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# Man & the Environment of the Llanos Orientales of Colombia

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MAN AND THE ENVIRONMENT OF THE  
LLANOS ORIENTALES OF COLOMBIA

A Thesis

Presented to

the Faculty of the Department of Geography and Geology  
Western Kentucky University  
Bowling Green, Kentucky

In Partial Fulfillment  
of the Requirements for the Degree  
Master of Science

by

William King Watts

May 1986



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MAN AND THE ENVIRONMENT OF THE  
LLANOS ORIENTALES OF COLOMBIA

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MAN AND THE ENVIRONMENT OF THE LLANOS ORIENTALES OF COLOMBIA

William King Watts

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129 pages

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The investigation of the problem in this paper dealt with performing an examination of the landscape of the humid tropical wet-dry savanna region of the Llanos of Colombia, in an attempt to record a cultural imprint of man in the twentieth century in that environment. Fieldwork involving two summer traverses of the Llanos yielded an inventory of fresh factual documentation about how man has adapted to and utilizes this environment.

Implementing the ecosystem concept as expressed by Barrows and Hegen, both man and the physical environment were studied to gain as complete a picture of the Llanos as possible. Data was collected and codified pertaining to the daily life of the colonists.

Man was found to be interactive with, and therefore an influence upon, the natural environment. He was further found to be making and attempting to improve his level of living in his adaptation and adjustment to the environment. Low levels of diet, health, and education were found to be serious problems for the llaneros.

## CHAPTER I

### AN INQUIRY ABOUT THE COLOMBIAN LLANOS

#### Introduction

Across the globe man is leaving everywhere a record of himself. Peculiar lineaments serve to identify the various cultures of man. One may observe how a society of man has changed aspects of the way the Earth was in a particular location before man was there. The collective cultural imprint has singularities discernible even when mixed in a crowd. This is evident in that the same site occupied by different societies in different chronological periods will yield different records, that is, imprints, of each of the societies of man. "There is of course no entity 'man': just men and women grouped together in the normal frequency distribution curve" (Chase, 1967).<sup>1</sup> The society, then, consists of "the agglomeration of all existing institutions, the people participating in those institutions, and the structural relations occurring between those people as individuals or collectives, between those people and institutions, and between institutions" (Pred, 1981).

---

<sup>1</sup>Sources cited are alphabetically arranged in the bibliography at the end of the text. Citations in the text are entered by the author's surname and year of publication. Names of institutions are abbreviated in the citations. Acronyms of Colombian governmental agencies used in the text are fully identified in the bibliography. Footnotes are numbered consecutively for each chapter.

In the Llanos Orientales, or eastern plains of Colombia, there are men, women, and children, and these might be termed the 'human element' in the ecosystem, or scheme of nature, here. As such, they become an active, even free (Hegen, 1966) agent in the surrounding utilized environment, that of the humid tropical lowland savanna and forest.

The natural environment in which these humans live is subject, then, to their interactive influence, based upon their "cultural intent" (Hegen, 1983) which "governs the choices and responses employed in ... (variations of efficiency in space) ...and changes ...(in efficiency in time) ...in the pursuit of optimal survival". The resultant modifications, whether culturally or ecologically beneficial or detrimental, become evidence in the landscape of the way man lives. The manifestations thereof bear noting as representative of man in the Llanos, also as part of the record of man in the late twentieth century.

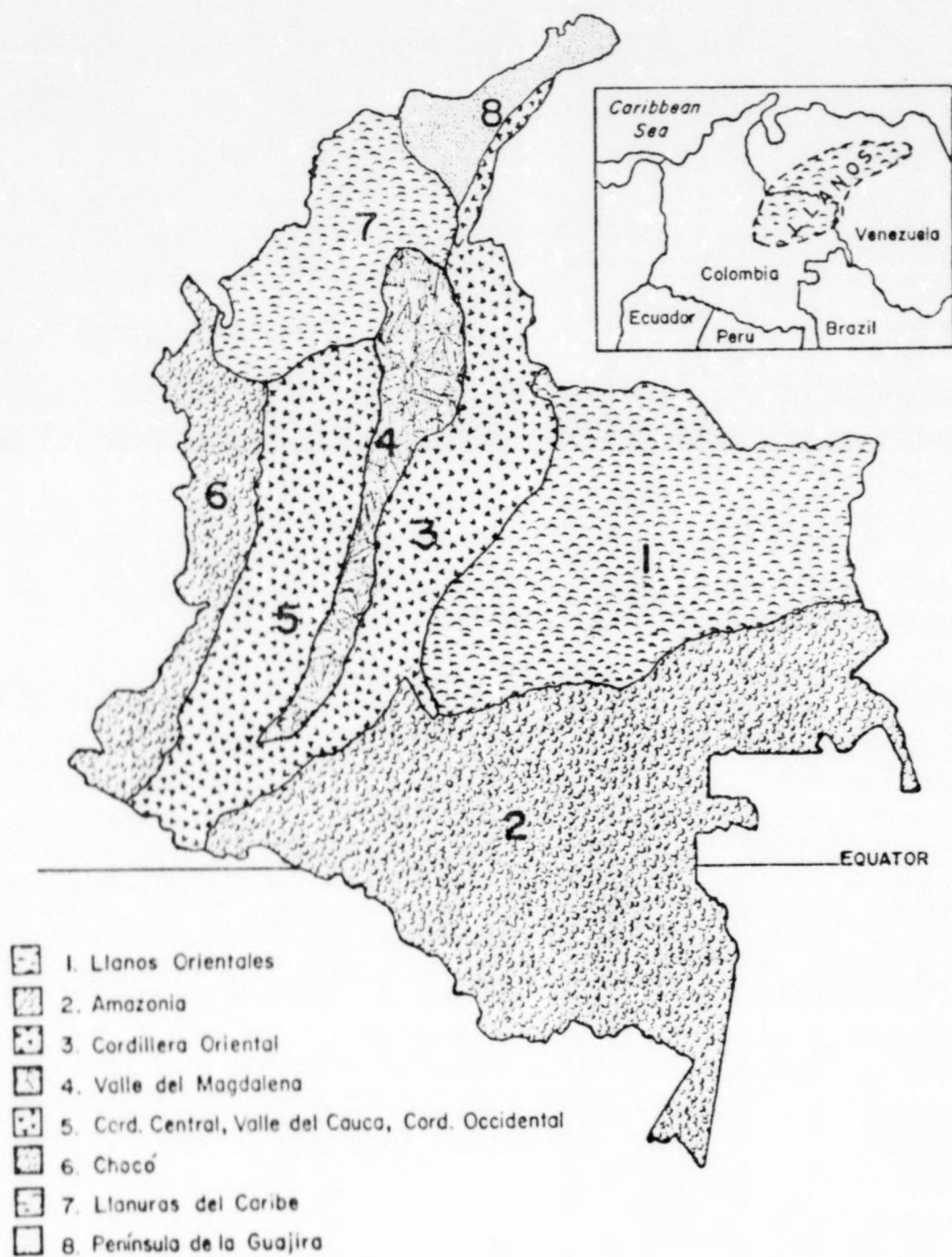
#### Setting of the Study

The Llanos of Colombia are a tropical wet-dry savanna region which lie approximately between the latitudes of three to eight degrees north, and the longitudes of sixty-eight to seventy-four degrees west, as well as covering a significant portion of Venezuela (see Figure 1). Although comprising a major physiographic region, the Colombian Llanos have not historically been an area of dense population accumulation, the settlers of Colombia preferring to inhabit the cordilleras of the Andes, the valleys of the Magdalena and



FIGURE 1

## REGIONS OF COLOMBIA



Cauca Rivers, and the Caribbean lowlands. The population density of Orinoquia, the eastern lowland and Amazonian regions which drain the Orinoco watershed, is for a large part less than one person per square kilometer. The more populated central regions of Colombia indicated above have densities upwards of 180 to 250 persons per square kilometer.

The culture which dominates Colombia today is one which has evolved through replacement as were, for instance, the coastal savanna people replaced by the invading forest people in the Sinu region (Gordon, 1957), resulting in the modification of the environment in differing manners by the two dissimilar peoples.

The inhabitants of the Llanos have migrated from various places in Colombia. In areas of frontier expansion, up to 70% of the population in 1971 was non-native, while in the older, more established towns such as San Martín, the proportion of immigrants stood at less than 50% (Brunnschweiler, 1972).

#### Frame of Reference for the Study

In the course of a graduate program in Geography, a seminar on Latin America yielded the writer an opportunity to study about, then travel to, the Llanos. The seminar served to introduce many of the English language references on Latin America. These included the early individual pioneers such as Isaiah Bowman, Robert S. Platt, G.M. McBride, P.E. James, Robert C. West, Raymond Crist, James Parsons, and many others, and their accounts of field studies of lands little

known to North American geography, a discipline itself yet fledgling and in large part influenced by these explorers into new regional frontiers.

These men authored early descriptive and analytical works of interest to geographers as well as many others, and opened the door to later multi-disciplinary studies which have amassed broad based data banks of remarkable regional knowledge. This led, in 1940, to Latin American Studies programs at the universities of North Carolina at Chapel Hill and Texas at Austin. Then in 1946 the Brookings Institution implemented the study of U.S. foreign policy for Latin America, followed by international development research by the Stanford Research Institute.

Studies of Latin America spread to universities across the nation, encompassing many disciplines. In 1969, the average semester hours offered related to Latin America for schools with at least a minor in this field was as follows, by selected disciplines (Needler, 1971):

TABLE 1  
AVERAGE UNIVERSITY CREDIT HOURS  
OF LATIN AMERICAN SUBJECTS

Spanish & Literature	89.8
Portuguese & Literature	11.3
History	14.3
Government	4.7
Economics	1.7
Anthropology	4.1
Geography	3.0

The focus of geography upon the study of Latin America led to a detailed comprehension of the physical and human



characteristics of the lands and peoples of South America. Fieldwork is the basis of this knowledge.

A benchmark for the writer of this paper was the meeting vis-a-vis of the reasoned knowledge delved from the seminar and texts with the experiential knowledge gained from the field reconnaissance in the Llanos. Here the concepts obtained in the classroom became reality, and the percepts (James, 1967) of the field gave strikingly new meaning to those concepts. Some facts not in the texts were also availed. The typical student might, for example, tend to disbelieve that in a restaurant live chickens scratched about on the floor for table-scrap, where all of the patrons had a view of them, and furthermore that chicken was a main course on the restaurant's menu. The explanation for this lies in the forced conservative efficiency of an economically underprivileged culture.

#### Investigative Methods

Beginning the research in the library with a survey of existing sources, the depth of knowledge on Latin America revealed itself to have multivariate pathways. Curiously, pertaining to the trend in dissertation subjects concerning Latin America, it has been noted (Gonzalez, 1983) that there were almost 140 percent more such related titles from the decade of 1961 to 1970 than there were in the entire preceding one hundred years. Specific literature regarding the Llanos Orientales was limited to a select group of researchers.

Further methods for this investigation included observational study in the field of the physical and cultural landscapes. This was undertaken in preliminary and follow up stages. Personal references developed during the visits to the field were relied upon in measure. A collection of source material was provided by Colombian governmental agencies and officers whose endeavor it is, in part, to focus upon various facets of life in Colombia such as population statistics from the Departamento Administrativo Nacional de Estadística (DANE), climate and weather data from the Instituto Colombiano de Hidrología, Meteorología y Adecuación de Tierras (HIMAT), development and planning of colonization from the Instituto Colombiano de la Reforma Agraria (INCORA), geographical studies from the Instituto Geográfico "Agustín Codazzi" (IGAC), administration of frontier departments from the Departamento Administrativo de Intendencias y Comisarías (DAINCO), as well as the Colombian office of the United Nations Food and Agriculture Organization (FAO).

#### Structure of the Inquiry

Man and his relationship to the environment is the major focus of this paper. Many approaches to this realm of study have been dealt with in the history of geography. Gregor (1970) illustrates some of the relevant themes which have been explored, such as whether the environment has an influence upon man; the viewpoint of the reciprocity between man and the earth; the earth as the basis for commercial

life; and the study of the visible works of man in connection with the cultural reasons for them.

In writing of man in the environment, Chase (1967) states in his work that "man is reluctant to accept his place in nature...indeed, he often seems determined to wreck that balance of nature in which he lives and has his being."

With the intent to devise a study of human ecology which would consider the concept that "back of the living human environment, moreover, and inseparable from an understanding of mankind, is the rest of the natural environment" (Sears, 1937), a guiding abstraction was formed, to which partial structure was lent principally by the thoughtful writings of the geographers H.H. Barrows and E.E. Hegen.

The viewpoint of geography as human ecology expressed by Barrows was put forth in his Association of American Geographers presidential address in 1923 (Barrows, 1923).

Previous to this time in the development of geographic thought a trend had existed as to there being "two geographies". It was held on the one hand that there was physical geography, as marked by the strong and widely accepted influence of W.M. Davis, and of Ratzel, also a proponent of the physical approach to the study of geography.

In contrast to the physical approach to geography was that of human geography, or the study of the relationship of man to the land. The end of the 19th and the beginning of the 20th centuries had seen the predominant support lean in favor of the physical side.



A current flowing through this framework, narrow and limited at first, was discernible. von Humboldt, for one, had, in addition to his study of the physical aspects of South America in his 1799-1804 expedition, paid heed to the man-land relationships there, exposed as he had been to the hardships of life in the tropics, the slave-trading of the Americas, and the cultural variation between the New World and the Old. He later even evinced his concern for human welfare by exerting influence upon the King of Prussia to declare slaving illegal in that domain.

Another who increased general academia's awareness of human geography was Carl Ritter, whose views toward the study of man in history held history and geography to be greatly interrelated. For forty years he influenced students, among them Arnold Guyot and Elisée Reclus. Too, the influence of Ellen Churchill Semple's (1911) concept of anthropogeography, for which she credits Ratzel, and Sauer's (1963) concept of the cultural landscape served to build the case for human geography as an associate of the more predominant physical geography.

While the 'position' of geography (Hartshorne, 1959) was that of areal differentiation, new aspects were to come to light about the 'character' of geography.

Barrow's concept brought forth support for the endeavor to relate to the knowledge of mankind on the earth as to where and how he made his living. Especially was emphasis placed upon the "aim to make clear the relationships existing between the natural environments and the distribution and

activities of man" (Barrows, 1923), and for the concern with natural resources as utilized by man. Barrows saw geography as not necessarily concerned with landforms, climatology, or plant or animal ecology, rather that it should investigate the aspects of "human activities in specific areas" (Barrows, 1923). While the paper to follow strives to adhere to the view that man's relationship to his environment is of utmost import, it further subscribes to the undertaking of the study of the general physical elements that constitute that environment. Likewise, as does Barrow's paper, this one supports the position that fieldwork is absolutely necessary to accomplish the study of a human ecosystem in the attempt to observe and interpret the interrelationships therein.

Additional guiding focus for this paper was derived from a seminar presentation in which the framework of the concept of Geography as Human Ecology (Hegen, 1983) was presented. Explained here was the "relationship between human groups (biocenoses) and their resource bases (biotopes) and the consequent patterns of survival in cultural landscapes". In accompaniment with this abstraction was the explanation that the "cultural intent--enviroming culture--converts the natural landscape into the cultural landscape" which as man's "resource base" is the medium in which aspects of culture "govern the outcome of the search for optimal survival". The fact that man is an element of the ecosystem indicates the need to present in this paper the features of both the physical and cultural elements of the environment of the Llanos.

### Objectives of the Inquiry

A major emphasis of this study was fieldwork since, as was written by Roger Bacon, "...without experience nothing can be sufficiently known..." (Cullimore, 1941).

The roots of geography lie in the undertaking of field study and travel. Study in foreign lands is a large and important part of this, as has been indicated by James Perkins: "A nation's welfare depends in large measure on the intellectual and psychological strengths that are derived from perceptive visions of the world beyond its own boundaries" (Gabler, 1981).

The intent of the fieldwork for this paper was to gain knowledge and experience which would enable the production of a descriptive and interpretive report of man's place in the natural environment or resource base (Barrows, 1923) in this region. By recording and codifying field observations on man's mutual relations with or adjustment to the environment, it was expected that an understanding of the characteristics of the society there could be ascertained as reflected in the cultural landscape, the result of culture acting upon a natural area (Brookfield, 1964). A determination of the problems and possibilities related to whether man's penetration to sites in the ineffectively utilized territory of the Llanos had yielded spatial spread (Hegen, 1963), which refers to advancement of economic, technological and socio-cultural interaction, or was but linear penetration in the form of "putting a certain distance between the milieu left



behind and a new situation - milieu and situation in the geographic sense" (Hegen, 1963). It is intended that this paper will illustrate how in the totality of the Llanos there is an indivisibility between man and the land, and culture and the resource base. At the least there would be a "study of the ecosystem's unique cultural landscape, which is to study the natural landscape and the action upon it of the environing culture" (Hegen, seminar lecture, 1983).

#### Background Sources

An associated basis of background for this paper was many of the relevant sources found in the preliminary literature search on the Llanos. Works were located pertaining to the physical environment and to human ecology.

Previous work of the author of one of the models after which the structure of this inquiry was based served to provide a guiding form of attention with which to pattern the investigation. Hegen (1966) provides exemplary advocacy of the concept of the "interrelationship between man as a free agent in his environment and in his culture" which directly calls for field study by the investigator because "each observable phenomenon of these relationships gives impressive proof."

By going into the field himself, the geographer is more likely to gain perceptual understanding to add to his ability to comprehend the character of a region. Brookfield (1964) has emphasized this in conjunction with his assertion that "human geography, by its first concern with the human

ecosystem, is inevitably...syncretic." The need to examine sociological, historical, physical, and other aspects of the total ecosystem of the Llanos becomes evident.

The total cultural relationship of man to the environment, involving agricultural, economic and demographic processes is referred to (Gregor, 1970) as pertinent to the research of a people.

Tinnermeier's (1964) study of land settlement in the Llanos, with an interest in education and experience levels of colonists, discussed the need in the region for development of roads, technical assistance, and farming practice improvements as means to bring about cohesion and productivity in a frontier region.

Writing of agricultural development in the Andean Oriente or lowlands to the east of the Andes, Stewart (1968) indicates that the potential for relocational settlement in the Llanos for the overburdened population centers of the highlands certainly has an alleviating capacity, although it may be hampered by cultural resistance as well as regional financial insufficiency.

Descriptive field studies of the tropical Llanos (Bates, 1948, 1952) and the bordering Venezuelan savanna (Crist, 1932, 1956) offer highly illustrative accounts of field work, as do reports of the search for historical towns (Martin, 1929), of the early missionaries (Rivero, 1956), and of the Indians of the lowlands (Allen, 1947). Works on the potential and implementation of colonization projects in the Llanos (Platt, 1932; Holt, 1964; Rucinque, 1972; Clawson, 1982) detail the

planning and progression of man's efforts at settling within the Llanos environment. The need for the development of roads in the Llanos has also been emphasized (Stoddart and Trubshaw, 1962).

Studies on the physiography of the Colombian Llanos provided the background which was a necessary forerunner to the undertaking of the field study.

The FAO (1965) report gives an analysis of the major physiographic characteristics of the Llanos, especially concerning soils and vegetation. A detailed study by Goosen (1972) provides minute soil analysis as well as physiographic definitions which generally apply to the Llanos region. Analyses of the natural vegetation of the western (Blydenstein, 1967) and the eastern (Vincelli, 1981) Llanos detail the region's variety of savanna types.

During the course of the preliminary investigation, uncertainties arose as to how to view the place of man in the Llanos. It was decided that man should be considered an active agent in the ecosystem both contemporarily and in light of the historical record of man in the Llanos. Attention would be given to how he survives as a part of the ecosystem, within the natural elements and the physical structure of the land, and the results of his activities therein. Interest would be focussed, too, upon his achievements, upon what his activities yield, what the ecosystem can be made to yield, upon efforts by man for its optimal use, and to what levels of social infrastructure he has devised. To what point in the stages of man's evolving influences upon and changes to



the environment had human 'cultural intent' (Hegen, 1967) developed? What signposts existed to identify this cultural intent, and did they result from man's efforts at survival, resource utilization or conservation?

A determination as to the benefit or detriment of the actions resulting from man's presence in the Llanos would be the outcome of observing the processes of the ecosystem at work in the field.

#### Progression of the Investigation

The progression of the investigation went from the background research for familiarity with available source materials to the preliminary field traverse of the Llanos in 1983. Direct exposure to the reality of the ecosystem yielded an emerging comprehension of the range of the current situation, as well as permitting the acquisition of data and resource information. Further fieldwork in 1984 after further study produced a clearer embrace of the structure and functioning of the ecosystem of the Llanos. Firsthand observation led to the development of a level of insight of the unique reality of a specific region of the world.

#### Intention of the Investigation

It is intended and hoped for that in this paper aspects of the current circumstances of man in the Llanos will be developed and explained, and that it will be shown how the mutual effect of man's interaction with the environment affects the ecosystem. Studying conditions as they are should

yield feasible suggestions for change toward improvement. An analysis of the problems of the region will aid in the ferment of their solutions. Fresh factual documentation researched in this study will aid in a clarification of how the life of man is conducted in the Llanos at the close of the twentieth century.

Perhaps an arguable assumption is, granting that man has the freedom in the Llanos to try and make better his life, he will want to do so. Considering that cultural traditions and education levels may play a role in determining his actions, this assumption requires clarification by field research. It was further determined that, upon discovering the means of living as devised by man in the Llanos, it would be necessary to consider the possible influence that the natural environment produces for man's optimal survival.

