3. TRANSPORT INFRASTRUCTURE DEVELOPMENT STRATEGY

3.1 DEMAND PROSPECTS

(1) Social/economic frame

As preconditions for transport demand forecast of passenger and freight, future population, economy and car ownership are forecast as stated below.

1) Population

In 1992, the National Statistical and Census Bureau made a long-term population projection up to 2010 as shown in Table 35, on which the Study will depends. Total population of Paraguay will be 6,980,000 in 2010, increasing by 1,500,000 over present population. Annual average growth rate of the period is 2.48%, lowering a little than 2.63% of 1990s. Rapid growth will be seen in Alto Paraná and Central Region while population will level off or decrease in the northeastern and southern regions where economy is comparatively stagnant.

The Bureau forecast also future urban and rural population (Table 36). In early 1990s, urban population exceeded rural population and urban population ratio is presently 54%, and it will rise to 59% in 2010 by progressive migration from rural to urban area.

Table 35 Population Projection by Department

	1990	1995	2000	2005	2010	2010/2000
ASUNCION	519,856	541,714	561,386	576,731	586,232	1.04
CONCEPCION	168,685	181,030	191,911	201,121	208,350	1.09
SAN PEDRO	270,442	314,446	361,786	411,619	462,441	1.28
CORDILLERA	212,743	215,394	215,516	213,173	208,514	0.97
GUAIRA	167,671	172,413	175,121	175,811	174,572	1.00
CAAGUAZU	393,030	428,718	461,937	491,740	517,156	1.12
CAAZAPA	134,016	139,791	143,889	146,412	147,376	1.02
ITAPUA	374,788	431,376	490,969	552,908	615,929	1.25
MISIONES	93,140	97,273	100,385	102,387	103,326	1.03
PARAGUARI	243,261	247,589	247,175	242,355	233,736	0.95
ALTO PARANA	391,982	530,812	705,137	917,609	1,170,650	1.66
CENTRAL	854,171	1,076,686	1,333,889	1,623,886	1,944,035	1.46
ÑEEMBUCU	82,326	85,948	88,285	89,021	88,183	1.00
AMAMBAY	104,162	120,606	136,910	152,366	166,583	1.22
CANINDEYU	105,073	124,978	145,841	166,837	187,214	1.28
PRESIDENTE HAYES	63,351	73,235	83,193	92,583	101,075	1.21
ALTO PARAGUAY	11,786	13,277	14,669	15,843	16,725	1.14
BOQUERON	28,249	33,190	38,451	43,545	48,224	1.25
TOTAL	4,218,732	4,828,476	5,496,450	6,215,947	6,980,321	1.27

Table 36 Urban and Rural Population Forecast

(unit:1000 person)

	1990	1997	2000	2010
Urban Population	2,052	2,685	2,965	4,127
Rural Population	2,162	2,400	2,498	2,853
Total	4,214	5,085	5,463	6,980

