adopted. In view of the low cost of the land, open-ditch drainage would be the most indicated and economic type.

As a specific case, the following information is rendered: There is one settler who has an underground drainage system but we believe this is the least indicated due to the texture and structure of the soil which would make it a shortlived system. The settlers should be advised not to extend this method, because due to its low cost it is easy to purchase but it would not render the services expected for the reasons mentioned above.

CHAPTER VIII

ECOLOGY

The information which is conveyed in a study of this nature on natural vegetation and ecology in general provides a series of data which in association with others leads us to conclusions of vital importance to agricultural planning and development. If the natural vegetation had not been affected by human activity, which, unfortunately, is not the case in this zone due to the successive burning it has been subjected to since time immemorial, this gives us a pattern to understand better the conditions of the soil, the climate, the relative humidity, etc.

In summary, it can be said that the natural vegetation is the reflection and the true manifestation of the ambient conditions which have prevailed and which constitute an accurate pattern of the productive potential of the soil and which teaches us the basic rules to be applied in order to obtain maximum yield.

According to the L. R. Holdridge classification system, this zone, ecologically speaking, is included in the tropical dry forest, characterized by the following factors:

- "Temperature above 24°C
- "Annual rain average between 1,000 and 2,000 mm
- "Elevation above sea level, 0 to 1,000 meters
- "Savannas suitable for cattle raising and with supplementary irrigation for agriculture."

The information in this chapter is not complete because the majority of the popular names by which the various vegetal species are known in the zone has not been found in the specialized catalogs of botanical classification.

Nevertheless, the popular names known in the zone will be mentioned, as well as the scientific names wherever circumstances permit. As expected, there are more species, but only those reported to us by people who live in this region will be mentioned.

The climate has influenced very greatly the ecological character of the zone. The climatological phases, dry and humid, impressed a certain "personality" upon the region, leading to a subxerophytic vegetation, characterized by gallery-type meadows along the rivers and major streams; Savannas with natural pasture lands, generally grass-bearing; in these savannas we find small trees, especially oak (*Curatella americana*).

Another one of the factors which have had a considerable influence on the ecology of the zone is the constant scorching to which the prairie has been submitted since long ago by the natives, as well as presently by the natives and the settlers.

The principal species forming the ecology of the zone are:

Trees:

Mangos (*Mangifera indica* L.)
Cassia tree (*Anacardium occidentale* L.)
Bongo (*Canivallesia plantanifolia* H.B.K.)
Congrio (*Aristolechia* spp.)
Cork Tree (---)
Caramatale or Heart Tree (---)
Oak Tree (*Curatella americana*)
Sassafras (probablemente *Cuminum cyminum* L.)
Verraco (*Sponia micrantha* Dcne.)
Cumin Laurel (*Aniba perutilis* Hemsli)
Sarrapia (*Coumarona odorata*)
Gualanday (*Jacaranda*, spp.)
Guamo Tree (*Inga* sp.)
Chicle Tree (*Achrasapota*)
Acato Tree (*Flacourtiaceae*)
Coffee Tree (*Connarus* sp.)
Myrtle (*Flacourtiaceae*)
White Saladillo (---)
Red Saladillo (---)

Yopo (*Piptadenia peregrina*)
Guareti (---)

Palm Trees:

Palma Araco (---)
Palma de Moriche (*Mauritia minor*, Burret)
Palma de Moriche Macho (---)
Palma Macana (---)
Royal Palm (*Sheelea* spp.)
Palma de Cumare (*Astrocaryum vulgare* Mart.)
Palma de Cubarro (---)
Palma de Seje (*Jessenia polycarpa* Karst.)
Palma de Cochi (---)

Pasture Land: 1 TO 31

Pasto Cadillo (*Dichromena ciliata* Vahl)
Pasto Carrizo (---)
Thorny pasture (*Leptocorypheim lanatum* - H.B.K. - Nees)
Fat Pasture (---)
Delicious Pasture (*Axonopus purpusi* (MEZ) Chase)
Straw Pasture (*Bulbostylis junciformis* - H.B.K. - Kunth)
Pasto Virola (*Cyperus* sp.)
Pasto Saeta (---)
Pasto Betiber (---)
Pasto Yunque (---)

CHAPTER IX

FAUNA → 7032

One of the primary purposes conservationists pursue is that of rationally utilizing the natural resources of nations.

