

## Mining

Mining activities are restricted to exploitation of stones, rocks, sand, and limestones as raw materials for lime factories. Mining of limestones reached its highest level in 1981 with 754,500 ton, and has fluctuated between 400,000 and 600,000 ton since then. Within the Lake Ypacarai basin there are quarries exploiting rocks, stones and gravel for construction, as well as clay for pottery and ceramics, constituting potential sources of environmental contamination if these operations continue unregulated.

American oil companies have been prospecting for oil in Western Paraguay for years, but no commercially exploitable oil reserves have been discovered to date. However, natural gas reserves have been reportedly discovered with a capacity to produce 5 million cubic meters per day.

## Industry

Manufacturing accounts for about 16% of GDP and 12% of EAP. Industrial activities consist mostly of processing farm, livestock and forestry products. These industries, including food processing, oil extraction, alcohol production, and tanneries are usually water consuming and water polluting, due to the generalized practice of dumping their effluents without treatment.

Manufacturing, strictly speaking, comprises a relatively small share, being usually dependent on imported raw materials. The major import items are oil and derivatives, and electrical tools and parts, comprising 16% and 14%, respectively, of total import values in 1986 (Table S4.2.6).

Industries located in the three Departments (Central, Cordillera and Paraguari) amount to 19% of the country in terms of number of factories, and 29.5% of the country in terms of taxes paid to local governments as operating licenses. The economic significance of manufacturing industries in the Lake Ypacarai basin is likely to keep growing due to the proximity to the largest domestic market, Asuncion, and due to the convenient location on National Highway 2 to Brazil which serves as a source of raw materials as well as possible market for finished products. The latest Five-year National Development Plan foresees a greater than average 7.6% annual growth rate of the industrial sector in the country between 1985 and 1989.

## Service

The service sector, comprising slightly over half of GDP, is estimated to account for 38% of EAP. Basic services amount to about 7% of GDP showing quite a constant structure with electricity accounting for slightly over 2%, water and sewerage for around half a percent, and transport and communications for nearly 5%. Non-basic services amount to around 44% of GDP, including commerce and finance - the single largest component of GDP - accounting for about 27%, government for slightly less than 5%, housing for about 3%, and other services for nearly 10% (Table S4.2.2).

## 2.2 National budget and public works investments

### 2.2.1 The 1988 national budget

The national budget appropriated for 1988 amounts to 854,738 Million G., of which 29% corresponds to the Central Government and 71% to decentralized or autonomous institutions (Tables S4.2.7 and S4.2.8). Revenues for the central Government come mostly from ordinary resources (tax and fees) amounting to over four-fifths of total revenues, while other sources (foreign loans, special accounts, and grants) account for less than one-fifth. Of ordinary resources, more than three-fourths are comprised by four taxes, namely, internal or domestic taxes (39%), corporate income tax (16%), customs tax (10%) and sales tax (10%), as can be seen in Table S4.2.9. A surplus of 4,673 Million G. is foreseen for 1988.

With regards to government outlays, the appropriated 1988 budget shows current expenses comprising 54% of overall government outlays, and 72% of Central Government outlays. The high proportion of current expenditures, especially for the Central Government outlays, constrains availability of investment funds needed for socioeconomic development.

The bulk of the Central Government budget corresponds to the Executive branch with 62%, while the Legislative branch and the Judicial branch together account for less than 2%, and "other obligations" comprise 36%. Within the Executive branch, the budget for National Defense comprises the highest proportion with 22%, followed by Education 21%, Public Works 19%, and Interior 14%. Each of the remaining seven ministries accounts for less than 10% of the budget for the Central Government.

## 2.2.2 Public works investments

Roads are under the jurisdiction of the Ministry of Public Works and Communications (MOPC). The total length of the road network in 1986 is estimated at 24,000Km, of which 9% is paved, 3% is gravel road and 88% is dirt road. Unpaved roads are closed to vehicular traffic when rainfall reaches a certain amount. The purpose is to save road maintenance and repair costs, but this practice greatly disrupts marketing of perishable farm products.

Of 29,163 Million G. MOPC budget, construction accounts for 88% as shown below.

	Amount (Million G)	%
Construction	25,761	88.33
Road Works	17,930	61.48
Minor roads	85	0.29
Rural road North Axis	1,172	4.02
Rural Road Caazapa	1,133	3.88
Paraguari Dev. Project	1,451	4.97
Stroessner airport	200	0.69
Concepcion bridge	3,790	13.00

It can be seen that the road component of three integrated rural development projects (North Axis, Caazapa, Paraguari) accounts for around 13% of the MOPC budget.

Water courses and water bodies are under the jurisdiction of the National Navigation and Ports Administration (ANNP) which is an autonomous institution with administrative relationship with the MOPC. Being an inland country, Paraguay depends heavily on the navigability of its rivers as the natural outlet to the sea, and as the main route for its international trade. ANNP is devoted to maintaining navigability of Paraguay's water courses with a budget of 8,991 Million G., 76% of which for capital expenditures and 24% for current expenditures (Table S4.2.10).

Telephone service is provided under monopoly of ANTELCO (National Telecommunications Administration) which is an autonomous institution. The capital city Asuncion concentrates over 70% of the telephone service available in the country. The telephone concentration in Asuncion is even higher for residential and coin operated telephones as compared with commercial and public office telephones. The 1988 budget for ANTELCO amounted to 39,731 Million G., 56% of which for capital expenditures and 44% for current expenditures.

As an example of public works at the District level, San Bernardino in 1987 spent 14.1 Million G. (29% of total expenses) for "constructions", of which 33% on rental of road machinery and 67% on construction per se.

## 2.3 Living conditions

### 2.3.1 Housing characteristics

Houses, according to the 1982 Census, are mostly (96.6%) independent units, leaving only 3% as multi-family dwelling units of the type of apartment buildings. Nearly half (47.5%) of houses have brick walls, while 29.5% have board walls. Roof is constructed of tiles (46%), straw (35%) and other materials. Dirt floors are most prevalent (44.5%), followed by brick floors (21%) and tile floors (17%). Housing characteristics are shown in Table S4.2.11.

Dwellings are located 45.9% in urban areas and 54.1% in rural areas. Housing size in terms of the number of rooms per house is 2.9 for the whole country, 3.6 for urban areas and 2.3 for rural areas. The average number of occupants per house is 5.2 for the whole country, 4.8 for urban areas, and 5.5 for rural areas. The resulting average number of persons per room is 1.8 for the whole country, 1.3 for urban areas, and 2.4 for rural areas. The most frequent housing situation consists of four persons living in a two-room house.

### 2.3.2 Basic services

Considering the country as a whole, only 9.5% of houses are connected to the public sewerage system and 16.8% to private sewerage systems, while 56% have common latrine and 14.9% have "municipal-type" latrine. Shower or bath facilities are present in 59.4% of houses. Public water supply systems service 20.5% of houses, while wells and springs are water sources

for 68.7%, and rivers and streams for 4.9%. Electrification has reached 38.8% of houses. The most prevalent waste disposal method is burying (76.2%), while only 13.7% of houses have a public refuse collection service (Table S4.2.12).

Considering now the urban areas of the country, 20.6% of houses are connected to the public sewerage system and 30.7% to private sewerage systems, while 30.3% have common latrine and 15.6% have "municipal-type" latrine. Shower or bath facilities are present in 81.3% of houses. Public water supply systems service 43.3% of houses, while wells and springs are water sources for 44.8%, and rivers and streams for 2.7%. Electrification has reached 75.2% of houses. Burying as a waste disposal method applies to 63.8% of houses, while 29.8% of houses have a public refuse collection service.

Lastly, considering the rural areas of the country, only 5% of houses are connected to private sewerage systems as public sewerage systems do not exist. Most houses (77.7%) have common latrine, while 14.3% have "municipal-type" latrine. Shower or bath facilities are present in 40.8% of houses. Public water supply systems service only 1.1% of houses, while wells and springs are water sources for 88.9% of houses, and rivers and streams for 6.7%. Electrification has reached only 8% of houses. There is no public refuse collection service, and 86.6% of houses rely on burying as a waste disposal method.

### III. FUTURE PLAN AND REGIONAL PROJECTS

#### 3.1 Economic development plan

The future development scheme of Paraguay is delineated in the latest Five-year National Development Plan which covers the 1985 - 1989 period. This development plan was formulated when Paraguay was beginning to rebound from two recessionary years (1982-1983) which affected the country after an unprecedented strong growth period (1976-1981). Accordingly, the development plan provides for consolidation of the economic recovery as a basis to achieve solid growth. Policies to attain consolidation of the economic recovery give high priority to production, especially employment generating productive activities, as well as integrated rural development projects and labor intensive projects.

##### 3.1.1 Objectives

###### a) Short-term and medium-term

- To upgrade efficiency of public administration
- To improve human resources through better education and health care systems
- To strengthen planning as a means to achieve social and economic objectives
- To consolidate economic recovery through adjustment and stabilization policies

###### b) Long-term

- To increase general welfare through faster growth of employment and income, as well as better income distribution
- To increase production and productivity through better use and better combination of production factors
- To increase domestic capital and to promote foreign investments
- To promote rational use of natural resources, and to protect and improve the natural environment

### 3.1.2 Development strategy

Paraguay has traditionally based its economic development on growth of agriculture, livestock and forestry activities. The latest Five-year National Development Plan delineates the development strategy along the same line of priority activities on the basis of the following principles.

- Agriculture, livestock and forestry will continue to be the basis of the national economy
- Growth is to be pursued through increased exports, opening of new markets and promotion of agroindustry
- The Government will continue playing a leading role in the promotion of economic development
- Urban-rural disparities are to be reduced concerning health, education, environmental sanitation, housing and social security

### 3.1.3 Target growth rates

The Five-year National Development Plan clearly states that agriculture, livestock, forestry and agroindustry will continue to be the basis of the national economy. This policy, the strategy to reduce urban-rural disparities, and the objective of natural resources conservation appear to be reflected in the sectoral target growth rates set in the National Development Plan. As compared with the 1977-1986 average sectoral growth rates (10-year average of year-to-year growth rates), the target sectoral growth rates are higher for agriculture, livestock, industry, transport and communications, but lower for forestry, mining, hunting and fishing. The target GDP annual growth rate for 1985-1989 is 6.1% as compared to 5.7% attained between 1977 and 1986. Details are shown below.

Sector	Growth rates	
	1985-1989 (target)	1977-1986
Agriculture	5.7	4.5
Livestock	5.8	2.5
Forestry	4.9	5.9
Hunting & fishing	6.9	10.2

Mining	6.1	13.5
Industry	7.6	5.7
Construction	10.0	12.2
Electricity	6.1	11.2
Water & sewerage	6.2	11.3
Transport & Communic.	6.7	5.9
Commerce	5.9	6.2
Government	3.9	6.3
Housing	3.7	4.7
GDP	6.1	5.7

Consistent with the above, the target employment creation for the 1985-1989 period is set at 240,000 distributed as follows : agriculture, livestock and forestry 96,000 (40%), industry 43,000 (18%), and construction 21,000 (9%).

