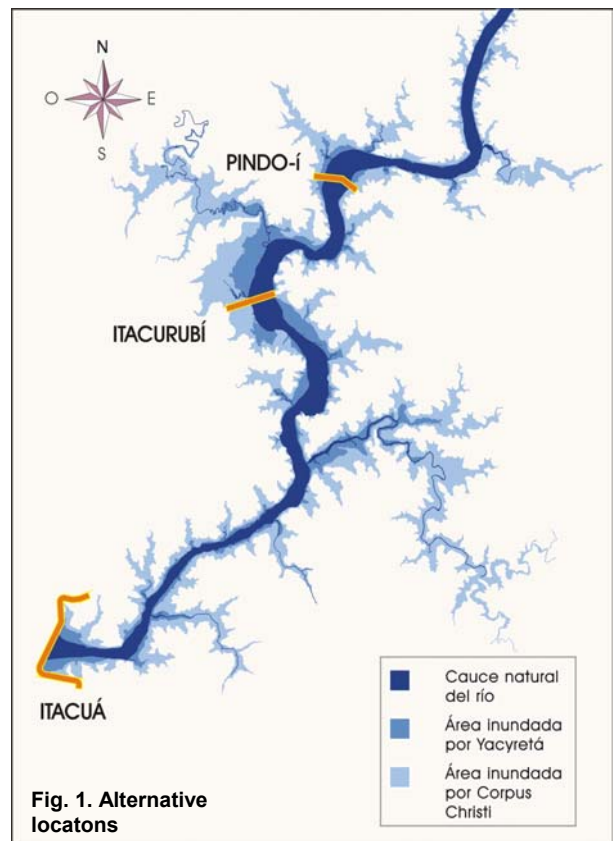


EXECUTIVE SUMMARY ¹

The studies carried out about the different locations (Fig. No. 1) for the Corpus Christi multi-purpose dam lead to the following conclusions:

Main conclusions from the study

- The Corpus Christi Project has lower environmental impacts than other hydroelectric works in the region, as the flooded area is comparatively smaller and a very small amount of population is affected.
- Globally considering the project in its different locations, its benefits outnumber its undesired effects. These effects may be mitigated without significant difficulties, by applying known and proved technologies and procedures that are available to the project. The Project implies an interesting opportunity to improve the region's economic and social situation through employment generation, economy activation and royalty collection, these aspects being highly relevant for the current socioeconomic context.
- From the environmental point of view, the best enclosure alternative is Pindo-í, as it results in low impacts on the natural and social environment. On the comparison bases adopted for this study, in this location the project would allow to achieve the benefits of the works with the lower number of undesired effects.
- The affected area² at Pindo-í is 13,966 ha, at Itacurubí 17,430 ha and at Itacuí 28,371 ha. Therefore, many environmental impacts detected for Pindo-í are lower than at Itacurubí. When compared with the above locations, environmental impacts at the Itacuí site are more significant.
- The impact on population is low. Works at Pindo-í affect only 281 families. At Itacurubí the figure rises to 382 and at Itacuí it involves 805 families.



¹ The information provided in this Executive Summary may be consulted in the 4 (four) volumes that make up the Corpus Christi Project Environmental Impact Assessment.

² Affected traverse for a 45,000 m³/s discharge plus security belt, adopted for the technical-economic feasibility studies.

- As regards affected property, infrastructure and services, estimated replacement costs vary for the enclosure alternatives: approximately USD 50 million at Pindo-í, 65 at Itacurubí and 140 at Itacua³ ⁴.
- The river section in the Project area is heavily modified by the Itaipú (upstream) and Yacyretá (downstream) dams. Current fishery resources are very different from the resources existing twenty or thirty years ago. Overfishing and the low efficiency of control systems over both banks have contributed to the deterioration of this resource.
- The Corpus Christi project includes multiple systems for fish transfer; two fish breeding stations will be built in the region, improving new resources for the area.
- From the environmental point of view, Pindo-í location:
 - Does not significantly increase the risk of new diseases of water origin. It is, in turn, a chance to improve health infrastructure in the area.
 - It implies a lower risk of water quality deterioration, particularly at sub-reservoirs.
 - It causes the lowest increase in gas oversaturation (additional 4%), whereas Itacua increases current values in an additional 9% (cumulative impact), with risk of fish mortality downstream Yacyretá.
- Enclosure at Pindo-í is the Project alternative with the lowest impact on gallery forests. With this enclosure, only 6% of the total existing gallery forests are lost (4,000 ha out of a total 70,000 ha).
- Enclosure at Itacurubí results in the loss of 10% of the gallery forests (7,000 ha), and with the enclosure at Itacua the impact covers 24% of the existing stock (17,000 ha).
- Enclosure at Pindo-í seldom affects the natural systems considered as a whole (gallery forests, native forests and pasture lands). With this enclosure, only 4% of the total existing stock is lost (6,000 ha out of a total 135,000 ha). Enclosure at Itacurubí increases the loss to a 7% (10,000 ha), and at Itacua the loss of natural ecosystems is about 15% (20,000 ha) of the existing stock.
- The impact on native communities of the Corpus Christi project at Pindo-í is not significant. These communities usually dwell at high topographic levels, located outside the Paraná River historical flood area. Therefore the impact, if any, involves part of the outreach area of these communities (an area of wide and scarcely defined borders) but not their houses.
- The enclosure at Pindo-í would affect only one native community (35 people), the enclosure at Itacurubí, two, and the enclosure at Itacua would affect five native communities.

³ The appraisal values applied are shown in the main body of the study.

⁴ The Corpus Christi Project will reduce the waterfall at Itaipú and Urugua-í. This is not considered a negative impact on these projects, as Corpus Christi was part of their future scenarios when these works were conceived.

- Due to the size of the work, the designated as new and renewable energy sources (wind, thermal solar or photovoltaic systems, fuel cells) cannot substitute for the Corpus Christi project (for comparison purposes, annual power and energy generation are estimated around 3,000 MW and 20,000 GWh respectively). On the other hand, weather conditions in the area are not appropriate for the contingent development of the most important ones (solar and wind).
- The only other viable energy alternative in the region was a thermal power plant. When the region's mid and long term energy needs are discussed, the Corpus Christi Project and the Alternative Project (Thermal power plant) appear as complementary instead of competitive projects.
- Corpus Christi offers the chance to get low-cost energy in the region to foster industrial activities. Completion of the project will result in a substantial impact on the economy growth rates of both riverbanks, expressed as an increase in their Gross Product. This does not imply an automatic benefit for local population, which will require organization in order to take advantages of the opportunities provided by the Project.
- Estimated royalties for the license period represent a yearly amount of USD 40 million for each riverbank. By the end of the license period, the project yields a yearly flow of over USD 300 million for each riverbank, fully available for the Republic of Paraguay and the Argentine Republic, which could in turn decide to fully allocate those resources to the Misiones Province.
- Local communities believe that the employment activation resulting from the works will have an important effect on the region's labor market. In order to maximize this benefit and in compliance with the issues agreed upon by both countries in the "*General guidelines for the concretion of the Corpus Christi project*", the local workforce should be trained to meet the project requirements.

Purpose of the study

In this first phase, the purpose of the Environmental Impact Assessment was to assess, at a *pre-feasibility level*, the environmental and socioeconomic impacts of the Corpus Christi Project at its Itacurubí and Pindo-í sites, and to develop a comparison parameter for the Itacua site through a prompt assessment of the environmental and socioeconomic impacts, based on the information and studies available at the COMIP. During Phase III, an *Environmental Management Plan* for the alternative selected at the feasibility level will be designed.

For the discussion of environmental impacts the following has been considered:

- The *area under direct impact*, that is, the one physically affected by the project's construction and operation activities, including the *area to be flooded by the dam* for a 45,000 m³/s swelling in the Paraná River, using the impact traverse defined for Corpus Christi as safety area, and other areas that according to analysis would receive a direct impact.
- To evaluate the impacts on the natural environment, the *flooded by the dam* area was estimated up to the elevation level derived from the current 14,400 m³/s mean discharge (hydrological series 1971 - 2002) in the Paraná River.