Figure 42 Change of Population by Region

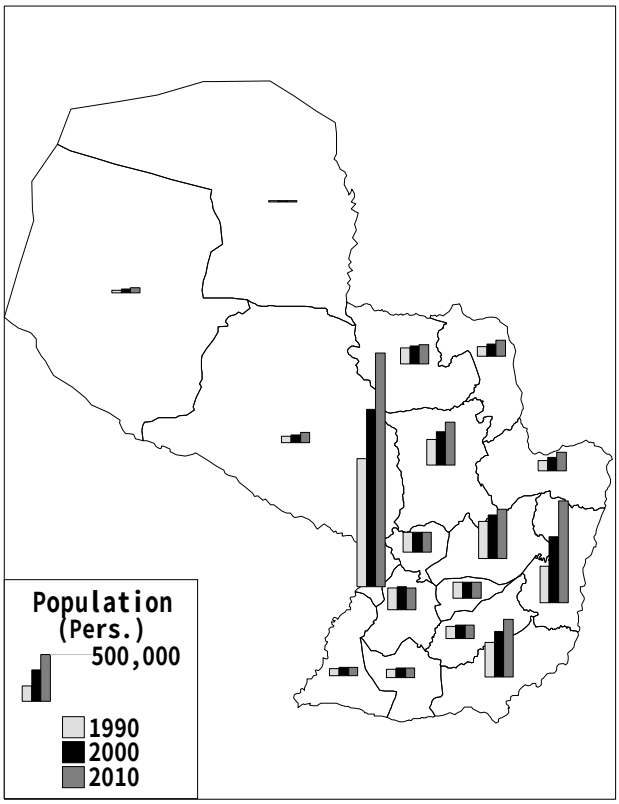
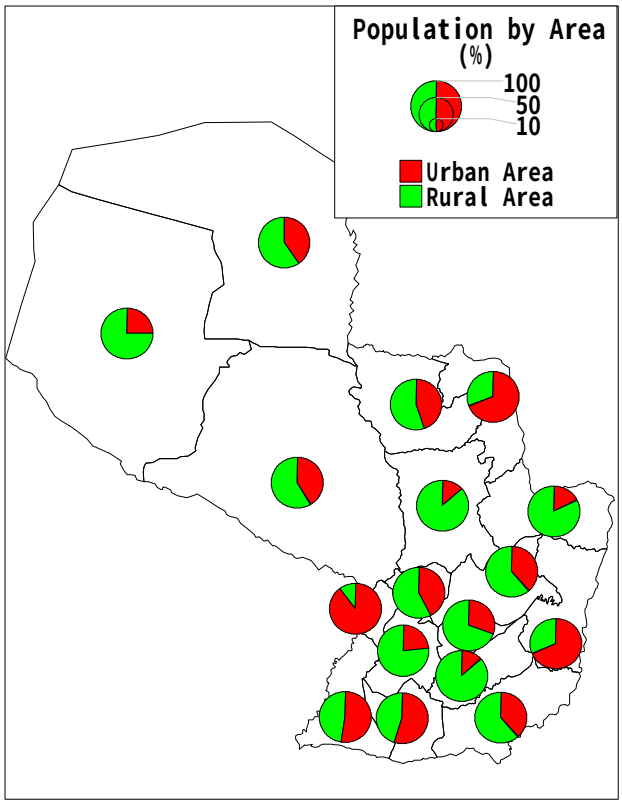


Figure 43 Distribution Rate of Population by Area (in year 2010)



2) Economic growth rate

Assuming a significant increase of investment and corresponding improvement in productivity between 2000 and 2005, a sustainable economic growth rate of 6% per annum can be achieved by 2005 and thereafter the rate will be maintained. Also in transportation demand forecast, production, consumption, export and import will be analyzed based on this scenario.

Future GDP by industry and GDP per capita are summarized as in Table 37. As the average economic growth rate in next ten years is 5% while population growth is 2.5%, GDP per capita will expectedly grow at 2.5%. Industrial structure in 1990 was 50% of tertiary industry, 22% of secondary and 28% of

primary. Corresponding to the urban population increase, this structure will change to 60% of tertiary and 20% of primary and secondary, respectively.

Table 37 Future Economic Growth for Planning Basis

	Indicator	Unit	1990	1997	2000	2010
1	Population	1000 person	4,214	5,085	5,463	6,980
2	Economically Active Population	1000 person	1,335	1,648	1,822	2,548
3	Gross Domestic Product*					
	Primary Sector	1000 Mill. Gs	255	307	311	385
	Secondary Sector	1000 Mill. Gs	202	223	231	375
	Tertiary Sector	1000 Mill. Gs	469	599	623	1,149
	Total	1000 Mill. Gs	926	1,130	1,164	1,908
	Gross Domestic Product**					
	Primary Sector	Million US$	1,993	2,402	2,431	3,009
	Secondary Sector	Million US$	1,582	1,744	1,806	2,930
	Tertiary Sector	Million US$	3,664	4,688	4,868	8,981
	Total	Million US$	7,239	8,834	9,106	14,921
4	GDP per capita*	US$/person	1,718	1,737	1,667	2,138

Note: * At 1982 constant price
** At 2000 price under the exchange rate of Gs 3500/US$

3) Number of passenger cars

There were 187,000 vehicles registered in Paraguay in 1990 and 380,000 in 1997, with an increase in every type of vehicle. As shown in Table 37, there was no change in GDP per capita during this period. It should be noted that private car ownership rate rose from 28 units per 1000 population to 48 units without any change of income level.