### 3.2 Regional development projects

Many regional development projects are in different stages of implementation. A development project under implementation is the Paraguari Department Integrated Rural Development Project which has the objective of improving income and living standard of small farmers and rural artisans. The means to accomplish the objective are : introduction of better technology ; provision of technical assistance and credit ; training ; improvement and expansion of rural road network ; improvement and expansion of health services, education and electrification ; improvement of land-holding structure ; and coordination of policies and actions of different institutions in charge of development and social welfare.

The above activities are being conducted through the implementation of seven subprojects : credit, training and social organization, roads, land-holding regularization, rural electrification, health, and education.

Total costs of the Paraguari Department Integrated Rural Development Project amount to 52 Million US\$, financed by 37 Million US\$ foreign loans and 15 Million US\$ national funds. This project was scheduled to be implemented in four years and it is nearing completion.



Similar integrated development projects, taking Departments as the project objective areas, have been or are being implemented in Caazapa, Alto Parana-Canindeyu, North Axis. Other regional projects consist of different road improvement projects, rural water supply and sanitation, and construction of a new international airport in Ciudad del Este.

## IV. REGIONAL SOCIOECONOMIC CONDITIONS

### 4.1 General description

#### 4.1.1 Project area

The Lake Ypacarai basin comprises an area of approximately 833Km<sup>2</sup> and includes 9 Districts of the Central, Cordillera and Paraguari Departments, namely, Aregua, Capiata, Itaugua, Luque, San Lorenzo, Ypacarai, San Bernardino, Paraguari and Pirayu.

#### 4.1.2 Population

The population of the Lake Ypacarai basin was estimated using the 1982 Population Census data which are published for each District as urban and rural population. However, the District administrative boundaries do not coincide with the Lake Ypacarai basin boundaries. Thus, when the urban center of a District straddles the basin boundary, the District urban population was prorated as a function of the number of households obtained from the aerial photographs. On the other hand, when the basin boundary cuts the rural area of a District, the District rural population was prorated as a function of the land area. The resulting estimated population of the Lake Ypacarai basin is shown in Tables S4.4.1, S4.4.2, S4.4.3, S4.4.4, S4.4.5, S4.4.6.

#### 4.1.3 Economic activities

The convenient location of the Lake Ypacarai basin with respect to Asuncion has been gradually shifting the importance of economic activities from the primary sector towards secondary and tertiary sectors. Accordingly, land use has been shifting from farming to housing development. Still, small farms are widespread within the lake basin, producing either for family consumption, or cash crops that can be successfully produced on small acreage, e.g., tomato, green pepper, strawberry.

There are still large cattle ranches in the lake basin accounting for some 61,000 heads (about 1% of the country's cattle population), distributed mostly between the Arroyo Yuquyry basin (28,561 heads) and the Arroyo

Pirayu basin (25,404 heads). Pigs numbering about 15,000 are raised mainly for family consumption rather than for the market (Table S4.4.7).

Manufacturing is more prevalent in Districts close to Asuncion such as San Lorenzo, Capiata, Itaugua, Luque and Aregua. Manufacturing operations are usually small, with a labor force of less than 20 employees in the majority of factories.

Housing development around the Ypacarai lake is rapidly expanding at the expense of farmland which used to be under traditional cash crops like cotton. These housing developments respond to initiatives of the private sector, since local authorities neither formulate development plans nor regulate their implementations.

#### 4.1.4 Tourism

The scenic beauty of the Ypacarai lake and its basin has not been fully exploited. Reportedly, main attractions for foreign tourists are Asuncion with its casino and shopping opportunities, and Ciudad del Este with its casino, shopping opportunities, the Itaipu hydroelectric dam and the Yguassu Falls. The Lake Ypacarai basin is located on the road joining these two touristic attraction poles. This circumstance can be exploited by means of appropriate promotion campaigns emphasizing nature oriented attractions like hiking and boating, or culture oriented attractions like churches and colonial buildings.

The hills surrounding the Lake Ypacarai provide tourists with opportunities for trekking amid the natural beauty of the lake basin. Magnificent views of the Lake Ypacarai and surroundings can be enjoyed from Cerro Coi and Cerro Chorori, Cordillera de los Altos, Cerro Patiño, and Cerro Yaguaron.

Innumerable sites contained within the Lake Ypacarai basin are of prime religious value, or of geological and recreational importance, such as the old churches in Pirayu and Yaguaron, the unique polygonal sandstone of Cerro Coi and Cerro Chorori, and the beaches of San Bernardino and Aregua, as shown in Fig. S4.4.1.

Of 370,743 tourists visiting Paraguay in 1986, nearly 80% came from Argentina and Brazil. Some 78% of tourists entered the country by land and

water, of which 39% from Argentina through Puerto Falcon near Asuncion and 23% from Brazil through Ciudad del Este.

There are no data to ascertain how or where foreign tourists spend their time and money once they have entered Paraguay. Considering that the estimated average length of stay of each tourist was only three days in 1986, it can be hypothesized that tourists visited only those well known places like Asuncion, the Yguassu Falls, and perhaps the religious Jesuit ruins around Encarnacion in the south. Doubtless, some tourists stopped in San Bernardino as their final destination or on their way between Asuncion and the Yguassu Falls (See Fig. S4.4.2).

If tourists could be offered more recreation and cultural opportunities around the Ypacarai lake, accompanied by widely covered information and promotion campaigns, an increasing number of tourists could extend their stay in Paraguay, thus contributing to the earning of foreign exchange.

## 4.2 Specific description by District

### 4.2.1 Aregua

The Aregua District covers 109Km<sup>2</sup> and its population, according to the 1982 Census, is 14,558 inhabitants, giving a population density of 134 persons per Km<sup>2</sup>. Male population comprises 50.2% and female population 49.8%. Between 1972 and 1982, total population grew at 2.7% yearly rate, urban male population at 2.9%, urban female population at 2.8%, rural male population at 2.6%, and rural female population at 2.5%. The current estimated population is 20,000 due to the population influx occurred in 1983 when victims of the Paraguay River big flood settled in the District, making it their home even after the flood.

Aregua has felt, throughout its history, the effects of its peculiar location. When the city was founded in 1861, followed almost immediately by the railroad service, Aregua became the main summer recreation place for Asuncion residents. This privileged situation was gradually lost as San Bernardino became the favorite summer recreation site, and petroleum powered vehicles overtook the railroad as the main transportation means. Even in this instance, the National Highway No. 2, constructed over 30 years ago, left Aregua at the end of a branch road from Capiata. It was only

in the 1980's when another road joining Luque, Aregua and Ypacarai was paved, considerably improving accessibility to Aregua.

A more accessible Aregua has created favorable conditions for the development of crafts, especially pottery, by facilitating marketing to people visiting the city or just passing by. Other crafts include jewelry, carpentry works, and articles made of reed. Intensified pottery production requires expanded use of clay, which is estimated at 60 ton per month, based on 30 potters using 2 ton per month per potter. Clay exploitation is not regulated, requiring only an agreement between interested potters and owners of the land where clay is found.

With regards to agriculture, Aregua is known for its strawberry, producing about half of the Paraguayan strawberry output. A natural development has been production of strawberry preserves. In addition, agricultural production includes vegetables, flower, fruit, dairy and honey, which are all appropriate as small farm activities.

Industries include a cotton gin and a soap factory, each employing over 100 persons. Other industries consist of food processing, textiles, absorbent cotton wool, furniture and ceramics. It is estimated that 94% of the factories employ between one and four workers.

In spite of the variety of economic activities existing in Aregua, an estimated 40% of the labor force hold employment in Asuncion.

#### 4.2.2 Capiata

The Capiata District covers 59km<sup>2</sup> and its population, according to the 1982 Census, is 44,629 inhabitants, giving a population density of 757 persons per Km<sup>2</sup>. The current population is estimated at 56,000, while the 1980 population was estimated at 25,000-30,000. Urban population comprises around 10% according to the population census of 1972 and 1982. Capiata is a District where the growth rate between 1972 and 1982 was higher for the rural population than for the urban population, for both male and female population. As a matter of fact, total population grew at 5.4% yearly rate, urban population at 4.7% and rural population at 5.5%. This can be attributed to the rapid urbanization of farmland.

Cotton used to be an important cash crop in the District, but because of rapid urbanization, crops at present consist mostly of vegetables. Other

production activities are ceramics and brick factories. An estimated 10%-15% of the labor force commute to work in Asuncion. The most important economic activity in the District is working in local industrial plants, of which the largest employer is CAPSA, a vegetable oil extracting factory. A commendable set up feature of this factory consists of an effluent treatment plant, which unfortunately is not operating because of some problems with the lagoon.

The Capiata Municipality welcomes establishment of industries as employment sources for the population. The Municipality is trying to set up a technical vocational school with a view to preparing human resources capable of handling diverse factory operations.

Water supply is serviced by SENASA using groundwater. Factories too use groundwater as water sources. Since groundwater appears to be plentiful, there are no plans to use water from the Lake Ypacarai for domestic or industrial purposes.

#### 4.2.3 Itaugua

The Itaugua District covers 82Km<sup>2</sup> and its population, according to the 1982 Census, is 25,959 inhabitants, giving a population density of 317 persons per Km<sup>2</sup>. Urban population comprises 20.7% and rural population 79.3%. Between 1972 and 1982, total population grew at 2.5% yearly rate, urban population at 3.6% and rural population at 2.3%.

The current population is estimated at around 35,000-40,000 inhabitants, growing by 1,000 persons a year. An important element of the population growth consists of people from Asuncion who still hold employment in Asuncion but can live in Itaugua thanks to road improvements. The housing need of these immigrants has been satisfied by an intense housing development in the past 10 years. Urbanization is currently taking place in 50 to 60 locations, each of which covering areas ranging between 1 and 30 ha. No regulations nor plans exist for controlling these housing developments.

Operating in Itaugua are many factories such as vegetable oil extracting companies, ceramics, cotton gin, furniture manufacturer and food processing industries. Local residents comprise 70% of labor force of these factories. An estimated 10% of the labor force commute to work in Asuncion.

The population at large seems unconcerned about the Lake Ypacarai pollution, and environmental matters in general. But the Itaugua Mayor feels the need for formulation and implementation of an urban plan, and regulations concerning industrial effluents.

#### 4.2.4 Luque

The Luque District covers 203 Km<sup>2</sup> and its population, according to the 1982 Census, is 64,288 inhabitants, giving a population density of 317 persons per Km<sup>2</sup>. The population is growing rapidly due to Luque's proximity to the capital city, making it possible to work in Asuncion and live in Luque at lower costs.

Between 1972 and 1982, the overall population of Luque grew at 4.7% yearly rate, the urban population at 6.4%, and the rural population at 3.7% yearly rate. A more detailed breakdown indicates that urban male population grew at 6.9%, urban female population at 5.9%, rural male population at 3.5%, and rural female population at 3.8%. Urban population comprises 40.3% and rural population 59.7%.

The location of Luque with respect to the capital city sets favorable conditions for both agriculture and industry. Farm products consist mainly of vegetables. A specialized farming activity in Luque is that of flower cultivation which supplies varieties of rose and carnation to flower shops in Asuncion.

Luque is well known for its handicrafts. Delicate silver and gold jewelry, high quality musical instruments such as guitar and harp, and such articles as hats and bags made of karanday palm are some of the crafts Luque is proud of.

Industrial activities in Luque span the range from the traditional small food processing to modern electronics. An electromechanical industry based in Luque manufactures turbines for the Itaipu hydroelectric dam giving employment to 600 persons in Luque, plus 600 at the dam site. Other industries include furniture, metal works, plastics, textiles, clothing, pharmaceuticals, each employing between 30 and 80 persons.