For this reason, we found the inclusion of a chapter on fauna necessary, trying to insinuate the establishment of rules governing the conservation and industrialization of the various species which, as observed in Orinoco land, are condemned to die if the abandon and indifference in this one more field of education persists. First, legislation already existent on this subject must be obeyed and specialized bodies must be created for their increment and vigilance.

The fauna of this entire zone is very interesting due to its variety and enormous wealth which lends the landscape a singular beauty.

The fauna of the Chelonians, reptiles, birds, fish, and other zoological species presently represented gives us an average idea of what the biological world of Orinoco land must have been many eons ago.

In the groves, streams, rivers, savannas, depressions, etc., there exist species such as those of the

monkeys
apes
tiger cats
gray foxes
jaguar
pumas
tapirs

wild pigs
lapas
tinajos
capybaras
water spaniels
deer
armadillos

Even more abundant and varied is the wealth of birds. The number of species with their variegated and most beautiful colors of their feathers and the melodies of their chants give these places a paradisiac aspect which may well be exploited by tourism.

Among others we have the following bird fauna:

pajuiles
turkeys (many varieties)
ducks (many varieties)
parrots
guacamayas
parakeets
royal ducks
guinea hens
garzas
garzons
pelicans
gabanes
sparrow hawks
mockingbirds
blackbirds
turpiales
gonzalitos
sangre de toro (bull's blood)
maiceros
hawks and many others

Among the fish we find an incalculable wealth which would be well worth exploiting. The scientific names were not included in view of the difficulty of their classification, owing to the popular names by which they are known in the region. The same may also be said regarding the birds and other species of the ground fauna.

Principal species:

A LIST OF THE MORE WELL KNOWN
SPECIES
FISH, FOLLOWS:

TO 36

SCALE FISH

<u>Fish</u>		<u>Kilograms</u>
Morocoto	approx. weight	6.0
morocoto piedrero	" "	0.5
cachama	" "	6.0
black cachama	" "	12.00
payara	" "	6.0
coporo (bocachico)	" "	1.00
yamu (bocon)	" "	0.5
palometa (edible fish)	" "	10.00
pavon (peacock)	" "	5.00
guabina (fresh water fish)	" "	0.5
mijo	" "	0.5
caribe burro	" "	2.0
caribe pinche	" "	0.5
caribe colorado (red caribe)	" "	0.5
arenca (herring)	" "	5.0
red tail sardine	" "	2.0
curvinata	" "	2.0
cuaracuo	" "	0.2
cabeza de manteco	" "	0.5
pampano	" "	0.5
large sardines	" "	5.0
vieja	" "	0.2
shad	" "	4.0
cucha	" "	0.3
caloche	" "	1.5
corrosco or nicure	" "	0.2
sapuhara	" "	7.0

SKIN FISH

valenton burro	approx. weight	200.0
valenton plumita	" "	60.
toruno or yellow fish	" "	60
cayaro	" "	36
snake fish	" "	5
bagre	" "	6
paleton	" "	5
manta	" "	4
mapurito	" "	2

dorado	approx. weight	40 kilograms
curito	" "	3 "
sierra	" "	25 "
manati or vaca marina	" "	220 "
barbiancho	" "	4 "
bagre tigre	" "	60 "
yaque	" "	4 "
lebranche	" "	2 "
bagre sapo	" "	2 "

The dolphin is quite abundant, a mammal of large dimensions whose anatomy is similar to that of a woman, particularly, regarding the genital organs and breasts. It is dangerous to navigate in small boats with children who cry because the dolphins believing that they are their young, cause them to get shipwrecked.

