No. 2

THE REPUBLIC OF COLOMBIA

THE FEASIBILITY STUDY ON THE ARIARI RIVER BASIN INTEGRATED AGRICULTURAL DEVELOPMENT PROJECT

ANNEX (I)

NOVEMBER 1989

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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ANNEX A: NATIONAL AND REGIONAL SOCIO-ECONOMICS

A.1 CHARACTERIZATION OF THE REPUBLIC OF COLOMBIA

A.1.1 Socio-economic Features

The Republic of Colombia lies to the north-western edge of the South American Continent with the latitude 4°13'30"S - 12°26'46"N and the longitude 66°50'54"E - 79°02'33"W. The territorial extension is 1.14 million km^2 which is divided into 23 departments, 4 intendancies and 5 commissaries.

According with topography and climate, the country can be divided into six regions: Caribe, Pacific, Andean, Amazon, East Llanos and San Andres y Providencia. These regions are delimited by Eastern, Central and Western Mountain Ranges which stretch the country from north to south. In terms of latitude, Colombia belongs to the tropical zone, but its climate differs greatly from region to region by the complex of topography.

According to the National Census of 1985, Colombia had a population of 27,867 thousand which had been growing at an annual rate of 2.52% since 1973; the population of the Special District of Bogota was 3,983 thousand occupying 14.3% of the national population. The population of Bogota had increased at a remarkably high pace of 7.3% per annum between 1964 and 1973, but the pace has slowed down from that time on recording an average growth rate of 2.81% for the period of 1973-1985 absorbing the flow of immigrants from other parts of the country. Urban population accounted for 67.2% of the total population.

The distribution of Colombian population by age group in 1983, is as follows: 37.5% (14 years old and younger), 56.5% (15-60 years old) and 6.0% (older than 60 years). And, the economically active population (in Colombia people older than 12 years are taken into account) was estimated to be 19,336 thousand in 1985.

The rate of unemployment in four biggest cities (Bogota, Medellin, Cali and Baranquilla) was in the level of 12.5%. (December, 1986)

The imbalance of income level among people is predominant and it is reported that urban employees have disposable household income three times as much as laborers. The legal minimum wage as of January 1987 was Col$683.66/day. The average household expenditure was calculated to be Col$84,923/month (1984-1985) and the Engel's coefficient was estimated at 25%.

Colombia's Gross Domestic Product (GDP) had grown at an average rate of 5.7% in the 1970s, but from 1980 to 1985, as a consequence of worldwide recession, its growth had decelerated to as low as 2.1% per annum. In 1986, the Colombian economy has recovered from the said sluggish performance during 1980 - 1985 obtaining a real growth rate of GDP at 5.1%. GDP per capita was Col$215,009 in 1986, which is equivalent to approximately US$1,200.

Referring to available data for the year of 1985, major sectors which contributed greatly to GDP formation are: manufacturing (21.3%) agriculture (20.9%) and personal and public services (15.9%). On the other hand, higher annual growth rate was recorded during 1970 - 1985 in the order of: Communications (10.9%), Electricity, gas & water (6.9%), Fisheries (6.5%) & Construction (5.7%). Manufacturing and agriculture - the two key sectors of GDP - had been slacking in the period obtaining such inferior growth rate as 4.3% and 3.3%, respectively. These figures are below GDP's average rate of 4.4%.

An external trade in Colombia is represented by agriculture and mining sectors for exports and raw materials and capital goods for imports. In 1987, of total exports, 79% were generated by agriculture and mining sectors including coffee and petroleum derivates. With respect to imports, raw materials reached 48% of the total and capital goods 39%, while final consumable accounted

for 13%. From 1981 to 1984, deficit in foreign trade had been registered due to depressed price of coffee in international market, but in 1985 the government's imports restriction policy had driven the situation to positive. Furthermore, a largest surplus of US$1,992 million was recorded in 1986 owing to "coffee bonanza"--sharp rise of international price on account of worsened output of Brazilian products. The current account balance which comprises services and transfers in addition to trade balance also achieved a surplus in 1986 after the five-year (1981-1985) continuous loss. The balance of payments for the same year accounted for a surplus of US$1,407 million.

In 1987, a surplus of trade balance dwindled by US$693 million due to both drop in exports and expansion in imports. The former is caused mainly by decline of coffee's international price. Thus, the balance of payments was reduced to US$24 million.

The net international reserve of the country, after recording its highest level--US$5,630 million in 1981, has shown a downward slide up to 1985 having been shrunk to US$1,795 million--one thirds of the highest level. Nonetheless, owing to positive values for three consecutive years from 1985 to 1987, the net international reserve as of the end of 1987 was recovered to US$3,392 million.

The external debt has been increasing in Colombia with higher pace than the growth of GDP and the percentage of external debt to GDP rose to 42% in 1987.

Since 1967 Colombia implemented an exchange control system (Decree 444, March 22), under which the Central Bank has total control or monopoly of foreign exchange entering or leaving the country. The exchange rate is set at the discretion of the Central Bank, which adjusts it in view of maintaining a constant real exchange rate. Since June 1975, there had been a continuous drop in the devaluation process, always under the inflation rate. In 1985, in accordance with the Economic Adjustment Plan agreed

with IMF, it was discussed the need to devaluate to a point of coincidence to the real exchange index similar to that recorded in the 70's. For this reason, during 1985, the country had the highest devaluation in the history, equal to 51.2%. An average exchange rate of Colombian peso to US$ was 332.56 for December 1988.

The largest trade partner of Colombia is the U.S.A.; the Colombia--U.S.A. trade represented 29.8% of the total exports and 34.0% of the total imports, respectively for the year of 1986. Other countries which participated a major portion in trade with Colombia are West Germany, Netherland, Japan and Venezuela as export partners and Japan, West Germany, Venezuela and Spain as import partners.

Since the middle of the 70's, a major effort of Colombian government has been directed towards stabilization of prices. The rate of inflation, although it is by no means low, had been maintained in relatively moderate level compared with other major Latin American countries such as Brazil, Mexico, Argentine, Peru, Venezuela and Ecuador; for the last decade (1978-1987), an annual variation of consumer's price fluctuates from 28.8% (1979) to 16.6% (1983). As table A-1-5 indicates variations of foods' price have been always superior to total variations. Thus, if the Colombian Government wishes to control price increase, attention should be paid to the depression of foods price.

Colombia has been long known for its prudent management of public finance, which had been maintained in surplus from 1976 to 1980. In recent years, however, the Government's financial situation has deteriorated because of continuous expansion of public expenditure and high ratio of tax evasion. in 1985, deficit of public finance reached Col$130,083 million - equivalent to 2.8% of GDP. Close to 30% of this deficit was covered by external credits and the rest by domestic credits being financed mainly from the Central Bank and sales of national savings bonds.

A.1.2 Agricultural Aspects

(1) GDP and the agricultural sector

In 1987, according to the preliminary estimate of the Central Bank (Banco de Republica), the agricultural sector generated Col$140,411 million at the constant price of 1975. For the last decade (1978-1987), the rate of growth of the sector had been stagnant; the output in the period rose at as low as 2.3% per annum, which was inferior to the yearly growth rate of the GDP (3.1%). Consequently, the participation of the agricultural sector in GDP fell down from 38% in 1950 and 29% in 1970 to 22% in 1987.

(2) Land use and land tenure

It is estimated that about 14.4 million ha of land in Colombia, or equivalent to 12.6% of the national territory (114 million ha) is arable for agricultural purpose, whereas land capable for pasture corresponds to 19.3 million (16.9% of the total). On the other hand, in 1985 crops harvested area and grazing or rough grazing land accounted for 3.9 million ha and 22.6 million ha, which intimates that there remains considerable margin of arable land for the expansion of agricultural production and some portion of them is actually used for grazing land due to the lack of infrastructure or other reasons.

Land tenure by size in the national level is, like in other Latin American countries, characterized by imbalanced distribution: small and medium land owners with holding less than 10 ha represent 78.1% of the total number of properties but only 8.8% of the total rural land, while 60.8% of the rural lands is held by only 3% of the land owners with holding more than 100 ha.

(3) Agricultural output

Coffee is the mainstay of the Colombian economy which accounted for close to 20% of the total value added to crop production in 1987.

According to preliminary estimate of the Ministry of Agriculture (Anuario, Estadisticas del Sector Agropecuario 1988), apart from coffee, following crops registered a higher contribution of value added to the total crop production: sugarcane (8.9%), plantain (8.3%), "panela" (7.2%), potato (7.1%) and rice (6.6%).

The crops which showed a higher growth in production for the period 1979-1988 are: oil palm (268%), cacao (179%), banana (145%), kidneybean (141%) and cotton (136%). The growth of these crops is attributable to the expansion in harvested area for oil palm, cacao and cotton and to an intensification of production per unit land for banana and kidney bean. On the other hand, a stagnation or recession in production was reported for cassava, soybean, maize and rice. Of these crops, as for rice, the decline in the harvested area has adversely affected the unit yield. The inactivity of production for the rest of the crops (cassava, soybean and maize) is due to combined stagnation both in harvested area and unit yield.

(4) Trade in agricultural products

In 1987, trade balance of agricultural sector resulted in surplus of US$1.97 million. This surplus owned in its great majority to coffee; if coffee is excluded from consideration, the surplus in agricultural sector would be reduced to as little as US$318 thousand.

Up to 1960, the participation of coffee in total national exports had been more than 90% in value terms and coffee contributed greatly to finance the government's budget. In recent years (1982-1985), because of an expansion of exports other than agro-

products, the contribution of coffee to total national exports has reduced to around 50%. Nevertheless, in 1986, coffee share was recovered to as high as 58.5%, attributable to coffee bonanza caused by sharp rise of price in international market which was rooted in the decline of Brazilian products.

In contrast with this, in 1987, the contribution of coffee to the total exports become the lowest level (in 32.9%) in the history because of the slack of international price (US$1.23/pound compared with US$2.20/pound in 1986).

In relation with other agro-products, there has been a large expansion in exportation of banana and cut flowers, while a decline in the share has taken in such exports as cotton, sugar and beef in recent years.

The importation of foods and agriculture-related materials and inputs accounted for 7.2% of the total imports in value terms for 1987, which was declined from 9.6% of average rate for the previous three years 1983-1986. A sharp drop in food and agriculture related materials and inputs both in value and volume in 1987 is due to the government's policy of import restriction. With respect to individual product, the share of wheat recorded the highest with the participation of more than one-fourth (25.8%); subsequently, soybean (12.9%), beef fat (5.7%), lentil (4.9%) and soybean oil (4.4%) were much imported in 1987. The importation of maize and sorghum shows a tendency to be reduced. Finally, it is worth while to note that the imported volume of foods had increased at an average rate of 8.5% p.a. between 1970 to 1985 that is considered a very high pace of expansion if one takes the yearly population growth rate -2.5% into account.

(5) Labor force

In 1984, the agricultural sector provided the greatest opportunity of employment within the country's labor market; it accounted for 33% of the total employment. As the case of

contribution to the GDP, the importance of the agriculture sector was reduced relatively in recent years; the participation of the sector, which registered 56% of the nation's total employment in 1951, declined to 49% in 1964, to 35% in 1980, and to 33% in 1984 (See Table A-1-8).

A.1.3 National Development Plan (1987 - 1990)

(1) General

The four year socio-economic development plan envisages an achievement of two targets simultaneously: a less social distortion and a consistent economic growth.

The first will be carried out with a slogan "eradicate absolute poverty" under a social climate of national reconciliation. Investment will be made in the interest of bettering the physical infrastructure in rural and marginal urban areas, and of human resources.

The second will be realized by intensification of production base as well as expansion of market, both domestic and external. The average annual increase rate of GDP during the plan period is set at 5% with the average increase of 5 - 6% in employment. Public investment will be focused on social overhead capital and on areas less developed and having strategical importance. Private investment is desired to increase by tax reform and more liberal foreign investment rules, which were declared at the end of 1986. The real annual increase rate of 6 - 7% in the export income is expected by the efforts of sectors in agriculture and mining, in which the value of non-traditional export goods is to be raised by 15% per annum. The domestic demand is expected to be sustained favourably by the efforts of sectors in manufacturing and construction.

The main objective of the macro-economic policy is to keep the economy growing while restricting inflation. The rate of deficit

of fiscal budget to the GDP is to be below 3%, and the amount of the external debt will be around US$2 billion per annum. The budget for the total plan is given below. The new borrowing for the plan is 7.3% of the total budget, for the 52.7% of which the government seeks resources outside the country, and domestic for the rest.

TOTAL BUDGET

Unit: In million of Col.$ at constant price of 1987

	1987	1988	1989	1990	Total
Current Revenue	1,116,026	1,206,498	1,421,373	1,445,453	5,189,350
Assets for Investment	107,126	104,407	93,814	89,511	394,858
Current Expenditure	877,684	946,497	1,095,515	1,104,117	4,023,813
Capital Formation	484,962	459,793	517,499	537,456	1,999,710
Balance	-139,494	-95,385	-97,827	-106,609	-439,315
Planned Borrowing	272,128	189,271	214,205	228,404	094,008
New Projects	864	27,394	40,760	49,404	118,422
(-): Amortization	181,633	185,746	208,178	215,537	791,094
Net External Credit	91,359	30,919	46,787	62,271	231,336
Net Domestic Credit	48,135	64,466	51,040	44,338	207,979
TOTAL DEBT	139,494	95,385	97,827	106,609	439,315

Source: Planes y Programas de Desarrollo Economico y Social 1987 - 1990, DNP

(2) Agriculture Sector

Policies of the agriculture sector aim to recover the dynamism of production and to endow farmers with resources that will permit them to enhance their living conditions and capacity for generating income. Additionally, with a view to attaining consistent economic growth, actions of the Government shall be directed to increase exportable products.

In order to attain the above-mentioned objective, a total of Col$273,000 (4.5% of the total budget) million will be allocated to the agricultural sector, which represents a growth of 11% which will be financed by external loans.

The sectorial development plan will be implemented by five different institutions affiliated to the Ministry of Agriculture.

21.8% of the sectorial budget is to be financed by external loans. The plan will be executed by 8 different institutions which are affiliated to the Ministry of Agriculture.

24.9% of the budget will go to the Fondo-DRI, through which integrated assistance to the farmers are carried out. This budget will be procured equally by domestic and external resources. 22.7% will go to INCORA, which functions as a major work force of agrarian reform. ICA, the chief agency for research and technology transfer will receive 22.6%, and HIMAT, which aims at improving and preserving the quality of farmland, will get 19.8%.

The budget for the national Plan for Rehabilitation is included in this sector. Those areas which will not be covered by the Fondo-DRI will be taken care of by this provision. The amount reaches Col$50,293 million, and is distributed to all the institutions but EMCOPER.

