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

Preparatory Survey on the Eastern Region Export Corridor Improvement Project in the Republic of Paraguay

Final Report

(Summary)

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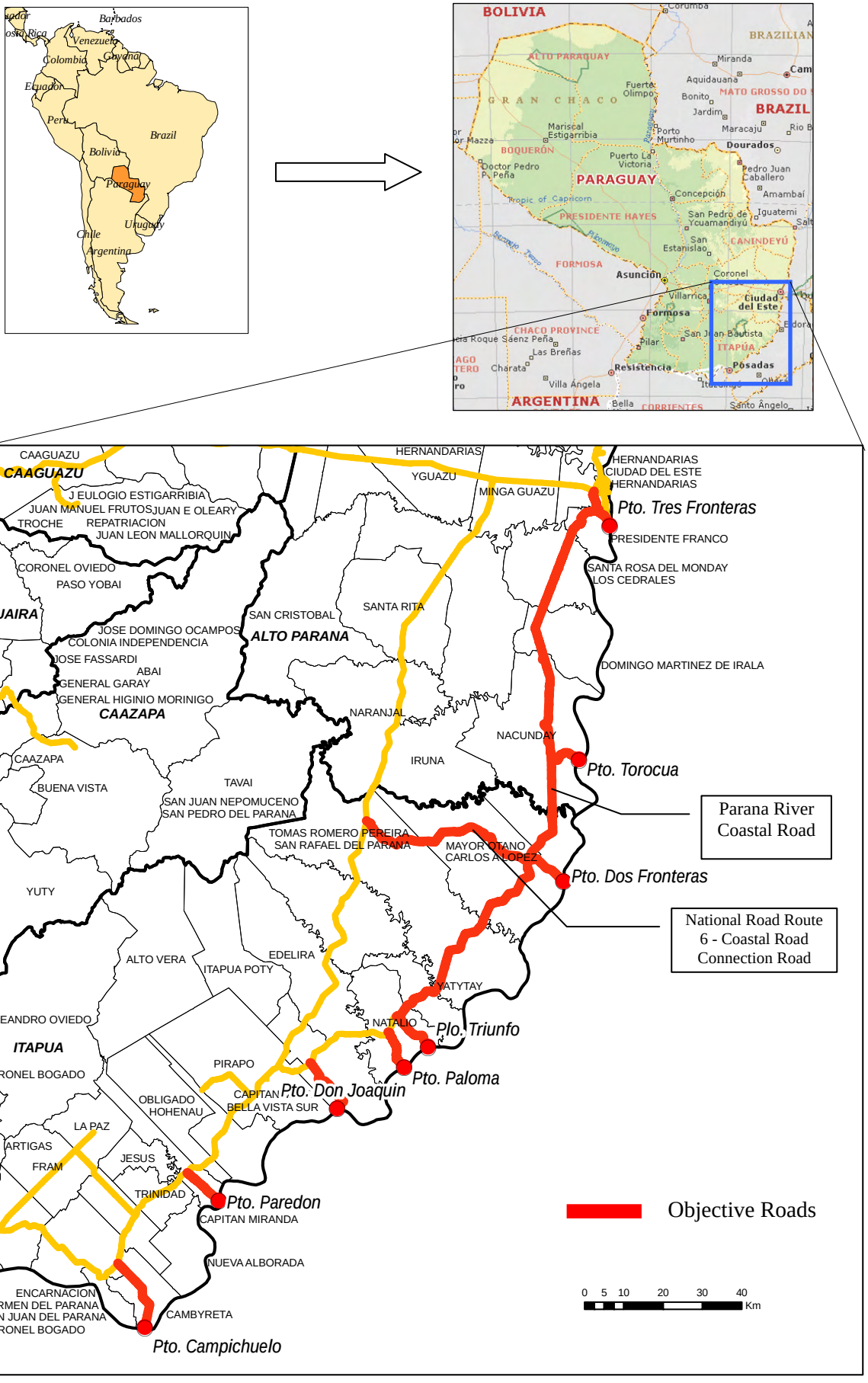
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CANINDEYU
ITAPUA
Asunción
Ciudad del Este
Pto. Tres Fronteras
PRESIDENTE FRANCO
SANTA ROSA DEL MONDAY
LOS CEDRALES
DOMINGO MARTINEZ DE IRALA
Pto. Torocua
Parana River Coastal Road
Pto. Dos Fronteras
National Road Route 6 - Coastal Road Connection Road
Plo. Triunfo
Pto. Paloma
Pto. Don Joaquin
Pto. Paredon
Pto. Campichuelo
Objective Roads
0 5 10 20 30 40
Km
CAAGUAZU
GUAIRA
CAAZAPA
ALTO PARANA
ITAPUA
HERNANDARIAS
CIUDAD DEL ESTE
YGUAZU
MINGA GUAZU
SAN CRISTOBAL
SANTA RITA
NARANJAL
NACUNDAY
IRUNA
TAVAI
TOMAS ROMERO PEREIRA
SAN RAFAEL DEL PARANA
MAYOR OTANO
CARLOS A LOPEZ
YUTY
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ITAPUA POTY
EDELIRA
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ABAI
GENERAL GARAY
GENERAL HIGINIO MORINIGO

Survey Area

Typical cross-section of the Parana River Coastal Road (W=6.0m)

Typical cross-section of the Parana River Coastal Road (W=9～11m)

When it rains, road condition become worse and it will be hard to traffic
(Parana River Coastal Road)

Pontoon Bridge crossing the Ñacunday River
(Parana River Coastal Road)

Timber Bridge crossing the Yacuy Guazu River
(Parana River Coastal Road)

Typical Stone Pavement Section
near the Ciudad del Este
(Parana River Coastal Road)

Present Objective Road (1)

Typical cross-section of the National Road Route 6 - Coastal Road Connection Road (Stone Pavement Section)

Typical cross-section of the National Road Route 6 - Coastal Road Connection Road (Dirt Section)

Port Access Road (to Pt. Paloma)
（Trucks are forming a long queue）

Port Access Road (to Pt. Don Joaquín)

Bridge on the Port Access Road (to Pt. Torocua)

Rolling Port Access Road (to Pt. Paloma)

Present Objective Road (2)

1. Study Background and Purpose

Promoting agricultural production and exporting agricultural products are vital means for the Republic of Paraguay ("Paraguay") to obtain foreign currency and its growth is important for the nation's economy. JICA carried out a Study on the Export Corridor and Grain Ports in Paraguay (the "F/S") in 2006, which covered the Eastern Corridor and ancillary harbor facilities and clarified the necessity of making improvements to the Export Corridor. Based on the results of the study, the Paraguayan Government has been considering a yen loan request. As almost five years have elapsed since the study was completed, socioeconomic conditions have changed and worldwide concern about environmental protection has grown. For these reasons and in view of the need for climate change countermeasures, a review of the F/S has become necessary.

The objectives of conducting this study review are to confirm the appropriateness of the project under consideration as a candidate for a new ODA loan item, and based on the substance of the previous F/S, to review information needed to consider execution as an ODA loan project.

2. Confirmation of Necessity and Importance of the Project

(1) Response to increased production of agricultural products

The production of major agricultural products greatly increased in the 10 years from 2000 to 2010, with soybean production growing 2.50 times, corn 4.80 times and wheat 6.07 times. Except for soybeans, the figures largely exceed the estimates in the former F/S. This production is the driving force for economic growth in Paraguay. The major production centers for these agricultural products are the Alto Parana Department and Itapua Department. This is the key reason for saying that the necessity of developing an export corridor through the grain centers is very high.

(2) Response to increasing need for river transportation

Along with the increased production of grains, the volume of exports shipped via the Parana River is increasing. The export volume in 2010 was 1.59 times that of 2006. These exports have been, and growing more than 12% on average annually. The export volume in 2010 is equivalent to that forecasted for 2015 volume in the 2006 F/S. The importance of exports shipped via the Parana River and the need to develop the export corridor is higher than it was in 2006.

(3) Response to impassability of roads due to rainfall

Prefectural and local roads may be closed for the purpose of maintenance during rainfall. Even in sections where roads are not closed, the roads may become muddy, which in effect makes passage of vehicles impossible. For the area under study, the number of rainy days is about 6 to 9 days a month, except for July to August. At a minimum the roads remain impassable during these periods of rain, which causes shipment delays and increased vehicle running costs. This indicates the urgent need for developing the export corridor — for reconstruction to convert the roads to all-weather roads.

(4) Responding to the needs of peasants

The problems faced by the peasants, whose population accounts for 80% of the agricultural population, must be solved to reduce poverty in Paraguay. Developing the export corridor will enable stable shipments unaffected by weather, and the time required for transportation to major consumption areas can be reduced. Realizing these objectives will support the livelihood of the peasants. Peasants produce unprofitable traditional crops such as cassava, corn, and cotton. To enable them to produce highly profitable crops such as soybeans, it is necessary to assure production volumes and the quality

and reliability of shipments. It can be said that the underdeveloped infrastructure, mainly roads, prevents improving the conditions faced by the peasantry. Development of the export corridor will meet the conditions for progress and enable peasants to grow soybeans, which will contribute to solving their problems.

3. Results of Reviewing the Project

(1) Design speed

Similarly to the case of previous F/S survey, the design speed was set to 100 km/h for the Parana River Coastal Road and 80 km/h for National Road Route 6 - coastal road connection road. A design speed of 80 km/h was established for the port access road by assuming the road would be paved with asphalt, and a speed of 50 km/h was used for sections with geographical constraints or for those passing through urban areas.

(2) Route plan

For the plan established as a result of previous F/S survey, a review was conducted of three sections and the following changes are recommended:

- Deletion of the route through Este as the second Amista Road is brought into shape
- Change of the route to bypass the site planned for a national park in the Nacunday area
- Change of the route in line with the relocation of Campichuelo Port

In regard to the section with the ANDE electric power transmission line, the plan to separate the up and down lanes and the plan for partial utilization were reviewed. It was decided that the plan to place them both on one side should be adopted, as was recommended in the previous F/S survey.

(3) Review of pavement design

A study was made of the pavement design based on a review of the design traffic volume. Since the volume of large vehicle traffic is expected to increase, the analysis period was set to 20 years and the wearing course thickness was set to a minimum of 10 cm.

(4) Preliminary design of structures

As certain bridges were repaired after the previous F/S survey, the integrity of existing bridges was examined again to select those requiring servicing. The results indicated that the number of bridges to be improved and serviced remained the same, and that widening of three bridges was required. (Replacement was proposed in the previous F/S survey.)

4. Environment and Social Considerations

After the previous F/S survey, MOPC implemented an environmental impact assessment (EIA) and completed the report in September 2009. Since five years have passed since the previous F/S survey, current conditions in the region were studied along with a review of environmental and social considerations due to changes in the plan.

Throughout the survey period, workshops in which residents participated were held to publicize the plan and to have the plan reflect the opinions of residents. In all areas, it was confirmed that the participating residents as well as mayors hoped for the early realization of this project and they said they would offer total cooperation for promotion of the project. Based on the assessment of the impact of the project on the environment, it was considered necessary to develop facilities for animals to cross the roads, to change the route to bypass the national park, to plan to link road development to regional development, and to take adequate measures for land acquisition and resettlement of residents.

5. Cost Estimation

The approximate project cost was computed by taking into account the changes of unit price since F/S survey in 2006, changes in work quantities due to the review of the design, etc. The results led to an estimated total project cost of $330 million. When compared with the previous results, this is a 2.3-fold increase on a dollar basis and a 1.6-fold increase on a yen basis.

Project Expense Resume

(Unit: million US$)

Construction site	Parana River coastal road	Route No.6・Coastal Road Connection Road	Subtotal	Port Access Road	Total
Length (km)	147.0	54.4	201.4	85.6	287.0
(a) Preparatory work	4.8	1.2	6.0	1.5	7.5
(b) Earth work	63.7	6.4	70.1	9.0	79.0
(c) Pavement work	89.3	32.2	121.5	40.8	162.3
(d) Pipe and culvert work	1.0	0.0	1.0	0.4	1.4
(e) New bridge construction & Widening work	6.4	0.0	6.4	0.4	6.9
①Building expense =(a)+(b)+(c)+(d)+(e)	165.3	39.7	205.0	52.1	257.1
②Design/Construction administrative expense =①×13%	21.5	5.2	26.6	6.8	33.4
③Land expense	6.0	2.0	8.0	3.4	11.4
④Compensation expense	0.0	0.7	0.7	0.1	0.8
⑤Subtotal = ①+②+③+④	192.7	47.6	240.3	62.4	302.7
Contingency = ⑤×10%	19.3	4.8	24.1	6.2	30.3
Total	212.0	52.4	264.4	68.6	333.0

Source: JICA Study Team

6. Project Evaluation

(1) Economic evaluation

The internal rate of return acquired from such a cash flow is as high as 23.4%, significantly surpassing the 12% economic discount rate and project judged to be feasible (Table 10.1-7.) Even the 2006 study estimated that the internal rate of return was 14.3% and judged feasible. The current study substantially exceeds that figure. The reason why economic efficiency was enhanced is due to the significant increase in soy bean production shored up by the steep rise of its international price and because of an upward adjustment of future transportation demand.

Project Economic Evaluation Index

Evaluation index	Unit	2006 Study	Current study
Internal rate of return (IRR)	%	14.3	23.4
Net Present Value (NPV)	US$1,000	33,178	274,668
Benefit Cost ratio (B/C)	―	1.32	2.35

Source: JICA Study Team

(2) Financial evaluation (annual repayment provisional estimate)

The repayment schedule and amount of annual repayment will be as indicated in Figure 10-4. The mean annual repayment amount will be US$11.7 million, including principal and interest. This corresponds to 4.0% of MOPC's mean road department aggregate budget. Although dependent on the cumulative total of loans and what repayment amounts to, it is thought that project repayment itself will not be unbearable, given MOPC's road fiscal resources.

7. Study of Project Execution System

(1) Execution Schedule

The Paraguayan Government is to select consultants separately for detailed engineering and construction management in accordance with national law, and we shall comply accordingly. Upon completion of this study, a consultant for detailed engineering will be selected in 2012 and detailed engineering will be done in 2013. Thereafter, in 2014, a consultant for construction management will be selected along with the company to undertake construction. Construction could be expected to commence in 2015.

(2) Cost of residents resettlement and land acquisition

We decided the scope of land acquisition by confirming the status of houses. To do this we used field surveys, the road designs and map data. The number of obstacles and number of site acquisitions are as follows:

[Number of obstacles: 26 in total]		[Number of land acquisitions: 1,810 in total]	
・ Parana River coastal road:	9	・ Total area:	268
・ Connection road between Route 6 and the river coastal road:	12	・ Partial area:	1,542
・ Port access roads:	5		

Source: JICA Study Team

On the basis of re-acquisition costs, the compensation amount for lost assets was calculated to be a maximum of US$ 12.156 million. This is equivalent to about 4% of the total project costs.

Items	Amount (1,000 US$)	Remarks
Land acquisition cost	11,356	Acquire all basic land width
Compensation for residents resettlement	800	Cost of resettlement and rebuilding
Total	12,156	

8. Conclusion and Proposals

All Export Corridor concepts subject to this study were appropriate, and facilitating execution of the project is proposed for the following reasons.

- The project aims at reducing the fragility of Paraguay's entire transportation infrastructure. The substance of the project corresponds to a national program. Implementation of the project will improve transportation efficiency, improve productivity of export activity, enhance competitiveness and, as a result, contribute toward vitalizing the economy of Paraguay.
- If construction and maintenance are properly carried out, the project's EIRR would be 23.4%. This indicates that the project is amply feasible. Furthermore, projecting it can help mitigate poverty and improve the living environment.

(1) Facilitating Improvement of Rio Parana Coastal Road, National Road Route 6 and Coastal Road Connection Road

- These arterial roads are positioned as "Southern Union Roads" forming the framework of southern Paraguay. The benefits from expediting the project are acknowledged for the following reasons.
- Southern Union Roads are arterial roads connecting Paraguay's southern departments where revitalized economies are promising. It is an effective project as an anti-poverty measure
- These roads will function as international roads forming the Paraguay link of a Both Oceans Traverse Road along the IIRSA Capriconio axis (The Tropic of Capricorn axis).

- Improving these roads can lead to lower transportation costs for exports and contribute to economic development, competiveness, social development, and poverty mitigation.

(2) Improving Port Access Road

- Improving the Rio Parana Coastal Road and the road linking the ports lining Rio Parana will enhance export competitiveness. In other words, by paving the access roads to ports, being at the mercy of bad weather can be avoided, and the port facilities could be used at all times. As a result, the efficiency of transportation of export products will improve significantly, and enhanced convenience for coastal inhabitants can be anticipated.

- Independent efforts have achieved small-scale improvements on port access roads. However, these are limited to minimum improvements, and their future remains obscure. Therefore, the need for the public sector to become involved in port access roads is high.

(3) Recommended items to facilitate project execution

For the project to be implemented in a smooth manner, the items indicated below are those we recommend that Government of Paraguay implement.

- Implement appropriate EIA and facilitate procedures for land expropriation.
- Expeditiously request financial assistance such as yen loan, and secure budgetary means for counterpart.

(4) Proposals to further develop project efficiency

The items indicated below are those the Government of Paraguay should implement to further enhance the effects of the project.

- Enhance positioning of the project within IIRSA and facilitate development of a regional road network connecting the country to adjacent nations.
- Post-project maintenance and operation.
- Facilitate regional development when road improvements are taking place.
- Upgrade Rio Parana coastal facilities and support stabilization of water transportation.

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Abbreviation

	English	Spanish
AASHTO	American Association of State Highways and Transport Officials	Asociación Americana de Funcionarios de Carreteras Estatales y Transporte
ANDE	National Administration of Electricity	Administración Nacional de Electricidad
ANNP	National Administration of Navigation and Ports	Administración Nacional de Navigación y Puertos
ASTM	American Society for Testing and Materials	-
B/C	Cost-Benefit Ratio	Relación Costo - Beneficio
BID	Inter-American Development Bank	Banco Interamericano de Desarrollo
BCP	Central Bank of Paraguay	Banco Central del Paraguay
BIRF	International Bank for Reconstruction and Development (IBRD)	Banco Internacional de Reconstrucción y Fomento
BNDES	Brazilian Development Bank	Banco Nacional de Desarrollo Económico y Social
CAF	Andean Corporation of Promotion	Corporación Andina de Fomento
CAPECO	Chamber of Cereals and Paraguayan Exporters	Cámara Paraguaya de Exportadores de Cereales y Oleaginosas
CBR	California Bearing Ratio	-
CONAM	National Environment Council	Consejo Nacional del Ambiente
CONATEL	National Telecommunication Committee of Paraguay	Comisión Nacional de Telecomunicaciones de Paraguay
COPACO	Paraguayan Telecommunication Company	Compañia Paraguaya de Telecomunicaciones
DGEEC	Statistics and Census Bureau, STP	Dirección General de Estadísticas Encuestas y Censos, STP
DINATRAN	Direction of National Transports	Dirección Nacional de Transporte
DMR	Direction of Meteorology and Hydrology	Dirección de Meteorología e Hidrología
DSR	Debt Service Ratio	Razón del servicio de la deuda
EDEP	The Study on the Economic Development of the Republic of Paraguay	Estudio sobre el Desarrollo Económico de la República del Paraguay
EIA	Environmental Impact Assessment	Evaluación de Impacto Ambiental
ESAL	Equivalent Single Axle Load	Carga de Eje Único Equivalente
ETNA	National Transport Master Plan Study	Estudio del Plan Maestro del Transport Nacional
FAO	Food and Agriculture Organization	Organización para la Agricultura y la Alimentación
FOB	Free On Board	Franco del Bordo
E/N	Exchange of Notes	Canje de Notas
FOCEM	Fond of Structural Convergent of Mercosur	Fondos de Convergencia Estructural del Mercosur
FONPLATA	Financial Fond for development of La Plata Basin	Fondo Financiero para el Desarrollo de la Cuenca del Plata
F/S	Feasibility Study	Estudio de Viabilidad
GMANS	Management and maintenance of road pavement for service level	Gestión y Mantenimiento de Carreteras Pavimentadas por Niveles de Servicio
GDP	Gross Domestic Products	Producto Interno Bruto (PIB)
HWL	High Water Level	Alto nivel del agua

	English	Spanish
IEE	Initial Environment Examine	Examen Ambiental Inicial
IIRSA	South American Regional Infrastructure Integration Action Plan	Iniciativa para la Integracion de la Infraestructura Regional Sudamericana
INCOOP	National Institute of Cooperativism	Instituto Nacional de Cooperativismo
IRR	Internal Rate of Return	Tasa Interna de Retorno (TIR)
IVA	Value Added Tax	Impuesto al Valor Agregado
JBIC	Japan Bank for International Cooperation	Banco del Japón para Cooperación Internacional
JETRO	Japan External Trade Organization	Organación de Comercio Internacional del Japón
JICA	Japan International Cooperation Agency	Agencia de Cooperación Internacional del Japón
KOICA	Korea International Cooperation Agency	Agencia de Cooperación Internacional del Corea
L/A	Loan Agreement	Acuerdo de Préstamo
MAG	Ministry of Agriculture and Livestock	Ministerio de Agricultura y Ganadería
MOPC	Ministry of Publics Works and Communications	Ministerio de Obras Públicas y Comunicaciones
NGO	Non-governmental Organization	Organización No Gubernamental
NPV	Net Present Value	Valor Presente Neto (VPN)
OD	Origin-Destination	Origin-Destino
OP	Operational Policies	Políticas Operacionales
OPEC	Organization of Exporting Petroleum Countries	Organización de Países Exportadores de Petróleos
PC	Prestressed Concrete	Hormigón Pretensado
PCU	Passenger Car Unit	Unidad (equivalencia) de coche pasajero
PMU	Project Management Unit	Unidad de la gestión de proyecto
P/Q	Prequalification	Pre Quolificación
RC	Reinforced Concrete	Hormigón Reforzado
SEAM	Secretariat of Environment	Secretaría del Ambiente
SIVIPAR	System of Road Infrastructure of Paraguay	Sistema de Infraestructura Vial del Paraguay
STP	Technical Secretariat of Planning	Secretaría Técnica de Planificación
SWR	Shadow Wage Rate	Tasa de sueldo sombra
UA	Environmental Unit	Unidad de Ambiental
UBI	Real estate Unit	Unidad de Bienes Inmobiliarious
UE	Execution Unit	Unidad ejección

1. Preface

1.1 Overview of Study

Promoting agricultural production and exporting agricultural products are vital means for the Republic of Paraguay ("Paraguay") to obtain foreign currency and its growth is important for the nation's economy. JICA carried out the Study on the Export Corridor and Grain Port in Paraguay (hereinafter referred to as "F/S") in 2006, which covered the Eastern Corridor and ancillary harbor facilities and clarified the necessity of making improvements to the Export Corridor. Based on the results of the study, the Paraguayan Government has been considering a yen loan request. As almost five years have elapsed since the study was completed, socio-economic conditions have changed and environmental preservation awareness has risen, and, in view of the need for climate change countermeasures, a review has become necessary.

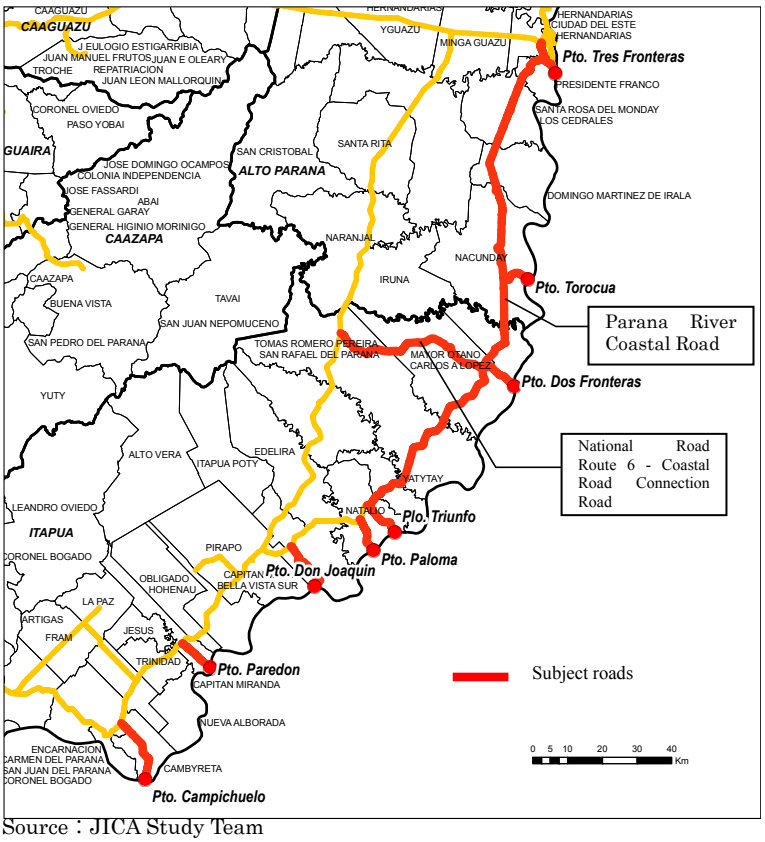
The objectives of conducting this study are to confirm the appropriateness of the project under consideration as a candidate for a new ODA loan item, and based on the substance of the previous F/S, to review information needed to consider execution as an ODA loan project.

1.2 Area Covered by Study

The routes to be studied are those routes passing through Alto Parana and Itapua departments.

- Local road (Parana River Coastal Road) Ciudad del Este to Natalio (approx.158km)
- National Road Route 6 - Coastal Road Connection Road, National Road Route 6 Naranjito - Parana River Coastal Road (approx. 54km)
- Port Access Road (8 ports altogether) (total length approx. 92km)

All routes are to be two-lane roads based on planned traffic volume. Project locations are as shown Figure 1-1.



Source：JICA Study Team

Figure 1-1 Study Area

2. Confirmation of the project background

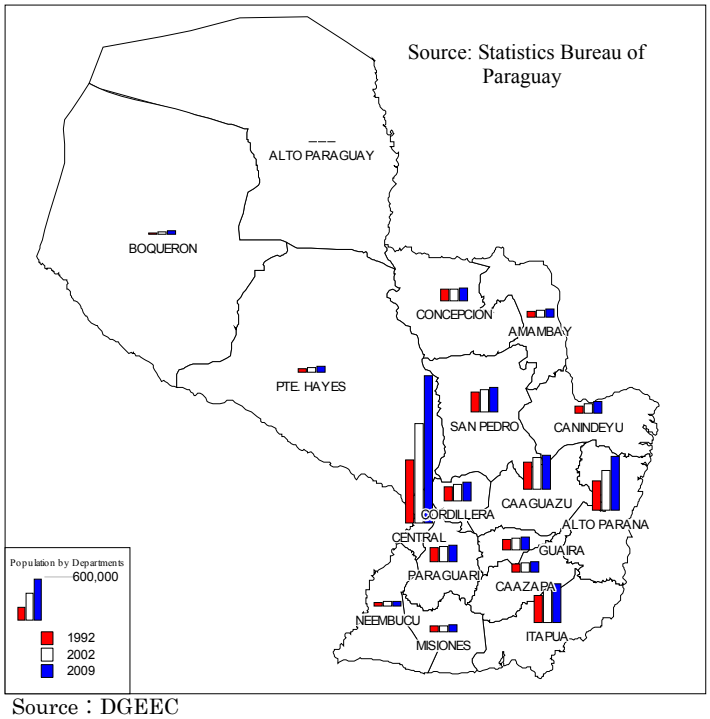
2.1 The region's socioeconomic conditions

(1) Population

The population of Alto Paraná Department has always grown at a higher rate than the national average.