Table 38 shows a result of vehicle projection made by linear regression of time series data for passenger cars, using passenger growth rate for buses and applying increase rate of cargoes for trucks and others. Total number of vehicles will almost double from 463,900 units in 2000 (estimated) to 900,100 units in 2010. Buses increases a little due to no significant passenger increase because of rapid increase of private cars.

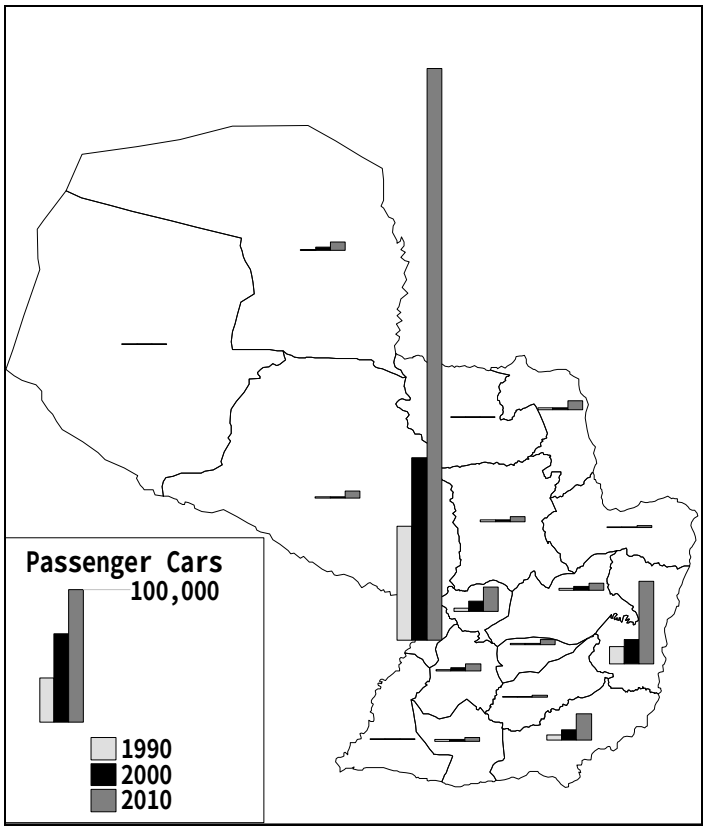
Table 38 Projection of Future Car Ownership

(1,000 units)

Vehicle Type	1990	1997	2000	2010
Car	118.8	241.8	294.9	571.6
Bus	3.2	5.9	6.0	6.4
Camion/Camioneta	62.7	128.4	158.2	316.9
Others	2.6	4.8	4.9	5.2
Total	187.3	380.9	463.9	900.1

As for the number of cars by department, Central marks an overwhelmingly large number, and it's expected that 431,000 cars, equivalent to 75% of the total, will be concentrated in this department. Other departments showing high growth rates are Alto Paraná and Amambay.

Figure 44 Change in Number of Passenger Cars



(2) Forecast of future traffic demand

1) Passenger demand

Table 39 shows the forecast of future demand of passenger among departments in 1997, based on the growth of population and of passenger cars by department. The total flow of passengers among departments is estimated to increase by 36%, from 74,000 passengers in 1997 to 100,000 passengers in 2010. The growth rate will be especially high in movement by car, and the number of cars will be more than double. However, trips by public transport will level off.