TOTAL BUDGET

Unit: In million of Col.$ at constant price of 1987

	1987	1988	1989	1990	Total	%
ICA	14,139	14,674	16,354	16,499	61,666	22.6
INCORA	14,662	15,445	15,792	16,148	62,047	22.7
INDERENA	3,272	3,527	3,793	3,778	14,370	5.3
HIMAT	7,091	14,903	16,113	16,027	54,134	19.8
IDEMA	1,844	360	570	370	3,144	1.2
EMCOPER	121	144	132	144	541	0.2
Fondo-DRI	12,062	12,165	19,288	24,446	67,961	24.9
DIRECCION SUPERIOR	1,742	2,759	2,193	2,230	8,924	3.3
TOTAL SECTOR	54,933	63,977	74,235	79,642	272,787	100

Source: Planes y Programas de Desarrollo Economico y Social 1987 - 1990, DNP

A.2 CHARACTERIZATION OF THE DEPARTMENT OF META

A.2.1 Physical and Social Features

The Department of Meta is located in the central part of the Republic of Colombia with latitudes between 1°32'30"N and 4°57'30"N and longitudes between 70°2'30"W and 74°57'00"W.

The total extension of the Department reaches 85,635km^2 (DANE), the second largest department next to Caqueta, covering about 7.5% of the national land. In accordance with topography, the territory of the Department can be divided into the following five sub-regions: Eastern Range (12,300km^2), Mountain Foot (10,619km^2), Natural Reserve of the Macarena (11,313km^2), Savanna (45,301km^2) and Middle Basin of the Guayabero River (6,100.5km^2).

The tropical humid climate dominates the whole of the Department. Temperatures are high throughout the year, mean monthly values are in the range of 25°C and 27°C. There are two clearly defined seasons determined by rainfall: rainy season (April - November) and dry season (December - March). Mean annual rainfall fluctuates widely from 4,500mm at the foot of the Eastern Range to 2,000mm in Savanna sub-region.

The Department was created relatively new, in 1959. Presently there are 24 municipalities including the capital city of Villavicencio.

Referring to 1985's national census, the Department had a population of 412,312 inhabitants, of which 174,602 lived in Villavicencio. The population of the Department has been growing rapidly with annual growth rate of 3.85% since 1973, very high pace compared with the national average (2.52%). This high rate of population growth has been brought by accelerated flow of immigrants from other parts of the country; the said census indicates that, of the total population in Meta, as low as 40% were native of the same department (national average was 64%).

It is predicted that the population of Meta will rise to around 800,000 in 2,000, if the prevailing growth rate will be kept in the future.

The infrastructure is under-developed in the Department. Relevant to transportation system, the shortage of road network constitutes one of constraints on development of the potentials of Meta. The paved road of 115km which links Villavicencio with Bogota is the only access for the Department to transport its products to the largest consumption market of the Republic. This road, however, is a "bottleneck" for the departmental economy, because, with maximum slop of 16% and innumerable curves, traffic is compelled to be sluggish and it happens to be closed sometimes due to inadequate maintenance. The total length of roads existing as of 1984 was 5,200km, of which only 220km (4%) were paved. The principal paved roads passing through the Department are: Villavicencio - Puerto Lopez (83km) and Villavicentio - Granada (85km).

The air traffic communicates Villavicentio with alienated towns from road transportation. However, the majority of air traffic is represented by light aircrafts, the service of which is limited within "Lianos Orientales" with irregular service time. As an exception, aircrafts are serving regularly between Villavicencio and Bogota. Furthermore, fluvial transportation is developed in some parts of the Department but its contribution to the regional economy is negligible.

Of 24 municipalities in Meta, only 9 municipalities have actually access to electric services provided by Electrificadora del Meta (EMSA), subsidiary and regional company of ICEL (Colombian Institute of Electric Energy). The rest are supplying electric power by means of generators. In these municipalities, the benefit of electric service is limited to urban area.

Besides electric power, other social infrastructure such as water supply and sewage treatment system is deficiently provided.

The coverage indexes of these three services are inferior to the national average (85's census) and less than half (46.7%) of families in the Department are covered by the whole of these three services (national average is 57%).

A.2.2. Economic Performance

Without being available up-to-date information on the Gross Regional Product (GRP) in Meta, reference was made to 1982's information -Cuenta Nacional de Colombia (Banco de la Republica). In this year, the GRP of Meta accounted for close to 1.5% of GDP. The agricultural and livestock sector is a mainstay of the departmental economic activity, which shared more than half (53%) of the GRP, and 3.5% of the national agricultural and livestock production. In this connection, the performance of the departmental economy is greatly affected by the agricultural and livestock sector.

This is particular the case with the economic performance for the year of 1986. In this year, due to decline in output (23.5%) of rice and sorghum, leading products in Meta, the progress of the agricultural and livestock sector was negative, and, consequently, the regional economic performance, as a whole, remained inactive. In the same year, the stagnation of economic vitality was also true in such other sectors as commerce, construction and mining, except for the exploitation of crude oil which was boosted with the growth of 9% from the previous year.

A.2.3 Agricultural Sector

(1) Agricultural production

Endowed with potential and abundant natural resources, the Department of Meta is considered to be one of major agricultural production regions of the country.

It is estimated that about two millions of land or equivalent to 23% of the departmental territory is potential land for crop production. Nevertheless, it is worth while to indicate, that, of this extension, only 215 thousand ha (10.7%) of land are presently used for agricultural purpose. This intimates that there remains a great expansion opportunity of agricultural production in the future.

Recent production of major crops in Meta is as explained below.

Rice is the leading crop cultivated in the Department and the output of the cereal is the second largest next to Tolima in the national level with a participation of 11.3%.

Production of rice in Meta reached its highest level in 1982, but it had caused a super-production in comparison with the processing capacity of rice mills. consequently, it is reported that not a little paddy had been lost or damaged its quality. This had lead to notable reduction of planted area of rice in 1988. From this year to 1986, rice production had been sluggish in the department, but owing to favorable farm-gate price, improvement of commercialization canal and availability of credit, it is estimated that the production in 1988 surpassed that in 1982. As cited above, Tolima and Meta are the leading rice productive area in Colombia.

Maize is one of major crops in the department with a participation of 5.6% in terms in cultivated area in 1987. This cereal was the second most important crop next to rice in 1983, but its importance has been decreased from that year on. Reasons for this inferior behavior of maize are: relatively gentle rise of farm-gate price, lack of access to credit service, difficulty to control insects and weeds, etc. Planted area for both technical and traditional cultivation is almost the same, while unit yield differs in such manner as: 2.0 ton/ha for the former and 1.5 ton/ha for the latter.

In Meta, sorghum, soybean and cotton are cultivated as a secondary crop for rain-fed rice. In 1987, planted area of these crops occupied 10.3%, 3.3% and 1.9% of the total area of the department. For the year of 1988, there is a substantial decrease in sorghum which is offset by increase of soybean. This tendency is reflected by profitability of the two crops. About 70% of soybean in the department is produced in Granada and Fuente de Oro.

Apart from rice, plantain has registered the largest production for the last five years, but its cultivated area has decreased a little in a couple of years due to such reasons as: renovation of aged plants, unfavorable climatic conditions, etc. More than half of the departmental output is produced in Fuento de Oro, Lejanias and Granada. The unit yield of this crop fluctuates around 7.0 ton/ha.

Planted area of cacao has increased recently, and its output in Meta has become in the fourth among 23 departments of the country with a contribution of 7.6% in 1988. Positive elements such as better farm-gate price, promotion program of new varieties suitable for the region have brought this growth of planted area. Predominant production area is the Ariari Region including Castillo, Granada, Lejanias and Cubarral. Approximately 500 kilograms of beans is produced in one hectare of land.

As of 1988, planted area of oil palm in Meta reached 35,000 ha, of which 12,500 ha are in production. In this area, 86,100 tons of palm oil - equivalent to 15.4% of the country's output - are produced yearly. Cultivated are of oil palm in Meta is concentrated in Acacias, San Carlos de Guaroa, Gumaral and San Martin.

(2) Livestock production

Being available vast land for grazing, cattle raising is extensively conducted in the Department. This can be supported

by the fact that lands distributed for grazing in Meta are the largest in the country (accounts for 24% of the share), while the number of cattle heads represents only 5.5% of the total number of cattle in Colombia. Thus, in Meta, one cattle occupies, on the average, 4.0 ha of grazing land, that is five times as extensive as the national average.

Breeds of cattle raised in Meta are represented in their greater majority by "Cebu" or its crossing with other breeds. These cattle are kept mainly for meat production, and the dual purpose (meat and dairy) of farming is scarcely practiced.

Regardless of being consumed locally, the principal destination of cattle raised in the Department is Bogotá, where about 60% of its meat consumption depends on Meta's cattle. However, cattle are directly transported to Bogotá without being slaughtered and processed, so meat and sub-products processing industry has been less developed in Meta.

The sub-sectors of swine and poultry farming and fish production are urban-developed in comparison with cattle farming.

A.2.4 Regional Development Plan

(1) Projects approved by the Departmental Congress for Impulse of the Development of Meta

After conducting socio-political and economic study and analysis, a total of 21 projects have been identified as alternatives to solve the most pressing need of the Department of Meta.

Of the said 21 projects, the following three projects are considered to be of major importance.

1) Meta Agro-industry Fund

The creation of the Meta Agro-industry Fund seeks to drive the development of agro-industry in line with the National Development Plan 1987 - 1990.

Objectives of the Fund are to enhance the agricultural sector for attainment of real development, to drive technical transfer, to try to attract an investment of private sector on processing of crops, etc.

Within the context of objectives mentioned above, the following sub-projects are propcsed.

- Meta Refrigeration Co., Ltd. (Establishment of freezing system for the commercialization of meat).
- Soyabean Processing Factory (Processing of oil and refuse of soybean)
- Promotion and commercialization of Grafted and Certified Varieties of Citrus (Establishment of orchard to introduce grafted and certified varieties of citrus, expansion of planted area and evaluation of alternatives on commercialization).
- Cassava Drying factory (Establishment of a factory consists of washing, cutting, drying, milling and packing facilities of Cassava)
- Plantain Powdering Plant (Establishment of plant to produce powder of plantain for both human and animal uses).
- Animal Fodder Production Plant (Production of animal fodder with high content of protein and economical price)
- IRACA Pisciculture Station (Establishment of pisciculture development station to contribute to improvement of nourishment and diversification of agricultural activity among small farmers)
- Soybean Production Development (Promotion of soybean production in Ariari Region)

2) Petroleum Contribution Fund for Public Works

The purpose to create the fund is to promote construction of infrastructure of public interest. Financial resources for the Fund are to be procured through contribution of Colombian Petroleum Enterprise (ECOPETROL).

With a contribution of ECOPETROL the following investments are anticipated for the period 1989 - 1991.

Sectors	Investments (Col$ million)
Health and Welfare	2,605
Public works	300
Education	400
Agriculrure	500
Total	3,805

3) Meta Water Supply and Sewerage Fund (FONAM)

The creation of the Fund has objective to grant water supply and sewerage system for all municipalities of the Department. The total investment cost of the Project during 1988 - 1991 is estimated at Col$6,262 million, of which 61.5% will be allocated to water supply development.

(2) National Rehabilitation Plan (PNR)

1) Introduction

The National Rehabilitation Plan (PNR) is one of key strategies within the context of the National Development Plan. In the Department of Meta, under the PNR, important actions have been implemented since 1986 in view of rectifying regional imbalance and creating necessary conditions for encouragement of the productive sector.

The PNR in Meta is implemented in 11 municipalities (hereinunder referred to as the "region") consist of: Granada, Cubarral, El Castillo, Fuente de Oro, Lejanias, Meseta, Puerto Lleras, San Juan de Arama, Vistahermosa, La Macarena and Puerto Rico. The extension of these municipalities cover approximately 34,885km^2 (40% of the departmental territory). The number of inhabitants is estimated at 155,535 as of 1988, which is equivalent to one-third of the departmental population close to 65% of the said inhabitants live in rural area.

The leading activity of the region is agriculture: the region produces 98% of the departmental production of coffee, 89% of plantain, 86% of cacao, 84% of maize, 42% of upland rice and 37% of sorghum. The region also shares 30% of the number of cows raised in the Department.

2) Investment Plan

1. Criteria para identification of projects

Prime priority is given to projects with higher social and economic effects; it is important that each community implements these projects with their participation. Higher priority is also given to such projects as to make as possible to promote physical and economic integration of the regional market and to such projects as are feasible to resolve pressing constrains of communities in a short term.

2. Investment Plan 1989 - 1991

Investment for the PNR will be distributed in the following manner:

Sector	1989	1990	1991	Total	(%)
Social Area	2,306.9	1,610.5	1,658.7	5,576.1	(10.8)
Social Infrastructure	1,340.9	352.0	144.1	1,837.0	(6.8)
Production	2,252.2	3,159.2	3,869.9	9,281.6	(34.5)
Economic Infrastructure	1,966.7	4,178.4	3,904.7	10,049.8	(37.4)
Institutions	21.6	40.0	60.0	121.6	(0.5)
Total	7,888.6	9,340.1	9,637.4	26.866.1	

Furthermore, the budget for the production Sector will be allocated to: acquisition and distribution of lands, lands improvement, farmer's credit, agricultural investigation, technology transfer and assistance, commercialization of agro-products, mechanical center, agro-industrial complex, management of river basins, etc.

TABLES

TABLE A-1-1 POPULATION AND ITS GROWTH RATE IN COLOMBIA

Year	Population	Annual Average Growth Rate(%)
1938	8,643,601	
1951	11,962,360	2.53
1964	17,484,509	2.96
1973	20,666,920	1.88
1985	27,867,326	2.52

Table A-1-2 GROSS DOMESTIC PRODUCT

	GDP				Población	GDP per Capita			
	Current Prices		Constant Prices of 1975			Current Prices		Constant Prices of 1975	
	Million of Col$%	Variation %	Million of Col$	Variation %		Col$	Variation %	Col$	Variation %
1970	132,768	--	307,496	--	21,448,847	6,190	-	14,336	-
1971	155,886								
1972	189,614	21.6	350,813	7.7	22,424,678	8,456	19.0	15,644	5.3
1973	243,160	28.1	374,398	6.7	22,915,229	10,611	25.5	16,338	4.4
1974	322,384	32.6	295,910	5.7	23,440,566	13,753	29.6	16,890	3.4
1975	405,108	25.7	405,108	2.3	23,967,997	16,902	22.9	16,902	0.1
1976	532,270	31.4	424,263	4.7	24,297,124	21,728	28.6	17,319	2.5
1977	716,029	34.5	441,906	4.2	25,027,543	28,610	31.7	17,657	2.0
1978	909,487	27.0	479,335	8.5	25,558,835	35,584	24.4	18,754	6.2
1979	1,188,817	30.7	505,119	5.4	26,090,573	45,565	28.0	19,360	3.2
1980	1,579,130	32.8	525,765	4.1	26,622,322	59,316	30.2	19,749	2.0
1981	1,982,773	25.6	537,736	2.3	27,153,634	73,021	23.1	19,803	0.3
1982	2,497,298	25.9	542,836	0.9	27,684,057	90,207	23.5	19,608	1.0
1983	3,054,137	22.3	551,380	1.6	28,213,128	108,252	20.0	19,543	0.3
1984	3,856,584	26.3	569,855	3.4	28,740,378	134,187	24.0	19,828	1.5
1985	4,965,003	28.8	597,561	3.1	29,265,499	169,684	26.5	20,077	1.3
1986P	6,701,425	34.9	617,527	5.1	29,787,676	224,973	32.6	20,731	3.3
1987Pe	8,779,424	31.0	650,568	5.4	30,319	289,567	28.7	21,457	3.5