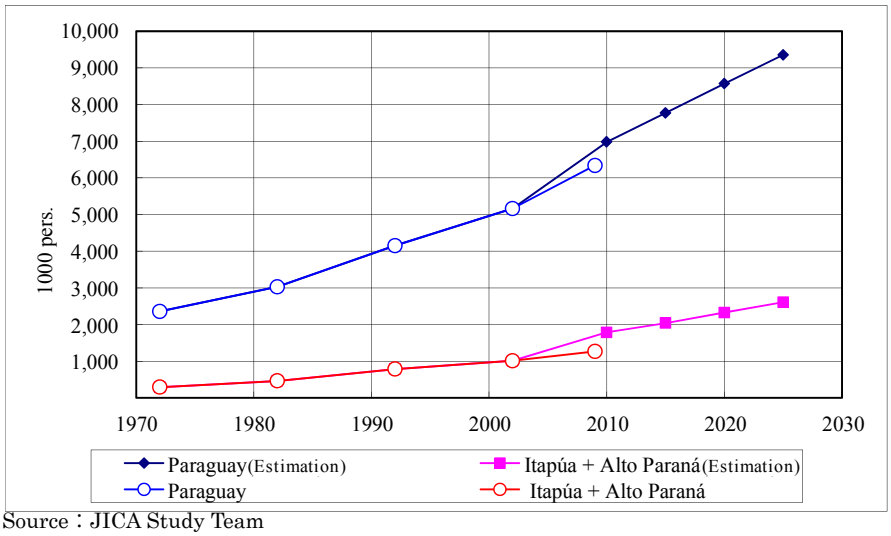
Two departments Alto Parana and Itapúa account for 20% of the entire population of Paraguay, and the rate is growing year by year.

Compared to the forecast at the time of the previous F/S, the projected national population is reduced by 640,000 (-10%) and Itapua and Alto Parana by 520,000, although with some difference between 2009 and 2010. With the cultivated land in Itapua and Alto Parana almost saturated, it is probable that population growth has slowed down.



Source：DGEEC

Figure 2-1 Changes in departmental populations



Source：JICA Study Team

Figure 2-2 Comparison with previous prediction (population)

(2) Economic situation

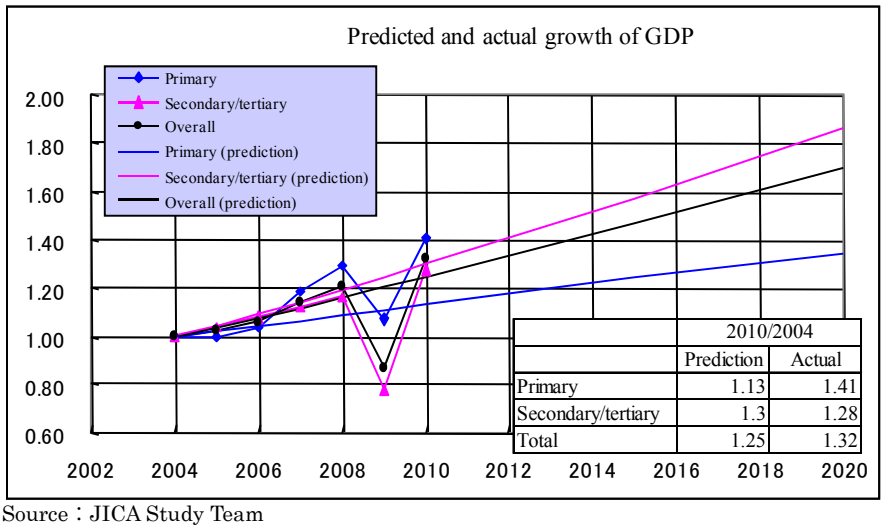
For the five years between 2006 and 2010, the GDP of Paraguay increased 1.24 times, with annual average growth at 5.6%. The primary sector is large, and the agricultural sector accounts for 27% of total GDP. Agricultural sector GDP has grown 1.5 times in the past five years.

Table 2-1 Changes in GDP (1994 prices)

Industrial sector	2004	2005	2006	2007	2008	2009	2010*	2010 /2006	Share(%)	
									2006	2010
Agriculture	2,838,870	2,684,907	2,717,962	3,372,656	3,726,784	2,795,088	4,108,780	1.51	22.2	27.0
Atock raising	857,751	987,244	1,092,327	1,022,313	1,089,038	1,141,311	1,238,323	1.13	8.9	8.1
Forestry	285,285	304,685	310,778	318,548	331,502	317,248	269,660	0.87	2.5	1.8
Fisheries	13,439	13,641	13,845	13,984	14,124	14,335	13,762	0.99	0.1	0.1
Subtotal of primary industry	**3,995,346**	**3,990,477**	**4,134,913**	**4,727,500**	**5,161,448**	**4,267,983**	**5,630,525**	**1.36**	**33.8**	**37.0**
Mining	16,415	17,695	17,306	17,912	18,808	19,372	20,398	1.18	0.1	0.1
Manufactuning	2,198,170	2,256,894	2,314,015	2,285,359	2,330,018	2,311,687	2,473,556	1.07	18.9	16.2
Construction	589,487	616,014	594,454	637,254	707,352	721,499	816,737	1.37	4.9	5.4
Subtotal of secondary sector	**2,804,072**	**2,890,603**	**2,925,775**	**2,940,525**	**3,056,178**	**3,052,558**	**3,310,691**	**1.13**	**23.9**	**21.7**
Electncpower,water supply and sewerage	264,501	271,945	295,061	312,469	323,406	338,929	360,960	1.22	2.4	2.4
Transportation	613,244	626,774	675,035	739,164	779,818	697,937	753,772	1.12	5.5	4.9
Commerce,financing	2,826,106	2,893,268	3,061,078	3,220,254	3,352,284	3,238,306	3,591,945	1.17	25.0	23.6
Administrative service	1,025,517	1,105,104	1,154,456	1,189,090	1,230,708	1,417,775	1,589,762	1.38	9.4	10.4
Subtotal of tertiary industry	**4,729,370**	**4,897,092**	**5,185,630**	**5,460,977**	**5,686,216**	**5,692,948**	**6,296,438**	**1.21**	**42.3**	**41.3**
Total	**11,528,788**	**11,778,172**	**12,246,317**	**13,129,002**	**13,903,842**	**13,013,489**	**15,237,655**	**1.24**	**100.0**	**100.0**

Source： BCP *:Estimate

If the GDP for 2004 is set at 1.00, the performance exceeded the predicted values in the F/S in 2006, excluding the drop in 2009.



Source：JICA Study Team

Figure 2-3 Comparison with previously predicted GDP

(3) Changes in agricultural production

1) Outline

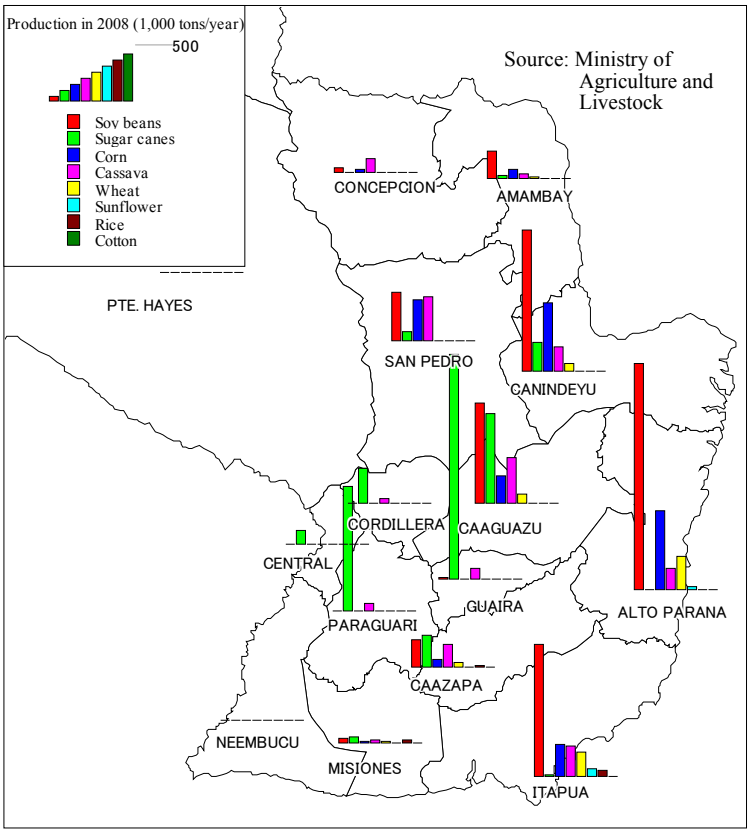
The production of major agricultural products in Paraguay is increasing other than cotton. The great growth was achieved in soybeans and corn. Corn was produced 2.85 times more. As compared to the prediction in the 2006 F/S, soybean was produced according to the prediction but corn and wheat were produced much more than the previously predicted figures. Due to the soaring market price, it is thought that planting of these agricultural products were promoted as secondary crop of soybean.

The major sites of production of soybean are Itapua Department, Alto Paraná Department, Canindeyú Department, Caaguazú Department, Amambay Department, San Pedro Department, etc. in the east and the north of Paraguay. In these Departments, corn and wheat are produced as secondary crop of soybean. In contrast, the central Guaira Department, Paraguari Department and Cordillera Department produce sugar canes and cassava much, and do not produce much soybean, corn and wheat.

Table 2-2 Production growth

	Production volume (1000ton／year)			Growth rate		
	2000	2005	2010	2005/2000	2010/2005	2010/2000
Soy beans	2,980	3,988	7,460	1.34	1.87	2.50
Sugar canes	2,245	3,583	5,131	1.60	1.43	2.29
Corn	647	1,090	3,109	1.68	2.85	4.80
Cotton	247	198	15	0.80	0.08	0.06
Wheat	231	800	1,402	3.46	1.75	6.07

Source: MAG



Source: MAG

Figure 2-4 Major products by department

(4) Peasant problem

According to a survey conducted by the Statistics Bureau in 2002, 48% of the country's population, which is 6 million, lives in farming villages, and agricultural production in them accounts for 40% of the country's total exports and 27.2% of GDP. Especially, the eastern areas where 97% of the population lives are suitable for agricultural production. Soybeans and wheat, the country's major export products, are produced in this zone, which constitutes the production zone supporting the economy. In this area, peasants cultivating 20ha or less live in the vicinity of large-scale farmers, mainly producing traditional crops of cassava, corn and cotton. A Food and Agriculture Organization (FAO) survey found the per capita annual GDP contributed by large farmers mainly producing soy beans is US$12,000; for peasants it is US$360. This income gap is expanding year by year, posing a social problem. The peasants grow unprofitable traditional crops (cassava, corn and cotton), are unable to obtain low-interest, timely loans, lack knowledge of the best land utilization methods, cultivation technology and distribution and sales know-how. Public services providing technical guidance are not fully functioning. Peasants account for 80% of the agricultural population and the response to their issues is an important point in reducing poverty in Paraguay.

2.2 Current road transportation situation

(1) Development of transportation facilities

1) Roads

The total length of highways in Paraguay has increased by about 10% since the previous survey. National roads account for about 4% of, this total; departmental routes account for 22%; and municipal routes account for about 10%. About 33% of the roads are paved with asphalt and concrete and, stone pavement has increased by about 418%. This is due to largely increased stone-paving of departmental roads as part of improvement of agricultural roads pursued according to a local road development plan (phase 1) of the Inter-American Development Bank (IDB) and a JICA's PG-P14 (agricultural sector strengthening plan).

Table 2-3 provides a breakdown of roads, road length by paving method and its growth.

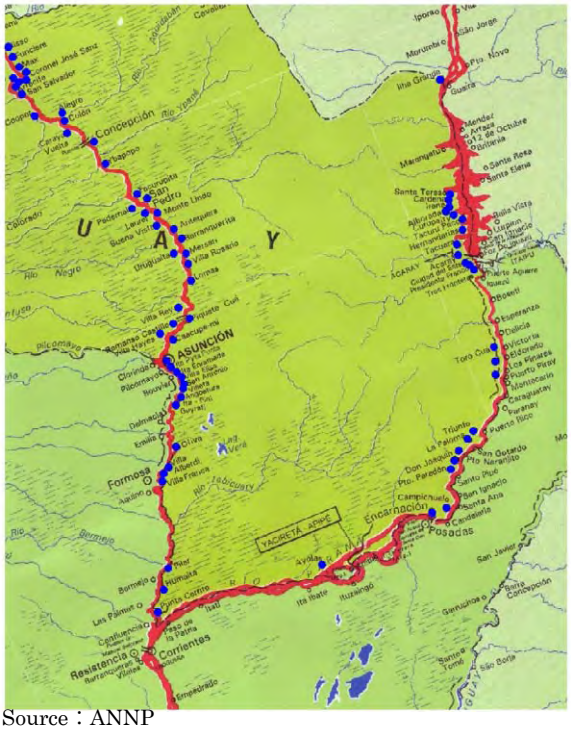
Table2-3 Roads, road length by paving method

	Pavement		Pavement (Rock)		Non Pavement		Total		Growth rate
Fiscal year	2005	2010	2005	2010	2005	2010	2005	2010	
National road	3,153	3,984	12	71	6,382	5,855	9,547	9,910	3.8
Departmental road	469	871	196	599	4,818	5,200	5,483	6,670	21.6
Municipal road	21	* 5	69	768	14,038	14,707	14,129	15,480	9.6
Total	3,643	4,860	277	1,438	25,239	25,762	29,159	32,060	9.9
Percentage (%)	12.5	15.1	1.2	4.5	86.3	80.4	100.0	100.0	
Growth (%)	33.4		519.1		2.1		9.9		

* This decrease is considered to be due to the method used to classify departmental and municipal roads.
Source: MOPC, as of June 2010

2) Ports

The ports along the Parana River and Paraguay River are shown in Figure 2-5, and there are many in and around Asuncion City and Este City. In neighboring Argentina, there are many ports. The object of this study is shown in Table 2-4. Pt. Campichuelo cannot be used due to rise of the water level as affected by the expansion work at Yacyreta Dam. A new port is under construction 400 meters upstream.



Source：ANNP

Figure 2-5 Locations of Ports

3) Railway

The railway in Paraguay is not in service. The Argentina Railway in Encarnación has been out of service since October last year due to submergence by the water in Yacyreta dam.

Table 2-4 Outline of the subject ports

Name of port	Tres Fronteras	Trocua	Dos Fronteras	Triunfo	La Paloma	Don Joaquin	Paredon
Owner	OTS S.A.	TOROCUA Terminal de Embarque S.A.(TOTEMSA)	Puertos del Sur SA	Ministry of Agriculture and Livestock	Cargill Agropecuaria SACI	Trans Agro S.A.	Gical S.A.
Administered and managed by:	Martin Arturo Gimenez	Ditto.	Martin Arturo Gimenez	Diagro S.A.	Ditto.	Osmar Herebia	Ditto.
Area	19.5 ha	7 ha	19 ha	6 ha	43 ha	22 ha	6 ha
Total receipt at peak hours	200 cars/day	120 cars/day	80 cars/day	70 cars/day 2,000t/day	240 cars/day	150 cars/day 4,050t/day	120 cars/day
Annual export/import by items							
Soy beans	200,000 ton	106,000 ton	200,000 ton	100,000 ton	160,000 ton	195,000 ton	90,000 ton
Soybean oil	200,000 ton	-	-	-	-	-	-
Soybean grounds	700,000 ton	-	-	-	-	-	2,000 ton
Wheat	-	-	10,000 ton	-	46,000 ton	81,000 ton	50,000 ton
Corn	-	-	60,000 ton	-	-	-	-
Fuel (import)	50,000 ton	-	-	-	-	-	-
Peak period	Jan.-May	Feb.-Jun.	Feb.-Jun.	Jan.-Feb.	Feb.-May	Feb.-Jun.	Jan.-Apr.
Mayjor shiping zone	Alto Parana	Alto Parana, Itapua (northern side)	Itapua-Alto Parana	Itapua-Alto Parana	Cooperative in the south of Itapua	Itapua, Alto Parana	Itapua
Conditions of access road	Stone pavement and soil	Earth road/regular maintenance	Red clay road/cannot be used in rain	Stone pavement in good condition	During stone pavement/difficult to pass at peak time	14kmstone pavement 2kmgravel road.	6 km stone pavement 5km gravel road

Source：JICA Study Team

(2) Current road traffic conditions

When we examined the traffic at the toll gates managed by MOPC, we found that about 6,000 cars pass Ypacarai per day, which is the most frequent. Next, about 4,000 cars pass through Remaso. As compared to the traffic in 2003, traffic at all toll gates except Cerrito has increased. The traffic more than doubled in seven years at Acceso Sur and Cuero Fresco. Iruna and Trinidad, the toll gates on National Road Route 6 pertaining to this study was 700 and 1,600 in one direction an increase of 30-40% from 2003.

Table 2-5 Traffic at toll gates

(Unit: cars/day, one way direction)

Toll booth	2010	2003	Groth rate
Ypacarai	5,919	5,578	6.1%
Remanso	3,529	2,644	33.5%
Ybyrato	2,195	1,277	71.9%
Coronel Oviedo	2,356	2,318	1.6%
Villa Florida	837	506	65.4%
Cerrito	405	412	-1.7%
Ciudad del Este (Iruña)	663	509	30.3%
Encarnacion (Trinidad)	1,561	1,100	41.9%
Coronel Bogado	1,101	610	80.5%
Tacuara	622	520	19.6%
Acceso Sur	1,586	791	100.5%
Cuero Fresco	334	162	106.2%
Emboscada	1,888	-	-
25 de Diciembre	1,339	-	-
Pozo Colorado	221	-	-

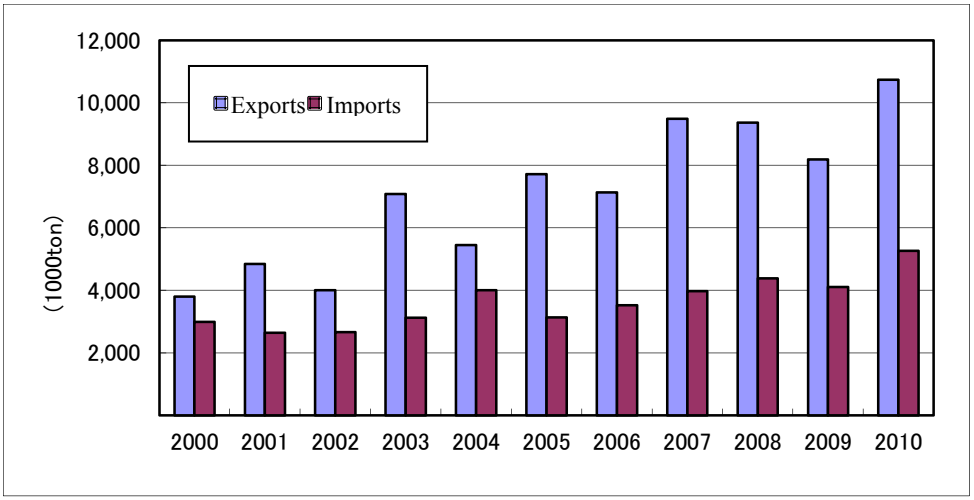
Source：MOPC

2.3 Export and import structure in Paraguay

(1) Export and import trends

1) Volume of exports and imports

Both exports and imports are increasing but exports are markedly growing. This is due to the fact that international demand for grains has grown.

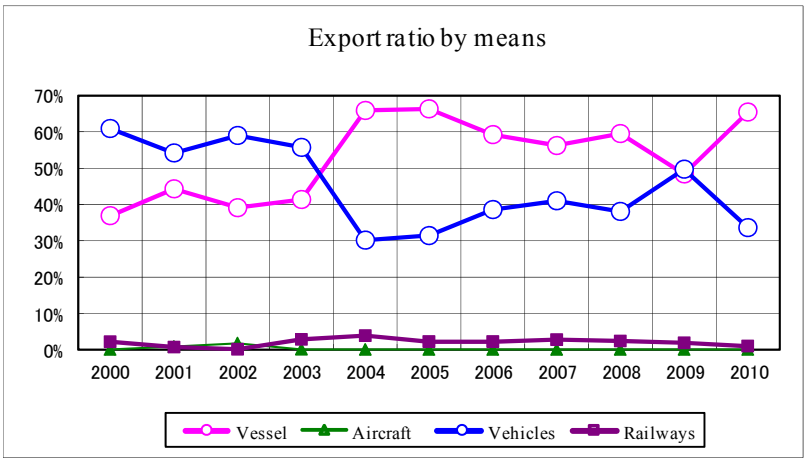


Source：BCP

Figure 2-6 Changes in Exports and Imports

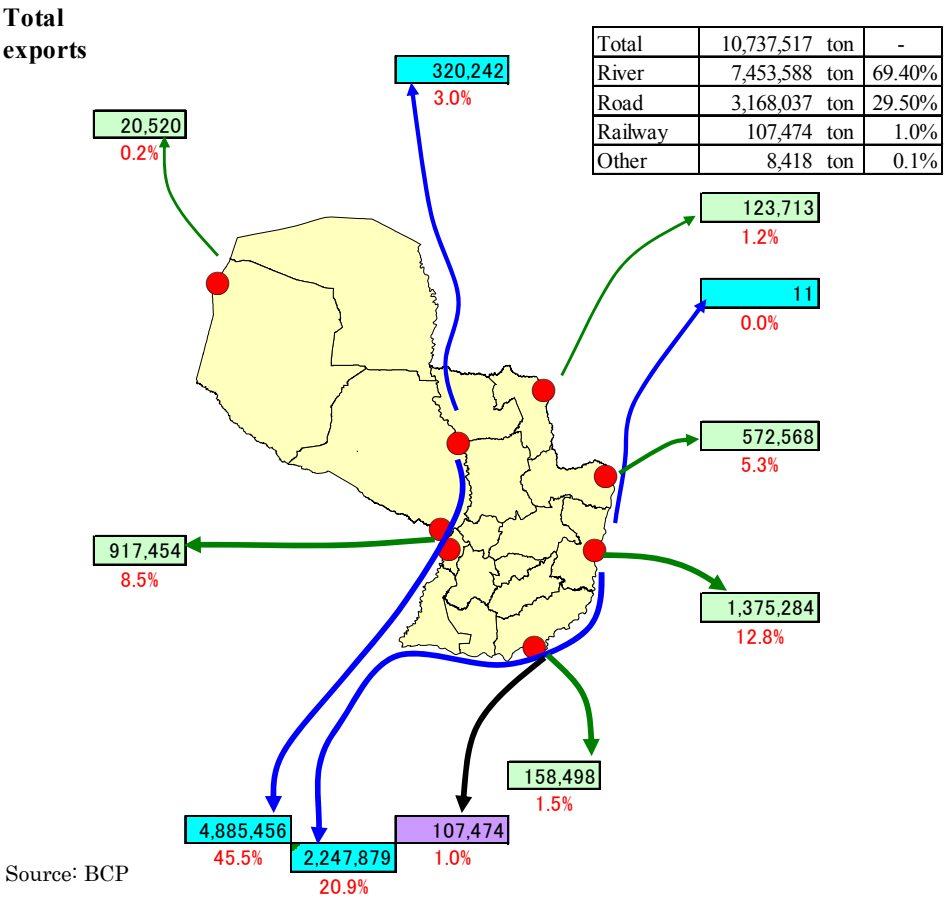
2) Means of transportation

Since 2004, river transportation has surpassed truck transportation as the main means of transport of export products. River transportation now accounts for 60-70% of shipments. The share of railway transportation is low, only 1.0% in 2010. In truck transportation, Este City to Brazil accounts for 12.6% of export product transport and Asuncion City to Argentina accounts for 9.5%. River transportation accounts for 20.9% on the Parana River and 48.5% on the Paraguay River.



Source: BCP

Figure2-7 Export product transportation

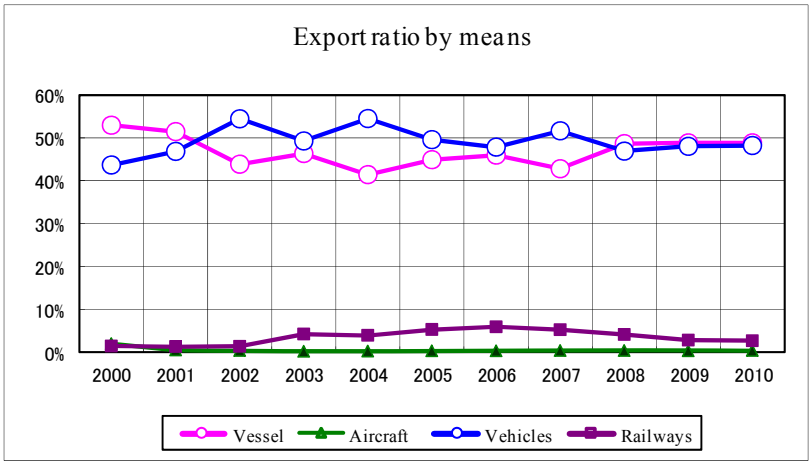


Source: BCP

Figure 2-8 Means of transporting export products (2010)

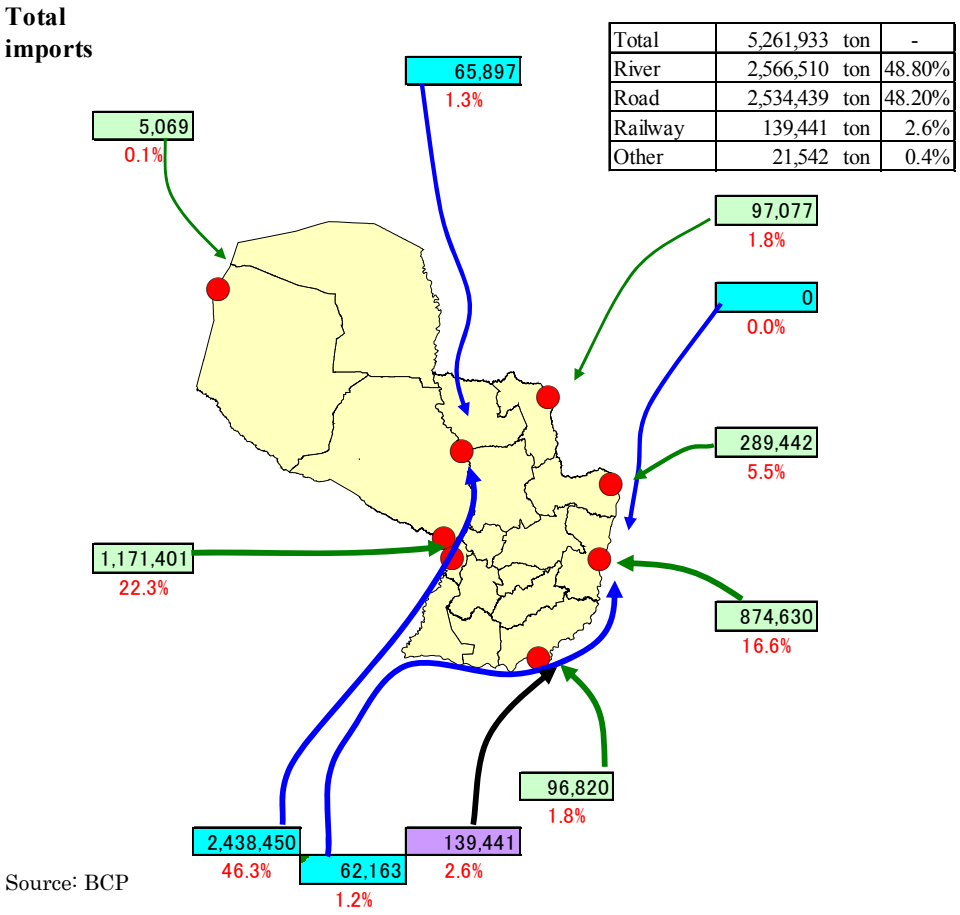
Truck transportation and river transportation account for about 50% each of transportation of imported products. Railways, which is gradually declining, accounted for 2.7% of import shipments in 2010.