Against the models upon which this investigation is based (Barrows, 1923; Hegen, 1983), a comprehension of the influence of man on the character of the region will be discerned by observing how, in man's settling of the Llanos, he has an effect upon the structure and functioning of the ecosystem. The results yielded shall be taken to be an objective, if partial, inventory of observations relating to man's adjustment and adaptation to this particular environment.

Within the norms to be described relating to the natural physical environment, man will be assumed to be a principal modifying agent in this ecosystem. Its optimal level of utilization could be realized if man were educated to this

end. Since the region is economically underdeveloped, the state of the social development of man must here be deficient. If man's overall living condition or situation is beneficially improved, regional development will follow. Observations on man's condition (INCORA, 1984) relevant to educational and economic status, and his use of the resource base, should serve as potential descriptive models of man and his culture in the Llanos of Colombia as it presents itself at this time.



## CHAPTER II

### PHYSICAL ENVIRONMENT OF THE LLANOS

#### Characterization of the Llanos

...There is something awful, but sad and gloomy, in the uniform aspect of these steppes. (Humboldt and Bonpland, 1819)

What would it be like to live in a land such as this, which is ever so much the same today in the late twentieth century as it was in 1800 when Baron Alexander von Humboldt traversed it on the scientific expedition from which he is here quoted? He goes on to say that

Everything seems motionless... We accustom ourselves with difficulty to the view of the Llanos... The extreme rarity of inhabitants; the fatigue of travelling beneath a burning sky; and an atmosphere darkened by dust; the view of that horizon, which seems forever to fly before us; those lonely trunks of palm trees, which have all the same aspect, and which we despair of reaching, because they are confounded with other trunks, that rise by degrees on the visual horizon; all these causes combined make these steppes appear far greater than they are in reality. (Humboldt and Bonpland, 1819)

There are more people inhabiting these plains now than there were then, which, however, serves to diminish only in part their appearance of being a region of vast solitude such as von Humboldt encountered.





A large savanna, spanning much of the Orinoco River drainage basin of Colombia and Venezuela, the Llanos Orientales encompass an area of approximately 360,000 square kilometers, forty-five percent of it belonging to Colombia. Of their total national land areas, about twenty percent of Colombia and thirty-three percent of Venezuela consist of these Llanos. The grasslands are comparable in size with several of the fifty United States (Figure 2).

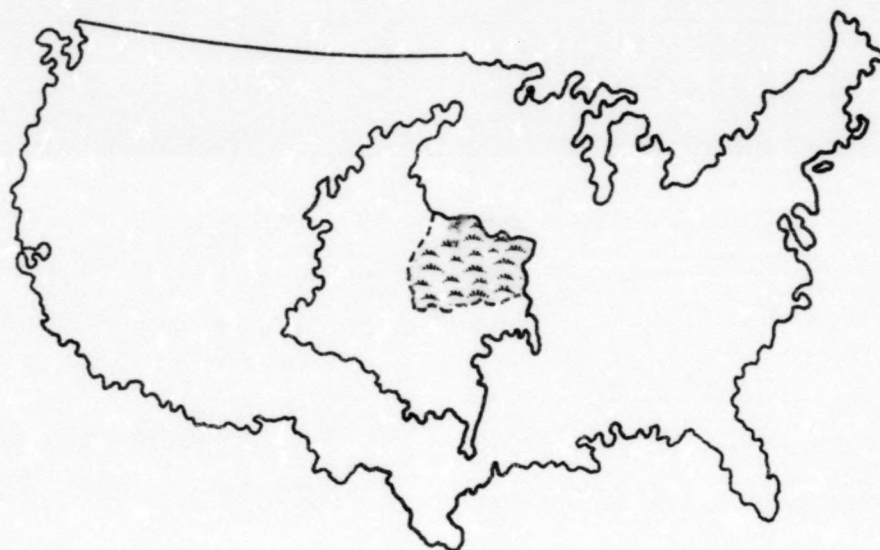


Figure 2. Map showing relative size of Colombia to the U.S. with Llanos region highlighted (after Colombia Information Service).

Lacking any major physical barriers as noticeable as, for instance, mountain ranges, the Llanos are a distinctively flat region. Crist (1932) describes the Llanos as being 'as flat as it is possible for land to be in nature'. There is, however, enough variety of features so that not every place



looks the same, although on a long traverse it might impress one as being so. The Llanos have as the western and northern perimeters the Andes and the Caribbean Basin; their southern extent is generally recognized to be the Guaviare River (Brunnschweiler, 1972), and the eastern boundary for the Colombian Llanos is the Orinoco River and the Guiana Highlands, and the Venezuelan border at the north.

This great grassland has grasses for a majority of its vegetative cover, with gallery forests along the rivers and tropical forest and woodlands in the western piedmont areas. Initially inhabited by pre-Columbian Indians, the Llanos were named by the 16th century Spanish conquerors; the ensuing centuries saw the region become inhabited, although sparsely, with ranchers, scattered villages, and missionary settlements. Diseases and insects made life difficult for these settlers, as well as for the Indians in the region, whose existence was of a subsistent and horticultural nature. Humboldt and Bonpland (1819) describe an awesome Indian method of fishing for electric eels, whereby wild horses were rounded up and driven into ponds ringed about by the Indians; the eels would then surface to attack the horses, discharging bolts of electricity into them. The eels were then harpooned as they went towards the edge of the pond in their escape. It was a very 'noisy and wild' experience, and left some of the horses dead from drowning due to the stun of the shocks.

The Llanos region is drained by many rivers which generally flow eastward toward Venezuela through natural grassland. In combination with the Orinoco River (the

eastern border with Venezuela), they contain a dense inland waterway system, integral to the transportation network of Eastern Colombia. Meandering over the level plains, the rivers leave oxbow lakes and lagoons in places where they have shifted their course. The unstable condition of the river course causes undercutting of the banks and acquisition of a great sediment load, which is frequently deposited as sand bars and mud flats. A recurrent and unalterable fact of the seasons is the annual inundation of much of the region by the torrential rainfalls of "winter," invierno, or the rainy season. Great yearly differences in the level of the rivers add to the unpredictability of wet season flood stage levels.

The amount of rainfall is the primary characteristic marking the change of the seasons in the Llanos. The temperature, however, is relatively unchanged on an annual basis. As a result of undergoing the variation from saturation in the rainy season to dehydration in the dry season, the soils are depleted, leached of the nutrients and minerals that are necessary for biotic fertility -- hence the growth primarily of bunch grasses, palms, and xerophytic trees.

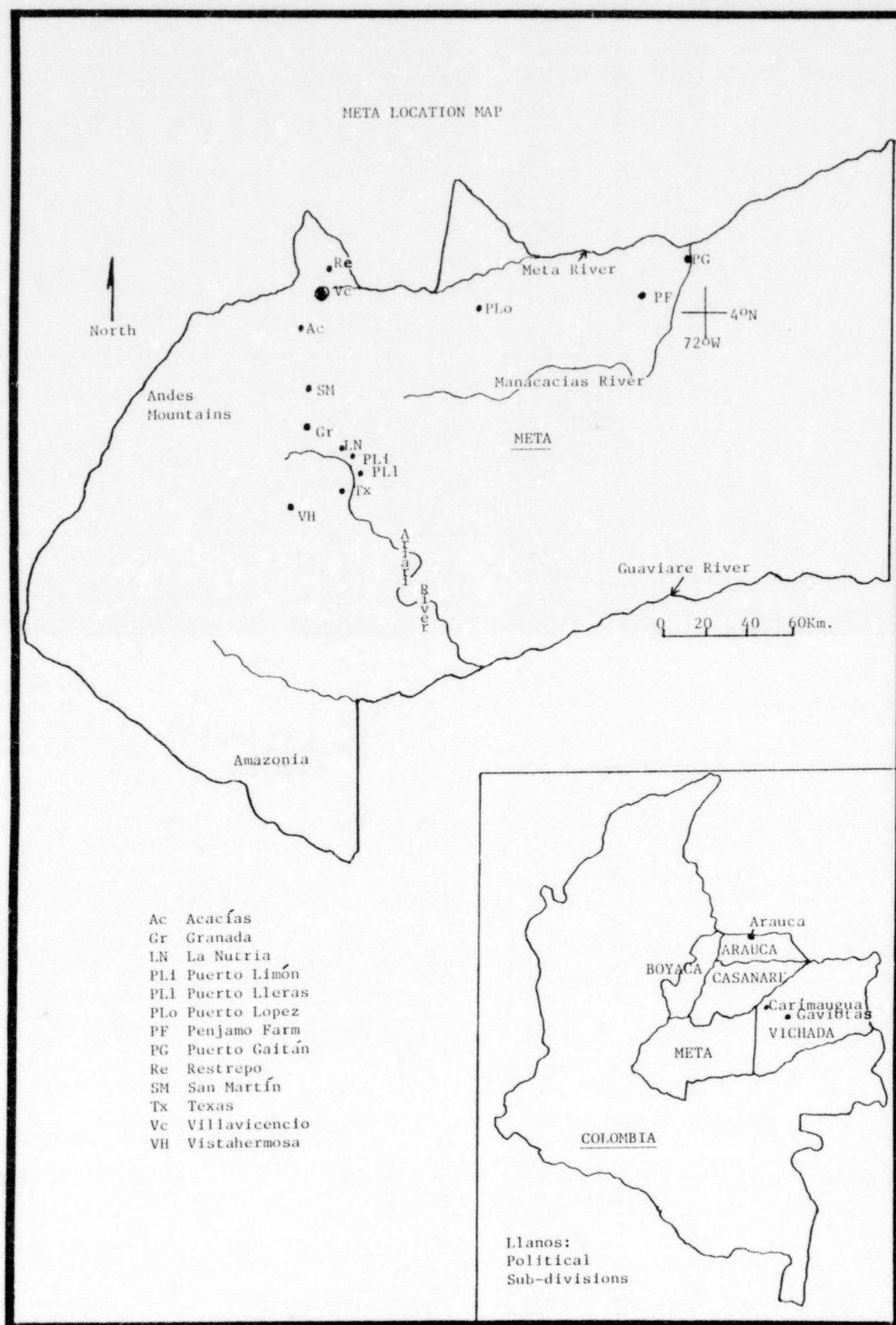
Members of the animal kingdom which inhabit this savanna are adapted to the deprivations of the climate. Found here are the rodents, rabbits, anteaters, bats, snakes, and birds. The rivers have a great variety of fish, including laulao (a catfish) and the piranha. Insects are the most numerous creatures to be found.

Human occupancy of the Llanos has been little developed. In the vast savannas of the Orinoco Basin of the Colombian Llanos, there are few ties to bind and promote community development, especially so east of the Manacacias River. Often, neighboring ranches are of such great distances apart as to render social interaction a nonexistent factor, thereby reducing chances for rural cooperation and mutual effort in developing roads, settlements, and bringing about significant change by man of the region. Martin (1929), writing of his observation of the chief drawbacks to settlement and development of the Llanos, mentions that

There is no community spirit among the inhabitants in the matter of maintaining trails or in any other communal relations. Cooperation is unknown; rather, intense jealousy among individuals prevails.

While the Llanos constitute twenty percent of the surface area of Colombia, only two to three percent of her population reside here. The largest city in this area of 160,000 square kilometers is Villavicencio in the Department of Meta (Figure 3) with a population of 100,000. There are no other major cities. There are lesser magnitude towns, but mainly the land is utilized in the extensive agricultural activity of cattle raising. The land has a low grazing capacity, which imposes the requirement of 4 to 10 hectares per head (FAO, 1964). The acreage needed per animal is reduced when stock such as goats or sheep are raised (although neither is popular here); it is nevertheless a vast pastoral region with poorly cultivatable soils.





### Geomorphological Aspects

Orinoquia as a physical region has a uniformity which stems from its geologic history. Located between the Andean Eastern Cordillera and the Guiana Continental Shield of Venezuela, it has been termed a marine embayment (Brunnschweiler, 1972). Undergoing subsidence in the Quaternary when the Andes were in the process of orogenic upheaval, the Llanos received sedimentary deposits from the mountains which contributed to the surface characteristics of level expanse and gently sloping terrain, with gradual decline in elevation from west to east.

Tectonic movement is rare, but there are underlying fault lines which, while more numerous in the lands south of the Guaviare River (IGAC, 1983) are thought to be responsible for changes in the surface features of the Llanos. For instance, a change in the flow of the Arauca River some thirty-five years ago, causing at one place a branching of the river in two, is possibly the result of the sinking (FAO, 1964) of adjacent land. The FAO report designates the Meta River as the eastern limit of subsidence, the river itself being a product of water flowing along a fault line.

The sedimentation of this region, which is about the size of France, produced seemingly uniform characteristics. Features may be identified which serve to give intraregional specificity of physical surface components.

The Llanos have six major landscape subdivisions or physiographic units (Goosen, 1972), based upon

geomorphological features. These have been delineated as follows, with sub-categories indicated:

- Piedmont:
  - (M) old alluvial fans
  - (P) sub-recent alluvial fans
- Terraces (T)
- Alluvial Overflow Plain (D)
- Aeolian Plain:
  - (E1) dunes
  - (E2) aeolian plain with escarceos
- Alluvium (V)
- High Plains:
  - (A1) level, well drained
  - (A2) level, poorly drained
  - (A3) dissected<sup>2</sup>

The piedmont area is that which is located at the base of the Andes cordillera and takes two general forms, the old alluvial fans and the sub-recent alluvial fans, dating to the Early to Middle Pleistocene and Late Pleistocene respectively (for excellently detailed geological features map, see: Goosen, 1972). Erosion has smoothed their features and carried much sediment to the plain below. Heavy annual rains erode the slopes. Man helps, too, to accelerate the degradational process by clearing the forest vegetation and exposing the hillsides to the rains.

Occurring next in the transition zone from the mountains to the plains are the terraces. Partly the result of deposition of eroded mountain sediment, and partly due to

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<sup>2</sup>The letter designations for each of these categories are those utilized in the FAO report and by Goosen, and will be adhered to in the text to follow.



faulting related to the cordillera (FAO, 1964), the terraces step out from the cordillera to the plains, declining in elevation as part of the striking topographic contour differentiation from west to east.

The terraces are cut through by rivers and streams flowing from the mountains, adding to the sediment load washed out onto the plains. Where the rivers flood and this sediment is spread by the winter rains, causing hardship for the population which inhabits the lands adjacent to the rivers, the landscape is termed recent alluvium. The river leaving its course is a grave menace which presents annual problems to the citizens thereabouts. Attempts to bulldoze the banks or natural levees up to a protective level have little effect, and the government is criticized for the consequences of nature in its cyclic behavior because the margins of the 'natural fountains' of water are the property of the state (Diario del Meta, vol. 240, 1984) in Colombia, therefore the obligation for maintenance befalls the owner. Characterizing the broad river channels are meander scars, floodplain, and natural levees.

Figure 4 is an aerial photograph<sup>3</sup> of the Puerto Gaitán vicinity of the Manacacias River which displays an area in which the river channel has altered its course, abandoning previous channels and leaving natural levees and sediment

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<sup>3</sup>Aerial photographs presented in this paper were obtained from IGAC. Taken in 1957, the photograph in Figure 4 is at the approximate scale of 1:40,000.

FIGURE 4



Figure 4: Aerial photograph of Puerto Gaitán, Meta, Colombia, area dated 16 January, 1957. At the scale of 1:40,000, the drainage patterns and dissection of this High Plains region are evident. The white spots visible in the lower right-hand corner are sedimentary wash-tails (Goosen, 1972) indicating sheet erosion of ant or termite mounds. Source: Instituto Geográfico "Agustin Codazzi," Bogotá.

load. Figure 5 is a landscape map drawn on the basis of the air photograph which was the partner in the stereopair for this region, which clearly outlines the variation and intermingling of surface features where a river passes through the high plains. The existence of gallery forest along the banks of the river contrasts with the barren slopes of the adjacent dissected and level plain.

The plains in Figure 4 are part of what is termed the high plains. Generally ranging equatorward from the Meta River, they consist of alluvial deposits from the former marine embayment (FAO, 1964) of the Pleistocene which have to this date been affected by the elements of climate related to the rainy season, or winter. Erosion has resulted in regional dissection for a large part of the high plains, enough so that it has gained the Spanish term serrania, or hilly area. Other parts of the high plains remain level, and may or may not be well drained of the annual rainfall.

Referring once more to Figure 4, telltale evidence of the drainage patterns and dissection of this high plains region may be seen in that the white spots visible in the lower right hand area are sedimentary wash-tails (Goosen, 1972) indicating sheet erosion of ant or termite mounds which dot the surface.

Where runoff is readily transported to a stream, the term 'well drained' is applied. In many areas, however, the land is flat enough that the abundant quantity of rain is not able to flow in any direction, so that it merely rests upon the surface, developing a paddy-like condition. Roads,



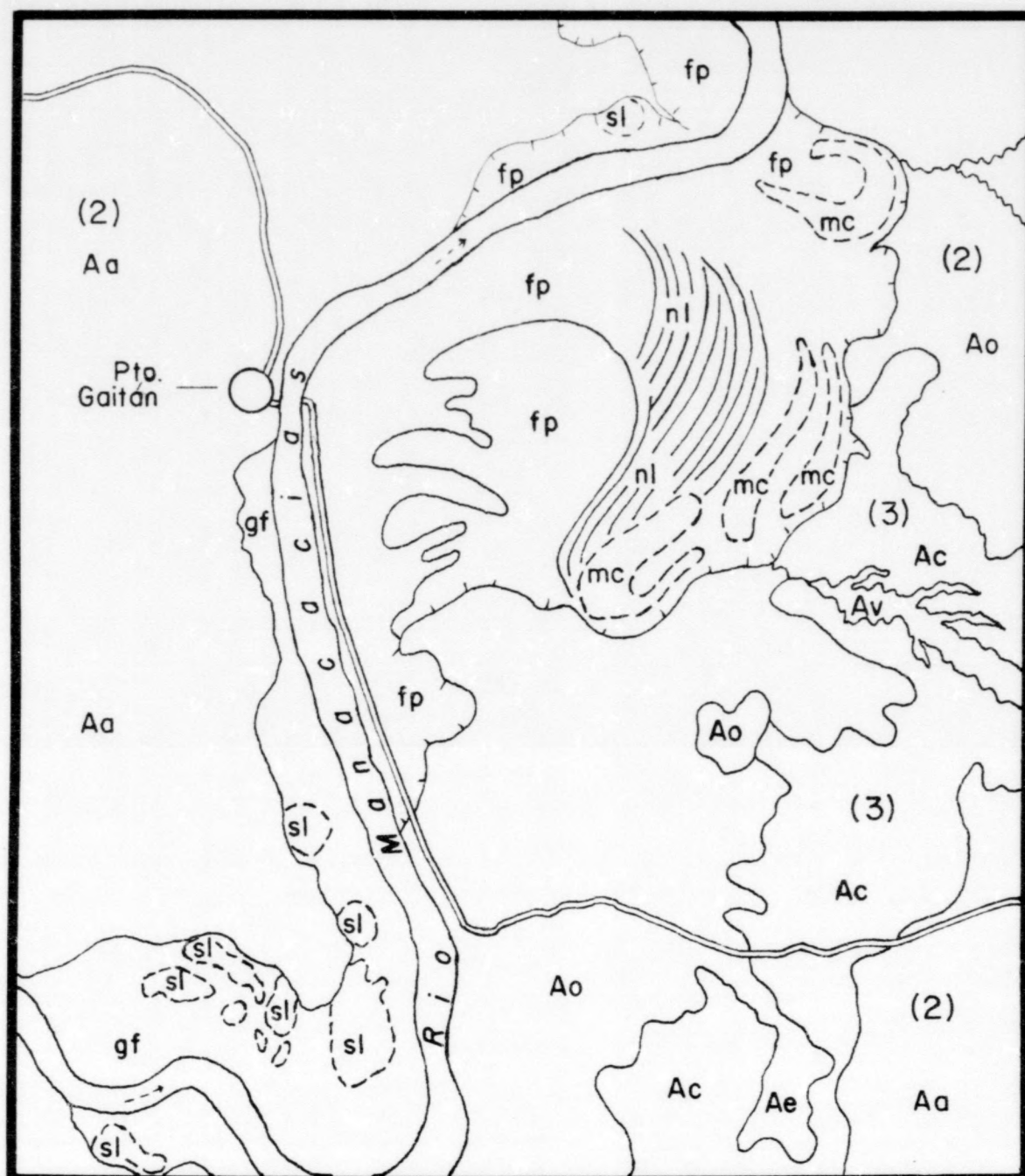


Figure 5 : Map of Puerto Gaitán, Colombia, vicinity, made from aerial photograph in figure 4 .

== Improved road

--> Channel flow

mc Abandoned meander channel

fp Flood plain

nl Natural levee

sl Slackwater basin

gf Gallery forest

(1) Level, poorly drained High Plain

(2) Level, well drained High Plain

Aa level, well drained soil

Ae esteros, along streams

Ao undulating land

(3) Dissected High Plain

Ac strongly dissected

Av colluvio-alluvial valley

which in this region are nothing more than vehicle track paths, become impassably saturated with the rainfall. Expanses of wet areas are not readily circumnavigated because the situation is regional. Conversely, in the dry season these level, well drained great plains offer little impediment to travel on or off the road. What Humboldt and Bonpland (1819) put in writing about travelling these plains comes to mind:

They display a beautiful verdure in the rainy season, but in the time of great drought assume the aspect of a desert. The grass is then reduced to powder; the earth cracks; the alligator and the great serpents remain buried in the dried mud; often in a space of thirty square leagues there is not an eminence a foot high.

Significant landform variation does occur within the high plains, as is noticeable in considering both Figure 4 above, with terrain changes observable from types of level plain to types of dissected plain, and Figure 6 below.