Fishing System - In general all the systems are used, but primarily the following:

1. Fish net
2. Fish hook
3. Bow and arrow (much used by the Indians)
4. Barbasco (practiced by the Indians)
5. Artificial bait
6. Harpoon and lantern during the night, especially used to catch tortoise and turtles.
7. Casting net
8. The carure, which is a device made of wood and thin reeds, and which is placed in the mouth of the rivers permitting the fish to enter but not leave.

For fishing with barbasco, the natives use special crops in their districts.

In the early days fishing with dynamite wads was used. Chinchoro fishing consists of a large net dragged by two boats moving in parallel.

In addition, there are the small irrigating canals or temblon and the tigrata skate with a 0.25 meter diameter. Cotton skate has a maximum diameter of 0.80 meters and weighs 30 kilograms. There are caymans up to 7 meters long and babillas cachirres up to 2 meters long.

This wealth calls for conservationist legislation. The quality and results of Venezuelan legislation were substantiated by the rigidity with which it is being applied, enriching and conserving the fauna of this brother country. Fishing and hunting are not forbidden, but they are based on conservationist principles.

Colombian legislation would look out for conservation, incrementation and industrialization of the autochtone species. Furthermore, the raising of certain species such as turtles, would be fomented which could be performed by a team of specialists who would conduct the biological study of the species in order for private enterprise to participate in the technical exploitation. This same group would outline parks, reserves and refuges, etc., and it would perform its administration and management.

With all this said, no one is more authorized than the Ministry of Agriculture to take the most appropriate measures: Because until now no minister has understood the importance of conservationist science and its significance to Colombia and the world.

CHAPTER XI

GEO-ECONOMIC ZONE

7039

Although the present study is limited to the Puerto Carrenio-Casuarito-San Rafael de Murillo triangle, the less fertile zone of the Comisaria, objective observations will touch upon almost all the territory of Vichada. This fact allows us to deal with the real aspects and condition of an extensive region which due to its highly favorable characteristics is justifiably considered a geo-economic zone of incalculable potential in the agricultural and cattle raising field.

The whole river banks of the Meta and Bitá rivers which run parallel, some 15 kilometers apart, offer ample and easy prospects for their immediate exploitation. This includes primarily the jurisdictional areas of Avispas and Nueva Antioquia. Avispas, for example, was only founded two years ago and has a population in excess of 1,000, the majority of whom are civilized; it has a cattle population of 45,000 head which confirms the quality of this land on the agricultural-cattle raising level.

During the last two years a progressive immigration of people and cattle coming from the Department of Meta, Boyaca, and the Arauca Intendency took place. These are people in search for a better living standard whom circumstances have brought together. This has created among them a community of interest and ideals, and it may be said that they practice collective action by which they maintain order and sanitary conditions in the urban zones; they have built their landing fields, they planted trees in the streets and they plan on other services such as the construction of roads, health centers, schools, sewers, and electric lighting with the aid of the state.

This geo-economic zone is short on river transportation service which maintains the unity of the region. Through this service the various products enter and leave, free of any taxes.

Products such as food, vegetables, garden fruit, liquor, beer, cigarettes, fabrics, cement, etc., travel via the Meta River, being sold along the river to both Colombians and Venezuelans. Frequently the transports arrive empty in Puerto Carreno, thus causing a shortage of food.

The Meta River has facilitated spontaneous colonization. The settlers are isolated and in some instances form small groups.

The lack of capital and the shortage of lines of communications are the main cause for the stagnation of the zone and its limited progress.

There are many native Capitanias in this zone. In Avispas there are six with a child population of more than 100 each. Their state of civilization is average.

In the Avispas jurisdictional zone, it would be necessary to install at least four schools to serve the school-age native population.

The settlement plan projected for this region will include shortly both the civilized and the native human element which, as stated elsewhere, exceeds 30,000 for the entire Comisaria.

Presently, the Avispas inspection zone collects \$10,000 per year but is in a position to raise this sum to \$100,000 per year from the tax on cattle alone which leaves the zone, if more effective controls were available.

