



THE COLOMBIAN LLANOS ORIENTALES

A PRELIMINARY REPORT

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The potential of the Llanos Orientales (Eastern Plains) of Colombia has been a subject of speculation for many decades. Some of the recent information obtained in the area, especially that related to soils, has bearing on the history, present status and potential of the savannah region, especially in Meta and Vichada. It is presented and briefly discussed in the present paper.

The term "Llanos Orientales" is understood by some to refer to the entire eastern 3/5 of Colombia, including both the jungle to the south and the savannahs to the north. This view seems logical since the entire region is rather level, especially when compared to the Andes to the west. However, it would appear that most Colombians refer only to the northern savannahs when they speak of the Llanos. Using the broader definition, based on topography, the region is bounded on the north by Venezuela (Arauca and Meta rivers), on the east by Venezuela and Brazil, to the south by Ecuador and Peru and to the west by the Eastern Cordillera of the Andean range. The total area approximates 670,000 Km<sup>2</sup> or 59% of the total area of Colombia. The region is populated by an estimated 325,000 inhabitants or 2.1% of the total population (1960 census). Many of those 325,000 inhabitants live in towns in the foothills of the eastern cordillera such as Villavicencio and Florencia, or in the surrounding piedmont farming and ranching regions. The population density for the entire Llanos is about 1 inhabitant/2Km<sup>2</sup>. Population density in the area comprised of Vichada, Vaupés and Amazonas (380,000 Km<sup>2</sup>) is less than 1 inhabitant/10 Km<sup>2</sup>.

The northern savannahs account for about 1/3 of the Llanos. The transition from savannah to jungle, which is rather abrupt, occurs along the Guaviare river in the department of Meta and roughly follows the Vichada river in the Comisaria of Vichada. Most of the savannahs north of the Meta in Boyaca and Arauca (the region generally known as "Casanare") are subject to extensive flooding during the rainy season from April through November. The savannahs south of the Meta in Meta and Vichada are generally well drained, with little or no flooding occurring even during the wettest months. Little is known of the jungle region but the northernmost part is probably well drained while it is likely poorly drained in the extreme south. The savannahs are much more accessible than the jungle, with unimproved trails penetrating most of the region. These trails are impassable during the rainy season in Boyaca and Arauca but open throughout the year in most of Meta and much of Vichada. For this and other reasons primarily problems related to drainage, this paper will deal principally with the savannah regions of Meta and Vichada:

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The first exploration of the Llanos was made by the conquistadores in

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1526. Villavicencio, the largest town in the region with a population of approximately 60,000 (D.A.N.E., 1967), was known as Gramalote until 1850. A modern 125 Km highway links Bogota to Villavicencio, dropping from 3,000 meters just outside Bogota to 500 meters at Villavicencio.

An all weather road continues 90 Kms to Puerto López, where a steel and concrete bridge nearing completion spans the Meta river. Unimproved trails continue eastward along the right bank of the Meta. Ferry service is provided at Puerto López, and at Puerto Gaitán, on the Manacacias, 100 Kms to the east of Puerto López. A spur of the main road terminates at El Porvenir, across the river from Orocué, where ferry service is available.

One road follows the right bank of the Meta to Puerto Carreño, a small town 100 meters above sea level of approximately 1500 inhabitants at the confluence of the Meta and the Orinoco rivers. It is impassable during 8 months + from April through November. The other main road follows the Muco and Vichada rivers to Santa Rita, a small village on the Vichada about 50 kilometers from the Orinoco and the Venezuelan border and some 800-900 kilometers from Villavicencio.

Violence erupted in the Llanos in the early 1950's as a general wave of violence engulfed the entire country. It was initially political in nature but by 1955 had degenerated to not much more than banditry. The Llaneros soon tired of the "imported" guerrilla war and were successful in eliminating most violence by 1957. The region has known uninterrupted peace since that time, in spite of several abortive attempts made by outsiders to stir the Llanero to revolution.