Source: Revista del banco de la republica, October 1988

Table A-1-3 CONTRIBUTION TO GDP AND GROWTH RATE BY SECTORS

SECTORS	CONTRIBUTION TO GDP								ANNUAL GROWTH RATE								
	1970	1975	1980	1981	1982	1983	1984	1985	1970-75	1976-80	1981	1982	1983	1984	1985	Average 1970-1985	Average 1981-1985
Agriculture	24.6	22.8	22.0	22.3	21.5	21.6	21.3	20.9	4.3	43.	3.3	-2.1	2.8	1.6	0.1	3.2.	0.6
Forestry	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	3.5	4.0	-5.8	8.4	2.3	4.7	2.5	3.3	4.5
Fishery	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	11.9	4.8	7.1	-0.1	2.1	5.5	1.7	6.5	2.2
Mining	2.7	1.7	1.3	1.3	1.3	1.5	1.7	2.2	-3.3	-0.8	5.4	1.8	14.2	22.0	26.6	2.9	15.7
Manufacturing	21.5	23.1	22.5	21.5	20.9	20.7	21.3	21.3	7.4	4.6	-2.6	-1.4	1.1	6.0	2.3	4.3	2.0
Electricity, Gas & Water	0.7	0.9	1.0	1.0	1.0	1.0	1.0	1.0	11.1	6.5	3.3	3.2	1.5	5.1	2.8	6.9	3.2
Construction	3.5	3.3	3.4	3.5	3.6	4.0	4.2	4.2	4.9	5.4	7.1	4.0	13.0	6.4	3.4	5.7	6.6
Commerce	10.0	10.5	10.1	10.1	10.0	9.7	9.7	9.8	7.1	4.3	1.2	1.0	-0.7	2.4	3.0	4.2	1.4
Transport & Warehouse	7.1	7.5	8.1	8.1	8.3	8.0	7.9	7.8	7.0	6.7	2.8	4.1	-1.4	0.7	1.3	5.0	1.2
Communications	0.7	0.9	1.3	1.4	1.6	1.6	1.7	1.8	10.9	13.3	11.9	11.4	2.1	11.8	5.7	10.9	7.7
Banking, Insurance and Enterprice Services	6.4	6.7	7.3	7.8	7.9	8.1	7.2	7.2	7.2	6.6	9.1	3.1	5.0	-8.7	2.0	5.2	0.2
House Rental	8.0	7.1	6.8	6.9	7.0	7.2	7.2	7.3	9.6	4.1	3.6	3.2	4.0	3.5	3.5	3.8	3.5
Personal & Rpublic Services	14.1	14.5	15.4	15.8	16.0	15.6	15.9	15.6	6.6	6.3	4.6	2.7	-0.2	4.9	0.2	5.1	1.9
GDP	100	100	100	100	100	100	100	100	5.7	5.4	2.3	0.9	1.6	3.4	2.4	4.4	2.1

Table A-1-4 BALANCE OF PAYMENT

Unit: US$ Million

ITEM	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
I. CURRENT ACCOUNT	330	512	104	-1722	-2885	-2826	-2050	1220	493	-543
A. Trade Balance	667	537	13	-1333	-2076	-1317	-404	149	1992	1299
Exports	3219	3515	4296	3397	3282	3147	3623	3882	5477	5240
Imports	2552	2978	4283	4730	5358	4464	4027	3734	3486	3932
B. Services Balance	-410	-127	-74	-631	-978	-1673	-1945	-1883	-2272	-2550
Financial Services	-301	-255	-211	-427	-787	-918	-1240	-1354	-1137	-1294
Others	109	128	137	-204	-191	-755	-705	-479	-1135	-1256
C. Transfers	73	102	166	242	169	164	299	464	774	700
II. CAPITAL ACCOUNT	142	977	945	2039	2231	1436	944	1850	1097	515
A. Long-term Capital	0	761	723	1618	1593	1522	1566	2058	2363	960
B. Short-term Capital	142	216	222	421	638	-86	-622	-208	-1266	-445
III. RESERVE ADJUSTMENT	0	24	24	24	0	-67	20	-39	50	62
IV. ERROS AND OMISSIONS	188	98	162	-100	-47	-266	-175	-307	-173	-11
CHANGE IN NET RESERVES	660	1611	1235	241	-701	-1723	-1261	284	1467	24

Sources: Bance de la República

Table A-1-5 CONSUMER PRICE INDEX

Base: December 1978=100

Year	GROUP									
	Total		Food		Housing		Clothes		Miecellaneous	
	Index Dic.	Annual Vari.	Index Dic.	Annual Vari.	Index Dic.	Annual Vari.	Index Dic.	Annual Vari.	Index Dic.	Annual Vari.
1978	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-
1979	128.8	28.8	132.0	32.0	126.0	26.0	125.8	25.8	126.2	26.2
1980	162.2	25.8	166.1	25.8	162.6	29.0	149.4	18.7	155.9	23.5
1982	254.2	24.0	265.6	24.4	250.8	23.5	216.0	19.6	240.0	23.2
1983	296.5	16.6	311.3	17.3	285.5	13.8	244.2	13.1	291.5	21.5
1984	350.8	18.3	372.5	19.6	322.2	12.9	288.0	17.9	363.1	24.6
1985	4429.5	22.5	475.7	27.7	372.0	15.5	335.0	16.3	433.2	19.3
1986	519.5	21.0	588.4	23.7	427.0	14.8	398.8	19.1	532.4	22.9
1987	644.3	24.0	748.2	27.2	507.2	18.8	473.4	18.7	661.4	24.2
1988 1/	768.9	19.3	921.6	23.2	564.8	11.4	528.3	11.6	764.9	15.6

Source: Boletin de estadistica, Dane
Note : 1/ June, 1988

Table A-1-6 CROPS' PRODUCTION IN COLOMBIA (1988)

	Planted Area		Production	Unit Yield (ton/ha)	Output	
	Area (ha)	%	Volume (ton)		Value[1/]	%
I. Annual Crops						
Cotton	232,030	7.0	383,240	1.65	4,098.7	4.6
Kdineybean	225,800	3.8	99,900	0.79	1,455.5	1.6
Maize	635,500	19.3	2,491,900	1.39	4,039.7	4.5
Potato	1,708,00	5.2	681,100	14.59	6,374.3	7.1
Rice	372,200	11.3	1,784,900	4.80	5,850.9	6.6
Sorghum	265,700	8.1	681,100	2.53	2,451.3	2.7
Soybean	55,370	1.7	101,100	1.83	990.3	1.1
Vegetables	102,330	3.1	1,457,200	-	5,422.2	6.1
II. Permanent Crops						
Banana	25,050	0.8	1,140,000	45.51	2,146.6	2.4
Cacao	118,840	3.6	57,700	0.49	1,694.8	1.7
Cassava	160,800	4.9	1,321,530	8.22	2,110.4	2.4
Oil P¿alm	5,521.0	1.7	168,750	3.06	2,636.7	3.0
Panela	230,300	7.0	1,187,960	5.16	6,440.1	7.2
Plantain	378,130	11.4	2,530,480	6.69	7,399.3	8.3
Sugarcane	108,000	3.3	1,390,400	12.87	7,946.1	8.9
Fruits	54,050	1.6	877,455	-	2,134.1	2.4
Total	3,298,850	100	-	-	89,296.1	100
II. Permanent Crops						

Source: ANUARIO ESTADISTICAS DEL SECTOR AGROPECUARIO 1988
Ministerio de Agricultura

Note : 1/ constant Price of 1975 (Col$ Million)

Table A-1-7 TRADE OF AGRO-PRODUCTS

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
A. EXPORTS										
Cofee (a)	1,978,725	2,005,086	2,360,509	1,243,264	1,561,494	1,506,187	1,764,504	1,745,521	2,990,530	1,650,648
Banana	80,523	79,612	94,141	122,430	151,119	147,096	197,915	156,115	199,842	210,333
Cut Flower	47,581	68,179	97,016	108,573	111,482	120,557	129,492	132,054	148,532	145,033
Beef	33,723	28,083	15,590	12,871	45,386	30,529	10,520	6,288	17,389	22,981
Sugar	19,536	42,634	164,676	76,881	54,720	68,922	28,617	36,857	36,218	15,826
Cotton	56,781	37,951	82,291	93,419	26,515	23,062	48,095	59,472	44,672	46,706
Others	82,717	105,251	162,072	101,345	158,830	155,425	184,455	183,770	216,526	181,715
Total Agro-Products (b)	2,299,586	2,365,796	2,946,295	1,938,783	2,109,546	2,051,778	2,363,599	2,320,077	2,653,709	2,273,242
Total Exports (c)	3,002,691	3,300,443	3,945,058	2,956,400	3,094,967	3,080,892	3,483,140	3,551,886	5,107,936	5,024,422
(b)/(c) x 100	76.6	71.7	74.7	65.6	68.2	66.6	67.9	65.3	71.5	45.2
(a)/(c) x 100	65.9	60.8	59.8	48.1	50.5	48.9	50.7	49.1	58.5	32.9
B. IMPORTS										
Wheat	50,740	52,553	128,797	71,405	104,321	127,441	119,166	98,552	84,810	78,557
Soybean	1,305	-	-	-	-	27,018	24,473	34,785	9,585	39,168
Maize	7,970	8,671	30,389	15,234	17,175	11,133	1,384	4,692	4,800	208
Sorghum	4,928	483	26,153	1,635	8,440	26,666	6,649	11,807	6,105	-
Apple	3,180	8,892	12,890	12,204	13,763	15,434	6,678	4,683	8,141	10,701
Pea	3,519	5,315	10,247	9,700	10,119	12,388	2,478	6,997	6,563	10,900
Lentil	8,419	5,406	11,447	9,542	7,935	12,026	5,608	5,344	10,626	14,801
Crude Soybean Oil	27,541	46,454	52,423	10,235	75,821	47,809	49,511	34,649	27,158	13,306
Beef Fat	14,449	18,501	20,357	12,780	12,806	15,750	16,605	19,129	13,618	17,337
Others	98,559	148,075	112,601	242,960	141,982	71,961	203,157	162,873	160,630	119,764
Total Agro-products (d)	220,600	247,896	405,303	385,695	392,416	478,726	435,709	383,511	332,036	304,742
Total Imports (e)	2,836,315	3,232,194	4,662,604	6,199,156	5,477,701	4,477,968	4,492,391	4,130,686	3,954,520	4,249,181
(d)/(e) x 100	7.8	7.7	8.7	6.2	7.2	10.7	9.7	9.3	8.4	7.2
C. TRADE BALANCE OF AGRO-PRODUCTS										
(b) - (d)	2,078,986	2,117,900	2,540,992	1,553,088	1,717,130	1,573,052	1,927,890	1,936,566	3,321,673	1,968,500

Table A-1-8 COMPOSITION OF EMPLOYMENT BY SECTOR

Sector	1938	1951	1964	1974	1980	1984
Agriculture	59.2	55.9	49.0	41.9	34.8	32.7
Mining	2.3	1.7	1.6	0.8	0.9	1.1
Manufacturing	14.1	12.7	13.2	14.3	17.5	16.4
Construction	2.8	3.7	4.5	4.7	5.6	5.0
Electricity, Gas Water	0.2	0.3	0.3	0.5	0.3	0.3
Commerce	5.7	5.6	8.9	12.6	16.5	17.8
Transport & Communications	2.0	3.6	3.9	4.1	4.4	4.5
Other Services	13.5	16.5	18.7	21.1	20.9	22.1
- Domestic	8.6		9.9	5.9	3.3	3.5
- Non-domestic	5.0		8.8	15.2	17.6	18.6

Source: Informe de Empleo, Misión chenery, July 1986

Table A-2-1 CROP PRODUCTION IN META (1988)

	Productio n (ton)			Unit Yield (ton/ha)	
	National	Meta	(%)	National	Meta
Cotton	410,000	5,200	1.3	1.78	1.30
Rice	1,866,800	409,100	11.3	4.98	4.93
Maize	999,500	23,900	2.4	1.45	1.75
Sorghum	796,900	46,000	0.6	2.82	2.30
Soybean	153,220	11,360	7.4	2.13	1.60
Cacao	55,400	4,186	7.6	0.51	0.57
"Panela"	1,181,960	11,800	1.0	5.09	4.72
Oil Palm	170,000	26,100	15.4	2.98	2.61
Plantain	2,480,000	86,100	3.5	6.53	7.00
Cassava	1,321,530	34,500	2.6	8.22	7.50