In truck transportation, Este City from Brazil accounts for 15.3% of total shipments, and Asuncion from Argentina 22.3%. Unlike exports, the cargos from Argentina handled by truck are greater. Parana River traffic accounts for about 1.2% of river transportation, and Paraguay River traffic accounts for an overwhelmingly high 47.5%. The ports along Parana River are mainly for grain shipments and there are no piers to offload other cargos.



Source: BCP

Figure 2-9 Changes in imports by means



Source: BCP

Figure 2-10 Imports handled by each means of transportation (2010)

(2) Characteristics of exports and imports by items

Transportation means and routes for major items are shown in Figures 2-11 to 2-15.

- Soybeans are exported via Paraguay River (60.8%) and Parana River (30.5%). In total, 91.3% is exported by rivers. In terms of the locations of production sites, Parana River is advantageous but the Paraguay River is used more often. This is due to lack of credibility of the transportation routes to the ports, and a shortage of storage facilities, ports and vessels on the Parana River. (Fig. 2-11).

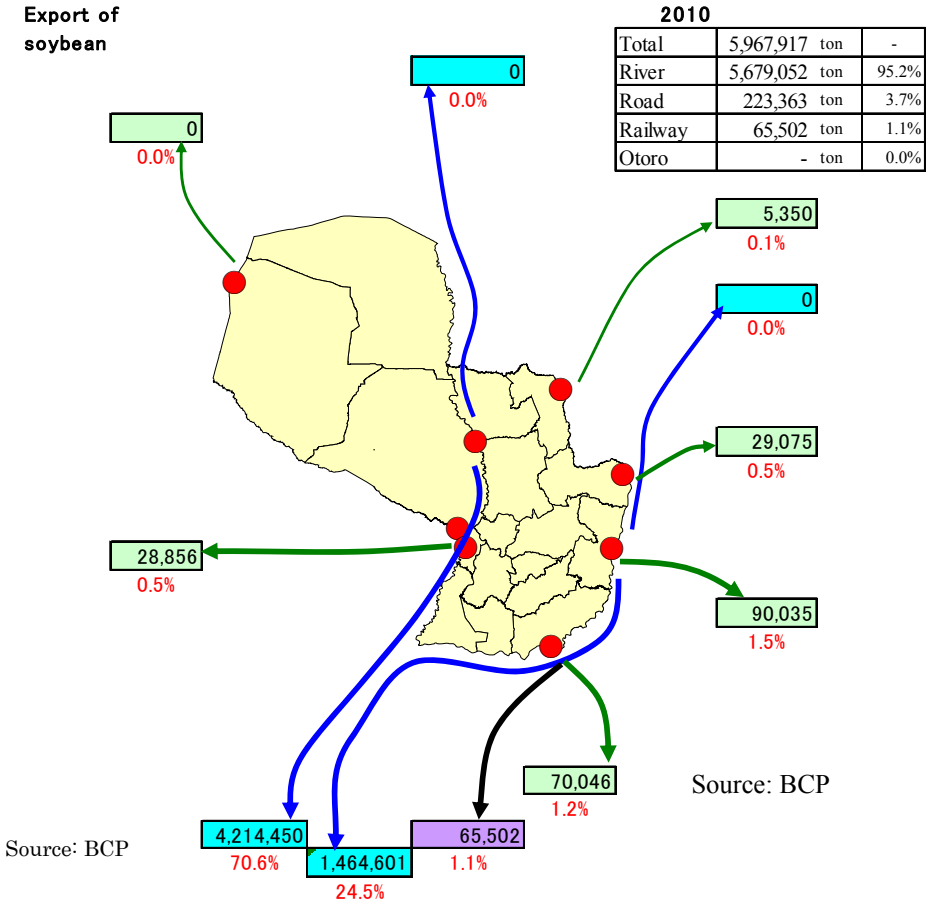


Figure 2-11 Export routes (Soybeans)

- For wheat, road transportation is used more than river transportation. In road transportation (truck transportation), the cargos are transported from Este City and Salto del Guaira City to Brazil. In river transportation, almost the same amount is transported to Uruguay via the Paraguay River (20.9%) and Parana River (22.1%). The wheat produced in Alto Parana Department and Itapua Department is transported via the Parana River. (Fig. 2-12)
- Corn shipments are transported via road (32%) and river (68%), not via railway. Mainly, it is exported to Brazil, Argentina and Uruguay. To brazil, it is transported by truck from Este City and Salto del Guaira City. To Argentina and Uruguay, it is exported via Paraguay River. What was produced in Itapua Department and Alto Parana Department is transported by truck to Brazil, and what is produced elsewhere is transported via Paraguay River to Uruguay and Argentina. (Fig. 2-13)
- Ninety-five percent of the petroleum products (crude oil and gasoline) are imported by water transportation. Most of them are transported via the Paraguay River to the refinery in Asuncion. Major suppliers are Argentina and Brazil, but imports from Venezuela are increasing. (Fig. 2-14).
- Fertilizers are imported 88% by land transportation, including trucks and railways: truck (70%), railways (18%). Imports from Brazil are the greatest and transported by trucks and rivers. Imports from Argentina and Uruguay are by railways (Fig. 2-15).

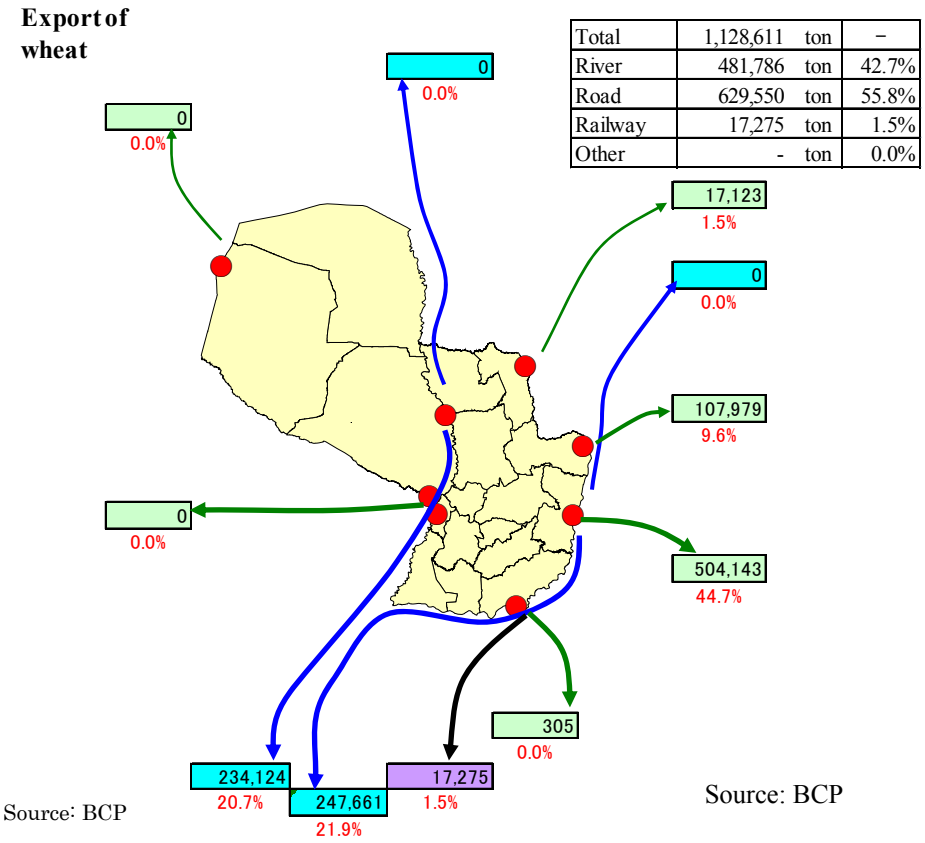


Figure 2-12 Export routes (wheat)

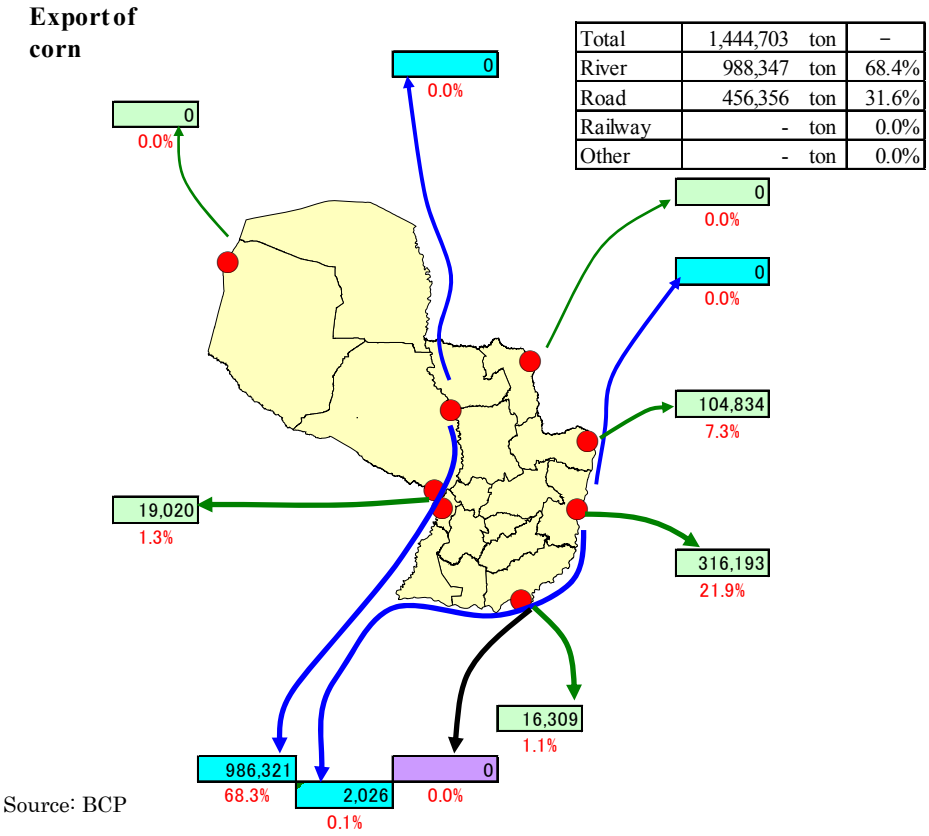
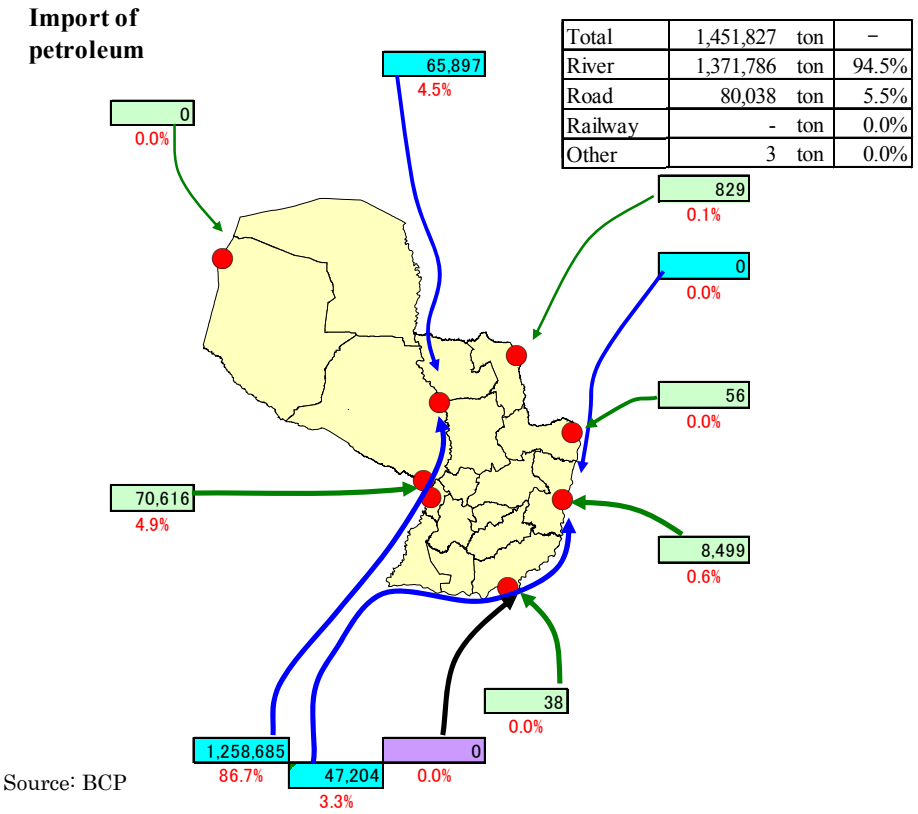
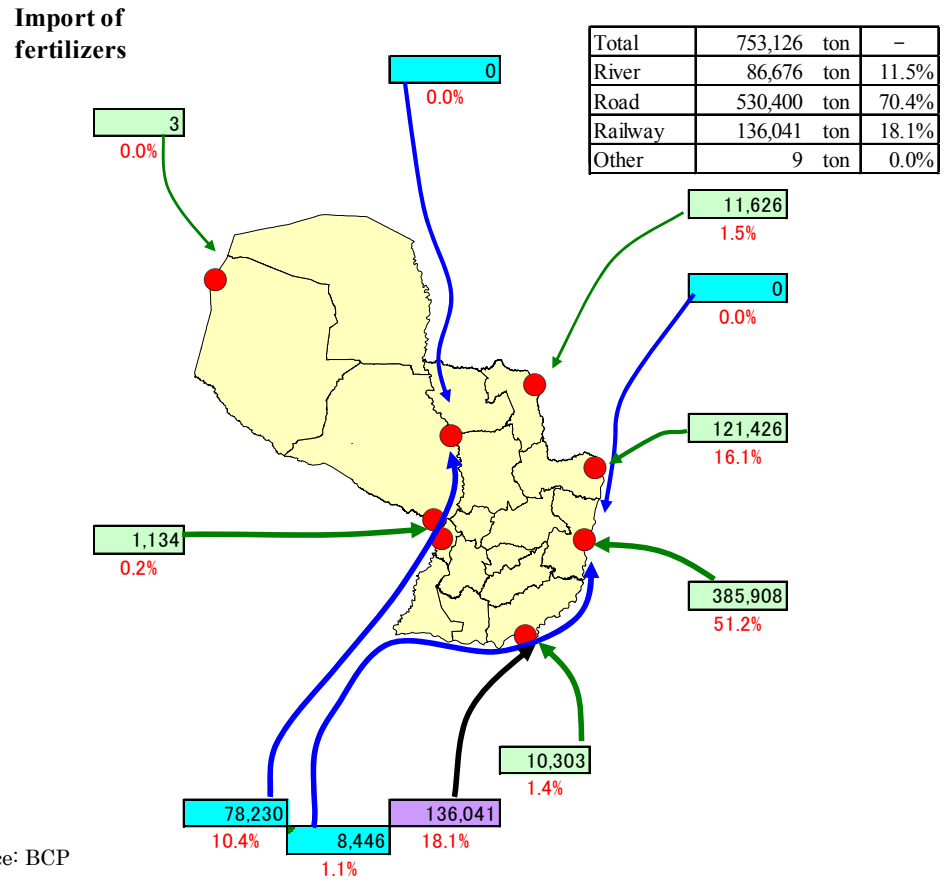


Figure 2-13 Export routes (corn)



Source: BCP

Figure 2-14 Import routes (petroleum)



Source: BCP

Figure 2-15 Import routes (fertilizers)

2.4 Management and operation of roads and ports

(1) Roads

1) Administrative districts and maintenance

Roads in Paraguay are classified into national roads, departmental roads, and municipal roads. MOPC has a Road Bureau and Local Road Bureau. The Road Bureau manages national roads, and the Local Road Bureau manages departmental roads and municipal roads. MOPC oversees 17 local offices to implement of road maintenance. Departments have their own maintenance organizations, but in practice the local offices of MOPC often handle this function. Paraguay has 32,000 km (as of 2010) of national roads, departmental roads and municipal roads, most of which are maintained by MOPC.

What is noteworthy in maintenance is that, with World Bank assistance, a "Maintenance, Improvement and Administration Program for the Road Network (GMANS) has been in progress since 2008. A maintenance project, the aim of GMANS is "maintenance of paved roads and improvement of service." It improves paved roads to a certain extent backed by World Bank (WB) and Inter-American Development Bank (IDB) funds, and private entities are entrusted to preserve the level of pavement. (Formerly, WB was the only party, but now IDB is participating.)

Table 2-6 shows the progress of GMANS. Table 2-16 shows the locations of GMANS.

Table 2-6 Progress under GMANS

Gmans	Road development	Maintenance
1	Ongoing	—
2	Ongoing	—
3	Completed	To be started from Aug. 2011
4	Completed	To be started from Aug. 2011
5	Completed	To be started from Sep. 2011
6	—	—
Urbano	Ongoing	—

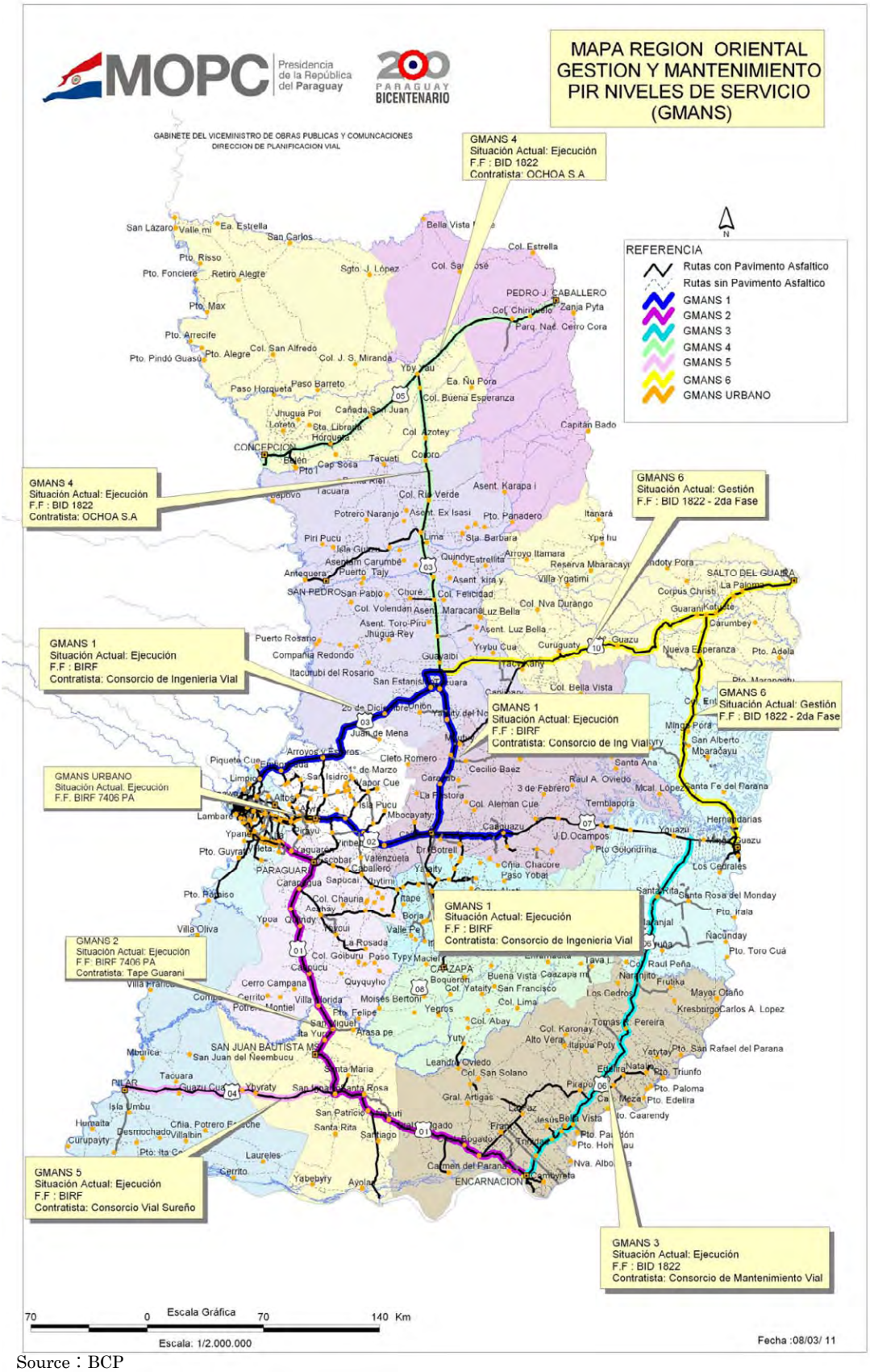
Source：MOPC

2) Toll road system (concession method)

It remains unchanged that fees are collected for driving on the national highways in Paraguay. This is done according to the principle that those who benefit should pay. However, the fees are treated as state revenue and not directly used for road development. It is planned that the fees collected under a a private concession system at two points in National Road Route 7 will be used for improvement work and maintenance, and that this approach will be further extended to National Road Routes Nos. 1, 2 and 6. The bill authorizing this program is awaiting approval of the national assembly.

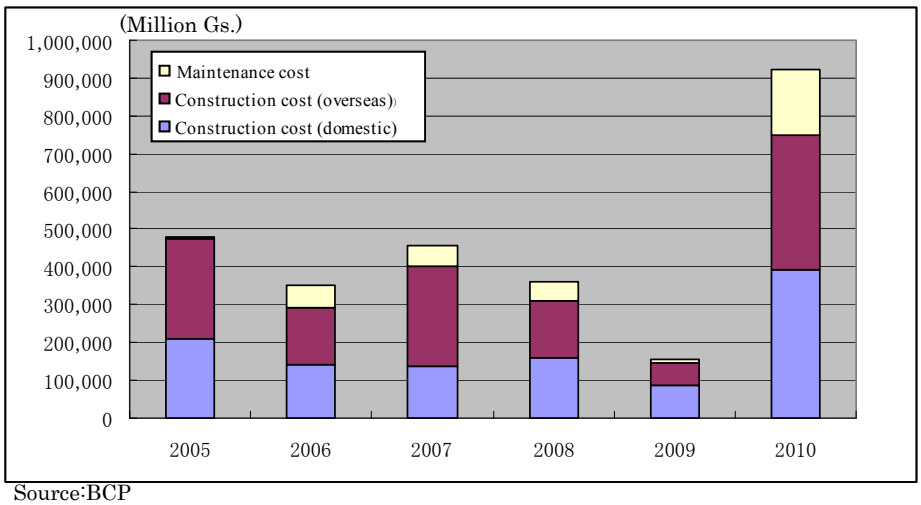
3) Roads budget

Financial resources for the roads budget comes from domestic sources and loans from international organizations. This budget changes greatly year by year depending on the country's financial situation. Approximately half of the funding for road construction comes from domestic sources and and the other half from foreign loans. Maintenance costs have been on the rise in recent years.



Source：BCP

Figure 2-16 Implementation of GMANS and its locations



Source:BCP

Figure 2-17 MOPC Road Bureau Budget (amounts spent)

(2) Ports

Development, maintenance of ports and water courses are conducted by ANNP (Administración Nacional de Navigación y Puertos) under the auspice of MOPC. However, ports have been licensed to be operated by private parties since 1994, and privatization has advanced. Since August 2001, private ports operate businesses as authorized by the Marina Mercante of MOPC, which sets standards for the development of private ports.

2.5 Related policies, plans and systems

(1) Economic strategy plan

No state development plan was established under the Lugo Administration, which began in August 2008. Alternatively, development was pursued under the "2008-2013 Socioeconomic Strategy Plan," a government development plan, which focuses on economic and social development, modernization of administrative organizations, strengthening the independence of the judiciary, strengthening competitiveness, agricultural reform, poverty reduction and anti-corruption measures.

The development of the export corridor considered here will have an important role in strengthening the competitiveness of agricultural products indispensable to the economic development of Paraguay. It will also play a significant role in the social development along the corridor. The subject areas have many granaries important to the economy in Paraguay, and improving the corridor can be expected to contribute significantly to reduce the poverty among the large peasants population. Therefore, the development of the export corridor is in line with the many focal areas in the socioeconomic strategy plan and this development is necessary as viewed at the highest level of planning.

(2) Initiative for the Integration of the Regional Infrastructure of South America (IIRSA[1])

The IIRSA was adopted at the first South American summit meeting held in 2000 with the aim of raising the competitiveness of the South American economies, and to promote socioeconomic development through integration and modernization of infrastructure in the 12 countries in the region. The IIRSA projects summarized below are related to this study.

1) Plan to develop the Second Amista Bridge No. 2

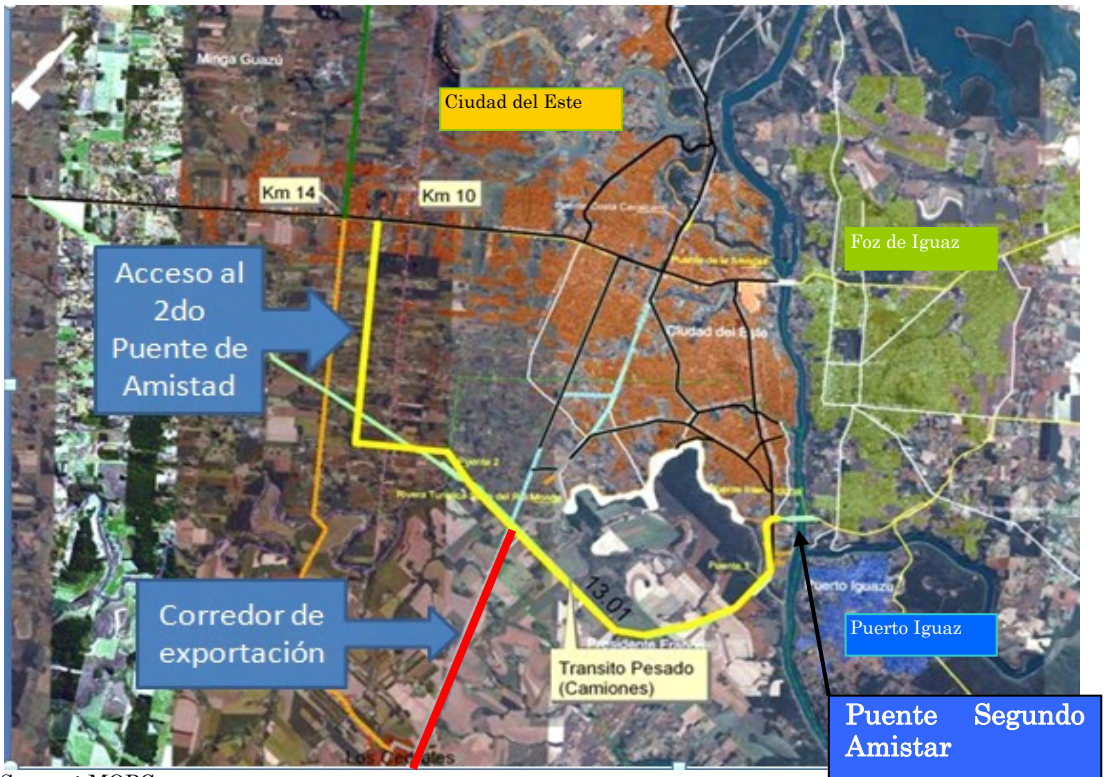
A "Plan to Construct the Second Amista Bridge" is being promoted as a major project to develop the

1 IIRSA: Initiative for Integration of Regional Infrastructure in South America

tropic of Capricorn axis of IIRSA. This project is being handled by the Dep. Nacional Infraestructura y Transporte of Ministerio de Transporte of Brazil. Detailed design work was to have been completed in December last year, an offer for tender was to have been conducted in February this year, and construction was to have begun in June. There was some change in the detailed design, and the offer for tender had not been made as of May 2011. However, the plan is for construction to start within this year.