The aerial photograph in Figure 6, which is of the Vichada region near the Tomo River, displays a zone of level, well drained high plain as it is encroached upon by a zone of dissected high plain. Again, this serrania evidences gallery forests along drainage channels, and no forest otherwise. On the level plain grows mainly grasses. The darker triangular area in the photograph is a fire scar, where burning, probably man-induced, has occurred. Burning is an annual occurrence which replenishes the vegetation desirable for cattle to graze upon.

FIGURE 6

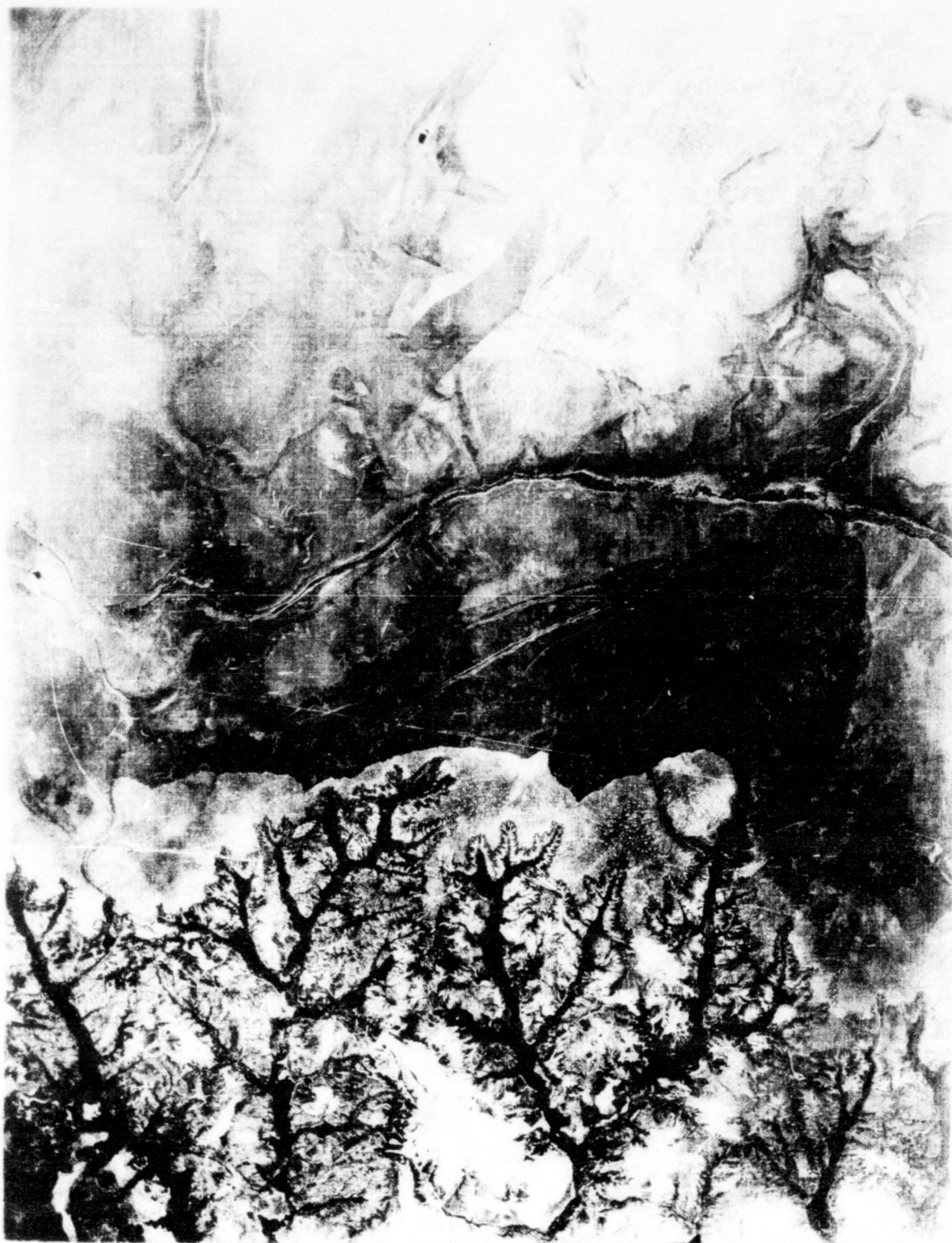


Figure 6: Aerial photograph of Vichada High Plains region.  
North is to the top. Source: IGAC



Just between the fire scar and the area of dissection, and other places on the photograph, are many more of the wash-tails of ant hills. From these, the direction of flow of sheet erosion may be discerned. An accompanying fact about the ant hills is that fire is in part responsible for their abundance in that it destroys the natural enemies of the ants, but little affects the ants (Goosen, 1972). They, in turn, are greatly active in the process of erosion by bringing the fine particles of soil to the surface in their digging. A mound a meter in height will cause the transference of a significant amount of subsoil. The frequency with which these may be observed in the photographs and in the field provides an insight into the active process here at work.

The amount of land surface thus affected may be up to 50 percent within an area (Humphreys, 1978), and causes definite "microvariability in soil fertility", apparently either to the benefit or detriment of the soil, dependent upon where the ant activity occurs.

The aeolian plain constitutes another major subregion of the Llanos. Wind-deposited soil makes up the surface material, which exhibits dunes of sand carried by the strong winds of the dry season (Goosen, 1972). The aeolian plain region is that area of the Colombian Llanos which is situated north and west of the Meta River. Interspersed within this region is the annually inundated alluvial overflow plain.

The overflow plain occurs where flood waters spread across the lands adjacent to the rivers, often because these

lands are at a lower elevation than the river itself. This is a result of the magnitude of sediment deposition, causing the banks to become built up higher than the plain, constructing a levee which, when the winter rains come, cannot retain the volume of water from spilling over.

The floodplain contains areas termed bajos, or surficial depressions, where the water accumulates. If the slope of the land is enough that water continues to flow in the general direction of the river, sediment deposition continues. Parallel to the river features develop, such as levees, demarking the extent of the broad area of seasonal inundation. Too, seasonal differences are apparent in other ways, as remarked by Crist (1932), who wrote that:

It surprises one travelling for the first time over the sun-baked mirage-dazzled llanos in the dry season to approach a ranch house distant from any stream and see a bongo (dugout canoe) tied to a stake.

### Soils

Nature reposes in its strength and majesty, inspiring with a sense of awe and sadness the solitary traveller lost in the wilderness.

In the above quotation Elisée Reclus (1894) aptly provides a clue as to the mood that the largeness of broad, flat expanse such as the Llanos might set upon one's disposition. Most of the Llanos have little slope to the trend of the terrain. Generally less than 350 meters above sea level, the soils of the region are alluvial and aeolian.

Subjected to the elements of the environment, the soils exhibit a markedly infertile condition. High rainfall, high temperature, and an annual cycle of seasonal inundation and dehydration are the principal causes of the nutrient deficiency which abounds in the soils of the Llanos.

Leaching of bases and nitrates follows when rain water percolates through the soil. The constraint upon vegetation of mineral insufficiency prohibits the existence here of many varieties of plant life. Further damage in this sense occurs because in the tropics annual evaporation from bare soil between the Equator and 10 degrees of latitude has been estimated at about 1,000 mm (40 in.) (Gourou, 1958), leading to its qualities of being 'poor and easily debased' (see Appendix I for related soil storage and evaporation loss quantities.)

Additionally, the wet-dry cycle serves to produce a hardpan, compact, impermeable soil, generally high in acidity. Hardpans are not suitable to agriculture, nor do they give rise to much varied natural vegetation when the topsoil layer is shallow.

The major classification of the soils in the humid tropics are those of the Oxisols and the Ultisols, with the larger proportion being acid infertile (National Research Council, 1982). These would compare to the Latosols and Red Yellow Podzolics respectively under the 1938 USDA Classification System. However, Buol and Sanchez (1978) indicates that the full range of the ten major soil groups are found in Colombia, among which the predominance of Oxisols and



Ultisols appears to be the general case, although there are localized variations which might be exploited for their agricultural value. For instance, Crist (1973) found the soils along rivers in the piedmont Llanos to be "deep, well-drained, medium textured, fertile, alluvial... adaptable to crops and improved cattle pasture". The pH reading he obtained was 6.0 to 7.0 at a depth of three feet. He determined that through intensive management and fertilization they could be made to be highly productive.

Differentiation from area to area follows the difference in landscape types, and difference in use of the land follows in this accord. In the observation of the landscape on a traverse of the Llanos, the writer obtained and did spot analysis of soils in seven locations with a field kit. Within the capabilities of the test equipment were nitrogen (N), potassium (K), phosphorus (P), and the pH level (Table 2).

The samples were gathered from a depth of 2 to 3 inches, were air dried, then crumbled to a fine consistency.

TABLE 2

## LLANOS SOIL TESTS

<u>Location</u>	<u>pH</u>	<u>N%</u>	<u>K%</u>	<u>P%</u>
1. Acacías	5	6	8	12
2. San Martín	4	8	8	8
3. Granada	4	8	8	2
4. Ariari River	8-9	8	2	8
5. Pto. Lleras	6	6	*	12
6. Texas farm	4	8	*	8
7. Penjamo farm	4	4	*	4

See location map in Figure 3.

\* results not obtained due to equipment loss in the field.

All of the sample sites were level, as is the overall tendency for the Llanos. The stoniness of the soil sample for each location was slight except for the sample obtained from the bank of the Ariari River, which was estimated to be about 80 percent stone or pebble. Erosion was slight for each of the sample sites, again except for the Ariari river sample, which was severely eroded. The vegetation at locations 1, 2, 3, 5, and 7 was short grass and/or bushes, all being flat fields with soil color of brown to dark brown. Each of these soil samples was from earth which was of firm consistency of loam to clayey loam.

The lime requirements for each of the sample sites may be estimated by comparing the pH value obtained to Bencloski's (1980) Lime Requirements Table in Table 3.

TABLE 3  
LIME REQUIREMENTS

<u>pH</u>	4.0	4.5	5.0	5.5	6.0	6.5	7.0
<u>Acidity</u>	Very strong- ly acid	Strong- ly acid	Moderately acid	Slightly acid	Neutral		
<u>Lime require- ments</u>	Lime needed ex- cept for crops requiring acid soil	Lime needed for all but acid- tolerant crops		Lime generally not required		No lime needed	

The Ariari River sample was from an area vegetated with palms and grasses which was subject to high water inundation and fresh deposition of sediment from the mountain or piedmont region, which may account for its great variance in

pH reading from the other more stably situated samples. Furthermore, this sample was from an island in the river, elevated 2 to 3 meters above the water flow level on flat terrain. The color of the soil was light gray, and it was of a very loose and stony consistency, containing much sand.

The final soil sample was from the farm "Texas" (see discussion in Chapter 3), where the vegetation was a cultivated stand of platano trees. The land was gently undulating with good permeability. The soil was a dark brown loam of firm consistency. It is believed that livestock had not been allowed to forage there, nor that fertilizer had been applied. This assertion is supported by the test results for pH, nitrogen, and potassium in that the readings obtained do not vary greatly from those of uncultivated areas.

While the attempt to arrive at accurate soil requirements for fertilizer application is beyond the scope of this study, perhaps a broad outline for this may be developed by applying the results obtained in the above tests for nitrogen, potassium, and phosphorus (N,K,P) to Bencloski's (1980) fertilizer requirements chart. Commercial fertilizers, marketed with formulas establishing parts per hundred of these substances, may be matched to the requirements obtained below (Table 4) for sample areas 1, 2, 3, and 4; sample areas 5, 6, and 7 are not dealt with because of incomplete testing results which were the outcome of, as indicated above, loss of certain equipment in the field.



To attempt to solve the agricultural problems of the farmers in the Llanos by soil testing is but a small part of the work required. One reason for this has been stated as follows:

Soil analysis is less reliable than plant analysis for deciding fertiliser application levels, and intelligence and skill are required to interpret the results of soil tests. It is necessary to estimate the response of the pasture to the soil situation. (Humphreys, 1978)

However, Buol and Sanchez (1978) report high yields for ideal situation experimental applications for crops and livestock in Latin America, and in the report dissuades one from placing too much emphasis on the unfavorable tropical climate in attempting to account for the overall low productivity of

TABLE 4  
FERTILIZER REQUIREMENTS

<u>Sample area</u>	<u>N - K - P</u>
1. Acacías	8 - 8 - 8
2. San Martín	10 - 8 - 6
3. Granada	10 - 8 - 3
4. Ariari River	10 - 4 - 6

the region, although not discounting the risks therein. Buol concludes that "the limited potential...because of unfavorable climate...is a myth." Buol sees world need as the key to the impetus needed to promote risk investment in the region.

### Weather and Climate

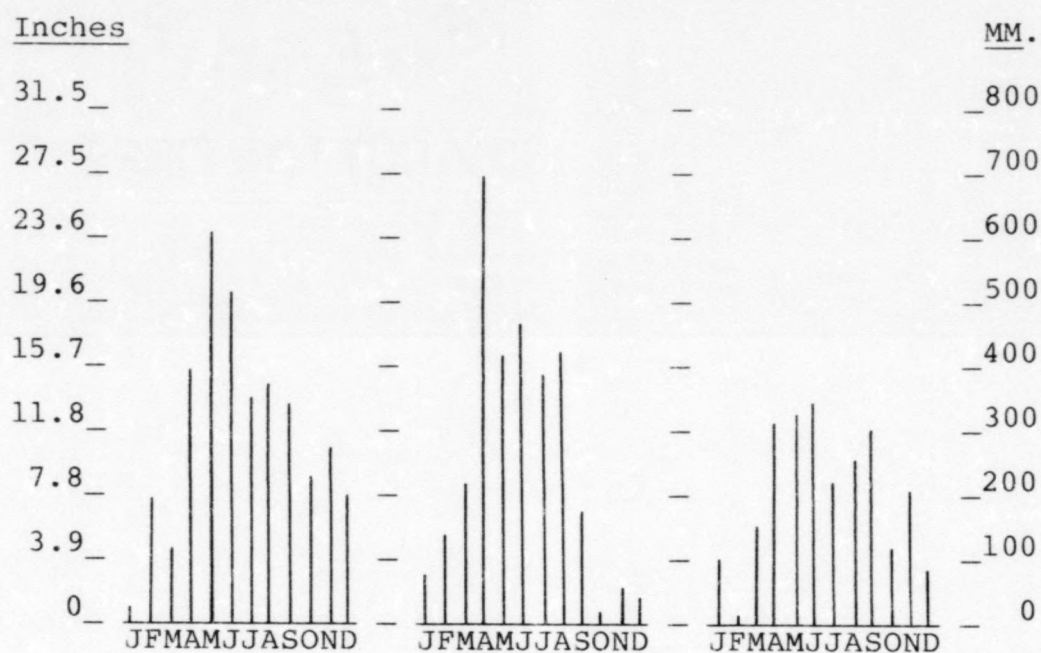
The climate of the Llanos Orientales has been designated as Aw by Koeppen, encompassing a tropical savanna. The moisture regime is marked by annual periods of heavy rainfall in the months from May to July and lighter rainfall from November to February.

The observations of precipitation data collected and provided by HIMAT illustrate (see Figure 7) the precipitation regime for eight stations in the Llanos.

On an annual basis the Llanos receive an abundant quantity of rainfall. Generally, the eastern Colombian Llanos receive less annual rainfall than the western Llanos, and the nearer to the Andes region, the more abundant is the quantity of rainfall. It should be noted also that the nearer to the Equator, the more abundant is the annual amount of rainfall.

From the graphs in the precipitation figures a pattern of rainfall distribution is observable which indicates a peak period of May to July, and a low period in the November to February months.

FIGURE 7

Monthly Precipitation

Station	Vistahermosa	La Nutria	Pto. Limón
LAT. N.	3°25'	3°45'	3°16'
LONG. W.	73°50'	73°21'	73°33'
ELEV. M.	325	280	225
d.o.d.*	1976	1972	1973

\* date of data

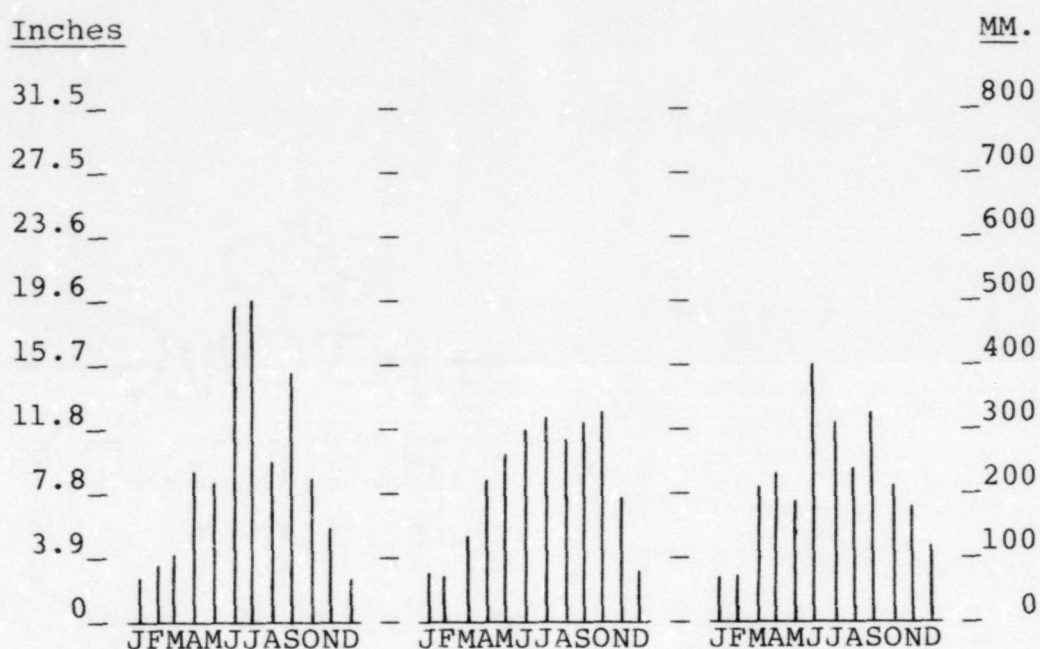
Source: HIMAT

See: location map in Figure 3

See also: Appendix II for detailed station Annual Water Budget analyses.



FIGURE 7 (continued)

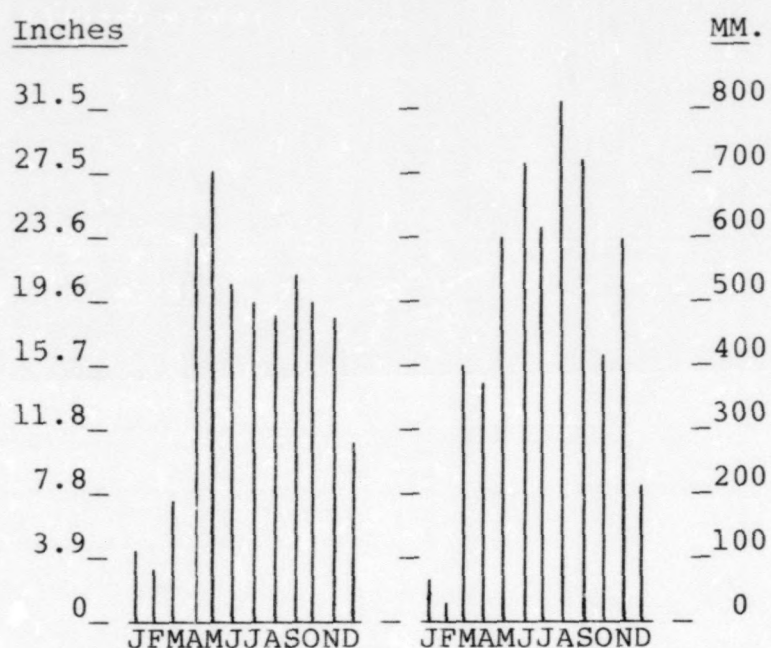
Monthly Precipitation

Station	Carimagua	Arauca	Gaviotas
LAT. N.	4°37'	7°05'	4°28'
LONG. W.	71°36'	70°44'	70°44'
ELEV. M.	220	122	183
d.o.d.*	1976	1977	1980

\* date of data

Source: HIMAT

FIGURE 7 - (continued)

Monthly Precipitation

Station	Villavicencio	Restrepo
LAT. N.	4°00'	4°18'
LONG. W.	73°48'	73°34'
ELEV. M.	498	450
d.o.d.*	1948	1973

\* date of data  
Source: HIMAT

This annual climatic pattern is a regular feature of life in the Llanos, as is depicted in the following poem, which was published in a local newspaper (Diario del Meta, vol. 248, 1984) in the Llanos, submitted by an anonymous author.

Rain Water

Water falling from the sky,  
Pure water like a spring,  
Water giving life to life,  
Water, you are the natural balance.

Water wandering where you may,  
Water calming this desperate thirst,  
Water, you are health and energy,  
Rain water saturating my existence.

Water from the sky,  
Which fills, reimburses, recaptures,  
Rain water who replenishes the reservoirs  
of villages, towns, and cities;  
Saving the existence of life.  
Rain water that I gather in canals;  
Sweet, clean water.

Water, the origin of birth  
And tranquil death, and without being.  
We drink with the greatest of pleasure  
Hand in hand  
Watching you rain.<sup>4</sup>

This characterization of life in poetry provides an insight into the influence of the rain upon the llaneros, or cowboys of this savanna region. Not surprising then is it that an expression such as "live the life of the climate" is

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<sup>4</sup>Translation by Craig Campell, graduate student,  
Department of Geography, University of Kentucky.



common here, implying the necessity of adapting oneself to go as the climate goes. While there may appear to be environmental deterministic attributes about such a philosophy, nevertheless certain aspects of life here are greatly influenced by the seasonal wet-dry rhythm.