CHAPTER XII

SETTLEMENT

SETTLEMENT PROJECT OF THE STRIP OUTLINED BY THE META, ORINOCO AND BITA RIVERS AND THE LA CULEBRA DEPRESSION

Not only this zone but all of Vichada may be the seat of a large family, of a society which today walks without aim through cities fully incapable of providing at least the most pressing vital necessities. The agglomeration of large human masses in these cities is creating problems of a social nature which, if not given a prompt solution, could have unpredictable results. It should not be permitted that these development problems assume dramatic profiles; there are many people who diligently seek an opportunity to work to attain their social and economic improvement.

In order to view the characteristics of the problem with all its probable consequences, let us assume only that the country within a short 20 years, will have an approximate population of 32,000,000, who must be provided with food, housing, education and all the material and spiritual guarantees permitting them to lead a dignified life. This must cause the most optimistic mind to search for solutions aimed at the welfare of the entire Colombian community.

For these reasons we point out the restlessness of the settlers who hope that compatriots will arrive to exploit the wealth of these abandoned regions and that they get enough credit, machinery, technology, etc., and that these zones integrate properly in the economy of the country.

Some settlers established in the zone under study and on the margins of the Bitá and Meta rivers, the Culebra depression and nearby zones forwarded some ideas which must be taken into account in the future settlement plans of these enormous prairies. It is interesting to see the goodwill and, at times, the enthusiasm with which the spontaneous settlers wish that these territories become an integral part of the country's economy. This is a zone to which the government has not given the slightest interest, leaving the problems to be solved by themselves.

Duly planned settlement as envisaged by these enthusiastic settlers has been conceived, calculated and organized for a long time, and is based on the experience they have acquired over many years during their continuous fight against a frequently cool mother nature.

In addition to their elementary knowledge on cooperativism, they have undertaken such worthy project as the Cosurco cooperative, established near the headwaters of the Tomo, Tuparro and Muko rivers.

It should be stated with caution that neither the government nor its specialized institutions such as Incora participated in any settlement plan; the settlers who have accomplished this have done so spontaneously, facing for obvious reasons, their difficulties without limit. They lacked credit, technical assistance, penetration roads, distribution and consumer centers for their products, etc. In spite of this, some have succeeded in overcoming all these difficulties and have made progress toward the objectives planned, all of which is an example worthy of being studied to establish, likewise, centers of settlement, with all these services and guarantees required by such enterprises. An example worthy to be imitated is the case of Venezuela, where special importance was attributed to the settlement plans through the National Agrarian Institute under the expert management of Dr. Wenceslao Mantilla, former professor at our university.

Present conditions in the zone. The strip is approximately 300 kilometers long by 15 kilometers wide and includes approximately 450,000 hectares.

In its terraced forest there exist large quantities of quality wood which would be worthy of an objective study to insure its rational exploitation. The following species

abound:

Sassafras, cedar, cumin, cumin laurel, saladillo, verraco, caramatale or corazon, acato, etc.

The following palm trees exist: the royal palm, the moriche, the cumare, the araco, the macana, and other palm trees which are used in the construction of roofs, the manufacture of boats and which also are a source of food for pigs.

There is also the pendare or Orinoco chicle, and a great variety of woods which may be an enormous source of wealth in the manufacture of paper, cellulose, plastics, plywood, etc.

In the beginning, a cattle raising industry could be established, of an extensive type, in the savannas, and a subsistence agriculture in the plains and in the prairies and alluvial islands, whose approximate area is 100,000 hectares, which offer special conditions for agriculture.

Of these islands and plains, presently the following is being planted with magnificent results: cotton, sesame, soy, rice, maize, beans, yucca, and potatoes.

Natural and artificial pastures. Regarding native grass and vegetables, representative samples were taken from the region for their ultimate identification.