Proximity to Asuncion is also favorable to expanded education opportunities. Luque has 9 grade schools and 7 high schools, some of them with enrollment reaching 1,000 students. In addition, Luque has 5

vocational schools for women, offering specialized training in crafts and home economics.

An estimated 80% of urban households receive water supplied by CORPOSANA, but only around 50% have sewer services.

#### 4.2.5 San Lorenzo

The San Lorenzo District covers 40Km<sup>2</sup> and its population, according to the 1982 Census, is 74,552 inhabitants, giving a population density of 1,864 persons per Km<sup>2</sup>. The current population is estimated at 120,000. The totality of the San Lorenzo population is classified as urban. Between 1972 and 1982, the San Lorenzo population grew at 7.3% yearly rate, but the growth rate is considered to have slowed down in recent years because there is virtually no more land for urbanization.

Revenue sources for the San Lorenzo Municipality are the same as for other Municipalities. However, the high population density and the concentration of numerous industries in the District make the San Lorenzo Municipality relatively more affluent than others. On the other hand, and for the same reasons, the San Lorenzo Municipality faces a wider range of responsibilities and expenditures than other Districts. The San Lorenzo Municipality has a budget for public works, but many times it has to finance even public works that are under the MOPC jurisdiction.

Water supply, sewerage and solid waste disposal are problems for the San Lorenzo Municipality that need to be addressed with the highest priority. Water is supplied by CORPOSANA with an independent system from that of Asuncion. Groundwater is the water source, and despite the low service coverage estimated at less than 50%, there are complaints concerning insufficient volume and low pressure.

Coverage of sewer services is estimated to be quite lower than that of water supply. The Municipality constructed a sewage treatment plant as part of an agreement with CORPOSANA on construction of water supply and sewerage facilities. The sewage treatment plant was operated by CORPOSANA until 4 years ago when sand accumulation put it out of service. In areas without sewerage system, septic tanks are constructed in the backyard.



The study and implementation of a solid waste disposal system is a pressing need, but the problem is the lack of willingness of the general population to pay for the service. Solid wastes are scattered inside and alongside the San Lorenzo stream. When heavy rainfall causes overflow of the stream channel, solid wastes tend to accumulate in low laying areas and on bush branches. The Municipality has to pay for the clean up of these accumulated solid wastes. The government office in charge of maintaining water courses is not clearly defined. The water quality of the San Lorenzo stream has been deteriorating due to inflow of domestic wastewater and industrial effluents. Monitoring of the stream water quality is under the SENASA jurisdiction. The San Lorenzo stream was, reportedly, swimmable, and abundant fish could be observed until some 15 years ago.

#### 4.2.6 Ypacarai

The Ypacarai District covers 111 Km<sup>2</sup> and its population, according to the 1982 Census, is 12,057 inhabitants, giving a population density of 109 persons per Km<sup>2</sup>. The current population is estimated at 15,000, growing by 1,000 persons per year. Between 1972 and 1982, total population grew at 1.4% yearly rate as compared to the 2.5% national average, urban population grew at 0.9% yearly rate and rural population grew at 1.8% yearly rate.

Limited local employment opportunities pose serious problems to the people of Ypacarai. Craft and manufacturing consist mostly of small scale operations where employment ranges from one to four workers in 93% of the factories. Despite existence of industries such as a vegetable oil extracting plant, ceramics manufacturer, tanneries, food processing, the Municipality estimates that 70% to 80% of the labor force are employed outside the District. Construction works at Itaipu and Yacyreta hydroelectric dams have attracted many local residents. Still, unemployment is high.

The vegetable oil extracting company and the sausage manufacturer dump their effluents directly into streams without any treatment. However, one of the tanneries has set up a lagoon for treatment of effluents.

Neither SENASA nor CORPOSANA supplies water in the District. Although shallow wells dug by each household are currently used as the only water source, the quality of groundwater is, reportedly, unsatisfactory.

The low quality of drinking water causes intestinal diseases, especially affecting children, resulting sometimes in fatalities.

Domestic waste water is usually discharged in the backyard or onto the streets. Human wastes are disposed of into septic tanks constructed in the backyard. The distance between a well and a latrine or a septic tank is regulated to be at least 30m, but the small size of the housing lot precludes, many times, compliance with this regulation, thereby worsening even more the quality of well water.

#### 4.2.7 San Bernardino

The San Bernardino District covers 109Km<sup>2</sup> and its population, according to the 1982 Census, is 6,591 inhabitants, giving a population density of 61 persons per km<sup>2</sup>. Founded in 1881 by German settlers, the city has taken advantage of its privileged location and flourished, especially in the past 15 years, into a fashionable resort and summer recreation site. This transformation is easily discernible from census data. Urban population in 1972 comprised only 17%, but 10 years later this proportion shot up to 34%. Total District population grew at 1.6% yearly rate as compared to the 2.5% national average. However, urban male population grew at 8.7% and urban female population at 9%, presumably attracted by job opportunities in services catering to the recreation industry. On the other hand, rural population had negative growth rates, -0.4% for male population and -1.0% for female population.

The urban population is 2,247 inhabitants, but reportedly, it trebles during the December-February period, which coincides with the summer vacation of the school system. Evidently, the summer months strain the city capacity to provide basic services such as waste disposal. The crowd of visitors during the summer months originates bursting activities bringing benefits to the city and the residents. The city is trying to find ways to extend for the whole year the intense visitor activities that currently last only three months of the year.

Revenues of the San Bernardino Municipality in 1987 came from taxes (40%), fees for services rendered (9%), sale of municipal land (31%), and the remainder from rents and special contributions. A breakdown of taxes indicates that car registration accounted for one-third of taxes, construction permits for 24%, licenses to operate professional / commercial / industrial

establishments for 12%, gambling tax for 11%, urbanization tax for 8%, and the remainder for diverse items. Most (85%) of fees for services rendered came from street sweeping and waste disposal.

Expenditures of the San Bernardino Municipality in 1987 were for constructions (29%), salaries and wages (15%), acquisition of office equipment and land (10%), materials and supplies (7%), contributions (9%), utilities (3%), debt service (23%), and the remainder for different items. Construction expenditures included rental of road machinery and equipment.

The pattern of revenues and expenditures indicates reliance on the visitor and recreation industries, showing predominance of activities leading to improvements in infrastructure, facilities and services.

Aside from services catering to visitors, other industries in San Bernardino include one instant coffee manufacturing plant giving employment to more than 50 persons, and some small food processing industries.

#### 4.2.8 Paraguari

The Paraguari District covers 273Km<sup>2</sup> and its population, according to the 1982 Census, is 13,644 inhabitants, giving a density of 50 persons per Km<sup>2</sup>. The Census data indicate existence of 2,806 houses, resulting in an average occupancy of 4.9 persons per house.

The scarcity of jobs induces population, especially male population, to migrate towards new settlement areas in the east and north of the country. Of the nine Districts in the Lake Ypacarai basin, Paraguari was the only one having an overall negative population growth rate between 1972 and 1982. The negative growth rates in the rural population (both male and female) could not be offset by positive growth rates in the urban population. Overall male population in Paraguari had a negative growth rate between 1972 and 1982, while overall female population had a positive growth rate.

There are 8 grade schools with some 1,600 students, 5 high schools with some 900 students, 3 health centers staffed with 4 nurses. Water supply by CORPOSANA is available in some sectors of the urban area, while wells and springs are prevalent in rural areas. Water flushed toilets are found mostly in the urban area, while latrines are prevalent in the rural area. Shower or

bath facilities are found in over half of households in the urban area. Electrification covers the urban area and some sectors of the rural area.

A brief analysis of land tenure shows that tenants amount to only 15%, while the majority is comprised by land owners. However, land ownership characteristics range from those who have fully paid up for the land, to those who are still paying, or those who share ownership with other persons.

Farms with land area ranging from 1 ha to 20 ha comprise 77.5% of all farms but amount to only 5.1% of the total land area owned by all farms. Farms with less than 5 ha of land need to increase cropping area by leasing farmland, usually on a sharecropping arrangement paying 30%-40% of harvest as land rent.

Estimated cropped area amounts to 150 ha of perennial crops, and 3,500 ha of annual crops including 700 ha of cotton, 150 ha of water melon, 100 ha of beans, 150 ha of sugarcane. Some cropping operations, like land preparation, are done by tractors on service hire from nearby ranches. The agricultural extension service is promoting soil conservation practices such as contoured cultivation, addition of organic matter, pH correction.

Cattle ranching is the most important livestock activity amounting to 23,658 heads that are raised on natural pasture complemented with considerable acreage of cultivated pasture. Pigs and chicken are raised mostly for family consumption.

Forest resources have been exploited with such an intensity that, reportedly, little timber of commercial value remains. Reforestation covers only 50 ha, but the agricultural extension service is promoting conservation of natural resources and reforestation.

With regards to mining, stones, slabs and granite are obtained from some quarries. In 1985, the Paraguari District industries included a cotton gin, 4 tanneries, 3 charcoal manufacturers, 10 rum distilleries, and 48 small brick manufacturers.

#### 4.2.9 Pirayu

The Pirayu District covers 141km<sup>2</sup> and its population, according to the 1982 Census, is 11,905 inhabitants, giving a population density of 85 persons per Km<sup>2</sup>. The current population is estimated at 14,000. The

population growth rate is low due to the constant outflow of young male population who emigrates seeking better job opportunities. Between 1972 and 1982, total population grew at 0.8% yearly rate as compared to the 2.5% national average, urban population grew at 2.1% yearly rate, and rural population grew at 0.4% yearly rate.

The water course of the Pirayu stream runs across the town. The bank of the stream crumbles easily, especially during flood, and there have been cases of houses and livestock being swept away. Flood occurs several times a year, when rainfall reaches 70mm-80mm, and flood water does not recede from lowlands for a couple of days.

Cattle ranching is prevalent in the District, taking advantage of the natural grassland, rather than planting improved pasture on deforested land.

Pirayu is well known for its cassava starch, which is manufactured in about 20 small scale processing operations. Starch production requires abundant water, either from streams or wells. Where stream water is used, effluents are directly discharged back into the stream. Where well water is used, effluents are usually stored in ponds and then discharged during rainfall. Effluents stored in ponds are usually sources of offensive odors.

Pottery and ceramics are frequently found activities in the District. Kaolin needed for ceramics is exploited in two quarries. Two large scale ceramics plants employ together around 60 persons. In addition, there are about 20 small scale brick manufacturers. They require large amounts of firewood which is cut off from nearby forests, giving origin to deforested mountains. However, the tree stumps and roots remaining on mountain slopes serve conservation purposes protecting the soil against erosion.

## V. CURRENT LAND USE IN LAKE YPACARAI BASIN

### 5.1 Location

The Lake Ypacarai Basin is located in the oriental sector of the Republic of Paraguay, about 30Km East of Asuncion. The lake basin comprises an area of approximately 833km<sup>2</sup> and includes 9 districts of Central, Cordillera and Paraguari Departments.