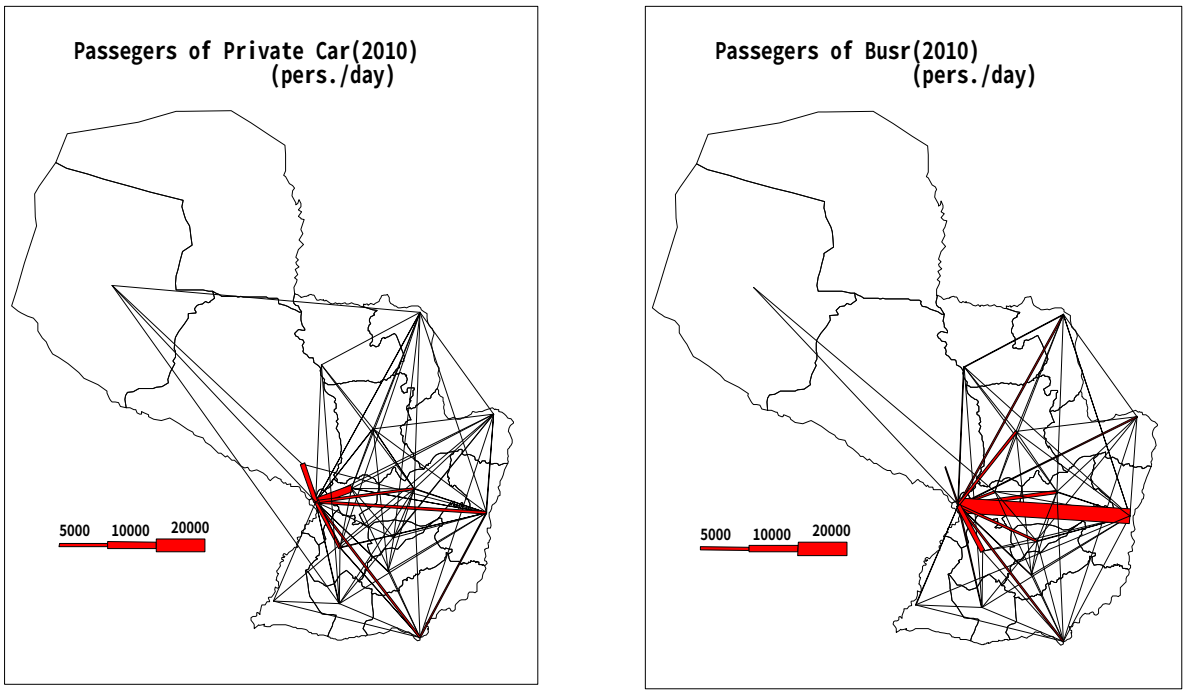
As for the distribution of passenger traffic among departments, regarding traffic by car, movement to all directions with Central Department as the center shows high volume. However, with regards to public transport, movement between Central Department and Alto Paraná Department exceeds 20,000 trips per day, indicating significant needs for public transport connecting Asunción and Ciudad del Este. The three big bus companies providing connection between cities have now services of almost one bus per hour between Asunción and Ciudad del Este and demand of about twice the current volume shall be expected.

Table 39 Inter-Departmental Passengers Trips

			1997	2010	2010/1997
Population		Persons	5,095,666	6,980,321	1.37
Passenger cars		Number of cars	241,787	571,691	2.36
Total passenger trips		Trips/day	73,869	100,603	1.36
	Cars	Trips/day	19,011	41,455	2.18
		Cars/day	7,760	16,920	
	Bus	Trips/day	54,858	59,148	1.08
		Cars/day	2,032	2,191	
	Railway	Trips/day	0	0	—

Average number of passengers cars: 2.45 persons/car Bus: 27.0 persons/vehicle

Figure 45 Inter-Departmental Flow of Car and Bus Traffic (2010)



2) Freight demand

Future freight demand was estimated by item, and results are shown in Figure 46 and Table 40. The method of estimation can be summarized as follows:

For agricultural products, production volume was estimated based on past trend.

a) For industrial products, production volume was estimated by multiplying the growth rate of GDP per industry and the past GDP elasticity by industry.
b) For consumption volume, estimation was made by multiplying the past consumption volume per head by the population, and by using the GDP growth rate.
c) Export volume was obtained as the surplus, subtracting consumption volume from production

volume.

d) Import volume was obtained as the shortage, subtracting production volume from consumption volume.

Total production will show an increase of 37%, from 31,020,000 tons in 1997 to 42,596,000 tons in 2010. On the other hand, consumption will increase by 47%, from 29,328,000 tons in 1997 to 43,325,000 tons in 2010. Exports will increase by 14%, from 4,416,000 tons to 5,026,000 tons, while imports are estimated to increase by 129%, from 2,725,000 tons to 6,241,000 tons. This is due to the fact that consumption volume will increase following the increase in population, etc., but production volume depends on GDP growth and will not increase so much; consequently, imports will increase.