For instance, there is now no technology available that will stop the annual inundation suffered upon much of the region from the seasonal rainfall. A major concern, therefore, is the control here of the waters which are essentially the 'essence of life and development' (Diario del Meta, v. 248, 1984). The article from which this phrase was taken spoke of the need in the region to make use of the technology and the ecosystem properly, for by the year 2000 A.D. the Meta region shall be the 'larder of Bogotá', and Villavicencio is forecast to be a major industrial city of Colombia, one with access to tremendous natural resources. The Llanos are spoken of as a 'sea of green earth'. The priority of the proper harnessing and use of water for industry, agriculture, and domestic purposes is an issue in planning and development which this frontier region now faces.

The eastern plains of Colombia are ultimately drained by the Orinoco River. The southern rainforest drains into the Amazon Basin. The two systems are separated at roughly two degrees north latitude. To paraphrase Jacques Cousteau, the rivers and streams are like the roots of the ocean into the land. In the Llanos, the ocean's main root is the Orinoco,

and its left bank branches are the rivers Arauca, Apure, Meta, Vichada, Guaviare, Inirida, and Atabapo.

Orinoco means 'a place to paddle', that is, a navigable place. Its source is at 3,353 meters elevation in Venezuela at about  $63^{\circ}21'W$ ,  $2^{\circ}19'N$ . Early in its course it undergoes a bifurcation, a unique feature which links it with the Amazon drainage system. The Orinoco flows through undeveloped grasslands, serving as the political boundary between Colombia and Venezuela across two degrees of latitude. Large river steamers can proceed from it's mouth upriver to about 6 degrees north latitude, a distance of about 1165 kilometers, to just above its junction with the Meta River, as well as up the Meta itself. In places in her lower course the Orinoco is over 8 kilometers wide, with a broad floodplain.

von Humboldt travelled up the Orinoco in 1800. His journal tells of encounters with wandering tribes of nomadic hunters and fishers, who suffered in the "violent heat, excessive humidity, bad nutriment, and pestilent exhalations" (Humboldt and Bonpland, 1819).

At that time, the only white settlers were the Jesuit missionaries. In this land of fever and disease, the government had no reach. A traveller could expect to be left in peace not if he had a letter of transit from the political governor of the region, but rather one from the president of the missions. Too, commercial exploiters were held in disfavor; at places on the river where portage was necessary, the Indian porters were sometimes less than careful with the

goods of merchants, so that often they went no further. There was evidently great respect for one's personal property, however. Stealing was said not to be a problem.

von Humboldt advised that the solitary traveller should camp well in the open between two fires as protection against alligators and jaguars. He relates that he once had to resort to pistol fire to ward them off. Henry Bates (1962) tells, however, of "firing a heavy charge of shot at them (the alligators), aiming at the vulnerable part of their bodies, which is a small space behind the eyes, but this had no effect other than to make them give a hoarse grunt and shake themselves; they immediately afterwards turned to receive another bone which I threw to them".

Above the junction with the Meta, the Orinoco passes through two series of raudales, or cataracts. The Raudales de Atures are nine kilometers of granite boulders, reefs, and gorges, where portage is necessary even for canoes, although the total elevation decline is but 90 meters.

Some 58 kilometers further upriver are the Raudales de Maipures, named, like the Atures, after the native Indian tribes of the region. The Raudales de Maipures rush over six kilometers of falls, declining a total elevation of 15 meters.

The Vichada River, a black water river, enters the Orinoco at about five degrees north. The Guaviare River, a yellowish-white argillaceous (containing clay) and alligator inhabited river enters at about four degrees north. Here, the elevation is about 1700 feet above sea level.



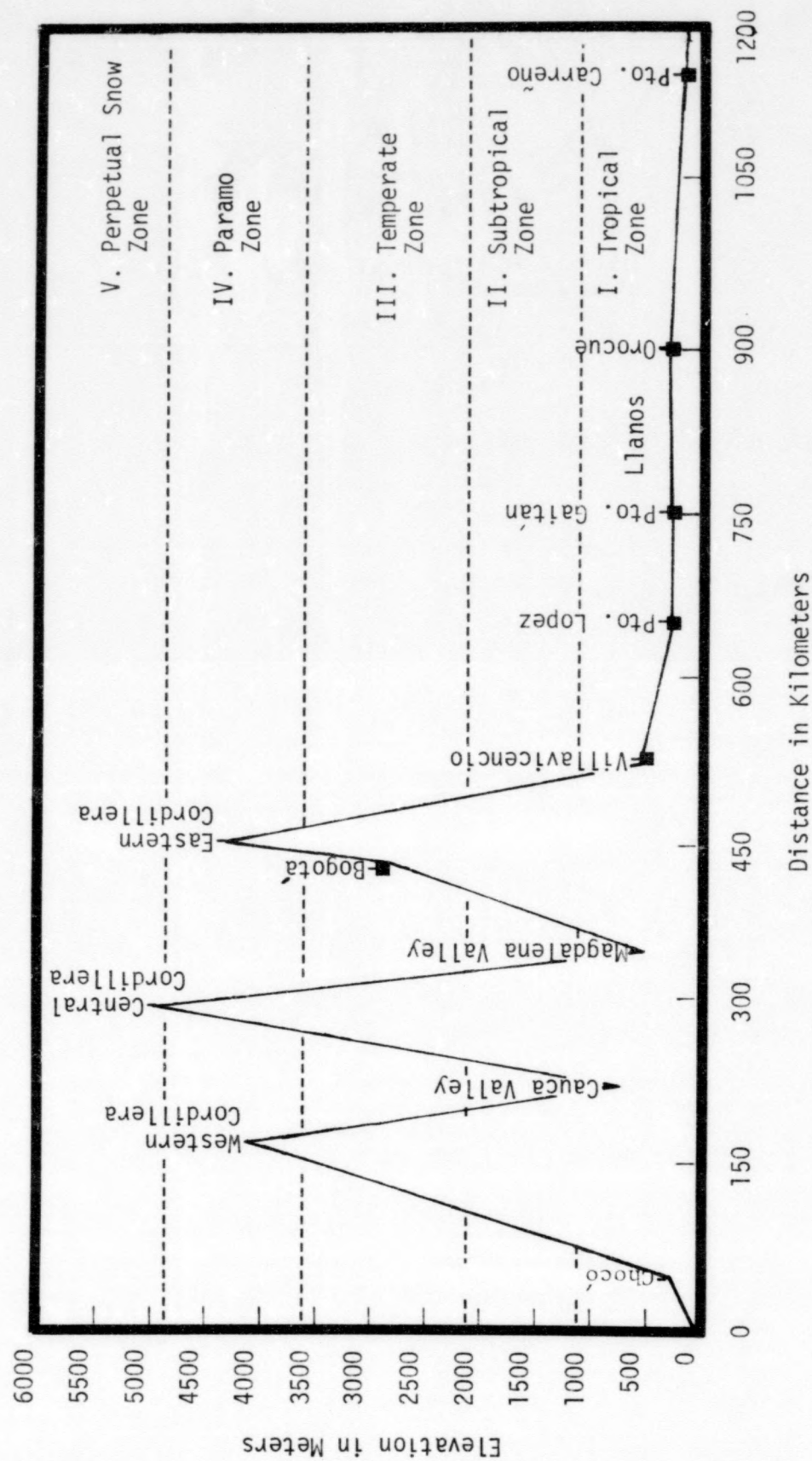
The Guaviare, sometimes termed the Western Orinoco, is navigable to its farthest headwaters, the Guayabero and Ariari Rivers. These two tributaries, which rise in the Andes Cordillera Oriental, are navigable to varying lengths dependent upon the time in the wet-dry seasonal cycle. As is the case with many of the streams of the region, they are in part intermittent, overflowing their banks in the wet winter, invierno, and subsiding or even ceasing to flow in the dry verano, or summer. Some streams form in the dry season terraced areas, playas (emerged sills) and charcos (meres).

Colombia is an equatorial country. As a result of this locational factor, her climate displays in the lowlands an isothermal effect, whereby the temperature remains approximately equal year round. Trewartha (Espenshade, 1974) indicates that the Llanos are in an 'always hot' (above 68 degrees F.) temperature zone. This is the tierra caliente, or hot lands, as depicted in Figure 8, which displays a cross sectional view of Colombia from the Pacific Ocean to the Venezuelan border. The Llanos lie within the tropical lowland climate, while Bogotá, some 100 kilometers to the west of the city of Villavicencio, lies well upon the tierra templada, or temperate zone.

An interesting climatic distinction occurs sharply where the Andes barricade the Llanos. Bogotá does not receive the quantity of rainfall that the Llanos do. In June, the northeast trade winds blow across the Llanos, carrying much moisture from the Atlantic ocean, accounting for the heavy rainfall that occurs.

FIGURE 8

Colombia In Profile  
Showing Vertical Climate Zones



Vertical Exaggeration X 100.

Source: Bates, Marston, for zones. Profile adapted from map: Colombia, Mapa Fisico, Denoyer-Geppert Co., Geography Map Library, Western Kentucky University.

As the clouds approach the Andes, they are forced upwards, resulting in orographic precipitation (as clouds rise, for every increase of 1000 feet of elevation, the temperature decreases 3.5 degrees fahrenheit). Cooling and condensing cause the rainfall. Great amounts precipitate as a result of two sizable physical features: the Atlantic with its endless supply of moisture, and the Andes, forming a tremendous and abrupt barrier to the progression of the travel of the tradewinds. The moisture is largely depleted from the clouds by the time the air masses pass over Bogotá.

In December, the Llanos dry season, the lack of rainfall results from the noon sun position perpendicular to the Tropic of Capricorn. This in turn causes the Southeast trade winds, which must travel over an extensive land mass prior to reaching the Llanos. During this time, most of the moisture content has been deposited in the Amazon Basin.

Trewartha indicates that the barometric pressure reading for both January and July in the Llanos is 1014 mb (Espen-shade, 1974). His wind pattern scheme shows that the winds predominantly originate with the N.E. and S.E. tradewind systems, alternating within the Intertropical Zone of Convergence (I.T.C.). Not discernible from Trewartha's charts is that the Llanos have an alternate wet-dry annual seasonal variation (Aw). The wet-dry pattern results from the annual migration of the I.T.C., which is a low pressure area between the N.E. and S.E. tradewinds. The I.T.C. shifts north and south of the equator with the seasons; when it crosses the Llanos, it causes the rainy, wet "winter" season



there. The relative humidity in this season is about 80% (Goosen, 1972), and about 50% to 60% in the dry season.

What do the people do with all of the water? This is a problem of significant proportions. Once the rain has fallen, gravity continues to work. The return of the water to the sea through the networks of waterways begins. Along the way there is tremendous potential for its utilization, if gravity can be harnessed.

It has been written that "in the final analysis it is climate which often dictated the economic feasibility of agricultural production" (Shelton and South, 1974). The agricultural potential of the volume of water which could be captured in the rainy season in the Llanos, then released as needed in the dry season (Diario del Meta, vol. 248, 1984) surely merits study. While regional developmental planning is beyond the scope of this study, computer-enhanced water budget calculations for the Llanos, based on data obtained from HIMAT in Bogotá and processed at the Kentucky Climate Center at Western Kentucky University are presented in Appendix II, following Mathers' summary of water budget ("the accounting of moisture inflows, outflows, and storages," Mather, 1978) in Appendix I.

#### Vegetation and Fauna

The earth is covered by four basic vegetational types: grassland, woodland, tundra, and desert.

Grassland types includes lea, meadow, and pasture, which are often near water sources, resulting in a moist

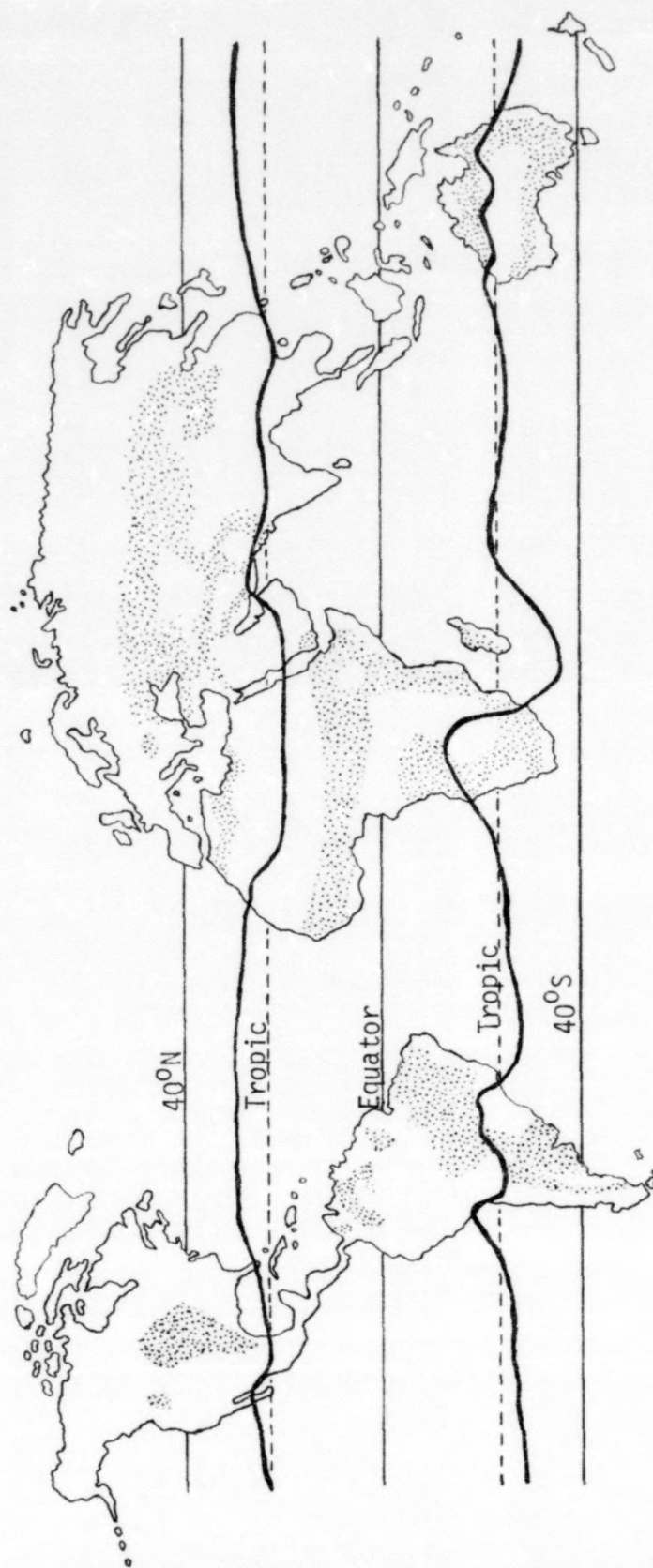
soil. On the plains, where there are few trees, the land is often flat or level. There are prairies, also treeless, covered with tall grasses in their natural state, and there is savanna in warm climates.

There are generally five types of grasslands recognized as naturally occurring in the world (McIlroy, 1972). These are the savanna grasslands, the grass steppe, the shrub steppe, the desert scrub, and the alpine grassland. It is the savanna grassland with which the present study is concerned. Grigg (1970) states that "the term savanna was originally used to describe treeless tropical grassland in South America, but has since been extended to include a variable combination of trees, grasses, thickets, and shrubs." He further qualifies the nature of the savanna as being such that they nearly always occur in tropical areas with alternating wet-dry seasons. This type of alternation is not of necessity indicative of a monsoon season (Whyte, 1968) of which there are none in South America.

Temperate grasslands abound on the globe. The veld is the grassland of Africa, the Pampa are of Argentina, the Steppe are of Russia. North America contains the Great Plains, the Texas Prairie, and the Palouse Hills of Oregon and Washington.

Within the tropical or subtropical regimes there are the grasslands of Northern Australia, subequatorial Africa, and of South America, especially of northeastern Brazil and the Llanos of Colombia and Venezuela (see Figure 9). There is

FIGURE 9



### Tropics and Grasslands

Map of the world showing Tropics as "area north and south of the equator which is included in the 18°C isotherm (heavy lines) for the coolest month of the year" (Humphreys), and global distribution of major grassland areas (shaded). Tropics map after Humphreys; grassland locations after Naden.



approximately 40% of the earth's surface in the tropical region (Barrett, 1928).

Most of the worlds grasslands have been greatly modified by man. The Llanos region is one of the few remaining areas where man has yet to intrude significantly.

Grasses once covered 40% to 45% of the earth's surface. Due in part to man's influence, that figure is now estimated at 20%. Grasses are the most important plant to man. We depend upon three groups for food: cereal grasses, the grains of which, like rice, wheat, rye, barley, corn, and oats, are eaten by all of mankind around the world; sweet grasses like sugarcane, the juices of which sugar and molasses are made; and pasture grasses, like Bluegrass and Bermuda grass, upon which livestock are grazed.

Within the Llanos, the vegetative cover varies by locale, as manifested in part by differences in elevation above sea level. Bates (1948) offers the following scheme which broadly classifies those differences:

<u>Elevation (meters)</u>	<u>Vegetation</u>
1200 or more	mountain vegetation
1199 - 500	foothill forest
499 - 200	piedmont forest
200 or less	savanna and galleria

Bates designates 1200 meters as the upper limit of the tropical life zone, above which is mountain vegetation. The differentiation in foothill and piedmont forest is that foothill forests are on the slopes of the mountains between 1200 and 500 meters, while piedmont forests (including rain

forests) are at the base of the mountains and below 500 meters.

There are three or four main types of savanna in the Llanos, depending upon the authority. McIlroy (1972), defining the area within the bounds of average elevation of 215 meters, annual rainfall norm of 80 to 180 centimeters, and average annual temperature of 20 to 28 degrees Celsius, declares these to be the open savanna, where there are the grasses alone; the orchard savanna, with scattered bushes and brush; and the palm savanna, with palm growth such as galleria forest and dry palm groves.

Another interpretation of the classification of the variety of savannas is that of Blydenstein (1967). Here the vegetation of the plains is separated into four major groupings, utilizing variables such as floristic characteristics and humidity levels. From these he determines that a vegetational segment of the Llanos is related by the occurrence of relict forest within them, indicating change over time. There are further the dry, humid, and inundatible savannas, which Brunnschweiler (1972) simplifies by indicating that the main distinction between them lies within the realm of their drainage capability for handling the annual rains.

Galleria forests are those which thrive along water courses. Here is much variety in species, including the moriche palm, the broadleaf evergreens (near the Andes), and the xerophytic chaparro (scrub oak) trees, and the dwarf palm.

In review, it is seen that the savanna has distinct geomorphological variations. The Eastern Plains of Colombia contain a vast intermixing of forests and savanna, notably the Llanos Altos (High Plains), which run parallel to the Andes and spread south and east below the Meta River; and the Llanos Bajos (Low Plains), which occur north of the Meta River and in the Orinoco River floodplain of Venezuela.

Local nomenclature for topographic peculiarities include the following: surale, an ant or termite-mound infested landscape; estero, a flooded bajo (low area); serrania, the dissected hill land; llanura aluvial de desborde, the floodplain (Rucinke, 1972).

The savanna grasses vary in height from high grasses of up to ten feet, where the precipitation is greatest, to the tall grasses, the midgrasses, and the short grasses.

Referring once more to the aerial photograph in Figure 6, there is clear evidence of burning of large areas of grasses by the burn scars (Denevan, 1977) in a roughly triangular pattern, darker than the adjacent grasses. McIlroy (1972) suggests that "ecology may be defined as the responses of a plant population to its environment". If burning of huge tracts of open savanna are part of that environment, then perhaps the savanna as a whole is a response to this. Perhaps man has helped cause the savanna to exist. Indeed, this is the basis for one of the arguments about the theory of the origin of these Llanos, that of the anthropic influence. Other explanations for their origin are



climatic, pedologic and edaphic, and geomorphic and biotic (Hills, 1965), or a combination of any or all of these.

Of further interest in Figure 6 are the dendritic drainage patterns of the eroded, dissected hill land, which levels off to bottomland where there runs a broad river (not shown). Along the gullies are gallery forests where thick stands of trees and palms thrive. On the flat parts of the plain water may be standing, unable to drain away or to permeate the waterlogged topsoil.

The savanna and its vast dendritic waterways is vegetated with gallery forests. These are home to a collection of diverse creatures, some of which feed on others. Mammals include the capybara (the largest living rodent on the earth), shrew, gophers, mice, rats, and bats. Less common are rabbits, deer, anteaters, armadillo, jaguar, and tapir. There are snakes, and turtles. Birds include white owl, burrowing owl, oriole, hummingbird, eagles, cranes, herons, ducks, swans, parrots, parakeets, and finches. Rivers contain many fish, among them large catfish, and voracious caribe (piranha); rivers provide habitat for caiman and boa constrictors, and electric eel, which will numb a person to unconsciousness if they even strike the bottom of his canoe. There is also the raya -- a flat fish that lies in the mud, has a hooked tail, and if it is sick and it stings a person, this will cause gangrene.