The lake Ypacarai basin has a length of around 52Km and an average width of 18Km. Its North-South limit would be an imaginary line, going from the beginning of Salado river (North limit) to the hills of Peró, Cristo Redentor, Jhú and Santo Tomás in Paraguari (South limit). The eastern border would be "Cordillera de los Altos", and the western border the highway No. 2 and "Cordillera de Yaguarón" as end limit.

### 5.2 Procedure and classification

For the land utilization state of the basin, the land category was first interpreted on the aerial photo and the result was transferred to the topographical map. Each land use classification area was measured with a planimeter and aggregated for each basin. The result is shown in Fig. S4.5.1 and Tables S4.5.1, S4.5.2, S4.5.3, S4.5.4, S4.5.5, S4.5.6.

The land within Lake Ypacarai basin was classified into seven categories (forest area, wild area, wet or shallowly flooded area, pasture area, cultivated area, urban area, and Lake, lagoon, etc.) based on the photo taken in February 1988. (Current Land use Map Fig. S4.5.2).

#### (1) Forest area

In the forest area two parts may be observed : the areas consisting of high trees and low trees (shrubs). Natural broad leaf trees occupy most of the forest area within the basin. Main forest areas are Cordillera de los Altos (El. 100m), Cordillera de Yaguarón, northeastern slopes of the hills between Ypacarai and Aregua, and in the periphery of the marshland spreading along Río Salado.

(2) Dry grass area

Dry grass area is spread sporadically in the Pirayú River basin, and Salado River basin (outside of the land use study area).

(3) Wet (or shallowly flooded) area

Wet area is distributed widely along Salado River from the northern end of Lake Ypacarai to Paraguay River (outside of the basin) and in the lower reaches of Arroyo Pirayú.

(4) Pasture area

Pasture is distributed widely in the area lower than 100m of Arroyo Pirayú Basin, and the foot of Cordillera de los Altos and Cordillera de Yaguarón.

Typical pasture is spread on the outside of the low-land of Arroyo Pirayú.

Pasture with shrub is distributed widely in the middle to upper courses of Arroyo Yuquyry, in the middle slope of Cordillera de los Altos and in the lower course of Salado River.

(5) Cultivated area

Cultivated area is distributed on the slopes of Cordillera de Yaguarón, in the hill area of the upper course and the right bank of the middle course of Arroyo Yuquyry, and on the plains with gentle undulation northward of Luque.

On the middle slope of Cordillera de los Altos, cultivated field mingled with forest are also found widely.

(6) Urban area

Urban area is distributed widely in the western part of the basin, on the left side of Arroyo Yuquyry (San Lorenzo, Capiata, Itauguá, Luque, etc.) and areas surrounding urban areas of San Bernardino, Areguá, Ypacarai, Pirayú, Paraguari.

Urbanization is in progress on the left bank of Arroyo Yuquyry. Development of housing sites is also rapid around San Bernardino. Colonies are distributed in the low-land hill areas along rivers and "arroyos".

(7) Lake, lagoon, etc.

The Lake Ypacarai, a shallow lake with an area of about 59Km<sup>2</sup> is located on the North-center of the basin.

In the lowest part of Arroyo Pirayú basin, innumerable large and small ponds are scattered, suggesting that this area had been the lake floor in the past and easily suffers flooding at present.

### 5.3 Characteristics

The study Area consists of some 833Km<sup>2</sup> and comprises 9 administrative districts. The present land use (refer Land Use Map Fig. S4.5.2) shows that the biggest area is occupied by pasture and cultivated land with 36.3% and 28.9% respectively.

- Pasture land is observed mainly in the Pirayú basin, along the Arroyo Pirayú and South-West zone of East Coast Basin area.
- Cultivated land is concentrated mainly in the southern zone of the Yuquyry basin and the West zone of the Pirayú basin.
- The Land use map shows that the densely populated areas are located in the North-West zone of the Yuquyry basin, developing along the national routes No. 1 and No. 2. Significant concentrations are observed in localities close to Asunción, capital of Paraguay.
- Following the above areas, the forest occupies 14.1% of the basin, and is located sporadically over the study area, generally in high zones (peak and slope of mountains) and along the waterstreams and rivers.
- The wet areas are located in the North and South zone of the Lake, along the Salado and Pirayú Rivers respectively.

Based on the aerial photograph (February 1988) and the current land use map, approximate distribution of the present land use is estimated as follows (refer to Tables S4.5.1, S4.5.2, S4.5.3, S4.5.4, S4.5.5, S4.5.6):



	Area (Km <sup>2</sup> )	Share (%)
Forest area	117.67	14.1
Dry grass area	3.75	0.4
Wet area	31.54	3.8
Pasture area	302.16	36.3
Cultivated area	240.51	28.9
Urban area	135.18	16.2
Lake, lagoon etc.	2.19	0.3
<b>Total</b>	<b>833.00</b>	<b>100.0</b>

#### 5.4 Land use area Comparison between 1965 and 1988

##### (1) Description of Land use (1965)

According to the 1965 aerial photographs 711.20Km<sup>2</sup> was taken as study area (excluding zones of Pirayú basin) due to lack of photograph data of the said zones.

The land use of 1965 shows as significant use 49.30% and 30.20% of cultivated and pasture lands respectively, followed by the forest land with 9.8% of the land area. Based on the aerial photographs, approximate distribution of the land use was estimated as follows (refer Fig. S4.5.3 and Tables S4.5.7, S4.5.8, S4.5.9, S4.5.10, S4.5.11).

	Area (Km <sup>2</sup> )	Share (%)
Forest area	69.87	9.8
Dry grass area	-	-
Wet area	18.30	2.6
Pasture area	214.49	30.2
Cultivated area	351.03	49.3
Urban area	57.51	8.1
Lake, lagoon etc.	-	-
<b>Total</b>	<b>711.20</b>	<b>100.0</b>

##### (2) Land use area comparison between 1965 and 1988.

This comparison was made, based on the aerial photographs taken in 1965 and 1988, taking land consisting of some 711Km<sup>2</sup> (not included P<sub>1</sub> to P<sub>10</sub> of the Pirayú basin for reason mentioned in (1)).

According to the comparison, the majority of present land use increased their areas, except the cultivated land which was 132.89Km<sup>2</sup> less in the current land area.

In the photo-interpretation process, cultivated land was difficult to differentiate from forest land. Thus, some parts of cultivated area may be included in the forest area, thereby overstating the forest land area estimated as the present land use.

A remarkable increase is noted in the urban land with 127% of increased area, due to the rapid population growth of sub-urban centers near Asuncion and surroundings. Therefore, the reason of the decreasing cultivated land was due to the rapid population growth in the North-West zone of Yuquyry basin and the population emigration from rural areas. Owing to the above described situations, the cultivated land has been converted into urban (mainly in Yuquyry basin, East and West Coast basin) or pasture land.

The growth rate of most sub-urban centers within the basin is expected to accelerate with the eventual construction of new infrastructures. So, many cultivated land, and some pasture and forest areas tend to disappear in the near future.

The present wet area increasing was probably due to a heavy rain in the flooding zone occupied formerly by the pasture area.

The estimated differences between 1965 and 1988 are shown in Figs. S4.5.4, S4.5.5 and Table S4.5.12.

## 5.5 Problems of the Present Land Use

The major problem in the present land use of Lake Ypacarai and its basin, is the existing intensive use and uncontrolled urbanizations and deforestation of available land. Life within the Lake Ypacarai and its basin is closely related to land, despite the existence of urbanised concentrations, especially in the Yuquyry basin. Within the surrounding compact settlements around Asunción, in a radius approximately of 60Km, the following can be detected.

(1) Asuncion, due to its small area, its rapid growth and the high cost of the land rent, and due to the shortage and high demand of the properties make

that neighbor communities develop the con-urban areas around the Capital City.

(2) The most integrated districts were Lambaré and Fdo. de la Mora. This integration tends to continue to San Lorenzo, while Luque was integrated later but not totally.

(3) With this integration, the supplier role that was carried out by the neighbor districts was displaced to the contiguous center of those districts.

(4) This phenomenon, with the road asphalt works, the transportation improvement, and the increasing demand of Asunción, made distant districts to be converted into direct suppliers of Asunción. Owing to the above situations, the old storing centers was disappearing from the neighbor districts (example : Paraguari).

(5) The growth rate of most sub-urban center within the basin is expected to accelerate with the eventual concentrations, new infrastructure and therefore the disappearing of agriculture land as mentioned in Land Use Area Comparison between 1965 and 1988.

From 1965, the North-West fringes of the study area (Yuquyry basin) have seen a proliferation of income-oriented urban settlement development. The fringes of the Yuquyry basin tend to be attractive areas for new construction because of the proximity to Asunción.

At the same time, in the Pirayú basin the rural population together with the cultivated area are decreasing due to emigration to other attractive cities. In the East basin, the rural area has had little change, however around San Bernardino, the proliferation of land lots and new construction are rapidly increasing because of the privileged location as touristic center.

These trends point out the urgent need for establishing planned and actively enforced directions and levels for future growth and land use. Because of the complexity and importance of this problem, the tentative suggestions presented here should lead to the finalisation of comprehensive land use regulations and policies only after a more exhaustive study of needs, land potentials, and the problems of implementation.

The foregoing facts lead to the following conclusions :

- Urbanization is in rapid progress in the western part.
- Deforestation and cultivation has made steady progress in the hill areas and the mountainside of Cordillera de Yaguarón, the western part of the study area.
- On the foot of Cordillera de Los Altos, deforestation, cultivation and urbanization are also in progress.
- The lowland area along Arroyo Pirayú, the lake floor in the past, is exclusively used for pasture.
- Wet grass area and its surroundings along Rio Salado is underdeveloped for the present ; however, housing sites are in preparation in a limited area.



## TABLES



Table S4.2.1 Economically Active Population by Department and by Activity

Unit: %

	Paraguay			Cordillera Dept.			Paraguari Dept.			Central Dept.		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Potential EAP (all 12 years old & up as % of Total Population)	66.60	66.10	67.10	65.90	65.40	66.40	65.80	65.40	66.20	70.40	69.70	71.10
Actual EAP (as % of Potential EAP)	51.50	83.20	20.30	47.60	81.40	13.50	48.30	82.00	14.70	52.40	81.30	24.50
Activities (% of Actual EAP)												
Profess. & Tech.	4.30	2.70	10.80	2.90	1.20	13.20	2.60	0.90	12.00	4.00	2.70	8.10
Executive	0.90	0.90	0.80	0.60	0.60	0.70	0.30	0.30	0.30	0.70	0.70	0.50
Office Clerk	5.20	4.10	9.70	1.70	1.40	3.50	1.60	1.30	3.00	6.60	5.80	9.40
Business & Sales	6.50	4.90	12.80	4.60	3.10	13.20	2.90	2.20	6.80	10.20	7.50	19.00
Agriculture	42.80	50.60	10.70	57.60	65.10	12.10	63.10	72.00	13.20	13.10	16.60	1.80
Transport	3.10	3.90	0.10	2.60	3.00	0.10	1.70	2.00	0.00	5.40	7.10	0.10
Craft & Manuf.	18.70	18.20	20.60	18.70	16.60	31.30	17.10	11.90	45.70	34.40	37.20	25.40
Laborer	2.40	2.80	0.80	1.80	2.00	0.70	1.20	1.20	0.70	4.30	5.20	1.30
Service	9.30	5.00	26.80	5.10	2.60	20.50	4.40	2.70	13.60	10.60	5.40	27.30
Searching Ist. Job	0.60	0.70	0.50	0.50	0.50	0.50	0.80	0.80	0.60	1.00	1.20	0.60
Unspecified	6.20	6.20	6.40	4.00	3.90	4.30	4.50	4.60	4.10	9.60	10.60	6.50