The Corpus Christi Project

The Paraná River Joint Committee (COMIP for its Spanish acronym) was created on June 16, 1971 by an agreement between the Argentine Republic and the Republic of Paraguay, with the purpose of performing the *study and evaluation of the technical and economic possibilities for the exploitation of the Paraná River resources in the border section between both countries, from its confluence with the Paraguay river to the Iguazú river mouth.*

In May 2000, the Argentine and Paraguay governments signed a Memorandum of Understanding, stating their intention to carry out the project through a license contract to be awarded to private investors, and appointing the COMIP to perform the necessary preliminary studies.

Between both dates, the Corpus Christi project has been the subject of a series of pre-feasibility, feasibility and executive project studies,⁵ where several alternative locations were discussed; the sites of *Itacuá* (Km post 1.597), *Itacurubí* (Km post 1.642) y *Pindo-í* (Km post 1.658) were pre-selected from them.

In these locations the Project was designed to achieve four main purposes:

- Electric power generation
- Navigation improvement
- Development of commercial and sports fishing
- Promotion of tourism and other related recreational activities

The Itacuá site was developed at *executive project* level in 1983; it was designed for an installed power of 4,600 MW and an average annual energy production of 20,100 GWH. This site had the required physical conditions for the provision of *peak energy*.

During the '90, deregulation of electricity markets and the development of new fossil fuel reservoirs (particularly natural gas in Argentina) caused significant decreases in energy prices, with a further decreasing trend. En this context, both countries' governments decided to carry out the project *only* through license, with the contribution of private funds.

In this new framework, the Corpus Christi project had to be *adapted* to make it competitive and attractive to private investors. The most important adaptation aimed at reducing the number of turbines, in a first stage, to reach a 2,880 MW power. This resulted in a thousand million dollars reduction for the project at Itacuá, but it turned out that in these conditions, the Itacurubí and Pindo-í locations could be equally attractive.

In April 1996, the Misiones citizens (left bank) stated their rejection to the Project by means of a plebiscite.

In this context, in 1996 the Argentine delegation to the COMIP requested⁶ the assessment of the Itacurubí and Pindo-í alternative sites, located upstream from Itacuá, with the purpose of evaluating their technical and economic pre-feasibility.

⁵ Lahmeyer - Harza y Asociados Consortium 1975 – 1983. Assessment of Paraná River use in the section between the Iguazú River mouth and the Encarnación – Posadas section, with particular focus on Corpus area.

⁶ Studies performed by Knight Piésold and Partners. Corpus Christi Hydroelectric Project Pindo-í and Itacurubí Pre-Feasibility Study. 1997

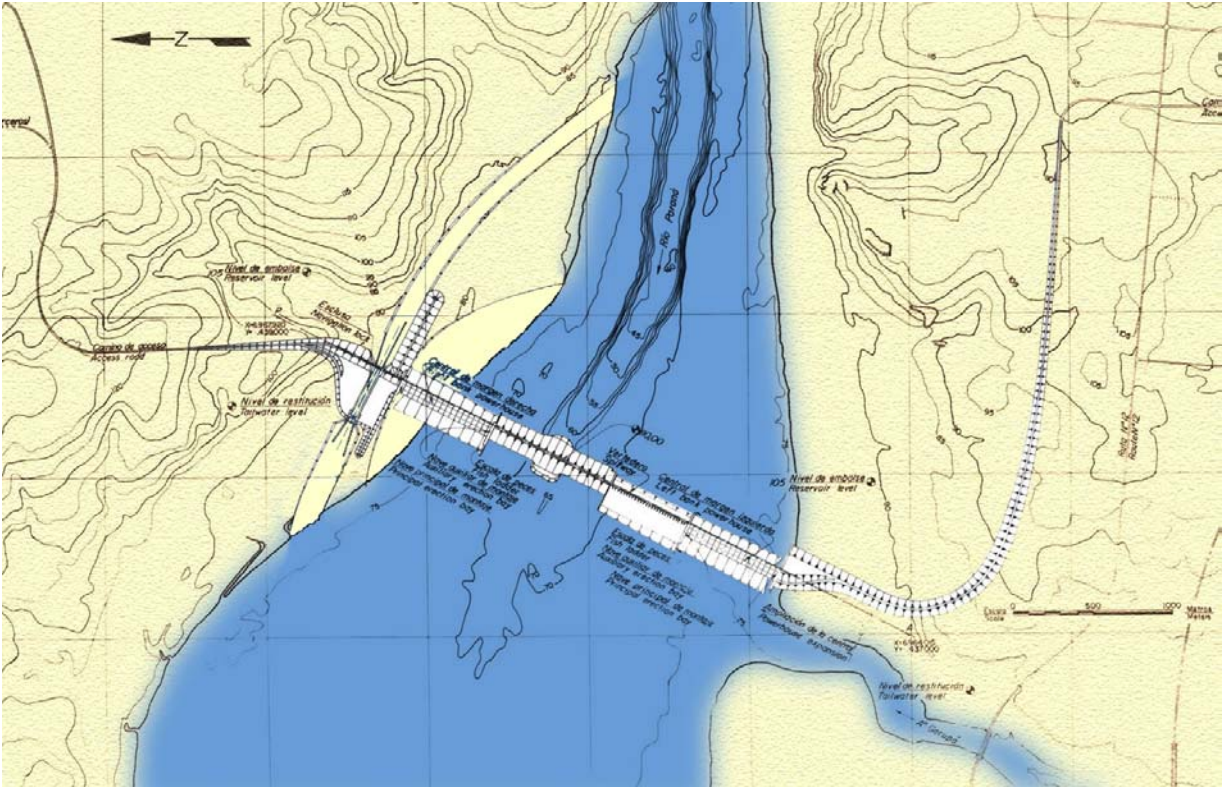


Fig. No. 2. Enclosure at Itacuí

Itacuí project: The Itacuí site is located at km 1597 in the Paraná River, immediately upstream the Garupá stream mouth, near the cities of Encarnación and Posadas.