Ponds contain salamanders, toads, hordes of bullfrogs that croak in the evening with a sound like the moans of suffering savages, and turtles. In the Llanos there are many insects such as black wasps, beetles, butterflies, gnats,

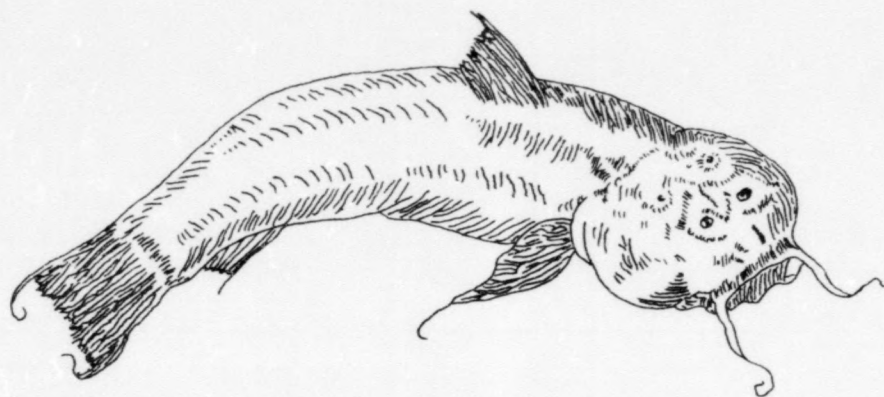
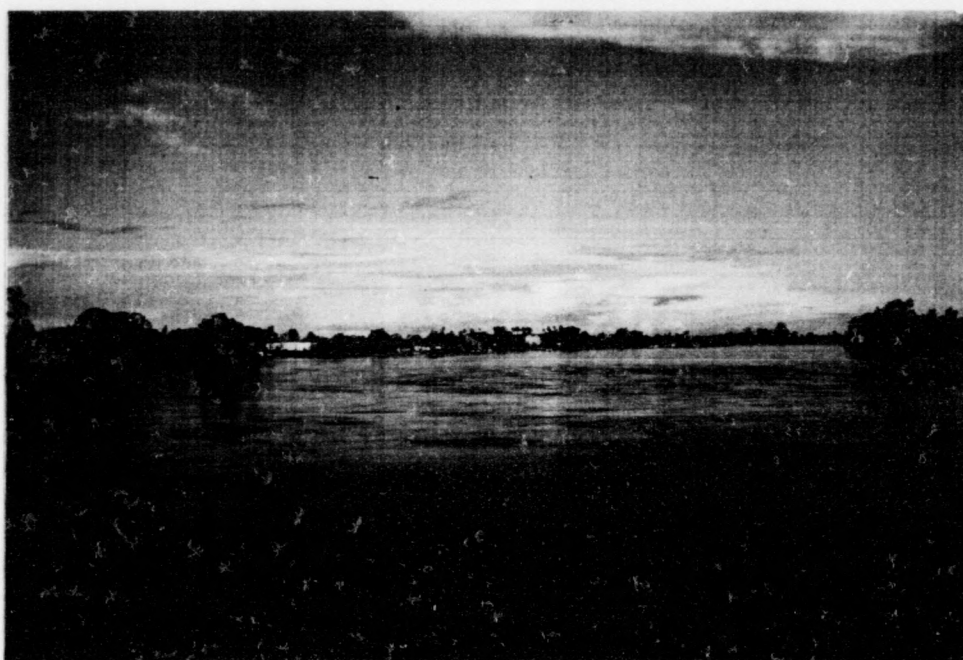


Figure 10. "A sketch of a South American catfish, from von Humboldt's journal" (from Botting, 1973).

grasshoppers, ants and termites (responsible for the surale mounds), and mosquitoes. The mosquito was responsible for the near destruction of the town of San Martín, where in the 19th century malaria killed many of the town's residents.

In some instances it is estimated that the number of insects may reach 100 per square foot on the land surface. Large numbers of insects result in an increase of the biomass bulk. Defined as "living weight" (National Research Council, 1982), the biomass weight is predominantly composed of plant matter, but the insect and animal component may influence the effect and state of the plant biomass. The more active of the insects are the termite, the grasshopper, and the ant.

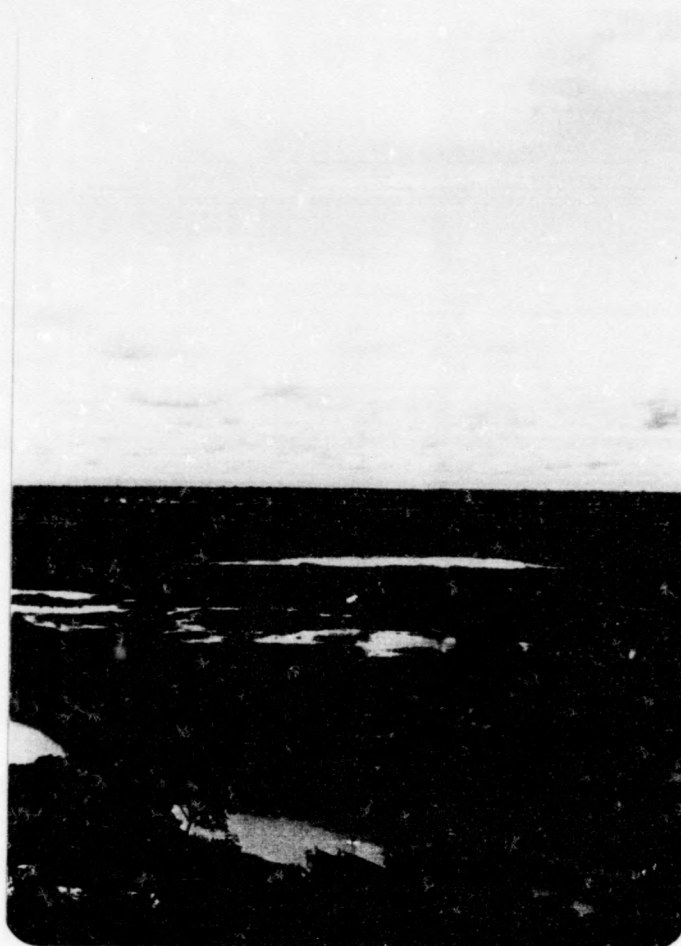
PHOTOGRAPH 1



The Ariari River broadens as it flows southward  
past Puerto Lleras.

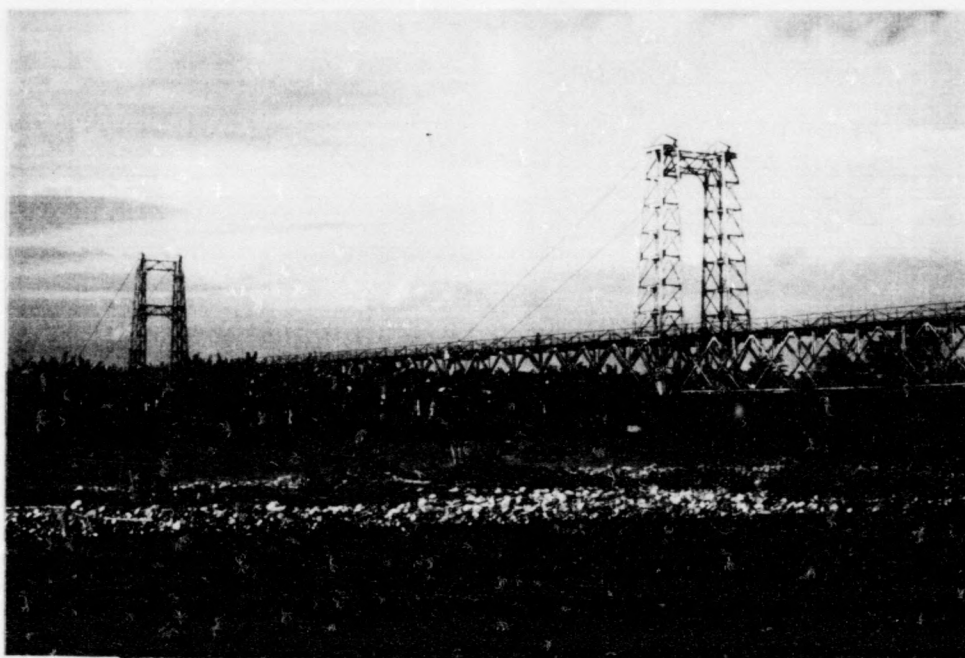


PHOTOGRAPH 2



Inundated floodplain of the low-lying Meta  
overflow plain, subject to poor runoff.

PHOTOGRAPH 3



The only bridge across the Ariari River. Located between Puerto Caldas and Granada, this is a one lane bridge, used by pedestrian traffic as well as motor vehicles.

## PHOTOGRAPH 4



Quiet caño off the left bank of the Ariari  
River, two kilometers north of Puerto Lleras.



PHOTOGRAPH 5



Street improvement in downtown Granada. On the left-hand side of the street, the existing condition. On the right-hand side of the street, the street has been readied to receive concrete.

PHOTOGRAPH 6



Puerto Lleras is located on the left bank of the Ariari River, along the dirt frontier road parallelling the Andes. Economic activities here include fishing, agriculture, retail and service enterprises.

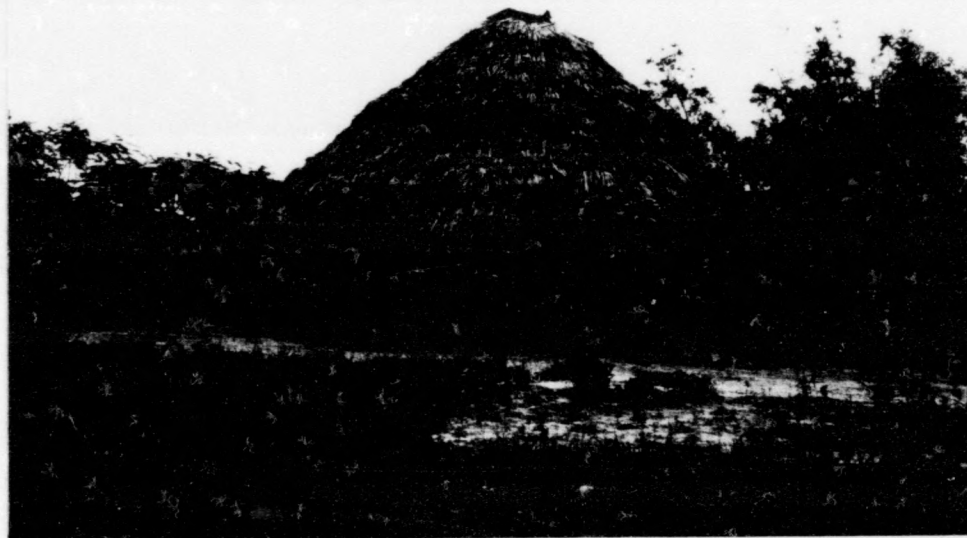
PHOTOGRAPH 7



Inhabitants of a dwelling along a piedmont road.



PHOTOGRAPH 8



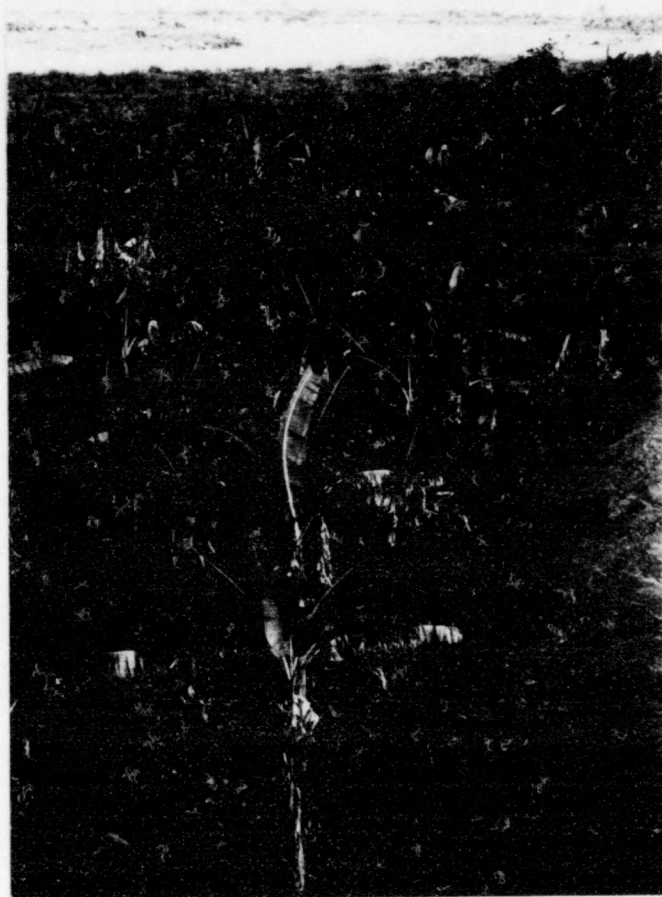
A bamboo kiosk, providing shelter from the heavy rains and the sun's heat alike, is a central location for social relaxation in Llanos villages and towns.

PHOTOGRAPH 9



A young pineapple tree in a poorly tended field.

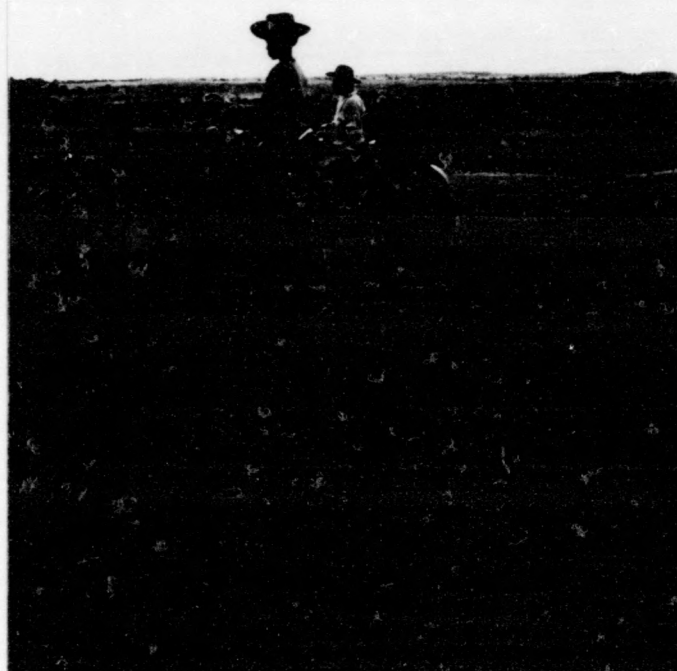
PHOTOGRAPH 10



Island subject to annual periodic inundation is utilized by farmers to grow plantain.



PHOTOGRAPH 11



High plains ranch hands cross the vast natural pastures,  
which are chiefly used in grazing.

## CHAPTER III

### MAN IN THE LLANOS ENVIRONMENT

#### Human Population of the Llanos

A sociology principle states that "human behavior is largely shaped by the groups to which people belong, and the social interaction that takes place within these groups" (Robertson, 1977). Learning from one another the patterns of behavior and life is a function of culture; more specifically, it stems from the chronological era plus the geographical areas in which the culture exists.

Bowman (1931), writing of the Hispanic culture in Latin America, remarks: "that which is customary has the force of the law, as one may test almost anywhere and standing upon the custom of the country."

With the beginnings of the settlement of a natural landscape, the intruding culture utilizes the surrounding physical environment. The human element within the ecosystem becomes a factor leading towards the "effective settlement" (Brunnschweiler, 1972) of the region. If, in its most basic form, "settlement is where people huddle around" (Hegen, seminar lecture, 1983), there was effective settlement of the Llanos by Indians in the pre-Hispanic period. After the Spaniards began to colonize and have an influence upon the Llanos and the "effective territory" (Hegen, seminar lecture,

1983) of the Andes, they left as "ineffective territory" much of the Llanos. Bowman (1931), tracing the cultural history of Latin America, indicates that "one of the most extraordinary features of South American life is the persistence of the frontier conditions through the centuries since the conquest." A further note of interest offered by Bowman (1931) is that many of those settlers which constitute the "pioneer fringe" consist of "freeman and fugitives (both criminal and political) who live there often to be beyond the reach of the law."

The Llanos of the present time period are not the undivided frontier region to which Bowman refers. The demand of recent decades for food products for a hungry nation and for export to provide international purchasing power for those articles not otherwise available have been the impetus for man to settle more of the usable land in the Llanos.

Initially man's economic pioneering followed lines of transportation: roads, rivers and the Andes piedmont. The agropecuario (agricultural and livestock production) base has accompanied spatial spread (Hegen, 1963), and is established in rice and cattle raising. These have increased from fundamental subsistence activities to competitive and complementary commercial enterprises where market-access allows financial investment implementation.

Geographic literature is available from authors that have documented the progression of man's land pioneering activities in the Llanos. Their investigations detail the



progression of agricultural subsistence (Crist, 1932; Rudolph, 1944) and the increase of the demand on the land (Crist, 1956; Stoddart and Trubshaw, 1962; Tinnermeier, 1964; Holt, 1964). Man's easterly spatial spread in colonization and settlement is presented in light of agricultural colonization problems (Stewart, 1968) and migrations (Clawson, 1982). A broad regional overview (Crist, 1973) presents ready general considerations; specific coverage of agriculture, livestock and the natural physical environment (FAO, 1965) has been undertaken; and there exists an especially qualified source on many of the essential characteristics and features of the Llanos (IGAC, 1983).

In deliberation of the above, this chapter will include surveys of Llanos population characteristics, followed with features from field experience pertaining to the human geography of the Colombian eastern frontier.

#### Population Data

Many details and attributes of the culture of man as he settles the land and utilizes the resource base may not be readily perceivable from an examination of population data; but in determining the degree of man's influence in the ecosystem, a consideration of the scope of the influx of man into a region is appropriate.

The total population figure for the Llanos of Colombia was 1,577,000 in 1972 (The New Encyclopedia Britannica, 1979). The Llanos, trending eastward from the Andes, have accrued a denser population concentration toward the Andean

piedmont outlets as the population pressure in the highlands has caused a spilling over of settlers eager for land.

The Department of Meta has absorbed the larger portion of this human tide. The largest department of the Llanos in area, Meta encompasses 55,100 square kilometers, and had in 1964 a population of 165,530 (Brunnschweiler, 1972), or about 3 persons per square kilometer. Although more densely populated than the Llanos on average, it may, however, be assumed to be reflective of the region in terms of population characteristics.

The population for Meta in 1973 was 242,664 (DANE), or an increase of 68% in a decade. Approximately 77,000 persons were immigrants, who, while spanning all age groups, predominantly range within the 15 to 40 year old age group (DANE, 1978). These newcomers marry and produce offspring, who are considered native to the region. A population pyramid of the age-sex groupings for the total population would show the typical broad based structure common to Third World countries (DANE, 1978). In 1973, there were in Meta 41,572 females in the 0-5 years of age category, and 44,782 males, as compared to 951 females in the 75 years of age and over group, which had 577 males (DANE, 1978). Generally, though, there is a greater number of males than females throughout all age groups.

Population growth projections for Meta provided by DANE display a birth rate of 42.9 per 1000 in 1973, a death rate of 10.6, to yield a natural increase of 32.3 per 1000. Adding to this a net migration of 19.1, the population

increase will be 51.4 per 1000 yearly. DANE has calculated that this figure will decrease to 51.0 between 1983 and 1988, to 43.4 between 1993 and 1998, and to 38.9 between 2003 and 2008.

The immigrants to Meta, while coming from all parts of Colombia, predominantly originate in the Department of Cundinamarca (DANE, 1978) and from the national capital city of Bogotá, as well as from the Colombian states of Tolima, Boyacá, and Valle.

Lastly, DANE's (1978) figures show that for 1973, there were 128,699 inhabitants of Meta living in towns or urban areas, while 100,137 inhabited the rural or farm areas, with no information for some inhabitants.

#### People of the Towns

In the course of fieldwork the writer, after walking 2 km northward along the road from Villavicencio on a typically rainy winter day, met and interviewed a young man who was clearing land. Juan Alejandro G. was busily employed removing shrubs in a mango orchard, which also served as a cattle grazing pen. A dwelling on the land was undergoing a conversion into a community center to be used for meetings and dances.

Nineteen years old, Juan is the youngest of his parents' five children, aged 19 to 30. His mother is 54 and his father is 59. One employee aged 41 lives with them. The mother and father both attained a primary level education, and all of their children attained the secondary level. The



distance Juan had to travel daily to school was 8 km, which required using public bus transportation.

Juan's father is presently retired and has a pension, and his mother is a housewife. One of his brothers is a bus conductor in the Llanos; one of his sisters has moved away to the mountains north of Bogotá to gain employment.

The family had no serious illnesses in 1983 other than grippe; nothing required hospitalization, nor were there any serious accidents in the family. The diet for the family consists of a steady regimen of milk, eggs, lard, oil, bread, butter, vegetables, fruits, rice, beans, and, on occasion, meat, fish and cheese.

The family has access to, or occasionally utilizes, television, radio, records, or movies. Additionally, they occasionally attend religious services in the town. At least one member of the family belongs to a sports club or a civic organization. Participation in these are affected by the distance to the activity, lack of organizations of interest, lack of personal transportation, and personal reasons.

On an average of once a month the family purchases of medicines, clothing, shoes, and other major needs are made. Twice or more per month purchases are made for food supplies.

Juan has travelled to Bogotá, north to Boyacá, south to Neiva, and east to Vichada. He is acquainted with the region. His family owns a car, a truck, and bicycles.

The family members have lived in their present dwelling, which they own, for 18 years. It needs no major repairs.

It has four rooms consisting of two bedrooms, one kitchen, and one indoor washroom. In the interview, Juan estimated the living space at 30 square meters, perhaps a low estimate.

They have a washbowl, open drainage, no latrine, and no hot water. Electricity is obtained from a public network. Gas is used for cooking. The water is of drinkable quality, with a sufficient supply available year round; the source of the water was not indicated. They have a garden with fruit trees. The land is one single owned unit, size not indicated, with no additional landholdings. There is permanent road access to the town.

The family is not a member of an agricultural organization because the conditions are not right for a cooperational nonprofit group of people with similar interests. Fertilizers of manure and vegetation matter are utilized on their land, which is 50% in fruit trees and 50% in natural forest.

