

12 TRANSPORTATION DEMAND IN 2012

12.1 Growth of Overall Transportation Demand

As of the end of the year 2000, a new national development plan has been under preparation by the Lagos Government. The Ministry of Public Works (MOP) carried out a series of studies entitled “*Plan Director de Infraestructura, 2000*” for consolidating a quantitative planning basis. The third progress report includes the forecasted results of the nationwide road transportation demand. The forecast was conducted by using a comprehensive network simulation model, MEPLAN, based on the most probable macro-economic scenario. Table 12.1.1 shows the main output of the forecast. Based on this future demand, the Study also estimates a deficit of road infrastructure by region and a demand for new road construction, widening, paving and maintenance.

Table 12.1.1 Future Transportation Demand by Region in Passenger-km and Ton-km

Region	Automobile (Pax-Km/day)			Bus (Pax-Km/day)			Truck (Ton-Km/day)		
	2000	2005	2010	2000	2005	2010	2000	2005	2010
1 Tarapaca	4,560	5,849	8,901	3,626	5,999	10,011	21,472	27,903	41,922
2 Antofagasta	5,266	6,258	9,397	4,959	8,298	12,479	49,908	71,827	95,714
3 Atacama	3,078	3,211	4,516	3,394	5,256	7,439	33,806	48,456	71,445
4 Coquimbo	4,952	6,243	9,154	6,200	8,301	11,559	27,541	39,699	60,369
5 Valparaiso	11,657	14,592	19,542	15,100	18,783	24,414	31,270	41,684	56,025
6 L.B.O'Higgins	2,988	3,743	5,227	4,049	4,989	6,685	15,330	21,124	30,498
7 Maule	3,966	4,880	6,478	5,823	6,840	8,698	13,890	17,631	23,115
8 Bio Bio	8,541	10,398	13,587	13,933	16,468	21,208	78,337	107,667	147,750
9 La Araucania	4,356	5,224	6,690	6,889	7,828	9,536	15,728	20,448	26,472
10 Los Lagos	7,332	9,479	13,024	11,781	13,840	17,927	21,144	27,396	35,346
11 Aisen del G.C.I.del Campo	496	1,209	2,209	1,367	1,641	2,862	1,742	3,471	6,317
12 Magallanes	646	1,031	1,881	2,742	3,467	5,233	6,970	12,077	22,394
13 Metropolitan Region	14,227	18,885	27,101	16,219	20,523	27,498	78,011	103,359	137,021
International	2,254	2,323	2,376	990	1,035	1,079	223,653	325,809	512,988
Total	74,065	93,007	129,717	98,082	124,238	167,559	397,149	544,747	756,398
(Growth rate: Yr 2000 = 100)	100	126	175	100	127	171	100	137	190

Source: "Third Progress Report for Plan Director de Infraestructura, 2000", MOP

According to the table, aggregate demand of passenger transport will increase by 4.7% (for cars) and by 4.9% (for buses) annually during the years 2000 – 2005, while cargo transport demand will increase at a higher rate of 7%. These rates will become much greater during the years 2005 – 2010, reaching 6.9% for cars, 6.2% for buses and 7.9% for trucks, respectively, due to the assumption of higher economic growth in the said period. As a result, during the first decade of the next century, national road transportation demand will expand approximately 1.7 times for passengers and more than double for cargoes.

Supposing average passenger occupancy is 2 persons per car and 25 persons per bus and that the average load factor is 10 tons per truck, in the year 2010, truck traffic will have a dominant share of 64% in terms of vehicle-km, cars 33% and buses 3%. By converting these figures into pcu-km (pcu: passenger car unit) terms, and assuming a passenger car equivalent of 1.0 per car, 2.0 per bus and 2.5 per truck, traffic burden on the road network for trucks becomes more significant at 80%, while for cars 16% and 3% for buses. Thus, the main concern for inter-urban traffic should be cargo transportation.

Total demand in pcu-km will double in 2010. Regarding the regions, comparatively less developed regions show higher growth compared to developed regions. The growth rates between 2000 and 2010 are 3.7 for Region XI, 3.0 for Region XII, 2.1 for Region VI and 2.0 for Region I. The rates for the more developed regions are 1.6 for Regions VII and IX, 1.7 for Region V and X, and 1.8 for the Metropolitan Region.

The Road Department (*Dirección de Vialidad*) of MOP conducts a traffic count survey annually at 78 stations along Route 5, from the northern border with Peru to Quellón on Chiloé Island. Future traffic volumes on Route 5 are estimated by multiplying AADT of MOP by the growth rates of corresponding regions in the above table. Table 12.1.2 shows such estimates. (The growth rates in 2011 and 2012 are assumed equivalent to those during the years 2005 – 2010.)

