

**Ministry of Public Works  
and Communications (MOPC)  
Republic of Paraguay**

# **The Study on the Export Corridor and Grain Port Improvement in Paraguay**

**FINAL REPORT (Summary)**

**August 2006**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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**YACHIYO ENGINEERING CO., LTD.  
CENTRAL CONSULTANT INC.**

Exchange rates: May 2006  
US\$1.00 = Guarani Gs.5,500  
US\$1.00 = Yen ¥114.58

## PREFACE

In response to the request from the Government of the Republic of Paraguay, the Government of Japan decided to conduct the Study on the Export Corridor and Grain Port Improvement in the Republic of Paraguay and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA dispatched a Study Team headed by Mr. Toshihiro Hotta of Yachiyo Engineering Co., Ltd. to the Republic of Paraguay between September 2005 and July 2006.

The Study Team held discussions with the concerned officials of the Republic of Paraguay and conducted the field surveys in the study area. Upon returning to Japan, the Study Team prepared this report.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the concerned officials of the Republic of Paraguay for their close cooperation extended to the Study.

August 2006

Kazuhisa MATSUOKA  
Vice President  
Japan International Cooperation Agency

# Letter of Transmittal

August 2006

Mr. Kazuhisa MATSUOKA  
Vice President  
Japan International Cooperation Agency

Dear Sir,

It is a great honor for me to submit herewith the final reports for The Study on the Export Corridor and Grain Port Improvement in Paraguay.

The study team, which consists of Yachiyo Engineering Co., Ltd. and Central Consultant Inc, and headed by myself, conducted field surveys and data analysis and feasibility study of the export corridor and Caarendy port, based on the terms of references instructed by the Japan International Cooperation Agency (JICA) from September 2005 to August 2006.

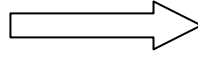
The study team held thorough discussions and investigations with Ministry of Public Works and Communication (MOPC), National Administration of Navigation and Ports (ANNP) and other officials concerned of the Government of Paraguay, accordingly, understanding of the present road, traffic, port and import/export system, plan of development for the export corridor and Caarendy port, environmental and social consideration, preliminary design and economic and financial analysis and so on. The results were compiled in the final report, main and summary volumes.

On behalf of the study team, I wish to express my heartfelt appreciation to the officials concerned of the Government of Paraguay for the warm friendship and cooperation extended to us during our stay in Paraguay.

I also wish to express my sincere appreciation to JICA, Ministry of Foreign Affairs, Ministry of Land, Infrastructure and Transport, Japan Bank for International Cooperation, the Embassy of Japan in Paraguay and other concerned governmental authorities for their valuable advises and cooperation given to us in the course of the survey.

Yours faithfully,

Toshihiro HOTTA  
Team leader  
The Study on the Export Corridor and  
Grain Port Improvement in Paraguay



Study Area



Typical Cross-section of the Parana River Coastal Road



Road condition becomes worse when it rains



Pontoon Bridge crossing the Nacunday River



Trucks are forming a long queue on the Port Access Road



Timber Bridge crossing the Yacuy Guazu River



Caarendy Port Planned Construction Site

### Present Conditions in the Study Area

## **1. Background and Objectives of the Study**

The purpose of “The study on the Economic Development of the Republic of Paraguay (EDEP),” which was conducted since October of 1998, was intended to propose policies to strengthen economic competitiveness and Paraguay’s exports. The Paraguayan government drew up a “Economic and Social Strategy Plan (PEES)” aimed at achieving an action plan proposed by the EDEP. It was promulgated as an Executive Order. This plan was based on four criteria, and the contents included in the EDEP action plan.

Against the above background, the Paraguayan government requested the Japanese government to conduct a feasibility study (F/S) on the improvement of roads directly connecting Paraguayan grain-producing areas to the Parana River and grain ports in Paraguay. The grain-producing areas include those with Japanese-Paraguayan communities. (Farmers of Japanese descent manage agricultural cooperatives in La Paz, Pirapo, and Iguazu.)

This study has the three following objectives:

- Formulation of a development plan for the export corridor and grain ports (roads and ports) to enhance export efficiency and strengthen export competitiveness to contribute to Paraguayan economic development.
- Implementation of a feasibility study on routes given priority after establishing an overall development plan
- Technology transfers to Paraguayan counterpart personnel during the course of the Study.

The study area comprises the Parana River Coastal Road, the extension of the National Road Route 15 (tentative name), and nine ports and access roads located along the banks of the Parana River (road length of about 330 km).

## **2. Export Corridor Development Plan**

### **(1) Road development plan**

The Parana River Coastal Road also functions as an international road. Consequently, the design speed was planned at 100 km/h, which exceeds the commonly designed speed of 80 km/h for existing national roads. The design speed was set at 80 km/h for the extended section of National Road Route 15 (tentative name) and at 50 km/h for access roads to ports. Since the design daily traffic volume is estimated to be a maximum of about 4,000 vehicles/day, all roads were designed as two-lane roads. Considering the volume of large-truck traffic, the lane width was set at 3.25 meters.

As there are existing roads over the entire section, the route was designed to be compatible with their alignments. The section deviates greatly from existing roads in cities like Ciudad del Este, Presidente Franco, Otaño, Antonio Lopez, etc. For these sections, the route was planned from technical and social viewpoints.

## (2) Caarendy Port development plan

Caarendy Port was planned as a public port compatible both for imports and exports. The project cost was calculated to be approximately \$6 million. Comparison of the annual operating cost and annual return for a case in which construction of Caarendy Port is made under grant aid indicated a favorable annual balance amounting to nearly \$300,000. This indicates that it was expected that sufficient sustainable business would be secured.

## 3. Environmental and Social Considerations for the Project

Throughout the study period, workshops in which residents participated were held to publicize the project and have it reflect comments from residents. In particular, the alternative to the planned route was selected jointly with residents to obtain their understanding. It was also confirmed through these workshops that no substantial objections to the project would arise.

At the stage, where the route plan was proposed on the basis of an initial environmental study, screening was made in each section. According to the JICA Guidelines for Environmental and Social Considerations (April 2004), this project was ranked at Category B, which was considerably closer to Category C. Accordingly, it was considered necessary to study the major environmental conservation measures in line with implementation of this project and to take appropriate measures related to resettlement of residents, installation of animal crossing facilities, and turbid water prevention measures in the course of bridge construction.

## 4. Approximate Project Cost

Segment Description	Paraná River Coastal Road	National Highway No.15 Extension Road	Sub Total	Port Access Roads	Total
Distance (km)	157.575	54.430	212.005	107.570	319.575
①Earth moving	14.8	1.7	16.5	3.1	19.6
②Asphalt Pavement	51.8	10.5	62.3	24.1	86.4
③Box Clvert	0.6	0.0	0.6	0.3	0.9
④Bridge	5.0	0.0	5.0	0.2	5.2
<b>(1) Construcccion Cost</b> ①+②+③+④	<b>72.1</b>	<b>12.2</b>	<b>84.3</b>	<b>27.8</b>	<b>112.1</b>
<b>(2) Engineering Fee</b> (1)× 13%	<b>9.4</b>	<b>1.6</b>	<b>11.0</b>	<b>3.6</b>	<b>14.6</b>
<b>(3) Compensation</b>	<b>1.6</b>	<b>0.3</b>	<b>1.9</b>	<b>0.5</b>	<b>2.4</b>
<b>(4) Contingencies</b> (1)~(3)× 10%	<b>8.3</b>	<b>1.4</b>	<b>9.7</b>	<b>3.2</b>	<b>12.9</b>
<b>(5) Project Cost</b>	<b>91.4</b>	<b>15.4</b>	<b>106.8</b>	<b>35.1</b>	<b>141.9</b>
(million US\$/km)	<b>0.58</b>	<b>0.28</b>	<b>0.50</b>	<b>0.33</b>	<b>0.44</b>



## 5. Economic Evaluation of the Project

The economic costs and benefits of the whole project were estimated for each fiscal year, and the economic internal rate of return (EIRR) was calculated. The result was 14.3% for the whole project (Case I), which exceeds the general capital opportunity cost of 11% in Paraguay. In other words, the project was determined to be economically feasible.

As regards trunk roads, the EIRR for development of the Parana River Coastal Road was the highest. The priority was found to be the highest for the Parana River Coastal Road, followed by the extension road section of National Road Route 15.

The EIRR for port access roads ranged from 7.8 to 20.6%. It was high for roads with a roadside population, but without pavement at present. Public commitment may be highly necessary for routes with a high EIRR. Since the EIRR of access roads as a whole exceeds 11%, it was thought that the development study should first be on routes with a high EIRR. In this case, the prerequisite from the public viewpoint is development of all of these routes.

The EIRR of Caarendy Port is significantly high at 22.8% because it is located near the production site, and the benefit of reducing the running cost is high.

**Project economic analysis**

Indicators		IRR	NPV	B/C
			US\$ million	Ratio
Case		%	at discount rate of 11%	
Case I	All Roads	14.3%	33.18	1.32
Case II	Coastal Road + Extension of Route No. 15	15.1%	31.83	1.42
Case III	Coastal Road	15.4%	29.67	1.46
Case VI	Northern Part of Coastal Road + Extension of Route No. 15	13.6%	14.83	1.26
PAR-0	Campichuelo	8.3%	-1.12	0.77
PAR-1	Paredón	20.6%	2.56	2.05
PAR-2	Caarendy	8.3%	-0.96	0.77
PAR-3	Don Joaquín	13.3%	1.06	1.22
PAR-4	Paloma	11.8%	0.18	1.07
PAR-5	Triunfo	7.8%	-0.52	0.75
PAR-6	Dos Fronteras	14.8%	0.51	1.37
PAR-7	Torocúa	11.9%	0.18	1.09
PAR-8	Tres Fronteras	9.8%	-0.17	0.90
	All Access Roads	11.2%	0.42	1.02
	Caarendy Port	22.8%	6.02	2.00

## 6. Preparation of the Implementation Plan

### (1) Operation schedule (Road sector)

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Feasibility Study (F/S)	■								
Preparation Work for Realization of JBIC Loan	■	■							
Exchange of Note		▲							
Loan Agreement and Approval by Parliament			▲						
Bidding of Consultants – Approval of Contract			■						
Detailed Design			■	■					
PQ, Bidding of Contractor – Approval of Contract				■	■				
Commencement of Construction					■	■	■	■	■
Registration of the Project on IIRSA		▲							
EIA	■	■							
Land Acquisition for Road			■	■	■				
Procedures for Resident Transfer				■	■				
On-going Road Development Project financed by JBIC	■	■	■						

Note: Prepared by the study team

### (2) Land acquisition for road

To achieve this project, land acquisition of about 700 ha is necessary along 296.2 km of the total 315 km. The cost for land acquisition is calculated to be about \$1.4 million.

#### Length of land acquisition for roads, etc.

Section	Acquisition length (km)	Acquisition area (ha)	Cost (US\$)
Parana River Coastal Road	134.2	362.3	686,832
Port access roads	107.6	216.2	467,072
Extension of Route 15	54.4	122.2	244,452
Total	296.2	700.7	1,398,356

### (3) Resettlement of residents

As regards resettlement of residents in the course of implementation of the project, 45 resettlement cases inside the planned road site (13.5 m wide) are required over the entire Parana River Coastal Road, including 43 in the access section to the inside of Ciudad del Este, and a total of two cases for the extension of Route 15 and port access roads. However, the cases inside the right-of-way of 50 meters (excluding the 13.5 meter-wide site) are 490 for all routes as shown in the table below. If the cases inside the road width are included, the total would be 538. Note, however, that 490 cases inside the right-of-way mostly do not hinder the work.

#### **(4) Fund procurement**

The project based on the loan assumes that part of the project funding must be appropriated by Paraguay. Since the project scale is large and, therefore, a substantial amount of funds must be prepared by the Paraguayan side and adequate budget preparation measures must be taken beforehand. Namely, the Paraguayan counterpart must secure about \$2 million annually during the period from 2007 to 2009 before the project starts and about \$9 million annually from 2010 to 2013. This funding may be secured as part of the Road Bureau budget. Considering the progress of the project with multiple donors, it is essential that the budget be secured according to the plan.

### **7. Conclusions and Proposals**

All of the export corridor plans for this project are reasonable, and the project implementation and promotion are proposed for the following reasons:

- 1) This project is intended to alleviate vulnerability of the transport infrastructure of Paraguay and its contents are compatible with the national plan. It is expected that implementation of the project will improve the transport efficiency, enhance the productivity of export products, and strengthen the competitiveness of export industries, and, in consequence, contribute to activation of the economy of Paraguay.
- 2) If construction and subsequent maintenance are appropriately implemented, the EIRR of the project as a whole should be 14.3%, meaning that the project is economically feasible. In addition, implementation of the project is expected to alleviate poverty and improve the living environment.

#### **(1) Promotion of development of the Southern Integrated Road**

- For the Parana River Coastal Road and the extension of National Road Route 15, the design was made by selecting the route with due consideration for the natural environment and resettlement of residents by employing the horizontal and longitudinal alignments appropriate to the design speed, by selecting the economic road structure, and by setting the number of lanes and pavement structure according to the design daily traffic volume. The technical validity of the project was demonstrated in this way. Implementation of the project shows a high economic benefit with the internal rate of return at 15% or more, which indicates that the project is highly reasonable. These trunk roads will be positioned as the “Southern Integrated Road” forming a framework of the southeastern part of Paraguay. Its operation at an early date will prove significant because of following reasons.
- The Southern Integrated Road will be a trunk road connecting the southeastern provinces of Paraguay, and it is expected to vitalize the regional economy. In this way, the project is expected to be effective for the poverty reduction program.
- In addition, this road will function as an international road forming the Paraguay link of the cross-continent road to connect two oceans along the IIRSA axis of the tropic of Capricorn.
- Finally, development of this road is expected to reduce cargo transport costs. This will contribute to enhancing agricultural productivity and strengthening export competitiveness, as stated in the national development strategy.