Source : Censo Nacional de Poblacion y Viviendas 1982, DGEC, MH, Junio 1986



Table S4.2.2 Structure of Gross Domestic Product

(Percent of Constant 1982 Values)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Agriculture	16.3	15.3	14.7	14.5	15.3	15.5	15.6	16.2	16.6	14.5
Livestock	9.6	9.0	8.4	7.9	7.4	7.7	7.8	7.9	7.8	7.9
Forestry	2.6	2.6	2.6	2.7	2.6	2.5	2.5	2.5	2.4	2.7
Hunting & Fishing	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.1
Sub-total	28.6	27.0	25.9	25.2	25.5	25.9	26.1	26.8	26.9	25.2
Mining	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Manufacturing	17.5	17.5	17.3	17.6	16.9	16.4	16.2	16.4	16.6	16.4
Construction	4.2	5.0	5.8	6.6	7.1	6.7	6.5	6.2	5.9	6.0
Sub-total	22.0	22.8	23.4	24.6	24.4	23.5	23.1	23.0	22.9	22.8
Total Production	50.6	49.8	49.3	49.8	49.9	49.4	49.2	49.8	49.3	48.0
Electricity	1.4	1.5	1.6	1.8	1.7	2.1	2.1	2.1	2.1	2.4
Water & Sewerage	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4
Transport & Communication	4.4	4.3	4.4	4.3	4.1	4.2	4.3	4.3	4.4	4.6
Sub-total	6.1	6.1	6.3	6.4	6.1	6.6	6.8	6.8	6.9	7.4
Commerce & Finance	26.3	27.0	27.3	27.0	26.9	26.6	26.6	26.3	26.5	27.3
Government	4.1	4.0	3.9	3.8	4.2	4.5	4.5	4.4	4.4	4.5
Housing	3.2	3.2	3.2	3.1	3.1	3.1	3.0	2.9	2.8	2.9
Other services	9.7	9.9	10.0	9.9	9.8	9.8	9.9	9.8	9.6	9.9
Sub-total	43.3	44.1	44.4	43.8	44.0	44.0	44.0	43.4	43.3	44.6
Total Services	49.4	50.2	50.7	50.2	50.1	50.6	50.8	50.2	50.2	52.0
Gross Domestic Product	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Cuentas Nacionales 1976 - 1986, BCP, Julio 1987

Table S4.2.3 Rate of Growth of Gross Domestic Product by Sector

Unit: %

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Agriculture	9.8	4.9	7.0	9.8	14.8	0.6	-2.8	7.4	6.0	-12.6
Livestock	1.0	4.0	4.0	4.0	3.0	2.0	-1.8	4.1	2.9	2.0
Forestry	9.2	8.2	12.7	15.8	5.7	-5.6	-1.8	2.5	0.9	11.7
Hunting & Fishing	14.4	37.4	31.8	7.4	4.0	3.0	-4.3	2.0	3.0	3.0
Sub-total	6.6	5.0	6.6	8.5	10.1	0.4	-2.4	5.9	4.6	-6.1
Mining	22.7	16.5	42.4	26.0	15.0	2.4	-7.3	1.0	4.4	11.9
Manufacturing	17.4	11.6	9.9	13.3	4.3	-3.7	-4.2	4.5	5.0	-1.4
Construction	31.1	32.0	30.0	26.0	16.7	-6.0	-5.7	-2.4	-1.0	1.0
Sub-total	19.8	15.6	14.7	16.6	7.8	-4.3	-4.7	2.5	3.4	-0.6
Total Production	12.0	9.6	10.3	12.4	9.0	-1.9	-3.5	4.3	4.0	-3.6
Electricity	11.7	16.1	20.1	20.4	4.0	25.0	-4.8	2.2	5.9	11.1
Water & Sewerage	12.6	23.3	12.2	10.0	12.5	10.3	18.1	2.0	6.1	5.5
Transport & Communication	8.3	11.0	11.5	10.5	3.2	2.0	-1.2	3.6	5.1	5.0
Sub-total	9.3	12.7	13.7	13.1	3.8	8.8	-1.4	3.1	5.4	6.9
Commerce & Finance	12.0	14.3	12.5	10.5	8.4	-2.2	-3.1	1.8	4.7	3.3
Government	6.0	7.9	9.9	7.0	22.8	4.0	-2.1	2.4	3.0	2.0
Housing	8.3	11.5	10.5	9.0	6.9	-2.0	-4.7	-	1.0	2.0
Other services	7.0	12.9	12.9	10.9	6.8	-1.0	-1.2	1.6	2.0	2.9
Sub-total	10.0	13.2	12.2	10.2	9.2	-1.3	-2.7	1.7	3.7	3.0
Total Services	9.9	13.1	12.4	10.5	8.5	-0.1	-2.5	1.9	3.9	3.5
Gross Domestic Product	10.9	11.4	11.4	11.4	8.7	-1.0	-3.0	3.1	4.0	0.0

Source : Cuentas Nacionales 1976 - 1986, BCP, Julio 1987

Table S4.2.4 Gross Domestic Product at Market Price by Sector

Unit: Million Constant 1982 US\$

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Agriculture	592	622	665	730	838	843	819	880	933	816
Livestock	352	366	380	396	407	416	408	425	437	446
Forestry	96	104	117	135	143	135	133	136	137	153
Hunting & Fishing	4	5	7	8	8	8	8	8	8	8
Sub-total	1,044	1,097	1,169	1,269	1,396	1,402	1,368	1,449	1,515	1,423
Mining	9	11	16	20	23	23	21	22	23	25
Manufacturing	637	711	781	885	924	890	852	890	935	922
Construction	154	203	264	332	387	364	344	335	332	335
Sub-total	800	925	1,061	1,237	1,334	1,277	1,217	1,247	1,290	1,282
Total Production	1,844	2,022	2,230	2,506	2,730	2,679	2,585	2,696	2,805	2,705
Electricity	53	62	74	89	93	116	111	113	120	133
Water & Sewerage	9	11	13	14	16	17	20	21	22	23
Transport & Communication	159	176	197	217	224	229	226	234	246	258
Sub-total	221	249	284	320	333	362	357	368	388	414
Commerce & Finance	958	1,094	1,231	1,361	1,475	1,442	1,398	1,424	1,491	1,540
Government	149	161	177	189	232	242	237	242	250	255
Housing	118	131	145	158	169	165	158	158	159	162
Other services	354	400	451	501	535	530	523	531	542	558
Sub-total	1,579	1,786	2,004	2,209	2,411	2,379	2,316	2,355	2,442	2,515
Total Services	1,800	2,035	2,288	2,529	2,744	2,741	2,673	2,723	2,830	2,929
Gross Domestic Product	3,644	4,057	4,518	5,035	5,474	5,420	5,258	5,419	5,635	5,634

Source: Cuentas Nacionales 1976 - 1986, BCP, Julio 1987

**Table S4.2.5 Export Volume and Value, 1986**

Product	Volume		Value	
	Ton	%	1,000US\$	%
Total	1,291,450	100.0	227,178	100.0
Food stuff	69,769	5.4	46,149	20.3
Beef	40,911		32,998	
Processed beef	557		268	
Fruit & Vegetables	13,652		5,209	
Paraguayan tea	233		102	
Palm heart	1,582		1,882	
Others	12,834		5,689	
Beverage & tobacco	4,822	0.4	4,493	2.0
Tannin	5,540	0.4	3,183	1.4
Oil seeds	650,052	50.3	45,495	20.0
Peanuts	6,066		899	
Soybeans	631,356		43,875	
Castor oil	12,615		715	
Others	14		7	
Vegetable oil	36,936	2.9	8,206	3.6
Coconut pulp	46		7	
Coconut	8,135		1,883	
Tung	8,515		2,475	
Others	20,240		3,841	
Essential oil	710	0.1	3,756	1.7
Hide & leather	4,529	0.4	9,425	4.1
Forest products	227,583	17.6	17,893	7.9
Textiles	109,310	8.5	79,727	35.1
Cotton lint & fiber	109,153		78,740	
Others	157		987	
Typical handicrafts	182,199	14.1	8,851	3.9

Source : Anuario Estadístico del Paraguay 1986, DGEC, MH, 1987

**Table S4.2.6 Import Volume and Value, 1986**

Product	Volume		Value	
	Ton	%	1,000US\$	%
Total	703,052	100.0	583,243	100.0
Food stuff	65,428	9.3	15,499	2.6
Beverage & tobacco	17,077	2.4	38,307	6.6
Oil & derivatives	320,173	45.5	93,561	16.0
Ceramics, asphalt & constr. mat.	95,151	13.5	8,175	1.4
Glass products	4,678	0.7	2,774	0.5
Paint & related products	1,321	0.2	2,320	0.4
Cosmetics	2,809	0.4	9,155	1.6
Fertilizer, pesticide, pharmaceutical	56,275	8.0	38,019	6.5
Iron, copper & other metals	43,410	6.2	39,776	6.8
Machinery & tools	8,665	1.2	45,814	7.9
Medical instruments	145	0.0	1,967	0.3
Watch & clock	1,191	0.2	11,690	2.0
Electrical tool, material & parts	19,745	2.8	84,174	14.4
Automobile & other vehicles	9,554	1.4	42,441	7.3
Wood, cork & basket	374	0.1	303	0.1
Paper & cardboard	15,385	2.2	9,676	1.6
Rubber & its products	4,693	0.7	10,548	1.8
Plastic & its products	13,137	1.9	10,801	1.9
Textiles	4,081	0.6	11,502	2.0
Shoes & hats	1,642	0.2	3,613	0.6
Other products	18,118	2.5	103,128	17.7

Source : Anuario Estadístico del Paraguay 1986, DGEC, MH, 1987

Table S4.2.7 1988 Budget for the Central Government

	Million current G.	% of total	% by Branch	% Current Expenses	% Capital Expenses
Central Government	250,680	100.0		71.8	28.2
Legislative Branch	923	0.4	100.00	97.4	2.6
Senators	315		34.13	100.0	0.0
Deputies	608		65.87	96.1	3.9
Executive Branch	155,217	61.9	100.00	74.3	25.7
Presidency of the Republic	872		0.56	90.5	9.5
Ministry of the Interior	22,042		14.20	95.3	4.7
Ministry of Foreign Relations	3,041		1.96	99.2	0.8
Ministry of Finance	5,410		3.49	87.0	13.0
Ministry of Education & Cult	31,937		20.58	92.2	7.8
Ministry of Agriculture	10,875		7.01	81.9	18.1
Ministry of Public Works & Communications	29,163		18.79	18.7	81.3
Ministry of National Defense	33,955		21.86	87.4	12.6
Ministry of Public Health & Social Welfare	14,225		9.16	63.6	36.4
Ministry of Justice & Labor	2,843		1.83	86.6	13.4
Ministry of Industry & Commerce	791		0.51	99.5	0.5
Ministry of Without Portfolio	21		0.01	100.0	0.0
Council of State	42		0.03	100.0	0.0
Judicial Branch	3,067	1.2		83.0	17.0
Other Obligations	91,473	36.5		66.8	33.2