On the other hand, the Plan to Develop the Connection Road for the Second Amista Bridge was started from a F/S and detailed design with assistance from the BID fund began in February 2011. The plan is for the project to be completed in December this year. No decision has been made as to funding for the connection road. We have heard that the funds for the Forcen Dam or Itaipu Dam will be appropriated.

Figure 2-18 shows the Plan for the Access Road to the Second Amista Bridge



Source：MOPC

Figure 2-18 Plan for the Second Amista Bridge

2) Development of the Parana River Axis

This axis runs north-south through the central axis between the two oceans, the Tropic of Capricorn axis, and the Merco Sur-Chile axis. The aims of the projects along these axes are the following: to develop water transportation facilities, mainly in La Plata and the Paraguay drainage systems; and to develop roads connected to the port facilities. The access roads to the ports along the Parana River and roads connecting these ports subject to this study are included among the related projects being proposed.

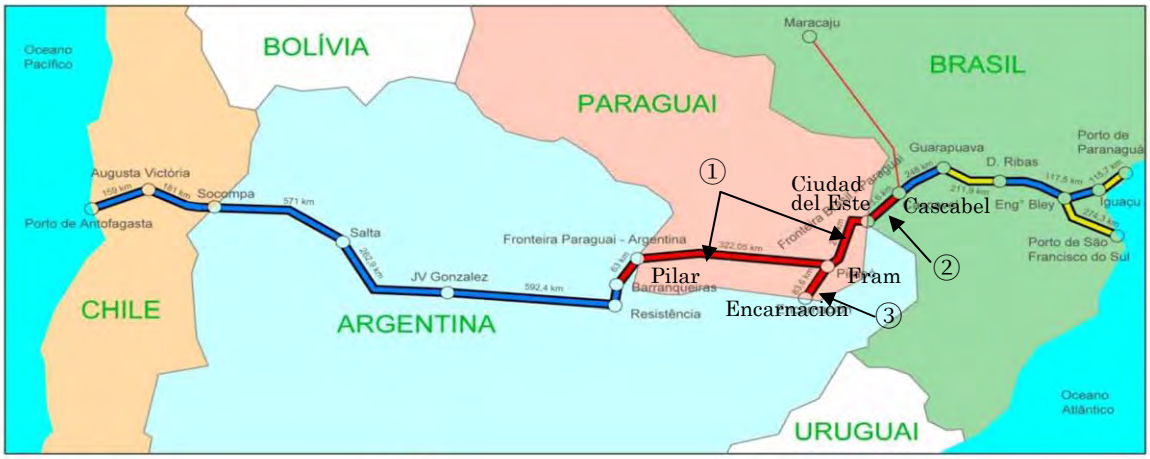
3) Railway construction under the IIRSA plan

As written in the 2006 report, the railway connecting the Atlantic and the Pacific has been held up by the missing link of Paraguay. However, Paraguay has been slowly studying it under the IIRSA plan. The plan related to railways and information on studies are as follows:

a. F/S of the railway connecting Ciudad del Este-Fram (Itapua Department)-Pilar: conducted by KOICA.

b. A railway construction project connecting Cascavel and Foz do Iguaçu will be started in 2012.

According to an person IISRA executive, the cost of the railway construction in Paraguay will be about US$1,300,000-1,900,000/km. The possibility of realizing such a plan seems low.



Contents of railway plan (construction and F/S sections)

① Pre-F/S route (Ciudad del Este-Pilar)

② Railway development in Brazil (Construction to start in 2012；Cascabel-Foz do Iguaçu (Ciudad del Este)

③ Railway development to compensate persons living in dam reservoir area by Yacyreta Dam Corp. (Encarnacion-Fram)

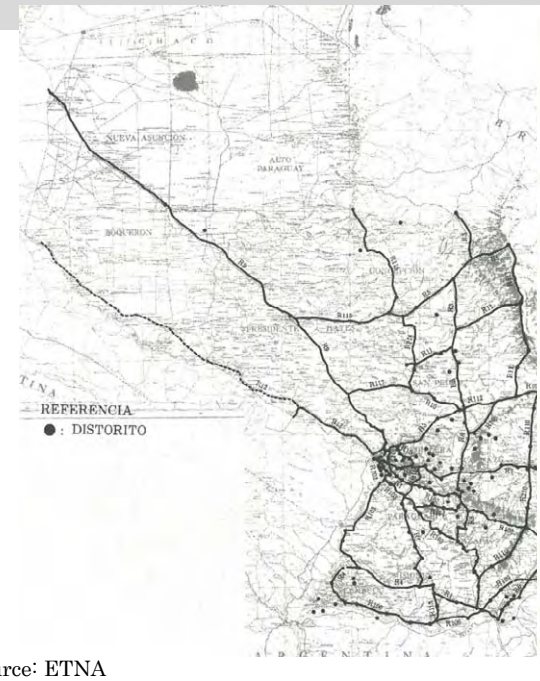
Source：MOPC

Figure 2-19 Railway construction projects

(3) MOPC development plan

As the master plan for road networks by MOPC, integrated national transport planning study(ENNA) was done in 1992 by JICA aiming at settling mid-term span road planning policy, which is fundamental rule for road network policy today (See Fig. 2-20).

In addition, economic development study (EDEP), which was done in 2000 by JICA, gave indication of future course of economic prosperity in Pakistan considering Mercosur and settlement action plan toward 2006. Among this investigation, promoting export is most necessary policy for economic prosperity in Pakistan. Therefore, implementation of the export corridor which includes this project is recommended (See Fig. 2-21).



Source: ETNA

Figure 2-20 Trunk Road Networks in Paraguay

Source: EDEP (2000)

Figure 2-21 Location of Export Corridor Projects

Figure 2-22 shows the location of urgent road projects planned by MOPC.
Parana River Coastal Road and Port Access Roads are included in the urgent projects list, and MOPC put those routes to the high priority.

Source: MOPC

Figure 2-22 Location of Urgent Road Projects

2.6 Confirmation of necessity and importance of projects

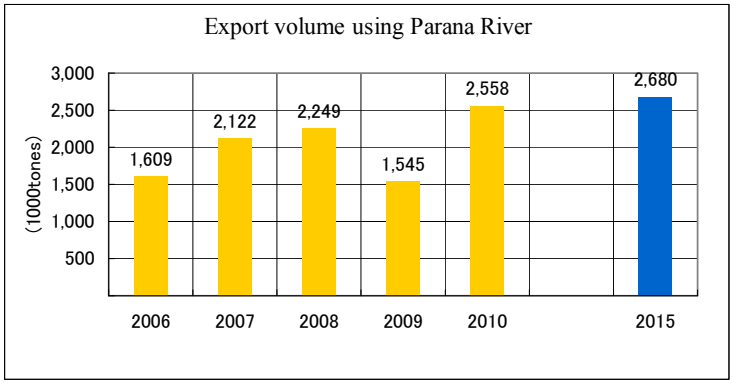
In view of the regional conditions and trends that have been considered, the necessity and importance of the projects (export corridor) can be confirmed. The following are the main points to consider.

(1) Response to increased production of agricultural products

The production of major agricultural products greatly increased in the 10 years from 2000 to 2010, with soybean production growing 2.50 times, corn 4.80 times and wheat 6.07 times. Except for soybeans, the figures largely exceed the estimates in the former F/S. This growth is driving the economy of Paraguay. The major centers for these agricultural products are the Alto Parana and Itapua departments. This is a key reason for saying that the need to develop an export corridor through the grain centers is very high.

(2) Response to increasing need for river transportation

Along with the increased production of grains, the volume of exports shipped via the Parana River is increasing. Figure 2-23 shows the changes in exports shipped via the Parana River between 2006 and 2010. That in 2010 was 1.59 times more than that of 2006. These exports have been growing more than 12% on average annually. The export volume in 2010 is equivalent to that in the forecasted for 2015 in the 2006 F/S. The importance of exports shipped via the Parana River and the need to develop the export corridor is higher than it was in 2006.



SOURCE: 2006-2010:CAPECO, 2015: ESTIMATION

Figure 2-23 Changes in volume of exports shipped on Parana River

(3) Devised method for road suspension on rainy days

Local roads are often suspended on rainy days because of road maintenance. In addition, some local roads which are not suspended are often interrupted when surface of a road becomes muddy as rain falling. Rainfall days are between 6 to 9 days per month except July and August in the study area, and then road suspension occurs during rainfall days. Because of this situation, delay of logistics occur cost increase. Therefore the export corridor is required to be improved for all-weather conditions.

(4) Responding to the needs of peasants

The problems faced by the peasants, whose population accounts for 80% of the agricultural population, must be solved to reduce poverty in Paraguay. Developing the export corridor will enable stable shipments unaffected by weather and the time required for transportation to major consumption areas can be reduced. Realizing these objectives will support the livelihood of the peasants. Peasants produce unprofitable traditional crops such as cassava, corn, and cotton. To enable them to produce

highly profitable crops such as soybeans, it is necessary to assure production volumes and the quality and reliability of shipments. It can be said that the underdeveloped infrastructure, mainly roads, prevents improving the conditions faced by the peasantry. Development of the export corridor will meet the conditions for progress and enable peasants to grow soybeans, which would contribute to solving their problems.

3. State of the Target Routes

3.1 Development state of the target routes

(1) Present-state survey of the roads

Paved roads have increased considerably since the previous survey. Approximately 40 km of dirt roads have been paved with stone or asphalt. In particular, the entire length of the access road to Tres Fronteras Port has been completely paved with asphalt. Therefore, this road is excluded from the scope of this development project.

Table 3-1 Result of survey of present condition of roads

Target section	Section name	Start point	End point	Length	2006 年 F/Sresult			Survery result of this year			Remarks
				(km)	Earth road	Stone pavement	Asphalt pavement	Earth road	Stone pavement	Asphalt pavement	
Parana River coastal road	M-1	Natalio	Rio Tembey	12.1	5.3	6.8	0.0	5.3	6.8	0.0	
	M-2	Rio Tembey (inc.bridge)	Ao. Gurapay	23.9	23.9	0.0	0.0	23.9	0.0	0.0	
	M-3	Ao. Gurapay	Connection	23.3	23.3	0.0	0.0	23.3	0.0	0.0	
	M-4	Connection	Rio Yacuyguazu	13.0	13.0	0.0	0.0	13.0	0.0	0.0	
	M-5	Rio Yacuyguazu (inc.bridge)	Rio Nacunday	24.8	24.8	0.0	0.0	24.8	0.0	0.0	
	M-6	Rio Nacunday (inc.Rio)	Los Cederales	43.0	43.0	0.0	0.0	43.0	0.0	0.0	
	M-7	Los Cederales	Prte. Franco	7.4	0.0	7.4	0.0	0.0	0.0	7.4	
	M-8	Prte. Franco	Super Carreterra	10.1	0.0	10.1	0.0	0.0	0.0	10.1	
	Sub-total			**157.6**	**133.3**	**24.3**	**0.0**	**133.3**	**6.8**	**17.5**	
Access road to the port	PAR-1	Route6	Pt. Campichuelo	19.7	19.3	0.4	0.0	19.3	0.0	0.4	
	PAR-2	Route6	Pt. Paredon	11.0	6.6	4.4	0.0	0.0	11.0	0.0	Under construction for stone pavement
	PAR-3	Parana Rivercoastal road	Pt. Don Joaquin	16.8	16.0	0.0	0.8	3.9	12.1	0.8	
	PAR-4	Parana Rivercoastal road	Pt. Paloma	10.5	10.5	0.0	0.0	0.0	10.5	0.0	Under construction for stone pavement
	PAR-5	Parana Rivercoastal road	Pt. Triunfo	11.8	9.4	2.4	0.0	0.0	11.8	0.0	
	PAR-6	Parana Rivercoastal road	Pt. Dos Fronteras	5.7	5.7	0.0	0.0	5.7	0.0	0.0	
	PAR-7	Parana Rivercoastal road	Pt. Torocua	8.7	8.7	0.0	0.0	8.7	0.0	0.0	
	PAR-8	Parana Rivercoastal road	Pt. Tres Fronteras	7.9	1.2	0.7	6.0	0.0	0.0	7.9	
	Sub-total			**92.1**	**77.4**	**7.9**	**6.8**	**37.6**	**45.4**	**9.1**	
Road connecting National Road Route 6 and river coastal road	C-1	Route6	Frutika	24.8	0.0	24.8	0.0	0.0	24.8	0.0	
	C-2	Frutika	Main Corridor	29.6	29.6	0.0	0.0	29.6	0.0	0.0	
	Sub-total			**54.4**	**29.6**	**24.8**	**0.0**	**29.6**	**24.8**	**0.0**	
Grand total				**304.1**	**240.3**	**57.0**	**6.8**	**200.5**	**77.0**	**26.6**	e

Source：JICA Study Team

(2) State of repair of structures

A repair state survey of existing road structures, mainly 32 structures, including two new ones, was conducted for the purposes indicated below (also see Figure 3-1). The previous survey identified the necessity of either a bridge or box culvert for these structures.

Points studied:

- Change, such as reconstruction, in the state of existing road structures

- Integrity of the existing road structures to be reused
- Changes in the surrounding conditions at locations where new construction is planned
- Whether or not there are locations for construction of new road structures

Details concerning the change in state and the integrity are shown in Table 3.2. As is known from the table, eight bridges were repaired and one bridge was washed away after the previous survey.

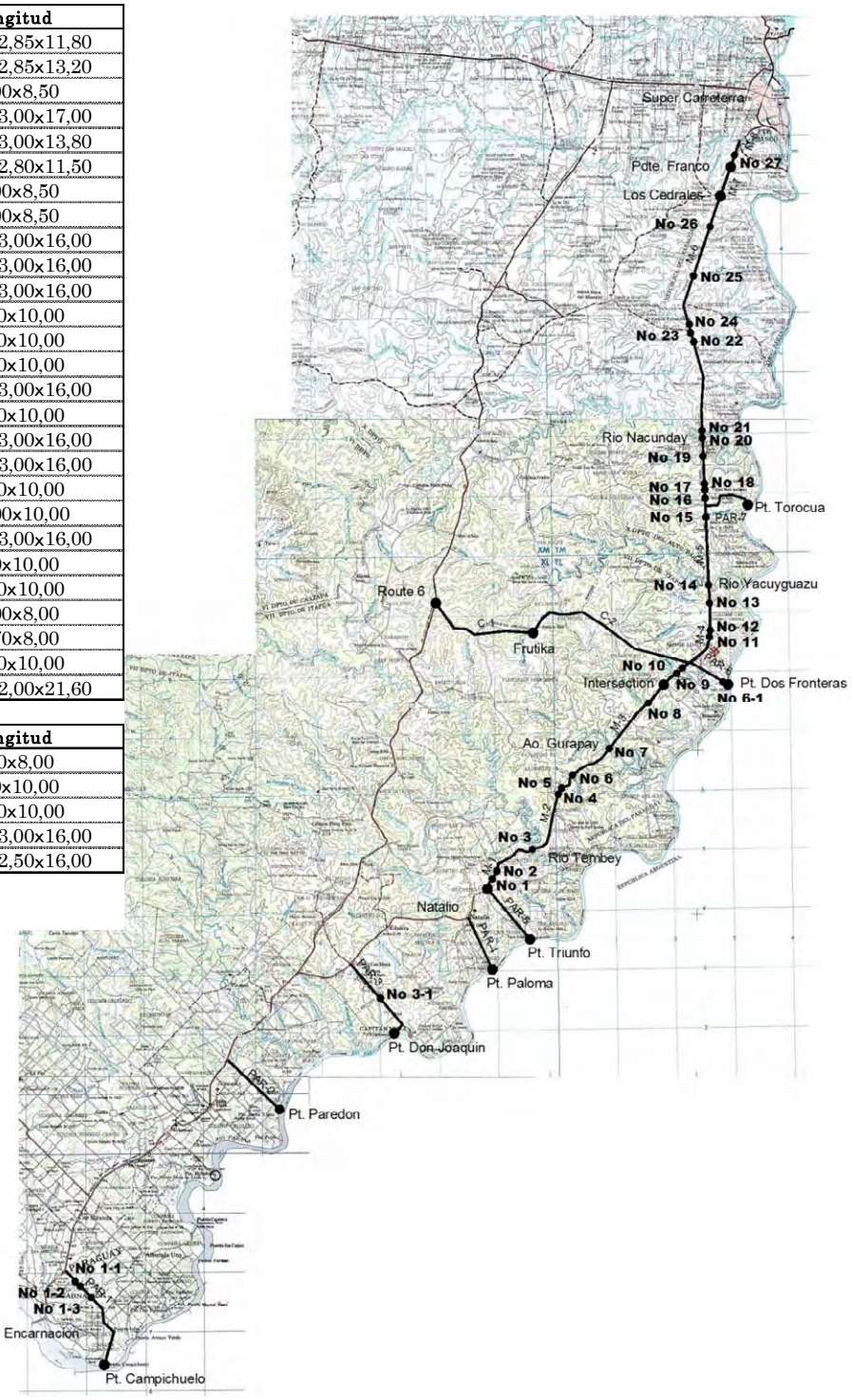
Parana River Coastal Road

N°	Estación	Tipo	Longitud
1	3+250	B/C	2-4,50x2,85x11,80
2	5+553	B/C	2-4,50x2,85x13,20
3	12+093	Br	70,00x8,50
4	22+768	B/C	1-3,00x3,00x17,00
5	23+623	B/C	1-3,00x3,00x13,80
6	27+777	B/C	2-4,50x2,80x11,50
7	35+989	Br	48,00x8,50
8	47+616	Br	48,00x8,50
9	55+137	B/C	2-3,50x3,00x16,00
10	56+642	B/C	2-3,50x3,00x16,00
11	64+430	B/C	2-4,50x3,00x16,00
12	64+562	Br	20,00x10,00
13	70+447	Br	20,00x10,00
14	72+250	Br	75,00x10,00
15	83+566	B/C	2-4,50x3,00x16,00
16	88+291	Br	15,00x10,00
17	89+425	B/C	2-4,00x3,00x16,00
18	90+000	B/C	1-3,50x3,00x16,00
19	94+240	Br	20,00x10,00
20	97+048	Br	100,00x10,00
21	99+782	B/C	1-3,50x3,00x16,00
22	111+462	Br	7,70x10,00
23	114+575	Br	20,00x10,00
24	117+337	Br	16,00x8,00
25	126+177	Br	25,70x8,00
26	134+683	Br	15,00x10,00
27	146+413	B/C	2-2,00x2,00x21,60

Port Access Road

N°	Estación	Tipo	Longitud
1-1	2+635	Br	6,00x8,00
1-2	3+223	Br	6,10x10,00
1-3	6+088	Br	15,00x10,00
3-1	8+711	B/C	2-4,00x3,00x16,00
6-1	5+650	B/C	1-2,50x2,50x16,00

Br Bridge
B/C Box Culvert



Source：JICA Study Team

Figure 3-1 Target structures

Table 3-2 Result of survey on existing road structures

	Basin No	No	River name	Previous suvey			Suvey this time		
				Type of structure	Material	Condition	Type of structure	Material	Condition
Ruta Costanera del Rio Paranã	1	3+250	Aro. Pai Curuzu(1)	Br.	Concrete	Good	Br.	Concrete	Good
	2	5+553	Aro. Pai Curuzu(2)	B/C	Concrete	Good	B/C	Concrete	Good
	3	12+093	Rio Tembey	Br.	Concrete	Good	Br.	Concrete	Good
	4	22+768	M-2-1	B/C	Concrete	Good	B/C	Concrete	Good
	5	23+623	M-2-2	B/C	Concrete	Good	B/C	Concrete	Good
	6	27+777	Aro. San Rafael	B/C	Concrete	Good	B/C	Concrete	Good
	7	35+989	Aro. Guarapay	Br.	Concrete	Good	Br.	Concrete	Good
	8	47+616	Aro. Yhaca Guazu	Br.	Concrete	Good	Br.	Concrete	Good
	9	55+137	Aro. Alegre	no existing			no existing		
	10	56+642	Aro. Cure-Ky	no existing			no existing		
	11	64+430	Aro. Emilia	Br.	Wooden	Normal	Br.	Concrete	Good
	12	64+562	Aro. San Juan	Br.	Wooden	Normal	Br.	Concrete	Good
	13	70+447	Aro. Yhaca-Mi	B/C	Concrete	Good	B/C	Concrete	Good
	14	72+250	Rio Yacuy Guazu.	Br.	Wooden	Poor	F/Br.	Potoon	Normal
	15	83+566	Aro. Diamante	Br.	Wooden	Normal	Br.	Wooden	Normal
	16	88+291	Aro. Imperial	Br.	Concrete	Normal	Br.	Concrete	Normal
	17	89+425	Aro. Imperial Afluen.1	Br.	Wooden	Normal	Br.	Wooden	Normal
	18	90+000	Aro. Imperial Afluen.2	Br.	Wooden	Normal	Br.	Wooden	Normal
	19	94+240	Aro. Carpincho	Br.	Wooden	Normal	Br.	Wooden	
	20	97+048	Rio Nacunday	F/Br.	Pontoon		F/Br.	Pontoon	Normal
	21	99+782	Rio Nacunday Afluente	Br.	Wooden	Normal	Br.	Wooden	Good
	22	111+462	Aro. Pira Pyta Afluen.1	Br.	Wooden	Normal	Br.	Concrete	Normal
	23	114+575	Aro. Pira Pyta	Br.	Wooden	Normal	Br.	Wooden	Good
	24	117+337	Aro. Pira Pyta Afluen.2	Br.	Concrete	Good	Br.	Concrete	Good
	25	126+177	Aro. Y-Tuti	Br.	Concrete	Good	Br.	Concrete	Good
	26	134+683	Aro. Yta Coty	Br.	Wooden	Poor	Br.	Concrete	Good
	27	146+413	M-7-1	Br.	Concrete	Good	Br.	Concrete	Good
Ruta Acceso a Puertos	1-1	2+635	Aro. Maestora	Br.	Wooden	Normal	Br.	Concrete	Good
	1-2	3+223	Aro. Pe	Br.	Wooden	Normal	Br.	Concrete	Good
	1-3	6+088	Aro. Curi-Y	Br.	Concrete	Good	Br.	Concrete	Good
	3-1	8+711	Aro. Pora	Br.	Wooden	Normal	B/C	Concrete	Good
	6-1	5+650	Aro. Cure-ky	Br.	Steel I-Beem	Normal	Br.	Steel I-Beem	Normal

Source:JICA Study Team

Br. : Bridge B/C : Box Culvert F/Br. : Floating Bridge Repaired structures

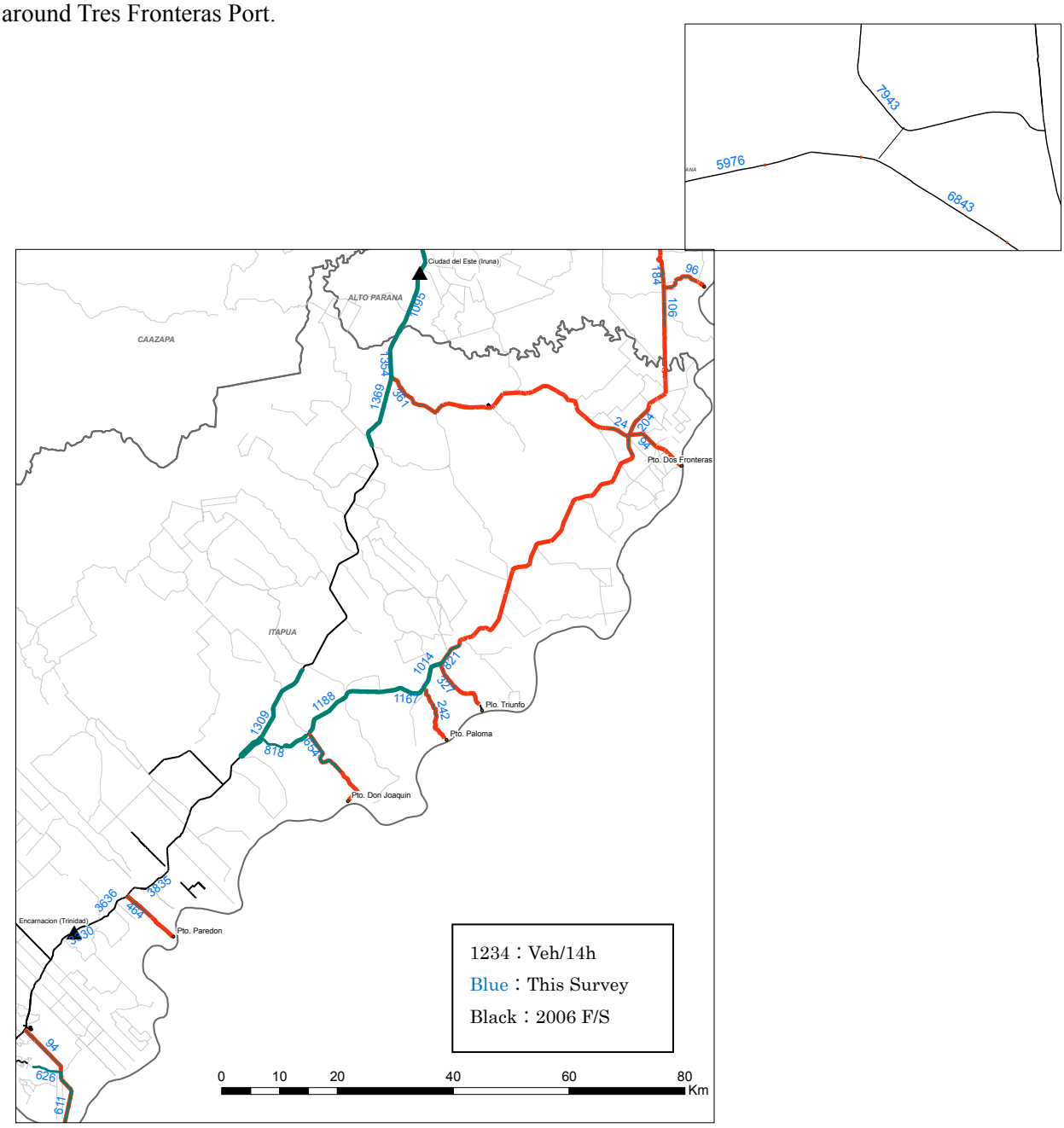
3.2 Road traffic volume on target routes

The traffic volume on target routes is shown in Figure 3-2 and Table 3-3.

Traffic on National Road Route 6 at the point where it connects with the road from Paredon Port was 3,600-3,800 units/14h. Traffic on target route after branching from National Road Route 6 was counted at 800-1,200 units/14h. Traffic at Natalio counted was 180-200 units/14h; and that at Tres Fronteras Port was 6,000-8,000 units/14h.