The father's pension was the only source of income mentioned. The family receives occasional technical assistance from a government program. They have year round production of mangos. They also have chickens for eggs.

Juan considers his living conditions acceptable because he is able to receive education, personal stimulus, and social status. However, he indicated that he may leave in a period of time of necessity to go to Bogotá. He stated that he desires the better civilization there, and desires more public services to better his life. In fact, the primary ambition of

his family in the improvement of their life was a modification of the home, but the major obstacle to this was a lack of money. Juan has no suggestion as how to overcome this.

Another man the writer met in the Llanos in 1983 was Francisco "Pacho" T., who worked as a hotel administrator in the town of Puerto Lopez. He was 54 years old, his wife 48 years old, and they had a son 11 years of age living with them. The other son was 25 years old, had a wife and baby, and lived 90 kilometers away in Villavicencio.

"Pacho" had worked at the hotel for a year and was very clever with the business of paperwork, electrical wiring, and general maintenance. He reads and writes well in both Spanish and English. He had lived for five years in Connecticut away from his wife, working at various jobs before returning to the Llanos. His eleven year old son was in secondary school, was learning English from the father, and was a Boy Scout, attended church and played soccer.

"Pacho's" wife worked as the head of guest services at the hotel, and had one female employee who worked as the laundress and the maid.

The health of the family was good; they had a staple diet of vegetables, fruits, soups, cheese, rice, and fish.

A year later in a follow-up encounter with "Pacho", it was found that he no longer worked at the hotel, because he had been discharged for business reasons. He was then working at his eldest son's retail record and cassette tape shop in Villavicencio. The entire family was then intact and



lived in a rented three bedroom apartment which had electricity, water, bottled gas, bottled drinking water, and an indoor shower and plumbing.

The family had a color television set, a radio, a 175 c.c. motorcycle, and one bicycle. The youngest son had a bedroom to himself. While doing well in appearance, the wife was unhappy due to her desire to emigrate to the United States to live with her mother in Miami. However, this would be expensive, and visas are difficult to obtain due to quotas.

While in Villavicencio, where these people lived, the writer took a survey of the market prices of basic foodstuffs and commodities. The following table was compiled (the exchange rate for the U.S. dollar was 98 pesos in June, 1984).

TABLE 5  
COST OF GOODS, VILLAVICENCIO, JUNE, 1984

<u>Item</u>	<u>Cost(pesos)</u>
green beans	70/kilo
potatoes, small	30/kilo
onions	80/kilo
tomatoes	60/kilo
avocado	50/unit
plantains	120/bunch
saltine crackers	50/small box
canned franks	110/can of 8
marmalade	85/7 ounce jar
chocolate cookies	137/20 count
beer, national	25/11 ounce bottle
mineral water	20/11 ounce bottle
coca-cola, national	17/11 ounce bottle
yogurt	35/8 ounce carton
slice of pineapple	20/slice
cooked hot dog	40/unit
flan	50/4 ounce cup
eggs, scrambled	50/serving of 2
steak, rice, salad	150/serving

TABLE 5 (con't)

## COST OF GOODS, VILLAVICENCIO, JUNE, 1984

black coffee	10/4 ounce cup
pastry	20/unit
Napoleon Brandy	225/150 c.c.
Aguardiente liquor	360/700 c.c.
toilet paper	30/roll
disposable razor	40/unit
gasoline, regular	82.2/gallon
gasoline, super	92.2/gallon
photocopies	5/page

The price of the goods in the town was stable for most locations visited, with slight fluctuation by quality or quantity offered. Living in the town one realizes a stability of the economy, even one depressed. This applies, too, to rural colonists who visit the towns for supplies, for they are subject to the prices in the town.

Notes on the Comunitaria Texas

Throughout the Llanos, many colonos, or colonists, have staked out their claim to the land and are working to reap life-giving sustenance and income from the earth. One such location of this endeavor is the jointly worked comunitaria, or communal farm enterprise, of Texas, an INCORA-sponsored (Brunnschweiler, 1972) farmstead which is the home of six families.

INCORA is the Colombian Agrarian Reform Institute, or the Land Reform Institute of Colombia (INCORA, 1984). In 1962 INCORA assumed responsibility for the promotion and maintenance of the government-sponsored colonization efforts in Colombia (Rucinque, 1972). At that time it was estimated

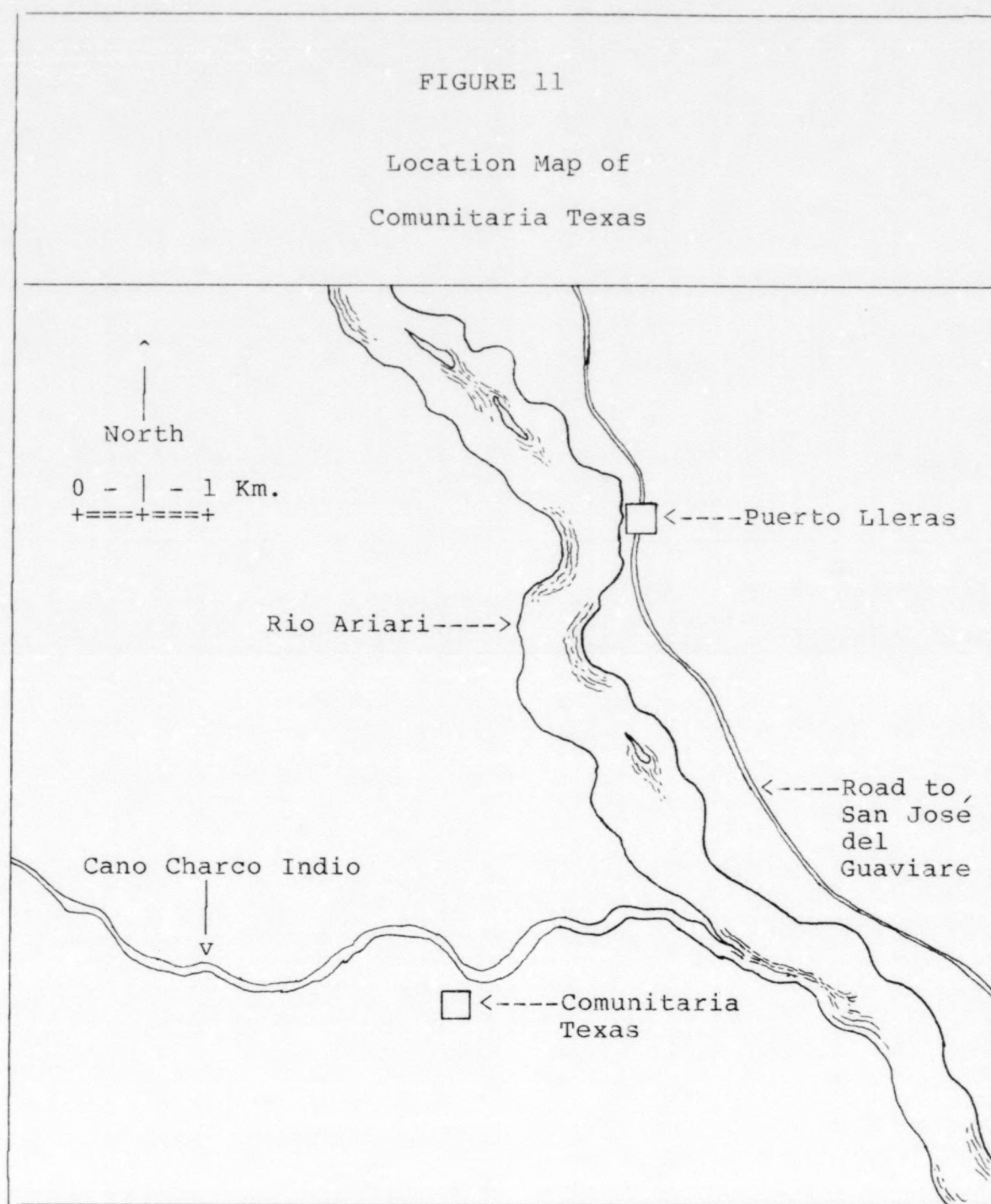
that there were about 100,000 families involved in spontaneous colonization in the country, bringing about the need for the granting of land titles for those presently in residence and conducting progressive activity on the land that they were colonizing (Rucinque, 1972).

Spontaneous colonization enjoys a larger constituency than does structured colonization. For INCORA to gain trust and respect among the colonists, it had to reliably and consistently offer "technical assistance in agricultural activities, assist with building new roads, offer credit and social services to the colonists" (Rucinque, 1972).

The family colonization project of Texas, under the structured guidance of INCORA, is located south of Puerto Lleras and is accessible in twenty minutes by motorized canoe or dugout by travelling downriver on the turbid argillaceous Ariari to its confluence with the stream Cano Charco Indio, which enters from the right (Figure 11). This stream is quite distinct in color from the light brown mud-filled Ariari, so that for a half a kilometer its dark greenish-black churning flow parallels the other before they begin to mix, producing a splendid display of fluid hydrologic beauty. Here it is necessary to proceed up the Charco Indio for some seven to eight minutes along its winding, placid, lushly tropical vegetation-lined course to arrive at the finca.

There is a surface road which connects the farm to the ferry station to the north, directly across the river from Puerto Lleras, but this track of unimproved road is





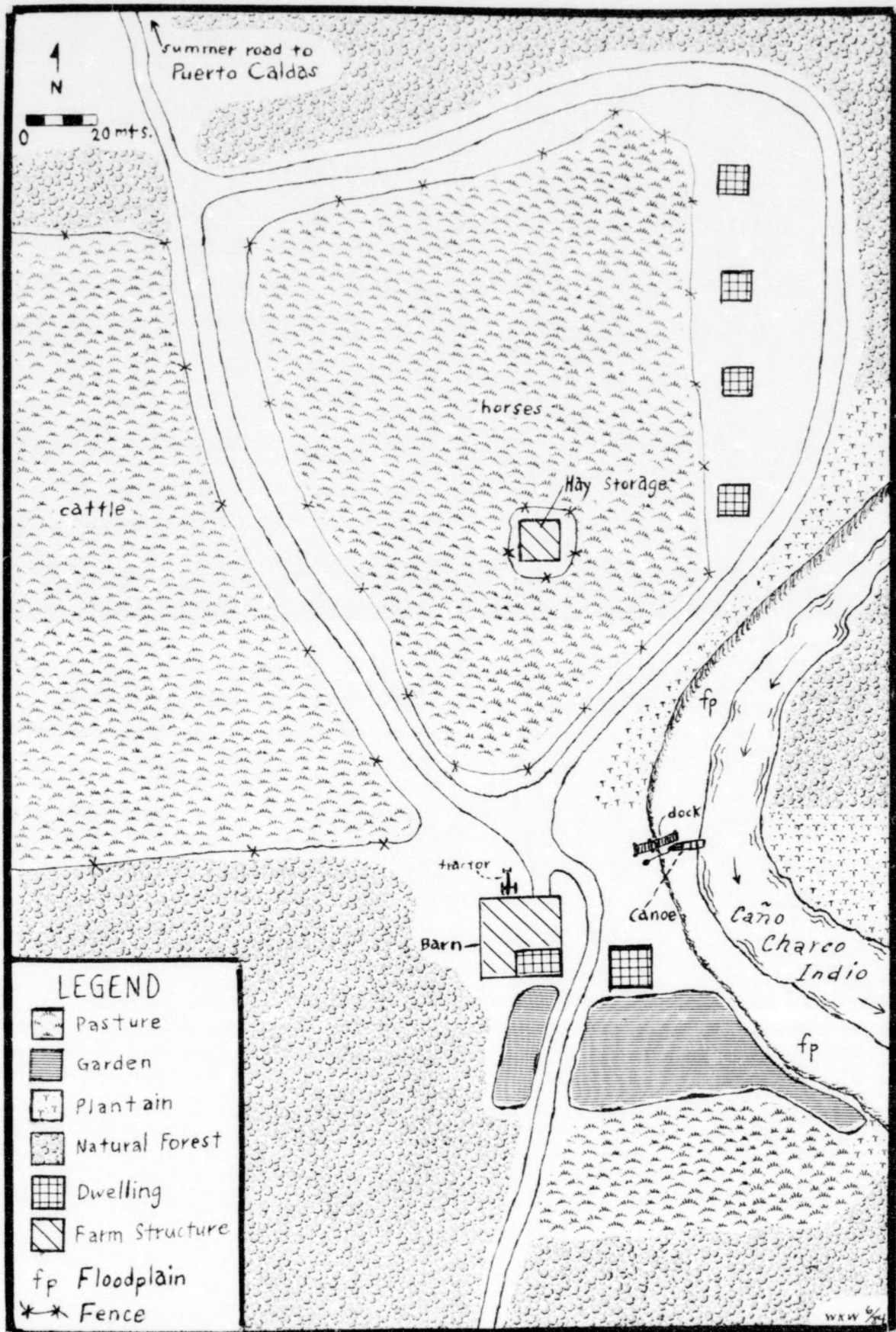
Distances:

- 190 Kms. Puerto Lleras south to San José del Guaviare
- 65 Kms. Puerto Lleras north to San Martín
- 10 Kms. Puerto Lleras south and west to Comunitaria Texas (approximately) by river route. At Puerto Lleras are located the nearest school, doctor and socio-economic center.

impassable throughout much of the rainy season, as it becomes waterlogged and mucky and unsupportive of any significant amounts of weight. This same road extends further north along this side of the river to the bridge at Puerto Caldas, the only such bridge across the Ariari. It is this righthand side of the river which historically sustains the most flooding. In 1961, the town of Avichure, located on this bank of the river about 18 kilometers north of Puerto Lleras, was washed away by floodwaters (Brunnschweiler, 1972). This places the Comunitaria Texas in a precarious location, one which someday might result in tragedy.

The approach via Charco Indio brings one through trees overhanging the banks to the stump to which the canoe is to be tied. As the craft glides through the water after the Johnson forty horsepower motor is turned off, then slips smoothly through the reeds over to the bank, the quietude of the area envelops one's senses. No longer the beneficiary of the pleasant breeze from the brisk canoe ride, one's body senses the stilled heat of undisturbed air and breathes in the heavy moistness of the humidity. In the midst of this hot, steamy piedmont selva, teeming with mosquitoes, wasps, spiders, ants and snakes -- man has come to make a home.

In the distance is a loud and clear confirmation of human presence - hammering. The first influx of families came to this spot in 1976 (Figure 12). For six families, 379 hectares were staked out cooperatively. Since that time, there have been changes in the makeup of the co-op as one family or another sold its interest to a new family.



FROM FIELD SKETCH OF COMUNITARIA TEXAS



The micro-governing structure here is a body of the member families who vote in the affairs of the group at meetings, of which the head of one family is deemed the president. As a body the community has had a cumulative debt of up to 500,000 pesos to INCORA for loans to purchase tractors, seeds, roofing material, and other farm supplies. The outstanding balance as of June 1984 was 200,000 pesos.

While they are in good stead with their loan accounts, it was the case recently that some of the family members had spoken to the INCORA representative against the president, indicating that they believed him to have not been fair with the group's money from crop sales which he had conducted. They wanted to be rid of the "robber" (in the INCORA representative's terminology). This man, the president, has a wife, two children, and is an original member of the community. He was observed to be the most active person present, directing the activities of the men as they worked about the farm. He had been the person to come to Puerto Lleras and fetch the INCORA representative precisely at the scheduled time, immediately after which back at the farm he had mounted a tractor to tow a four wheeled flatbed trailer to the field, taking three of the other men to begin work. One question which arises is whether the charges are correct as stated, or if the root of the problem lies elsewhere in the sociological realm of personal or group relationships and manifests itself in this way.

One particular problem on the finca is that of disease of man and beast. While one of the traditional solutions was to invoke prayer to be rid of parasites, the INCORA veterinarian instead utilized pharmaceutical practices. Being a concerned man and sincere in his work, he furthermore prescribed medicines for the human population at the farm for their physical distresses. Sickness and poor health is an accepted part of life for the majority of people in the Llanos, largely out of their ignorance of any method to counter the situation. However, even with prescription in hand, few have the extra money (or faith in the value of its expenditure upon medicines) to make the purchase from the apothecary in the town.

More important is it that the money be spent upon farm implements. Readily observable items of utility here bespoke of the basic nature of the lives of these settlers, as indicated in Table 6.

TABLE 6

## COMUNITARIA IMPLEMENTS

- tractors, Massey-Ferguson, two
- harrowing plows (disks), four
- flatbed trailer, four-wheeled
- horsetack
- bicycles, two
- battery, six volt, expended
- hydraulic jack
- canoe and outboard motor
- machete
- hand saw
- pitchfork (spading fork)
- chainsaw
- fishing net with cork floats
- wheel barrow
- spade
- shovel

TABLE 6 (continued)

- chisel
- trowel
- pliers
- claw hammer
- wooden mallet
- nails
- wire, light gauge
- rope, both leather and hemp
- 50 gallon drum for gasoline
- spool of barbed wire
- plastic tubing, 1" and 2"
- chicken-wire fencing
- brick, made on-site of earth
- cement
- zinc sheeting
- kitchen dishrack
- broom
- dishes
- arepa former
- dozen assorted pots and pans
- thermos jugs, two
- stove, kerosene-type
- kerosene
- instant coffee and milk
- laundry detergent
- transistor radio, batteries
- bird cage
- flower pots
- metal frame single bed

What comes of the use of these implements is a means of subsistence for these people through their expenditure of labor.

The farm had the following livestock: chickens, some new chicks, several ducks, and a dozen head of beef cattle. As pets there were dogs, cats, parakeets, and a parrot.

Agricultural activity here yielded the following on-farm consumable produce: yuca, mango, oranges, onion, avocado, tomato, and sugar cane. The only commercial crop consisted of platanos (Figure 12) from 8000 trees. For a man in town who wanted to purchase them, the president cut four platano



bunches of about fifteen-count each. He did this by hacking the trunk of the tree with the machete at shoulder height. It was felled with only four or five strokes, because it was a soft-fibered vegetative plant. The upper portion of the fifteen foot tree toppled, from which was retrieved one bunch of platano. This would net 100 pesos in town. From four trees came four bunches, and 400 pesos of income was at hand.



Figure 13. Drawing of a platano [Plantain (*Musa paradisiaca*)] tree (after Bates).

The remaining stump of the tree would grow again into a tree. This orchard was young and in good shape, and the platanos were healthy. Older, more mature trees are capable of yielding multiple bunches of fruit, but calculated at the present rate of one bunch per tree, the commercial worth of this orchard at present figured as 8000 trees by 100 pesos per bunch for 800,000 pesos, or four times the outstanding balance of the debt owed by the comunitaria to INCORA.

It would not have been possible, however, to liquidate at once this harvest. The local market area has an abundant number of competitive suppliers for this product, and there are too few local consumers to have an impact on the daily demand of one product. A means of bulk shipping to distant markets is nonexistent. Practically any place in the Llanos could grow this same crop. Beyond the Llanos region, the point of diminishing profit return for shipping makes the undertaking unfeasible.

Nevertheless, this farmstead has its existence within the ecosystem. At the penetration site of Texas, the land is utilized primarily for survival and small-scale exploitation, thus falling within the transition from Stage I to Stage II of the table of the effects of man and cultural intent on the environment (Hegen, 1967).



Figure 14. Drawing of a mango (after Bates).

In a humid tropical climate an abandoned area will be overgrown and deteriorated as unattended land is soon reclaimed by the rapid and dense growth of the river forest

in its year-round growing season. Regarding the history of the Llanos, it is known that "Whole villages of the colonial period seem to have vanished.... The spot where (San Juan de Arama) stood is now covered by the jungle" (Martin, 1929).

When man first enters this ecosystem, his primary task is the clearing of the land. At Texas, the land that has been cleared for pasture has been planted, in accordance with the technical advice of the INCORA representative, in Bracharia decumbens supplemented with tropical kudzu [Pueraria phaseoloides] (McIlroy, 1972), a legume which requires a long, warm, wet growing season. The colonists' loans are in fact dependent in part upon cooperation with supervised practices outlined by the governmental bureau, checked periodically for colonist compliance. Ostensibly a commendable practice, there are in fact too few technicians in ratio to the great number of colonists. Additionally, as dedicated as they are, the officials face the statistical reality that daily in the Llanos there are many new mouths to feed, and perhaps no new INCORA people to give the needed instruction, as the economic situation of the 1980's in Latin America manifests itself as insufficient budgets for such programs. Can the few instructors reach the many settlers?

In the short term, if the efforts of INCORA can be transformed into proper techniques of labor and production by the farmer so that his toil will yield lasting results, at least partial success will have been attained. But for man, bricks of poor composition which deteriorate in the heavy rains make necessary many hours of repair or complete



rebuilding the next year. The wood used for fencing, house frames, and other construction rots under the climate. Much work for results that will not long endure is a source of frustration. Adding to this the foreknowledge we have of the future generations of people which will inevitably arrive magnifies the intensity of the problem. Weak building constructions or makeshift arrangements will not house the children of the future.

Exemplified by the interaction with the ecosystem by the inhabitants of Texas, the effects of man upon the natural environment do not here evidence much to the detriment. He has substituted specific food-crops for natural growth. He has constructed dwellings on which to base his daily existence. He gardens the plants which constitute his diet and his commerce. He keeps the few animals which provide him with eggs, milk, meat, feathers, and leather.

His small-scale subsistence activity is indeed a struggle within an ecological regime which man must interact with to make accommodation. It can be argued that the ecosystem has more detrimental effects upon these people than they have upon it. Given that the hand-laundering activity with the use of powdered detergent causes an amount of micro-environmental pollution, it is offset by the shallow water table which virtually underlies every square foot of land in the community, thereby assuring rapid assimilation and dispersal of the toxins.