## **(2) Development of port access roads**

- Development of the road connecting the Southern Integrated Road with ports along Parana River will effectively strengthen export competitiveness — namely by paving the port access roads. In this way, the port facilities can be used any time regardless of weather conditions. In consequence, the transport efficiency for corn exports will be greatly improved along with improved convenience for roadside residents.
- Technical validity can be secured by means of the design by selecting the route with almost no resettlement or other social effects, employment of horizontal and longitudinal alignments appropriate to the design speed, and by setting the number of lanes and pavement structures according to the design traffic volumes.
- Regarding construction of port access roads, there was a case in which private funding was introduced for Campichuelo Port. The roads covered by this project are to be newly constructed (earthen road), and pavement of existing roads will required. This will entail an extremely large amount of construction cost, and introduction of private funding is thought to be very difficult. The internal rate of return from implementation of the project exceeds 11%, which confirms that construction of access roads alone will be sufficiently feasible for the national economy. In this context, public commitment is highly needed for port access roads.

## **(3) Development of Caarendy Port**

- The production of soybeans, the principal export product of Paraguay, is expected to double from the present level in the year 2015. Along with this, export via water transportation on the Parana River is expected to rise 1.9-fold. Although there are many small private ports located along the Parana River, supply/demand will be stringent if the existing facilities are left as they are. This means that the measures must be taken to cope with the expected increase in the demand to utilize the ports.
- On the other hand, the existing port facilities are mostly used exclusively by large enterprises, excluding practically general users. Considering that these enterprises deal only with large-scale farms, the benefit of increase in the export of crops, mainly soybeans, will be limited to large-scale farms and may be difficult to cause vitalization of the economy of Paraguay as a whole.
- Therefore, Caarendy Port must cope with the increase in export demand as a part of export promotion policies while at the same time acting as an effective linkage for small-scale farm measures and regional prosperity. The port should be developed under the following conditions:
  1. As a public port so that many people can enjoy benefits
  2. Appropriate size (export cargoes: annual 200,000 tons) to avoid constraining operation of other private ports
  3. Handling of import cargoes (fertilizer, fuels, agricultural chemicals) that cannot be handled in other ports
  4. Tie-ups with existing agricultural cooperatives to ensure organization and sustained operation of medium-to-small size farms
- In these cases, it is expected that access roads will be developed concurrently.

#### **(4) Proposal for smooth promotion of the project**

To ensure smooth promotion of this project, the Paraguayan counterparts are expected to implement the following measures:

- Adequate EIA and land acquisition procedures
- Securing the budget allowance for the counterpart funds, while requesting a highly concessive yen loan and other financial assistances in order to complete the project.

#### **(5) Proposal for further demonstration of the benefits of this project**

To further demonstrate the benefits expected from this project, the Paraguayan counterparts should undertake the following:

- Strengthen the positioning of this project in IIRSA and promote the wide-area road network by communicating with other countries
- Adequate maintenance and operation after completion of the project
- Upgrade the Parana River coastal port facilities and support stabilization of transport by water

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## List of Abbreviations

	<b>English</b>	<b>Spanish</b>
1. AASHTO	American Association of State Highways and Transport Officials	Sociación Americana de Rutas Estatales y Oficiales de Transporte
2. AID	Area of Direct Influence	Área de Influencia Directa
3. AII	Area of Indirect Influence	Área de Influencia Indirecta
4. ANDE	National Administration of Electricity	Administración Nacional de Electricidad
5. ANNP	National Administration of Navigation and Ports	Administración Nacional de Navegación y Puertos
6. BCP	Central Bank of Paraguay	Banco Central del Paraguay
7. BID	Inter-American Development Bank	Banco Interamericano de Desarrollo
8. BM	World Bank	Banco Mundial
9. CAB	Commonwealth Agricultural Bureau	Oficina de la Mancomunidad Agrícola
10. CAF	Andean Corporation of Promotion	Corporación Andina de Fomento
11. CAN	Andean Community	Comunidad Andina
12. CAPECO	Chamber of Cereals and Paraguayan Exporters	Cámara Paraguaya de Exportadores de Cereales y Oleaginosas
13. C/B	Cost-Benefit ratio	Relación Costo – Beneficio
14. CCT	Technology Adjustment Group	Comité de Coordinación Técnica
15. CDE	Committee of Executive Direction	Comisión de Dirección Ejecutiva
16. DF/R	Draft Final Report	Borrador del Informe Final
17. DIEA	Direction of Farming Censuses and Statistics	Dirección de Censos y Estadísticas Agropecuarias
18. DINATRAN	Direction of National Transports	Dirección Nacional de Transporte
19. DGEEC	Statistics and Census Bureau, STP	Dirección General de Estadísticas Encuestas y Censos, STP



	<b>English</b>	<b>Spanish</b>
20. DSGM.	Direction of the Military Geographic Service	Dirección de Servicio Geográfico Militar
21. EDEP	The Study on the Economic Development of the Republic of Paraguay	Estudio sobre el Desarrollo Económico de la República del Paraguay
22. EIA	Environmental Impact Assessment	Evaluación de Impacto Ambiental
23. EIRR	Economic Internal Rate of Return	Tasa Interna de Retorno Económico
24. E/N	Exchange of Notes	Canje de Notas
25. FONPLATA	Financial bottom for the Development of the Silver River basin	Fondo Financiero para el Desarrollo de la Cuenca del Plata
26. F/R	Final Report	Informe Final
27. GDP	Gross Domestic Products	Producto Interno Bruto
28. GPS	Global Positioning System	Sistema de Posicionamiento Global
29. GTEs	Technology Execution Group	Grupos Técnicos Ejecutivos
30. IC/R	Inception Report	Informe Inicial
31. IDB	Inter-American Development Bank	Banco Interamericano de Desarrollo
32. IEE	Initial Environment Examine	Examen Ambiental Inicial
33. IIRSA	South American Regional Infrastructure Integration Action Plan	Iniciativa para la Integración de la Infraestructura Regional Sudamericana
34. IRR	Internal Rate of Return	Tasa Interna de Retorno
35. IT/R	Interim Report	Informe Intermedio
36. IVA	Vallue Added Tax	Impuesto al Valor Agregado
37. JBIC	Japan Bank for International Cooperation	Banco del Japón para Cooperación Internacional

	<b>English</b>	<b>Spanish</b>
38. JICA	Japan Internacional Cooperation Agency	Agencia de Cooperación Internacional del Japón
39. MAF	Ministry of Agriculture and Farming	Ministerio de Agricultura y Ganaderia
40. MAG	Ministry of Agricultura And Livestock	Ministerio de Agricultura y Ganadería
41. MERCOSUR	South Common Market	Mercado Común del Sur
42. MH	Ministry of Finance	Ministerio de Hacienda
43. MIC	Ministry of Industry and Commerce	Ministerio de Industria y Comercio
44. MLIT	Ministry of Land, Infrastructure and Transport	Ministerio de Territorio, Infraestructura y Transporte
45. MOPC	Ministry of Publics Works And Communications	Ministerio de Obras Públicas y Comunicaciones
46. NPV	Net PresentValue	Valor Presente Neto
47. OCIT	Consultative office and of Technical Investigation	Oficina Consultiva y de Investigación Técnica
48. OD	Origin-Destination	Origin-Destino
49. OPEP	Organization of Exporting Petroleum Countries	Organización de Países Exportadores de Petróleos
50. PEES	Economic and Social Strategy Plan	Plan Estratégico Económico y Social
51. P/R	Progress Report	Informe de Progreso
52. SEAM	Secretariat of the Atmosphere	Secretaría del Ambiente
53. SEDP	Study on Economic Development in Paraguay	Estudio sobre Desarrollo Económico del Paraguay
54. SIAMV	Integral System of Road MaintenanceAdminstration	Sistema Integral de Administracion del Mantenimiento
55. STP	Technical Secretariat of Planning	Secretaria Técnica de Planificación
56. TEU	Twenty feet Equivalent Unit	Unidad Equivalente a Veinte Pies

**English****Spanish**

57. THM

Triangular Hydrograph Method

Método Hidrográfico Triangular

58. VOC

Vehicle Operation Costs

Costos Operativos de Vehiculos

# 1. INTRODUCTION

## (1) Background of the study

The Paraguayan government requested the cooperation of the Japanese government to support its policy to strengthen economic competitiveness and expand exports. In response to this request, Japan International Cooperation Agency (JICA) conducted “The Study on the Economic Development of the Republic of Paraguay (EDEP),” which began in October 1998. The Paraguayan government drew up a "Economic and Social Strategy Plan (PEES)" with the aim of realizing the goals of the action plan proposed by this EDEP study. It was promulgated as an Executive Order. This plan was based on four criteria. The first one is to “Strengthen economic competitiveness and expand exports.” For the most part this is included in the action plan of the EDEP study.

Against this background, the Paraguayan government requested that the Japanese government conduct a feasibility study, “The study on the export corridor and grain port improvement in Paraguay.” This study was conducted based on the minutes of a meeting. An agreement on this signed between JICA and the Paraguayan implementing agency in March 2005. JICA dispatched a study team, led by Mr. Toshihiro HOTTA to Paraguay in September 2005. The two sides signed an agreement on the Scope of Work with Ministry of Public Works and Communications (MOPC), which is the counterpart agency on Paraguay side. The study team conducted the study in Paraguay from September 2005 to June 2006.

## (2) Objectives of the study

This study has the three objectives described below.

- Formulation of a development and improvement plan for the Export Corridor and Grain Ports
- Implementation of a feasibility study on projects given priority
- Technology transfers to counterpart personnel during the course of the Study

## (3) Study area

The study area covered the following export corridors and ports.

### 1) Target roads

- Parana River Coastal Road between Ciudad del Este and Natalio (Approx. 165km)
- Extension road section of National Road Route 15  
between Naranjito and Parána River Coastal Road (Approx. 50km)
- Access roads to ports (total of nine ports)
  - 1) Access to Tres Fronteras port (Approx. 5km)
  - 2) Access to Trocuá port (Approx. 9km)
  - 3) Access to Dos Fronteras port (Approx. 16km)
  - 4) Access to Triunfo port (Approx. 11km)
  - 5) Access to Paloma port (Approx. 11km)
  - 6) Access to Don Joaquin port (Approx. 18km)
  - 7) Access to Caarendy port (Approx. 16km)
  - 8) Access to Paredón port (Approx. 12km)
  - 9) Access to Campichuelo port (Approx. 21km)

## 2) Target ports

- Nine ports along the Parana River right bank: Implementation of general surveys
- Caarendy port: Establishment of a repair plan

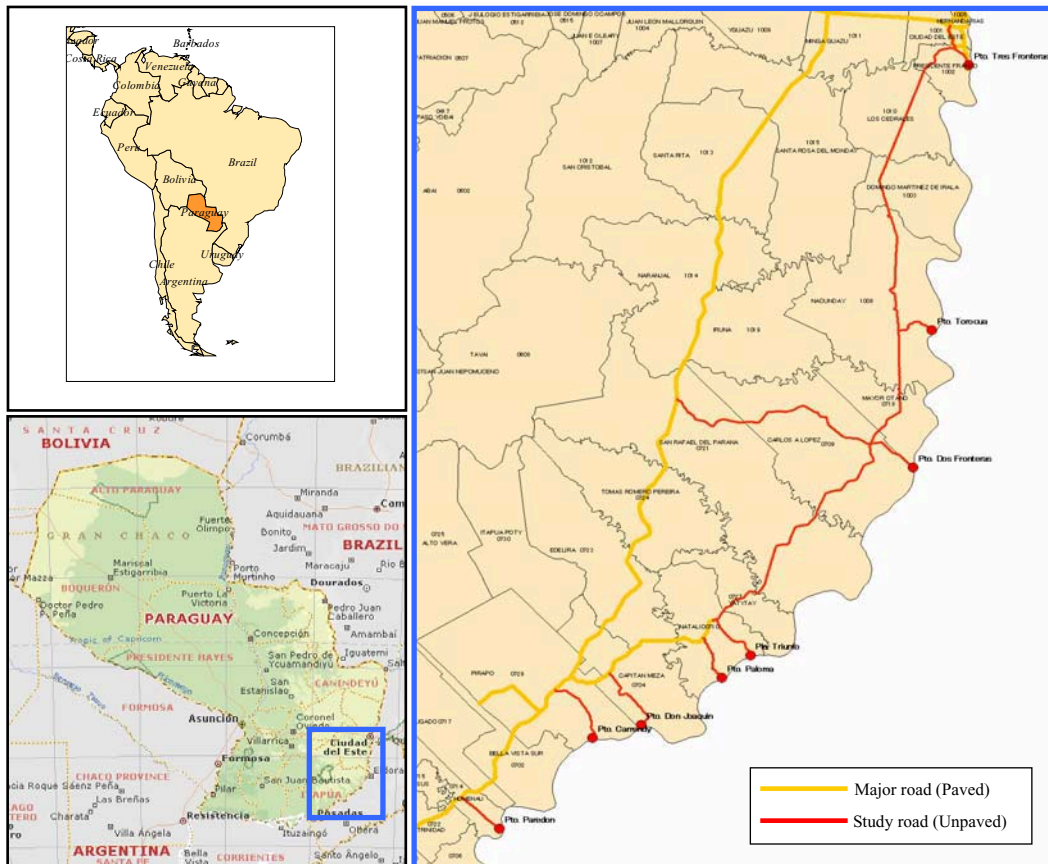


Figure 1.1 Study Area

## (4) Study organization

When this study started, JICA dispatched a JICA study team headed by Mr. Toshihiro HOTTA and organized a JICA Study Support Committee in Japan to seek advice according to the progress of the study. The Paraguayan government organized a counterpart team headed by Mr. Jose Gomez inside MOPC to conduct the study with the JICA study team and organized a Project Coordination Unit to facilitate the smooth implementation of the study.