Source: Botetin Estadisticas Agropecuarias, Marzo 1988
Ministerio de Agricultura

F I G U I R E S

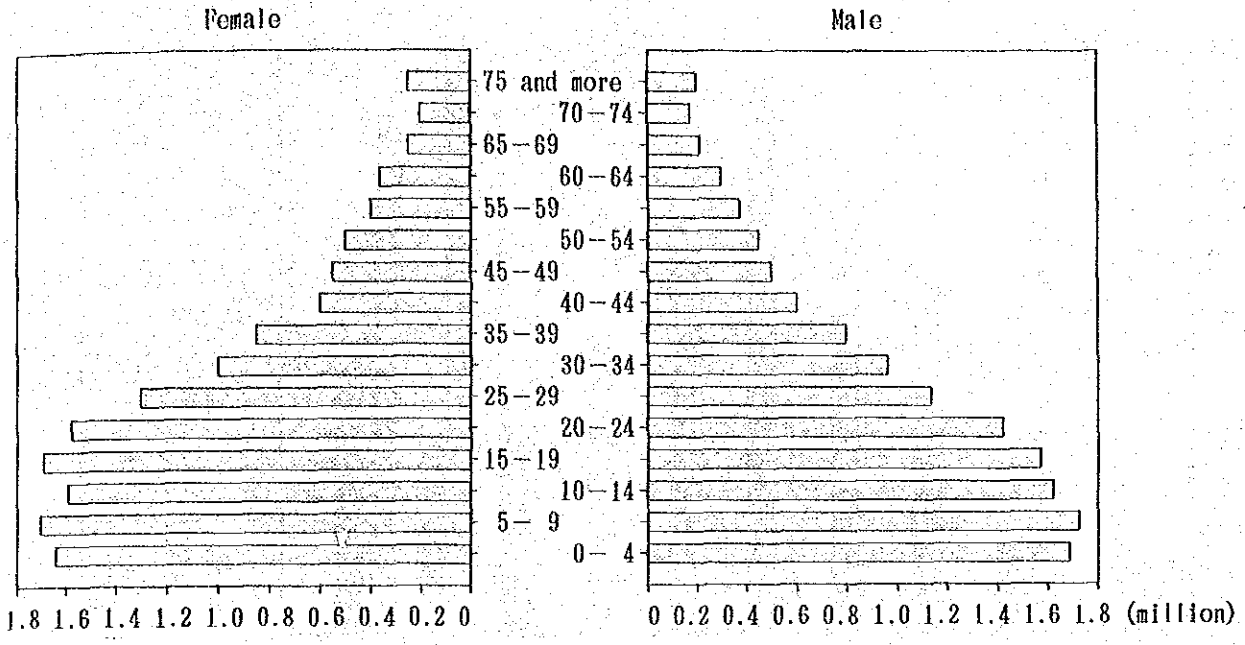

FIG. A-1-1 DISTRIBUTION OF POPULATION BY AGE GROUP IN COLOMBIA

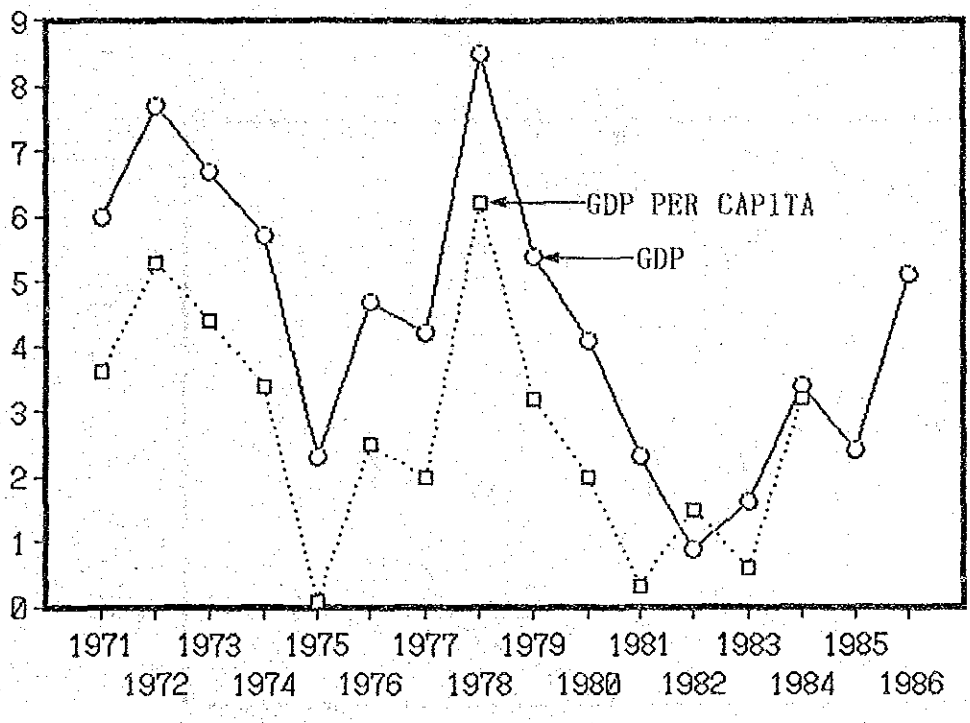

FIG. A-1-2 GROWTH RATE OF GDP AND GDP PER CAPITA
AT CONSTANT PRICE OF 1975

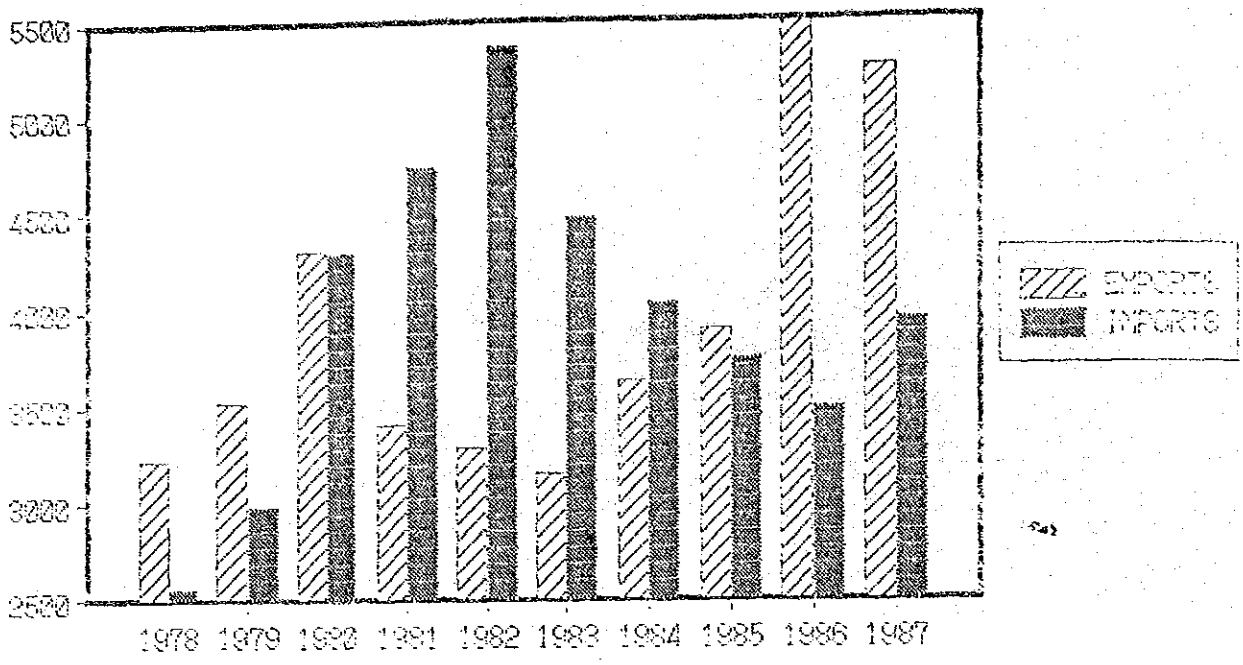

FIG. A-1-3 EXPORTS AND IMPORTS IN COLOMBIA

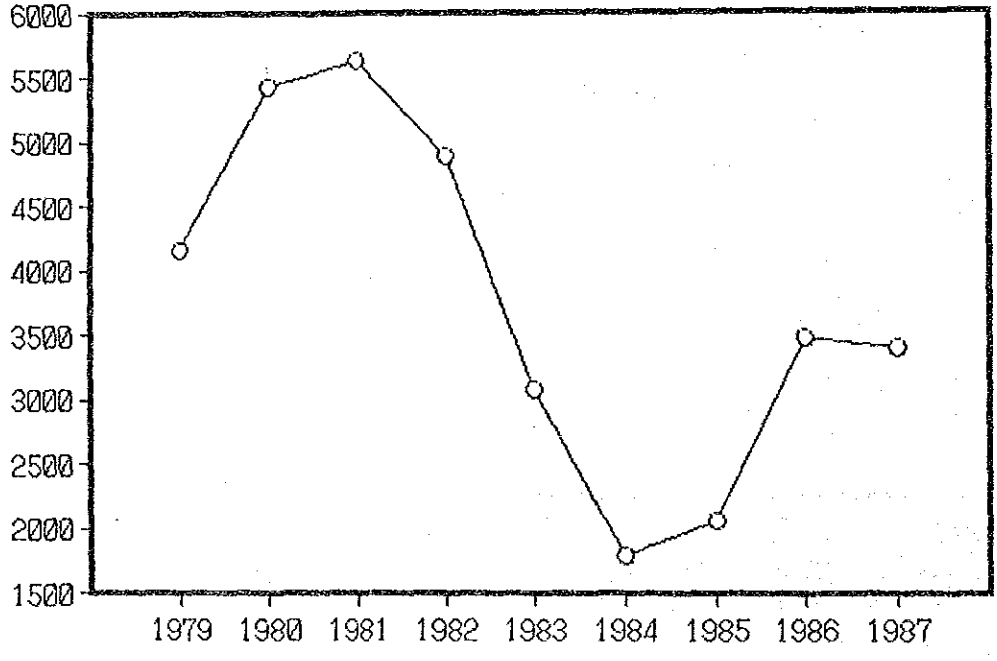

FIG. A-1-4 COLOMBIA'S NET INTERNATIONAL RESERVES

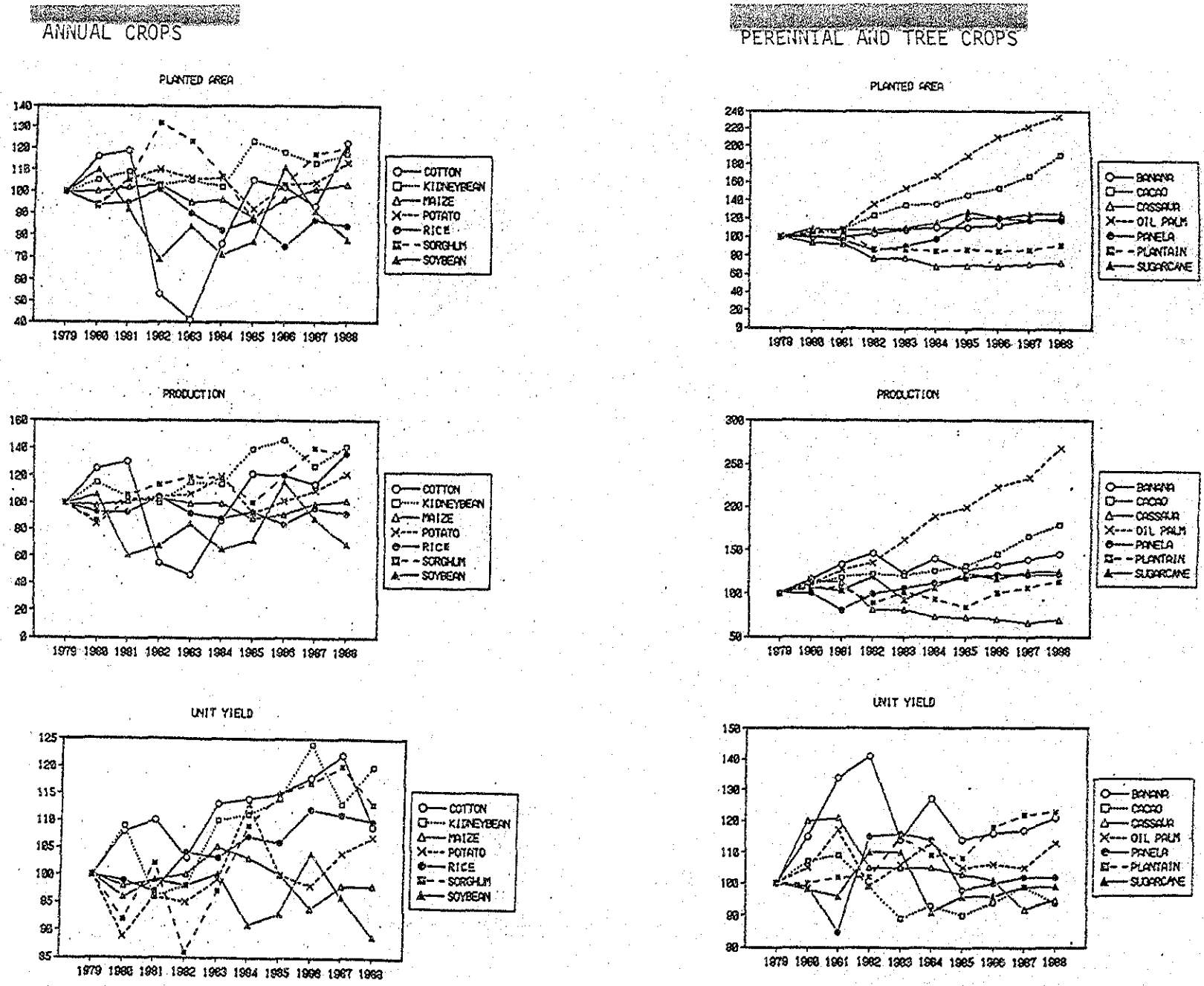

Fig.A-1-5 EVOLUTION OF PLANTED AREA, PRODUCTION AND UNIT YIELD

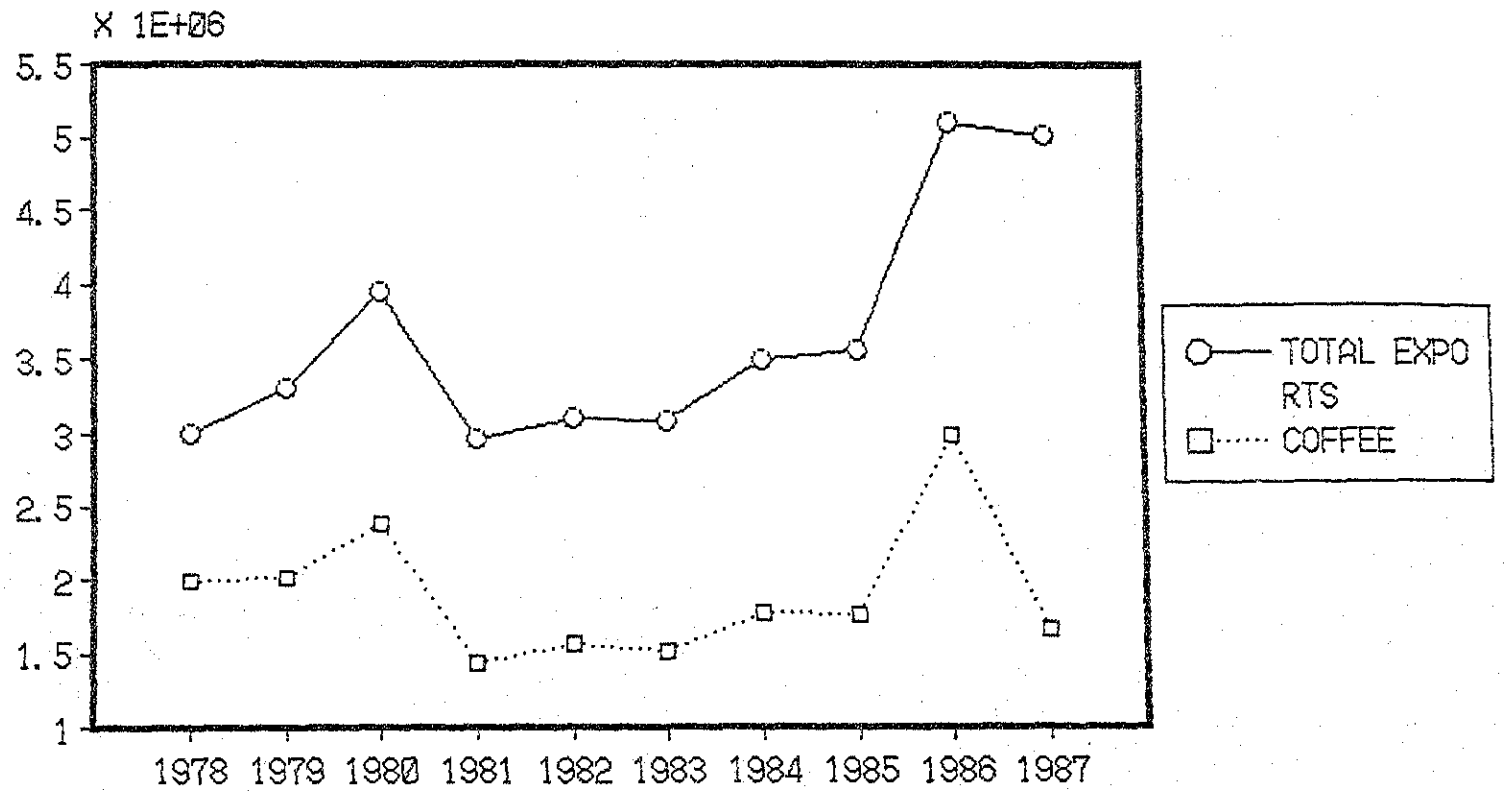

Fig.A-1-6 TOTAL EXPORTS AND COFFEE

ANNEX B : TOPOGRAPHY, GEOLOGY, GROUNDWATER AND WATER QUALITY

ANNEX B : TOPOGRAPHY, GEOLOGY, GROUNDWATER AND WATER QUALITY

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ANNEX B. TOPOGRAPHY, GEOLOGY,GROUNDWATER AND WATER QUALITY

B.1 Topography

The Area is located in the eastern side of the Eastern Range and is extended in a plain between San Martin plateau on the northern side and San Juan de Arama plateau on the southern side (Fig. B-1- 1). The topographic feature of the Area shows principally composite fans and alluvial plains. The altitude of the Area varies from approximately EL 240 m to EL 788 m (Fig. B-1-2).The gradient of the ground surface varies highly between approximately 1/50 and 1/2,000.