The percentage of trucks in all the traffic was 21-28% for the target route after branching from National Road Route 6, and as high as 38-48% around Natalio. On the other hand, it was as low as 6% around Tres Fronteras Port.

When compared with the result of the traffic survey of 2005, traffic on the target routes increased substantially, by about 30% for the route branched from the National Road Route 6, and by 130-320% around Tres Fronteras Port.



Source: JICA Study Team

Figure 3-2 Traffic survey result (all vehicles)

Table 3-3 Traffic survey results (vehicles/14h)

Survey Point	Entry	Volume in 2011					Volume in 2005	Rate of Change
		Car	Bus	Truck	Total	Truck rate		
P2 Campichuelo	N	92	0	2	94	2%	60	57%
	E	27	0	6	33	18%	50	-34%
	S	473	73	65	611	11%	272	125%
	W	484	73	69	626	11%	310	102%
P3 Paredon	N	2,682	186	967	3,835	25%	2,317	66%
	E	373	5	86	464	19%	334	39%
	S	2,534	183	919	3,636	25%	2,207	65%
	W	287	4	30	321	9%	254	26%
P4 R6xNewRd	N	813	57	439	1,309	34%	1,034	27%
	E	637	22	159	818	19%	697	17%
	S	1,322	73	570	1,965	22%	1,675	17%
P5 Don Juaquin	N	636	2	190	828	23%	398	108%
	E	914	21	253	1,188	21%	932	27%
	S	510	1	143	654	22%	637	3%
	W	934	22	258	1,214	21%	743	63%
P6 Paloma	E	777	32	268	1,077	25%	824	31%
	S	57	0	185	242	76%	107	126%
	W	804	32	331	1,167	28%	927	26%
P7 Triunfo	N	70	0	14	84	17%	66	27%
	E	574	22	225	821	27%	646	27%
	S	237	10	80	327	24%	204	60%
	W	725	28	261	1,014	26%	824	23%
P8 R6xR15	N	846	57	451	1,354	33%	1,076	26%
	E	258	0	103	361	29%	349	3%
	S	850	57	462	1,369	34%	1,055	30%
P9 Dos Fronteras	N	121	0	83	204	38%	-	-
	E	55	0	39	94	41%	-	-
	S	83	0	53	136	41%	-	-
	W	15	0	9	24	39%	-	-
P10 Trocua	N	93	2	89	184	48%	-	-
	E	21	0	75	96	78%	-	-
	S	84	2	20	106	19%	-	-
P11 Tres Fronteras	N	7,200	235	508	7,943	6%	1,908	316%
	E	6,077	305	461	6,843	7%	2,024	238%
	W	5,279	384	313	5,976	5%	2,568	133%

(Shadowed portions show the traffic volume of access roads to the ports.)
Source：JICA Study Team

4. Review of the Route Plan

4.1 Design conditions

(1) Road standard and design speed

1) Parana River coastal road

- This road connects existing port facilities scattered along the Parana River to enable efficient port operation.
- This is a trunk road connecting departments: Canindeyú to Alt Parana to Itapua.
- This is a road to create the interoceanic road link along the IIRSA tropico de Capricornio axis.

Considering these characteristics, the road design standard speed will be set at 100km/h, and a design standard similar to that for the national roads in Paraguay will be applied.

2) Road connecting National Road Route 6 and coastal road

Proposed in the 1992 National Overall Traffic Survey,(ETNA) this route runs from the Capital Asuncion, via Paraguari, Guaira, and Caazapá departments, to Itapúa department. This road is a vital link between the les-developed Caazapá department in the eastern part of Paraguay with the Parana River coastal ports. The design speed is 80 km for this road, which is the same as for the national roads.

3) Port access roads

The approximate length of each access road is less than 20 km, so that the time reduction effect by increasing the design speed is small. In addition, these roads are expected to handle large numbers of trucks carrying crop exports and to function as service roads to wayside urban areas. In view of these factors, it is considered reasonable that their design speed be 50 km/h. However, vehicles tend to run at higher speeds on asphalt roads, and the normal traffic speed in Paraguay is actually about 80 km/h. Considering this, a design speed of 80 km/h will be used. However, it will be reduced to 50 km/h for the geologically constrained sections and sections running through urban areas.

(2) Geometric design standard

Basically, the AASHTO standard will be applied as the geometric design standard. Table 4-1 shows a list of geometric design standards.

Table 4-1. Geometric design standards

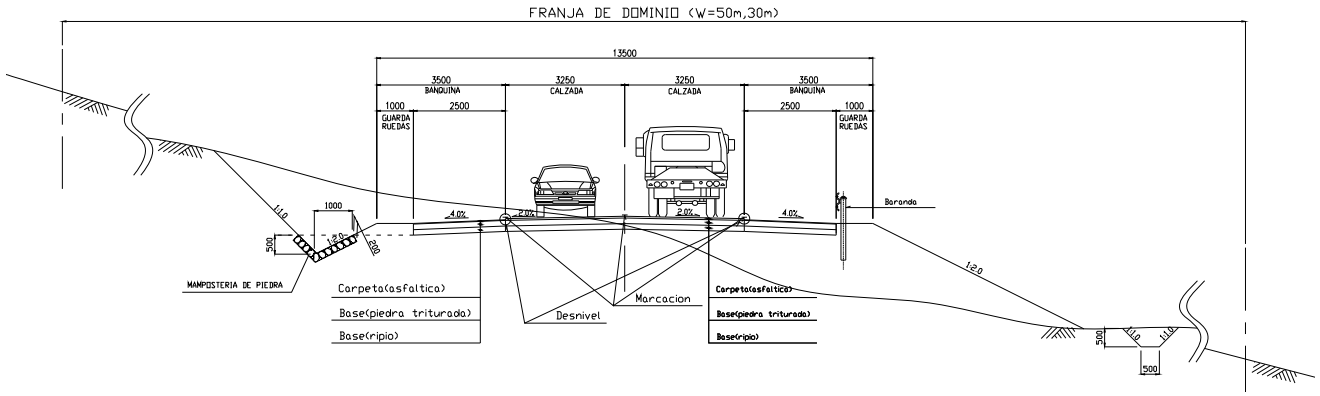
Parameters		Unit	Parana River coastal roads	Roads connecting National Road 6 and coastal road, and port access roads	Remarks
Design speed		km/h	100	80	
Minimum radius of curvature		m	360	210	
Maximum grade	Flat land	%	3	4	
	Hilly terrain	%	4	5	
	Mountainous area	%	6	7	
Minimum radius of vertical curve	Convex	m	52	26	L = K×A L: Minimum vertical curve length A = (Algebraic difference of grade)
	Concave	m	45	30	

Source：JICA Study Team

4.2 Road widths

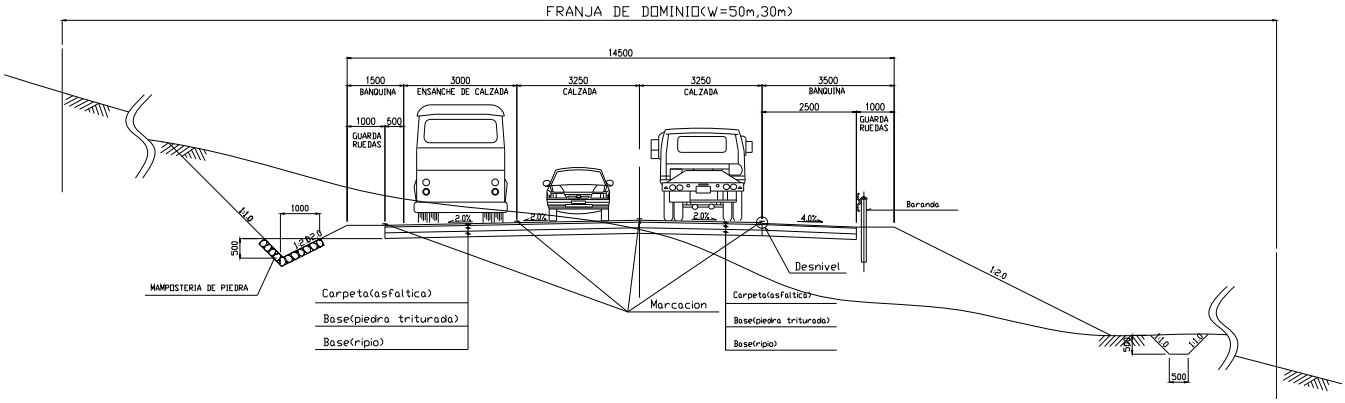
Roads equivalent to national roads in Paraguay generally consist of a cross-section structure as shown below. This is slightly narrower than the AASHTO standard. In this project, road widths will be designed while referring to the widths shown below, and by taking into account the integrity with other roads and economic efficiency:

- Lane : Width 3.25m, crossfall 2.0%
- Shoulder : Width 2.50m, crossfall 4.0%
- Bridge : Total width 10.0m, roadway width 8.0m, curb (wheel guard) width 1.0m



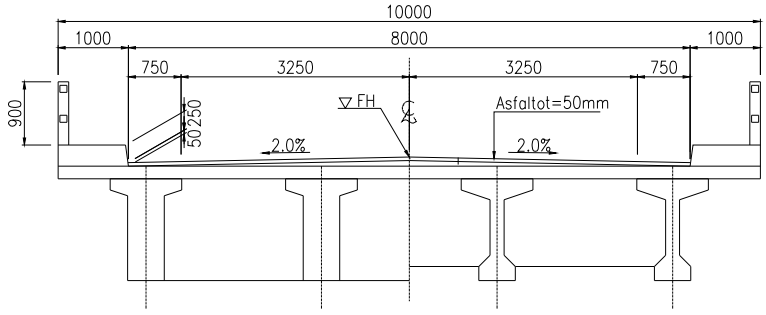
Note: The right-of-way of Parana River coastal roads is 50m while that of others is 30m.
Source：JICA Study Team

Figure 4-1 Standard width



Note: Considering economic efficiency, since continuous trafficability and safety, not traveling performance, are critical for the access road, no auxiliary lanes will be provided.
Source：JICA Study Team

Figure 4-2 Width of the auxiliary lane



Source：JICA Study Team

Figure 4-3 Width of new bridge

4.3 Review of proposed alternative routes

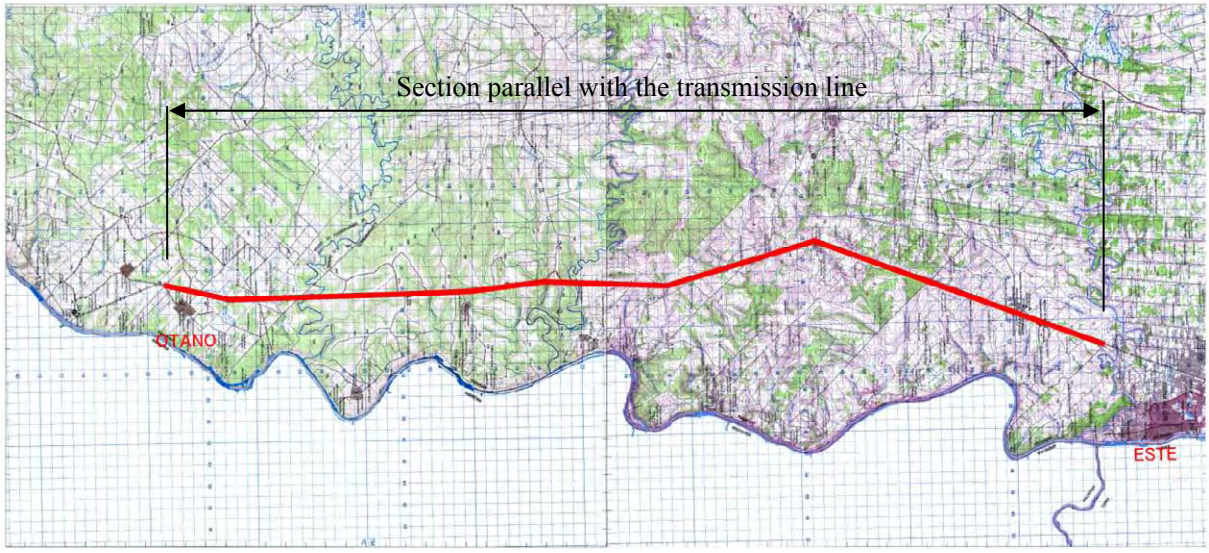
Route selection was completed in the previous year. As new control points have been extracted in the course of the survey this year, a review was made of proposed alternative routes for the target section.

(1) Parana River coastal roads

1) Section parallel with the transmission line

The section parallel to the 220 kV transmission line is shown below. To ensure safety and to facilitate maintenance, a total width of 50 meters, 25 meters on each side of the transmission line, is under control of ANDE. Note that land acquisition for this purpose has not been made. In addition, the following regulations apply to the section concerned:

- Crops can be grown, but structures are not allowed.
- A road may be built (installation of transmission line in the right-of-way also permitted).
- A distance of 9.0 meters or more should be secured between the transmission line and the road surface.



Source：JICA Study Team

Figure 4-4 Section parallel to transmission line

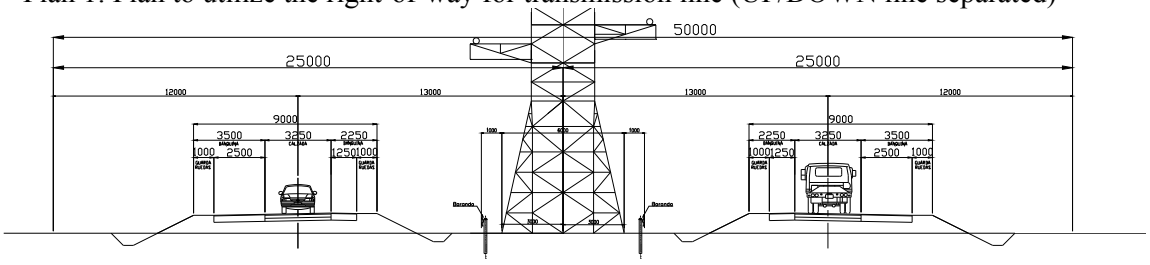
Since the 50 meter-width section along the transmission line is already subject to various constraints set by ANDE, acquisition of right-of-way for a road is considered to be relatively easy. A review was made of the three plans below according to the road development pattern. The result was that “Plan 2: Plan to utilize the right-of-way for a transmission line (one side)” was adopted.

Plan 1: Plan to utilize the right-of-way for transmission line (UP/DOWN line separated)

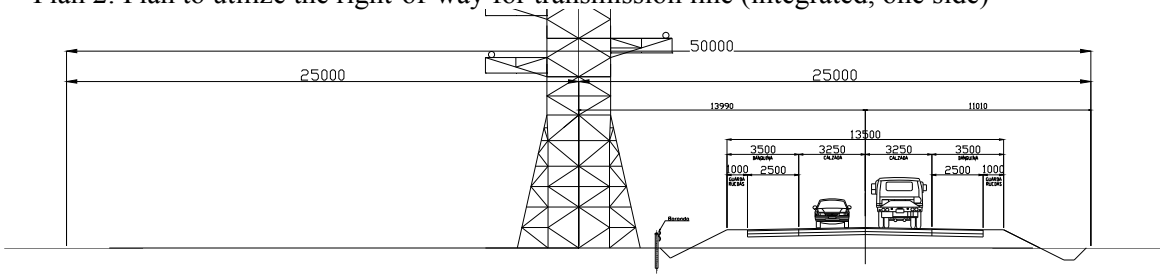
Plan 2: Plan to utilize the right-of-way for transmission line (integrated, one side)

Plan 3: Plan to utilize a part of the right-of-way for transmission line

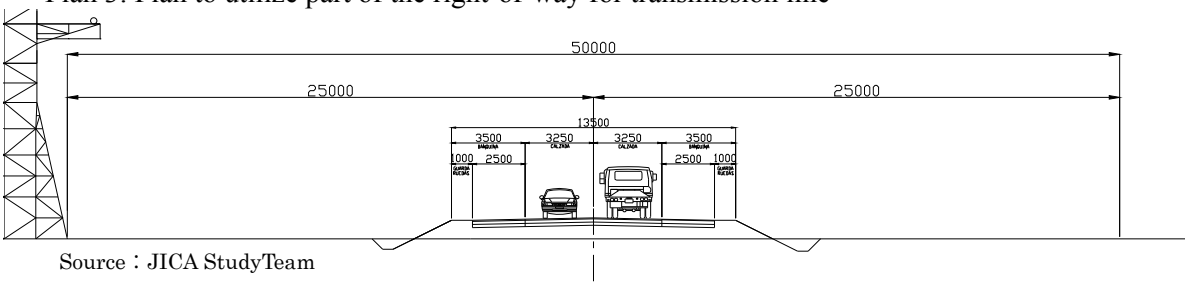
■ Plan 1: Plan to utilize the right-of-way for transmission line (UP/DOWN line separated)



■ Plan 2: Plan to utilize the right-of-way for transmission line (integrated, one side)



■ Plan 3: Plan to utilize part of the right-of-way for transmission line



Source：JICA StudyTeam

Figure 4-5 Proposed section structure

Table 4-2 Comparative study on the section parallel to the transmission line

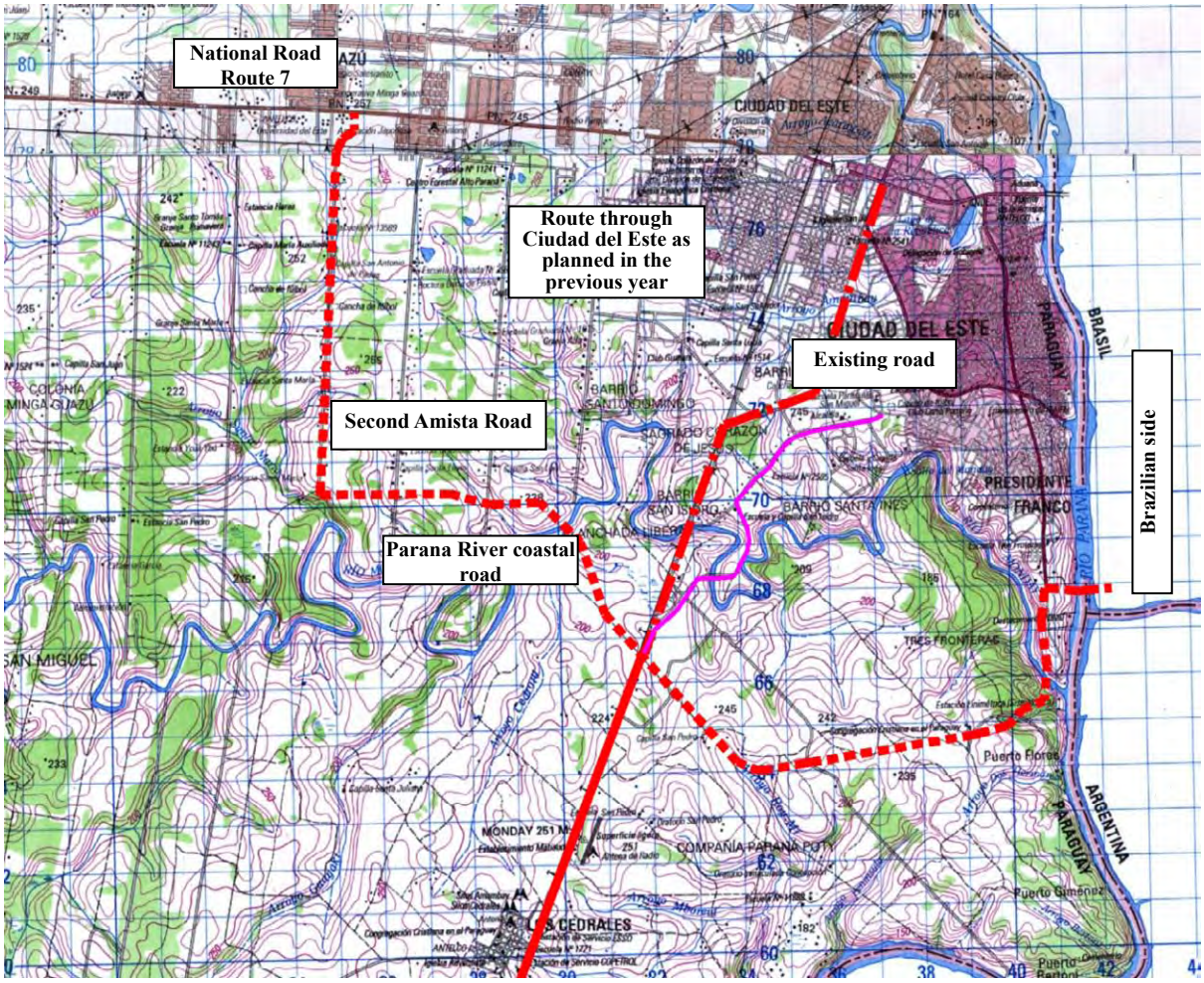
Item	Plan 1	Plan 2	Plan 3
Merits	・Road construction in land under control of ANDE. Land acquisition is considered relatively easy.	・Road construction is in land controlled by ANDE. Land acquisition considered to be relatively easy. ・Expansion of road functions is easy because similar land is available on opposite side with reference to steel towers.	・As there is no constraint on right-of-way for road, planning can be made easily. ・Expansion of road functions is easy because no obstructive materials in right-of-way for road (ANDE).
Demerits	・Sections requiring cut or fill, if any, may require diversion of road toward private land so as to prevent adverse effect on ANDE's steel towers. ・ As UP and DOWN lines are separated, it is necessary to provide U-turn and passing lanes for each section. ・The road development area is the largest, so this plan has the highest project costs.	・For the sections with cut and fill, the measures as described in Plan 1 are necessary. But the adverse effect caused by such measures can be smaller than the case of Plan 1 because the lanes are integrated on one side.	・Since the most of area for acquisition is not the land of ANDE's possession, it is possible that lot of time may be required for acquisition.
Evaluation	△	○	△

2) Route through Ciudad del Este

At present, a road connecting to the second Amista Bridge is being planned in Ciudad del Este. The second Amista road crosses the Prana River from the Brazilian side, bypassing Ciudad del Este, while keeping a considerable distance on its south side and connecting to National Road Route 7. This road will intersect with the export corridor on the south bank of the Monday River flowing in a suburb of Ciudad del Este.

The plan for the second Amista Road was not completed officially in the previous years, so the access was planned up to National Road Route 7. In the review this time, the Parana River coastal road was planned up to the intersection with the second Amista Road.

- The Parana River coastal road is expected to be used by large numbers of trucks. The surrounding environment will be heavily impacted if it passes through the urban area.
- When this road passes through Ciudad del Este, land acquisition issues may arise along with relocation of residents. Project costs will rise and implementation issues may increase.
- Trucks have access to National Road Route 7 or to Brazilian side via second Amista Road.
- Small vehicles have access to Ciudad del Este via the existing connected road.

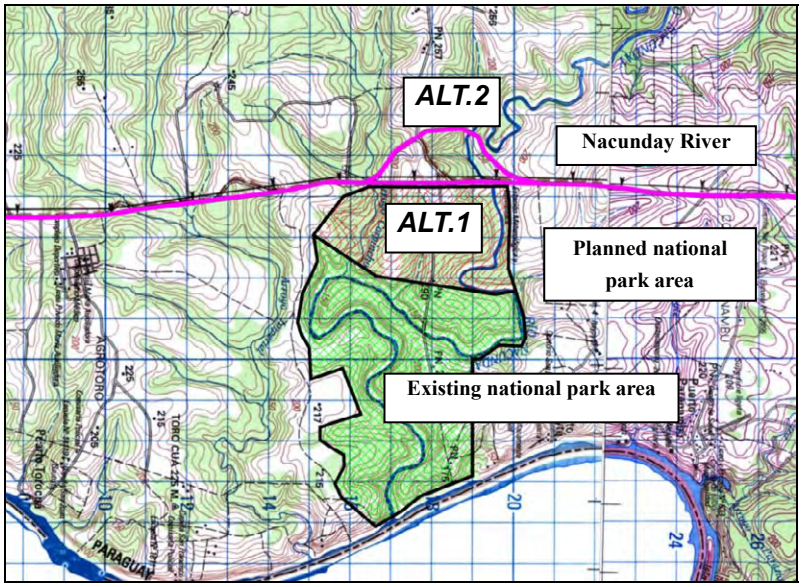


Source：JICA Study Team

Figure 4-6 Proposed alternative route through the Este area

3) Nacunday section

In the course of the environmental survey this year, it was found out that there is a plan of expanding the national park area toward the upstream side along the Nacunday River, as shown below. For this section, priority will be given to environmental protection. Namely, ALT. 1 proposed in the previous year was reviewed and ALT. 2 was selected to avoid the national park area and bypass it on the west.

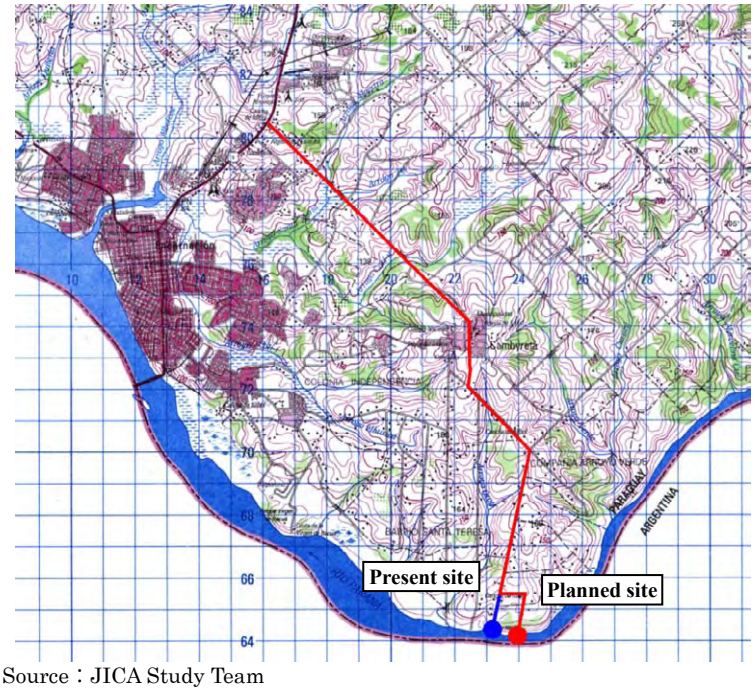


Source：JICA Study Team

Figure 4-7 Proposed alternative route through Nacunday area

(2) Port access roads

Campichuelo Port will be submerged on completion of the Yacyreta Dam. It will be relocated to a point about 400 meters upstream. Accordingly, the connection point to the port has been slightly changed as shown in Figure 4-8.



Source：JICA Study Team

Figure 4-8 Proposed alternative route to Campichuelo Port

4.4 Review of road structures

(1) Policy for bridge development plans

The target route has 32 sites (including two newly planned sites) that require drainage facilities with the total length of 2 meters or more (box culvert or larger), as shown in Table 3-2. For these structures, the development plan was established according to the policies outlined below:

- Maximum utilization of existing bridges. Existing sound bridges with a roadway width of 7.0m (3.25×2 + 0.25×2) or more will be effectively used. If the roadway width is less than 7.0 m, sound existing bridges may be used after widening.
- All wooden bridges will be replaced.
- Structures with a flow capacity equivalent to or greater than the existing one will be provided.
- The size (flow section, etc.) of structures will be determined on the basis of hydraulic/hydrographic analysis.
- In addition, the bridge will be replaced if it is desirable when considering the location of structures and the river flow state.

(2) Bridge development plans

A development plan for target 32 sites has been established on the basis of these policies (Table 4-3).