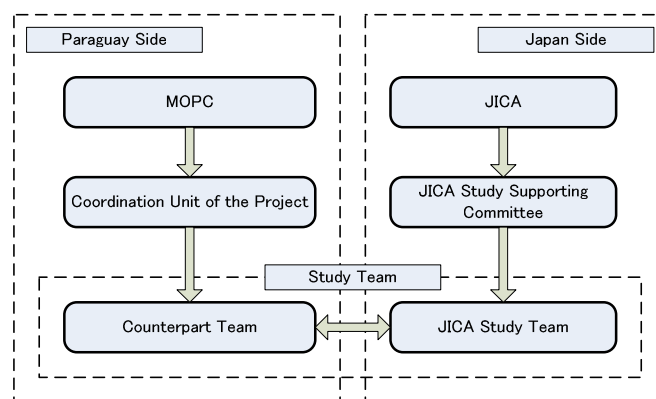


Figure 1.2 Study Organization

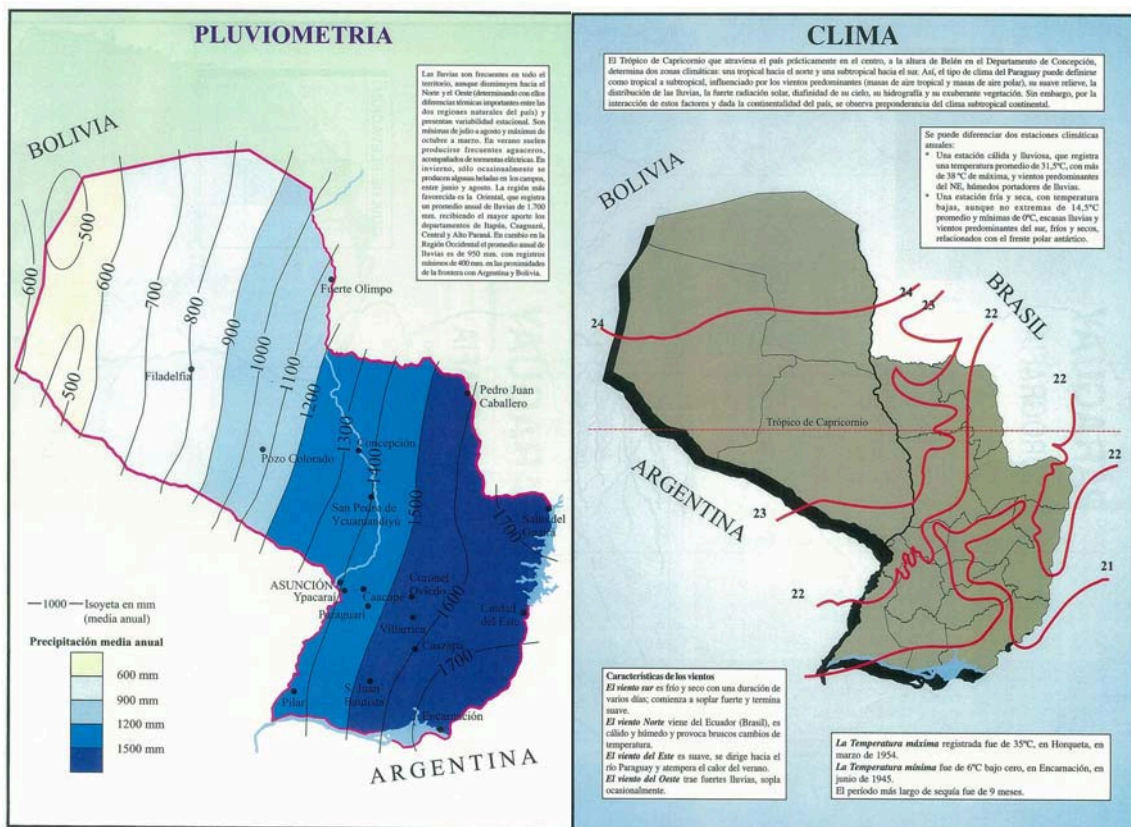
# I PRESENT CONDITIONS

## 2. OUTLINE OF THE TARGET REGION

### 2.1 GEOGRAPHY, TOPOGRAPHY AND CLIMATE

The Study Area is the highly vegetated hilly regions of Alto Paraná and Itapúa along the east and west sides of the Paraná River in Paraguay. The planned road passes through a hilly region at elevations of 100 to 300 m. There are four major rivers associated with the planned road, and all four flows into the Paraná River

In terms of weather, Paraguay is divided into two regions by the Tropic of Capricorn, which cuts across the country nearly at the middle (at the latitude of Belén in Concepción). The north is a tropical region and the south is a subtropical region. Geographical conditions make the subtropical climate the predominant one. The entire country frequently receives rainfall. The eastern side of the country is the rainy region with decreasing rainfall amounts as you move northwest. Average annual rainfall in the east is 1700 mm, with the western region receiving an average of 950 mm of rain per year. Precipitation amounts are lower from July through August, and higher from October through March.



REFERENCE ●: Asunción ●: Ñacunday River

Figure 2.1 Rainfall Distribution Map

Figure 2.2 Temperature Distribution Map

Table 2.1 Japan Meteorological Agency Data (●: Asunción)

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC		
Promedio Temperatura(°C)	27,4	26,8	25,8	22,7	19,8	17,7	17,4	18,7	20,5	23,2	24,9	26,5	Promedio de mensual Temperatura(°C)	22,6
Cantidad llluvias(mm)	156,2	136,5	124,7	161,5	127,4	77,1	42,5	78,9	82,7	138,4	140,2	140,9	Cantidad llluvias de anual(mm)	1407,0

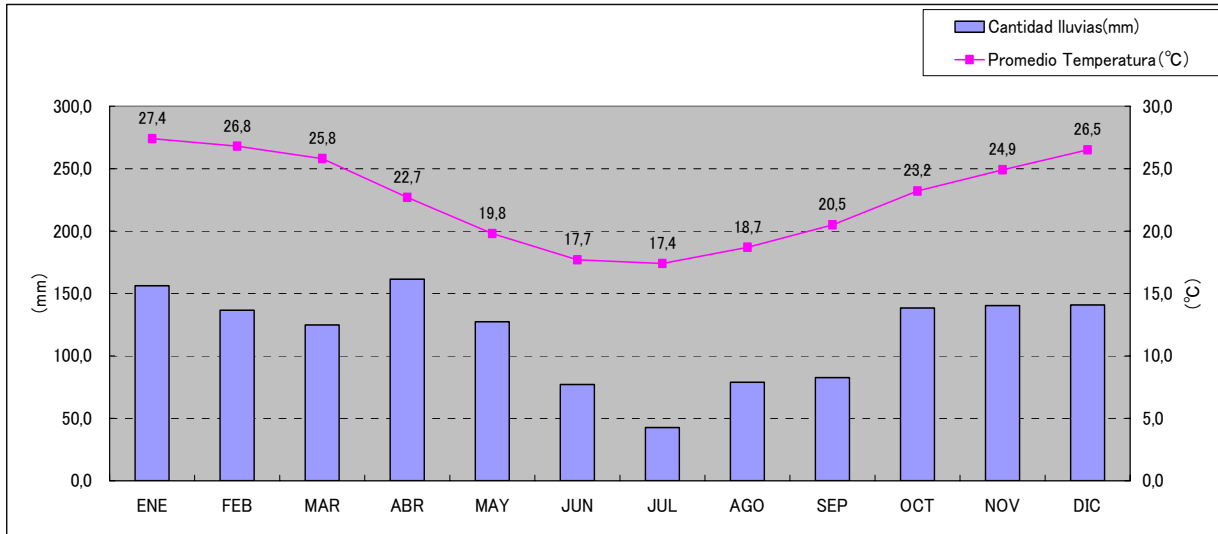


Figure 2.3 Monthly Average Temperature and Monthly Average Precipitation (Asunción)

Table 2.2 A.N.D.E Observation Data (●: Ñacunday River)

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC		
Promedio Temperatura(°C)	21,2	20,7	19,9	18,1	13,9	13,1	10,7	11,4	13,8	17,3	18,7	20,4	Promedio de mensual Temperatura(°C)	16,6
Cantidad llluvias(mm)	136,9	159,6	93,3	134,5	140,1	122,0	80,1	54,3	113,9	222,1	146,0	168,4	Cantidad llluvias de anual(mm)	1571,3

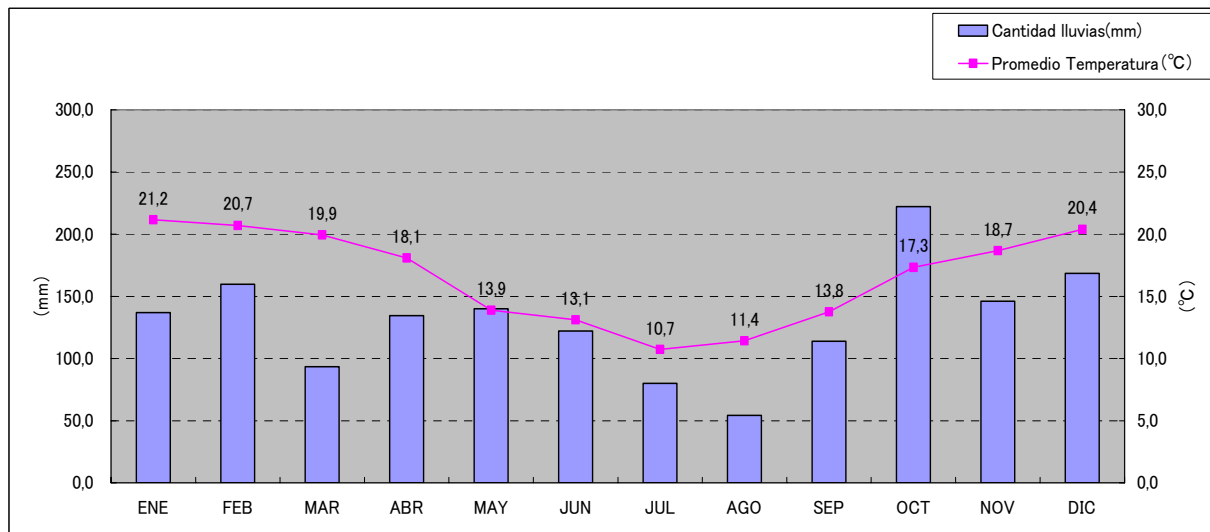


Figure 2.4 Monthly Average Temperature and Monthly Average Precipitation (Ñacunday River)



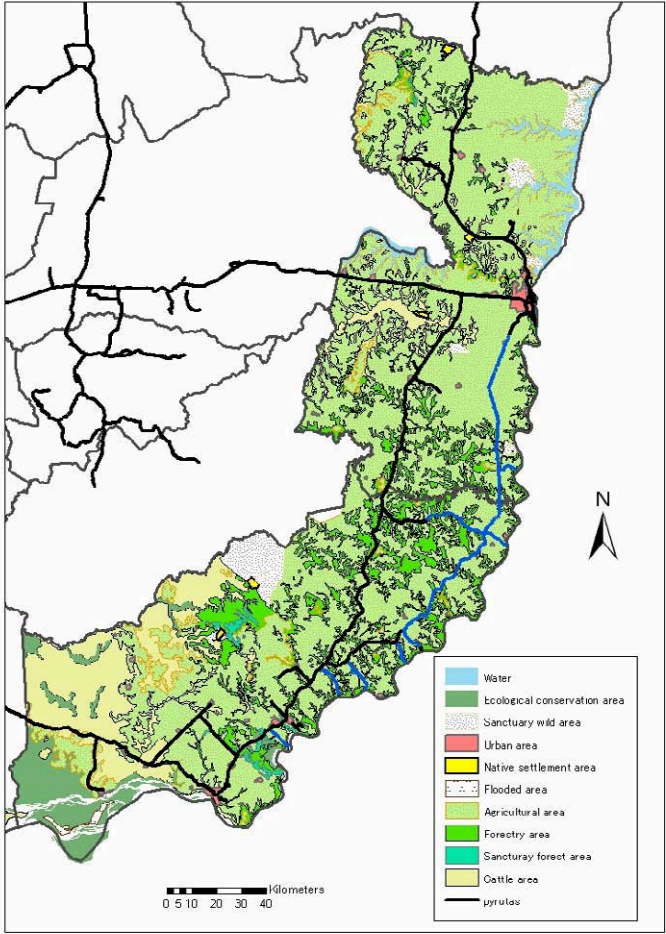
## 2.2 SOCIOECONOMIC CONDITION

### (1) Population

According to the data of the population census bureau, for the years 1992 to 2002, Paraguay's population increased to 5.16 million from 4.15 million in 1992: An increase tendency of 1.24. The growth rate of the Central Department, which includes the Asunción metropolitan area, is the largest, indicating 1.57 times. In the study area, it is 1.37 times in the Alto Paraná Department, and 1.20 times in the Itapúa Department. Moreover, these two departments account for an increase of 19.6% of the entire Paraguayan increase, and this ratio increases every year.