On the property of one settler near Casuarito, the presence of Yaragua Uribe or Faragua pasture land was observed (*Hypharrena rufa* Nees) stopf., a leafy species despite the prevailing dry climate. This causes us to think that the following grass and vegetables could be introduced:

Roads, Argentina, Pangola, Amor, Dollis, Bahia, Negro, Elefante, Sorgo Almun, Sudan, Forrajero, Rabo de Iguana, Bejuco de Chieve, Amor Seco, Tropical Kudzu, Terciopelo, Kidney beans, Caupi and Cargadita, etc.

A MOSHAV [Hebrew for Settlement]

AN AGRICULTURAL SETTLEMENT OF SMALL LANDOWNERS

Possible Method to be followed - In the beginning, 200 families properly distributed would be established.

One mobile team would be qualified to construct the housing and for this purpose, material of the region such as woods and palm trees would be used. In order for these new settlers to develop their physical and mental capacities normally, they would be provided with a center of activities affecting the entire zone politically and administratively. This small town would be located on an equidistant site which could well be the La Venturosa or Avispas farm and would provide services such as those provided by a cooperative, a school, a hospital, etc.

The investment for each family would be distributed as follows:

<u>Quantity</u>	<u>Price per Unit</u>	<u>Total Cost</u>
50 young heifers	\$ 300.	\$ 15,000.00
3 bulls		\$ 5,000.00
3 mares and one horse		\$ 5,000.00
1 ass and 2 donkeys		\$ 500.00
Tools worth		<u>\$ 1,000.00</u>
Total per each family:		\$ 26,500.00
Total for 200 families:		\$5,000,000.00
Cost of the Citadel (cooperative, hospital, school, approximately)		<u>\$100,000.00</u>
Sum Total for the Investment:		\$5,400,000.00

At the end of five years the cattle stock would have multiplied five-fold and appreciated as follows: Each family would have the following property:

265 heads of cattle worth \$800 each ... \$212,000.
 200 families with \$212,000 each in
 cattle worth\$42,000,000.
 There would be a total of 53,000 heads of cattle.

Interest on the money loaned for five years will amount to

$$I = \frac{5,400,000 \times 8 \times 5}{100}$$

$$= 2,160,000.$$

$$2,160,000 + 5,400,000 = 7,560,000$$

We did not include neither did we take into account production costs resulting from crops and stable maintenance, which, although being of the subsistence and use type, would no doubt leave a balance for other investments. W

From the five-year product we deduct the loan and would obtain:

$$42,000,000 - 7,560,000 = 36,440,000$$

These figures demonstrate clearly the quality of an investment of this nature. All figures must be adjusted to reality and the experience of the promoters of a project of this type.

The zone mentioned is served by a road which connects it with Villavicencio, which would be leveled so that no delays occur and so that trade with the interior of the country could be expedited. Air service exists frequently to La Venturosa and Avispas, but there is a possibility of scheduling it regularly and expanding it not only to this settlement but also to the entire zone due to the facility which exists regarding airport construction. Among the patriotic programs of SATENA, which services 70 locations throughout the National Territory, there is one calling for an increase in airports in the Vichada Comisaria.

CHAPTER XIII

CONCLUSIONS

From the general observation of the Comisaria and a direct and objective study of the Casuarito-Puerto Carreno-San Rafael de Murillo triangle, the following conclusions may be drawn:

1. The entire territory of the Comisaria is public land, the few settlements have no ownership title; potential zones suited for extensive livestock farming are considerable.

2. The rivers constitute the lines of communication, particularly during the winter. Motorized transportation is feasible primarily during the summer. The Puerto Carreno-Puerto Lopez road may be used during the summer without interruption.

3. Ecological and health conditions are stimulating factors for the establishment of vast cattle raising enterprises for meat packing, designed for export, particularly to Venezuela, and via the Orinoco to Europe.

4. On the banks of the rivers, originating in the Cordillera Oriental, there are alluvial soils suited for a subsistence agriculture; even so, along the banks of the rivers originating in the prairie, there are soils with good humidity content, useful for pasture land and vegetable growing. The prairie rivers have well-established basins with rare flooding, but have many windings which delay navigation.

5. The greatest source of income of the zone under study is provided by agricultural, livestock and commercial activities.