### Geology

The Andean uplift resulted in a geosyncline (zone of subsidence) between the new mountains and the ancient Guayana shield of Venezuela and Brazil. This depression was gradually filled with massive sediments during the tertiary and quaternary ages, mostly of Andean origin. The northern savannahs are situated on these thick sediments (terraces). The Meta river follows a fault line, the south bank being  $\pm$  100 ft. higher than the north bank along much of its course. This in part explains the great difference in the two regions, separated by the Meta, as to drainage and flooding.

A relatively narrow strip of high, well drained, non-dissected smooth plains extends from Puerto López almost to the Orinoco River along the south bank of the Meta. This area is estimated at 3,000,000 hectares. South of this strip and along the major stream beds within the strip described is found the "serrania", which was formed by dissection of the uplifted plain. The serrania presents a landscape of rolling, grass covered hills, with remnants of the original surface still apparent. The plains of Casanare north of the Meta are generally quite smooth.

### Climate

Few climatological data are available for the Llanos. Annual rainfall is known to decrease gradually as one moves northeast along the Meta with approximately 2,000 mm. at Puerto López, 1,700 at Orocué and perhaps 1,200 at Puerto Carreño. Rainfall is much higher in the piedmont, reaching 6,000 mm. or more in the foot hills of the eastern Cordillera. Rainfall distribution is relatively uniform between early April and late November.

Mean temperatures for the savannah region are estimated at 26-27°C, decreasing as one approaches the cordillera. Winds are common and strong, especially during the dry season; December-March. Prevailing winds are from the northeast. Blowing sand is common along the vast beaches of the Meta and other major streams, exposed during the dry season. Windmills are used successfully to provide water for livestock and domestic use.

### Vegetation

The high, well drained savannahs of Meta and Vichada are covered by native grasses and some legumes. The predominant grass species is Trachypogon vestitus (paja de savannah); others being Paspalum pectinatum, Axonopus purpusii, (guaratara), Paspalum carinatum. Along the stream beds which drain the high savannahs, abundant timber is found in gallery type forests.

### Soils

The soils of the smooth savannahs in Meta and Vichada are highly weathered, medium textured and well drained, with very little relief. They are quite acid; pH 4.5-5.0, highly aluminum saturated and very low in bases (Ca, Mg, K) and phosphorus. A typical chemical analysis is given in Table 1. Note extremely high Al/base ratio. Organic matter content is surprisingly high in surface horizons, excepting in sandier soils, ranging to 4% or higher. Sub-soils are bright red, iron rich, medium textured, generally free of concretions (plinthite). The clay fractions which have been examined are composed of 2:1 intergrade mineral, kaolinite, and goethite.

Soils in the serrania region are generally of coarser texture, with outcroppings of laterite stone and gravel common on side slopes and knoll tops. Little is known of the fertility status of these soils but they are apparently quite similar to soils of the smooth savannahs in that respect.

### Ranching and Agriculture

Commercial farming in the Llanos is confined to the narrow piedmont region, especially around Villavicencio. Most commercial crops are grown on the flood plains where recent alluvium of cordillera origin usually provides sufficient fertility for acceptable corn, cotton, sorghum and upland rice production. Plantain and bananas are also grown along with some sesame, oil palm and citrus. Flooded rice is grown extensively with fertilizers on the less fertile terrace soils of the piedmont where topography is more favorable

than in the flood plains. Rice is one of the few crops considered to be of high enough commercial value to warrant use of fertilizers.

Commercial rice is almost unknown in the high plains of Meta and Vichada. Yuca, topocho (a type of plantain), mango and occasionally citrus, avocado, cashew and cacao are found in very small acreages on many ranches. These "kitchen garden" crops are frequently planted on old corral sites, taking advantage of the fertility concentration process provided by occasionally penned range cattle.