### (2) Land Use

In the Study Area: The majority, with 62% of the whole, is used for agriculture. The remaining area can be subdivided in to: 13.6% for cattle raising; 12.8% for forestry, and only 1.0% for urban areas.



Source: MAG

Figure 2.5 Present land use

### (3) Economic Condition

Figure 2.6 shows the transition of gross domestic product from 1993. The growth rate of 2001, 2003 and 2004 was 2% and the indication of recovery is seen. Although the Paraguayan economy showed a steady economic growth in the first half of the 1990's, it was unable to move upwards, and went into a depression for three years from 1998 in 2002.

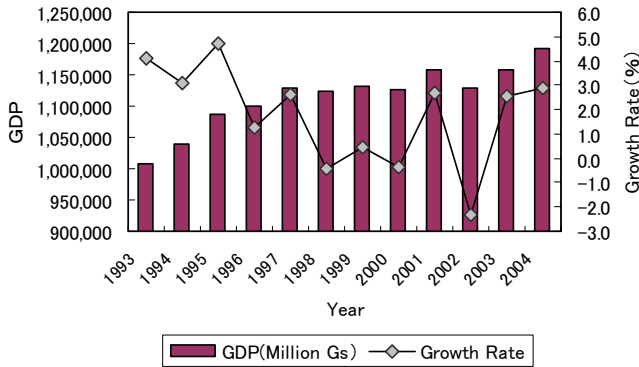


Figure 2.6 Transition of Gross Domestic Product

As for the composition ratio of the gross domestic product of Paraguay, according to the survey in 2003, agriculture shows a large share: of 21.1%, a well as a large share of commercial and financial:



with 20%. Moreover, the growth rate of the primary industry (Agriculture and Stock farming) is high; the growth rate of the second and the tertiary industries is lower in growth rate according to industry. Thus it is shown that the key industries of Agriculture and Stock farming are the most important in the Paraguayan economy.

**(4) Transition of Agricultural Outputs**

Figure 2.7 shows the transition of the output of the main agricultural products in Paraguay. The outputs, with the exception of raw cotton, tend to have increased. The output of Soybeans in 2004 is 2.01 times more compared to the output in 1993, one of corn is 2.55 times more, the one of wheat is 1.68 times more, and the one of sugar cane is 1.29 times more.

Figure 2.7 shows the output of the main agricultural product by department in year 2004. The output of the Itapúa department and the Alto Paraná department, with the exclusion of raw cotton, exceeds that of the other departments by many times. This shows that these two departments are the main agricultural product producing areas in Paraguay. Moreover, Figure 2.8 shows the transition of the planted acreage by department and the output of soybean. The planted acreage and the output increased in the Canindeyú department, the Caaguazú department, and the Caazapá department, and other departments in the inland besides the Itapúa department and the Alto Paraná department that are the main home of the soybean.

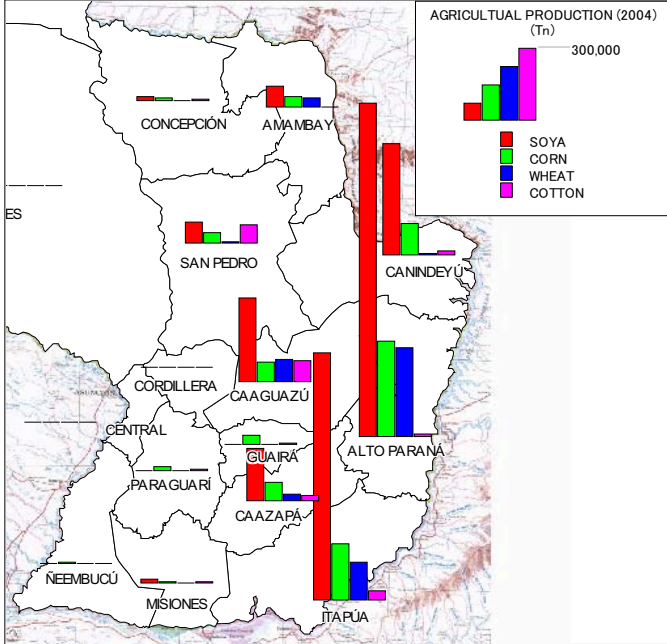


Figure 2.7 Production by Department

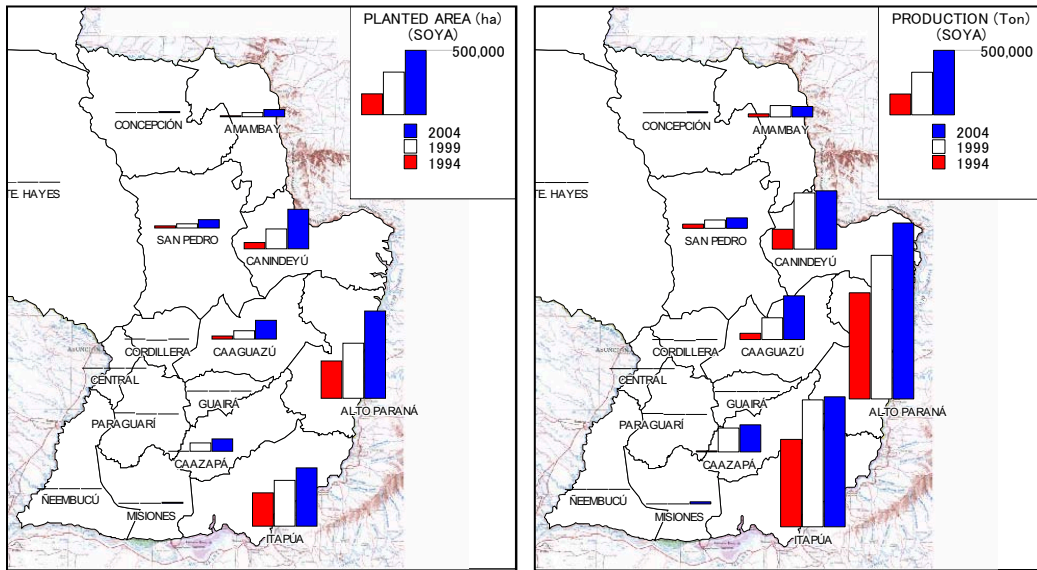


Figure 2.8 Planted Area and Output of Soybean by Department

### 3. TRAFFIC AND ROAD CONDITION

#### 3.1 PRESENT CONDITION OF TRAFFIC FACILITIES

##### (1) Road

Paraguay, which is the inland country, has river transportation (52%) using the Paraná river and Paraguay river, over-the-road hauling (44%), and railway and air (4%) and as a transport infrastructure of an overseas trade. It depends on the river and the over-the-road hauling for most of the mode of transportation. The ratio of land transportation decreases and the one of the river transportation increases comparing with the ratios in 1997.

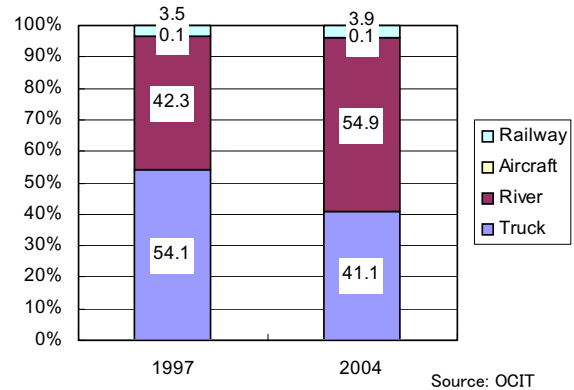


Figure 3.1 Change in Import and Export

The trunk road connecting major cities across the country is specified for the national road or the departmental road. The extension is approximately 15,000km. 3,800km, about 1/4 among these, is the paved road. And remainder 3/4 is earth roads of the unpaved. The earth road receives the road damage of the pothole etc. easily with a heavy vehicle as truck etc. It causes the decrease at the operation speed of the vehicle and the damage of the vehicle. Moreover, running becomes a difficult situation at the rainfall.

## (2) Ports

There are the public ports and the private ones in Paraguay. National Administration of Navigation and Ports (ANNP: Administraración Nacional de Navegación y Puertos) of Ministry of Public Works and Communications (MOPC: Ministerio de Obras Públicas y Comunicaciones) is managing main ports facilities. As for the port in Paraguay are river ports, the use ship is limited by the water level of the river and the sea route depth situation, etc. Moreover, the facilities scale of the port is limited by the dry season and the rainy season, etc.

The situation of ports in the Paraná River Coast that becomes target ports is shown in Table 3.1 Ownership, management of the ports are implemented by the private organization excluding one place, and the silo and the shooter are set up as facilities. However, there is no facility in the Caarendy port at present.

Table 3.1 Situation of Ports in Paraná River Coast

Address	Port Name	Owner or Administrator	Facilities		Transport Charge (to Nueva Palmira)
			Storing Facilities	Loading Capacity	
Alto Paraná Department	Tres Fronteras	OTS	25,000t(grain) 6,000t(oil)	6,000t/day	30 US\$/t
	Trocuá	TOTEM	18,000t	4,000t/day	27 US\$/t
Itapúa Department	Dos Fronteras	Puerto del Sur	16,000t	4,000t/day	25 US\$/t
	Triunfo	MAG (Cargill)	N/A	4,000t/day	23 US\$/t
	La Paloma	Cargill	9,000t	4,000t/day	23 US\$/t
	Don Joaquin	Trans Agro	25,000t	4,000t/day	21 US\$/t
	Caarendy	Pirapo Agricultural Cooperative	None	Facilities none	-
	Paredon	Gical	35,000t	3,500t/day	21 US\$/t

Source: Rodolfo Riego Gauto Co.,LTD.

## (3) Railway

Because the service of railway in Paraguay is suspended now, export with the railway is done from the terminal in an Argentine railway in Encarnación. In IIRSA, there is a plan that connects Cascaver in Brazil and Asunción. The track gages of the railway of the two countries in Brazil and Argentine are 1.0m. It connects to the Atlantic Ocean in Brazil and connects the Pacific Ocean coast in Chile and the part in Paraguay becomes a missing link.

### 3.2 PRESENT CONDITION OF TARGET ROAD

The following are considered to be the problem areas in the current roads. These areas will be taken into consideration when proceeding with future designs.

- Steep gradient in the approach parts to the lower position such as bridges
- Steep gradient in the approach parts to the higher place such as hill

- Rain water erosion to the surface because of vulnerable drainage system (Picture1)
- Rain water erosion to the cut slope (Picture 2)
- Submerged surface because of the lack of an appropriate drainage system (Picture 3)
- In spite of having sufficient road width, it is not used in a effective way (Picture 4)
- Lack of protection to the adjoining iron tower to the road (Picture 5)
- Weak structure of a bridge (Picture 6)



Picture 1



Picture 2



Picture 3



Picture 4



Picture 5



Picture 6

### 3.3 SYSTEM OF ROAD AND PORT MANAGEMENT

#### (1) ROAD

##### 1) *Management Division*

The Paraguayan roads are divided into three categories: the national roads, the departmental roads. MOPC Road Bureau (Dirección de Vialidad) manages the national roads and also occasionally assists with the construction of these roads. It is also in control of maintenance and management of the departmental roads and the rural roads. Despite the fact that, the organizations within the departments originally do the maintenance management of the roads, the MOPC Road Bureau substantially executes this control and management. Therefore, MOPC does substantial control of maintenance of about 15,000km of these national roads, departmental roads, and principal rural roads. The paved extent of these roads is 4,000km (about 14%), and the remainder are unpaved roads. 12 routes are recognized as national roads in Paraguay now. However the connecting roads between the departmental capitals, and the access roads to the principal port facilities are not recognized as national roads, and a problem related to the maintenance and/or the management of these roads occurs. MOPC specifically examined these missing links with a view to the necessity of new national roads, and to the development of a new road network.

##### 2) *Toll Way System*

On the national roads in Paraguay, toll is paid by the user, on the benefit principle. There are 14 toll collection points, and MOPC collects the money directly at 12 points. As for the two remaining places, the toll collection is executed by concession contract of a private organization. Moreover, toll collection is permitted on the departmental roads and the rural roads.

##### 3) *Budget of Road Bureau*

Funding sources for roads are domestic resources and loans from international organizations. Domestic resources are composed of fiscal resources, specified fiscal resources, a government bond and selling of electricity by hydro-power. Gas tax and the toll road collection by MOPC is dealt with as annual revenue in the country, and not used directly for the road maintenance. The road budget changes greatly by year and the budget is a provisional budget. In addition, the execution thereof changes greatly according to the financial conditions.

Table 3.2 Road Bureau Budget

(Unit: 1000 US\$)

Year	2000	2001	2002	2003	2004
Budget Planning	145,062	200,619	140,064	167,114	182,202
Amount of Budget Execution	110,390	83,819	72,191	62,771	111,212
Cost of Construction (Domestic)	34,900	33,239	2,576	11,613	41,936
Cost of Construction (Foreign Aid)	62,591	36,300	62,826	45,888	64,496
Administrative and Maintenance Expense	12,899	14,280	6,789	5,270	4,779
Execution Rate (%)	76%	42%	52%	38%	61%

Source: MOPC

## **(2) PORTS**

The National Administration of Navigation and Ports (ANNP:Administración Nacional de Navegación y Puertos) under the jurisdiction of MOPC execute the control and maintenance of ports and waterways. However, ports have been authorized businesses in the private sector since 1994, and privatization has advanced. Private ports which obtained the authorization of Ports and Harbors Bureau of MOPC, have done business since August, 2001, and have been setting the facility maintenance standards of private ports.