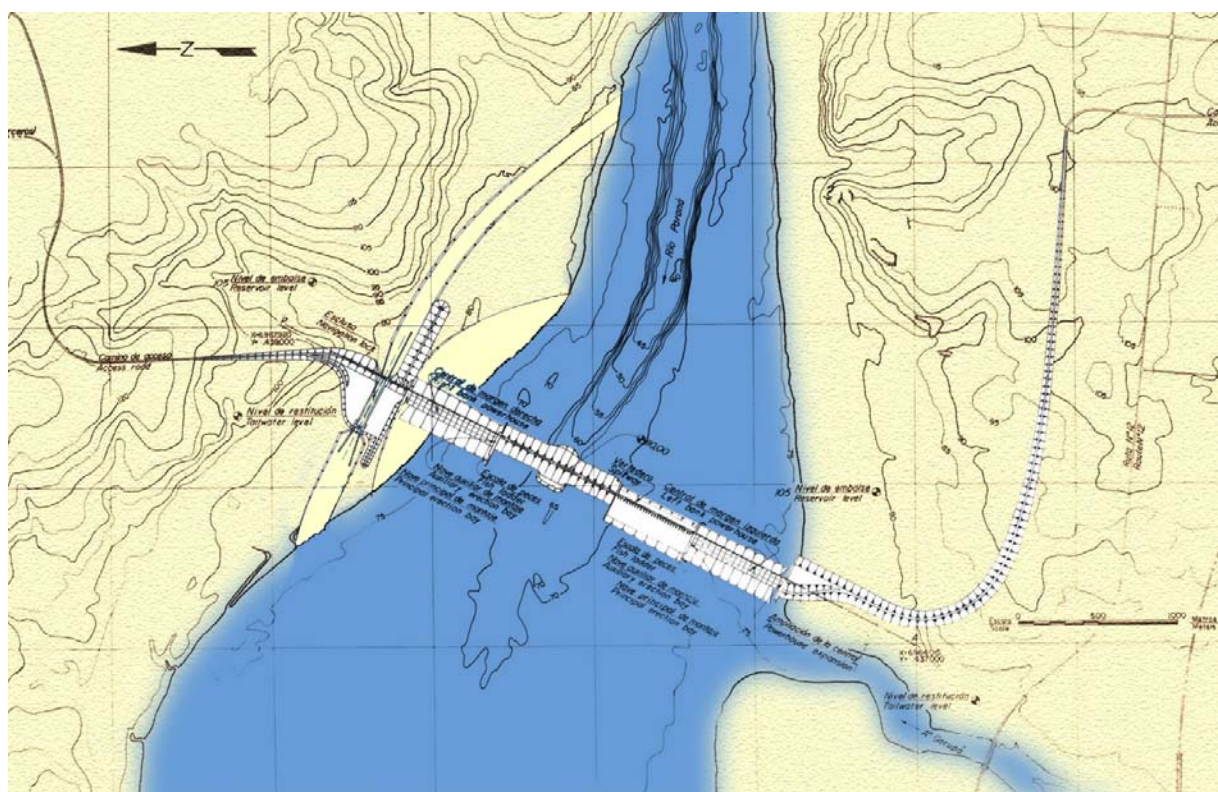


Fig. No. 3. Enclosure at Itacurubí – Kaplan turbines option

Itacurubí Project: The Itacurubí site is located at km 1642 in the Paraná River, 45 km upstream from Itacuí. Two options were evaluated:

The Itacurubí with Bulbo turbines option: Two power plants, each equipped with 24 generators in modules of six, Bulbo type, 60 MW power. Total installed power (initial) is 2,880 MW.

The Itacurubí with Kaplan turbines option: Two power plants, each one equipped with 10 Kaplan groups, with 144 MW power each, totaling, like in the previous option, 2,880 MW.

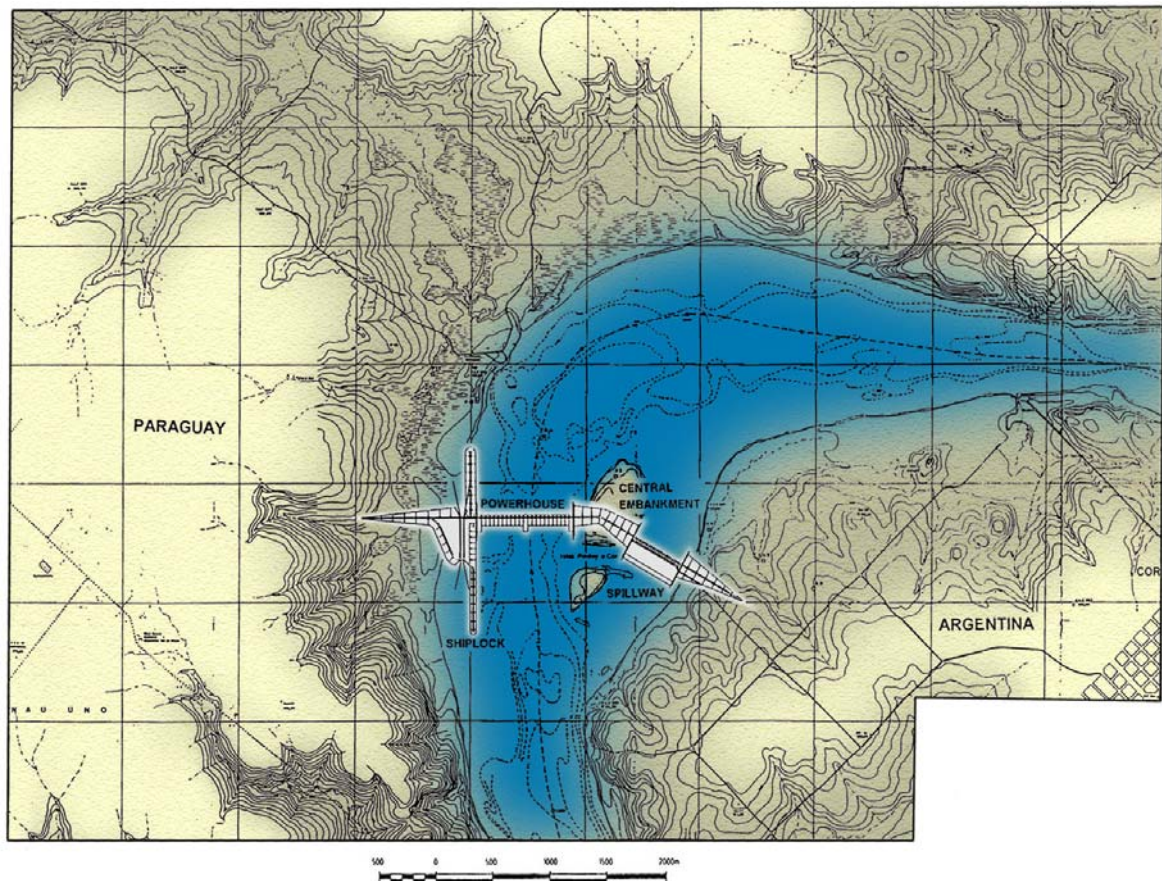


Fig. No. 4. Enclosure at Pindo - í

Pindo - í Project: The Pindo-í site is located at km 1658 in the Paraná river, 61 km upstream from Itacúa and 16 km from Itacurubí. It consists of a single equipment housing located in the central area of the riverbed, equipped with 20 144 MW Kaplan turbines, for a total 2,880 MW.

Every option includes a multiple-type fish transfer system.

Area under study

The area under study⁷ is enclosed by the Yacyretá reservoir at the Encarnación / Posadas axis (on the South), the Itaipú dam (North), the No. 6 Road in Paraguay (West), the No. 12 National Road in the Argentine province of Misiones (East), and it includes adjacent areas that had to be considered on account of indirect impacts related to the Project.

From the territorial jurisdiction point of view, it involves two riverside departments in the Republic of Paraguay (right bank): Itapúa and Alto Paraná, including the Encarnación, Cambyretá, Nueva Alborada, Trinidad, Hohenau, Obligado, Bella Vista, Pirapó, Capitán Meza, Natalio, Yatytay, San Rafael del Paraná, Carlos Antonio López, Mayor Otaño, Ñacunday , Domingo M. de Irala, Los Cedrales, Presidente Franco, Ciudad del Este and Hernandarias districts.



Fig. No. 5. Regional location of the area under study

⁷ Project area of influence

In the Argentine Republic (Left Bank) it involves the following municipal districts⁸: Esperanza, Libertad, Wanda, Puerto Iguazú, Colonia Victoria, Colonia Delicia, Eldorado, Capioví, El Alcázar, Garuhapé, Puerto Leoni, Puerto Rico, Caraguatay, Montecarlo, Puerto Piray, Colonia Polana, Corpus, General Urquiza, Gobernador Roca, Jardín América, San Ignacio and Santo Pipó.

The climate is warm, humid subtropical type, and not very harsh. Annual average temperature is 20°-21°C, lowering towards Northeast due to the increase in height. Occasionally, minimum temperatures of almost -7° C or maximum temperatures of 41 °C may occur. Frosty days are unusual, particularly near the Paraná River. Rains are uniform, there is no dry season. Rains reach 1,500 mm per year, with slight peaks in spring and fall. Predominant winds blow from the East, and to a lesser degree, from the South and North.



Fig. No. 6. Area under study

⁸ Some theme areas include the Candelaria and Capital departments in the analysis, which were affected by the location in Itacuí.

The Paraná River

The Paraná is one of the most abundant rivers in South America. Current discharge at the Posadas - Encarnación axis is 14,400 m³/s with significant variations of mean discharges. Extreme mean values have been recorded for a maximum monthly mean discharge of 39,009 m³/s (June 1983) and a minimum monthly mean discharge of 4,062 m³/s (October 1944).

The discharge series for the 1901-2002 period shows an increasing trend for mean discharges, mainly resulting from the extreme values of the 1982-83 and later years swellings. Estimated maximum probable swelling (MPS) is 95,000 m³/s. Intermediate basin water contribution⁹ is scarcely significant, as it represents between 3% and 7% of the Paraná discharge at Posadas.