Regarding transport demand for freight, it will increase by 50%, from 36,469,000 tons to 54.492,000 tons in 2010. The international transport (export volume plus import volume) will increase by 58%, from 7,141,000 tons to 11,267,000 tons, and its percentage of the total transport demand increases from 19% to 21%, indicating that international transport will become more important. Its importance will also increase taking into consideration increase in transportation distance.

Figure 46 Forecast of Transport Demand by Commodity Item

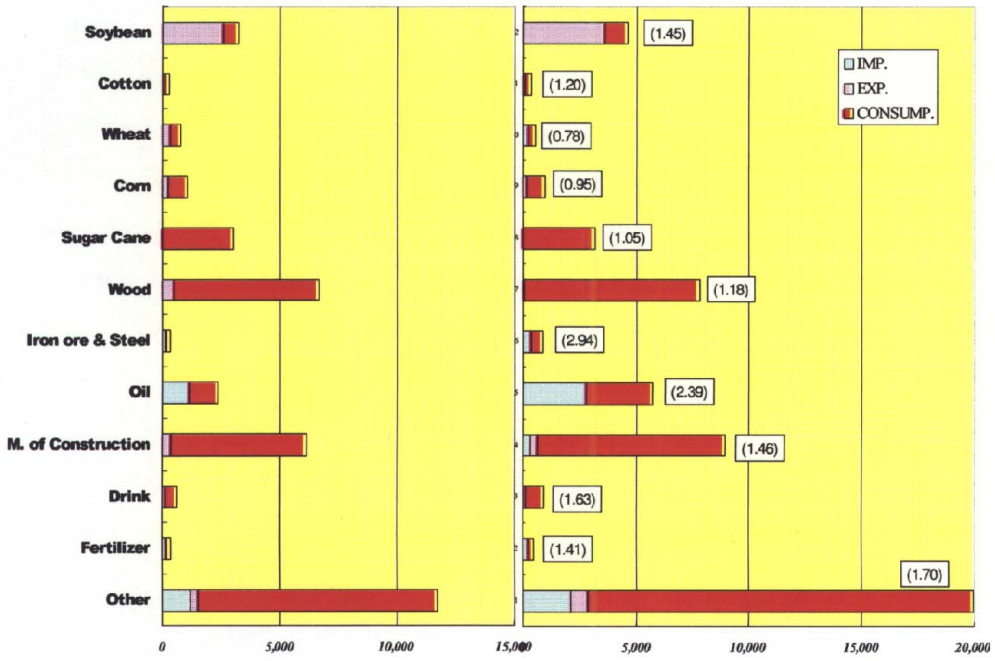


Table 40 Forecast of Production, Consumption, Export, and Import Volume by Commodity Item

(1000 ton/year)

	1990					1997					2010				
	PRDUCT.	IMP.	EXP.	CONSUMP.	Transport	PRDUCT.	IMP.	EXP.	CONSUMP.	Transport	PRDUCT.	IMP.	EXP.	CONSUMP.	Transport
Soybean	1,795		1,641	154	1,795	3,211		2,582	629	3,211	4,655		3,631	1,024	4,655
Wheat	533	1	232	302	535	288	4	61	231	296	382	6	57	293	356
Cotton	318		181	137	318	746	4	308	441	753	531	251		335	586
Corn	961		1	960	961	1,056		223	833	1,056	1,000		169	831	1,000
Sugar Cane	2,688			2,688	2,688	3,019		6	3,013	3,019	3,184			3,184	3,184
Wood	5,093		200	4,893	5,093	6,639	2	486	6,156	6,644	7,817		32	7,784	7,817
Iron ore & Steel	55	58		113	171	52	129	50	130	309	120	394		514	908
Oil,Gas	3,253	686		3,939	4,625	127	1,134		1,261	2,395	150	2,785		2,935	5,720
Materials of Construction	4,258			4,258	4,258	6,087	18	333	5,773	6,124	8,308	319	365	8,262	8,946
Drink	675	24		699	723	381	109	28	462	599	746	115		861	976
Fertilizer							172		172	344		242		242	484
Other	2,955	528	792	2,691	4,011	9,414	1,152	339	10,228	11,718	15,703	2,129	772	17,060	19,962
Total	22,584	1,297	3,047	23,012	25,178	31,020	2,725	4,416	29,328	36,469	42,596	6,241	5,026	43,325	54,592
Source	BCP	BCP	BCP	MAG/BCP	EDEP	BCP	OCIT	OCIT	EDEP	EDEP	EDEP	EDEP	EDEP	EDEP	EDEP

The following is the consideration by commodity item.