6. Cattle is transported between the production centers and Orocue-Puerto Lopez, via the Meta River on diesel motor-driven barges.

7. The zone under study is the least fertile of the entire Vichada territory and its cattle raising exploitation is more difficult by the obstacles in the way of establishing artificial pasture grounds due to the sandy texture of the soil; however, in turn, it is useful for growing fruit such as mango, maranon, watermelon, guanabana, tomatoes, etc.

8. Along the banks of the rivers, particularly those of the Meta River, there are small cattle raising nuclei which may well become the advanced centers to initiate programs of agricultural and livestock farm programs. These centers are located in Puerto Carreno, Tres Matas, San Rafael, El Porvenir, Puerto Murillo, La Venturosa, Parure, Nueva Antioquia, Tierra Macha, San Jorge and Avispas.

9. The ichtyological wealth harbored by the Orinoco, Meta and Bita Rivers is immense.

10. The native population lives under the most deplorable conditions of misery and abandon. There are expressions of non-conformity on the part of the natives, which is reflected in the regular and continuous attacks to which settlers are subjected.

11. On the other hand, the native element is being exploited.

next

CHAPTER XIV

RECOMMENDATIONS

end

1. With fill, the Puerto Carreno-Puerto Lopez road can easily be adapted to be used at all times up to the La Culebra depression, some 450 kilometers away.
2. The project of joining the road above with Santa Rita will enormously facilitate the development of the center of the Comisaria.
3. It is urgent to start work in the agricultural and cattle farming sector and in public works in order to improve the living conditions and to stimulate immigration. The zone studied must be devoted to growing fruit, particularly mango and maranon, or cashew trees. The Orinoco River Bank included in this study offers special conditions for planting sarrapio whose production is bought by Venezuela, although this commerce tends to disappear due to the synthetic production the essences obtained. Presently one kilogram is worth five bolivars.
4. The installation of a canning company will soon be a pressing need for the utilization and commercialization of mango and maranon, which are of excellent quality.
5. The zone will have good communications when the road to Puerto Lopez is adapted and when the project of joining it to Santa Rita is completed, provided there is regular river traffic on the Orinoco, Meta and Bitá rivers.
6. It is necessary to begin with the construction and maintenance of the roads and with expanding air and river navigation.

7. Orinoco, Meta and Bitá rivers have considerable ichthyological wealth and its exploitation collides with conservationist principles. It is urgent to make a specialized study, establishing the times of prohibition for the various species, for their proper exploitation. Even so, meadows, which are refuges and food sources to the aquatic fauna, must be supervised.

8. Establishment of branch offices of the Agrarian Bank in Avispas, Guacamayas, Cumaribo, and Casuarito is recommended in addition to extending the road to the branch office of Puerto Carreno.

9. INCORA*, the cattle bank, nearby roads and other similar projects must be provided for this zone to establish development programs by means of supervised, cooperative credits, and by incrementing colonization.

10. The Catholic missions are doing nothing positive for the benefit of the native population, and it is therefore necessary that the Indigenous Affairs division of the Government Ministry plan and establish adequate programs to redeem this valuable element, such as was done in Venezuela with the native population centers duly equipped with saw mills, carpentry shops, vocational schools, etc., where a specialized group of instructors provides the instruction.

11. The Border Integration between Colombia and Venezuela must extend to this zone for the benefit of both communities with identical problems. Presently the integration plans do not include this zone.

12. The comisarios for these territories must be professionals in some of the agricultural and cattle raising branches, they must come equipped with good technician teams, in the exploitation of the various natural resources, since goodwill and patriotism are insufficient, without their technical and administrative capacity, so that the progress of the comisario is not braked or retarded.

13. Due to the administrative and technical lack of capacity, the budgets for these territories did not become realities: If they were all put together in order to complete a specific job, as for example, settlement, the progress enjoyed by these zones would be much more distinct.

*INCORA = Instituto Colombiano de Reforma Agraria = Colombian Agricultural Reform Institute.

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