The Upper Zone occupies approximately 17% (7,250 ha) of the Area with steep gradient between approximately 1/50 and 1/100.The Middle Zone and the Lower Zone occupy approximately 35% (14,600 ha) and 43% (20,830 ha) with gradient ranges between approximately 1/100 to 1/200 , and 1/200 to 1/2,000, respectively. Thus the gradient of the Lower Zone becomes more gentle.

The Upper Zone is constituted with composite fans on which many spindle shaped hummocks composed of sand and silt with many round and sub-round gravels are arranged when extended south-eastward. Fine sediments are deposited between these hummocks that correspond to the small streams (caño). Thus, slight waved morphology is found widely, however erosion is not developed heavily. Three river terraces are recognized discontinuously on both banks of the Guape river in this zone. The relative heights of each terrace are approximately 2 m, 5-6 m and 15-20 m from the actual river bed. These terraces gently dip towards the lower reach. High river terraces are found at neighborhood of Mesa de Yamanes with many slope failures along water route.

The Middle Zone corresponds to the transitional zone between composite fans and alluvial plains. Many small streams are formed densely because of thin sand, silt and clay beds overlied

complicately on the sedimentary rocks with waved surface. Some hills and monadnocks composed of ancient alluvial sediments of

principally red silt and clay are distributed. Concaved morphologies are found among hills and show poor drainage areas. Ancient sediments form high hills of approximately 10 m high. River terraces show relative level of 2 m high from actual river bed although distinct natural levees were not developed.

The Lower Zone is constituted with alluvial plains. Fine sediments which principally composed of silt and clay overlaied on the ancient alluvial sediments. Some small streams flow down meandering with relatively low density in the eastern gentle sloped plain. Similary in the Middle Zone, hills composed of ancient alluvial sediments and plains of recent alluvial sediments are recognized.

The Area is situated in the Ariari river system. The Ariari river system originates in the Eastern Range located at the departmental boundary between Meta and Huila and flows into the Guaviare, Meta and Orinoco rivers, successively. This river system has its own outfall to the Carribean Sea in Venezuela. The Ariari river system flow straightly through deep valley of mountain area because of their steep slope of river bed. On the other hand, rivers show large scaled mendering throung jungles and plains due to their slight slope (Fig. B-1-3).

The Ariari and Guape rivers, a tributary of the Ariari river, being located in the northern boundary of the Area show unstable wandering and meandering in many parts of their courses because of frequent flood and river bed fluctuation. It is noted that many dividedd river traces are shown in large flood plain area. Their river width is approximately 1.5 km at the most in the lower reaches from the confluence between the Guape and Ariari rivers.

In the Area small streams (caños) flow from the west to the east and the majority of them have confluence at the Ariari river. The major caños are: Sardinata, Mucuya, Urichare, Guanayas, etc. Water sources of these caños come from rainfall water and

groundwater. Their flow depend on geology, topographic feature, groundwater level, nd soil characteristics at origins and stream courses. Many meanderings and oxbow lakes as scars of meander can be found in the gentle slope near the river-mouth.

B.2 Geology

The Area is situated eastward from Guaicaramo Fault which is eastern boundary of the Eastern Range. Three geological formations in the order of time are recognized in the Area: Metamorphic rocks, Sedimentary rocks and Non-consolidated sediments. The characteristics of each formation are described as follows (Fig. B-2-1):

(1) Metamorphic rocks

Metamorphic rocks may be equivalent to Quetame group and have been assigned to the Paleozoic (Cambrian-Ordovician). Their lithofacies are green schist, black schist, phyllite, slate and some portion of sandstone that occupy a large area of the Eastern Range extended from the north-northeast to the south-southwest.The metamorphic rocks are distributed at steep slope (35-70°) and deep valley rivers. Many foldings, joints and fractures are recognized. Rock quality is generally fresh.But some weathered parts show rock-slide forming colluvial slope because of the concentration of clay minerals and characteristics of groundwater.

The Area provides outcrops of hard black and green phyllites to the west from the point approximately 600 m east of the Angostura bridge. Clear schistosity with gentle dip and slight foldings are recognized.

(2) Sedimentary rocks

Sedimentary rocks may correspond to Guaduas and Gualanday formations and have been assigned to the Cenozoic,Terciary (Eocene) in age. Their lithofacies are softy clay, slate and a little hard sandstone. These rocks have an unconformable relationship with the metamorphic rocks, showing a basal conglomerate.Many types of eroded morphology are shown because of the weakness to erosion.

In the Area, these rocks are recognized at the foot of San Juan de Arama plateau, a part of piedmonts of the Eastern Range, concaved parts and some parts of the Guape river. These rocks are generally gray and light yellow clay or silt, light yellow sandstone (0.3-2.5 m in thickness), and coal bed (0.1-5 cm in thickness) are recognized in little portion. Plant fossils such as roots, trunks and leaves are observed. Moreover, ripple marks are shown near Lejanías that indicate a littoral sedimentary environment.

(3) Non-consolidated sediments

Non - consolidated sediments were deposited during the Quaternary and can be divided into alluvial, colluvial and fluvial sediments.

1) Alluvial sediments

These sediments are extensively distributed eastward from the Eastern Range showing alluvial fans, alluvial plains and terraces .

Alluvial fans are differentiated according to distinct time of formations: Recent and Ancient alluvial deposits.

Ancient alluvial deposits were formed by gravitational and hydraulic forces during orogenic movement on the piedmont belt zone of Llanos. Gravels, silts and peats predominate in clayish matrix. High content of oxidized iron caused the deposits to turn reddish. The deposits are distributed in San Martin and San Juan de Arama plateaus, monadnocks and hills in the Area and the surroundings.

Recent alluvial fans were formed by hydraulic force of main rivers in the concaved zone between ancient alluvial deposits. Principal lithofacies are pebbles, gravels, sand and silt. Many pebbles and gravels are

distributed in the surroundings of the fan apex, on the other hand, the fine sediments become more predominant toward the fan border. This type of fan is recognized in the Upper Zone and the major Middle Zone.

Alluvial plains were formed chiefly by transportation and sedimentation of the Ariari river and are widely distributed in a part of the Middle Zone and most of the Lower Zone. Sand , silt and clay are the principal lithofacies. Bedded sedimentary structure is generally recognized, but cross-bedding is also shown locally.

Terraces are shown on both margins of the Guape river in the Upper Zone which is principally constituted with pebbles, gravels, sand and silt with clear beds of different grain size of almost 3 m at the maximum.

2) Colluvial sediments

Colluvial sediments are distributed on foot of plateau and piedmont consisting of heterogeneous materials of gravels, coarse sand and silt. This type of sediments should be formed by: gravitational sliding, debris deposits on hard rocks, sliding of clay rocks, tectonic movement (fault), etc. These sediments are unstable because of the formation of many waterways due to good permeability.

3) Fluvial sediments

These sediments were formed during the Holocene by fluvial hydrodynamic force. Topographic feature is shown such as river bed, low river terrace and flood plain along the Guape and Ariari rivers consisting of silt, sand and gravel. The river course changes annually and therefore wide deposits are distributed.

B.3 Groundwater

Measurement of groundwater level at existing 111 shallow wells has been carried out during the rainy and/or dry seasons in 1988 and 1989.

Location map of measuring points and groundwater levels are shown in Fig.B-3-1 and Table B-3-1, respectively. Moreover, isobath map of two seasons is presented in Fig. B-3-2.

In relation to groundwater level by zone, rainfall infiltrates rapidly due to steep gradient and predominant sand/gravel soils showing deep groundwater level in the Upper Zone. On the other hand, the level generally is shown shallower than 2 m from ground surface except to hills and monadnocks in the Middle and Lower Zones, moreover some parts with less than 0.5 m of the level.

Seasonal characteristics of the groundwater level show the sporadic presence of parts with less than 0.5 m in the rainy season, but only at the base of San Juan de Arama pleateu in the dry season.

Thus the variation of groundwater levels is differed in accordance with the zone and season. Basically the following items have relation with the groundwater fluctuation.

- Feature of micro-topography
- Figure of paleo-topography under recent alluvial deposits
- Soil texture
- Rainfall pattern

These variations do not cause damage to the agricultural production in the Area. But appropriate groundwater levels should be kept for crop growth in planning of drainage.

B.4 Water Quality

Water quality analysis has not been carried out to date and therefore, the objective of this study are to grasp the present situation and problems, and to establish some measurement if necessary.

(1) Methodology

To grasp the present conditions on water quality in the Area field survey, water sampling and laboratory analysis were carried out to grasp the characteristics for irrigation and domestic uses (Fig. B-4-1). Sampling points were selected to cover the whole area. Sampling was carried out at 13 points and dry seasons. Moreover, 5 samples were obtained for bacterial analysis of water used for domestic use (Fig. B-4-1). The results of analysis are shown in Tables B-4-1,2 and 3.

(2) Standards of Water Quality

The standards of water quality for irrigation and domestic use, etc., have been established by the Ministry of Health, Colombia (Decree No.1594, 26 of July, 1984). These standards are only stipulated for pH, ions, heavy metals and coliform groups, etc., however, those of BOD, COD, SS and EC are not yet set up.

Water quality standards are summarized in Table B-4-4.

(3) Considerations

Surface water analysed was classified based on the electric conductivity which is indicated in micromhos per centimer and the SAR. All samples of surface water and potable water are classified as C_1S_1 (low sodium and low salinity water). This type of water has good characteristics for irrigation and crops cultivation.

On the other hand, chemical characteristics for potable

water is generally suitable for domestic use.Only one sample of groundwater shows acidic (pH=6.0) that is not suitable for potable use.

Although some results of bacterial analysis are not reliable, the results show positive in total coliform and fecal coliform, but those values remain in the tolerance limit set by the standard for all types of use.

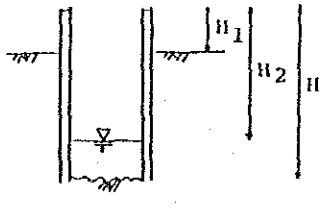
Consequently, the water quality analysis doesn't perform the limiting factor for use, but other analysis items such as BOD, COD and SS, etc. should be carried out to confirm the exact diagnosis. Moreover, detail environmental assessment in relation to water quality has to be carried out before the implementation of the Project.

TABLES

Table B-3-1 Groundwater Levels No.1

N°	Owner	Location	Depth of Well (H)* (m)	Well Curb (H_1)* (m)	Water Level (H_2) (m) Rainy Season**	Dry Season***
1	Jose Mosquera	C.Blanco	3.19	0.20	1.22	2.39
2	Raul Garcia	P.Avicure	4.70	0.30	3.30	-
3	Julio Amador	C.Blanco	3.86	0.40	2.54	3.66
4	Raul Martinez	C.Blanco	2.83	0.46	1.43	2.34
5	Fabian Hernandez	V.Altamira	2.20	0.20	1.47	2.50
6	Antonio Perez	V.Guanaya B.	3.75	0.45	2.00	2.49
7	Ubaldina Pinto	V.Guanaya B.	3.87	0.20	1.82	2.78
8	Rafael Espejo	V.Guanaya B.	3.87	0.20	1.11	-
9	Enrique Valderrama	V.Guanaya B.	4.14	0.30	1.25	3.35
10	Jorge Leon	V.Guanaya B.	4.70	0.10	1.80	3.40
11	Desconocido	V.Mogote	4.05	0.40	1.92	-
12	Juan Vergara	T.7	4.25	0.30	1.62	2.67
13	Alirio Ayala	T.7 Pta.Brava	3.10	0.57	1.04	2.25
14	Jesus A. Forero	T.7	2.40	0.20	1.44	2.79
15	Marsiana Boloños	T.7	3.45	0.25	0.80	2.34
16	Giba Avila	T.7	2.10	0.40	0.75	-
17	Eber Sanchez	T.7	2.80	-	1.70	-
18	Rodrigo Alvarez	V.Mogote	3.24	0.20	1.06	2.42
19	Hernando Duque	T.3 V.Mogote	4.20	0.10	2.30	-
20	Hernando Hoyos	T.3 Boca Uri.	5.37	0.20	2.77	2.95
21	Gilma Rodriguez	T.3	3.87	0.50	2.30	2.47
22	Fernando Londoño	T.3	4.03	0.30	2.20	2.95
23	Murcal Borga	T.3	3.68	0.60	2.70	-
24	Arnulfo Menezes	T.3 Pto.Nuevo	3.30	0.20	1.60	2.28
25	Gilberto Caicedo	T.3 Pto.Nuevo	3.10	0.10	2.24	2.89
26	Clemencia Aragon	T.3 Pto.Nuevo	4.16	0.80	3.30	2.99
27	Valtazar Puentes	Cooperativa	2.20	-	0.70	-
28	Artora Palacio	T.5	5.05	0.60	2.63	3.91
29	Hernan Vergara	T.5	5.15	0.30	2.50	3.56
30	Desconocido	T.5	4.25	-	2.48	2.75

(Note) *



** measured from 30, October to 6, November of 1988

*** measured from 7 to 9, February of 1989

Table B-3-1 Groundwater Levels No.2

31	Edwardo Alarcon	T.5 V.Venado	3.68	0.30	1.46	2.85
32	Maria de Caro	T.5	2.90	0.20	0.80	1.70
33	Bautista Montegro	T.5	1.90	0.20	1.00	1.54
34	Lizandro Mendez	T.5 V.Naranjo	3.45	0.70	1.50	-
35	Salvador Garcia	T.5	2.20	-	0.70	1.35
36	Jorge A. Torres	V.Pto.Caldas	9.10	-	4.74	6.74
37	Rafael Pardo	T.9	3.82	0.40	1.72	2.79
38	Alejandro Barreno	T.9 V.Esperanza	2.50	0.30	0.77	-
39	Israel Andrade	T.9 V.Urichare	3.65	0.25	1.10	3.33
40	Juan Vergara	T.9	3.48	0.40	0.84	2.05
41	Jose Gomez	T.9	3.30	-	2.40	-
42	Feliz Aula	T.9	2.60	-	1.00	2.31
43	Jorge Salive	T.9	2.83	0.10	0.80	1.69
44	Marino Quiroz	T.9	2.40	-	0.70	1.60
45	Camilo Iregue	T.9	4.90	0.50	1.40	2.17
46	Simon Rojas	T.9	3.28	0.10	0.80	1.86
47	Humberto Lopez	T.9 La Union	2.90	-	0.40	-
48	Reineiro Romero	T.9 V.Ariari	2.62	0.20	0.80	1.88
49	Silvestre Mahamon	La Union Ariari	6.20	-	2.15	-
50	Rafael Garcia	La Union Ariari	5.00	-	2.20	3.66
51	Octavo Colorado		5.36	0.60	2.50	-
52	Guillermo Castro	V.Caño Blanco	5.82	0.60	2.60	-
53	Javier Lozano	T.11 V.Guanaya	3.55	0.60	1.24	2.90
54	Basilio Perez	T.11 V.Guanaya	2.00	-	0.77	4.96
55	Aura Zapata de Muñ	T.11 V.Guanaya	1.20	-	0.00	0.00
56	Henry Angel	T.11 V.Yari	4.00	0.30	1.00	-
57	Arles Tanaka	T.11	3.30	0.60	1.60	-
58	Gonzalo Agudero	T.9	4.33	0.70	0.90	-
59	FARI LTDA.	Pista Aerea	6.60	0.30	1.90	3.49
60	Alcides Albadan	Troncal	3.56	0.90	1.68	3.05
61	Isidro Garcia	T.11	2.50	0.70	1.00	-
62	Clemencia Plaza	T.12	2.54	0.40	0.70	-
63	Reyes Romero	Carretera	4.92	1.00	1.10	2.37
64	Alcides Albadan	Carretera	3.80	0.20	0.64	2.75
65	Alcides Albadan	Carretera	4.18	0.25	1.24	4.47
66	Jaime Ramirez	Carretera	3.45	0.40	0.77	2.43
67	Hugo ?	T.12 V.Cabaña	2.68	0.50	1.05	-