The cutting of the useful chuapo [chusquea Sp.], similar in structure and appearance to bamboo (Gordon, 1957), in

stalks with diameters from three to five inches, serves to thin the natural vegetation. Long hours are spent in hacking off the rotted ends, splitting the tube, smoothing the lengths, and shaving the shreds of woody fiber. This basic construction material, once taken to the dwelling, can be measured and fitted to build shelving, interior wall veneer, rungs for a pole-ladder, or a retaining wall for a dirt hearth.

An unobtrusive facet of the ecosystem is man here in his simple pioneer existence. In sum, the people of Texas are agricultural floodplain-dwellers on a cooperative landholding. The dwellings of each of the six families are a quarter kilometer from one another, and the land is fenced, demarcating pastures and gardens. A typical dwelling has a cement floor in the bedrooms and central room and a dirt kitchen floor; its doorways are open. The walls are of earthen bricks and chuapo support-poles. The roof is a rectangular saddle shape, and is covered with zinc sheets (one older dwelling on the farm has all dirt floors and a thatch roof). The fireplace is of hard-packed earth built up against the walls in a corner, with a retainer of chuapo poles and slats. Hammocks or metal frame beds are used for sleeping.

As one type of a settlement effort in a virgin region, the Comunitaria Texas presents a portrait of man and his cultural adaptation to and influence upon the natural environment of the Llanos in a rudimentary level on a still

new frontier. In turn, it represents for the inhabitants there a unique version of life in the twentieth century upon Earth.

#### Data on the Colonists

The colonists of the Comunitaria Texas may appear to have a rough life, but it was even more difficult at the place where they came from. The validity of such an assertion is portrayed whenever mass migrations occur, for colonists are people seeking a better life. In the Ariari River region under the INCORA-administered Meta colonization project there are 16,582 colonial families (INCORA, 1984).

The project is subdivided into administrative areas called municipios, of which there are nine. These are named according to the town serving as the seat for the various branch offices. They are as follows, with the number of colonist families in each municipality listed:

El Castillo	1,191
Cubarral	923
Granada	1,744
Lejanias	1,504
San Juan de Arama	2,355
Vista Hermosa	4,325
Mesetas	1,604
Puerto Lleras	1,957
La Macarena	979

The municipios are further subdivided into rural areas called veredas, literally meaning 'footpath' or 'route.'

Data obtained from the files of the Puerto Lleras branch office of INCORA, collected by that office in April and May of 1984, offers illustrative insight into the core aspects of the lives of the colonists, and of man in the Llanos.



The following information concerns twenty-one families in Project Meta, and was selected at random. The membership structure of the families is portrayed on the age/sex pyramid below. There were a total of fifty male members and forty-five females. The mean age as a group was 23.56 years; the median age was 18 years old. Typical of underdeveloped regions of the world, the bottom portion of the pyramid is the broadest, exhibiting features which denote high birth rates, as there are here 51 members less than twenty years

TABLE 7

## AGE/SEX PYRAMID

Municipios, Project Meta, Colombia

	<u>MALE</u>	:	<u>FEMALE</u>
60+			-:X
55-59	XXX:-		
50-54	X:XX		
45-49	XX:XX		
40-44	XXX:XXX		
35-39	XXXXXX:XXXXXX		
30-34	XX:XX		
25-29	XX:XX		
20-24	XXXX:XXX		
15-19	XXXXXX:XXXXXXX		
10-14	XXXXXXXXXXXX:XXXXXXXX		
5-9	XXXXXXXX:XXXXXXXXXX		
0-4	XXX:-		
Age Group	Number of Members		

old, or nearly 54 percent of the total group. A relatively short lifespan is indicated in that only one member of the population is over sixty years old. The approximately one percent figure for this group contrasts sharply with, for example, that of the 25 percent figure which is expected in

the United States in the coming decades for roughly this same age category. This comparison, although inexact and incomplete, offers hints of the realm of difference of the human situation between a Third World and a First World nation.

Representative of the land colonizers of the humid tropical Ariari River piedmont, the landholding size of these twenty-one family units ranges from ten hectares (ha.) to one thousand ha. The mean size is 129.1 ha., and the median 70 ha.

In terms of years of permanent residency at the settlements, variation between one and twenty years occurred, with the mean being 7.14 years and the median 10 years.

Of the 21 families, 62 percent had been awarded their land through colonization from INCORA; 38 percent were small landowners who had purchased it. None were renters or leasers, squatters, bailees, or in receivership.

Two of the families belonged to a work association of farmers in the region. No family indicated belonging to any kind of sports club, cultural group, cooperative, or other group.

The size of the dwellings varied; the number of bedrooms was indicated to be one by 13 families (62%), two by 7 families (33%), and three by one family (5%).

Not one family responded positively that their dwelling was connected with a sewer, an aquaduct for water, or electric power.

The predominant roofing material was eternit or zinc for 20 homes (95.2%), straw or thatch for 1 home (4.8%), with no

family indicating concrete, cement, or earthen tile for the roof. Of interest here is that eternit is largely composed of asbestos. It is widely utilized throughout the tropics because of its ready application and resistance to the rainy climate. The knowledge of health-related problems associated with asbestos makes this a questionable material to be so utilized.

The predominant material from which the walls of the dwellings were made was split wood beams for 13 homes (62%), wood, or lumber for 7 homes (33%), and cane or reed for 1 home (5%).

The floors were made of earth, none having floors of wood, tile, concrete, block, or synthetic material.

Seventeen families (81%) indicated the designation of a room used solely as a kitchen, while 4 families (19%) had no such room. All families had, however, a dishwashing sink. The type of open hearth used by all of the families was of the wood burning category; none here claimed to have a stove of gas, electric, oil, or coal fuel.

As for sanitation facilities, no home had connection with a sewer, and none with a septic tank. Two families (9.5%) had an outside latrine, and 19 families (90.5%) responded that they had no such facilities whatsoever. This may likely be interpreted to mean that they had at least an outhouse of some sort, probably enclosed.

That the dwelling was in need of repair for the walls, the floors, and the kitchen was indicated by all of the



families, but only 15 families (71%) indicated that the roof required repair.

The water source available within this undeveloped frontier for these families is either a river or stream, a well or cistern, or rain water. None had pipes or plumbing. Also, none had water for human consumption which was filtered or chemically treated.

The trash or garbage was indicated as being disposed of around the house by 18 families (85.7%), or in the distance by 3 families (14.2%). The disposition of the trash was that it was buried (24%), burned (24%), or heaped (33%); no response was given by 19% of the families.

Scrimshaw (1965) notes that half of the world population's diet is deficient in quality and quantity, but that "an adequate source of calories and sufficient quantities of the essential nutrients in any acceptable form taken at appropriate intervals is all that is needed for a suitable diet." Table 8 below shows the staples of diet for the twenty-one families, categorized as to whether the items are produced on-farm, purchased, or both.

Noticeably absent from the list is bread, perhaps because bread is generally purchased and consumed in town when one is there, but it is not brought back to the farm in much quantity because of its limited fresh storage life.

Other items missing from the list which are known from observation to be widely consumed are the mango (which grows abundantly in the Llanos), onions, aguardiente (sugar cane liquor), and beer.

TABLE 8  
STAPLES OF DIET

<u>Produced</u>	<u>Purchased</u>	<u>Both</u>
milk	meat	eggs
cheese	beans	corn
fowl	potato	sugar
oranges	rice	cabbage
banana	lard	broadbean
platano	oil	beet
yuca	lentil	
pineapple	carrots	
papaya	brown sugar (panela)	

The distance to the nearest supply center is generally great enough that for the colonists daily or frequent trips are not feasible, especially in consideration of the means of transportation available. Canoes with outboard motors are widely used, for the rivers form the natural routes of passage within the Llanos, complementing the horse and foot trails and the motor vehicle routes.

Not all of the households reported consuming the same items, as may be observed in Table 9 below.

Market towns must be visited to obtain goods that cannot be produced on the farm. The trip to the town for business, shopping, and pleasure is an all day affair, due in part to the time involved in travel, and in part from taking advantage of the opportunity for the break from the solitude of the farm, where some pleasures of social life are scarce.

The sale of farm produce in town gives the farmer cash to purchase the foods which make up the balance of his diet. Also, many find time to relax at the open air restaurants for a beer or coffee and a meal. In the small towns, animals

often are left to roam about freely in search of discarded scraps, and it sometimes happens that while dining at a restaurant a patron may find it necessary to wave away a chicken that has jumped up onto the table in its search for feed.

TABLE 9  
HOUSEHOLD FOOD CONSUMPTION

<u>all (21) consume:</u>	<u>most (20-11) consume:</u>
rice	cheese
beans	fowl
lard	oranges
milk	banana
eggs	oil
corn	
yuca	
platano	
meat	
potato	
brown sugar	
<u>some (10-5) consume:</u>	<u>few (4-0) consume:</u>
lentils	carrots
cabbage	pineapple
beet	papaya
sugar	broadbean

An analysis of the reported basic diet of the twenty-one colonist families for which the statistics in this report were obtained yields an estimated average of a typical weekly food intake pattern on a per person basis. Table 10 below indicates a range, median, and mean weekly consumption quantity for the basic foodstuffs of the colonists.



TABLE 10  
PER PERSON WEEKLY CONSUMPTION

<u>Food</u>	<u>Quantity*</u>	<u>Range</u>	<u>Median</u>	<u>Mean</u>
panela	kg	.11-7.0	3.0	2.5
potato	kg	.14-5.0	2.4	2.2
yuca	kg	0.00-6.0	2.0	2.0
meat	kg	.33-2.0	1.0	1.1
corn	kg	.11-2.0	1.0	1.0
rice	kg	.11-2.5	1.0	.95
beans	kg	.11-2.0	.75	.75
lard	kg	.11-1.0	.5	.47
platano	unit	.50-6.0	1.3	1.9
banana	dozen	0.00-7.2	.25	.67
orange	dozen	0.00-6.2	.125	.8
cheese	kg	0.00-2.5	.4	.46
fowl	unit	0.00-0.53	.125	.14
oil	liter	0.00-0.5	.2	.175
egg	unit	4.00-30	10.0	11.6
milk	liter	1.50-24	6.0	7.1

\* quantities: kg = kilogram  
unit = single item  
liter = 0.91 quart

From a nutritional view point it is indicated that an abundant amount of carbohydrates, fats, even proteins are consumed, but missing are the green vegetables. Also, much of the nutritional value of food consumed arises from the manner in which it was prepared. Prolonged boiling, as was occasionally observed, reduces the nutritional value of food, thereby resulting in little more than the ingestion of bulk and carbohydrates and fats.

Concerning the educational levels of the twenty-one families, there were entries regarding literacy for only 61 of the 95 members. For members under 6 years of age no entry was made. Eighteen of the 61 members had the designation of being able to read and write, while 43 had no ability to read or write. Of the 89 members above the age of six years, 51

members (57.3%) had not received any formal education, and 38 members (42.6%) had received a primary education. None had received any education at the levels of secondary, bachelor classical or technical, university, or other education.

The health status for each family member for a one-month period indicates a great amount of illness. Twenty-five percent of the group had had diarrhea (no cause listed); one percent had vomitted; 43 percent had at least once had an upset stomach; 39 percent reported fever within that month (no cause listed); 63 percent had been ill with grippe; and 38 percent had been subject to some other form of illness.

A final note is that of all of the families none reported that there was on the premises a female that was with child, but five reported the presence of a female that was nursing.

#### The Burden of Pioneers

There is a saying in the Llanos: "with hunger, peace is not possible" (Zeta, 1984). This is reflective of the movement toward solving the world's hunger problems through revolution. However, it is also said that "cleverness is better than force" (Salazar, 1977). The latter may have been the predominant attitude among the inhabitants of the Llanos, for on May 28, 1984, a truce was declared between the revolt group FARC (Fuerzas Armadas Revolucionarias de Colombia) and the elected government of Colombia. A twenty year struggle of opposing sides was, temporarily at least, coming to a halt to work for the improvement of the common lot.

There are still problems, as indicated in the local newspapers: "The country can fall down like a castle of cards. There are many maledictions. The economy is profoundly submerged. It cannot sustain a rigor of burdens without hope of alleviation". (Zeta, 1984)

A world of problems without hope of solution is a world of despair for anyone that lives in it. In the world of the present, however, that is the situation for many of the inhabitants, as noticeably represented by man in the Llanos. It is here that men, farmers, cattlemen, and their families are living with a want of security, both financial and personal. Due to difficulties imposed by financial duress, some farmers are abandoning their lands to move to the towns to live in turgios (hovels, dumps) without public services and with only elementary health conditions (Zeta, 1984), where there is no work to be found.

As the population of the cities continues to rise, there is little potential for solving the daily problems of man related to health, diet, education, unemployment or crime for the many who are underprivileged and displaced. The push to the land must continue where man, with his cultural intent toward peace and attainment and use of knowledge, can reap benefit from the Llanos frontier and its resource base. Ready access to the distant reaches of land must be gained to facilitate this growth.

Even if only to be accomplished through regional-national political platform promises (Zeta, 1984), or foreign geo-political maneuvering, as in the proposed commercial



interchange between Colombia and the U.S.S.R. (Zeta, 1984) intended to result in the construction of rail lines and oil exploration, industry or commercial exploitation must be developed to promote economic growth. The accompanying infrastructure must be constructed, such as schools, roads, health, and sanitation facilities, "for the dignity of life of all of the llaneros" (Zeta, 1984).

## CHAPTER IV

### CONCLUSIONS

The investigation of the problem in this paper dealt with performing an examination of the humid tropical wet-dry savanna region of the Llanos Orientales of Colombia, in the attempt to make a record of man in the late twentieth century in that environment. An examination of the cultural imprint of aspects of man's livelihood in the Llanos was viewed as a way to gain evidence of the way man lives there. It was hoped that the importance of the Llanos as the home of man would be brought out by "the collection of data from direct observation" (James, 1967), or by gaining "percepts..." which are "a direct observation of a thing or event" (James, 1967).

The problem thus required fieldwork in order to provide a descriptive report of man in the Llanos. The idea of this being so arose from Barrow's theme that "I believe that geography has been too much a library subject, and too little a field subject. I hold that the field is the geographer's laboratory" (Barrows, 1923). Indeed, one writer expressed the need for direct observation by expressing the following thought: "Only by crossing and recrossing it (the grasslands) can one appreciate fully its apparently infinite distances and get that impression which comes in mid-ocean and in great deserts where one gazes interminably at the horizon" (Tower, 1918).

The fieldwork helped to solve the problem of gaining an insight into the way man lives and adapts himself to the environment in the Colombian Llanos. By examining selected locations, at least a basic understanding of some aspects of the society as a whole could be elucidated, for "society projects itself through the individual, and the individual herself through society" (Pred, 1981).

The attempt to view man and his relationship to the environment was an important endeavor in so much as there is a need to gain a perceptual understanding of this frontier region and its human element, of man in the pioneering stage on a little-developed cultural landscape. The character of man is evident in the failures and successes of his efforts in the interaction with the environment. It is necessary to study the "activities of man in his natural environment" (Barrows, 1923) to determine the actions of man in his adjustment to the environment, which becomes the basis of "human ecology" (Barrows, 1923).

Furthermore, it is important to "penetrate contemporary societies" (Brookfield, 1964) because we have to know more about the people on the land, to gain fresh factual documentation and knowledge, which is of pertinent value. One must be able to present what one was able to discern beyond that which was already known. The importance of the problem was to attempt to establish the place of man in the natural scheme, and to present the major features of the



natural environment and their mutual interaction. It was an attempt to portray how life was carried on in the Llanos by man.

"...Then they would try  
Ever new modes of tilling their loved crofts,  
And mark they would how earth improved the taste  
Of the wild fruits by fond and fostering care".  
Lucretius, 98(?) - 55 B.C. (Cullimore, 1941)

The methodology followed in this investigation included the preliminary preparation and background library research to gain points of reference from which to structure the inquiry. Sources in print were located which provided guidance and direction for the investigation, and helped lead eventually to the final product. The writer went into the field on two traverses to seek observable phenomenon and situations which would aid in comprehending and illustrating the region and man's role within it. The accumulation of personal observations was an attempt to make the work an empirical one. Correct specific observations on the material culture, the diet, health, and education, were gathered to reflect a portrait of the culture. By observing the activities of man, some ideas as to how he makes his living in the Llanos were discernible.

One question which attracted the writer's attention was that of "the ecosystem concept, which places man at the center of our thinking without in any way disregarding the whole environment in which he has his being" (Brookfield, 1964). This prompted the taking of a close look at the environment, as well as an investigation into the activities

of man. This follows with a study of the geobiosphere to obtain a knowledge of the geomorphology, soils, climate, vegetation, fauna, the resource base, man's level of living (Hegen, 1983), and statistics on the population and culture of man in the Llanos. The field study on the Llanos ecosystem yielded characteristics of the region as a natural environment. It was an attempt at undertaking the regional approach to the geography of the Llanos governed by the concept of human ecology.

The utilization of descriptive observations of life in the Llanos, and the use of population data gathered from available sources were combined to display present day characteristics about the people there. Some of the methodology, too, was to "collect data and try to make it speak for itself" (Gould, 1981). By examining manifestations of the cultural landscape (Hegen, 1983), the writer was clearly able to gain an emerging comprehension of the region and some of the influences and forces at work there, such as climate, man, agriculture, education, and population growth.

An outcome of the investigation was that man was observed to have an effect upon the structure and functioning of the ecosystem in his settling of this region, because man was found to be interactive with the environment. Such was the case with the colonists at the Texas community, who had carved out a homestead in the frontier, created a cultural relationship and influence upon the natural landscape, producing a "cultural landscape" (Hegen, 1983). They replaced the natural vegetative cover with food crops, they

built houses, they cleared fields for pasture, and they kept domestic animals.

The assumption that as man settles a region he will try to improve his life was supported by the evidence obtained in the field. The research proved this to be the case in that the colonists were attempting to provide as best they could for their families, to better the lives of their children through education and economic gain, and that they were interested in upgrading their social development.

A question which was not answered was whether, as man's living situation was improved either individually or collectively, overall regional development would ensue. This question would perhaps require a time-based study to pursue. It is supposed that the answer would be in the positive, for, as was written of the agricultural cattle-minder, "out of the accumulation of his tilling came civilization" (Wells, 1914). The economic growth of the region would furthermore help in the economic growth of the nation.

Observations yielded an inventory of how man adjusts and adapts to an environment. They also show how he affects the natural environment and the surroundings natural to that place as it was prior to his intrusion. An elucidation of some current circumstances of man in the Llanos as an interactive element of the ecosystem revealed aspects of the advance of the cultural frontier (Hegen, 1967).

It is the experience of pioneers on new frontiers - be it in Oregon, U.S.A. in the mid-19th century, or in the Llanos of Colombia at the end of the 20th century - that they



were and are the forerunners of a much slower advancing development which, however, is only more secure, more successful, precisely because of the sacrifices and sweat of the pioneers.

Specific observations on the settlers pointed out that there were too many people in the towns and not enough jobs. These people are not able to devote time to gaining an education when they are without food or money. There are no breadlines for them to stand in. There would appear to be too many babies. One long-term solution to help alleviate this would be with the implementation of birth control methods, if the people would accept and utilize them.

Fresh factual documentation in this paper revealed some of the evolving influences which the activities of man yield in the Llanos. The colonists and the data pertaining to them displayed the current education levels of the people, the diet and health status, the level of living, and statistics pertinent to the family structure. In his activity, man is interactive with the environment in the clearing of the land, replacement of natural vegetative cover with crops, opening up of new roads, and using some level of the natural energy in the ecosystem. Man is responsible for the settling of towns, bringing commerce and agriculture to the region, and his involvement in hunting and fishing.

It is said that "The earth is my school, the trees the college, and their fruits the university of life" (Diario del Meta, 1984). Some of the benefits to man as he settles the Llanos are that he can inhabit lands far from the crowded

cities and highlands, he can open up new lands to agriculture, and he can grow and reap as a member of his society from the land to the benefit of that society. Man was found to be highly interactive in the development of the frontier region as man interacts with the "effective territory" (Hegen, 1983). These findings were for the writer the beginning of an understanding of the physical environment of the Llanos as resource base, and the cultural landscape which has accrued there.

In light of the current condition of man in the Llanos, there is ample opportunity for future research in various subjects which may be taken up subsequent to this paper. One might be a long term study of ways which may improve life for man, for change toward betterment of the society, and which may result in a ferment of solutions for certain prospects in this frontier area for the effective territory and the cultural frontier.

Some suggestions for the above have been made (Diario del Meta, 1984) for the alleviation of problems which now exist in the towns. The control of garbage and its contamination, the use of fertilizer, and treeplanting in waterway riverbeds have been suggested, as has the exploitation of the earth and its natural resources, like water and its wealth as a valuable resource. The skill levels of the people in the towns need improving, as do the development of health and education. The people should support their folklore and arts and poetry, and their history should be preserved. It was further suggested that all

attempts should be made to overcome suffering and moral degradation.

In a climate which produces much seasonal rainfall, the abundance of wet season water could be captured to alleviate some of the problems of the dry season drought. In the Llanos there is ample water, which is energy and capital, so that it should be captured and utilized, and doled out efficiently in time of need, possibly with the use of aquaducts or dams. Similar is the need for future study dealing with roads, the key to the growth of the region. The questions of where roads are and where they should be (Hegen, 1966) need to be answered, as well as whether their implementation should be strictly planned by the government or if a policy of laissez faire should determine where they should run.