Table 4-3 Bridge development plans

MAIN CORRIDOR

Basin No	No	River name	Area (ha)	Length (m)	Culvert Box n b(m) h(m)	Bridges L(m)	Bridges B(m)	Bridges H.W.L.(m)	Remarks
1	3+250	Aro. Pai Curuzu(1)	1,310	5,300	2 - 4.500 × 2.850	—			Reuse
2	5+553	Aro. Pai Curuzu (2)	850	4,300	2 - 4.500 × 2.850	—			Reuse
3	12+093	Rio. Tembey	116,140	153,700	—	70.000	8.500	134.400	Reuse
4	22+768	M-2-1			1 - 3.000 × 3.000	—			Reuse
5	23+623	M-2-2			1 - 3.000 × 3.000	—			Reuse
6	27+777	Aro. San Rafael	1,140	3,500	2 - 4.500 × 2.800	—			Reuse
7	35+989	Rio. Guarapay	32,840	48,700	—	48.000	8.500	166.200	Reuse
8	47+616	Aro. Yhaca Guazu	23,770	35,700	—	48.000	8.500	173.200	Reuse
9	55+137	Aro. Alegre	2,240	7,900	2 - 3.500 × 3.000	—			Construction
10	56+642	Aro. Cure-Ky	1,160	4,700	2 - 3.500 × 3.000	—			Construction
11	64+430	Aro. Emillia	2,466	8,250	2 - 4.500 × 3.000	—			Reconstruction
12	64+562	Aro. San Juan	8,660	18,700	—	20.000	10.000	155.320 *1	Reconstruction
13	70+447	Aro. Yhaca-Mi	6,810	19,600	—	20.000	10.000	164.689	Reconstruction
14	72+250	Rio. Yacuy Guazu	73,000	117,500	—	75.000	10.000	173.200	Reconstruction
15	83+566	Aro. Diamante	2,250	6,300	2 - 4.500 × 3.000	—			Reconstruction
16	88+291	Aro. Imperial	3,940	14,300	—	15.000	10.000	163.100 *1	Reconstruction
17	89+425	Aro. Imperial Afluen.1	1,750	8,300	2 - 4.000 × 3.000	—			Reconstruction
18	90+000	Aro. Imterial Afluen.2	370	3,400	1 - 3.500 × 3.000	—			Reconstruction
19	94+240	Aro. Carpincho	5,580	15,100	—	20.000	10.000	147.800 *1	Reconstruction
20	97+048	Rio. Nacunday	243,820	237,600	—	100.000	10.000	154.419	Construction
21	99+782	Rio. Nacunday Afluente	490	3,400	1 - 3.500 × 3.000	—			Reconstruction
22	111+462	Aro. Pira Pyta Afluen.1	1,390	5,400	—	7.700	10.000		Reuse Widening of Wid
23	114+575	Aro. Pira Pyta	16,730	25,900	—	20.000	10.000	188.700 *1	Reuse od Existing Pier
24	117+337	Aro. Pira Pyta Afluen.2	3,550	9,800	—	16.000	8.000	192.300 *1	Reuse Widening of Wid
25	126+177	Aro. Y-Tuti	9,310	14,200	—	25.700	8.000	199.400 *1	Reuse Widening of Wid
26	134+683	Aro. Yta Coty	7,210	14,900	—	15.000	10.000	199.000 *1	Reconstruction
27	146+413	M-7-1			2 - 2.000 × 2.000	—			Reuse
PORT ACCESS ROAD									
1-1	2+635	Aro. Maestora	1,350	5,900	—	6.000	8.000		Reuse Widening of Wid
1-2	3+223	Aro. Pe	920	3,400	—	6.100	10.000		Reuse Widening of Wid
1-3	6+088	Aro. Curi-Y①	6,700	16,900	—	15.000	10.000	124.000 *1	Reconstruction
3-1	8+711	Aro. Pora	1,850	6,600	2 - 4.000 × 3.000	—			Reconstruction
6-1	5+650	Aro. Cure-ky	860	102,000	1 - 2.500 × 2.500	—			Reconstruction

(Note) Area:Catchments Area :Catchments Area
Length: River Length : River Length
*1 is presumed he height than topographical map

Source：JICA Study Team

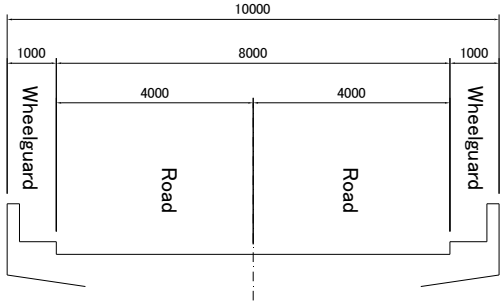
(3) Establishing the design conditions

1) Applicable design standards

Paraguay is currently developing a road planning manual. Since the present design standard is based on AASHTO, this study will also use AASHTO.

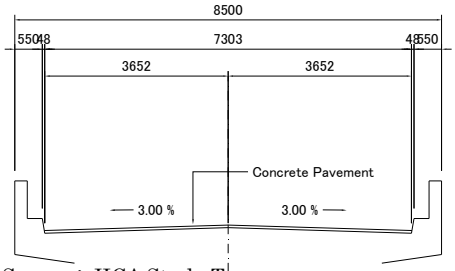
2) Bridge width

As negotiated with MOPC, the bridge width will be as shown below.



Source：JICA Study Team

Figure 4-9 Standard bridge section



Source：JICA Study Team

Figure 4-10 Reusable bridge width

3) Design live load

As specified in AASHTO the design live load in Paraguay is “HS20-44.” The total weight of vehicles permitted is 49.5 tons. Since the surcharge load per axle is about 100kN, “HS20-44” specified in AASHTO is applied to the design of structures. Note however that the detailed design must employ the design live load specified in the road planning manual currently under review.

5. Prediction of future traffic volume

5.1 Setting socioeconomic frame

(1) Population

Population data for the period from 2000 to 2009 was used by the Government of Paraguay to predict future population trends by department, sex and age by cohort method. It is predicted that the population of Paraguay will be about 7 million in 2015 and about 7.5 million in 2020. The population in Central Department grew the most, and the population in the subject area in Alto Parana Department grew more than the national average.

Table 5-1 Future population by department

Departamentos	2000	2005	2010	2015	2020	2015/2010	2020/2010
Asunción	513,405	519,647	518,222	511,523	500,665	0.99	0.97
Concepción	186,666	189,749	190,464	189,083	185,535	0.99	0.97
San Pedro	331,955	346,564	357,251	364,275	367,229	1.02	1.03
Cordillera	242,158	260,248	276,945	291,971	304,680	1.05	1.10
Guaira	185,858	192,530	197,030	199,490	199,807	1.01	1.01
Caaguazú	453,037	469,910	480,786	486,331	486,419	1.01	1.01
Caazapá	145,728	149,399	151,288	151,570	150,157	1.00	0.99
Itapúa	470,084	504,736	535,512	561,418	581,246	1.05	1.09
Misiones	105,014	111,438	116,953	121,537	124,943	1.04	1.07
Paraguarí	231,650	236,945	239,576	239,665	236,968	1.00	0.99
Alto Paraná	585,131	670,072	753,658	833,703	907,668	1.11	1.20
Central	1,414,788	1,722,691	2,068,066	2,450,360	2,863,314	1.18	1.38
Ñeembucú	79,581	82,188	83,833	84,539	84,203	1.01	1.00
Amambay	118,474	122,874	125,341	125,989	124,846	1.01	1.00
Canindeyú	143,228	163,610	183,668	203,073	221,178	1.11	1.20
Presidente Hayes	85,171	94,532	103,436	111,886	119,617	1.08	1.16
Boquerón	42,382	49,809	57,752	66,125	74,777	1.14	1.29
Alto Paraguay	11,955	11,708	11,339	10,866	10,297	0.96	0.91
Paraguay Total	5,346,265	5,898,650	6,451,120	7,003,404	7,543,549	1.09	1.17

Source:DGEEC/STP

(2) Future economic growth

Rapid growth has mainly been seen in the primary industries since 2005. Therefore, based on GDP data between 2005 and 2010 (excluding 2009), we projected GDP growth up to 2020, using linear regression and exponential regression (growth rate curve). The result of using the linear regression method indicates that economic growth in the ten-year period from 2011 through 2020 will be 3.9%; the result of applying exponential regression indicates 5.7% growth for the same period. The economic development plan (EDEP) drawn up in 2000 projected annual economic growth of 6% per annum until 2020. We decided that the future frame will be GDP based on a growth rate curve resulting from exponential regression.

Table 5-2 Annual economic growth rates

Annual economic growth rate (%)	Linear regression	Exponential regression
2000 – 2005	2.89	2.89
2006 – 2010	5.62	5.62
2000 – 2010	4.08	4.08
2011 - 2020	3.92	5.72

Source: JICA Study Team

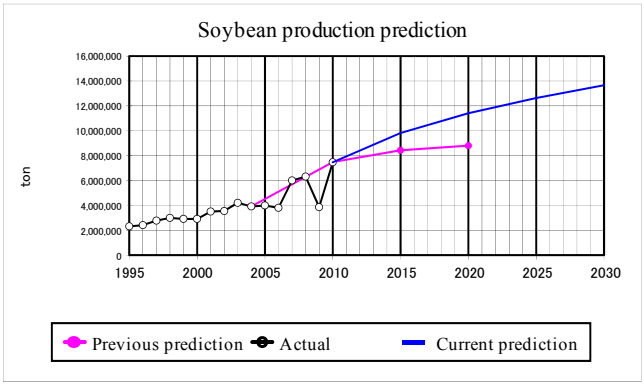
5.2 Prediction of materials flow

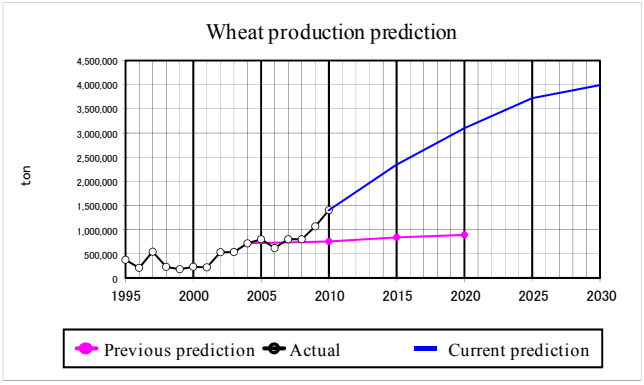
(1) Projected growth in major agricultural products

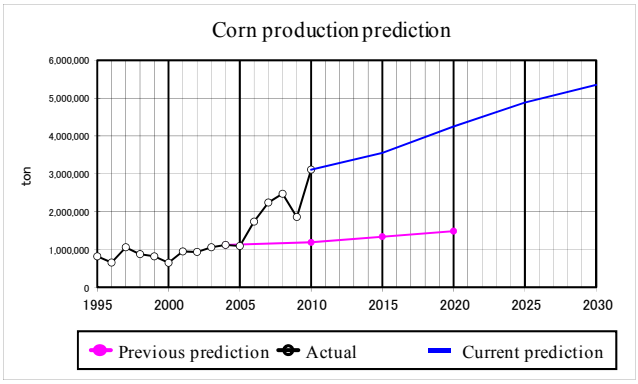
Soybeans: Predicted by Planted area x Yield per 10 are. The total production is predicted to be 11.41 million tons in 2020, 1.53 times more than the 7.46 tons in 2010 (1.30 times more than the previously predicted 8.8 million tons).

Wheat: Predicted by Planted area x Yield per 10 are. Total production is predicted to be 3.1 million tons in 2020, 2.2 times more than the 1.4 million tons in 2010 (3.5 times more than the previously predicted 0.89 million tons).

Corn: Predicted by Planted area x Yield per 10 are. Total production is predicted to be 4.25 million tons in 2020, 1.37 times more than the 3.11 million tons in 2010 (2.9 times more than the previously predicted 1.48 tons).







Source：JICA Study Team

Figure 5-1 Predictions of annual production

5.3 Prediction of future traffic demand

(1) Traffic on the subject roads

Transportation on the subject roads is composed of intra-regional transportation used by the residents and crop transportation to ship export crops to Parana River ports.

If the subject roads are developed, a part of the traffic now using National Road Route 6 will be shifted to them. If built the new roads will also be used for new traffic generated by economic development in the areas along them.

In this study, we will predict future traffic demand from intra-regional traffic, crop transportation traffic and traffic shifting to the new roads.

(2) Prediction method and results

1) Intra-regional traffic

The intra-regional traffic in 2020 was obtained by: (Transportation survey – Crop-related transportation) x Day and night ratio x Traffic growth.

2) Conversion traffic

The conversion traffic in 2020 was obtained by: (Current OD table obtained from the transportation survey implemented in Iruna and Trinidad toll gates in National Road Route 6 – Crop related transportation) x Traffic growth. Aformula representing the rate of traffic shifting from the subject road to National Road Route 6 was used to calculate the conversion traffic volume.

Traffic using the toll gates in 2020 was projected to be 6,600 cars/day, 1,400 cars/day of this would come from vehicles arriving earlier by using the subject road rather than National Road Route 6. Actual converted traffic was 1,000 cars/day, 16% of all traffic.

Table 5-3 Traffic switching from National Road Route 6 to the subject road in 2020

(Unit: cars/day)

	Passenger cars	Buses	Two axes trucks	Three axes or more	Trailers	Total
Toll gate passing traffic	4,910	210	350	560	610	6,640 -
Traffic subject to conversion	920	120	90	130	170	1,430 (21%)
Conversion traffic	690	80	70	90	110	1,040 (16%)

Source:JICA Study Team

3) Crop transportation traffic

If the subject road is completed, crops from specific zones will be shipped via the Parana River with less transportation cost due to shifting from shipment via the currently used Paraguay River.

In this study, we created a river selection model using the land transportation cost to the ports of two rivers for soybeans and wheat, and water transportation cost to Buenos Aires. Corn is mostly exported via the Paraguay River, and we assumed that the current condition would continue.

Predictions for 2020 using this model indicated that opening the subject road would promote shifting shipments of 0.6 million tons of soybeans and 0.2 million tons of wheat from the Paraguay River to Parana River. If we convert the annual tonnage to daily number of cars, the traffic shifted to the Parana River after opening of the subject road would be equivalent to an increase of 300 vehicles.

Table 5-4 Conversion of crops in 2020

(Unit: million tons/year)

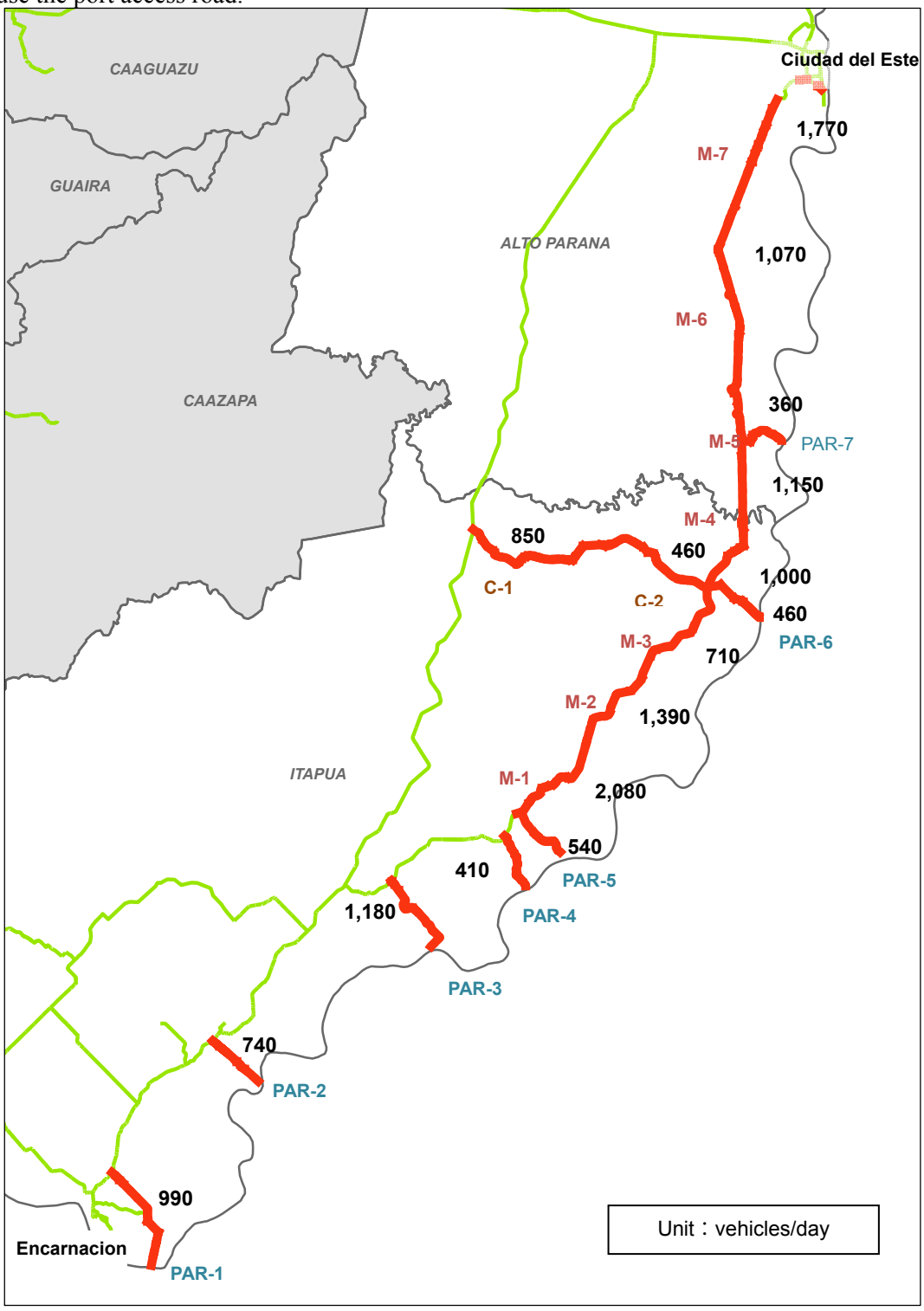
		Use of Paraguay River	Use of Parana River	Conversion
Soybean	Without development	7.2 (79%)	2.0 (21%)	0.6
	With development	6.6 (72%)	2.6 (28%)	
Wheat	Without development	0.5 (49%)	0.6 (51%)	0.1
	With development	0.4 (35%)	0.7 (65%)	

Source: JICA Study Team

4) Traffic volume by section

Given below is the projected traffic volume in the indicated sections in 2020, a total of intra-regional traffic, shifted traffic and crop transportation traffic.

In 2020, 700-2,080 cars per day will use the road along the Parana River; 460-850 cars per day will use the National Road Route 6 - the river coastal road connection road; and 360-1,180 cars per day will use the port access road.



Source：JICA Study Team

Figure 5-2 Traffic volume by section in 2020

6. Environmental and Social Considerations

6.1 Background for survey of environmental and social considerations

During the previous F/S, we retained a local consultant to conduct an initial environmental survey (IEE). Thereafter, MOPC prepared a basic environmental questionnaire and submitted it to the Environmental Agency (SEAM). SEAM decided that MOPC needs to conduct an environmental assessment as the project party.

MOPC retained Consorcio Elintec, a local consultant, to conduct an environmental impact assessment (EIA). This report was completed in September 2009. Originally, the EIA was to have been sent to SEAM after local hearings for its evaluation, but five years has passed since the previous F/S, involving changes in routes, road structures and road plans. No hearing was held and no EIA was submitted to SEAM.

As a result of screening summarized below, the category is set as B and there has been no change from the previous survey.

6.2 A review of environmental and social conditions and issues pertaining to the project and proposed countermeasures

Table 6-1 arranges issues and countermeasures based on the results of the commissioned survey, site surveys, and hearings with related organizations.

Table 6-1 Current issues and proposed responses

Item	Current status	Response
(1) Relationship with the natural environment	In not only the rivers but also their branches, i.e. small streams where the proposed road crosses, there is much vegetation. Such places are habitats of small animals.	Where the road crosses streams, destruction of vegetation will be minimized. Structures for animals to safely cross the road (eco-road) will be provided.
(2) Relationship with the Nacunday National Park	Nacunday National Park will be created near the point where high voltage cables of ANDE cross the Nacunday River. The basin of this river is a natural treasure, and is expected to be a precious resource for tourism. As a substitute of the routes nearby, there is a route to run directly under the high voltage cable and to largely circumvent the current road.	Recommended circumvention route not going through the national park.
(3) Traffic safety	We often see shoulders of arterial roads that are not paved in Paraguay. In consideration of the safety of motorcycle and bicycle riders and pedestrians, it is necessary to design a proper pavement structure. Parking for long-distance trucks is another necessity.	To enhance traffic safety, shoulders should be paved. In sections passing through the city center, sidewalks should be created and the road paved. Parking zones at certain intervals (e.g., every 20km) should be created to enable truck drivers to rest..
(4) Relationship with communities	The relationship between the arterial road where cargo trucks drive at high speeds and the surrounding rural communities and the residents living could be estranged.	Some of the devices listed below are needed to link development of arterial roads to development of local communities. 1) Goods sales at parking belts 2) Installation of Michinoeki (road station) 3) Development of branches to hamlets 4) Development of resources for tourism 5) Strengthen ties with surrounding cities
(5) Existence of farmer tents demanding agrarian reforms	Under the high voltage cable of ANDE near the Nacunday River, farmers demanding agrarian reforms have set up tents, occupying the land of ANDE, to demonstrate their demands. These farmers have demanded agrarian reforms to the Regional Development Agency (INDERT) as a farmers union of 3,000 families.	We need to request INDERT in charge of agrarian reforms, and departments and cities as local governments to consider proper solutions, and make preparations so that land acquisition by MOPC will not be hindered in the future.
(6) Land acquisition	Between Natalio and Mayor Otano on the road along the Parana River, there will be not much problem in land acquisition and compensation. The area surrounding Mayor Otano City needs new construction, and land acquisition and compensation issues arise. Under the high voltage cable of ANDE, ANDE has the right to use, but when building a new road, MOPC needs to acquire the land. In the sections of National Road Route 6 - the river coastal road connection road, it is necessary to consider acquisition of land surrounding the Frutika Company. In the access road to each port, it is necessary to consider sections in city areas.	Limit the road construction as much as possible to widths in line with the current ones (50m, 30m, etc.). Minimize land acquisition and compensation. Pursue solutions in good faith with sufficient discussions with local governments and local residents.

6.3 Schedule for acquiring environmental certification

MOPC projects and other projects requiring an environmental impact assessment must obtain an environmental license (Licencia Ambiental) from SEAM. The process and schedule for its acquisition are shown in Table 6-2.

Table 6-2 Procedures related to environmental and social considerations

Implementation item	2011												2012											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
F/S(SAPROPF)																								
Environmental assessment(final)																								
Summary of environmental assessment																								
Distribition to municip alities of summary of environmental assessment																								
Hearing(as necessary)																								
Examination and approval by SEAM																								
Environmental assessment approval publication																								
Environmental certification (effective for 2 years)																								

Source: JICA Study Team

6.4 Assistance in preparing plan for resettling residents and acquiring land

(1) Land ownership of the current roads

1) River coastal road, National Road Route 6- the river coastal road connection road (national roads)

- Roads were developed without acquiring the land in 1970s. There is a de facto use right, but it may be that the certificate of title and similar documents do not exist.
- A provision for the current road site exists on the land register, but the owner is not specified..
- ANDE has the permanent right of use for the power cable sections but not land ownership.

2) Port access roads

- It is possible that they have been owned by the local municipality since the development of the roads.
- It is necessary to verify ownership relations, acquire land as needed.

In other words, although the current road sites may be acquired free of charge, it is necessary to ensure that the road sites are owned by the public. Therefore, plans should provide for official land acquisition.

Basic concepts in land acquisition

The scope of land acquisition should be right of way (ROW) in principle. The ROW of the subject road is 50 meters for the Parana River riverside road, and 30 meters for other roads. However, the underlying principle regarding existing roads has traditionally been the width used. These are 20 meters in local areas and 16 meters in urban areas. Therefore, the scope of land acquisition for each road is set as follows:

- Parana River coastal road⇒50m
- National Road Route 6 - the river coastal road connection road⇒20m to 50m
- Port access road⇒16m to 30m

(2) Cost of residents resettlement and land acquisition

We decided the scope of land acquisition by confirming the status of houses. To do this we used field surveys, the road designs and map data. The number of obstacles and number of site acquisitions are as follows:

Number of obstacles 26 in total		Number of land acquisitions 1,810 in total	
· Parana River coastal road:	9	· Total area:	268
· National Road Route 6 – the river coastal road connection road :	12	· Partial area:	1,542
· Port access roads:	5		

Source: JICA Study Team

The calculation of compensation for lost assets based on repurchase cost is as follows:

Land acquisition cost:

Acquire all basic land width：US$11,356,000

Compensation for loss and residents resettlement:

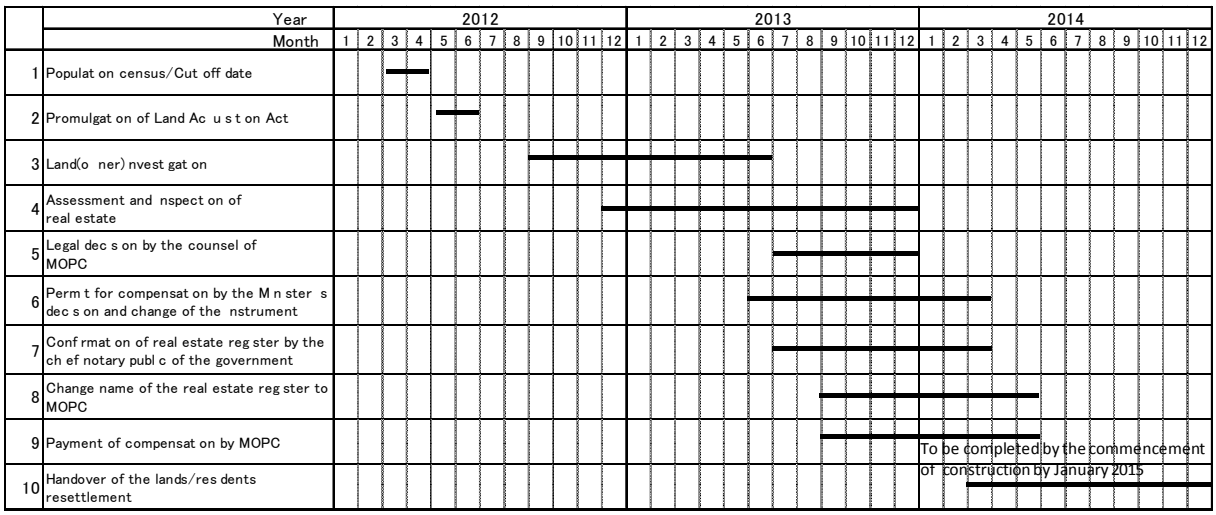
US$800,000 (cost for resettlement and rebuilding)

In other words, the total would be US$12,156,000 at maximum in total, which is about 4% of the total project cost discussed later.

(3) Schedule for resident resettlement and land acquisition

MOPC has experience carrying out resettlement of residents and acquisition of land for projects undertaken in cooperation with the World Bank and IDB It has prepared RAP and understands its necessity. MOPA can be expected to properly respond.

Table 6-3 Implementation schedule



Source: JICA Study Team

7. Preliminary Design

7.1 Preliminary road design

The target section was divided into 16 sub-sections, and the road alignment was reviewed for each sub-section. Horizontal and vertical alignments were determined on the basis of the results.