Source : Law 1277, December 4, 1987

Table S4.2.8 1988 Budget for Decentralized (Autonomous) Institutions

	Million current G.	% of total	% Current Expenses	% Capital Expenses
Decentralized Institutions	604,058	100.0	46.4	53.6
Education	6,872	1.1	79.0	21.0
Asuncion National University	6,872		79.0	21.0
Social Security	40,520	6.7	77.2	22.8
Social Security Institute	29,356		89.7	10.3
Retirement Funds	10,770		44.6	55.4
National Institute for Indians	394		37.9	62.1
Development Promotion	176,523	29.2	11.8	88.2
Public Corporations	314,495	52.1	66.0	34.0
Other Institutions	65,648	10.9	22.9	77.1
Central Bank of Paraguay	13,482		81.1	18.9
National Labor Bank	52,166		7.9	92.1

Source : Law 1277, December 4, 1987

**Table S4.2.9 Estimated Government Revenue Sources for 1988**

		Million G.	% Total	% Group	% Sub- group
I	Central Government	250,848	29.2	100.0	
	Ordinary resources	208,904		83.3	100.0
	Customs tax	21,308			10.2
	Internal (domestic) taxes	81,413			39.0
	Alcohol tax	10,615			5.1
	Consular fees	3,888			1.9
	Sales tax	21,051			10.1
	Specific tax	1,323			0.6
	Income tax	33,999			16.3
	Real estate tax	7,300			3.5
	Postal fees	251			0.1
	Retirement & pension	11,860			5.7
	Various revenues	15,896			7.6
	Special accounts	14,579		5.8	
	Foreign loans	26,412		10.5	
	Grants	952		0.4	
II	Decentralized institutions	608,563	70.8	100.0	
	Education	6,872		1.1	
	Social security institute	42,162		6.9	
	Development promotion	177,166		29.1	
	Public corporations	316,172		52.0	
	Other institutions	66,191		10.9	
III	Total	859,411	100.0		

Source : Law 1277, Dec. 4, 1987



Table S4.2.10 1988 Budget for Decentralized Public Corporations

	Million current G.	% of total	% Current Expenses	% Capital Expenses
Decentralized Public Corporations	314,495	100.00	66.0	34.0
State Merchant Fleet	11,160	3.55	58.2	41.8
CORPOSANA (Water & Sewerage)	12,691	4.04	46.6	53.4
ANTELCO (Telephone & Telegraph)	39,731	12.63	43.5	56.5
APAL (Alcoholic beverage)	20,953	6.66	55.0	45.0
National Railroad	1,830	0.58	55.8	44.2
National Ports Administration (ANNP)	8,991	2.86	24.3	75.7
Paraguayan Airlines (international)	47,993	15.26	88.2	11.8
National Airport Administration	1,427	0.45	87.9	12.1
National Airlines (domestic)	273	0.09	71.1	28.9
ANDE (electricity)	55,791	17.74	37.4	62.6
National Cement Industry (portland)	25,857	8.22	59.6	40.4
SIDEPAR (steel)	627	0.20	17.1	82.9
PETROPAR (oil refinery)	87,172	27.72	95.0	5.0

Source : Law 1277, December 4, 1987

Table S4.2.11 Housing Type by Department

	Paraguay			Cordillera Dept.			Paraguari Dept.			Central Dept.		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Houses												
Total (%)	100.0	45.9	54.1	100.0	27.3	72.7	100.0	22.5	77.5	100.0	61.2	38.8
Room per House	2.9	3.6	2.3	2.3	3.0	2.0	2.3	3.2	2.0	2.7	3.1	2.2
Housing Type (%)												
Independent	96.6	93.0	99.5	99.4	98.6	99.8	99.8	99.3	99.9	97.5	96.5	99.2
Others	3.4	7.0	0.5	0.6	1.4	0.2	0.2	0.7	0.1	2.5	3.5	0.8
Housing Materials (%)												
Wall												
Brick	47.5	73.1	25.8	60.0	84.2	51.0	52.9	79.0	45.3	84.4	89.1	77.0
Board	29.5	19.1	38.2	2.9	2.5	3.0	5.3	4.6	5.5	5.7	6.5	4.5
Roof												
Tile	46.1	71.7	24.3	41.8	74.7	29.5	37.3	69.8	27.9	76.1	85.0	62.1
Straw	34.6	10.6	55.0	55.9	22.5	68.5	59.6	25.6	69.5	12.8	3.5	27.4
Floor												
Brick	20.9	26.6	16.0	39.6	59.8	32.0	35.3	55.8	29.3	33.5	30.5	38.3
Tile	17.2	34.7	2.4	3.6	10.5	1.0	3.6	12.8	0.9	26.5	36.7	10.5
Dirt	44.5	17.0	67.9	52.3	23.1	63.3	57.2	25.3	66.4	24.3	16.1	37.1

Source : Censo Nacional de Poblacion y Viviendas 1982, DGEC, MH, Junio 1986

Table S4.2.12 Services Available to Households by Department

Unit : %

Services	Paraguay			Cordillera Dept.			Paraguari Dept.			Central Dept.		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Sanitation												
Sewerage (Public)	9.5	20.6	-	0.6	2.1	-	0.4	1.6	-	2.3	3.8	-
Sewerage (other)	16.8	30.7	5.0	10.0	25.5	4.2	9.6	26.7	4.6	42.8	56.0	22.0
Municipal latrine	14.9	15.6	14.3	14.6	26.0	10.3	14.9	23.8	12.4	14.8	13.7	16.4
Common latrine	56.0	30.3	77.7	72.7	44.5	83.3	72.3	46.7	79.8	38.6	25.4	59.3
None	2.9	2.8	3.1	2.2	1.8	2.3	2.8	1.3	3.2	1.5	1.0	2.3
Bath &/or Shower												
Exclusive	53.9	72.5	38.1	33.6	58.8	24.2	34.8	64.3	26.2	62.0	70.3	48.9
Shared	5.5	8.8	2.7	2.9	5.9	1.8	3.4	7.3	2.2	7.8	9.8	4.6
None	40.6	18.7	59.2	63.5	35.3	74.1	61.8	28.4	71.6	30.2	19.9	46.5
Electricity												
Connected	38.8	75.2	8.0	20.7	60.1	5.9	15.8	59.4	3.1	64.7	82.5	36.8
Not connected	61.2	24.8	92.0	79.3	39.9	94.1	84.2	40.6	96.9	35.3	17.5	63.2
Waste Disposal												
Collection service	13.7	29.8	-	2.4	8.9	-	0.4	1.6	-	13.2	21.6	-
Burying	76.2	63.8	86.6	87.8	88.0	87.7	90.1	95.3	88.5	82.9	75.5	94.6
Other	10.2	6.4	13.4	9.8	3.0	12.3	9.6	3.1	11.5	3.9	2.9	5.4
Water supply												
Well or Spring	68.7	44.8	88.9	84.0	56.0	94.5	90.5	80.3	93.4	62.0	45.4	88.2
Rain Water	2.1	2.0	2.1	1.7	3.8	1.0	1.8	3.9	1.2	2.1	2.3	1.8
River & Stream	4.9	2.7	6.7	3.0	2.7	3.1	4.5	3.4	4.8	1.4	1.1	1.8
Public system	20.5	43.3	1.1	9.2	31.7	0.7	3.1	11.0	0.5	22.0	32.9	4.9
Other	3.8	7.0	1.1	2.1	5.8	0.7	0.1	0.5	0.0	12.5	18.3	3.3

Source : Censo Nacional de Poblacion y Viviendas 1982, DCEC, MH, Junio 1986

**Table S4.4.1 Summary of Population in Lake Ypacarai Basin**

Catchment Area	Population	Percentage (%)	Involved Districts
Ⓟ Arroyo Pirayú Basin	25,157	12.1	Paraguari, Pirayú, Ypacarai, Yaguarón, Itá and Itaiguá
Ⓡ East Coast Basin	6,065	2.9	San Bernardino.
Ⓜ West Coast Basin	13,664	6.6	Ypacarai, Areguá and Itaiguá
Ⓨ Arroyo Yuquyry Basin	162,440	78.4	Itá, Areguá, Itaiguá, Capiatá, San Lorenzo, Fdo. de la Mora and Luque.
Total	207,326	100	Total 12 districts

Note : Estimation based on Census Data of 1982

Table S4.4.2 Population by District and by Sub-basin of the Arroyo Pirayú Basin

BASIN		POPULATION (NO. OF PERSONS)														TOTAL
CATCH- MENT AREA	SUB- BASIN	PARA- GUARI	PIRAYU	YPACA- RAI	YAGUA- RON	ITA	SAN- BERNAR- DINO	AREGUA	ITAUGUA	CAPIATA	SAN LORENZO	FDO. DE LA MORA	LUQUE	LIMPIO	EMBOS- CADA	TOTAL
②	P1	1,185														1,185
	P2	322														322
	P3	155														155
	P4															-
	P5	286														286
	P6	692														692
	P7	216														216
	P8	134														134
	P9	44														44
	P10	63	148													211
	P11		296													296
	P12	241	96													337
	P13			117												117
	P14	37	553													590
	P15			174												174
	P16			248												248
	P17		296													296
	P18		2,647			84										2,731
	P19		251													251
	P20		247													247



Table S4.4.3 Population by District and by Sub-basin of the East Coast Basin

BASIN		POPULATION (NO. OF PERSONS)														
CATCH- MENT AREA	SUB- BASIN	PARA- GUARI	PIRAYU	YPACA- RAI	YAGUA- RON	ITA	SAN- BERNAR- DINO	AREGUA	ITAUGUA	CAPIATA	SAN LORENZO	FDO. DE LA MORA	LUQUE	LIMPIO	EMBOS- CADA	TOTAL
⑥ East Coast Basin	E1						35									35
	E2						288									288
	E3						297									297
	E4						363									363
	E5						172									172
	E6						153									153
	E7						465									465
	E8						412									412
	E9						431									431
	E10						1,017									1,017
	E11						950									950
	E12						646									646
	E13						97									97
	E14						318									318
	E15						84									84
	E16						-									-
	E17						337									337
<b>TOTAL</b>							6,065									6,065

Table S4.4.4 Population by District and by Sub-basin of the West Coast Basin)

BASIN		POPULATION (NO. OF PERSONS)																
		CATCH- MENT AREA	SUB- BASIN	PARA- GUARI	PIRAYU	YPACA- RAI	YAGUA- RON	ITA	SAN- BERNAR- DINO	AREGUA	ITAUGUA	CAPIATA	SAN LORENZO	FDO. DE LA MORA	LUQUE	LIMPIO	EMBOS- CADA	TOTAL
⊗  West Coast Basin	W1				1,233						515							1,748
	W2				1,463													1,463
	W3										510							510
	W4										328							328
	W5										703							703
	W6										676							676
	W7										482							482
	W8										713	129						842
	W9										680							680
	W10										699							699
	W11										5,533							5,533
TOTAL					2,696					7,625	3,343						13,664	



Table S4.4.5 Population by District and by sub-basin of the Arroyo Yuquyry Basin

BASIN		POPULATION (NO. OF PERSONS)														
CATCH- MENT AREA	SUB- BASIN	PARA- GUARI	PIRAYU	YPACA- RAI	YAGUA- RON	ITA	SAN- BERNAR- DINO	AREGUA	ITAUGUA	CAPIATA	SAN LORENZO	FDO. DE LA MORA	LUQUE	LIMPIO	EMBOS- CADA	TOTAL
① Arroyo Yuquyry Basin	Y1					175		956	15,702							16,833
	Y2					164			6,734	7,147						14,045
	Y3									16,579						16,579
	Y4							2,690		2,332						5,022
	Y5									16,246	20,246					36,492
	Y6										31,325	7,965				39,290
	Y7												6,191			6,191
	Y8										2,375			4,708		7,083
	Y9													11,287		11,287
	Y10													3,117		3,117
	Y11								3,287					3,264		6,551
TOTAL					339			6,933		44,629	51,571	7,965	28,567			162,440

Table S4.4.6 Population by Administrative Districts (Annex)

Source: Dirección Gral. de Est. y Censos.