The Paraná River and The Paraguay River are international rivers. However, there is a section which Paraguay maintains independently; this is between Asunción and Valle Mi. The other sections are under the cooperative management with an adjacent country or adjacent country management.

### **3.4 RELATING POLICY, PLAN, AND SYSTEM, ETC.**

#### **(1) South American Regional Infrastructure Integration Action Plan (IIRSA=Iniciativa para la Integración dela Infraestructura Regional Suramericana)**

In the 6th ministerial-level Executive Committee in 2004, "Agenda concerning the mutual agreement of execution of the matter for years 2005-2010" (Refer to Figure 3.2) that consists of 31 projects (about four billion dollars in the investment total) is approved. The financing decision for the road construction of the extension of 1200km that connected Brazil with Peru was signed as a concrete project by the head of the two countries at the end of the year. A severe austerity is forced on many of the attending countries. Therefore the funding related to an individual project becomes an important problem including calling in the private investment from various foreign countries. 25% of funding is private capital, 25% is governmental capital, and the remainder, 50% is semi-governmental capital.





Figure 3.2 Agenda Concerning Mutual Agreement of Execution of Matter for Year 2005-2010

The project of IIRSA that relates to this study is as follows.

### 1) Capricorn Axis Development

It is the east and west axis along the tropic of Capricorn and the second Amista bridge construction plan crossing the Paraná River is advocated as one of the 31 priority projects. The project is the road construction with concession where Foz do Iguacu in Brazil and Ciudad del Este in Paraguay are connected, and the route map including alternatives is examined (Refer to Figure 3.3). Moreover, the interest to Paraguay is low even though Argentina is proposing a bridge, where Puerto Iguazú adjacent to Ciudad del Este, connects as a northern part development, as a two country project.

### 2) Development of Paraguay - Paraná River Axis

This axis is the north south axis that runs through the center of three axes of Central Axis between Both Oceans, Capricorn Axis, and MERCOSUR-Chile Axis that crosses South America. The issues of this axis are aimed mainly at development of the water transportation facilities to La Plata and a Paraguayan water system that flows to the north south and the road development connection to the port facilities. A related project is proposed, including the improvement of the access roads to exporting ports along the Paraná River and the connecting road, these are the target of this study.

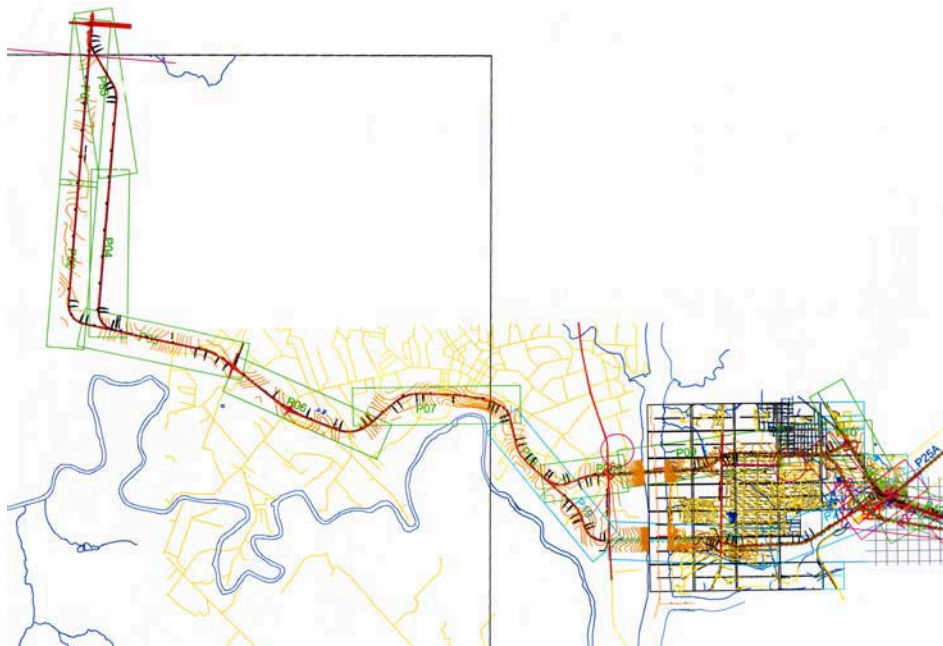


Figure 3.3 Second Amista Bridge Construction Plan

## **(2) Related Projects**

### ***1) Yacyreta Dam***

The submergence compensation is late as the dam construction has been completed. The water level of the dam has adjusted to 76m and hydro-power is produced now. Submergence compensation, the submergence prevention embankment, and construction of excavation in the river are still scheduled to be undertaken for three years. The deriving of power generation at a water level of 83m of the dam will be done in 2008.

### ***2) Corpus Dam Construction Plan***

There is a construction plan of the Corpus dam between Yacyreta dam and Itaipú dam in the Paraná River. The interest to Paraguay is low although it is an international dam with Argentina. Paraguay is not interested in power-generation activities for selling electricity to Argentina any more since Paraguay already sells 99% the Paraguayan share of the power generation of Yacyreta dam. The dam will become a Concession if Paraguay executes the dam, and the government plans not to take part immediately.

### ***3) New Port Construction for Submergence Compensation of Encarnación Port***

The construction of a new port with a pier of 200m in total for containers and a grain terminal is planned in Arojo Quiteria in the area of Encarnación. The capital allowance has not been made yet, and it is desirable to start construction in about three years. It is thought that recent port management of ANNP is private by Concession management, and that this new port will not be an exception.



#### 4. STRUCTURE OF EXPORT AND IMPORT IN PARAGUAY

The value of imports and exports of Paraguay showed a decrease in 1997, which remained stable from 1999 to 2002. Although it started to show a tendency to increase again, with the economic recovery in 2003, it had not as yet reached the level of 1990.

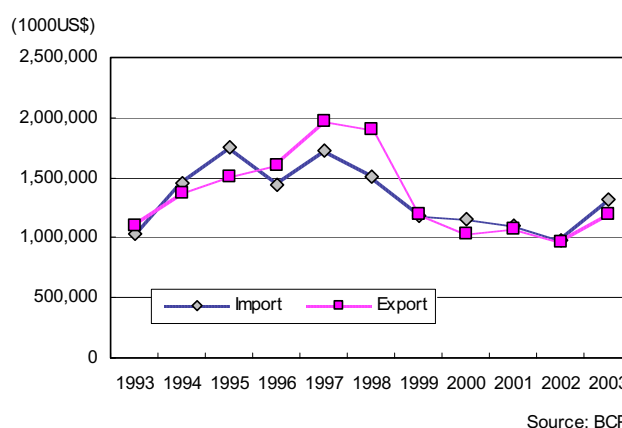


Figure 4.1 Transition of Value of Imports and Exports

The quantity of total export of Paraguay in 1997 was about 4.4 million tons on weight basis. The main export products were agricultural goods such as soybean, wood, wheat, and corn. Moreover, the export quantity of, especially soybean, increased greatly, and has shown that the importance of soybean has risen. The tonnage of total export in 2004 increased by 5.6 million, though the quantity of the main export items did not change. On the other hand, an increase in fertilizer made up the entire amount of the import.

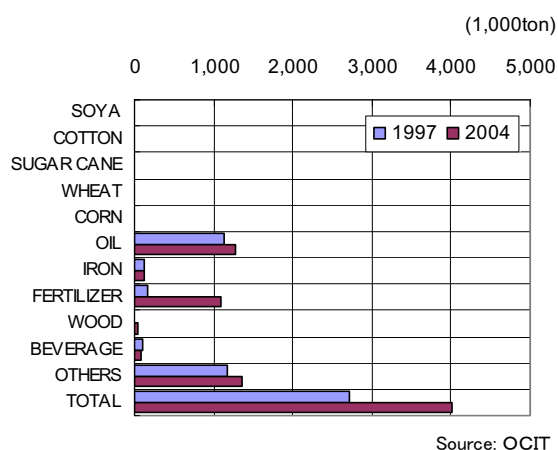
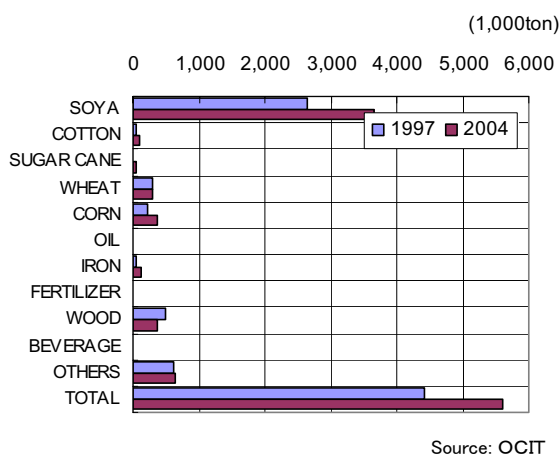


Figure 4.2 Transition of Amount of Export and Import by Article

In addition, river transportation tended to increase, reflecting an increase in the amount of export of soybean, as a transportation mode. It is assumed that this tendency will continue in the future as long as the export structure in Paraguay is not greatly changed, and the ratio of river transportation increases, the resulting appropriate maintenance of harbors and access roads will become necessary. On the other hand, the use of river and road transportation, for export, will be at almost the same rate as that for import (Refer to Figure 4.3).

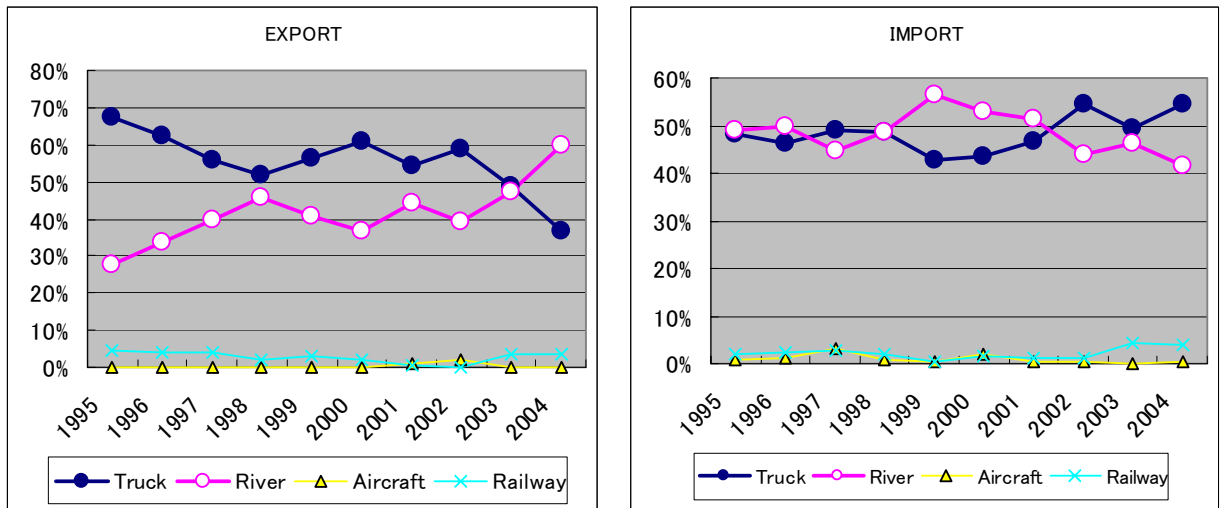


Figure 4.3 Change in Transportation in Imports and Exports

Figure 4.4 shows the change of the origin for imports and the destination for exports in Paraguay. The amount of exports to Brazil, Argentina and Europe decreased, and exports to Uruguay and other Latin American regions increased. The reason for the decrease of exports to Brazil is that entrance of genetically-modified soybeans was temporarily prohibited and export through the Paran gua port was decreased. On the other hand, the imports from Brazil and Argentina increased with the ratio of 61% in 1995 to 78% in 2004, and shows that the intraregional trade within MERCOSUR become active.

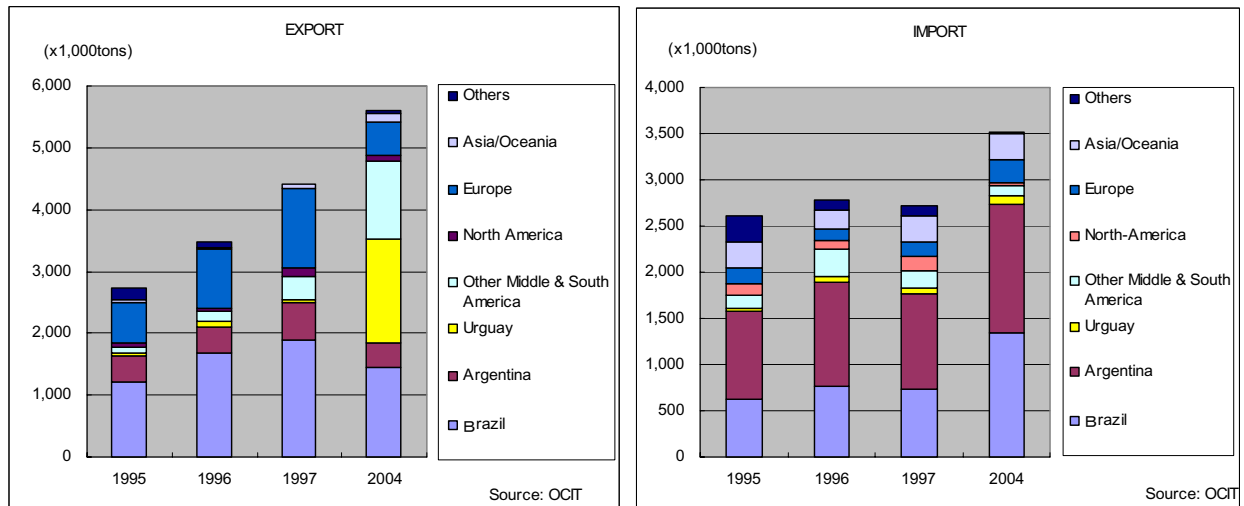


Figure 4.4 Change of the Origin for Imports and Destination for Exports in Paraguay

The route and the transportation used in imports and exports are shown in Figure 4.5. In exports, the amount to Argentina on the Paraguay River and the Paran  River accounts for about 60% of the amount of all exports. This indicates the importance of river transportation in exports. However, the Paraguay River is used more than Paran  River at present. For land transportation, the quantity to

Brazil through Ciudad del Este accounts for approximately 20% of the entire amount. In imports, the amount carried by using the Paraguay river from Argentina increased by 44% of the whole of the amount, in addition; land transportation to Asunción and Ciudad del Este from Argentina and Brazil also increased. The total amount of these two account for about 40% of the total of all imports.