Total sediment load, estimated at Posadas in 6,541,000 t/year (7.68 Hm³ / year), shows that volume reductions at the reservoirs will not exceed 5% in 50 years; these very low values do not compromise project's life at any of its locations. Sedimentation will result in small banks at the mouth of tributary streams, but on account of the water surface height at these mouths, it will have no significant effects on runoff.

Judicial and institutional framework

The review of the judicial and institutional framework at both riversides as a part of this study ranged from municipal and national regulations to international treaties with bi-national, regional and international scope. It aimed at knowing and comparing the legislation and regulations currently in force with regard to environmental impact assessments, land property and condemnation, population re-location and other related issues.

A comparative table of existing regulations was made¹⁰, applicable to the international section, with the purpose of getting an overview of the points of coincidence and possible voids in legislation. In general, no significant legal voids were found. Legislation of both countries covers every essential aspect of the issues dealt with by the study.

Field Surveys

An evaluation at pre-feasibility level of the project-related impact on population, natural systems, protected areas, cultural heritage, native communities, housing and industrial facilities, infrastructure and public services was performed.

A detailed field survey covering the whole affected area was carried out for that purpose. On the right bank, the field survey included the Itacuí - Itacurubí section, with the same level of definition as the others.

⁹ Paraná tributaries between the Iguazú river mouth and the Encarnación - Posadas axis.

¹⁰ It is included in full in the Legal Chapter of this report.

The magnitude of the impact resulting from the *different enclosure alternatives* was preliminarily determined with the purpose of *establishing basic reference* values for its contingent compensation or relocation.

The scope and depth of the studies and the accuracy of these estimations are limited by the *pre-feasibility* level at which the environmental impact assessment was performed. Nevertheless, the quality of the survey exceeds the conditions set forth in the study, and allows assuring that the impact quantifications are highly representative of the current situation in the area under study.

Cartography from the COMIP, aerial photographs, satellite images, special low altitude aerial surveys, and survey with watercraft along the whole section were used. Work scales ranged from 1:10,000 a 1: 50,000.

Meeting and seminars were held with local stakeholders, and notes requiring information on population, infrastructure or locations of interest that in principle could be affected by the Project were sent to every municipality, riverside district, national and provincial agencies and NGOs.

Surveys were performed on the main ecological systems and protected areas, sites of conservation interest, sites of tourism interest and water falls; tributary streams were also surveyed and fishermen polls were carried out.

Cadastral survey on both riversides included data as: Owner, household groups, main uses, infrastructure, land uses, facilities and harbors. Independent survey commissions were created on each bank, with national personnel residing in the affected area, which ensured previous knowledge of the region and the language of the interviewed inhabitants. The lots were accessed by land, and in poor road infrastructure areas, by water.

All the surveyed sites were positioned by GPS and included in the Geographic Information System (GIS, ArcView release 3.2.) to confront them with the flood line caused by the reservoir's different alternatives. This allowed the accurate identification of the affected sites.

The Geographic Information System (GIS) with all the study information was delivered to the COMIP as an ideal tool to systematize, organize, process and manage data having a geographic component particularly relevant for the analysis. The GIS allows to organize information in theme layers, and to link each element in the theme layer to its related information. With this tool the COMIP is able to incorporate complementary information (from new studies) to its database, and to reprocess the information to meet its future needs for new results and conclusions.

Main Project environmental impacts

As mentioned, the Environmental Impact Assessment was carried out at a *pre-feasibility level*, considering Yacyretá dam's elevation at its final operation level as base backwater elevation and as Corpus Christi operation elevation, the 105 m a.s.l. level in the dam and its related upstream backwater.

To determine the impacts on the *natural environment* (riverside woods, pasture lands) the mean discharge rate was used ($Q = 14,400 \text{ m}^3/\text{s}$), whereas for the impacts on the *social* (families, housing, native communities) and *economic environment* (infrastructure, productive units, tourism areas) the impact traverse defined for Corpus Christi, drawn over a $45,000 \text{ m}^3/\text{s}$ swelling was used.

Any environmental or social item included between Corpus Christi impact line and Yacyretá impact line was deemed *affected* by the Project.

Local people's opinion and participation was crucially important during the process of identification and assessment of environmental impacts. Their contribution allowed the incorporation into the study of local viewpoints, sensitive issues and expectations.

Local authorities played a fundamental role throughout the study. Governors and mayors, in their capacity of democratic representatives of each location, acted as qualified informants regarding issues of particular local interest. They contributed to the study by providing social and environmental information regarding their towns, asking at all times that the Environmental Impact Assessment included their expectations and sensitive issues.

Having the appropriate contractual framework provided by the COMIP's Terms of Reference was also very important. Its modern conception for approaching the issue and its design in compliance with the latest international recommendations¹¹ allowed the development of the job in a participation environment, which made it possible to include the interested parties' opinions from the beginning of the study, and focus the efforts towards the environmental and social issues of higher local interest.

The affected area

Corpus Christi is a multi-purpose hydroelectric project that, in relative terms, has a very small affected area compared to its energy production. However, the alternative enclosures discussed in this study result on environmental effects of different magnitude.

Downstream Pindo-í, the reservoir has a higher lateral development, mostly related to its tributaries' flood. It is in this area where the most important environmental and social problems occur.

¹¹ Dams and Development A New Framework for Decision-Making Final Report of the World Commission on Dams. WCD, 2000.

Table 1 shows the relationship between flooded area and energy production. (as a comparison basis). Comparisons made when explaining the impacts in the table are based on a unit value for the Pindo-í location.

	Installed Capacity (MW) (Base)	Affected area (ha)	Average Annual Energy Generation Capacity (GWh) ¹²	Affected Area / Average Annual Energy (ha/GWh)
Pindo-í	2.880	13.966	20.175	0,69
Itacurubí	2.880	17.430	20.625	0,85
Itacuá	2.880	28.371	21.358	1,33
Itaipú	12.600	120.000	80.000 ¹³	1,50
Yacyretá	3.000	92.000	20.700	4,44
Urugua-í	120	8.840	355	24,90
Acaray	210	59.900	993	60,32

Table No. 1. Affected area vs. average annual generation ratio for different projects in the region.

Corpus Christi at Pindo - í, originates a relatively small lake. The affected area covers 13,966 ha, approximately 10% of the area affected by Itaipú and 15% of the area affected by Yacyretá.

If the area affected to produce 1 GWh is measured, compared to similar projects Corpus Christi's low environmental cost is remarkable. So Corpus Christi at Itacuá affects almost twice the territory affected by Pindo-í per generated GWh. In turn, Yacyretá , Urugua-í and Acaray show respective values 6, 37 and 87 times higher than Pindo-í.

¹² Given the relative importance of these comparisons, the average annual energy adopted corresponds to a base operation, with the discharge series from year 1971, as this one is the most representative of current conditions in the basin and the most probable in the future.

¹³ Year 2001 data

Social and economic aspects

Social situation in the area under study is difficult, on account of the economic crisis the region has been suffering for years. The future seems scarcely promising for the next years, as structural issues contributing to restrict the economic and social progress appear in both riversides:

- A very high (and increasing) percentage of the population is below the poverty line.
- Poverty is closely related to a low level of education.
- A highly unequal income distribution persists.
- A very high unemployment rate persists.
- The region's long recession cycle shows no sign of recovery.
- There is a pronounced precariousness in work relationships, and a low level of retirement and health coverage.

Enquiries show that the population is sensitized towards the Project. In every visited town a highly favorable opinion towards the Project was detected, from the general public as well as from municipal and provincial authorities and governors.