In 2010, the heaviest traffic will occur in Region IV between La Serena and Coquimbo where most sections are urbanized. The AADT over 80,000 vehicles will require two expressway-standard highways with two lanes in each direction. From the Metropolitan Region to the north, there is an alternative route (Route 57) with access controlled by four lanes via Colina and Chacabuco tunnel to Los Andes, and therefore part of the volume exceeding the capacity of Route 5 will be diverted to this route.

Route 5 has been doubled recently between Region VI and Puerto Montt, Region X, through concession projects, and has enough capacity until 2010. Traffic on Route 5, between Regions I and III, will continue to be less than 10,000 before the year 2010 but will exceed present capacity after 2006. Therefore, the capacity of Route 5, in northern Chile, will need to be increased by widening the existing route or constructing a new alternative route. This is especially true for the sections between the border and Arica in Region I, between Carmen Alto and the south access of Antofagasta in Region II and between Caldera and Copiapo in Region III.

Table 12.1.2 Forecast of Traffic on Route 5

(AADT, Vehicle/day)

Region		1998		2006		2012		Capacity in 1996	
		Max	Min	Max	Min	Max	Min	Max	Min
1	Tarapaca	3,231	703	5,066	1,102	8,265	1,798	6,200	4,800
2	Antofagasta	2,516	518	4,449	916	6,276	1,292	6,200	4,800
3	Atacama	3,123	1,435	5,601	2,574	8,937	4,107	6,200	4,800
4	Coquimbo	29,099	2,403	52,819	4,362	87,131	7,195	11,400	6,200
5	Valparaiso	14,629	6,549	23,185	10,379	33,075	14,807	11,400	6,200
6	L.B.O'Higgins	25,256	11,473	42,509	19,310	65,971	29,968	17,600	11,400
7	Maule	17,431	4,343	25,729	6,410	35,678	8,889	17,600	11,400
8	Bio Bio	10,870	7,445	18,108	12,403	26,423	18,097	11,400	11,400
9	La Araucania	7,561	5,435	11,505	8,270	15,684	11,274	11,400	11,400
10	Los Lagos	14,231	1,687	21,491	2,548	29,130	3,453	17,600	11,400
13	Metropolitan Region	36,971	11,241	58,043	17,648	81,407	24,752	50,000	50,000

Source: Elaborated by Study Team based on "Third Progress Report for Director Plan of Infrastructure, 2000", MOP

12.2 Export of Main Commodities

The main export commodities in terms of tonnage are mineral products including copper, iron and other metallic and non-metallic products, wood/wood chips, fish/fish meal and fresh fruits. These products are mainly exported from the many ports located along Chile's long coastline.