An enormous discrepancy can be seen in the form of the river transportation in exports and imports. The use of Paraguay River has increased overwhelmingly in imports, while both rivers are used almost equally for exports. This is because equipment, such as piers needed for imports is not provided to harbors on the Paraná River banks. The improvement of ports that have the import equipment on the Paraná River banks is expected to resolve the imbalance of the import and export quantities by efficient port use.

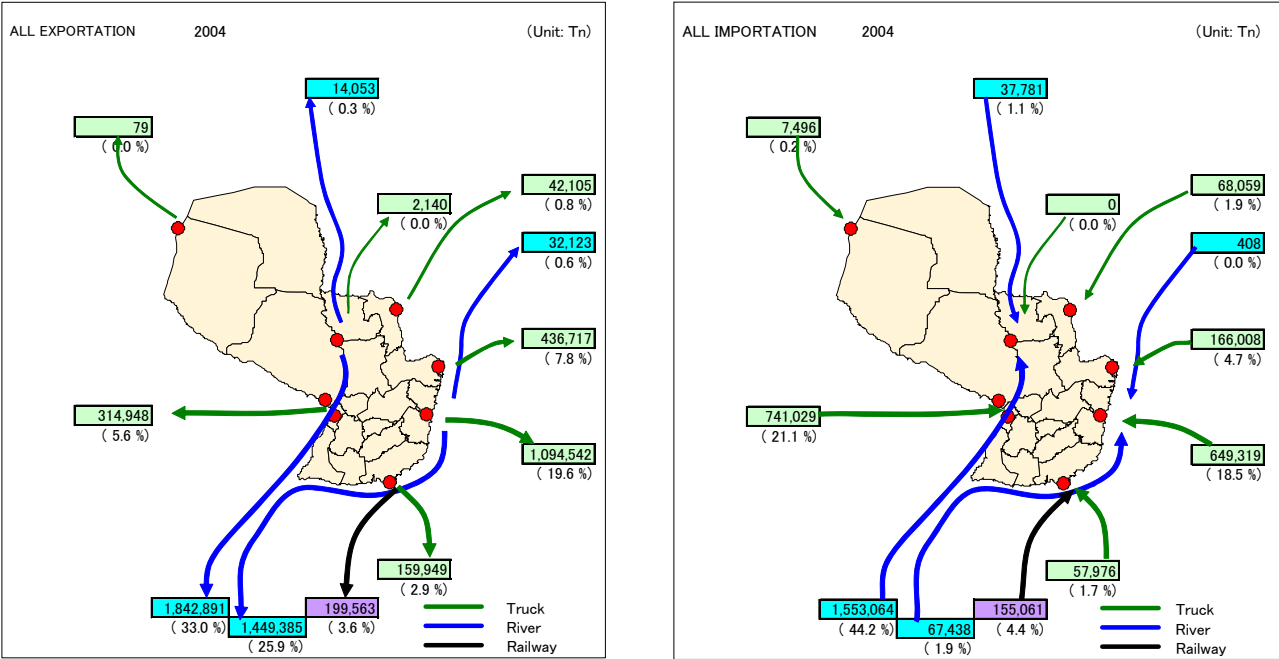


Figure 4.5 Amount of Imports and Exports by Route and Transportation (2004)

**5. CURRENT PROBLEMS**

**(1) General**

Paraguay’s improved productivity was asserted by trading improvements with the neighboring countries, and by actively participating in Mercado Común del Sur (Mercosur). Paraguay, which is a landlocked country, exports using river transportation (60%) through the Paraná River and the Paraguay River, road traffic to neighboring countries (37%), and rail traffic. Air shipment (3%) is the means of transportation for overseas trade. Most transportation relies on river and road traffic. However, the maintenance of the transport infrastructure is poor and the roads that connect production bases to export gates are unpaved. Heavy vehicles, such as trucks, are subject to damage while

traveling on these unpaved roads due to potholes and the like. These bad conditions force vehicles to reduce speed, cause damage to the machines, and make driving especially difficult after rainfall. Moreover, there are lots of private ports located on the Paraná River bank, and most of them are exclusively used for grain export. Most of these ports are small scale and take advantage of the geographical features of their location, though each port is located near the corresponding producing district. Also, a lot of access roads from trunk roads to export ports are not connected with all-weather roads, which sometimes becomes a problem when the delivery work gets held up.

## **(2) Road Related Problems**

### ***1) Roads Closed by Rainfall***

The departmental and rural roads in the study area are often closed to traffic after heavy rainfall, and cars often cannot drive on these roads for quite some time. The number of rainfall days in the study area are about 6-9 days/month except in July and August, which means that there can be no traffic on the roads for at least these rainy days.

### ***2) Decline of Producer Prices Caused by Undeveloped Roads***

Deals are made taking into consideration the spot-sale price calculated from the international market price (forward pricing) though exports such as grain depend on the contract with the exporter. And grain purchase contractors transport it from accumulation areas or from production areas to the transportation port on their own account or through a contract with the carrier. All of these transportation costs fall substantially on production farmers, and the spot-sale price is decided by subtracting the transportation cost from the shipping value. Because the transportation risk of potential transport delays due to rainfall and increase of vehicle operation cost is added to the transportation cost, the proportion of transportation cost on the final price of production goods - especially from an undeveloped area of the export corridor - is high, and the producer price lowers and leads to a decline in the willingness to produce.

## **(3) Problems Related to Ports**

Ports in Paraguay are distributed along the Paraná River and the Paraguay River, but their size is limited because they are constructed ashore along the rivers. Also, the loading ability of each port is 3,500-4,000 ton/day. Moreover, yearly contracts are entered into with some major trading companies. Therefore, general users are hardly able to use these ports though there are a lot of private ports.

Producers secure sales contracts for risk reduction in relation to the market price before growing about 60% of the production. Therefore, the structure allows the other 40% to be sold off, adjusted by the current supply-demand situation. However, as mentioned above, port facilities are monopolized by some big traders who can use them at all times, and even if medium-small farmers come during

advanced time of clearance, they often cannot sell off. As a result, very often medium-small farmers are forced to make deals with excessive risks.

#### (4) Poverty

The latest data on poverty in Paraguay come from a survey executed in August-December, 2004 in association with IDB (Inter-American Development Bank). According to the results of the survey, necessary food cost of 410,189 Gs per family (4.7 people). is set as the extreme poverty line and necessary living cost of 643,539 Gs per family is set as the poverty line. 41% of the population is below the poverty line and half of those are below the extreme poverty line on the national average. In the Itapúa Department, the extreme poverty rate reaches 24% of the whole; higher than the national average. However, this poverty rate is near the national average. On the other hand, the poverty and the extreme poverty rate of the Alto Paraná Department are becoming smaller than those of the national averages.

Table 5.1 Poverty Situation in Paraguay

Residential Area	Total Population	Poverty Population	Poverty Rate %	Extreme Poverty Population	Extreme Poverty Rate %
Paraguay Total	5,701,675		41.4		20.1
Asunción	509,190		24.8		8.2
Urban Area (Central)	1,331,170	655,783	49.3	191,097	14.4
Urban Area (Others)	1,401,143	454,009	32.4	185,009	13.2
Rural Area	2,406,172	986,869	40.1	560,933	22.8
Alto Paraná	556,002		29.1		15.0
Itapúa	451,247		41.1		24.1

Reference : Praguay Pobreza y Deigualdad de Ingresos a Nivel Distrial (2004), DGEEC

## **II BASIC PLANNING**

### **6. DEVELOPMENT STRATEGY OF THE EXPORT CORRIDOR**

#### **6.1 NEEDED FUNCTIONS AND ROLES OF THE EXPORT CORRIDOR**

Development of the access road and feeder roads leading to the major ports in the Study area is not only important to support export and economic development in Paraguay, but is also significant for the promotion of the regional development along the road corridor. That is to say, while the former has the function of being the “distribution corridor”, the latter has the role and expectation of being the “development corridor”. Furthermore, Paraguay is one of the South American countries with an under developed infrastructure; therefore, it is especially essential, as a landlocked country, to develop a well established transportation infrastructure in order to promote exportation.

Thus, the functions required of the export corridor could be summarized to the following three development strategies.

- 1) Development as export corridor
- 2) Development as regional service roads
- 3) Development as a component of the international/regional network in South America

#### **6.2 DEVELOPMENTS STRATEGY BY FUNCTION**

##### **(1) Development as Export Corridor**

The most needed function of the export corridor is the stable, smooth and efficient exportation of grains represented by soybean and wheat produced in the Study area. To make this possible, there are three indicative strategies to be taken into account.

##### ***1) Development of stable land transport***

When precipitation is severe in the Study area, provincial roads and local roads, for the reason of road management, often close and virtually no vehicles can pass along these roads. Moreover, rainfall hinders grain transport while increasing transportation cost. Therefore, there is a need of an all-weather paved road, as well as reinforcement in the maintenance system of such a road to make it possible for large grain transport carriers to use these roads, all year round.

##### ***2) Acquisition of land routes to the neighboring countries***

It is estimated to export approximately 50% of the overall Paraguayan grain from the Alto Paraná province and the Itapúa province in the year 2015. Within the transportation means, 58% relies on river transport, 35% on road, and the remaining on railroad. Therefore, it is not only necessary to pre-consider access by river transport to the main port, but also to consider maintenance of roads that makes smooth exportation possible by truck transport in the Brazil (Paranáguá) and Argentina

(Buenos Aires) direction. Especially, as exports increase, there might be a possibility of causing bottlenecks in both, Brazilian and Argentinean sections and as it has been proposed in the South American Regional Infrastructure Integration Action Plan (IIRSA), construction of a new Second Amistad bridge and improvement of the Encarnación-Posadas bridge should come together with the development of the export corridor of this Study that links the producing center to the shipping center.

### ***3) Efficiency in Transport***

Many private small-scale ports are located along the Paraná River, and most of these ports are used exclusively for grain exports. Whether private or publicly owned, these ports should be opened to public use, however, in reality, large businesses arrange annual contracts with these ports and general public users do not have access to these ports. Therefore, increase in port capacities, especially, those open for public use shall be strived for while further improvement in port management efficiency shall be aimed at by improving reciprocal port communication that attains proper sharing of port facilities.

### **(2) Development as Regional Service Road**

Despite low traffic, a road is necessary from a regional development standpoint. Itapúa, which is within the Study area, has a high poverty rate and it is an area where regional development is necessary. Indeed, the export corridor primarily functions as a “distribution corridor” in delivering products such as grains smoothly and precisely to the destination while also functioning as a “development corridor” for alleviation of regional disparities from a development standpoint. This is precisely why, it is indispensable to secure the function as export corridor while locating the route planned close to the city; in addition environmental countermeasures are also required within the city area.

### **(3) Development as International Road Network in South America**

As mentioned previously, Paraguay is a landlocked country, thus, it is indispensable to form a network that will support exportation to outside the country. Further, it is also necessary to develop a transport infrastructure that will connect to an international network in South America. As for river transport, the South American Regional Infrastructure Integration Action Plan (IIRSA) proposes the development of the road along the Paraná River and road access to the main port as this Study target, in order to form a river transport network system by utilizing two international rivers, Paraguay and Paraná. On the other hand, as to land transport, the level of road development in Paraguay is extremely low compared to the neighboring countries and is in need of improvement. In land transport, in order for Paraguay to connect to the wide-range South American network, it is desirable to establish a mutual network that links the border points while improving accessibility to the major international borders.

In the IIRSA framework, it is desired for Paraguay to strengthen an axis of the portion of the road system that links the two oceans, the Pacific and the Atlantic; by developing a widerange EastWest road system in the northern (Chaco) and the central (Asunción Ciudad del Este ) regions of Paraguay.

In IIRSA, it is proposed to develop a service of paved road between Brazil and Bolivia in the Chaco region as the northern network. In the central region, it is planned to improve the existing bridge (Encarnación -Posadas) and construct new bridges (Second Amistad Bridge, New Pilar Bridge) on the Brazilian and Argentinean borders in order to solve the capacity shortage of bridges. In order to make effective use of these bridges, a road link between the Second Amistad Bridge and New Pilar Bridge is essential; and the project of this Study is highly significant as a part of the international network along the Paraná River.