Everybody points out that the project is necessary for the region, but indicates that the following should be considered:

- That the negative experiences resulting from other dams built in the area (arbitrary decisions, lack of consultation to and participation of inhabitants and non-performance of agreed upon terms) are prevented.
- That political priority is given for the prompt performance of complementary works (housing and infrastructure for population relocation), before dam completion.
- Environmentalist NGOs from the left bank strongly reject the Corpus Christi Project. Their arguments make no distinctions between locations, as the Project in itself is deemed inconvenient.
 - ⇒ They state that the Misiones citizens have already expressed their opinions through the 1996 plebiscite, resulting in a negative to the construction of the Project.
 - ⇒ Specifically, they have concerns on issues like fish transfer systems and the impact on gallery forest (relict), even without knowing whether relict forests may be conserved in the long term in the event the Project is not built.
 - ⇒ They point out that political decisions being made lack proper planning for social and environmental management, and that no research supports these aspects.

- Right Bank NGOs do not fully share the left bank organizations' point of view. No irreconcilable opposition towards the project has been detected. Appropriate studies and an adequate environmental management are demanded.

Local communities feel that the employment activation resulting from the works will have an important effect on the region's labor market.

In this context, the Project effects on the social and economic components of the region are perceived as highly positive in the short and mid term. The benefits of the project exceedingly outnumber the undesired effects, which in turn may be easily mitigated.

In Paraguay (RB) the Gross Domestic Product average annual growth rate could increase between a minimum 7% and a maximum 53% as a result of the project¹⁴.

The effect is similar in Misiones (LB). When discussing the importance of Corpus Christi investment with regards to the provincial Gross Geographic Product, it appears that the investment is approximately 40% of the GGP in pesos, and 145% of the GGP if currently measured in dollars¹⁵.

Based on the above, the project's socioeconomic impact will be higher in a low growth scenario like that of the region. In this respect, the project might act as a neutralizing element for recession and economic stagnancy.

As indicated at the beginning, estimated royalties for the license period represent a yearly amount of USD 40 million for each riverbank.

By the end of the license period, the project yields a yearly flow of over USD 300 million for each riverside, fully available for the Republic of Paraguay and the Argentine Republic, which could in turn decide to fully allocate those resources to the Misiones Province; this would increase both economies' capital, as shown in following table where the permanent value of this capital flow is calculated.

¹⁴ GDP growth rate would rise from 0.7% per year to 1.07% (53% rise) in a slow growth scenario like the current one, or from 4.5% to 4.83% per year (7% rise) in a high growth scenario.

¹⁵ In dollars at BCRA buying exchange rate: ARS 3.47 per dollar (May 2002).

Concept	Amounts in USD million			
	Itacurubí		Pindo-í	Itacuá
	Bulbo	Kaplan	Kaplan	Kaplan
Energy sales estimated income	682	682	667	706
Estimated net income (after operating, maintenance and environmental management costs)	649	647	634	668
Interest rate	10,0%			
Permanent capital value	6.487	6.472	6.339	6.679
Permanent capital value (50%) by river bank	3.243	3.236	3.170	3.340

Table No. 2. Permanent capital value by the end of the license agreement.

The impact on population is low, as shown in table No. 3:

Location	Bank	Total affected families/houses	Total affected people
PINDO – Í	Right	176	921
	Left	105	450
	Total	281	1371
ITACURUBÍ	Right	267	1375
	Left	115	491
	Total	382	1866
ITACUÁ	Right	454	2263
	Left	351	1062
	Total	805	3325

Table No. 3. Impact on houses and population.

The low level of impact is related to a relatively small flooded area. With only 281 affected families, Pindo-í location has the lowest negative impact.

Table No. 4 shows the affected areas on each riverside.

Location	Bank	Corpus Christi Affected Area (ha)
PINDO – Í	Right	7.880,3
	Left	6.085,3
	Total	13.965,6
ITACURUBÍ	Right	10.597,3
	Left	6.832,7
	Total	17.430,0
ITACUÁ	Right	13.125,3
	Left	15.245,4
	Total	28.370,7

Table No. 4. Affected areas on each riverside as per impact traverse.

With regard to the impact on property, infrastructure and services, replacement costs differ for the enclosure alternatives, as shown in table No. 5: ¹⁶

Enclosure	Bank	Land (USD)	Land improvement (USD)	Port Facilities, Industries, Infrastructure and Services (USD)	Total (USD)
PINDO – I	Right	9.439.856	3.361.008	13.222.022	26.022.886
	Left	5.426.491	5.116.212	12.272.100	22.814.803
	Total	14.866.347	8.477.220	25.494.122	48.837.689
ITACURUBÍ	Right	12.879.639	4.842.784	19.245.382	36.967.805
	Left	6.419.715	6.734.367	14.342.000	27.496.082
	Total	19.299.355	11.577.152	33.587.382	64.463.889
ITACUÁ	Right	16.223.880	7.184.047	19.704.282	43.112.209
	Left	15.677.416	26.439.439	53.777.100	95.893.955
	Total	31.901.296	33.623.487	73.481.382	139.006.165

Table No. 5. Impact on land, improvements, infrastructure and services by riverbank

¹⁶ The Mean Market Values method was used. November 2001 land and renovation prices in USD with relation to local currencies were used for both riversides. USD 1 = PYG 4,643 (Source Republic of Paraguay Central Bank) and USD 1\$S = ARP 1 (Source Argentine Republic Central Bank). Appraisal values are included in the main body of the study.

The Environmental Management Plan to be designed on Phase III of the study includes the following aspects:

- Management Program for Development Technical and Credit Assistance
- Local Tourism Promotion Program
- Municipal, Business and Social Consultant Services Program
- Work Training for Affected Population Program
- Community Communication Program
- Functional Replacement of Work Supply Program
- Housing Replacement Program
- Industrial Infrastructure Replacement Program
- Road Infrastructure Replacement Program
- Service Infrastructure Replacement Program
- Port Infrastructure Replacement Program
- Program for Promotion of Reservoir Recreational Usage

Costs resulting from implementation of the Environmental Management Plan Programs, both during dam construction and operation stages, shall be borne by the Licensee and shall be included in their total Project costs.

Health

Current health situation is not optimal in the Project area. Both on the left and right banks, health systems are pronouncedly insufficient and do not meet local demand. This situation results from last years lack of investment in the health area; the trend shows no signs of reversal on account of the deteriorating economic situation in both countries.

Regional economic crisis consistently causes an increase in population's vulnerability to diseases, particularly poverty-related ones like vector-borne diseases or those of water origin. In the next years, on account of population growth and the transference of users from the impoverished private sector (private hospitals), the demand for public health services will increase. Therefore a strong deficit in health services and an increasing risk of poverty-related pathologies can be expected in the near future.

The Project's Environmental Management Plan will include resources to strengthen the local health services. This aims at preventing an excessive demand resulting from the population increase due to the dam construction (estimated at 8,000 people for construction peak) on a currently deficient infrastructure. Health care for personnel directly and indirectly involved in the Project shall be ensured. Improvements to health services will remain in the region once the Project is completed. Therefore the Corpus Christi Project means an opportunity to strengthen the local health services and improve the population's health care quality. It can be inferred that if the dam was not built, this opportunity would be lost and the region's health system would not be able to modify its trend to further deterioration.

With regard to the possible development of new diseases derived from the project, studies show that if Corpus Christi was built, the risk of development of diseases like schistosomiasis and malaria *could* be increased. Vectors for these diseases could find favorable conditions in the sub-reservoirs with low still water areas, like the ones to occur at Itacurubí (Capiibary stream) and Itacuá enclosures (Capiibary, Yabebyry, San Juan, Santa Ana streams).

In the event that the Corpus Christi dam was not built, *the area would not be risk-free for these diseases*. Both snails and mosquitoes currently exist in all the region's flooding areas, like stream basins, marshes and rice fields.

Therefore, the main risk factor to be controlled, independently from Corpus Christi project, is the border traffic of potential carriers which, in association with the sanitation systems deficit particular to the area, is the main factor of epidemiological risk. These are controllable diseases, but they require a comprehensive and epidemiological approach (vectors, carrier population, sanitation systems) to prevent that they spread in the region. Prevention and control mechanisms are known and viable for the Corpus Christi project.