Section	Start point	End point	Length (km)
M-1	Natalio	Tembey River	
	0 + 0.000	12 + 93	12.1
M-2	Tembey River (inc. bridge)	Gurapay Stream	
	12 + 93	35 + 989	23.9
M-3	Gurapay Stream	Connection	
	35 + 989	59 + 315	23.3
M-4	Connection	Yacuyguazu River	
	59 + 315	72 + 285	13.0
M-5	Yacuyguazu River (inc. bridge)	Nacumday River	
	72 + 285	97 + 56	24.8
M-6	Nacumday River (inc. bridge)	Los Cedrales	
	97 + 56	140 + 72	43.0
M-7	Los Cedrales	Prte.Franco	
	140 + 72	147 + 0	6.9
PAR-1	Route6	Pt. Campichuelo	
	0 + 0	19 + 50	19.1
PAR-2	Route6	Pt. Paredon	
	0 + 0	11 + 0	11.0
PAR-3	Parana River coastal road	Pt. Don Joaquin	
	0 + 0	16 + 750	16.8
PAR-4	Parana River coastal road	Paloma Port	
	0 + 0	11 + 830	11.8
PAR-5	Parana River coastal road	Triunfo Port	
	0 + 0	11 + 870	11.9
PAR-6	Parana River coastal road	Dos Fronteras Port	
	0 + 0	6 + 360	6.4
PAR-7	Parana River coastal road	Torocua Port	
	0 + 0	8 + 720	8.7
C-1	Route6	Frutika	
	0 + 0	24 + 800	24.8
C-2	Frutika	Parana River coastal road	
	24 + 800	54 + 430	29.6

Source: JICA Study Team

Figure 7-1 Sectioning map

(1) Parana River coastal road

1) Itapúa Department (M-1 to M-3 sections)

Basically, the horizontal alignment was matched to that of existing roads for the following reasons:

- Easy implementation with limited land acquisition
- Future applicability of existing structures (bridges, box culverts) to an appropriate degree

Any curved section of existing roads that could not meet the design speed (V=100km/h), will be improved by applying the radius of curvature compatible with the standard.

The existing road is not to be used for the intersection with the road between National Road Route 6 and coastal roads in the M-3 section. Instead, the plan is to have the road pass in the neighborhood of Otano and Lopez.

Basically, the vertical alignment was matched to that of existing roads for the following reasons:

- To reduce impact on private land areas
- To utilize existing structures to a maximum degree

Any steep slope on existing road, which could not meet the design speed (V=100km/h), will be improved to the gentle vertical grade (steepest vertical grade I=6.0%).

2) Alto Paraná Department (M-4 to M-7 sections)

The horizontal alignment was planned while taking the following factors into account:

- To have the right to use the land which ANDE has rights for the road plan of the section concerned.
- Where the cut or fill of the local ground may affect the steel towers, the alignment will be set to divert in such a manner to avoid the effect.
- For the south bank of Nacunday River, the route will be established in a way to bypass the area planned for the national park.
- At the Nacunday River crossing point, the alignment will be set to cross the river at a right angle to reduce the bridge length.

Basically, the vertical alignment was matched to that of existing roads for the following reasons:

- The alignment plan will be appropriate for the local ground as much as possible.
- At the Nacunday River crossing point, the vertical alignment was planned by controlling structure height in the preliminary design.

Any steep slope section of existing road, which could not meet the standard was improved to a gentler slope that can meet the design speed (V=100km/h) (steepest vertical grade I=6.0%).

The M-7 section is already improved to the asphalt pavement road, offering smooth alignment both horizontally and vertically. Accordingly, it was decided to utilize the existing road while performing over-lay and shoulder work.

(2) Road connecting National Road Route 6 and the coastal roads (C-1 to C-2)

Basically, the horizontal alignment was matched to that of existing roads for the following reasons:

- As C-1 is already paved with stone, the plan will be matched to the existing road as much as possible to reduce construction costs.

- C-2 can be readily implemented in terms of land acquisition, etc. by matching it to the horizontal alignment of existing road.
- Any existing section with a small curve that did not meet the standard will be improved to a radius of curvature compatible with the design speed of V=80km/h. (Minimum radius of curvature is R=210m.)

The vertical alignment was planned while taking the following factors into account:

- The vertical design of C-1 will be based on the existing vertical alignment because the existing vertical grade offers the smooth alignment. (Vertical grade meets the standard of design speed of V=80km/h. Steepest vertical grade is I=7.0%)
- The impact of C-2 on private land areas can be reduced by matching the vertical alignment of the existing road.

- Existing sections with steep grade that do not meet the standard will be improved to a gentler vertical grade meeting the standard of design speed of V=80km/h. (Steepest vertical grade is I=7.0%.)
- Since the end point becomes the intersection with the Parana River coastal road, its design height will be matched to that of the intersection.

(3) Port access road plan

There are a total of seven routes for port access roads. All begin at either the Parana River coastal road or National Road Route 6 and end at the entrance to the ports. Apart from the access roads listed below, port access roads are dirt roads:

PAR-2 (Paredon Port): Stone pavement over entire route
PAR -3 (Don Joaquin Port): Stone pavement over almost entire route
PAR -4 (Paloma Port9: Stone pavement over entire route
PAR -5 (Triunfo Port): Stone pavement over entire route

Basically, the horizontal alignment was matched to that of existing roads for following reasons:

- Ready implementation in terms of land acquisition, etc. by matching it to the horizontal alignment of existing road
- The basic policy is that any section with a small curve that does not meet the standard will be improved to a radius of curvature compatible with the design speed of V=80km/h. However, the design speed will be V = 50 km/h for geologically constrained sections or urban areas. (The minimum radius of curvature will be R=70m.)

Basically, the vertical alignment was matched to that of existing roads for the following reasons:

- To reduce its impact on private land areas by matching the vertical alignment of existing road
- Particularly for roads already paved with stone, the plan will be matched to existing road as much as possible to reduce construction costs.
- The basic policy is that any section with a steep slope that does not meet the standard will be improved to a vertical grade compatible with the design speed of V=80km/h. However, the design speed will be V = 50 km/h for geologically constrained sections (with lots of cuts and fills) (steepest vertical grade I=10.0%).
- The height of start and end points will be matched to the planned Parana River coastal roads and residual elevation of ports.

(4) Auxiliary facilities

1) Safety facilities

① Installing guardrails

Guardrails will be installed at the following points:

- Sections with fills, where the difference between high and low points is large. (Sections where the the difference is about 2.0 meters or more.)
- In sections where the planned road will be built in close proximity to the steel towers, guardrails will be provided as if encircling the towers.
- Apart from the above, sections where structures requiring guardrails are located in the neighborhood

② Installing traffic signs and markings

Traffic signs and markings will be provided at the following points:

- Regulatory signs for speed limits and pedestrian crossings will be installed in an adequate layout.
- Informational signs showing direction and distance to destinations, toll gates, etc. will be installed in an adequate layout.
- Warning signs at intersections or curves will be installed in an adequate pattern.
- Marking for center strips and side strips will be provided.

2) Traffic control facilities

Axle load scale yards to prevent truck overloading and toll gates to collect tolls for road maintenance will be provided.

3) Parking areas

Parking areas will be provided for disabled cars or as rest areas. The interval will be about one area per km.

4) Climbing lanes

The low speeds of trucks on upgrades will lead to decreased traffic capacity and lower levels of safety and comfort. Accordingly, a climbing lane will be provided on upgrades where the speed of large vehicles may drop to 50 km/h or less. By eliminating the low-speed vehicles from the through lane, the originally intended capacity, safety and comfort will be secured.

5) Roadside station (Michi no Eki)

Roadside stations are facilities with rest areas integrated with regional development facilities. They have three functions: to provide road users with an opportunity to rest and shop; they will have facilities to provide information for road users and regional residents, and they will provide a "regional liaison function" to promote regional tie-ups around the station. Installation of these facilities is considered to be desirable.

6) Study of eco-roads

The aim is to construct the road based on consideration of coexistence and matching with the natural environment of the region. For sections running through forests, the road structure will allow installation of pipe culverts enabling passage of animals to prevent division of animals' habitats or accidental contact with cars.

7.2 Pavement design

(1) Design conditions

1) Subgrade strength

CBR tests were conducted at four points: on both banks of the Nacunday River and on both banks of the Yacuy Guazu River. The test results are summarized below:

- CBR tests on both banks of the Nacunday River produced a value of 4,9.
- CBR tests on both banks of the Yacuy Guazu River produced a value of 9,12.

The design CBR value was set based on the above CBR test results. It was decided to design with CBR = 5.

2) Materials used in each course

Materials used are those commonly used in Paraguay:

- Surface and binder courses : Asphalt mixture
- Base course : Crushed stone for mechanical stabilization
- Subbase course : Crusher run

3) Other conditions

- Reliability: 90
- Design CBR: 5%
- Present serviceability index Po (initial value): 4.5 Pt (ultimate value): 2.5
- Analysis period: 20 years
- Traffic volume growth rate: 5.93%
- The surface course of shoulders is to be subject to surface down, with a thickness of 3 cm.

(2) Pavement composition

The pavement composition of each section was determined on the basis of the following conditions. The results are shown in Table 7-1.

Table 7-1 List of pavement composition

Name of section	DesignESAL (million ESAL)	Surface course	Base course	Subbase course	Pavement thickness	Name of type
M-1	2.939	10	25	35	70	Type1
M-2	2.115	10	25	30	65	Type 2
M-3	1.524	10	25	30	65	Type 2
M-4	3.818	15	25	25	65	Type 4
M-5	3.671	15	25	25	65	Type 4
M-6	3.230	15	25	25	65	Type 4
M-7	6.005	15	25	30	70	Type 5
C-1	4.444	15	25	25	65	Type 4
C-2	4.885	15	25	25	65	Type 4
PAR-1	1.114	10	20	30	60	Type 3
PAR-2	1.068	10	20	30	60	Type 3
PAR-3	2.945	10	25	35	70	Type 1
PAR-4	3.039	10	25	35	70	Type 1
PAR-5	0.526	10	20	20	50	Type 6
PAR-6	4.319	15	25	25	65	Type 4
PAR-7	3.640	15	25	25	65	Type 4

Source: JICA Study Team

7.3 Designing the road drainage facilities

For the drainage facilities, a study was conducted of the cross-sectional drainage facilities (pipe culvert) and longitudinal drainage facilities (gutter at toe of slopes).

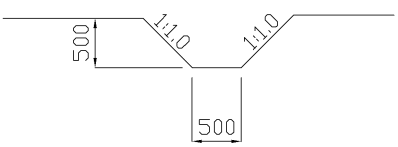
(1) Cross-sectional drainage facilities

The cross-sectional drainage facilities are classified into the following types:

- Gutters at toes of slopes (fill and cut sections)
- Stone-built gutter at toe of slope (immediate vicinity of water plumbing)

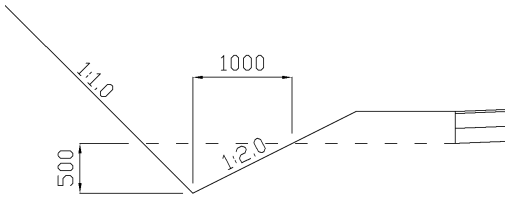
The gutters at toes of slopes were configured as shown below.

Fill



Source：JICA Study Team

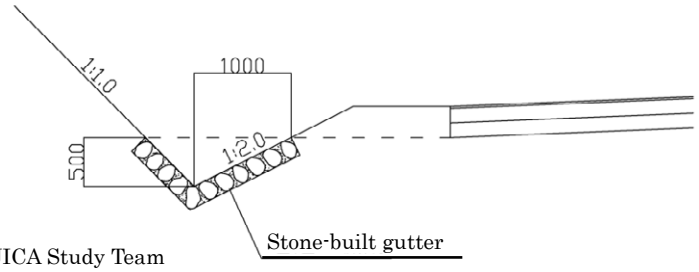
Cut



Source：JICA Study Team

Figure 7-2 Configuration of gutter at end of slope

Erosion may occur because the flow increases and the flow rate rises in the immediate vicinity of water pipes. channel, stone gutters were to be used in view of need for reinforcement of channel.



Source：JICA Study Team

Figure 7-3 Configuration in immediate vicinity of water pipes

(2) Cross-sectional drainage facilities

Since pipe culverts cover small drainage areas, it is difficult to accurately identify drainage areas on a plan view used for design. Basically, therefore, the plan is to replace existing culverts found in the road inventory survey. Since maintenance to reduce areas filled with soil sedimentation is difficult to perform, a maximum size of φ1.0m currently available will be used in view of the margin of the section. Apart from existing installation locations, the sag point in the longitudinal plan will allow accumulation of surface drainage, so that pipe new culverts will be provided. Table 7-2 shows the number of pipe culverts installed in each section.

Table 7-2 List of pipe culverts

Name of section	Start point	End point	Pipe size	No of locations
M-1	Natalio	Rio. Tembey	φ1.0	3
M-2	Rio. Tembey(inc. bridge)	Ao. Gurapay	φ1.0	7
M-3	Ao. Gurapay	Connection	φ1.0	9
M-4	Connection	Rio. Yacuyguazu	φ1.0	9
M-5	Rio. Yacuyguazu(inc. bridge)	Rio. Nacunday	φ1.0	11
M-6	Rio. Nacunday(inc. bridge)	Los Cedrales	φ1.0	18
M-7	Los Cedrales	Prte. Franco	φ1.0	1
PAR-1	Route No.6	Pt. Campichuelo	φ1.0	7
PAR-2	Route No.6	Pt. Paredon	φ1.0	11
PAR-3	Parana River coastal road	Pt. Don Joaquin	φ1.0	10
PAR-4	Parana River coastal road	Pt. Paloma	φ1.0	8
PAR-5	Parana River coastal road	Pt. Triunfo	φ1.0	8
PAR-6	Parana River coastal road	Pt. Dos Fronteras	φ1.0	7
PAR-7	Parana River coastal road	Pt. Torocua	φ1.0	5
C-1	Route No.6	Frutika	－	0
C-2	Frutika	Parana River coastal road	φ1.0	19

Source: JICA Study Team

7.4 Preliminary design of structures

(1) Selecting bridge types

For small-scale bridges less than 30 meters long, the bridge types shown in Table7-3 will be applied because they have proven to be economically superior and because of past construction experience in Paraguay.

As the result of a comparative study, pre-stressed concrete continuous composite girders were selected for the two bridges more the 30 meters long that cross the Nacunday and Yacuy Guazu Rivers.

Table 7-3 Standard structural type by bridge length

Bridge length　L(m)	Bridge type
10 m< L < 15 m	Reinforced concrete structure
15 m< L < 30m	Pre-stressed concrete structure

Source: JICA Study Team

(2) Preliminary design of bridges

1) Superstructure

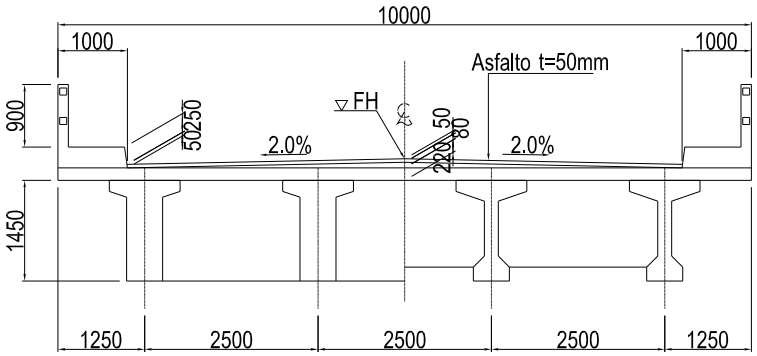
The superstructure types used for bridges are shown in Table 7-4.

Table 7-4 Superstructure type

Section	No	Station No	Name of river	Bridge length (m)	Width (m)	Structural type
M-4	12	64+562	San Juan Stream	20.00	10.00	PC simple composite girder
M-3	13	70+447	Yhaca Mi Stream	20.00	10.00	PC simple composite girder
	14	72+250	Yacuy Guazu River	75.00	10.00	PC 3 span continuous composite girder
	16	88+291	Imperial Stream	15.00	10.00	PC simple composite girder
	19	94+240	Carpincho Stream	20.00	10.00	PC simple composite girder
M-6	20	97+048	Nacunday River	100.00	10.00	PC 4 span continuous composite girder
	23	114+575	Pira Pyta Stream	20.00	10.00	PC simple composite girder
	26	134+683	Yta Coty Stream	15.00	10.00	PC simple composite girder
PAR-0	32	0.0+6.2	Curi-Y Stream	15.00	10.00	PC simple composite girder

Source: JICA Study Team

The section of bridge is shown in Figure 7-4. For the PC simple composite girder, the ratio of the height of beam with the span of 1/17 proves most economical. In this review, the heights of girder of 1.0 m, 1.15 m, and 1.45 m will be employed for the necessary bridges of 15.0 m, 20.0 n, and 25.0 m. As regards the number of girders, four main girders will be used, with the distance between main girders being 2.35m-2.5m, for the two-lane road (width 10 m).



Source：JICA Study Team

Figure 7-4 Bridge girder section

2) Substructures

① Geological characteristics

The geological composition at bridge locations consists of sandy silt, clay, and rock.

The bearing layer is a soil layer with an N value of 30 or more as determined from a standard penetration test. The layer is located 1.0 to 5.0 meters below the ground surface.

② Foundation type

For the foundation type, it is necessary to identify the superstructure, geology, and construction method with considerable accuracy if the most economical type is to be selected. At present, layers with an N value of 30 or more are considered as the bearing layer after studying economic feasibility,

constructability, groundwater levels, and work width. A spread foundation will be chosen if the bearing layer depth is less than 4.0 meters. The pile foundation will be chosen if the bearing layer depth is 4.0 meters or more. Based on the terrain survey, the bearing layer is located at a depth of approximately 4.5 m within the survey area this time. Therefore, a spread foundation will be used.

③ Abutments

Appropriate abutments will be chosen according to height, as shown in Table 7-5. The abutment type is affected by the conditions of the local bearing layer, the abutment height, and economic feasibility. Since the planned abutment height is 5.0 to 12.0 meters, an inverted T-type abutment will be used.

Table 7-5 Abutment type and standard structural height

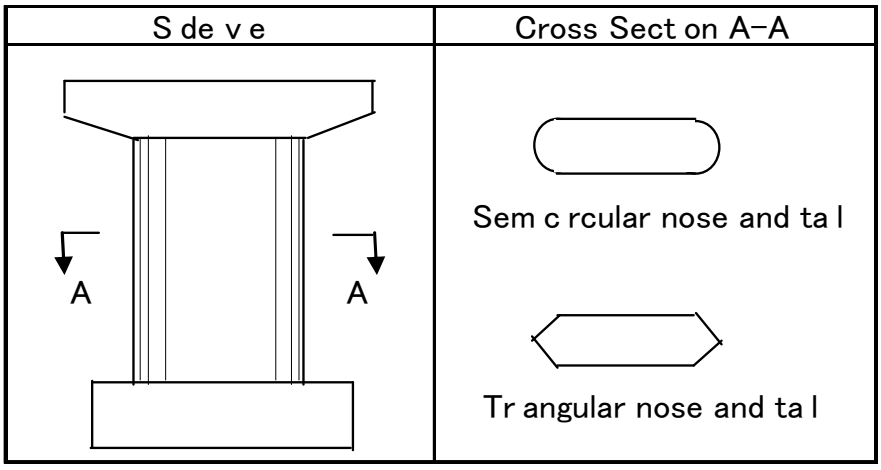
Abutment Type	Height (m)		
	10	20	30
Gravity Type			
Semi-gravity Type			
Cantilever Type			
Counterfort Type			
Rigid FrameType			

Source: JICA Study Team

④ Pier type

Paraguay does not have earthquakes, which means that small piers can be used. When reviewing pier types, it is essential to comply with the required structure performance. It is also desirable to minimize materials consumption while ensuring the economically superior structure.

However, the Nacunday and Yacuy Guazu Rivers where piers are to be built have high flow rates. In particular, bridges across the Nacunday River have been swept away by floods. Accordingly, wall piers as shown in the figure will be employed on this route because they do not hinder river flow.



Source: JICA Study Team

Figure 7-5 Pier types

8. Development of the Construction Plan and Implementation Plan

8.1 Construction policy

Since this project will be implemented based on the technical capabilities of the counterpart government, a construction policy as described below was established:

- Construction sites will be areas purchased as the right-of-way for roads.
- Work in the rivers is planned to be done in the dry season. Erection will be done by using a truck crane, which is the common practice in Paraguay.
- There are many uncertainties related to procuring equipment and materials and undertaking construction in the river. Accordingly, the work schedule will have sufficient leeway.
- The amount of earth handled by the earth work is as great as 9.8 million m^3, which means that the soil distribution plan must be implemented efficiently.
- The ANDE's administrative road is currently in service. During the work, diversion will be planned and, in principle, road blockage will not be considered.

8.2 Material and equipment procurement policy

Materials are mostly procurable in cities around the site. However, quality sand (fine aggregate) is difficult to procure around the site and must be procured from Encarnación. There are no particular problems in regard to construction machinery because contractors have their own. The principal material, cement, is produced in Paraguay. Asphalt and rebars are imported from Argentina and Brazil, but the supply is sufficient and there is no problem. PC steel wires and other special materials are imported from Brazil.

8.3 Schedule plan

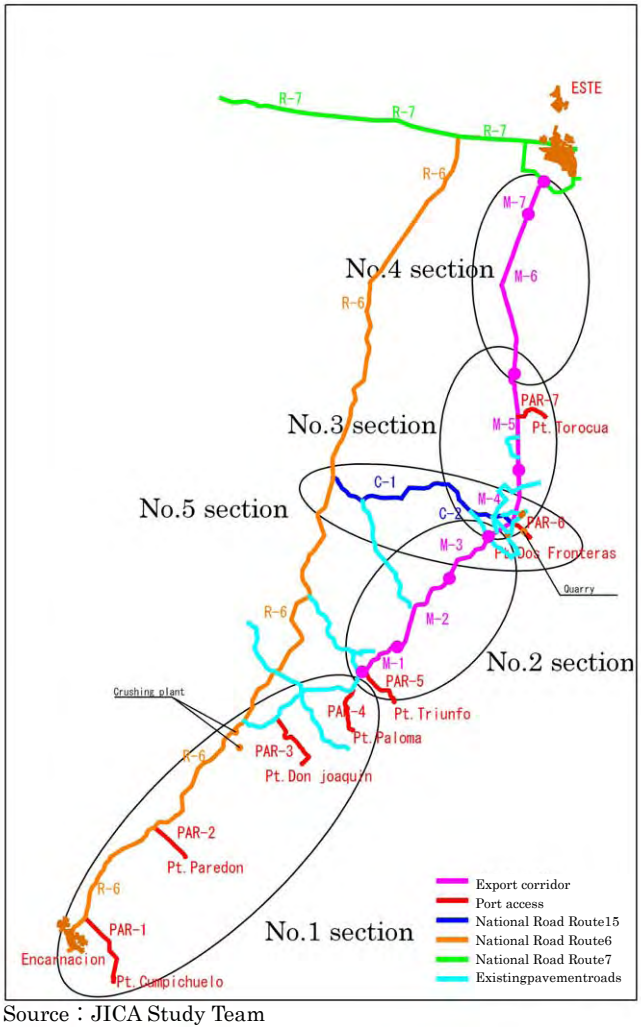
Prior to drafting the work schedule plan, the whole construction section was divided as follows. The schedule was drafted in a way to enable ordering five construction sections simultaneously. The overall work period will be planned as three years and two months at the longest. Figure 8-1 shows the proposed schedule.

- The construction scale of sections 2 and 3 allow the entry of leading contractors. Sections 1, 4, and 5 were supposed to be of a scale allowing entry of medium-size contractors.
- The work period was organized so that each sub-period is equal (two years, eight months to three years, two months).
- The intersection with the road connecting National Road Route 6 with the coastal roads will be a node of construction sections. The section on the north side was divided into two, while, on the south side, four port access roads were put together into one construction section.
- The end point of the export corridor was set at the intersection with the second Amista road.
- The sectioning described above is one without the M-8 section falling outside the Parana River coastal road. This is because the second Amista road intersection was used as the end point for the sectioning during the F/S in 2006, except for the port access roads to Caarendy and Tores Froteras ports.

Table 8-1 Construction sections

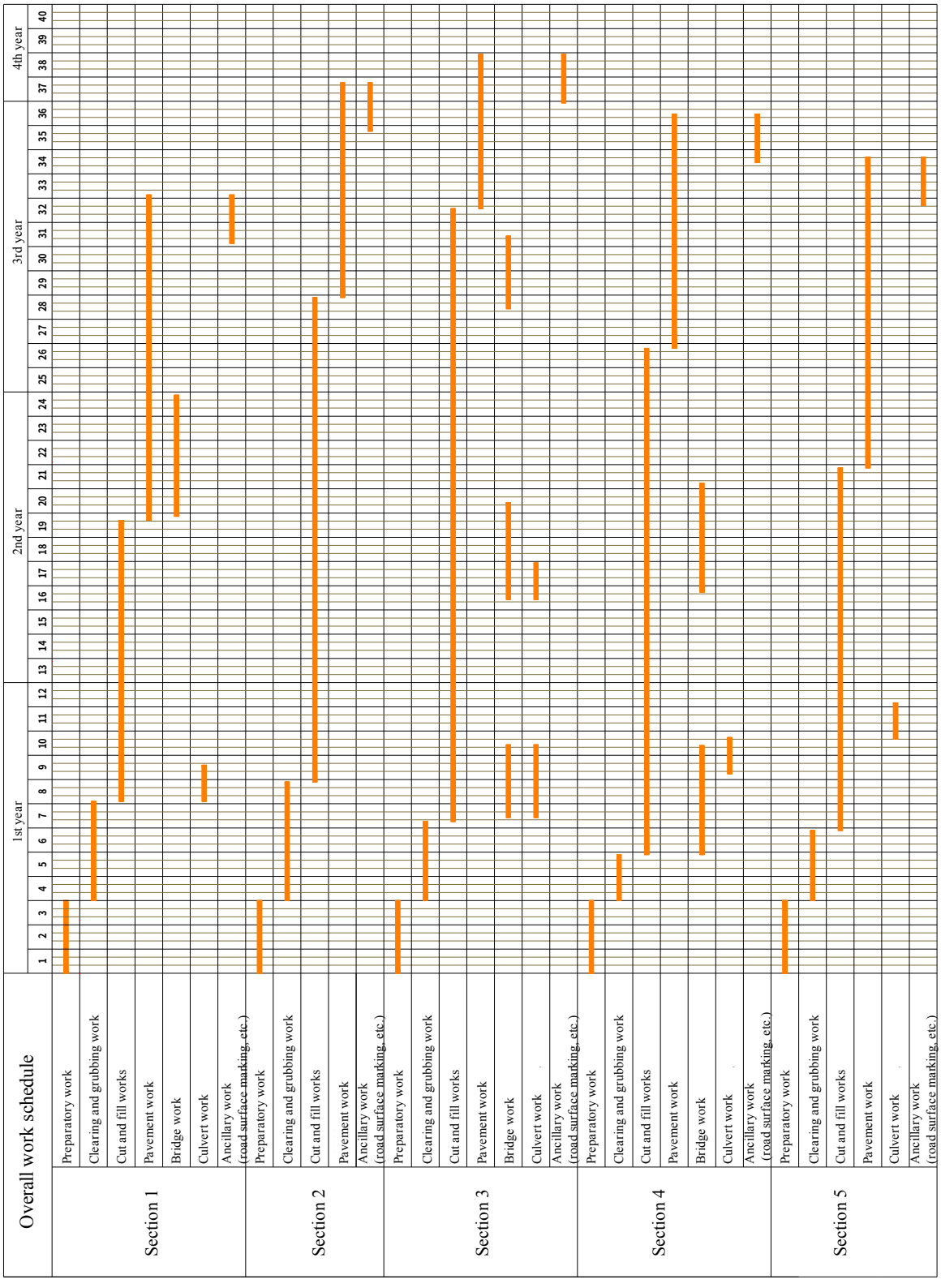
Name of section	Name of route	Start point	End point	Length(km)	Total(km)	Remarks
No.1 section	PAR-1	Route No.6	Pt. Campichuelo	19.1	58.7	One bridge One C-BOX
	PAR-2	Route No.6	Pt. Paredon	11.0		
	PAR-3	Parana River coastal road	Pt. Don Joaquin	16.8		
	PAR-4	Parana River coastal road	Pt. Paloma	11.8		
No.2 section	M-1	Natalio	Rio. Tembey	12.1	71.2	
	M-2	Rio. Tembey(inc. bridge)	Ao. Gurapay	23.9		
	M-3	Ao. Gurapay	Connection	23.3		
	PAR-5	Parana River coastal road	Pt. Triunfo	11.9		
No.3 section	M-4	Connection	Rio. Yacuyguazu	13.0	46.5	Five bridges Six C-BOXes
	M-5	Rio. Yacuyguazu(inc. bridge)	Rio. Nacunday	24.8		
	PAR-7	Parana River coastal road	Pt. Torocua	8.7		
No.4 section	M-6	Rio. Nacunday(inc. bridge)	Los Cedrales	43.0	49.9	Three bridges One C-BOX
	M-7	Los Cedrales	Prte. Franco	6.9		
No.5 section	C-1	Route No.6	Frutika	24.8	60.4	One C-BOX
	C-2	Frutika	Parana River coastal road	29.2		
	PAR-6	Parana River coastal road	Pt. Dos Fronteras	6.4		
Total					**286.7**	**Nine bridges Nine C-BOXes**

Source: JICA Study Team



Source：JICA Study Team

Figure 8-1 Positions of the sections



Source : JICA Study Team

Figure 8-2 Paraguay export corridor development plan work schedule

9. Estimated Project Expense Quantity Survey

The costs of bridge construction, pipe and culvert work, and road construction were calculated based on changes to unit costs since the 2006 F/S. The calculated result was a project cost of US$333 million. It has increased by US dollar base by 2.3 times compared with the previous F/S Survey in 2006.