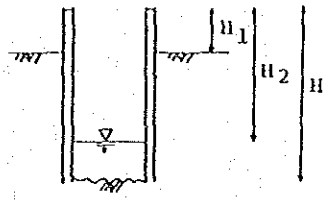
Table B-3-1 Groundwater Levels No.3

68	Pablo Valero	T.12 V.Cabaña	2.78	0.75	1.40	2.71
69	Arnulfo Barrera	T.12 V.Cabaña	3.58	0.35	0.84	2.57
70	Guillermo Gaviria	T.14	2.08	0.80	1.00	1.70
71	Carlos Velez	T.14	2.00	0.30	0.80	-
72	Amanda Castañeda	T.12	3.50	0.30	1.00	2.43
73	Salomon Sanchea	T.12	2.60	0.50	1.50	2.15
74	Herminia Gallego	V.Rivera	2.00	-	0.80	1.59
75	Ubaldo Lopez	V.Rivera	2.84	0.15	0.84	2.37
76	Escuela La Rivera	V.Rivera	4.00	0.25	2.14	3.27
77	Guillermo Lozano	V.Rivera	1.55	0.20	0.40	1.20
78	Gilberto Amaviles	V.Rivera	1.80	0.42	0.90	-
79	Manuel Llansi	V.Rivera	2.46	0.25	1.15	-
80	Ana Blen Urueñae	T.12	3.10	0.20	1.00	2.15
81	Elieser Muñoz	V.Dos Quebr.	3.79	0.35	1.25	2.93
82	Gustavo Valero	V.Dos Quebr.	2.60	0.10	0.90	2.39
83	Jaime Barios	V.Dos Quebr.	3.25	0.30	2.00	-
84	Maria Ortiz	V .Dos Quebr.	3.70	0.40	1.50	-
85	Santo Gutierrez	V.Crucero	3.47	0.30	1.40	-
86	Alberto Rojas	V.Crucero	3.20	0.30	1.10	2.39
87	Hernanda Cerquera	V.Cubillera	2.98	0.20	1.30	2.03
88	Isabel Agudero	V.Cubillera	3.72	0.40	1.30	-
89	Henry Noboha	V.Guanayas	1.94	0.15	1.20	-
90	Geremias Viera	T.Brillante	3.84	0.30	1.15	2.40
91	Joselino Fernandez	V.Brillante	3.20	0.20	1.50	-
92	Francisco Lonbuna	V.Roble	3.10	0.60	1.00	-
93	Jose Torres	V.Roble	3.10	0.45	1.86	3.44
94	Florinda Caldenas	V.Roble	3.60	0.35	1.30	2.52
95	Jose Caldenas	V.Darien	2.00	0.80	1.40	1.83
96	Jose Navarro	V.Darien	6.00	0.50	4.30	5.65
97	Escuela Darien	V.Darien	5.45	0.20	4.20	4.40
98	Engelberto Aragon	V.Aguas Clara	2.00	0.35	0.70	1.21
99	Efigenia Sanchez	V.Aguas Clara	1.80	0.10	1.00	1.44
100	Ester Cruz	T.4 V.Florida	2.80	0.25	1.40	2.54
101	Carlos Vasabe	V.Florida Alto	2.36	0.47	1.54	-
102	Nepomuseno Moreno	T.12 V.Flor B.	3.33	0.80	1.80	1.98
103	Jose Maria	T.4	1.60	0.15	1.00	1.68

Table B-3-1 Groundwater Levels No.4

104	Carlos J.Casallas	T.4	5.28	0.25	1.70	-
105	Carlos Ortiz	T.4	3.20	0.25	1.90	-
106	Ignacio Mosquera	T.4 V.Crucero	2.30	0.20	1.00	1.67
107	Saulo Rojas	T.4 V.Cacayal	3.20	0.40	1.25	5.54
108	Victor Moreno	V.Cacayal	4.75	0.60	1.88	5.28
109	Humberto Menezes	V.Sta Rita	3.86	0.30	1.42	-
110	Cesar Torres	V.El Convenio	5.20	0.40	2.80	-
111	Alba Velasquez	T.4	6.30	1.00	2.80	-

(Note) *



** measured from 30, October to 6, November of 1988

*** measured from 7 to 9, February of 1989

Table B-4-1 Surfacewater Quality

(Rainy Season)

Item	Unit	No.1	No.2	No.3	No.4	No.5	No.6	No.7
T°	°C	18.3	24.4	25.3	25.0	21.3	24.4	25.4
pH		7.0	7.1	7.6	7.1	7.1	7.6	7.4
DO*	mg/ℓ	8.54	7.48	7.81	7.21	8.81	7.88	7.48
CO_2*	mg/ℓ	6.38	6.60	16.28	9.24	6.38	14.52	9.24
EC	μmho/cm	104.0	72.0	62.0	42.0	32.0	74.0	60.0
$CaCO_3$	mg/ℓ	37.5	24.0	18.5	12.5	8.5	22.0	17.5
Ca++	mg/ℓ	12.8	7.2	5.6	3.8	2.8	6.6	6.0
Mg++	mg/ℓ	1.3	1.4	1.1	0.7	0.3	1.3	0.6
Na+	mg/ℓ	1.4	1.3	1.1	0.9	0.9	1.6	1.2
K+	mg/ℓ	0.4	1.7	2.0	1.3	1.3	2.3	0.9
CO_3 --	mg/ℓ	0	0	0	0	0	0	0
HCO_3 -	mg/ℓ	64.8	38.0	34.4	21.7	22.9	37.6	30.5
Cl-	mg/ℓ	0.5	0.4	0.5	0.4	0.4	1.3	0.2
SO_4 --	mg/ℓ	10.5	3.9	2.0	0.0	0.0	0.0	2.8
RES	meg/ℓ	0.54	0.28	0.31	0.18	0.28	0.31	0.25
SAR	meg/ℓ/2	0.09	0.10	0.09	0.11	0.13	0.14	0.11
Class.for irrigation water		C_1S_1	C_1S_1	C_1S_1	C_1S_1	C_1S_1	C_1S_1	C_1S_1

* analysis in situ.

(Dry Season)

Item	No.8 (463)	No.9 (461)	No.10 (462)	No.11 (464)	No.12 (460)	NO.13 (459)
T°						
pH	6.2	7.0	6.7	6.1	7.6	6.0
DO*						
CO_2*						
EC	43	120	57	33	198	46
$CaCO_3$	14.0	37.5	18.0	10.0	62.5	39.5
Ca++	5.0	8.6	4.0	3.4	20.0	2.8
Mg++	0.36	3.8	1.9	0.36	2.7	1.5
Na+	1.7	3.3	2.1	2.1	1.5	2.3
K+	0.7	2.0	1.1	2.7	1.4	2.8
CO_3 --	0.0	0.0	0.0	0.0	0.0	0.0
HCO_3 -	30.0	52.3	26.7	13.3	91.4	14.4
Cl-	0.7	17.3	1.7	2.9	1.4	3.9
SO_4 --	2.7	3.3	3.3	0.5	12.5	0.0
RES	0.32	0.29	0.17	0.06	0.57	0.01
SAR	0.18	0.22	0.21	0.28	0.07	0.27
Class. for Irrig. Water	C_1S_1	C_1S_1	C_1S_1	C_1S_1	C_1S_1	C_1S_1

Table B-4-2 Water Quality of Aqueduct

Item	Unit	465	466	467	468	469
Location		Dos Queb.	Cacayal	Lejanías	A. Claras	Canaguaro
Resource		C.Venado	C.Mucuya	C.Urichare	C.Sardinata	Pozo
pH		6.7	7.3	8.2	7.7	6.0
EC	μmho/cm	109	279	186	269	30
$CaCO_3$	mg/ℓ	34.0	54.0	52.0	52.5	8.5
Ca^{++}	mg/ℓ	7.6	20.0	20.0	19.8	2.4
Mg^{++}	mg/ℓ	3.6	0.97	0.48	0.72	0.60
Na^{+}	mg/ℓ	4.4	4.2	2.0	3.3	0.7
K^{+}	mg/ℓ	0.7	1.0	0.8	1.0	0.6
CO_3^{--}	mg/ℓ	0.0	0.0	0.0	0.0	0.0
HCO_3^{-}	mg/ℓ	46.0	149.1	53.2	12.8	13.9
Cl^{-}	mg/ℓ	1.4	2.0	1.5	2.4	0.9
SO_4^{--}	mg/ℓ	3.3	13.2	14.5	14.5	1.0
RES	meg/ℓ	0.24	1.89	0.22	1.48	0.10
SAR	meg/ℓ/2	0.32	0.24	0.11	0.19	0.10
Class.for Irrig. Water		C_1S_1	C_1S_1	C_1S_1	C_1S_1	C_1S_1

Table B-4-3 Bacterial Analysis

	Sampling Date	Sampling Time	Analysis Date	Total Coliform (M.P.N./1000 ml)	Total Fecal Coliform (M.P.N./1000 ml)	Result
N° 1						
Angostura in the Guape River	15,Oct.'88	06:55	16,Oct.'88	2,400	113	Positive
N° 2						
Upper Reach of Urichare Caño	15,Oct.'88	07:33	16,Oct.'88	2,400	220	Positive
N° 7						
Crossing part of the national road with Urichare Caño	15,Oct.'88	08:45	16,Oct.'88	2,400	45	Positive
N° 8						
Crossing part of the national road with Guanayas Caño	15,Oct.'88	08:55	16,Oct.'88	2,400	350	Positive
Aqueduct of Lejanías	09,Abr.'89	10:50	10,Abr.'89	540	350	Positive
Aqueduct of Cacayal	09,Abr.'89	10:00	10,Abr.'89	460	240	Positive

Table B-4-4 Standards of Water Quality (Decree N° 1594, Colombia)

ITEM	ART 30 for human & domestic	ART 39 for potable water	ART 40 for agri-cultural	ART 41 for pecuary	ART 42 for recrea-tion 1	ART 43 for recrea-tion 2	ART 48 for industrial
N	1.0	1.0	-	-	-	-	-
AS	0.05	0.05	0.1	0.2	-	-	-
Ba	1.0	1.0	-	-	-	-	-
Cd	0.01	0.01	0.01	0.05	-	-	-
CN	0.2	0.2	-	-	-	-	-
Zn	15.0	15.0	2.0	25.0	-	-	-
Cl	250.0	250.0	-	-	-	-	-
Cu	1.0	1.0	0.2	0.5	-	-	-
Fe	0.002	0.002	5.0	-	0.002	-	-
Cr	0.05	0.05	0.1	0.1	-	-	-
PCB	No Detectable		-	-	-	-	-
Hg	0.002	0.002	-	0.01	-	-	-
$N\text{-}NO_3$	10.0	10.0	-	100.0	-	-	-
$N\text{-}NO_2$	1.0	1.0	-	10.0	-	-	-
pH	5.0 - 9.0	6.5 - 8.5	4.5 - 9.0	-	5.0 - 9.0	5.0 - 9.0	5.0 - 9.0
Ag	0.05	0.05	-	-	-	-	-
Pb	0.05	0.05	5.0	0.1	-	-	-
Se	0.01	0.01	0.02	-	-	-	-
SO_4	400.0	400.0	-	-	-	-	-
ABS	0.5	0.5	-	-	0.5	0.5	0.5
Coll.T	20,000	1,000	5,000	-	1,000	5,000	5,000
Coll.F	2,000	-	1,000	-	200	-	-
Al	-	-	5.0	5.0	-	-	-
Be	-	-	0.1	-	-	-	-
Co	-	-	0.05	-	-	-	-
F	-	-	1.0	-	-	-	-
Li	-	-	2.5	-	-	-	-
Mn	-	-	0.2	-	-	-	-
Mo	-	-	0.01	-	-	-	-
Ni	-	-	0.2	-	-	-	-
V	-	-	0.1	-	-	-	-
B	-	-	3.0 - 4.0	5.0	-	-	-
Salt Cont.	-	-	-	3,000	-	-	-
DO (%)	-	-	-	70.0	-	70.0	70.0