Ranching in the piedmont consists primarily of grass fattening of feeder cattle brought in from the savannahs of Meta, Vichada, Boyacá and Arauca at 3-4 years of age. Pastures are usually unimproved but frequently partially or entirely dominated by introduced species, especially molasses grass (Melinis minutiflora) and puntero (Hyparrhenia rufa), both of which seed profusely, are well adapted to the region, and therefore spread spontaneously. Some pastures have been seeded to these species and others such as Brachiaria (Brachiaria decumbens), guinea grass (Panicum maximum). Pasto negro (Paspalum plicatulum) is one of the best native species.

Cattle may be fed on contract or purchased by piedmont ranchers as feeders. In many cases, they are produced by a rancher who owns land in the piedmont and the savannah. They are usually kept on grass for 8-10 months, then shipped via truck to Bogota for slaughter.

Ranching in the high savannahs to the east of the piedmont is generally oriented toward the production of 3-4 year old feeders, under extensive range type management or no management at all. With few exceptions, Zebu bulls are left with the criolla and criollo-Zebu cow herd year round. Few ranchers castrate young bulls and they run with the cow-heifer herd until sold. Many ranches are completely bounded by fences and rivers or creeks while others are open (especially in more remote regions), excepting for natural boundaries.

Calving percentages are very low, estimated at 20-30%. This is not too surprising in view of breeding management, disease and parasite problems, and the extremely low calcium and phosphorus content of native forages.

Since land has long been available for the taking, ranches are extensive. A 10,000 Ha. ranch is not considered large. Cattle population is low, rarely exceeding 0.1 head/Ha. and frequently as low as 0.02 head/ha. This is not necessarily an indication of the carrying capacity of the native range, although ranchers speak of carrying capacities of 0.20 to 0.05 head/Ha. All indications are that increased grazing pressure improves the native range and that there are few if any cases of over grazing or even approaching the carrying capacity of the native range. Under present management practices, the availability of edible herbage during the dry season would undoubtedly be the major factor limiting carrying capacity.

Burning of the native range is a common management practice used to destroy coarse, dry herbage and permit regrowth of more palatable, edible young shoots. The practice is widely condemned as being destructive and largely responsible for the acidity and low fertility of the savannah soils.

In reality, burning likely has little to do with soil characteristics. The burn is typically very rapid and superficial. Soil temperatures are likely affected only to very shallow depths as evidenced by the rather high organic matter content of soils on savannahs which have been burned for centuries. Ca, Mg, K, P, and other plant nutrients (with the exception of nitrogen) are not lost in the burning process. They remain in the ashes from which they are leached into the root zone by the first rain. There they are absorbed by the roots of the perennial grasses and other species, and serve to stimulate regrowth. Under the circumstances which presently prevail, burning is probably the only management practice available to the rancher by which he can provide edible forage for his herd. If properly used it may be effective in improving the native range.

Under intensive management and rotational grazing at or near the carrying capacity of the native range, it might be possible to eliminate the practice of burning or to replace it with an occasional mowing operation. However, we do not have any evidence to indicate that the burning as such is detrimental, excepting in the case of species such as molasses grass which will not recover after burning.

Most ranchers supply range livestock with salt. Use of mineral supplements is a relatively recent innovation practiced only by the most progressive ranchers. Unquestionably this practice will improve reproductive and growth performance, and should reduce bone breakage markedly.

Most of the ranges in Meta and Vichada are well watered throughout the year. Casanare ranges are frequently short of surface water during the dry season, or distances to water are excessive for sound management. Windmills could be used to provide water from shallow wells (4-6 meters in many of the high savannahs). Depth to ground water in Casanare is unknown to the authors, but assumed to be no greater than in Meta.

Improved pastures are rare outside the piedmont. One rancher is known to have approximately 200 hectares of molasses grass, on which he grass fattens cattle for sale on the Bogota market. In pastures 6 or more years old, molasses grass continues to dominate native species and supply excellent grazing at 1 head/ha. during the rainy season. These pastures were seeded after plowing and disking with no fertilizer nor lime applied, on an extremely acid, infertile savannah soil. No other species has been found which is well adapted to the native soil conditions on this particular ranch. Puntero has been seeded successfully without fertilizer nor lime in the same general area but on better soils, ie. less acid soils of higher organic matter content and finer texture.