DISTRICTS	1962			1972			1982		
	TOTAL	URBAN.	RURAL	TOTAL	URBAN.	RURAL	TOTAL	URBAN.	RURAL
	PARAGUARI	13,028	4,880	8,148	13,767	5,036	8,731	13,644	6,592
PIRAYU	10,871	2,753	8,118	10,923	2,698	8,225	11,905	3,308	8,597
YPACARAI	10,102	5,281	4,821	10,454	5,195	5,259	12,057	5,719	6,338
YAGUARON	17,904	2,763	14,331	19,306	3,368	15,938	21,301	4,476	16,825
ITA	23,863	6,265	17,598	25,146	7,041	18,105	28,419	9,311	19,108
SAN BERNARDINO	5,093	570	4,523	5,613	949	4,664	6,591	2,247	4,344
AREGUA	10,287	3,699	6,588	11,209	3,941	7,268	14,558	5,177	9,381
ITAUUGUA	17,645	3,064	14,581	20,233	3,767	16,466	25,959	5,382	20,517
CAPIATA	20,892	2,062	18,830	26,444	2,827	23,617	44,629	4,456	40,173
SAN LORENZO	18,573	8,593	9,980	36,965	11,616	25,349	74,552	74,552	1/
FDO. DE LA MORA	14,519	10,194	44,325	36,834	36,834	1/	66,597	66,597	1/
LUQUE	30,834	11,008	19,826	40,493	13,921	26,572	64,288	25,896	38,392
LIMPIO	10,126	1,438	8,688	12,761	2,219	10,542	16,036	3,288	12,748
EMBOSCADA	5,902	1,040	4,862	6,651	1,222	5,429	6,976	1,876	5,100
TOTAL	208,829	63,610	145,219	276,799	100,634	176,165	407,512	218,877	188,635

(1/ By law, all the municipal area is considered urban area)

Table S4.4.7 Heads of Livestock in Lake Ypacarai Basin

Catchment Area	Cow	Pig	Horse	Sheep	Goat	Donkey	Mule	Total Catch-area	Percentage (%)	Remarks
Ⓐ Arroyo Pirayu Basin	25,404	3,711	1,209	1,234	101	49	64	31,772	(39.22)	
Ⓑ East Coast Basin	2,040	434	60	65	1	2	-	2,602	(3.21)	
Ⓒ West Coast Basin	5,064	1,744	205	54	50	24	5	7,146	8.82)	
Ⓓ Arroyo Yuquyry Basin	28,561	8,722	1,343	408	310	98	56	39,498	(48.75)	
Total	61,069	14,611	2,817	1,761	462	173	125	81,018	(100)	

NOTE : Estimation based on Census Data of 1981

Table S4.5.1 Summary of Land Use Area of Lake Ypacarai Basin (1988)

Unit: Km<sup>2</sup>

Catchment Area	Forest	Dry grass area	Wet or shallowly flooded area	Pasture	Culti-vated	Lake, Lagoon, etc.	Urban	Total Catch. area	Remarks
Ⓐ Arroyo Pirayu Basin	64.82	0.79	13.11	176.52	78.51	1.81	18.14	353.70 (42.5)	Catchment Areas of Lake Ypacarai
Ⓔ East Coast Basin	19.75	0.15	0.98	20.54	21.71	0.29	11.78	75.20 (9.0)	
Ⓝ West Coast Basin	13.00	1.60	1.05	21.33	13.49	0.09	9.64	60.20 (7.2)	
Ⓨ Arroyo Yuquyry Basin	20.10	1.21	16.40	83.77	126.80	--	95.62	343.90 (41.3)	
Total Land use	117.67 (14.1)	3.75 (0.4)	31.54 (3.8)	302.16 (36.3)	240.51 (28.7)	2.19 (0.3)	135.18 (16.2)	833 (100%)	( ) Percentage
Total Area of Lake Ypacarai Basin 833Km <sup>2</sup> (100%)									

**Table S4.5.2 Sub-basin Area of Lake Ypacarai Basin (1988)**

Arroyo Pirayu Basin		East Coast Basin		West Coast Basin		Arroyo Yuquyry Basin	
Ⓐ	Area (Km <sup>2</sup> )	Ⓔ	Area (Km <sup>2</sup> )	Ⓖ	Area (Km <sup>2</sup> )	Ⓕ	Area (Km <sup>2</sup> )
P <sub>1</sub>	20.10	E <sub>1</sub>	2.30	W <sub>1</sub>	8.60	Y <sub>1</sub>	59.60
P <sub>2</sub>	9.90	E <sub>2</sub>	5.30	W <sub>2</sub>	8.50	Y <sub>2</sub>	63.90
P <sub>3</sub>	3.90	E <sub>3</sub>	6.30	W <sub>3</sub>	4.20	Y <sub>3</sub>	45.90
P <sub>4</sub>	0.00	E <sub>4</sub>	6.30	W <sub>4</sub>	1.60	Y <sub>4</sub>	28.10
P <sub>5</sub>	8.10	E <sub>5</sub>	2.30	W <sub>5</sub>	8.10	Y <sub>1</sub>	29.80
P <sub>6</sub>	21.90	E <sub>6</sub>	1.20	W <sub>6</sub>	4.30	Y <sub>6</sub>	24.20
P <sub>7</sub>	24.30	E <sub>7</sub>	7.90	W <sub>7</sub>	2.70	Y <sub>7</sub>	8.50
P <sub>8</sub>	13.40	E <sub>8</sub>	3.40	W <sub>8</sub>	6.70	Y <sub>8</sub>	11.50
P <sub>9</sub>	3.90	E <sub>9</sub>	1.00	W <sub>9</sub>	2.70	Y <sub>9</sub>	12.90
P <sub>10</sub>	16.30	E <sub>10</sub>	4.40	W <sub>10</sub>	3.90	Y <sub>10</sub>	7.10
P <sub>11</sub>	10.50	E <sub>11</sub>	3.10	W <sub>11</sub>	8.90	Y <sub>11</sub>	52.40
P <sub>12</sub>	6.90	E <sub>12</sub>	12.50				
P <sub>13</sub>	2.10	E <sub>13</sub>	2.70				
P <sub>14</sub>	3.70	E <sub>14</sub>	4.20				
P <sub>15</sub>	8.60	E <sub>15</sub>	1.70				
P <sub>16</sub>	13.70	E <sub>16</sub>	0.80				
P <sub>17</sub>	6.70	E <sub>17</sub>	9.80				
P <sub>18</sub>	8.10						
P <sub>19</sub>	5.20						
P <sub>20</sub>	9.90						
P <sub>21</sub>	8.00						
P <sub>22</sub>	17.90						
P <sub>23</sub>	28.10						
P <sub>24</sub>	4.70						
P <sub>25</sub>	16.60						
P <sub>26</sub>	8.00						
P <sub>27</sub>	8.30						
P <sub>28</sub>	10.60						
P <sub>29</sub>	7.80						
P <sub>30</sub>	3.50						
P <sub>31</sub>	3.90						
P <sub>32</sub>	1.30						
P <sub>33</sub>	10.80						
P <sub>34</sub>	4.60						
P <sub>35</sub>	15.60						
P <sub>36</sub>	6.80						
<b>TOTAL</b>	<b>353.70</b>	<b>TOTAL</b>	<b>75.20</b>	<b>TOTAL</b>	<b>60.20</b>	<b>TOTAL</b>	<b>343.90</b>

**Table S4.5.3 Land Use Areas by Type of Use and by Sub-basin  
of the Arroyo Pirayú Basin (1988)**

BASIN		LAND USE AREAS (Km <sup>2</sup> )							
CATCH- MENT AREA	SUB- BASIN	FOREST	DRY	WET	PASTURE	CULTI- VATED	LAKE, LAGOON, ETC.	URBAN	TOTAL
Arroyo Pirayú Basin	P <sub>1</sub>	5.13	0.05	0.85	7.70	3.50	0.11	2.76	20.10
	P <sub>2</sub>	2.50	0.06	-	6.00	1.22	-	0.12	9.90
	P <sub>3</sub>	0.05	-	-	3.63	0.09	0.08	0.05	3.90
	P <sub>4</sub>	-	-	-	-	-	-	-	0.00
	P <sub>5</sub>	1.20	0.02	-	1.30	5.26	-	0.32	8.10
	P <sub>6</sub>	4.00	0.02	-	11.91	5.02	-	0.95	21.90
	P <sub>7</sub>	8.17	0.03	0.20	9.70	6.10	-	0.10	24.30
	P <sub>8</sub>	3.52	-	-	9.73	0.07	0.08	-	13.40
	P <sub>9</sub>	0.25	-	0.12	3.48		0.05	-	3.90
	P <sub>10</sub>	5.40	-	0.21	9.37	1.11	0.11	0.10	16.30
	P <sub>11</sub>	1.10	0.04	0.14	8.65	0.17	0.20	0.20	10.50
	P <sub>12</sub>	0.40	-	0.14	2.11	3.75	-	0.50	6.90
	P <sub>13</sub>	0.30	-	0.18	1.22	0.20	-	0.20	2.10
	P <sub>14</sub>	0.60	-	-	1.60	1.30	-	0.20	3.70
	P <sub>15</sub>	3.50	-	-	2.60	2.30	-	0.20	8.60
	P <sub>16</sub>	4.50	-	-	5.67	3.38	-	0.15	13.70
	P <sub>17</sub>	0.50	-	0.06	5.60	0.28	0.16	0.10	6.70
	P <sub>18</sub>	0.80	0.03		0.47	5.60	-	1.20	8.10
	P <sub>19</sub>	-	-	0.33	3.75	0.72	0.20	0.30	5.20
	P <sub>20</sub>	1.40	-	0.03	6.20	1.65	0.12	0.50	9.90