FIGURES

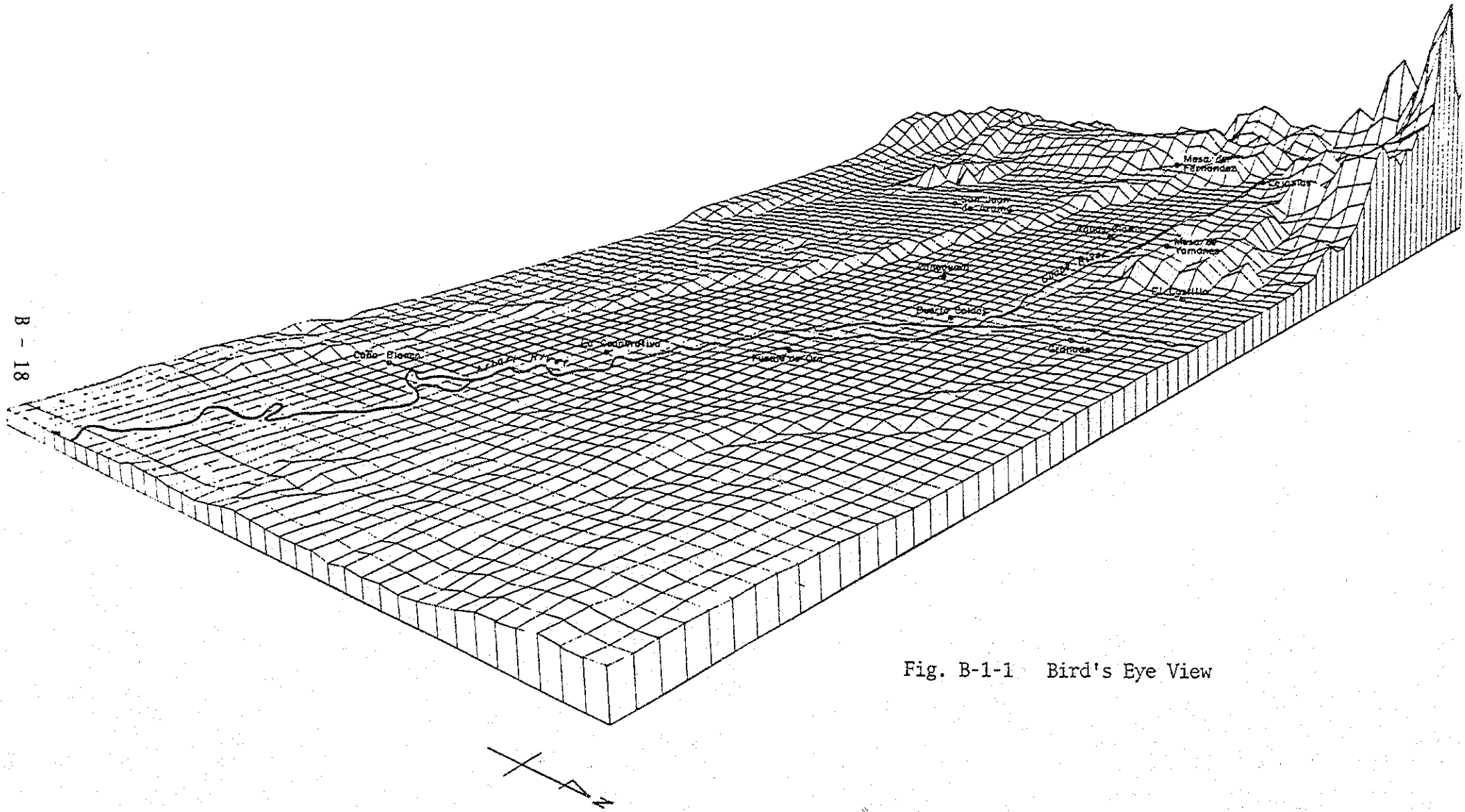


Fig. B-1-1 Bird's Eye View

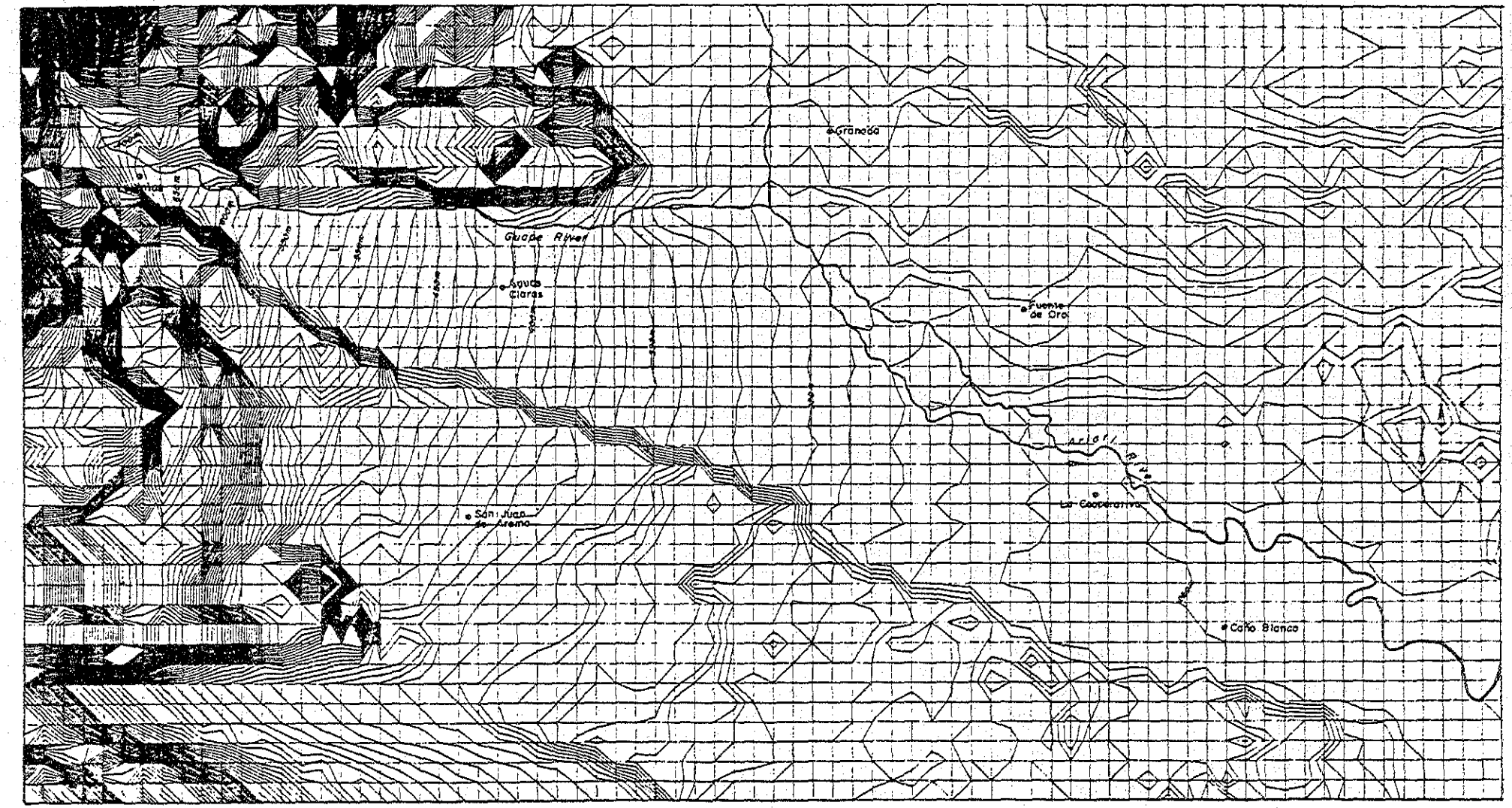
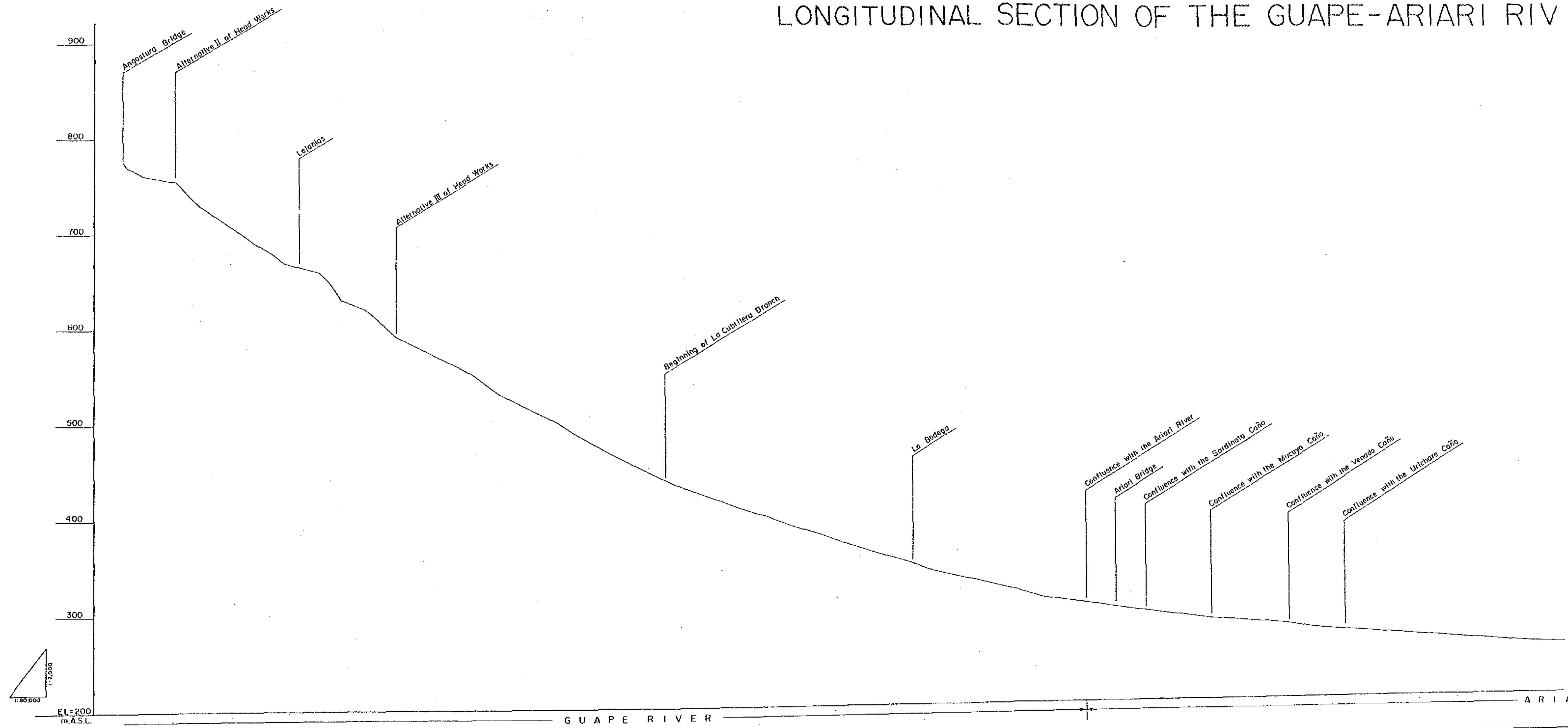


Fig. B-1-2 Counter Map

LONGITUDINAL SECTION OF THE GUAPE-ARIARI RIV



River Bed Slope (Approx.)		1/75	1/60	1/75	1/120	1/160	1/290	1/460

Accumulated Distance (km)	River Bed Elevation (m.A.S.L.)
0.000	774.28
0.892	761.10
2.096	745.50
2.588	740.25
2.636	730.18
3.336	727.51
3.688	720.05
4.240	710.48
4.896	700.15
5.376	690.34
6.088	680.25
6.568	670.42
8.080	660.29
8.488	650.35
8.792	640.27
9.024	630.72
10.016	620.21
10.472	610.56
11.312	591.35
12.176	580.12
12.864	570.27
13.752	560.14
14.464	550.62
15.088	540.26
15.592	530.87
16.336	520.56
17.160	510.17
17.992	500.02
18.640	490.05
19.312	480.36
20.048	470.27
20.784	460.39
21.536	450.21
22.382	440.68
23.270	430.17
24.478	420.44
25.494	410.29
26.790	400.57
27.814	390.41
29.086	380.27
30.190	370.19
31.542	360.83
32.894	350.42
33.982	340.27
35.694	330.76
37.310	320.15
38.670	310.02
41.774	299.54
42.862	295.38
43.094	292.27
44.382	290.31
45.974	285.67
48.150	281.25
49.254	278.48
50.286	274.56
51.718	271.03
52.182	270.48
59.694	255.71