Table 9-1 Project Expense Resume

(F/S Survey in 2006) (Unit:million US$)

Construction site	Parana River coastal road	Route No.6・Coastral Road Connection Road	Subtotal	Port Access Road	Total
Length (km)	157.6	54.4	212.0	107.6	319.6
(a) Preparatory work	—	—	—	—	—
(b) Earth work	14.8	1.7	16.5	3.1	19.6
(c) Pavement work	51.8	10.5	62.3	24.1	86.4
(d) Pipe and culver work	0.6	0.0	0.6	0.3	0.9
(e) New bridge construction & Widening work	5.5	0.0	5.5	0.2	5.7
①Building expense =(a)+(b)+(c)+(d)+(e)	72.1	12.2	84.3	27.8	112.1
②Desigb/Construction administrative expense =①×13%	9.4	1.6	11.0	3.6	14.6
③Land expense	1.6	0.3	1.9	0.5	2.4
④Compensation expecse	0.0	0.0	0.0	0.0	0.0
⑤Subtotal = ①+②+③+④	83.1	14.1	97.2	31.9	129.1
Contingency = ⑤×10%	8.3	1.4	9.7	3.2	12.9
Total	91.4	15.4	106.8	35.1	141.9

(This Study in 2011) (Unit:million US$)

Construction site	Parana River coastal road	Route No.6・Coastral Road Connection Road	Subtotal	Port Access Road	Total
Length (km)	147.0	54.4	201.4	85.6	287.0
(a) Preparatory work	4.8	1.2	6.0	1.5	7.5
(b) Earth work	63.7	6.4	70.1	9.0	79.0
(c) Pavement work	89.3	32.2	121.5	40.8	162.3
(d) Pipe and culver work	1.0	0.0	1.0	0.4	1.4
(e) New bridge construction & Widening work	6.4	0.0	6.4	0.4	6.9
①Building expense =(a)+(b)+(c)+(d)+(e)	165.3	39.7	205.0	52.1	257.1
②Desigb/Construction administrative expense =①×13%	21.5	5.2	26.6	6.8	33.4
③Land expense	6.0	2.0	8.0	3.4	11.4
④Compensation expecse	0.0	0.7	0.7	0.1	0.8
⑤Subtotal = ①+②+③+④	192.7	47.6	240.3	62.4	302.7
Contingency = ⑤×10%	19.3	4.8	24.1	6.2	30.3
Total	212.0	52.4	264.4	68.6	333.0

Source: JICA Study Team

10. Economic Evaluation

10.1 Summary of Economic Evaluation

The subject project is to be evaluated from several viewpoints indicated in Figure 10-1. In (1), the Economic Evaluation, the project will be evaluated by cost-benefit analysis comparing direct economic benefits and economic cost (actual amount of investment and maintenance costs) brought about by the project

This is not a toll road project. Consequently, in (2), the Financial evaluation will not include a financial analysis suggesting the extent to which the investment can be recovered by toll revenue. Instead, as the project assumes yen loan as source of funding, and the significance of the project being financed by the government will be considered.

(3) Environmental Impact Evaluation has already been discussed in Chapter 6. As far as this aspect is concerned, whether or not the project will have any negative impacts on the natural and social environment will be mainly investigated. If there are any, eliminating or minimizing them have been proposed. Here, as for (4), the Social Impacts, positive aspects which the project will bring about will be mainly considered.

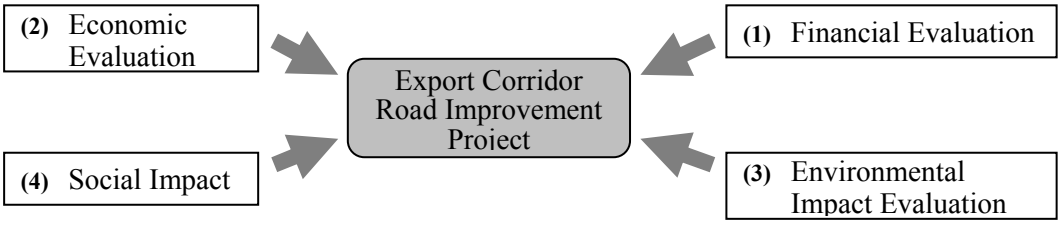


Figure 10-1 Perspective of Project Evaluation

10.2 Evaluation Method

This Export Corridor Road Improvement project will be evaluated from an economic viewpoint according to cost-benefit analysis. The evaluation process will be as indicated in Figure 10-2.

Both cost and benefit will be measured by Economic Price. Therefore, project expenses estimated by market price will be converted to Economic Price. Conversion will be performed by eliminating tax included in project expenses, eliminating price contingency, eliminating financial cost incidental to loan borrowing, and by applying the Shadow Wage Rate (SWR) labor cost of the unskilled work force.

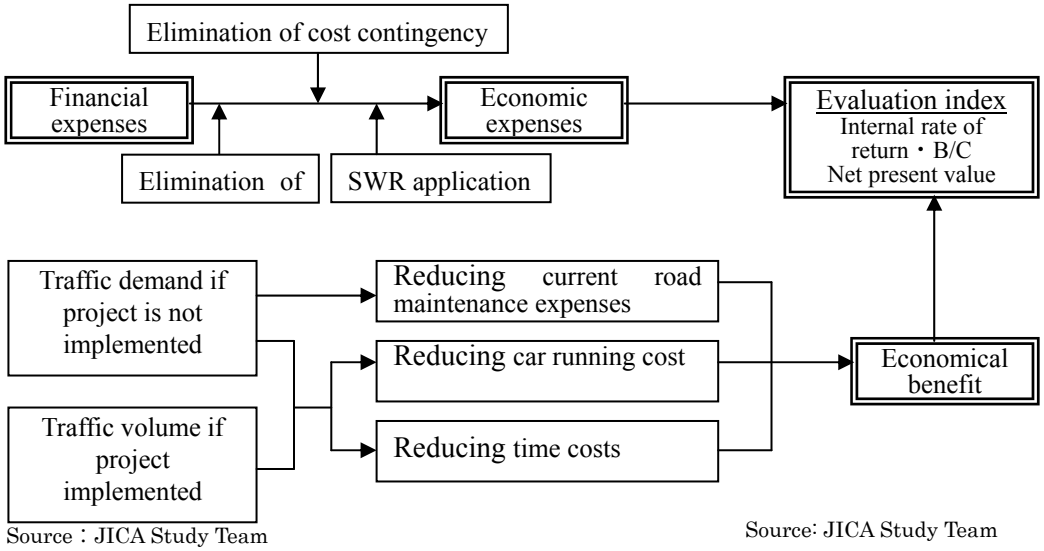
As for benefit, limited to benefit which can be anticipated to accrue most directly, three types of benefits, i.e. (1) cutting down on car running cost, (2) reducing travel time of those on the road and, (3) reducing road maintenance expense. Traffic volume forecasts will be made to calculate benefits if the project is carried out and if it is not, and the results will be measured by "with" and "without" comparison.

The conditions denoted below were assumed for the economic evaluation.

- Duration of project evaluation to be 25 years (2018 - 2042)following date of being opened to traffic.
- Economic discount factor to be 12%[1].

[1] An economic discount factor of 11% was used in the JICA 2006 F/S, but as MOPC pointed out in the interim report for the project (June 26, 2011) that 12% was presently being used, 12% is used here.

- Car running cost to be that estimated annually by DINATRAN[3] (MOPC affiliate) per model similar to JICA's 2006 F/S. This running cost differs depending on road conditions, not traffic volume. In other words, traffic congestion is not assumed.



Source：JICA Study Team　　Source: JICA Study Team

Figure 10-2 Work Procedures for Economic Evaluation

10.3 Project Economic Cost

The economic cost converted from financial expenses is estimated to be US$265.0 million as indicated in Table 10-1. This corresponds to 80.0% of financial expenses.

Table 10-1 Project Economic Cost

(US$ 1,000, 2011 quotation)

Cost item	Financial expenses	Economical expenses
(1) Preparatory work	7,489	6,133
(2) Earthwork	79,008	64,700
(3) Pavement work	162,342	132,942
(4) Pipe and culvert work	1,433	1,173
(5) New bridge design・Widening	6,858	5,616
a. Total (1)～(5)	257,130	210,564
b. Supervising expenses ((a) x13%)	33,427	27,373
c. Land expense	11,356	11,356
d. Indemnity cost	800	800
e. Total (a-d)	302,713	250,093
f. Contingency ((e) x10%)	30,271	15,136
Grand total	332,984	265,229

Source: JICA Study Team

10.4 Economic Benefit Estimation

Three types of economic benefits would be obtained by the road improvement in the project, namely, lower car running costs, shortened travel times and less maintenance and repair expenses if roads were not to remain as they currently are. As for future traffic demand, it can be classified into two categories, namely, trucks carrying the three major grains from farms to port of export and other general traffic. If the roads are improved, some of the trucks now carrying grain for export along Rio Paraguay would convert to Rio Parana. In this respect, it would not be the transportation cost from

the field to the loading port, but a comparison of the cost to the port of exportation located at Rio de la Plata estuary. Here the curtailment will be a benefit.

The results of the various economic benefits are indicated in Table 10-2. The 2010 figures are fictitious benefits assumed to have been obtained if the road project had been completed. Approximately 60% of the total is accounted for by the running cost reduction for trucks carrying grain. This benefit would be allocated among grain producers, distributors and grain dealers, but when intensified grain purchasing price competition is taken into consideration, the main beneficiary could turn out to be the producers. The benefit of better and improved roads would lead to increased income for producers, and if it would bring about further incentive to produce, the project will have achieved its primary objective.

Table 10-2 Compiled Economic Benefits

(US $ million/year)

Type of benefit		Fiscal year	
		2010/2011	2020
Car running cost curtailment	Grain transportation	35.4	51.9
	Other traffic	9.5	12.5
Time cost curtailment	Other traffic	9.9	13.1
Maintenance expense curtailment			3.3
Total			80.8

Note: Grain transportation benefit pertains to 2010 and others are 2011 values.
Source: JICA Study Team

10.5 Economic Evaluation

Cash flow figures will be derived comparing annual benefits measured by economic costs. The cash flow will be projected using the following assumptions:

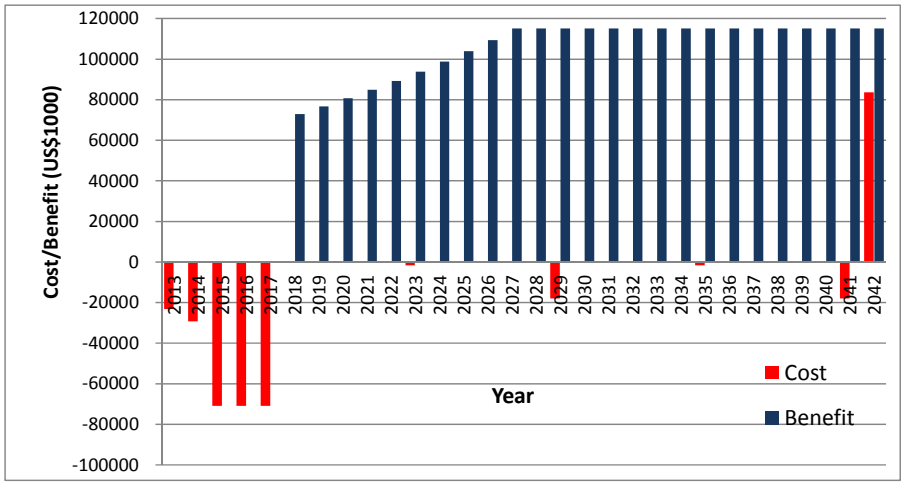
- Economic life of the project shall be thirty-five years.
- Duration for evaluation shall be a further shortened twenty-five years after being opened to traffic. Due to this, 28.6% (= (35-25)/35) of the project expenses excluding land cost which is a residual value and total land cost have been treated as negative cost.
- Production of export grain including soy beans and others is gradually nearing maximum in Alto Parana and Itapua departments and the production center is shifting westward, to the hinterlands of Rio Paraguay. Therefore, as exports via Rio Parana will not increase without any limitation, all benefits are at the plateau reached in 2025.

The internal rate of return from such a cash flow is as high as 21.7%, significantly surpassing the 12% economic discount rate and project judged to be feasible (Table 10.1-7.) The net present value exceeding US$200 million and a B/C ratio over 2.0. Even the 2006 study estimated that the internal rate of return was 14.3% and judged feasible. The current study substantially exceeds that figure. The reason why economic efficiency was enhanced is due to the significant increase in soy bean production shored up by the steep rise of its international price and because of an upward adjustment of future transportation demand.

Table 10-3 Project Economic Evaluation Index

Evaluation index	Unit	2006 Study	Current study
Internal rate of return (IRR)	%	14.3	23.4
Net Present Value (NPV)	US$1,000	33,178	274,668
Benefit Cost ratio (B/C)	—	1.32	2.35

Source: JICA Study Team



Source：JICA Study Team

Figure 10-3 Project expenses and flow of benefits

10.6 Financial Evaluation (annual repayment provisional estimate)

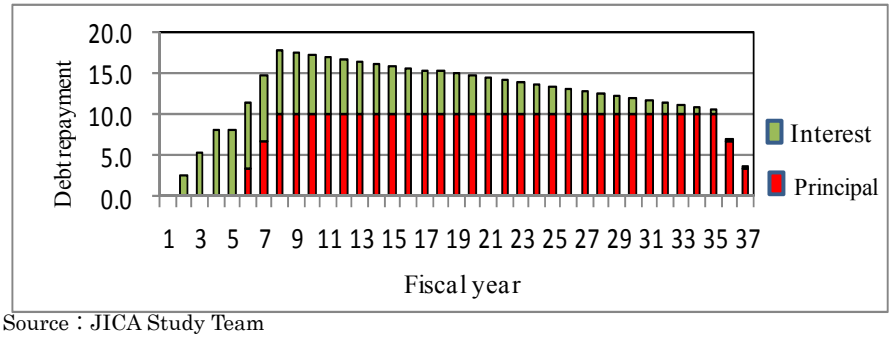
The Export Corridor of the project is basically not a toll road. Therefore, a financial evaluation to determine whether or not funds invested can be recovered will not be performed. Given the financial situation of Paraguay's road development, let us now consider what impact annual repayment will have on MOPC's finances if the project is financed by loans.

(Provisional estimate conditions)

- The total loan would be US$300 million
- The loan to be provided over three years, US$100 million per annum
- Interest to be 2.7% per annum, five year period of deferment, repayment over thirty years

(Results of provisional estimate)

The repayment schedule and amount of annual repayment will be as indicated in Figure 10-4. The mean annual repayment will be US$11.7 million, including principal and interest. This corresponds to 4.0% of MOPC's mean road department aggregate budget. Although dependent on the cumulative total of loans and what repayment amounts to, it is thought that project repayment itself will not be unbearable, given MOPC's road fiscal resources.



Source：JICA Study Team

Figure 10-4 Loan Repayment Schedule (Example)

10.7 Socioeconomic Impact

The economic benefits referred to in the economic evaluation are the most direct benefits brought about by road improvements and other indirect effects and long-term impacts to regional development, affecting daily life of roadside inhabitants, including those which are diversified. Impacts which are comparatively large will be taken up at this time for further consideration.

(1) Employment Creation Effect during Road Improvement

In road improvement projects, labor accounts for approximately 20% of construction costs, and about 50% of that is for unskilled labor procured in the neighborhood of construction sites. Job opportunities at construction sites are enhanced in adjacent cities, towns and villages. As of July 2011, the legal monthly minimum wage is 1,685,232 *guaranies* (US$398.00) equivalent to 11,280 *guaranies* (US$2.70) per hour. If aggregate wage paid to unskilled labor force is divided by this monthly wage, the total unskilled force mobilized would turn out to be 809 workers per month.

(2) Living Space Expansion

Paved roads bring about shortened travel time thus expanding living space. If mean cruising speed on a paved road is assumed to be 80km/hr, and if the same speed on a dirt (earth) road prior to the project is assumed to be 25km/hr, reaching Mayor Otano from Ciuadad del Este or Encarnacion separated by almost equal distances would require four hours prior to improved road conditions but only 1.4 hours from the former and 2.3 hours for the latter after improvements. The transformation of being able to travel to a major city from an isolated village served by public transport only once a week within less than an hour, when it used to take 3 to 4 hours is significant. Improved accessibility to educational facilities, medical institutions and cultural facilities would bring about positive changes in livelihood.

Villagers hopefully say, “A weekly trip to Este to purchase sundries and going to Brazil by boat on the other side of the river to sell merchandise is now routine, but if a road is developed and a bus route established, daily trips will become possible.” Even women who kept to themselves at home and seldom had the opportunity to go outside would be able to go to cities, come into contact with various cultures if and when family income improves. Might not “Getting to know” and “Getting involved” be the very first steps to improve the status of women?

(3) Other Assumable Impacts

The facilitation of regional development (tourism and agriculture-related industries) and employment and a revitalized regional economy are other expected effects. Tourism could be promoted by attracting tourists in cooperation with Argentina and Brazil without limiting such activity to relying on regional resources would be an option. This type of assistance should be pursued for

agriculture-related industries such as grain processing, flour milling, and oil extraction, for businesses supplying agricultural inputs such as fertilizers, pesticides, and herbicides and for support industries such as agricultural machinery and equipment, and parts manufacturing and repairs. Developing the Export Corridor is one precondition for increasing grain transportation. Exerting efforts in a wide range of fields is required to sufficiently make use of road improvements.

11. Study of Project Execution System

11.1 Project Execution Structure

The project will be executed by the MOPC. In the actual implementation, a project implementation unit similar to PG-P13 execution will be set up. As stated in the F/S in 2006, environmental impact analysis (EIA) procedures for land expropriation, relocation of inhabitants, etc. will have to be performed by commencing construction subsequent to decision for project execution. Such procedures will be handled by the Environment Department and Estate Department of MOPC.

11.2 Execution Schedule

This project is being planned with the precondition of a yen loan becoming available. A proposed execution schedule is indicated in Table 11-1. The Paraguayan Government is to select consultants separately for detailed engineering and construction management in accordance with national law, and we shall comply accordingly. Upon completion of this study, a consultant for detailed engineering will be selected in 2012 and detailed engineering will be done in 2013. Thereafter, in 2014, a consultant for construction management will be selected along with the company to undertake construction. Construction could be expected to commence in 2015.

Table 11-1 Duration of Bid Tender, etc. pertaining to Project Implementation

	Duration	Remarks
1) Exchange of official notes (E/N)	2012・March・April	
2) Loan Agreement (L/A)	2012・May・June	
3) Consultant selection (detailed engineering)	July to December, 2012	6 months
・Proposal preparation・submittal	45 days	Site survey, preparation 30 days
・Technological・Cost evaluation, JICA consent	90 days	
・Agreement・JICA approval	45 days	
4) Detailed engineering, preparation of tender documents	January to October, 2013	10 months
5) Consultant selection (construction management))	November 2013 to April 2014	6 months (breakdown identical to detailed engineering)
6) Contractor selection	May to December, 2014	8 months
・P/Q examination・evaluation/JICA consent	45 days	
・Proposal preparation・Submittal	60 days	Site survey 20 days. Preparation 40 days
・Technological・Cost evaluation, JICA consent	90 days	
・Agreement・JICA approval	45 days	
7) Construction commenced	January 2015 onwards	

Source: JICA Study Team

11.3 Operation and Maintenance Structure

The project is to be undertaken by MOPC's Operations and Finance Bureau. Maintenance subsequent to completion would be handled by MOPC's Public Works and Communication Department (Departamento de Conservacion Rutas.)

As for the budget of the Departamento de Conservacion Rutas, about 10% of the planned budget was utilized in the past. However, the execution ratio of the maintenance budget has increased more than six-fold since 2009. It is thought that GMANS's influence had much to do with that, and it is felt that adopting CMANS system also for the project is desirable. No zones would require repair and maintenance immediately after construction is completed. It is also thought to be possible to improve the service life of the pavement by carrying out daily and periodical maintenance, resulting in low-cost maintenance. However, for maintenance of this project, in the F/S performed in 2006, it was verified that daily and periodical maintenance expenses could be covered by tolls collected at two toll gates installed at Natalio and Cedrales on the route . In other words, it is considered amply possible even if the contemporary maintenance system were to be implemented subsequent to completion of the project.

Table 11-2 Road Maintenance Expenses

	Maintenance expenses (Gs.)		Implementation ratio
	Budgetary plan	Budget implementation	
2009	150,000,000	90,000,000	60%
2010	178,000,000	157,000,000	88%
2011	150,000,000	110,000,000 (Finalized)	73%

Source: MOPC

12. Conclusion and Proposals

12.1 Main Changes since F/S

- In comparison to the assumed figures the F/S was conducted in 2006, the populations of Itapua and Alto Parana departments in 2010 have decreased by more than 500,000. Along with the delay in improving the Export Corridor, this is thought to be due to the fact that arable land within the district has almost been fully cultivated. It is thought that the population of the regions concerned would increase in the years ahead if the Export Corridor is improved and accessibility to Este and Encarnacion is upgraded,.
- Although overall agricultural production in Paraguay once dropped due to the steep rise in the grain market and a drought in 2009, a sharp rise has occurred since 2007 due to improved plant breeding and other causes. The rate of increase is building up at a faster speed than assumed in the 2006 F/S. It is expected that this trend will continue for Paraguay as a whole.
- Both exports and imports are increasing for all of Paraguay, particularly exports of grain. Road transportation and river transportation play equal roles in the handling of imports, but about 60% of the exports are transported via river and the role played by river transportation is becoming significant.
- The necessity for an Export Corridor and improving transportation has increased since 2006. It is thought that expeditiously improving the Export Corridor will help sustain the booming Paraguayan economy, contribute to the development of the regional economy, and lead to an effective means or solving the problems faced by impoverished small farmers.
- Not many amendments have been made to the route plans since the F/S was conducted in 2006. The route through Este requires certain adjustments between the second Amista Bridge and its

access road.

- Independent and original efforts exerted by parties concerned have improved the condition of the port access road compared to 2006, but stone pavement seems to have been the order of the day. It goes without saying that asphalt pavement is desirable from the point of view of improving traffic flow and comfort. Urgently improving unpaved sections and repaving stone pavement sections with asphalt is required.
- The recent study has revealed that sections secured as road sites for the planned road are extremely limited. However, portions are actually being used as roads, and roadside inhabitants look forward to roads being improved. It can be assumed that land purchases will take place without hindrance. In addition, only a limited number of obstructing objects will have to be removed.

12.2 Conclusion and Proposals

All Export Corridor concepts subject to this study were appropriate, and facilitating execution of the project is proposed for the following reasons.

- The project aims at reducing the fragility of Paraguay's entire transportation infrastructure. The substance of the project corresponds to a national program. Implementation of the project will improve transportation efficiency, improve productivity of export activity, enhance competitiveness and, as a result, contribute toward vitalizing the economy of Paraguay.
- If construction and maintenance are properly carried out, the project's EIRR would be 23.4%. This indicates that the project is amply feasible. Furthermore, projecting it can help mitigate poverty and improve the living environment.

(1) Facilitating Improvement of Rio Parana Coastal Road, National Road Route 6 and Coastal Road Connection Road

- These arterial roads are positioned as "Southern Union Roads" forming the framework of southern Paraguay. The benefits from expediting the project is acknowledged for the following reasons.
- Southern Union Roads are arterial roads connecting Paraguay's southern departments where revitalized economies are promising. It is an effective project as an anti-poverty measure
- These roads will function as international roads forming the Paraguay link of a Both Oceans Traverse Road along the IIRSA Capriconio axis (The Tropic of Capricom axis).
- Improving these roads can lead to lower transportation costs for exports and contribute to economic development, competiveness, social development, and poverty mitigation.

(2) Improving Port Access Road

- Improving the Rio Parana Coastal Road and the road linking the ports lining Rio Parana will enhance export competitiveness. In other words, by paving the access roads to ports, being at the mercy of bad weather can be avoided, and the port facilities could be used at all times. As a result, the efficiency of transportation of export products will improve significantly, and enhanced convenience for coastal inhabitants can be anticipated.

- Independent efforts have achieved small-scale improvements on port access roads. However, these are limited to minimum improvements, and their future remains obscure. Therefore, the need for the public sector to become involved in port access roads is high.

(3) Recommended items to facilitate project execution

For the project to be implemented in a smooth manner, the items indicated below are those we recommend that Government of Paraguay implement.

- Implement appropriate EIA and facilitate procedures for land expropriation.
- Expeditiously request financial assistance such as yen loan, and secure budgetary means for counterpart.

(4) Proposals to further develop project efficiency

The items indicated below are those the Government of Paraguay should implement to further enhance the effects of the project.

- Enhance positioning of the project within IIRSA and facilitate development of a regional road network connecting the country to adjacent nations.
- Post-project maintenance and operation.
- Facilitate regional development when road improvements are taking place.
- Upgrade Rio Parana coastal facilities and support stabilization of water transportation.