Figure 6.1 Development Plan of International Highway Network proposed in IIRSA (Only related to Paraguay)



# 7. FUTURE TRANSPORTATION DEMAND FORECAST

## 7.1 SETTING A SOCIOECONOMIC FRAMEWORK

### (1) Population

The country population is forecasted to reach 5.5 millions in 2000, 6.98 millions in 2010, and 8.57 millions in 2020, approximately, from 4.22 million people in 1990. In other words, the growth rate is forecasted to show a slight decrease in the future, from a tenyear 1.30 growth rate (2000/1990) to 1.27 (2010/2000) to 1.23 (2020/2010). The populations of the Alto Paraná Department (1.66 times) and Central Department (1.33 times) are expected to show a great increase in ten years (2010/2000). Please refer to Figure 7.1.

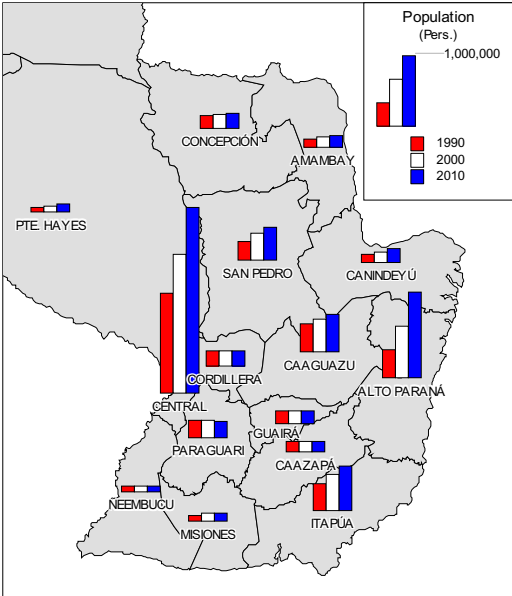


Figure 7.1 Population Estimation per Department

### (2) Economic Growth Rate

The Study on Economic Development in Paraguay (SEDP), suggests building a structure that would enable the 6% annual growth rate to last and increase in relation to the economic growth rate in Paraguay during the Action Plan period (2001 –2006). However, it is a considerably high goal, taking into account the results averaging 2.3 –2.9% during the last 3 years.

Table 7.1 shows the economic growth rate per industry. Productivity is forecasted not according to GDP but in relation to tendencies by using the method of advantage in relation to future population per industry. The average growth rate forecasted from 2004 to 2010 is 3.76% from 2010 to 2015 is 3.29% and from 2015 to 2020 is 2.94%

Table 7.1 Economic Growth Rate Forecast

	Average Annual Growth Rate (%)		
	Primary	Secondary and Terciary	TOTAL
2000 -2005	4.25	0.07	1.26
2005 -2010	2.36	0.44	1.05
2010 -2015	2.11	0.43	1.00
2015 -2020	1.91	0.42	0.95

## 7.2 PRODUCT FLOW FORECAST

### (1) Production Forecast of the Main Agricultural Products

In this section, we will provide a soybean, wheat and corn forecast, since these are the main products of the Study Area. This forecast has been prepared based on a method that takes into account the planted acreage with a future trend analysis, and then the cultivation acreage is multiplied by the average yielding per area (production volume per area unit).

### (2) OD Traffic Volume Forecast per Product

OD transportation volume is estimated in relation to the origin and destination of the main agricultural and agro industrial products. The traffic distribution patterns come from the Study on Economic Development of Paraguay (SEDP).

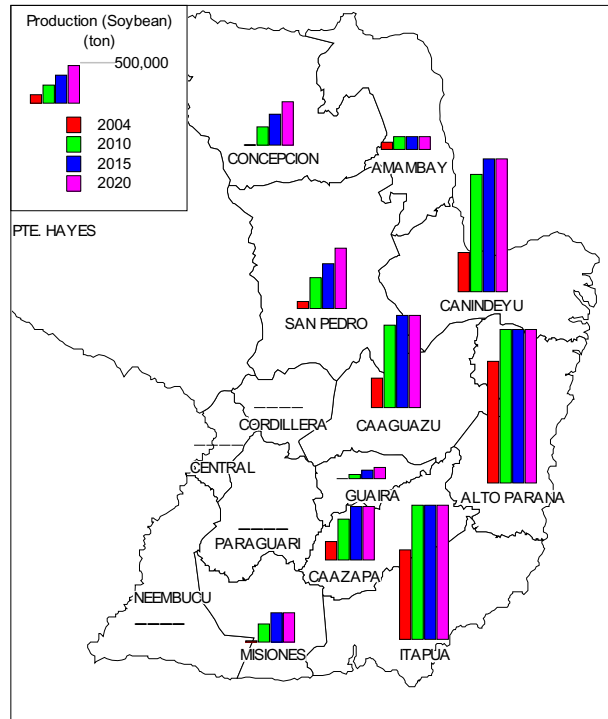


Figure 7.2 Soybean Production Forecast per Department

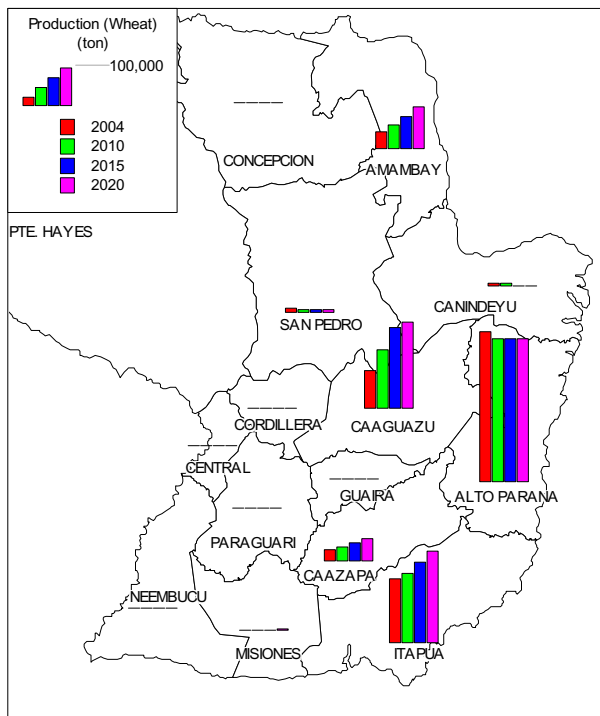


Figure 7.3 Wheat Production

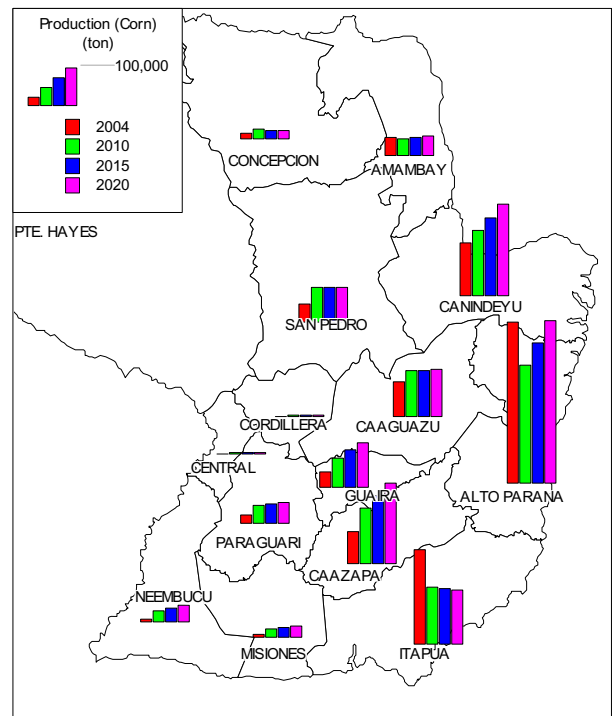


Figure 7.4 Corn Production

### 1) Soybean and related product

The volume of exports through the Paraguay River is expected to grow as production new lands gradually shift from the west side shores of the Paraná River. The use of the Paraná River for exports is expected to double from its current use, approximately. Likewise, the amount of soybean exports is expected to increase, too.

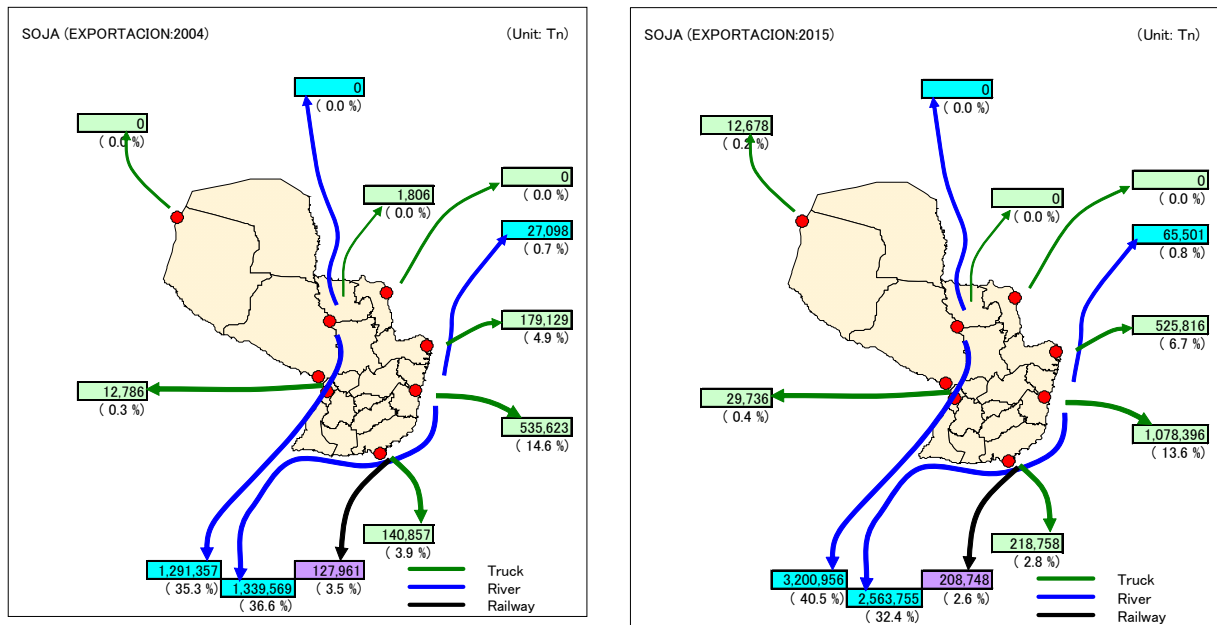


Figure 7.5 Road Change for Soybean and Related Product Exports

### 2) Wheat

As the national consumption of wheat increases, future exports will not increase much. The use of the Paraguay River for exports is expected to increase as soybean production land shifts towards the west side.

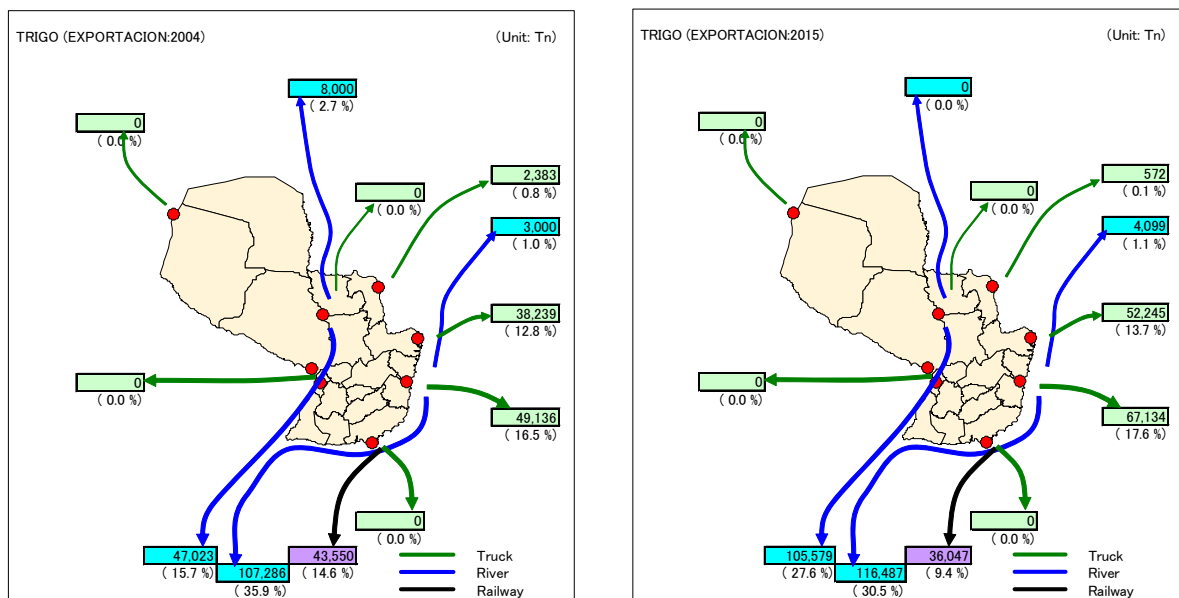


Figure 7.6 Road Change for Wheat Exports

### 3) Corn

Since the highest amount of corn exports goes to Brazil, the Paraná River is not used. Its use is not expected to increase in the future.