One future research project is the study by the Colombian government, now in the preliminary stages, that would someday undertake to build a city and military base in the vast plains of eastern Colombia, in order to cause settlement to come about. Undertaken by universities in conjunction with agencies of the government, this project is currently in the conceptualization and design stage, and will not be available in the short term. The land, 25 thousand acres (El Tiempo, 7 June, 1984), will be distributed to colonizers. The city is expected by the government to thrive, but it will be very costly. This factor has caused dissent among those who believe that the money should be used to alleviate more contemporary problems, and go so far as to



call the plan a "utopian idea or fantastic mirage" (Zeta, 1984). However, if the Llanos are to be able to accomodate a projected five million inhabitants (Colombia Information Service, 1981), then steps must be taken today to plan for them. Time will show if this land is a certain breadbasket of the future, or an uninviting wilderness habitable only by the most hardy.

What was distilled out of the knowledge gained in the researching of this paper was an insight into the fabric of life (Hegen, 1983) of a region of the earth, that of the Llanos Orientales of Colombia. It follows along the lines of Barrow's concern for the character of human geography, which relates to the knowledge of mankind on earth as to where and how he makes his living, and the "investigation of human activities in specific areas" (Barrows, 1923). It was learned that there is a great need for fieldwork to gain an emerging comprehension of subject matter for the regional specialist.

Some question arises on whether or not a regional specialist of the Llanos might not need to specialize in tropical geography. To deal with special problems of environments of the tropics and of the place of man in them is sufficiently large because "forty percent of the earth's surface is in the tropics" (Barrett, 1928).

The observed contemporary conditions in the Llanos are such that the most readily accessible locations are developed first. The undeveloped areas of today will later be developed as more people come here to settle. Man's living

environment is made up of many aspects: agriculture, settlement, trade, commerce, and social endeavor.

There is much which is hard, sad, cruel, and impoverished about life in the Llanos. Many men and women here have never attained more than a primary level (if any) education. There is a Colombian saying: "an ignorant town is the implement of its own destruction" (Zeta, 1984). Life in the Llanos can be made feasible and productive for many, but the problem is to teach the people what they don't know, and guide them to use their capabilities to shape their own destinies.

This exercise taught the writer much about the features of Latin American life, and about the fieldwork involved in geography. "There are many curious places in Latin America, and I hope that geographers never lose the urge to search them out and seek to explain them" (Denevan, 1977).

## APPENDICES



## APPENDIX I

Introduction to the Water Budget (Mather, 1978)

The water budget of a place, region, or of the whole world is an accounting, for some selected time period, of what happens to the precipitation. It is concerned with a quantitative evaluation over time of the various ways that the precipitation can be dispersed, utilized, stored, or changed. Though simple in concept, it is often a most complex undertaking to try to evaluate all the factors of the budget even at a single place. Few factors such as interception of precipitation, evapotranspiration, infiltration, soil moisture storage (ST), underflow, or deep percolation are measured except only under short-period experimental conditions at a very small number of places in the world.

Though much is known about the principal factors that influence the water budget--namely, precipitation and evapotranspiration--our knowledge still has serious gaps. Average precipitation over a drainage basin, for example, may actually be less well understood than evapotranspiration losses from the basin, although the former may be measured at several sites and the latter not measured at all but only estimated on the basis of other measured factors. Though precipitation can be thought of as a true climatic factor, evapotranspiration is under only partial climatic control. It is, in part, influenced by human activities, by soil and vegetation, and by geology and topography....

When the seasonal march of precipitation is compared with the march of water need in a water budget, one obtains information on many aspects of the water relations at a place. First, it is possible to estimate actual evapotranspiration (AE) or the actual loss of water from the plant and soil surfaces, which, in many cases, is different from the climatic water need or potential evapotranspiration (PE) defined as the water loss from a homogeneous, closed cover of vegetation that never suffers from a lack of water. It is extremely difficult to measure actual evapotranspiration in practice because of its dependence on such factors as soil type, land use, plant cover, and soil moisture content.

Second, the difference between potential and actual water loss provides a quantitative value of moisture deficit at a place, the amount by which available moisture fails to satisfy the climatic demand for water. The deficit is a measure of the agricultural need for water by means of irrigation. Third, when precipitation exceeds water need, excess moisture that infiltrates the soil will first be used to

recharge the soil root zone. After this has occurred, any remaining excess water will become water surplus and be lost from the soil by subsurface runoff. This water will ultimately find its way back to streams and rivers or be used to recharge the groundwater table. Fourth, during those periods when water need is greater than precipitation, the water demand is met in part by using stored soil moisture. Thus, it is possible to calculate the amount of soil moisture storage at any time either on a daily or monthly basis. This factor has utility in problems of the tractionability or trafficability of soils or in construction or farming operations where moving or plowing soils is necessary. These four factors--actual evapotranspiration, water deficit, water surplus, and soil moisture storage--derived from computations of the water budget are significant in any effort to understand or use the water or energy resources of an area.

## APPENDIX II

Annual Water Budget for  
Llanos Precipitation Stations

Source of Data: HIMAT (see Chapter II, Figure 7)

Data input to: Annual Water Budget Equal Availability  
computer program at Kentucky Climate Center,  
Department of Geography and Geology, Western  
Kentucky University, Glen Conner, Director.



## ANNUAL WATER BUDGET - VISTAHERMOSA, COLOMBIA

	ANNUAL WATER BUDGET EQUAL AVAILABILITY												ANNUAL
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
VISTAHERMOSA COLOMBIA 1976													
	80.78	80.24	78.62	76.82	75.46	74.66	74.66	76.46	77.36	78.80	79.34	78.98	
TEMP (F)													
TEMP (C)	27.10	26.80	25.90	24.90	24.70	23.70	23.70	24.70	25.20	26.00	26.30	26.10	
HEAT INDEX	12.92	12.70	12.06	11.37	11.23	10.55	10.55	11.23	11.57	12.13	12.35	12.21	140.87
UNADJ PE (CM)	14.51	13.98	12.46	10.91	10.62	9.24	9.24	10.62	11.36	12.62	13.12	12.78	
LATITUDE FAC	1.03	0.93	1.04	1.01	1.05	1.02	1.05	1.05	1.01	1.04	1.01	1.03	
ADJ PE (CM)	14.95	13.00	12.96	11.02	11.15	9.42	9.70	11.15	11.47	13.12	13.25	13.16	
PE (IN)	5.89	5.12	5.10	4.34	4.39	3.71	3.82	4.39	4.52	5.17	5.22	5.18	56.85
PRECIP	0.94	6.96	3.34	15.07	21.97	16.57	12.89	13.17	9.47	7.31	8.56	4.34	120.59
PRECIP-PE	-4.95	1.84	-1.76	10.73	17.58	12.86	9.07	8.78	4.95	2.14	3.34	-0.84	
CHANGE IN ST	-4.50	1.84	-1.76	4.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.84	
ST	0.00	1.84	0.08	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	3.66	
AE	5.44	5.12	5.10	4.34	4.39	3.71	3.82	4.39	4.52	5.17	5.22	5.18	56.40
DEFICIT	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
SURPLUS	0.00	0.00	0.00	6.31	17.58	12.86	9.07	8.78	4.95	2.14	3.34	0.00	55.03

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## ANNUAL WATER BUDGET - LA NUTRIA, COLOMBIA

	ANNUAL WATER BUDGET EQUAL AVAILABILITY												ANNUAL
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
LA NUTRIA COLOMBIA 1972													
TEMP (F)	77.72	79.52	79.52	78.44	78.26	76.82	76.28	77.18	78.44	78.80	79.88	79.70	
TEMP (C)	25.40	26.40	26.40	25.80	25.70	24.90	24.60	25.10	25.80	26.00	26.50	26.50	
HEAT INDEX	11.71	12.42	12.42	11.99	11.92	11.37	11.16	11.50	11.99	12.13	12.56	12.49	143.66
UNADJ PE (CM)	11.56	13.22	13.22	12.20	12.04	10.79	10.34	11.09	12.20	12.53	13.57	13.39	
LATITUDE FAC	1.03	0.93	1.04	1.02	1.05	1.03	1.06	1.05	1.01	1.03	1.00	1.03	
ADJ PE (CM)	11.91	12.29	13.75	12.44	12.64	11.11	10.96	11.64	12.32	12.91	13.57	13.79	
PE (IN)	4.69	4.84	5.41	4.90	4.98	4.37	4.31	4.58	4.85	5.08	5.34	5.43	58.78
PRECIP	2.01	5.28	8.55	26.18	14.99	16.60	14.24	16.10	5.38	0.90	3.48	3.16	116.67
PRECIP-PE	-2.68	0.44	3.14	21.28	10.01	12.23	9.93	11.52	0.53	-4.18	-1.86	-2.27	
CHANGE IN ST	-2.68	0.44	2.24	0.00	0.00	0.00	0.00	0.00	0.00	-3.00	0.00	0.00	
ST	0.32	0.76	3.00	3.00	3.00	3.00	3.00	3.00	3.00	0.00	0.00	0.00	
AE	4.69	4.84	5.41	4.90	4.98	4.37	4.31	4.58	4.85	3.90	3.48	3.16	53.47
DEFICIT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	1.86	2.27	5.31
SURPLUS	0.00	0.00	0.90	21.28	10.01	12.23	9.93	11.52	0.53	0.00	0.00	0.00	66.40

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## ANNUAL WATER BUDGET - PUERTO LIMÓN, COLOMBIA

	ANNUAL WATER BUDGET EQUAL AVAILABILITY												ANNUAL
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
TEMP (F)	79.70	81.68	81.32	78.80	78.44	78.98	78.80	79.16	78.44	78.44	78.80	77.72	
TEMP (C)	26.50	27.60	27.40	26.00	25.80	26.10	26.00	26.20	25.80	25.80	26.00	25.40	
HEAT INDEX	12.49	13.28	13.14	12.13	11.99	12.21	12.13	12.28	11.99	11.99	12.13	11.71	147.47
UNADJ PE (CM)	13.35	15.47	15.07	12.46	12.12	12.64	12.46	12.81	12.12	12.12	12.46	11.45	
LATITUDE FAC	1.03	0.93	1.04	1.01	1.06	1.03	1.06	1.05	1.01	1.03	1.00	1.03	
ADJ PE (CM)	13.75	14.39	15.67	12.58	12.85	13.02	13.21	13.45	12.24	12.48	12.46	11.79	
PE (IN)	5.41	5.67	6.17	4.95	5.06	5.13	5.20	5.30	4.82	4.91	4.91	4.64	52.17
PRECIP	3.17	0.00	4.70	11.42	13.74	13.30	7.12	8.90	10.80	4.56	8.85	2.24	88.80
PRECIP-PE	-2.24	-5.67	-1.47	6.47	8.68	8.17	1.92	3.60	5.98	-0.35	3.94	-2.40	
CHANGE IN ST	-2.24	-2.26	0.00	4.50	0.00	0.00	0.00	0.00	0.00	-0.35	0.35	-2.40	
ST	2.26	0.00	0.00	4.50	4.50	4.50	4.50	4.50	4.50	4.15	4.50	2.10	
AE	5.41	2.26	4.70	4.95	5.06	5.13	5.20	5.30	4.82	4.91	4.91	4.64	57.29
DEFICIT	0.00	3.41	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.88
SURPLUS	0.00	0.00	0.00	1.97	8.68	8.17	1.92	3.60	5.98	0.00	3.59	0.00	33.91

PUERTO LIMÓN COLOMBIA  
1973

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## ANNUAL WATER BUDGET - CARIMAGUA, COLOMBIA

CARIMAGUA COLOMBIA 1976		ANNUAL WATER BUDGET EQUAL AVAILABILITY												KENTUCKY CLIMATE CENTER DEPARTMENT OF GEOGRAPHY AND GEOLOGY WESTERN KENTUCKY UNIVERSITY		
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL		
TEMP (F)		78.82	81.14	80.95	78.26	77.36	75.38	75.02	76.82	77.18	79.52	78.88	79.34			
TEMP (C)		25.90	27.30	27.20	25.70	25.20	24.10	23.90	24.90	25.10	26.40	26.60	26.30			
HEAT INDEX		12.06	13.07	12.99	11.92	11.57	10.82	10.68	11.37	11.50	12.42	12.56	12.35	143.31		
UNADJ PE (CM)		12.40	14.88	14.69	12.07	11.28	9.66	9.39	10.82	11.12	13.25	13.60	13.08			
LATITUDE FAC		1.02	0.93	1.04	1.02	1.06	1.03	1.06	1.05	1.02	1.03	0.99	1.01			
ADJ PE (CM)		12.65	13.84	15.28	12.31	11.96	9.95	9.95	11.36	11.34	13.65	13.46	13.21			
PE (IN)		4.98	5.45	6.02	4.85	4.71	3.92	3.92	4.47	4.46	5.37	5.30	5.20	58.65		
PRECIP		0.44	1.23	2.48	10.74	10.16	17.27	16.94	7.34	12.60	5.63	2.23	0.61	87.67		
PRECIP-PE		-4.54	-4.22	-3.54	5.89	5.45	13.35	13.02	2.87	8.14	0.26	-3.07	-4.59			
CHANGE IN ST		-4.54	-3.46	0.00	5.89	2.11	0.00	0.00	0.00	0.00	0.00	-3.07	-4.59			
ST		3.46	0.00	0.00	5.89	8.00	8.00	8.00	8.00	8.00	8.00	4.93	0.34			
AE		4.98	4.69	2.48	4.85	4.71	3.92	3.92	4.47	4.46	5.37	5.30	5.20	54.35		
DEFICIT		0.00	0.76	3.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.30		
SURPLUS		0.00	0.00	0.00	0.00	3.34	13.35	13.02	2.87	8.14	0.26	0.00	0.00	40.98		

## ANNUAL WATER BUDGET - ARAUCA, COLOMBIA

	ANNUAL WATER BUDGET EQUAL AVAILABILITY												ANNUAL
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
TEMP (F)	80.42	83.12	82.84	82.58	78.26	77.00	75.82	75.08	77.90	79.34	80.06	80.42	
TEMP (C)	26.90	28.40	28.30	28.10	25.70	25.00	24.90	25.60	25.50	26.30	26.70	26.90	
HEAT INDEX	12.78	13.87	13.80	13.85	11.92	11.44	11.37	11.85	11.78	12.35	12.63	12.78	150.22
UNADJ PE (CM)	14.06	17.21	16.99	16.54	11.86	10.70	10.54	11.69	11.52	12.92	13.67	14.06	
LATITUDE FAC	1.01	0.92	1.03	1.03	1.07	1.05	1.07	1.06	1.02	1.02	0.99	1.00	
ADJ PE (CM)	14.20	15.83	17.50	17.04	12.69	11.24	11.28	12.39	11.75	13.18	13.53	14.06	
PE (IN)	5.59	6.23	6.89	6.71	5.00	4.43	4.44	4.88	4.63	5.19	5.33	5.54	64.86
PRECIP	1.77	0.11	4.76	7.87	9.21	10.47	11.34	8.70	8.82	9.13	4.92	0.98	78.08
PRECIP-PE	-3.82	-6.12	-2.13	1.16	4.21	6.04	6.90	3.82	4.19	3.94	-0.41	-4.56	
CHANGE IN ST	-3.82	-0.68	0.00	1.16	3.34	0.00	0.00	0.00	0.00	0.00	-0.41	-4.09	
ST	0.68	0.00	0.00	1.16	4.50	4.50	4.50	4.50	4.50	4.50	4.09	0.00	
AE	5.59	0.79	4.76	6.71	5.00	4.43	4.44	4.88	4.63	5.19	5.33	5.07	56.82
DEFICIT	0.00	5.44	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	8.04
SURPLUS	0.00	0.00	0.00	0.00	0.87	6.04	6.90	3.82	4.19	3.94	0.00	0.00	25.75

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ARAUCA COLOMBIA  
1977

## ANNUAL WATER BUDGET - GAVIOTAS, COLOMBIA

	ANNUAL WATER BUDGET EQUAL AVAILABILITY												ANNUAL
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
GAVIOTAS COLOMBIA 1980													
	80.78	84.20	82.76	78.62	78.08	76.64	75.56	77.00	78.08	77.54	80.96	78.98	
TEMP (F)													
TEMP (C)	27.10	29.00	28.20	25.90	25.60	24.80	24.20	25.00	25.60	25.30	27.20	26.10	
HEAT INDEX	12.92	14.32	13.72	12.06	11.85	11.30	10.89	11.44	11.85	11.64	12.89	12.21	147.19
UNADJ PE (CM)	14.49	18.51	16.73	12.31	11.80	10.52	9.63	10.83	11.80	11.31	14.68	12.65	
LATITUDE FAC	1.03	0.93	1.04	1.01	1.05	1.02	1.06	1.06	1.01	1.03	1.00	1.02	
ADJ PE (CM)	14.92	17.21	17.40	12.43	12.39	10.73	10.21	11.48	11.92	11.65	14.68	12.90	
PE (IN)	5.87	6.79	6.85	4.89	4.88	4.22	4.02	4.52	4.69	4.59	5.78	5.08	62.17
PRECIP	0.71	0.00	7.48	9.33	8.46	15.00	10.20	7.13	11.34	8.03	0.91	2.76	81.35
PRECIP-PE	-5.16	-6.78	0.63	4.44	3.58	10.78	6.18	2.61	6.65	3.44	-4.87	-2.32	
CHANGE IN ST	-5.16	-2.84	0.63	4.44	2.93	0.00	0.00	0.00	0.00	0.00	-4.87	-2.32	
ST	2.84	0.00	0.63	5.07	8.00	8.00	8.00	8.00	8.00	8.00	3.13	0.81	
AE	5.87	2.84	6.85	4.89	4.88	4.22	4.02	4.52	4.69	4.59	5.78	5.08	58.23
DEFICIT	0.00	3.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.94
SURPLUS	0.00	0.00	0.00	0.00	0.65	10.78	6.18	2.61	6.65	3.44	0.00	0.00	30.31

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## ANNUAL WATER BUDGET - VILLAVICENCIO, COLOMBIA

	ANNUAL WATER BUDGET EQUAL AVAILABILITY												ANNUAL
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
VILLAVICENCIO COLOMBIA 1948													
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TEMP (F)	80.42	81.86	81.86	79.88	79.98	77.90	77.54	78.44	79.70	80.06	80.06	79.52	
TEMP (C)	26.90	27.70	27.70	26.60	26.66	25.50	25.30	25.80	26.50	26.70	26.70	26.40	
HEAT INDEX	12.78	13.36	13.36	12.56	12.60	11.78	11.64	11.99	12.49	12.63	12.63	12.42	150.24
UNADJ PE (CM)	14.05	15.67	15.67	13.47	13.59	11.51	11.18	12.02	13.29	13.66	13.66	13.10	
LATITUDE FAC	1.02	0.93	1.04	1.02	1.06	1.03	1.06	1.05	1.01	1.03	1.00	1.02	
ADJ PE (CM)	14.33	14.57	16.30	13.74	14.41	11.86	11.85	12.62	13.42	14.07	13.66	13.36	
PE (IN)	5.64	5.74	6.42	5.41	5.67	4.67	4.67	4.97	5.28	5.54	5.38	5.26	84.85
PRECIP	3.66	2.56	7.44	23.58	27.36	18.23	19.37	18.90	16.77	20.43	17.13	8.43	183.86
PRECIP-PE	-1.98	-3.18	1.02	18.17	21.69	13.56	14.70	13.93	11.49	14.89	11.75	3.17	
CHANGE IN ST	-1.98	-3.18	1.02	4.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
ST	6.02	2.84	3.86	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	
AE	5.64	5.74	6.42	5.41	5.67	4.67	4.67	4.97	5.28	5.54	5.38	5.26	84.85
DEFICIT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SURPLUS	0.00	0.00	0.00	14.03	21.69	13.56	14.70	13.93	11.49	14.89	11.75	3.17	119.21

## ANNUAL WATER BUDGET - RESTREPO, COLOMBIA

	ANNUAL WATER BUDGET											
	EQUAL AVAILABILITY											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
RESTREPO COLOMBIA												
1973												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TEMP (F)	77.54	80.86	77.90	76.28	74.30	72.50	72.32	73.04	74.12	73.40	73.40	73.04
TEMP (C)	25.30	27.20	25.50	24.60	23.50	22.50	22.40	22.80	23.40	23.00	23.00	22.80
HEAT INDEX	11.64	12.99	11.78	11.16	10.41	9.75	9.68	9.95	10.35	10.08	10.08	9.95
UNADJ PE (CM)	11.83	14.62	12.10	10.89	9.53	8.39	8.28	8.72	9.41	8.95	8.95	8.72
LATITUDE FAC	1.02	0.93	1.04	1.02	1.06	1.03	1.06	1.05	1.01	1.03	1.00	1.02
ADJ PE (CM)	12.07	13.60	12.58	11.11	10.10	8.64	8.78	9.16	9.50	9.22	8.95	8.89
PE (IN)	4.75	5.35	4.95	4.37	3.98	3.40	3.46	3.61	3.74	3.63	3.52	3.50
PRECIP	2.52	0.00	14.46	13.55	23.74	29.33	23.02	31.26	27.20	15.62	22.83	7.55
PRECIP-PE	-2.23	-5.35	9.51	9.18	19.76	25.93	19.56	27.65	23.46	11.99	19.41	4.05
CHANGE IN ST	-2.23	-5.35	7.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST	5.77	0.42	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
AE	4.75	5.35	4.95	4.37	3.98	3.40	3.46	3.61	3.74	3.63	3.52	3.50
DEFICIT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SURPLUS	0.00	0.00	1.93	9.18	19.76	25.93	19.56	27.65	23.46	11.99	19.41	4.05
												162.92
												48.26
												127.82
												48.26
												48.26

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