#### Diseases and Pests

The more progressive ranchers vaccinate for control of foot and mouth disease, blackleg, anthrax, hemorrhagic septicemia and brucellosis, depending on region and suspected presence of disease. Other diseases of importance are piroplasmiasis, anaplasmosis and trichomoniasis. Recent studies indicate that ranchers should be alert to problems with gastrointestinal parasites, particularly among young stock.

Ticks are common throughout the savannahs. Progressive ranchers dip

or spray their herds more or less regularly to control this problem. It is reported and has been observed that cattle grazing on molasses grass remain tick free. The grass is very waxy and highly aromatic. The mechanism of tick control is unknown. Nuche warble is serious in most of the piedmont but almost unknown in the open, high savannahs.

#### Agronomic Research

Through the cooperation of different ranchers, ICA initiated agronomic research in the savannahs of Meta and Vichada during the first half of 1966. The first experiments were planned in May and June at "El Piñal", a ranch located across the river from Orocué, some 300 kilometers from Villavicencio. Corn (H-104) was planted in small plots treated with different levels of lime, phosphorus and nitrogen in all combinations. Figure 2 is based on results of the first and the second planting of H-104 corn. Note the striking response to all these nutrients. Yields of best treatments were disappointing when compared with those obtained in traditional corn growing regions in Colombia. In subsequent experiments, with better insect control, yields have increased markedly. Some 1968-A experiments using H-253 have yielded 6 tons of grain.

During 1968, experiments have been initiated at Gaviotas, a government-sponsored development center just inside Vichada on the road to Sta. Rita. Work in pastures and soils continues at El Piñal and at other sites between Piñal and Pto. López. Results to date indicate that the most promising species for the soil and climate include rice, peanuts, cowpeas, sorghum, sesame and soybeans. Corn can be grown but has relatively high fertility and lime requirements.

#### Animal Science Research

A trial was initiated in 1967 at "El Piñal" with weanling San Martinero heifers to demonstrate the effect of mineral supplementation on growth, fertility, calving percentages, calf mortality and weaning weights. This trial will continue for three years. A similar trial was initiated in 1968 at Gaviotas. Preliminary data from "El Piñal" and "La Libertad" where an identical trial is being conducted with Romosinuano heifers, indicates higher growth rates in the mineral supplemented groups.

In addition, a grazing trial has been initiated at "El Piñal" to determine beef production/hectare on native range.

#### Conclusions

Agronomic research indicates clearly that soils of the Llanos Orientales of Colombia can be made highly productive with adequate lime and fertilizer applications. Lime and phosphorus requirements are much lower than had been suspected. There are undoubtedly many fertility and management problems, solutions to which will require major research efforts.

Under present market conditions, some crops could be produced economically

while others would be marginal. As access routes are improved and costs of inputs decrease, the region should be able to compete in the domestic and world markets in the production of rice and other grains as well as many other crops including oil seeds.

Livestock management could be greatly improved with rather simple measures including supplemental feeding of minerals and basic animal health programs. Productivity could be greatly increased through increased calving, decreased mortality, greater carrying capacity through improved range management and earlier marketing of fat cattle.



Figure 1.- LLANOS ORIENTALES OF COLOMBIA.