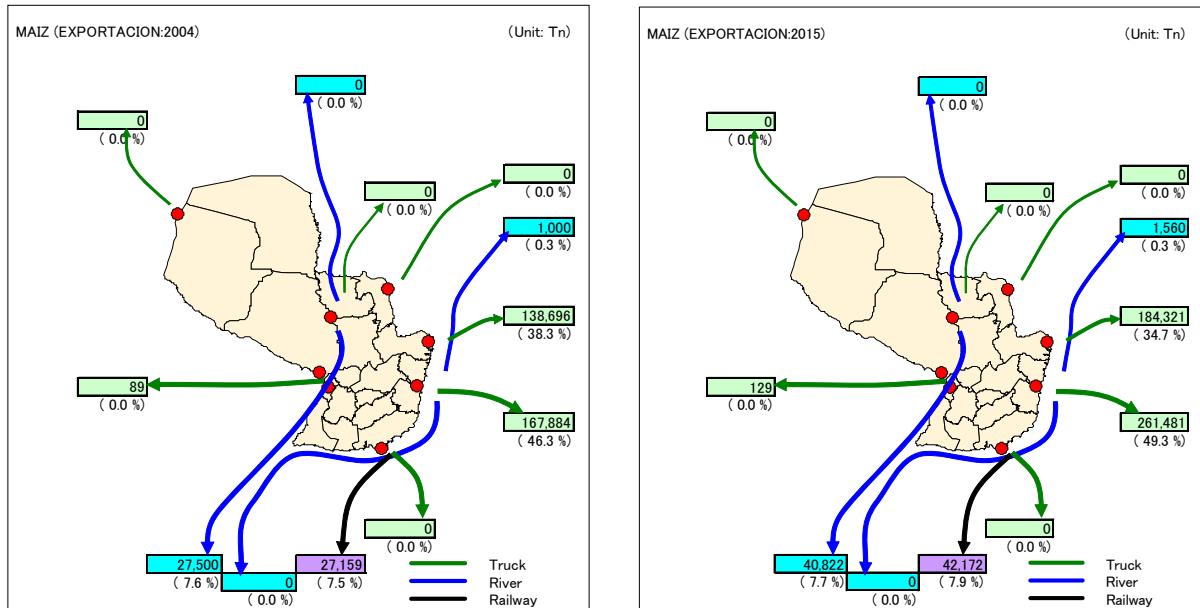


Figure 7.7 Road Change for Wheat Exports

## 7.3 FUTURE TRANSPORTATION DEMAND FORECAST

We make a forecast of the future traffic volumes per road section, for the time the road along the Paraná River and the river port access roads are developed. The Objective year is 2015.

- Grain export related freight truck traffic
- Utility traffic of the residents along the road
- Long distance traffic detoured from National Road Route 6.

### (1) Forecast of Grain Export Related Freight Transport

In the previous chapter, we have studied the customs for grain exports based on the existing patterns. However, if we manage to decrease transportation costs by improving road infrastructures, we may be able to present a variation in the grain export road. In relation to this, the forecasted OD transportation volume per freight in the previous chapter was estimated from the transportation volume per section, preparing a traffic distribution model per section, taking transportation cost as a parameter.

Transportation volume increases in most of the sections due to an increase in the transportation that will use the ports in operation on the Paraná River once the corresponding roads that correspond to the Paraná River coast road and the extension of National Road 15.

Table 7.2 Paraná River Use Ratio Increase with the Improvement of the Export Corridor

	Without Export Corridor	With Export Corridor
Paraguay River Use	155,540 units (54.7%)	145,330 units (51.1%)
Paraná River Use	128,760 units (45.3%)	138,970 units (48.9%)
Total	284,300 units (100.0%)	284,300 units (100.0%)

## (2) Traffic Forecast for Resident along the Roads

According to the Traffic Study Report, the traffic observed on the coast road alongside the Paraná River and the extension of National Road 15 is shown in Table 7.3. The actual 24h traffic volume was calculated by multiplying the traffic volume by the day/night ratio (24 hours / 14 hours) observed in the Trinidad toll gate. Besides, we also looked for an average transformation quotient from the observation data corresponding to the year 2005 on National Road Route 6. We also took into consideration that this last information includes the average traffic volume considered. Also, port access roads were also estimated based on the results of the traffic volume of the Study.

Table 7.3 Traffic Forecast for Residents along the Roadside

(Paraná River Coastal Road and Extension of National Road Route 15)

### (1) Natalio-Pdte.Franco

	Car	Bus	Truck	Total
(A) Observed traffic volume (veh/14h)	449-686	20-37	174-280	646-932
(B) Day / night ratio (24h/14h)	1.11	1.17	1.15	-
(C) Current traffic volume (veh/day) (section average) (A*B)	626	30	254	910
(D) Annual average variation quotient	1.002	0.891	0.891	-
(E) Future traffic volume (veh/day)	1.39	1.39	1.39	-
(F) Future traffic volume (veh/day) (section average) (C*D*E)	870	40	310	1,220

### (2) Pdte.Franco-Road 7

	Car	Bus	Truck	Total
(A) Observed traffic volume (veh/14h)	1,323-1,680	235-630	258-350	1,908-2,568
(B) Day / night ratio (24h/14h)	1.11	1.17	1.15	-
(C) Current traffic volume (veh/day) (section average) (A*B)	1,667	506	350	2,523
(D) Annual average variation quotient	1.002	0.891	0.891	-
(E) Future traffic volume (veh/day)	1.39	1.39	1.39	-
(F) Future traffic volume (veh/day) (section average) (C*D*E)	2,320	630	430	3,380

### (3) Extended Section of National Road Number 15

	Car	Bus	Truck	Total
(A) Observed traffic volume (veh/14h)	225	10	114	349
(B) Day / night ratio (24h/14h)	1.11	1.17	1.15	-
(C) Current traffic volume (veh/day) (section average) (A*B)	250	12	131	393
(D) Annual average variation quotient	1.002	0.891	0.891	-
(E) Future traffic volume (veh/day)	1.39	1.39	1.39	-
(F) Future traffic volume (veh/day) (section average) (C*D*E)	350	20	160	530

### (3) Forecast of Inter-Departmental Traffic Detoured from National Road Route 6

There are three detoured traffic patterns from National Road Route 6 to the project road, as shows by Figure 7.8. Due to the existing speed differences between National Road Rooute 6 and the Paraná River Coastal Road, case this latter increases speed, it includes the traffic detoured from National Road Route 6. In case there is a 20% time shortening in comparison to National Road Route 6, we have set the conversion curves shown in Figure 7.8 assuming an 80% detour from the total.

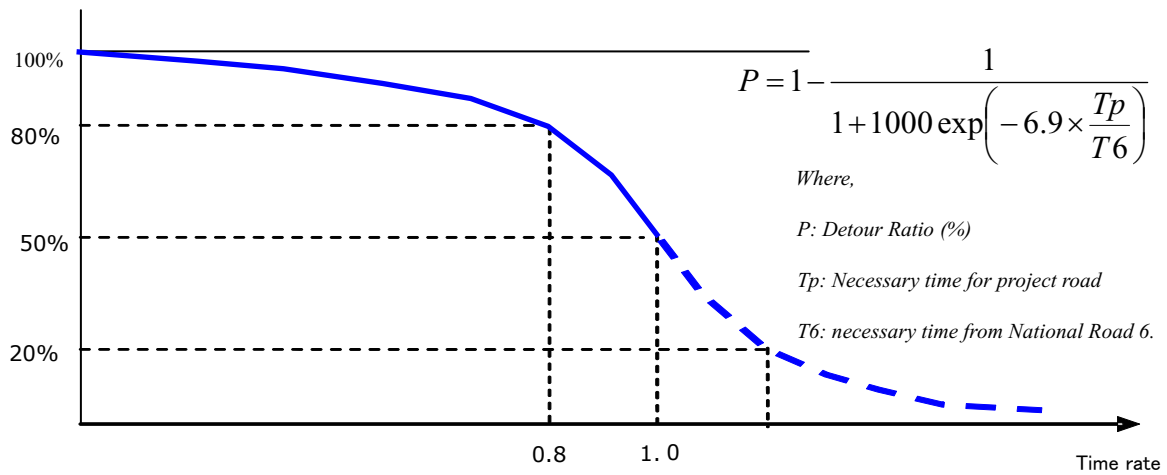


Figure 7.8 Detour Ratio Curve

Table 7.4 Summary of the Traffic Volume Detoured from National Road Route 6

Detour pattern		Traffic Volume of Detoured Area	Detoured Traffic Volume
I		<b>2005 (veh./day)</b> Car 208 Bus 52 Truck 144 Total 404	<b>2005 (veh./day)</b> Car 80 Bus 31 Truck 43 Total 154 *Detour Indexo 38.1%
			<b>2015 (veh./day)</b> Car 110 Bus 40 Truck 50 Total 200
II		<b>2005 (veh./day)</b> Car 235 Bus 5 Truck 113 Total 353	<b>2005 (veh./day)</b> Car 90 Bus 5 Truck 35 Total 130 *Detour Index: 36.8%
			<b>2015 (veh./day)</b> Car 130 Bus 10 Truck 40 Total 180
III		<b>2005 (veh./day)</b> Car 38 Bus 1 Truck 61 Total 100	<b>2005 (veh./day)</b> Car 4 Bus 1 Truck 9 Total 14 *Detour Index 14.0%
			<b>2015 (veh./dia)</b> Car 10 Bus 0 Truck 10 Total 20

#### (4) Total Future Traffic Volume

The result of the study shows that the traffic volume on the Paraná River coast road is 1,410 – 4,080 units per day. From Natalio towards the north there is a higher volume. Also, the traffic volume that corresponds to the extension of Road number 15 is 690 – 700 units per day. With the formation of a road net between National Road Route 6 and the Paraná River Coastal Road the volume of traffic will double in relation to the current volume. Likewise, the volume that corresponds to the port access roads is 210 – 2,960 daily units, PAR-8 which corresponds to downtown Ciudad del Este presents a higher amount. However, the other accesses go from 210 – 1,010 daily units.

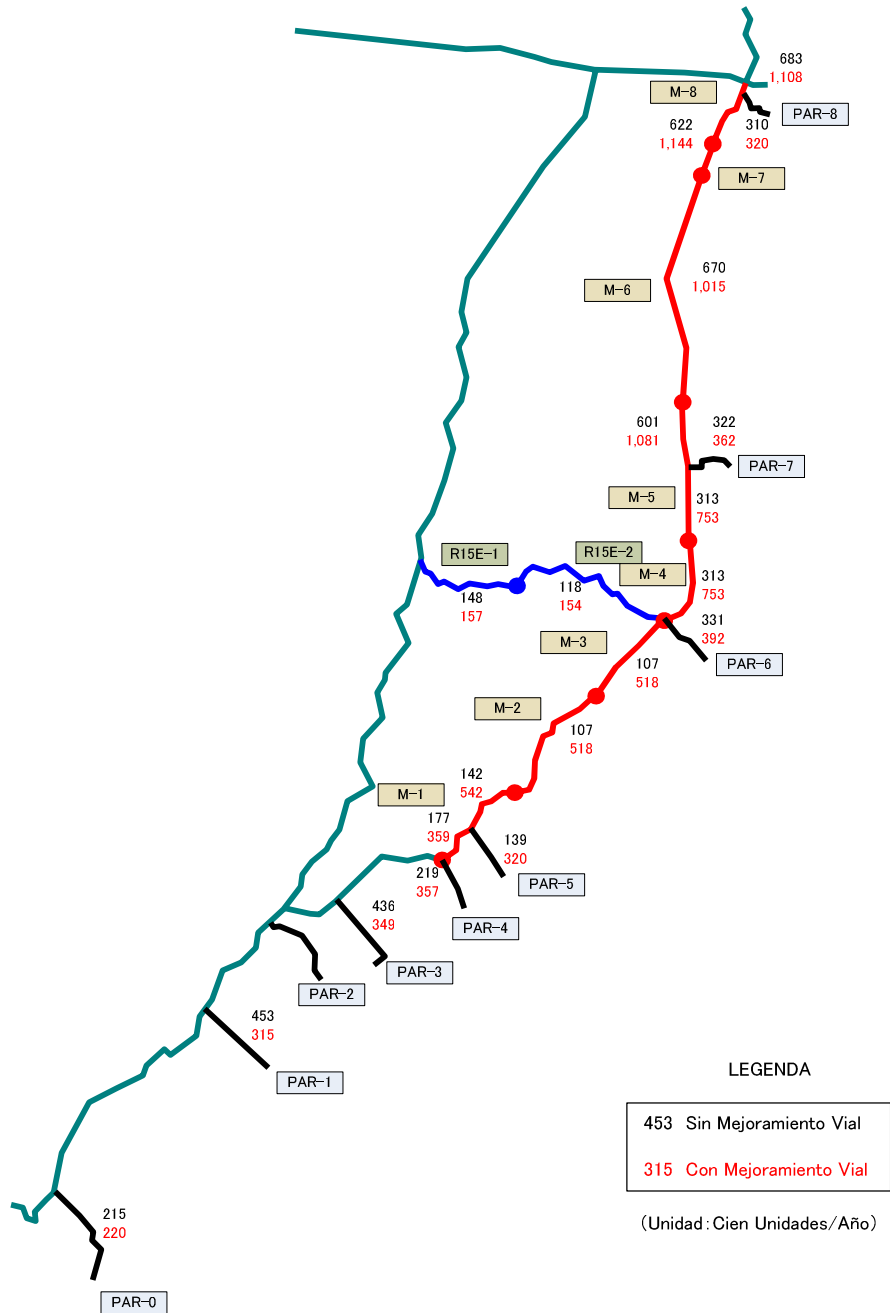


Figure 7.9 Traffic Volume Forecast