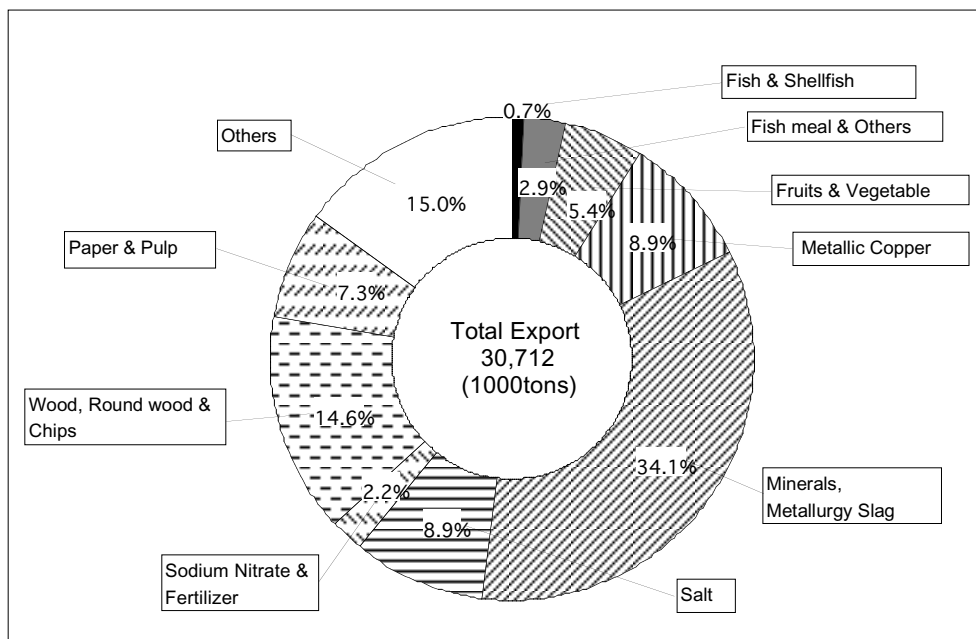


Figure 12.2.1 Main Exporting Commodities in 1999

Source: Cámara Marítima y Portuaria de Chile, 1999

(1) Copper

a. Present Situation

Copper has been the most important traditional exporting good since the 1970's. Since then, Chile has maintained its position as the number one copper producing country in the world. Copper exports in 1999 reached US\$5,888 million, which is equivalent to about 40% of total Chilean exports. There are three types of investment groups in the mining sector: the state-owned company, CODELCO, international investors (the two most important groups), and small-scale producers in the domestic private sectors.

CODELCO was established in 1976 in accordance with the nationalization policy of the military regime, consisting of four divisions that correspond to the main mines, Chuquicamata, El Salvador, Andina, and El Teniente. These four mines represented 84% of total Chilean copper production at that time. Between 1980 and 1987, CODELCO was the major investor, equivalent to approximately 70% of total investment, some US\$500 million in 1995 prices.

External investors have accelerated their activities since the late 1980's as shown in Figure 5.2.2. As a consequence, their share has exceeded more than half of total copper production in 1996. Consequently the average total investment between 1990 and 1997 is estimated to be approximately US\$1800 per annum.

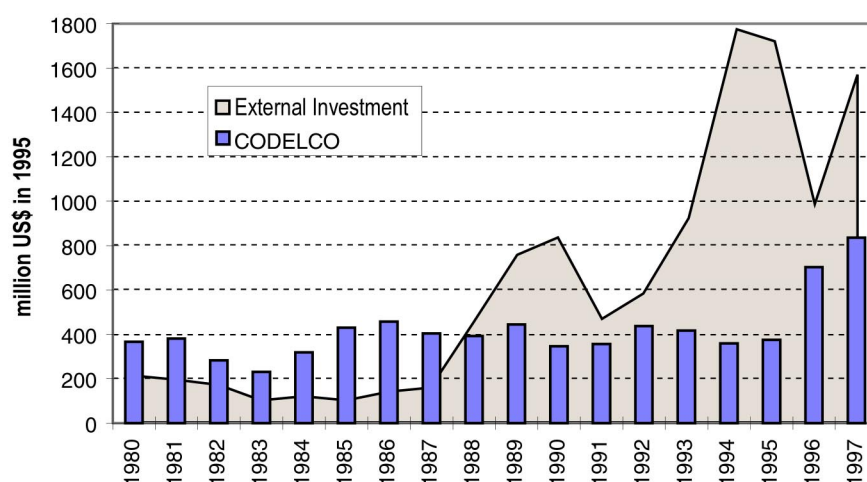


Figure 12.2.2 Past trend of investment by CODELCO and External Investors

Source: Comité de Inversiones Extranjeras y Manual de Estadísticas Básicas, Gerencia de Estudios y Gestión Estratégica, CODELCO.

Chile's total copper production is shown in Table 12.2.1. We can observe that copper production is concentrated in the northern regions, particularly Region II. We can also observe that production in the North Zone, i.e., Region I to III, shows an increasing trend, while the production trend between Region IV and the southern regions is rather stagnant, particularly in recent years. This indicates that the relative importance of the north zone, in terms of copper production, has been further increasing.

Table 12.2.1 Copper Production in Chile

Unit : ton/yr

Province	1990	1991	1992	1993	1994	1995	1996	1997	1998
I Tarapaca	18,269	17,832	20,050	22,145	50,713	104,121	145,939	144,571	217,751
II Antofagasta	821,615	1,072,406	1,117,152	1,174,968	1,255,168	1,303,094	1,816,741	2,157,326	2,238,388
III Atacama	154,966	157,582	164,109	154,245	182,777	314,354	360,318	376,741	414,313
IV Coquimbo	44,673	44,436	56,244	63,588	67,743	71,799	75,225	88,027	69,174
V Valparaiso	219,618	226,242	207,396	221,465	224,335	236,010	242,825	227,781	247,584
VI L.B.O'Higgins	298,577	278,908	314,374	307,754	314,459	331,924	353,277	361,239	353,440
VII Maule	7	14	2	0	0	0	0	0	0
VIII Bio Bio									
IX La Araucania									
X Los Lagos									
XI Aisen del Campo	30	0	0	0	0	0	0	0	0
XII Magallanes									
TOTAL	1,557,755	1,797,420	1,879,327	1,944,165	2,095,195	2,361,302	2,994,325	3,355,685	3,540,650