**Table S4.5.3 (continued) Land Use Areas by Type of Use  
and by Sub-basin of the Arroyo Pirayú Basin (1988)**

BASIN		LAND USE AREAS (Km <sup>2</sup> ) (1988)							
CATCH- MENT AREA	SUB- BASIN	FOREST	DRY	WET	PASTURE	CULTI- VATED	LAKE, LAGOON, ETC.	URBAN	TOTAL
Arroyo Pirayú Basin	P <sub>21</sub>	2.80	-	0.10	3.30	1.80	-	-	8.00
	P <sub>22</sub>	2.80	-	0.25	11.30	3.20	0.10	0.25	17.90
	P <sub>23</sub>	2.80	0.26	0.02	13.35	9.65	0.02	2.00	28.10
	P <sub>24</sub>	0.20	-	-	3.87	0.47	0.06	0.10	4.70
	P <sub>25</sub>	1.20	-	1.00	4.00	9.60	-	0.80	16.60
	P <sub>26</sub>	1.20	-	0.50	5.47	0.50	-	0.33	8.00
	P <sub>27</sub>	1.20	0.10	0.65	1.15	2.70	-	2.50	8.30
	P <sub>28</sub>	1.40	0.03	0.49	5.10	3.22	0.10	0.26	10.60
	P <sub>29</sub>	1.40	0.07	0.07	4.70	0.96	-	0.60	7.80
	P <sub>30</sub>	0.10	0.08	0.30	2.30	0.09	0.08	0.55	3.50
	P <sub>31</sub>	0.10	-	0.10	3.40	0.02	0.08	0.20	3.90
	P <sub>32</sub>	-	-	0.03	1.27	-	-	-	1.30
	P <sub>33</sub>	2.00	-	-	4.50	3.10	0.10	1.10	10.80
	P <sub>34</sub>	0.40	-	0.54	2.82	0.04	-	0.80	4.60
	P <sub>35</sub>	2.60	-	3.10	7.60	1.44	0.16	0.70	15.60
	P <sub>36</sub>	1.30	-	3.80	1.70	-	-	-	6.80
TOTAL		64.82	0.79	13.11	176.52	78.51	1.81	18.14	353.70

**Table S4.5.4 Land Use Areas by Type of Use and by Sub-basin  
of the East Coast Basin (1988)**

BASIN		LAND USE AREAS (Km <sup>2</sup> )							
CATCH- MENT AREA	SUB- BASIN	FOREST	DRY	WET	PASTURE	CULTI- VATED	LAKE, LAGOON, ETC.	URBAN	TOTAL
② East Coast Basin	E <sub>1</sub>	0.10	-	-	0.68	-	0.03	1.49	2.30
	E <sub>2</sub>	1.10	-	-	1.95	2.24	-	0.01	5.30
	E <sub>3</sub>	1.40	-	-	1.80	2.90	-	0.20	6.30
	E <sub>4</sub>	0.80	0.15	0.20	3.02	0.88	0.15	1.10	6.30
	E <sub>5</sub>	0.25	-	-	1.25	0.35	0.11	0.34	2.30
	E <sub>6</sub>	0.10	-	-	0.25	0.10	-	0.75	1.20
	E <sub>7</sub>	1.90	-	-	1.10	2.90	-	2.00	7.90
	E <sub>8</sub>	0.80	-	-	0.13	1.30	-	1.17	3.40
	E <sub>9</sub>	0.30	-	-	0.34	-	-	0.36	1.00
	E <sub>10</sub>	1.10	-	-	0.45	1.05	-	1.80	4.40
	E <sub>11</sub>	1.00	-	-	0.45	0.43	-	1.22	3.10
	E <sub>12</sub>	3.90	-	0.08	4.50	2.85	-	1.17	12.50
	E <sub>13</sub>	1.30	-	0.12	1.14	-	-	0.14	2.70
	E <sub>14</sub>	1.50	-	-	1.20	1.47	-	0.03	4.20
	E <sub>15</sub>	0.90	-	-	0.40	0.40	-	-	1.70
	E <sub>16</sub>	0.10	-	0.25	0.37	0.37	-	-	0.80
	E <sub>17</sub>	3.20	-	0.33	4.47	4.47	-	-	9.80
<b>TOTAL</b>		19.75	0.15	0.98	20.54	21.71	0.29	11.78	75.20



**Table S4.5.5 Land Use Area by Type of Use and by Sub-basin  
of the West Coast Basin (1988)**

BASIN		LAND USE AREAS (Km <sup>2</sup> )							
CATCH- MENT AREA	SUB- BASIN	FOREST	DRY	WET	PASTURE	CULTI- VATED	LAKE, LAGOON, ETC.	URBAN	TOTAL
West Coast Basin	W <sub>1</sub>	0.30	-	0.15	2.36	3.85	0.09	1.85	8.60
	W <sub>2</sub>	1.50	0.20	0.20	4.75	0.50	-	1.35	8.50
	W <sub>3</sub>	1.40	-	0.45	2.20	0.10	-	0.05	4.20
	W <sub>4</sub>	0.40	0.03	0.03	1.00	0.14	-	-	1.60
	W <sub>5</sub>	2.00	1.30	0.06	2.54	1.70	-	0.50	8.10
	W <sub>6</sub>	1.20	-	0.10	1.60	1.00	-	0.40	4.30
	W <sub>7</sub>	0.20	-	-	2.00	0.05	-	0.45	2.70
	W <sub>8</sub>	2.10	-	-	1.70	2.30	-	0.60	6.70
	W <sub>9</sub>	0.20	-	-	1.20	0.70	-	0.60	2.70
	W <sub>10</sub>	1.80	-	0.06	0.50	0.70	-	0.84	3.90
	W <sub>11</sub>	1.90	0.07	-	1.48	2.45	-	3.00	8.90
TOTAL		13.00	1.60	1.05	21.33	13.49	0.09	9.64	60.20

**Table S4.5.6 Land Use Areas by Type of Use and by Sub-basin  
of the Arroyo Yuquyry (1988)**

BASIN		LAND USE AREAS (Km <sup>2</sup> )							
CATCH- MENT AREA	SUB- BASIN	FOREST	DRY	WET	PASTURE	CULTI- VATED	LAKE, LAGOON, ETC.	URBAN	TOTAL
Arroyo Yuquyry Basin	Y <sub>1</sub>	1.40	0.05	1.00	9.35	37.90	-	9.90	59.60
	Y <sub>2</sub>	2.90	0.30	1.30	14.80	34.60	-	10.00	63.90
	Y <sub>3</sub>	2.20	-	0.30	15.00	10.90	-	17.50	45.90
	Y <sub>4</sub>	2.40	0.10	0.30	4.20	15.50	-	5.60	28.10
	Y <sub>5</sub>	0.50	0.05	0.10	9.15	1.00	-	19.00	29.80
	Y <sub>6</sub>	1.00	0.40	0.30	4.20	0.90	-	17.40	24.20
	Y <sub>7</sub>	0.20	-	-	2.60	0.90	-	4.80	8.50
	Y <sub>8</sub>	0.90	0.03	0.20	5.60	3.60	-	1.17	11.50
	Y <sub>9</sub>	1.90	0.05	-	2.40	2.70	-	5.85	12.90
	Y <sub>10</sub>	0.70	0.03	-	0.87	4.70	-	0.80	7.10
	Y <sub>11</sub>	6.00	0.20	12.90	15.60	14.10	-	3.60	52.40
<b>TOTAL</b>		20.10	1.21	16.40	83.77	126.80	-	95.62	343.90

Table S4.5.7 Summary of Land Areas of Lake Ypacarai Basin (1965)

CATCHMENT AREA	LAND USE AREAS (Km <sup>2</sup> )							Total Catch. Area	REMARKS
	FOREST	DRY	WET	PASTURE	CULTIVATED	LAKE, LAGOON ETC	URBAN		
Ⓐ Arroyo Pirayú Basin	24.52	-	10.70	120.20	71.26	-	5.22	* 231.90	Catchment Areas of Lake Ypacarai
Ⓑ East Coast Basin	21.04	-	0.40	17.24	32.42	-	4.10	75.20	
Ⓒ West Coast Basin	12.50	-	0.80	15.65	28.20	-	3.05	60.20	
Ⓓ Arroyo Yuquyry Basin	11.81	-	6.40	61.40	219.15	-	45.14	343.90	
Total	69.87	-	18.30	214.49	351.03	-	57.51	711.2	* not included sub-basin P <sub>1</sub> to P <sub>10</sub>
LAND AREA ACCORDING TO 1965 AEROPHOTO - 711.2Km <sup>2</sup>									

**Table S4.5.8 Land Use Areas by Type of Use and by Sub-basin  
of the Arroyo Pirayú Basin (1965)**

BASIN		LAND USE AREAS (Km <sup>2</sup> )								
CATCH- MENT AREA	SUB- BASIN	FOREST	DRY	WET	PASTURE	CULTI- VATED	LAKE, LAGOON, ETC.	URBAN	TOTAL	REMARKS
Arroyo Pirayú Basin	P <sub>1</sub>									Not inclu- ded
	P <sub>2</sub>									
	P <sub>3</sub>									
	P <sub>4</sub>									
	P <sub>5</sub>									
	P <sub>6</sub>									
	P <sub>7</sub>									
	P <sub>8</sub>									
	P <sub>9</sub>									
	P <sub>10</sub>									
	P <sub>11</sub>	0.60	-	-	9.90	-	-	-	10.50	
	P <sub>12</sub>	-	-	-	6.90	-	-	-	6.90	
	P <sub>13</sub>	-	-	0.15	1.95	-	-	-	2.10	
	P <sub>14</sub>	0.80	-	0.15	2.95	0.35	-	0.05	3.70	
	P <sub>15</sub>	2.52	-	-	1.00	5.00	-	0.08	8.60	
	P <sub>16</sub>	5.20	-	-	4.50	4.00	-	-	13.70	
	P <sub>17</sub>	0.70	-	0.20	5.55	0.25	-	-	6.70	
	P <sub>18</sub>	0.50	-	-	0.40	6.53	-	0.67	8.10	
	P <sub>19</sub>	-	-	0.03	4.37	0.60	-	0.20	5.20	
	P <sub>20</sub>	1.30	-	0.03	6.40	1.92	-	0.25	9.90	

**Table S4.5.8 (continued) Land Use Areas by Type of Use  
and by Sub-basin of the Arroyo Pirayú Basin (1965)**

BASIN		LAND USE AREAS (Km <sup>2</sup> )								
CATCH- MENT AREA	SUB- BASIN	FOREST	DRY	WET	PASTURE	CULTI- VATED	LAKE, LAGOON, ETC.	URBAN	TOTAL	REMARKS
Arroyo Pirayú Basin	Ⓟ P21	2.10	-	-	2.40	3.50	-	-	8.00	
	P22	1.50	-	0.10	10.00	6.30	-	-	17.90	
	P23	1.50	-	0.50	11.70	13.70	-	0.70	28.10	
	P24		-	-	4.40	0.30	-	-	4.70	
	P25	2.10	-	-	2.90	11.40	-	0.20	16.60	
	P26	1.00	-	-	6.00	0.90	-	0.10	8.00	
	P27	0.30	-	-	3.00	3.80	-	1.20	8.30	
	P28	1.10	-	0.45	5.30	3.70	-	0.05	10.60	
	P29	0.80	-	-	3.80	3.08	-	0.12	7.80	
	P30	-	-	0.14	3.14	0.10	-	0.12	3.50	
	P31	-	-	-	3.74	0.08	-	0.08	3.90	
	P32	-	-	-	1.30	-	-	-	1.30	
	P33	1.90	-	-	4.95	3.95	-	-	10.80	
	P34	-	-	0.25	3.55	-	-	0.80	4.60	
	P35	1.80	-	3.40	8.60	1.80	-	0.60	15.60	
	P36	-	-	5.30	1.50	-	-	-	6.80	
	TOTAL		24.52	-	10.70	120.20	71.26	-	5.22	231.90