Fig. B-1-3 Longitudinal Section o

TUDINAL SECTION OF THE GUAPE-ARIARI RIVER

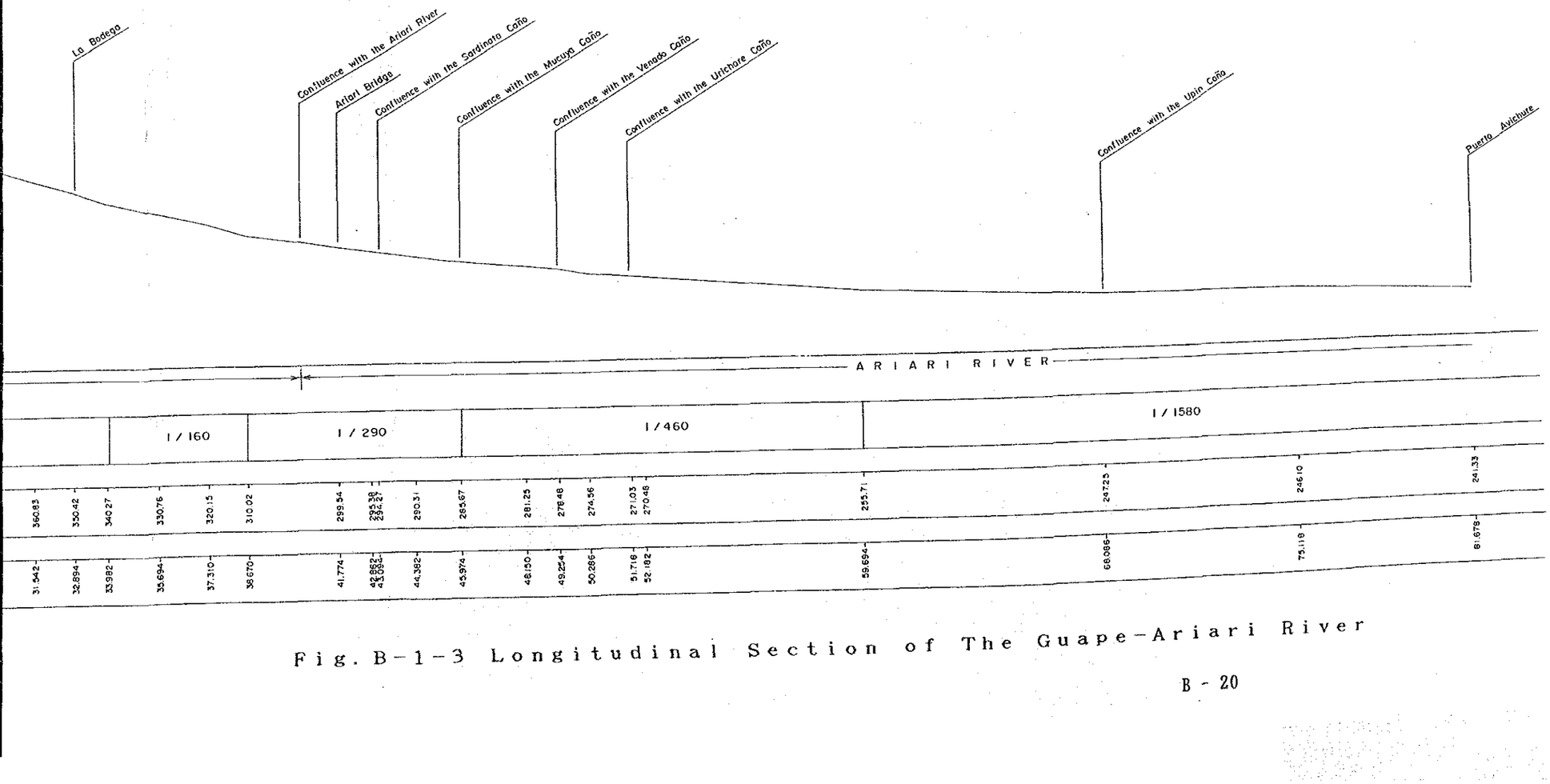


Fig. B-1-3 Longitudinal Section of The Guape-Ariari River

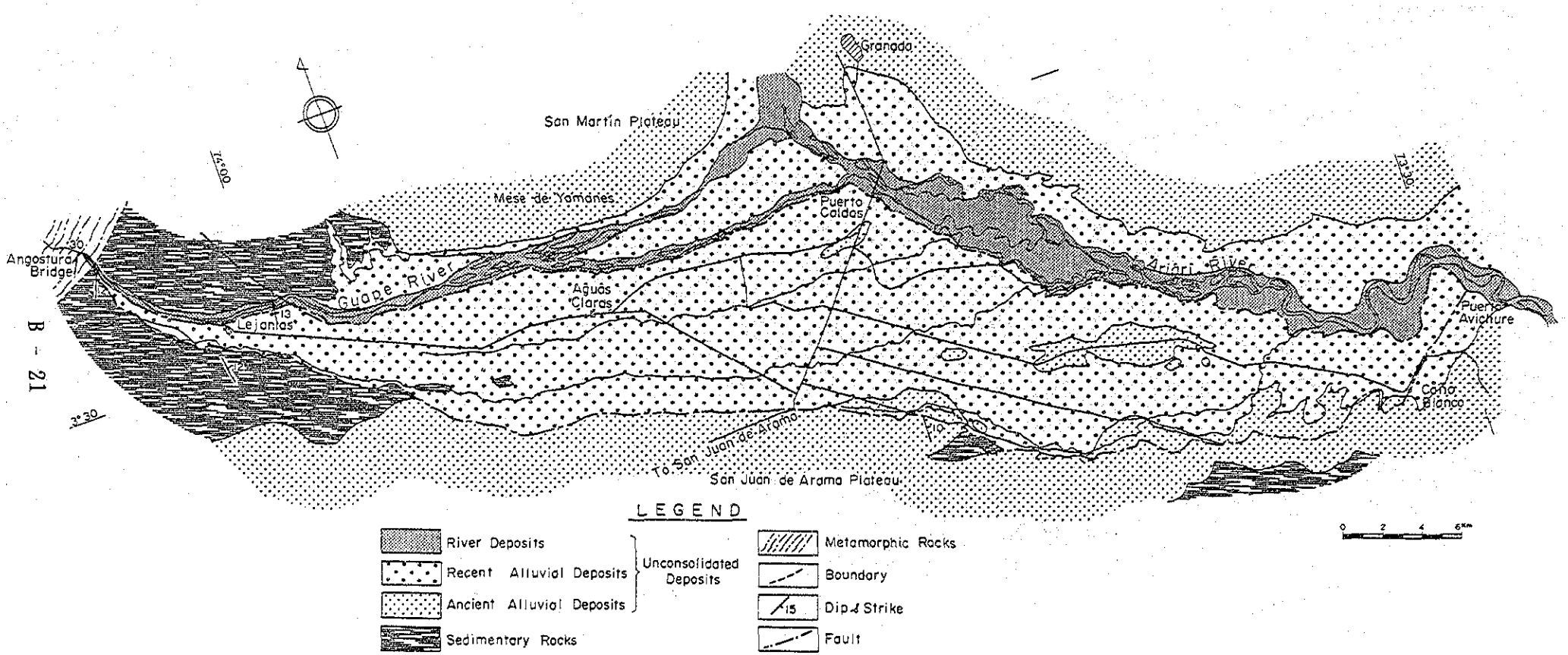


Fig. B-2-1 General Geological Map

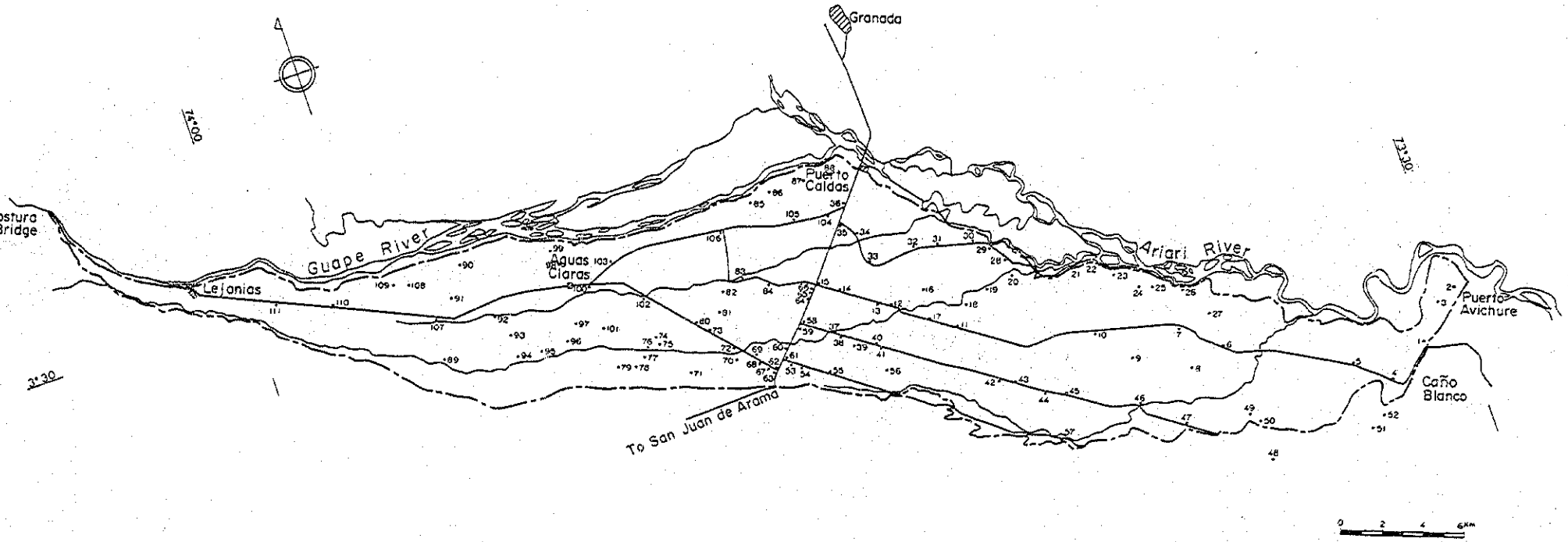


Fig. B-3-1 Location Map of Measuring Points of Shallow Groundwater Level

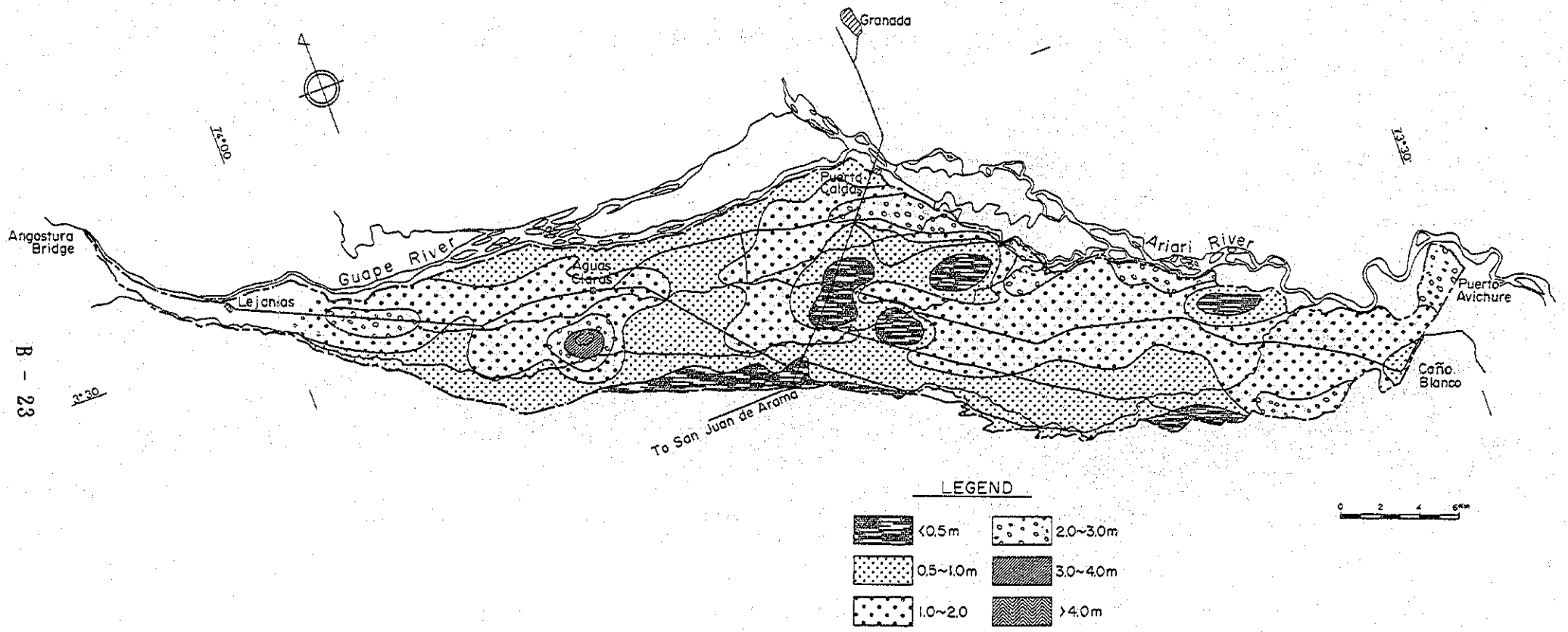


Fig. B-3-2 Isobath Map of Shallow Wells (Rainy Season)

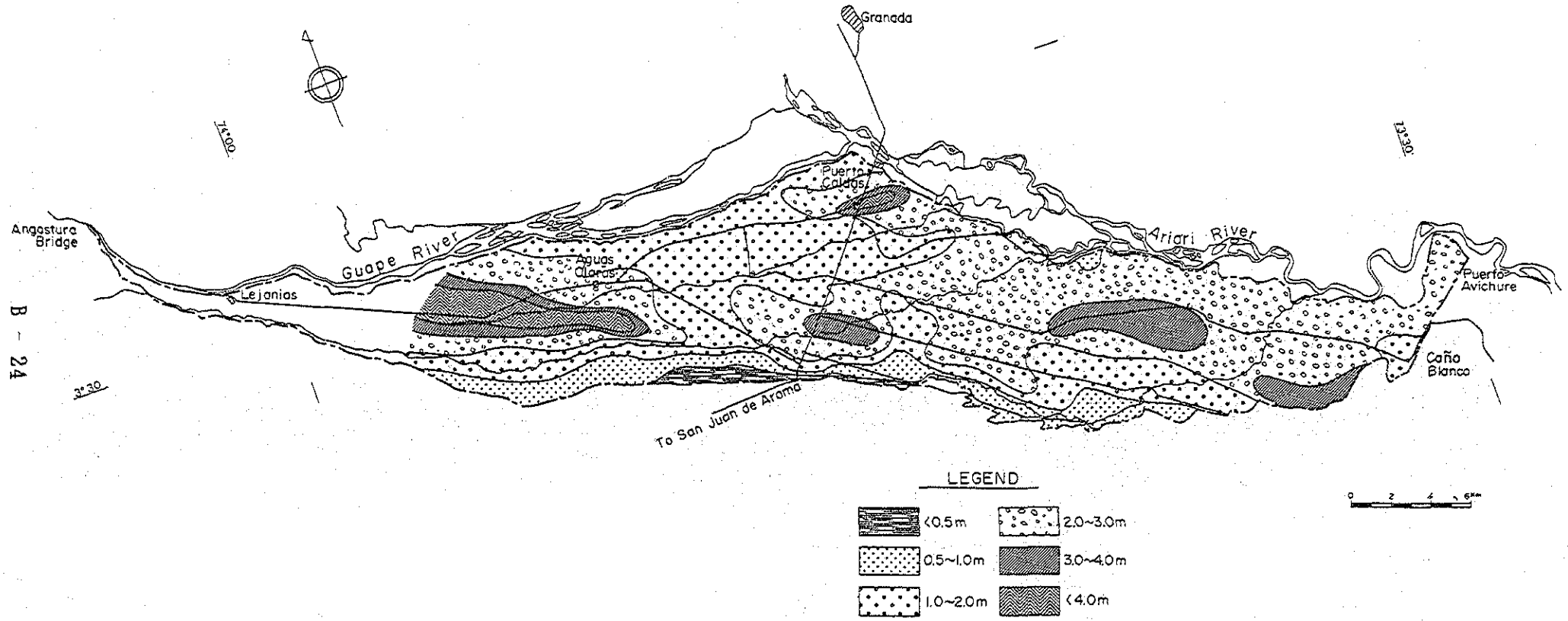


Fig. B-3-2 Isobath Map of Shallow Wells (Dry Season)

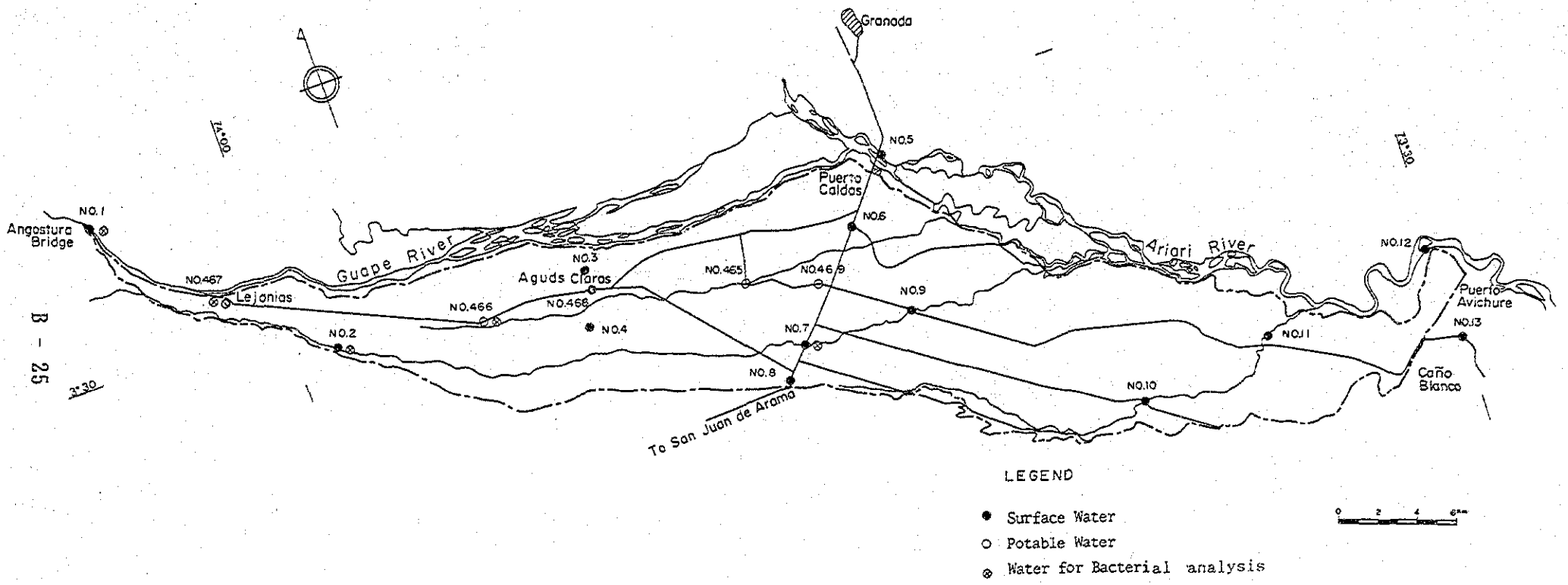


Fig. B-4-1 Sampling Points for Water Quality Analysis