Source: Anuario de Minería, INE

b. Perspectives

As shown in Table 12.2.2, there are still many copper reserves in Chile. Furthermore, there is a possibility that new deposits could eventually be found. Between 1998 and

2000, mining sector investments seem to have remained similar to investments made between 1990 and 1997. According to information provided by CODELCO, the company will continue investments of at least US\$600 million per year beyond the year 2000. Private sector investment is forecasted to somewhat decrease, in new mining exploitation, due to the market price in recent years. However, some new projects that have been postponed could be re-initiated between 2001 and 2005 with the expectation of higher profitability.

Table 12.2.2 Estimated Copper Reserves in the World

Million ton

Country	Total Reserve	Exploitable Reserve1)	%
EU	90	45	12.7
Australia	21	7	2.0
Canada	23	11	3.1
Chile	185	132	37.3
Peru	25	7	2.0
Philippine	11	7	2.0
Zaire	30	10	2.8
Zambia	34	12	3.4
Russia	36	20	5.6
Poland	36	20	5.6
Others	144	83	23.4
Total	635	354	100.0

Source: CODELCO Manual de Estadística Básicas

Note: 1): Economically exploitable reserve

Based on the investment trend highlighted above, the growth rate of copper production and export will decrease over the next few years compared to the copper boom in the early 90's. The projection conducted by CODELCO until the year 2005, is shown in Table 12.2.3. Reflecting the relatively low investment growth, copper production will grow at a rate of 3.6 % per annum for the period between 1999 and 2005. However, a strong demand for high-grade refined copper will be continually anticipated in North American and Asian markets, including Japan.

CODELCO projections after the year 2005 do not exist; therefore, the forecast is made based on the following assumptions:

- The current elasticity of the copper production growth to the GDP growth in the macro zone will prove applicable to future projections.
- Production in Region VI will be included in exports from the Central Zone. Consequently, the production growth rate between 2006 and 2012 is estimated at 7.7% per year.

By using the growth rate of copper production, the future exporting volume is extrapolated by the macro-region as shown in Table 12.2.4. As a result, the total copper export in 2012 will grow by as much as 1.95 times the present volume.

Table 12.2.3 Projection of Copper Production

Copper mines	1998	1999	2000	2001	2002	2003	2004	2005
CODELCO Total	1,403	1,507	1,507	1,556	1,590	1,667	1,702	1,693
Division Chuquicamata	650	630	626	644	646	655	628	633
Division Salvador	98	92	85	86	91	97	96	96
Division Andina	164	249	255	249	242	248	254	242
Division El Teniente	339	346	351	346	346	391	448	446
Radomiro Tomic	152	190	190	231	265	276	276	276
Private Sector Total	2,261	2,845	2,941	2,991	3,094	3,303	3,485	3,696
El Salvado	67	85	83	80	76	88	91	92
Los Bronces	143	162	137	140	140	173	179	175
Mantos Blancos	89	101	97	98	102	102	102	102
Escondida	842	938	897	823	951	1,203	1,242	1,402
El Indio	27	15	14	14	14	0	0	0
Los Pelambres	9	12	303	358	301	281	304	289
Lince	51	50	52	60	48	41	44	44
Tuina	4	4	4	0	10	12	12	12
Minera Valle Central	18	20	20	20	20	20	20	20
Quebrada Blanca	71	73	73	75	75	75	75	75
Cerro Colorado	75	100	100	100	100	100	100	100
Candelaria	209	220	192	186	186	179	175	175
Ivan/Zar	9	12	14	16	8	6	6	6
Manto Verde	48	51	51	51	50	48	47	46
Zaldivar	135	151	146	134	124	119	119	118
Andacollo	21	22	22	20	20	20	20	20
El Bronce	0	0	0	0	0	0	12	27
El Tesoro	0	0	0	72	86	86	85	85
El Abra	199	220	195	196	190	190	170	180
Lomas Bayas	19	45	49	50	52	55	55	55
Collahuasi	47	423	400	409	398	356	309	287
Others	178	141	92	89	143	149	318	386
Total Production	3,664	4,352	4,448	4,547	4,684	4,970	5,187	5,389

Source: Genrerencia de Estudios y Gestion Estrategica, CODELCO, Chile.