(Soybeans)

The production of soybeans is estimated to increase from 2,670,000 tons to 3,724,000 tons. There is almost no domestic consumption of soybeans, so they are transported to exportation and to the oil squeezing plant. Soybean oil and soybean cake, which are the output of the oil squeezing plant, have almost no domestic consumption, so they are also dispatched for export. Therefore, the export volume of soybean-related products is 3,631,000 tons, corresponding to 60% of the total volume of exports.

Soybeans are exported mainly to the European market, followed by Brazil. Exports to neighbor countries like Brazil and Argentina are not increasing in these years, and the volume to be increased in future production shall be exported to European and North American markets. Therefore, water transport from Paraná riverside, near to the soybean growing center, is expected to grow in importance.

Soybean oil and soybean cake are exported to neighbor countries mainly by land, and this trend is expected to continue.

(Cotton)

The production of raw cotton has been low recently but a slight increase is expected. However, because of the increase in consumption due to growth of GDP, a small volume will remain for export. This will keep almost the same level: 59,000 tons in 1997 and 57,000 tons in 2010.

(Wheat-related products)

Wheat is being produced as a secondary crop of soybeans, but as its production requires labor and time, the trend for the future is a decrease in production. On the other hand, consumption volume is increasing, and 83,000 tons will have to be imported in 2010. The main origin of imports will be Argentina, as it is now, and it is expected that the import method will be by water through Paraguay River, to the flour

mills or to the department of Central, with its big market.

(Maize)

The production of maize will be maintained the same level as today, and the major part will be applied to domestic consumption. The surplus is exported but, due to the increase in consumption, export volume will decrease from 223,000 tons in 1997 to 169,000 tons in 2010. Exports are made by land to Brazil and by water to North America and Europe.

(Sugar cane)

The production volume will show a slight increase, but almost all of it will be applied to domestic consumption. It will correspond to a big portion of domestic transport.

(Lumber-related products)

Felling volume may decrease due to a reduction in fellable forest, but some specialists are of the opinion that while the amount of lumber with high quality and large size will decrease, the lumber will be processed adequately and consequently the felling volume will not change significantly. The production forecast, therefore, was made based on GDP growth rate. As a result, production volume was estimated to increase by 1,178,000 tons, but export was estimated to decrease from 486,000 tons in 1997 to 32,000 tons, mainly because of the increase in consumption. The main destination of exports will be Brazil, by land. However, water transport to North America, Europe, Asia, etc. will also increase by approximately 100,000 tons. Taking into consideration the producing center, water transport via Paraná River will increase.

(Iron ore, steel products)

The import of iron ore has been decreasing every year. However, the blast furnace in Villa Hayes has been privatized, and it is expected to have a production capacity of 120,000 tons per year. Consequently it will be necessary to import 150,000 tons of iron ore for this production.

The growth in GDP will result in an increase of steel consumption. The import volume of iron ore and steel products is expected to double from 148,000 tons to 394,000 tons. Iron ore will be transported by water, through Paraguay River, to Villa Hayes. Steel products will be transported by land.

(Crude oil, oil)

Almost all of the demand for oil comes from cars. As the number of cars will increase by 167%, the demand for oil will increase drastically. On the other hand, the refining capacity of PETROPAL is limited; consequently, the import of oil will increase significantly. The import volume of oil will increase by 150%, from 1,100,000 tons in 1997 to 2,785,000 tons in 2010. Oil is imported mainly from Argentina by water transport, but land transport from Brazil is increasing. However, taking into

consideration the fact that the greatest increase in the number of cars will be in Central department, it can be estimated that water transport thorough Paraguay River will increase significantly.