As main actions to be considered from the epidemiological and public health perspective to prevent and/or mitigate the Project's effects, the Environmental Management Plan includes the following:

- Baseline design: accurate and updated description of the social and health condition of the region's population.
- Strengthening of the health care network: investment plan to recover and strengthen the health services public network in both countries.
- Development of integrated monitoring, supervision and epidemiological-environmental control systems: strengthening and development of alert and control devices for infectious-contagious diseases.
- Strengthening, horizontalization and coordination of vertical programs: considering risk criteria, particularly the programs focusing on most vulnerable groups, like mothers and children.
- Environmental sanitation: Extension of sewage and drinking water networks.

Water quality

The Paraná River has a remarkable capacity for dilution and self-depuration. As a consequence, successive samplings from the main stream channel show very good values of physical, chemical and bacteriological quality. There are, however, specific water quality problems near industrial discharges (scarce but of a high volume), near important urban centers (Encarnación and Posadas) or in low circulation tributary streams that receive discharges.

If the Corpus Christi reservoir was built, the quality of the Paraná water in the main stream channel would not be significantly modified, on account of the reservoir's high turnover rate. However, deterioration hazards might appear at the tributaries (sub-reservoirs) in the event of untreated waste discharges.

The three main sources of water pollution are agriculture (agrochemicals and pesticides), industry (chemicals, BOD, COD) and domestic sewage (BOD, bacteriological). If these waste discharges are reasonably controlled, the Paraná River will keep its water good quality, with or without the Corpus Christi works. Otherwise water quality may deteriorate in the future. The degree of deterioration will depend more on the rate of these waste discharges, particularly those related to the level of economic and industrial activity, than on the existence of the reservoir.

At present, specific untreated waste discharges are found, from the cellulose and paper industry (on the left bank) and agrochemicals and pesticides (mainly on the right bank) with high residual value that build up and concentrate in fish tissues.

The control of these waste discharges and of urban conglomerates that discharge into the waterways by a proper agricultural management of tributary basins and the installation of efficient sanitation systems in all industrial facilities is imperative. Provided this purpose is achieved, the Paraná River will continue to have very good water quality with or without the Corpus Christi dam.

The Pindo-í enclosure implies a lower risk of undesired changes to water quality. The reservoir volumes of downstream enclosures, Itacurubí and to a higher degree Itacuí, are higher, and therefore water residence time is longer. In addition, the more southern the enclosure is located the larger the inflow basin, both from agricultural origin and urban centers.

Considering the Project's contribution to the Paraná river gas oversaturation, the effects of which appear downstream Yacyretá, estimations show that an enclosure at Pindo-í increases saturation by 4% to present values, whereas at Itacuí the increase is almost 9%. Therefore the Pindo-í enclosure is the best alternative with regard to water quality.

Water quality environmental management shall include the following:

- Spillway design and operation criteria to minimize gas oversaturation
- Water quality monitoring program
- Gas oversaturation monitoring program
- Limnoperna fortunei monitoring program
- Macrophyte (water hyacinths, waterweeds) manual and mechanical removal

On the other hand, the Corpus Christi Project implies the opportunity to channel resources (direct or through royalties) from local governments to improve existing sanitation systems, build new ones and design management plans for hydrographic basins.

Fish fauna

In this section the Paraná River is heavily modified by the two large regional hydroelectric projects: *Itaipú* (upstream) and *Yacyretá* (downstream). This is an important aspect as current fishery resources are very different from the river resources twenty or thirty years ago. The most important change is found with large migrating fish, like dorados (*Salminus maxillosus*) and surubis (*Pseudoplatystoma coruscans* and *Pseudoplatystoma fasciatum*); their number has remarkably decreased on account of the restriction of their home range. Overfishing and the low efficiency of control systems over both banks have contributed to the deterioration of this resource.

At present, in the Encarnación and Posadas area the most captured species are the sábalo (*Prochilodus platensis*) and the boga (*Leporinus obtusidens*), whereas capture of dorados (*Salminus maxillosus*), surubis (*Pseudoplatystoma coruscans* and *Pseudoplatystoma fasciatum*) and pacús (*Colossoma mitrei*) is secondary. Capture of the most important species has heavily decreased in the last decade, with a further *declining trend*; it shows that the fishery resource's main economic and/or sport interest species are running the risk of being lost in the mid term.

In the Misiones harbors (left bank), the pacú, dorado and surubí captures, which in 1994 totaled 2700, 2300 and 4700 tons respectively, reached only 800, 300 and 800 tons respectively in 2000. In this context of fish resources heavily modified by pre-existing works, Corpus Christi's environmental impacts are scarcely significant in relative terms.

With proper management the Corpus Christi Project may be an opportunity to improve the situation. The resource's declining trend may be balanced by concrete actions along time.

The Corpus Christi reservoir can allow the development of new fishing related resources. Potential fish yield at Pindo-í and Itacurubí locations has been estimated by theoretical modeling as near 4 kg / ha per year. It shows an interesting potential that might allow the development of fishing related activities.

With regard to the dam "barrier effect", the Corpus Christi Project will incorporate fish transfer combined systems to allow upstream and downstream fish moves. Therefore, whether the works exist or not does not seem to determine the fish resource's future quality.

Actually the future status of this resource depends on a series of actions to be performed on the basin, to which the Corpus Christi Project could directly or indirectly contribute. For the resource to be properly managed, actions carried out at Corpus Christi, Yacyretá and those carried out by local authorities should be coordinated. Some of the required actions are the following:

- Installation of hydro-biological stations and monitor networks at the basin and tributary sub-basins levels.
- Improvement and preservation of tributary streams as strategic value sites for the spawning of species of interest.
- Installation of fish breeding stations for repopulation, and support of private fish breeding.
- Creation of the conditions for the development of commercial fish breeding as a new local economic activity.
- Creation of the conditions for the improvement of capture control systems.

Natural systems and protected areas

The Corpus Christi dam at any of its locations covers territories pertaining to the *Cerrado* provinces (called the Corrientes-Misiones-Paraguayan Fields) in a very small area downstream San Ignacio, and to the *Paraná Forest* in the rest of its coverage.

The Pindo - í site, but basically Itacurubí and to a higher degree Itacuá, are located where the *ecotone* begins¹⁷ between the *Paraná forest* and *Los Campos* phytogeographical district, which gives the territory a very special interest on account of the *tension zone* nature that all ecotone transition areas have, but particularly in this case where the transition goes from forest vegetation to pasture or straw lands.

In this transition area there is a phytogeographic unit called "*urunday woods*". Its ecological importance lies in the fact that these *ecotones* not only have both forest and field species, but also species specific to the transition area and restricted to it.

¹⁷ *Ecotone* is the transition zone between two ecosystems. It features biological species common to both ecosystems and a high *biodiversity*.

The Paraná basin acts as a bioclimate passage that allows tropical flora and fauna to move southward, up to the province of Buenos Aires (Argentina) At present its *passage* role has deteriorated on account of the division resulting from human activities advance.

Historically, human activities with a higher capacity for land transformation have been the following (in a decreasing order of importance):

- Selective wood extraction, particularly fine woods.
- Wide forest plantations with exotic species (Pinus sp, Eucaliptus sp).
- Industrial plantations (citrus fruits, tea, "yerba mate" [Ilex paraguarensis]), mainly on the left bank.
- Annual crops (soy, wheat, corn), mainly on the right bank.
- Construction of large hydroelectric projects.
- Extensive cattle breeding.

The analysis of the tendency for the next 50 years show that if transformation rate is constant, *relict* natural areas will progressively give in to the agricultural border expansion.

One of the main deteriorating factors is *rural poverty*. Marginal populations, forced to survive on the natural environment, are compromising the conservation of natural areas that they depend on.

There is a heavy deterioration of the genetic resources pertaining to these areas (particularly their fauna), as they provide the poorest population with proteins and fats.

On the left bank (LB) for instance, the native *tupí guaraní* population in the Moisés Bertoni Reservation is causing the *complete defaunation* of the reservation's area. Following this trend it is possible that by 2030 the reservation has become a *defaunated* ecosystem.

The substitution of native forest with agriculture or forestry rapidly extends over natural areas. On the left bank, the remaining native forest elimination rate for conversion into productive areas, is approximately 1300 ha per year. If this rate is kept constant, the remaining active forest in the left bank (LB) area under study could disappear in 50 years.