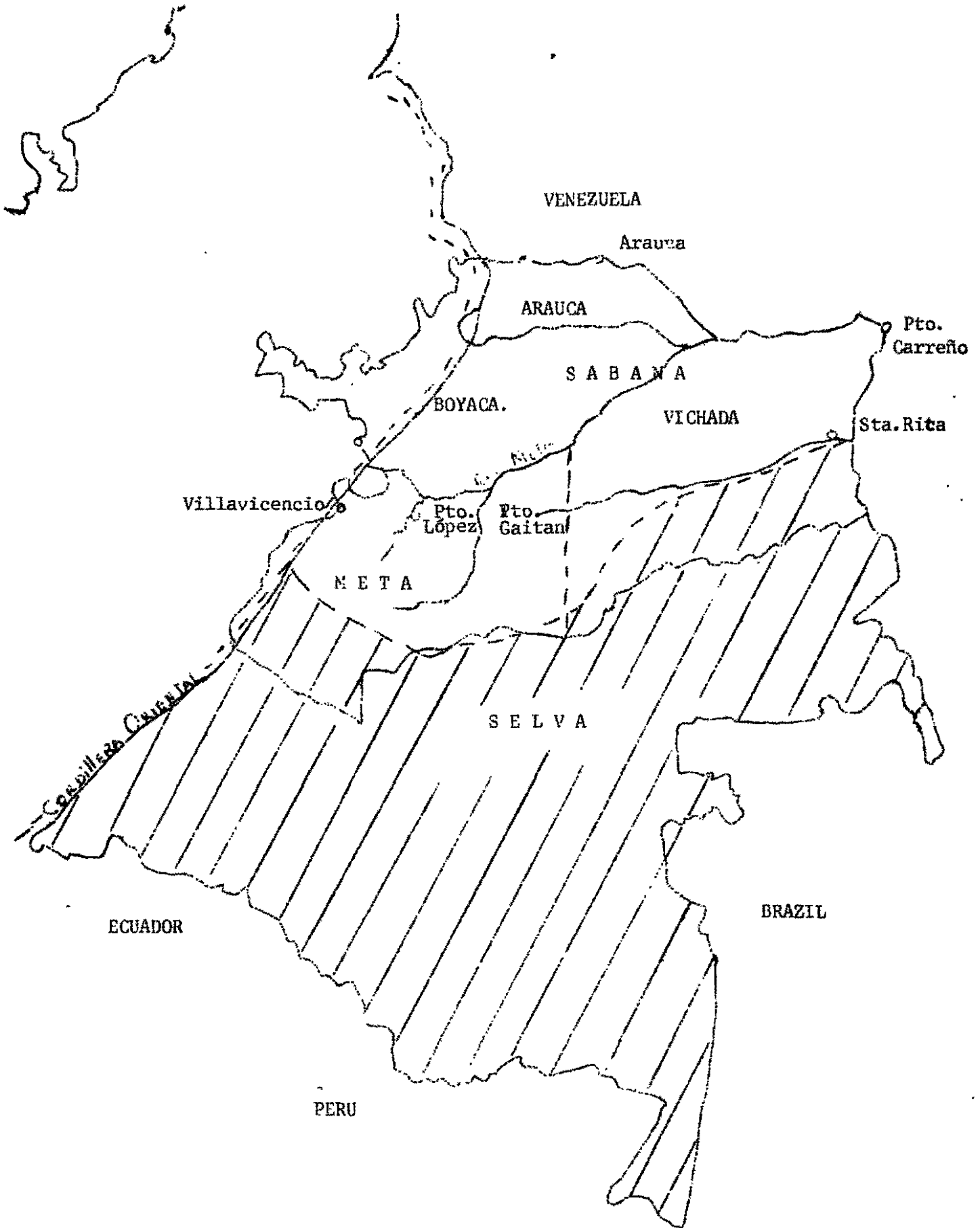




Figure 2. RESPONSE OF CORN TO NITROGEN, PHOSPHORUS AND LIME  
IN SAVANNAH SOILS, LLANOS ORIENTALES, COLOMBIA



Table 1. Typical chemical analysis of soils in the High Plains of Meta and Vichada, Colombia.

pH	4.8	Ca <sup>++</sup> meq	0.6
M.C.	3.0	Mg <sup>++</sup> meq	0.4
C.E.C. meq	12.0	K <sup>+</sup> meq	0.05
P, ppm.	1.5	Al <sup>+++</sup> meq	3.5

$$\frac{Al^{+++}}{\text{Total bases}} = 3.5$$