(Construction materials)

Due to the growth in GDP, the production of construction materials will significantly increase from 6,087,000 tons to 8,308,000 tons. On the other hand, consumption volume is increasing, and export will have almost no change, and import will significantly increase from 18,000 tons to 319,000 tons. However, this volume is still small compared to the total production, and physical distribution is mainly domestic transport. Regarding procurement of construction materials, it will be mainly from neighborhood of the construction site (except for cement); the majority will be transported within the same department. Cement will be supplied nationwide from the plant in Vallemi.

(Beverages)

Consumption of beverages will increase due to population growth, but production will also increase. Imports will be 115,000 tons, almost the same level as today. About half of the imports will be by land from Brazil and Argentina, and half by water from North America and Europe.

(Fertilizer)

Due to growth in soybean production volume, the import volume of fertilizer will increase by 40%, from 172,000 tons to 242,000 tons. A large part will be by land (truck, railway) from Brazil and Uruguay. Railway transport will show a trend to increase.

(Others)

Regarding “other products,” imports, exports, and domestic consumption will double due to the growth in GDP. About 25% of the imports of “other products” will be products from Asia and Australia. Their transport route will be mainly by water from Buenos Aires to Asunción, and by land from Brazil to the customs in Encarnación. Depending on repair of the Bioceanic Road, the possibility of land transport from Chile is high. Among the products, cars are the principal item.

(Distribution of Freight Flow)

The result that the distribution of domestic freight flowing and flowing to the customs was estimated is as shown in the figure.

Freight flow was estimated using the gravity model considering the amount of production at the origin zone, the amount of consumption, which depends on population or number of factories, the destination zone and travel time according the OD table of 1990. After that, each OD volume were settled through the amount of occurrence and the amount of concentration by factor method. At this time, an export-import pattern (country, mode rate) made a pattern that was the same as the present one principle.

Figure 47 Distribution of Freight Flow in Year 1997

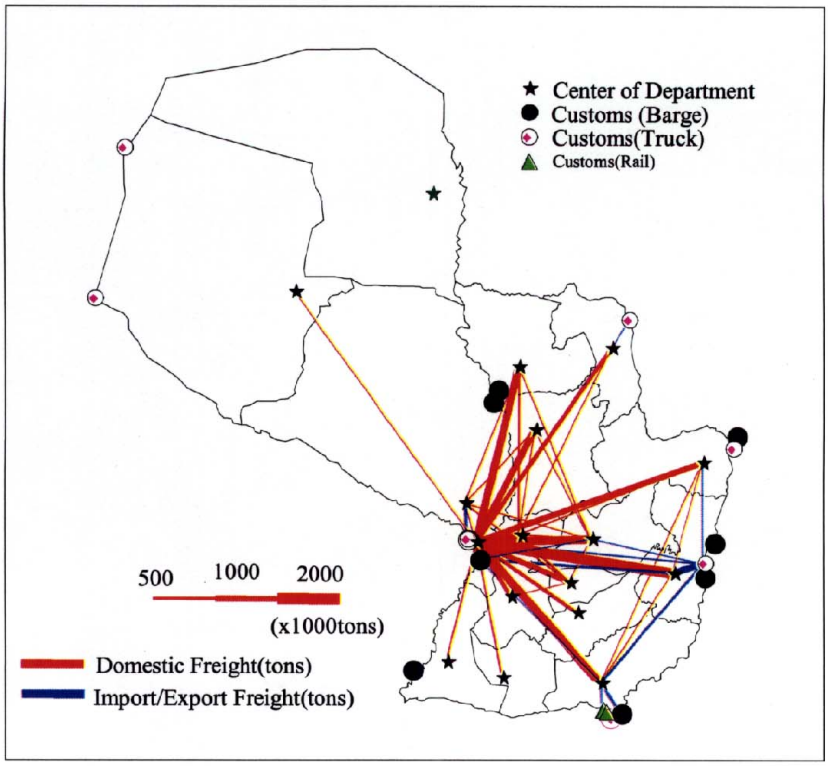
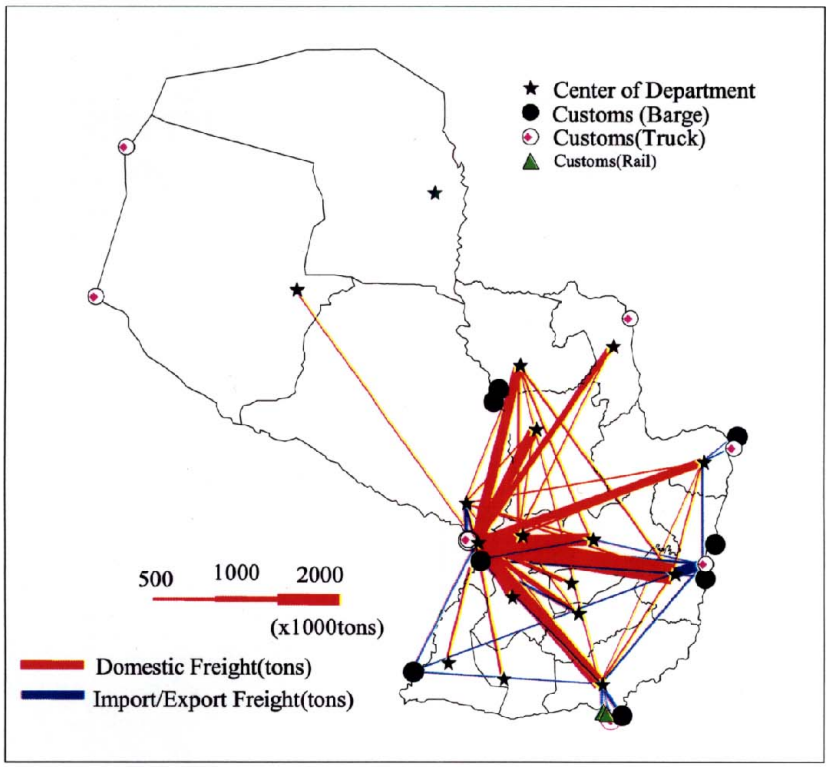