In this context, losses resulting from Corpus Christi Project are not significant in relative terms. Information processing with a *geographic information system* (GIS) allowed the accurate calculation of the main impact on natural systems resulting from the enclosure, as shown in table No.6:

Type of coverage	Impact caused by Itacuá		Impact caused by Itacurubí		Impact caused by Pindo - í		Stock in the area under study
	ha	%	ha	%	ha	%	ha
Gallery forest	16.960	24	7.344	10	4.226	6	70.139
Native forest	444	0,8	444	0,8	396	0,7	55.862
Pasture land	2.277	22	1.753	17	1.244	12	10.182
Rural	8.059	3,5	5.891	2,5	4.562	2	227.748

Table No. 6. Impact on different natural systems.

The Project alternative affecting the lowest amount of natural systems is the enclosure at Pindo-í. Corpus Christi at Pindo-í scarcely affects the gallery forests. With this enclosure only 6% of the existing gallery forests is lost (4,000 ha out of a total 70,000 ha).

The enclosure at Itacurubí affects about 10% of the existing gallery forests (7,000 ha). At Itacuá the impact is higher, since the loss of gallery forests reaches 24% (17,000).

Considering all natural systems as a whole (gallery forest, native forest and pasture lands), they are scarcely affected by Pindo-í enclosure, since only 4% of the current stock is lost (6,000 ha out of a total 135,000 ha), whereas at Itacurubí the loss reaches 7% (10,000 ha). The natural ecosystem loss at Itacuá is the highest one, as it reaches 15% (20,000 ha) of the total stock.

Corpus Christi backwater effect at the bottom of the Falls is not significant, since it has been estimated in about 4 m in mean water conditions (water level found 60% of the time). Bank flood is minimal (around 10 ha) as the steep lateral slopes prevent the reservoir from having lateral development. As the river bank at the bottom of the Falls is rocky and practically devoid of vegetation up to several meters from the water surface, the Iguazú National Park flora is not affected. This effect is equivalent for all Corpus Christi locations.

The rise of the water level will affect the San Martín island sand bank, which is used as a natural harbor for the boat that transports tourists to the island. At present, when the level rises as a result from rains on the basin or upstream reservoir operation, sailing to the island is interrupted since on account of the lack of docks and berths it becomes dangerous for the tourists. Other vessels (pneumatic boats or rubber rafts) will benefit from a safer and more extensive navigation.

Once the Corpus Christi Project is built the river will be deeper. Therefore the risk of collision with the bottom rocks (*bar*) is reduced. Boat crossing at high elevation levels would be facilitated if there was a berth in San Martín Island and another one on the coast. These berths were planned when the National Park license contract was awarded but they were never built. In this matter the Corpus Christi project is an opportunity to improve the Park's infrastructure.

Both on the left and right banks, the creation and conservation of natural protected areas (NPA) is of essence to compensate for the loss of natural areas resulting both from agriculture and exotic species forestation for the cellulose industry. In addition they could compensate the deterioration of the remaining natural areas (without a formal protection status) currently taking place in the region, as well as the impacts resulting from Corpus Christi.

In the present scenario of regional socioeconomic crisis, it is very difficult to incorporate new natural areas into the PNA systems, and even to properly maintain the already existing PNAs. As a consequence trends show that the degradation rate of *relict natural areas* is much faster than the inclusion into the PNA system. In this scenario the trend is a sustained and gradual reduction.

The Corpus Christi Project may mean an opportunity for the constitution of new reservation areas and the support of the existing ones throughout the exploitation period. This study proposes a ratio of 5 ha of new reservations per hectare of affected natural system, which means approximately a total 30,000 ha for new reservations for the Pindo-í alternative.

The main environmental management measures proposed in the study aim at specially considering the opportunities to set the following programs:

- Program for the creation and operation of new compensation reservations¹⁸
- Program for compensation and support of the protected areas affected by Corpus Christi¹⁹
- Environmental Awareness program
- Protected Natural Areas monitoring program.
- Valuable fauna and flora rescue program - During filling
- Flora and fauna predation control program
- Local research support program

Land uses

In the Itapúa and Alto Paraná departments in Paraguay, 60% of the territory is apt for agriculture. They make up one of the most productive right bank regions, with an expansive and very dynamic agricultural sector. Production is heavily concentrated in the farming and cattle breeding sectors; farming represents two thirds and cattle breeding the remaining third.

Cotton, soy and hog cattle breeding, considered as a whole, exceed 50% of the total agricultural production, whereas yerba mate, wheat and cow breeding total about 20%. Agro-industry is the most outstanding industrial sector and it is located particularly in Itapúa. Grain silos provide 20% of the sector employment, yerba mate producers, 15% and cotton gins, 12%. All three activities concentrate 50% of labor demand in the sector.

Misiones (LB) is the main yerba mate, tea, tobacco and citric fruit producer in Argentina. At present, yerba mate covers 172,000 ha, and demand is stable at 5.2 kg per person / year, whereas tea reaches 250 grams per person / year. The forestry sector is very dynamic, with high pine roll consumption for the cellulose industry. It represents 45% of national consumption.

Land flooding resulting from the Project is relatively small. Since productive areas are located at levels higher than the flood elevation level, few are affected.

¹⁸ Proposed compensation ratio for the affected natural systems (gallery forests + native forests + pasture lands) is 5:1. Affected areas are: Pindo-í 5,866 ha, Itacurubí 9,540 ha and Itacúa 19,680 ha. Land cost has been estimated at USD 400 + 100% for infrastructure installation and improvements. During Operation Stage, estimated operation cost is USD 10 / ha per year.

¹⁹ Proportional to the affected natural area. During the Operation Stage, at USD 50 / flooded ha per year.

The Pindo-í enclosure is the lowest impact alternative. The Itacurubí enclosure and, to a greater degree the Itacuá enclosure, have a greater impact because they involve the largest streams (Capiibary, Yabebyry, San Juan, Santa Ana), which have wide flood plains.

Agricultural activities (farming and cattle breeding) are associated to these streams. The impact on each bank is not equivalent. On the right bank, the higher impacts occur on productive lands, whereas on the left bank different stages of native forests, with a varying degree of exploitation, are affected.

The chance of low-cost energy provided by the Project also allows the development of local agro-industry. However, this should be understood as a possibility that the Project offers and not as an actual immediate consequence. Local communities should organize themselves and petition before the authorities to achieve this benefit.

The main environmental management measures proposed in the study aim at setting the following programs:

- Tributary basin regulation management program
- Promotion of border integration program
- Promotion of agricultural and agro-industrial activities program
- Organization and management plan program for the area surrounding the lake.

Cultural and archaeological heritage

In the area under study, and before the Itaipú and Yacyretá reservoirs were filled, renowned international experts carried out a series of archaeological investigations that allowed the recovery of significant cultural evidences. Despite the scarce sites and non-sites²⁰ identified in the preliminary approaches of these studies, it may be inferred that in the Corpus Christi affected area, sites and non-sites similar to the ones recovered at Yacyretá, Itaipú and Urugua-í may be found.

However, when analyzing the Corpus Christi Project effects on cultural and archaeological heritage, it appears that most of the territories to be flooded are located in areas heavily disturbed by human activities. As a consequence, findings of great significance or uncovered by the previous Yacyretá and Itaipú studies are not expected.

Anyway, the larger the flooded area, the higher the probability of affecting the archaeological and cultural heritage. Therefore the potential impact is higher at Itacurubí than at Pindo-í, and even higher at Itacuá. Enclosures located downstream Pindo-í imply a higher risk of affecting the archaeological heritage as their larger flooded areas may affect unknown fields or sites of interest.

The sites of tourist interest that may be affected by the Project are located in direct association to the riversides. Normally they are fishing clubs and resorts servicing the local short distance tourism. The degree of impact on these sites is related to two complementary factors: the extension of the flooded area and the population density or nearby urban centers using these resorts. Therefore, enclosures located downstream have a higher impact on tourist areas, as they involve larger flooded areas and more densely populated zones.