Figure 48 Distribution of Freight Flow in Year 2010



3) International physical distribution

Table 41 shows the transport from/to final import origin or export destination, based on the above forecast.

Regarding the origin of imports, Brazil and Argentina will increase their share. The proportion of imports from Central and South America is increasing because Colombia is considered as the import origin of oil and crude oil.

As for exports, the proportion to Europe and North America will increase slightly, but Brazil and Argentina are the main destinations.

Table 41 Export Destination and Import Origin

	1997				2010			
	Import origin		Export destination		Import origin		Export destination	
	(1000t)	(%)	(1000t)	(%)	(1000t)	(%)	(1000t)	(%)
Brazil	737	27.1%	1,903	43.1%	1,706	27.3%	2,012	40.0%
Argentina	1,058	38.8%	612	13.9%	2,755	44.1%	621	12.3%
Uruguay	75	2.7%	42	1.0%	119	1.9%	28	0.6%
Chile	40	1.5%	27	0.6%	73	1.2%	44	0.9%
Bolivia/Peru	1	0.0%	65	1.5%	1	0.0%	89	1.8%
Central and South America	131	4.8%	279	6.3%	351	5.6%	361	7.2%
North America	135	5.0%	141	3.2%	335	5.4%	142	2.8%
Europe	164	6.0%	1,255	28.4%	313	5.0%	1,654	32.9%
Asia/Australia	277	10.2%	85	1.9%	539	8.6%	64	1.3%
Africa/Middle East	20	0.7%	5	0.1%	49	0.8%	11	0.2%
Not clear	87	3.2%	0	0.0%		0.0%		0.0%
Total	2,725	100.0%	4,416	100.0%	6,241	100.0%	5,026	100.0%

a. Transport method

Regarding transport method, it is estimated that there will be little change.

An exception will be a change in the transport of grain, which will be more shifted to water transport. Figure 49 shows production volume and change in export route of the main grains. The data is for grain only; oil/cake are excluded. As for wheat, export doesn't appear as imports will surpass exports by 2010.

These data indicate that increasing demand for water transport will likely expand the proportion of transport using Paraná River, which is closer to the growing district than Paraguay River.

Figure 49 Production Volume and Export Route of Main Grain