²⁰ Non-site: Scattered artifacts and ecofacts that identify hunters-gatherers occupying a territory.

The impact on waterfalls is low, and it is equivalent for all the enclosure alternatives, as every waterfall is located upstream Pindo-í. On the right bank the Tembey fall is affected. On the left bank, the 3 de mayo fall, Gruta India and Cueva del Yaguareté.

According to the study the Corpus Christi Project results in no significant impact on the native communities from both riverbanks. These communities usually dwell at high topographic levels, located outside the Paraná River historical flood area. Therefore the impact, if any, involves part of the outreach area of these communities (an area of wide and poorly defined borders) but not their houses.

Field survey allowed the detection of some communities located very close to the Corpus Christi flood line. Therefore, and with the purpose of being conservative regarding the preservation of these communities, they have been considered as affected groups requiring specific studies on the Executive Project stage. Communities detected as partially affected are the following:

- Marangatú community (LB), located upstream Pinto-í by the Cuña Pirú stream. All three locations affect it.
- Cambay community (RB), located at Jesús, by the Capiibary stream. Itacúa and Itacurubí affect this community.
- Ñu Porá (located by the Yabebiry stream), Kopeí and Guaraní communities in Puerto Viejo (located by the Paraná river), San Ignacio (LB). Only Itacúa affects all three communities.

In the event the impact is confirmed, these communities should be compensated or relocated and rehabilitated, in compliance with the guidelines and criteria set forth by the legislation of Paraguay and Argentina, the Itapúa department and the province of Misiones, as well as by international financial institutions (e.g., World Bank 2001a y 2001b) and international agencies like the World Commission on Dams (Cfr. WCD 2000; Bartolomé, De Wet, Mander y Nagraj 2000).

The Corpus Christi Project, as Yacyretá and Itaipú in their time, is an opportunity for enhancement and systematization of both scientific knowledge and research on cultural and archaeological heritage of this region. This is so even admitting the possible loss of minor though potentially interesting sites, from the archaeological point of view.

Project's Environmental Management will aim at setting the following programs:

- Tourist and historical sites protection program
- Archaeological research and recovery program
- Native communities relocation and compensation program ²¹

²¹ Affected communities have an average 35 people. 100% for infrastructure and improvements. In the Operation stage, compensation cost is estimated at USD 50,000 / year per affected community.

Alternative energy sources

The possibility of generating energy in the same amount and quality as generated by Corpus Christi was discussed. Energy generation capacity was deemed the most suitable comparison base to the designated as *new and renewable sources* (wind energy, photovoltaic systems, solar-thermal, fuel cells), but on account of the size of the project (approximately 3,000 MW installed power and 20,000 GWh mean annual energy generation used as reference data) the substitution was not deemed possible.

Wind energy relates to marginal market values (0.5% of the total in Germany), and its development is based on some countries' subsidies, which pay up to USD 100 per MWh (twice the wholesale power rate).

The area required for installing 3,000 MW power with wind and/or solar energy²² is very large, as shown in table No. 7.

Allocation of such areas may be uncontroversial in semi-desert areas, but in forest regions like the province of Misiones and Paraguay it would result in very significant environmental impact.

Generation	Required area
Thermal power plant	60 ha (Plant) + 7.500 ha (Gas pipeline) ²³
Solar energy	15.000 ha
Wind energy	22.500 ha
Corpus Christi	13.966 ha (Pindo-í)
	17.430 ha (Itacurubí)
	28.371 ha (Itacuá)

Table No. 7. Required areas per generation type

Based on the above, the only other power generation alternative equivalent to Corpus Christi is another conventional source, in this case a *thermal power plant*, which without being equivalent to the Corpus Christi in a series of aspects, allows for an indirect comparison to the reservoir's main use.

²² "Senior expert symposium on electricity and the environment" IAEA, Helsinki, Finland, 1991

²³ Gas pipeline service strip 1,500 km long and 50 m wide.

The most importance difference is that Corpus Christi is a *multi-purpose facility* aiming at several simultaneous purposes:

- Electric power generation,
- Navigation improvement,
- Development of commercial and sports fishing,
- Promotion of tourism and other related recreational activities.

From the socioeconomic point of view, Corpus Christi's most important contribution is the approximately USD 80,000,000 / year in royalties for both river banks, which would have a very positive effect on both countries. On the contrary, the Thermal Project would only aim at the power generation purpose and would pay no royalty to the region. Royalties for gas consumption would be paid at the field site areas.

The thermal project may have in turn some other related advantages that exceed comparison with Corpus Christi. For instance, in the event that distributed gas was used as generation fuel, and a gas pipeline was built across Paraguay and the Argentine Northeastern region, gas provision would be possible to wide currently un-serviced areas. In this case, a benefit additional to power generation would occur, at market values.

Therefore, when the region's mid and long term energy needs are discussed, the Corpus Christi Project and the Alternative Project (Thermal power plant) appear as *complementary* instead of competitive projects.

The most significant thermal generation environmental impact is related to the generation of greenhouse gases. From a global point of view, plant-emitted gases would contribute to greenhouse effect, and at the regional level they would have an impact on air pollution.

In addition, and as a consequence of the *prevented emissions*, the Corpus Christi Project offers the possibility of generating economic resources for *Environmental Management* within the framework of *carbon bonds* marketing, as a possibility for using some mechanisms based on environmental services also provided by the Project.

If property rights to those credits were assigned to a *binational environmental fund with regional scope* (to be created), these resources might be allocated to facilitate the sustainable development of the region where the project is physically and environmentally located.

As a consequence, this Project-provided service, which implies a global environmental benefit, would also become a significant regional environmental benefit.

Environmental impact comparative tables

Main environmental impacts Positive (+) ; Negative (-) / High (H) ; Mid (M) ; Low (L)	Pindo-í	Itacurubí	Itacuá
Natural systems and protected areas			
Loss of gallery forests	(-) L	(-) L	(-) M
Impact on biological passages	(-) M	(-) M	(-) H
Impact on protected natural areas	(-) M	(-) M	(-) H
Impact on forest-field <i>ecotone</i>	No impact	(-) L	(-) H
Opportunity to create new protected areas	(+) H	(+) H	(+) H
Cultural and archaeological heritage			
Risk of affecting sites of archaeological interest	(-) M	(-) M	(-) H
Risk of affecting sites of historical interest	(-) L	(-) L	(-) L
Risk of affecting sites of tourist interest	(-) M	(-) M	(-) H
Risk of affecting native population	(-) L	(-) M	(-) H
Health			
Risk of water diseases	(-) M	(-) M	(-) H
Excessive demand on local health services	(-) M	(-) M	(-) M
Opportunity to improve local health services	(+) H	(+) H	(+) H

Principales Impactos Ambientales Positivo (+) ; Negativo (-) / Alto (A) ; Medio (M) ; Bajo (B)	Pindo-í	Itacurubí	Itacuá
Water quality			
Risk of water quality deterioration	(-) L	(-) L	(-) M
Increase in gas oversaturation	(-) M	(-) M	(-) H
Fish fauna			
Fish fauna deterioration in the project area	(-) L	(-) M	(-) H
Risk of fish mortality for increase on gas oversaturation	(-) M	(-) M	(-) H
Opportunity to develop new fish resources	(+) M	(+) M	(+) M

Principales Impactos Ambientales Positivo (+) ; Negativo (-) / Alto (A) ; Medio (M) ; Bajo (B)	Pindo-í	Itacurubí	Itacuá
Socio-economic aspects			
Impact on population	(-) L	(-) L	(-) M
Impact on housing	(-) L	(-) L	(-) M
Loss of productive land	(-) L	(-) L	(-) M
Impact on infrastructure	(-) M	(-) M	(-) H
Generation of employment	(+) H	(+) H	(+) H
Local economy reactivation	(+) H	(+) H	(+) H
Opportunity to get low cost energy in the region	(+) M	(+) M	(+) M
Improvements to river navigation and transportation	(+) H	(+) H	(+) H
Reduction of greenhouse gases	(+) M	(+) M	(+) M