Table 12.2.4 Total Copper Export from Chile

Zone	1000 ton / yr		
	1999	2005	2012
North Zone	2,091	2,577	4,473
Central Zone	640	659	873
South Zone	0	0	0
Total	2,731	3,236	5,346

Source: JICA Study Team

(2) Other Mineral Products

a. Present Condition

As for the mineral products other than copper, the major exporting items are metallic products such as iron, gold, silver and manganese and non-metallic ones such as salt, nitrate etc. Table 12.2.5 shows the production of these products over the past several years.

Table 12.2.5 Production of Major Exporting Mineral Products excluding copper

Products	1994	1995	1996	1997	1998
Iron	8,643,900	8,431,647	9,081,481	8,738,191	9,112,055
Gold	39	45	53	49	44
Silver	983	1,041	1,147	1,082	1,337
Manganese	62,870	70,449	62,887	62,750	48,159
Molybdenum	14,949	17,889	17,415	21,339	25,517
Sub-Total	8,724,735	8,523,066	9,164,979	8,825,408	9,189,110
Salt	3,177,898	3,494,451	4,042,796	5,488,135	n.a.
Nitrate	822,400	894,800	808,500	847,000	881,700

Source: Anuario Minería, INF, Boletín Mensual Agosto 2000, Banco Central de Chile

Such metallic products as zinc and limestone are also exported in addition to the products listed above. In terms of tonnage of metallic products, iron ore holds the predominant share accounting for approximately 90% of total metallic products exported abroad. Asian countries, particularly Japan, are the major markets for iron ore while European countries are the predominant markets for silver and manganese. Non-metallic exporting products such as iodine and lithium sodium sulfate are also included, however, these exports have not yet reached significant levels compared to the products highlighted in the table.

The production area for the above products is located primarily in the northern part of Chile, similar to the location of copper in Regions II, III and IV; hence the export ports are also concentrated in the North Zone as shown in Table 12.2.6.

Table 12.2.6 Export of Other Mineral Products in 1999

Region	metric ton			
	Salt	Other Metallic Minerals	Sodium Nitrate non-metallic	Total
I	2,744,004	974,746	95	3,718,845
II	20	2,365,606	670,397	3,036,023
III	0	4,100,983	105	21,466
IV	0	54,135	0	54,135
V	412	3,266,016	1,793	3,268,221
VI	0	0	0	0
VII	0	0	0	0
VIII	0	1,437	150	1,587
X	0	0	0	0
XI	0	68,940	0	68,940
XII	0	0	0	0
Total	2,744,436	10,831,863	672,540	10,169,217

Source: Camara Marítima y Portuaria de Chile

b. Future perspectives

The export trend of metallic products shows a slight increase over the past few years, equivalent to an average of approximately 3% per annum. This tendency is likely to continue in the future, at least in the short term. The estimated reserves of metallic mineral products identified until now are already sufficient for a production period of more than 30 years from now, as shown in Table 12.2.7.

As for non-metallic mineral products, the mining sector will develop by increasing the variety of products to be exported, rather than increasing the two main products, salt and nitrate. Lithium, iodine and borate will increase at a higher rate due to their high quality and high content rates.

Table 12.2.7 Estimated Reserves of Mineral Products: Excluding Copper

1000ton	
Products	Reserves
Iron	360,000
Silver	2.4
Molybdenum	2,446
Salt	10,000,000
Nitrate	250,000
Lithium	4,290
Borax / Borate	9,144
Iodine	363

Source: Diagnostics de la Minería de Chile Luis Guarachi INTEC-Corfo

However, the growth rate levels for salt exports will remain low, although there are plenty of reserves in the Atacama Region. This is because the export volume has almost reached levels of saturation in main market countries such as Ecuador and Colombia. Accordingly, it is assumed that salt for export will grow at a rate similar to the average population growth rate in market countries.

As for metallic and non-metallic mineral products, the export projection is based on the following assumptions.

- The current elasticity of total metallic mineral products for export, with respect to GDP growth of the macro-region, will be used to estimate the future export of metallic minerals.
- Likewise the elasticity, with regards to GDP growth of the macro-region, will also be used to estimate the future export of non-metallic products.

As a result, the export volumes of other mineral products are projected as shown in Table 12.2.8.

Table 12.2.8 Export of Other Mineral Products

Macro Region	Year	ton		
		Salt	Minerals, Metallurgy Slag	Sodium Nitrate & Fertilizer
North	1999	2,743,964	7,080,168	669,572
	2005	3,053,972	9,106,776	890,605
	2012	3,389,435	12,551,572	1,280,984
Central	1999	412	3,319,248	1,793
	2005	459	4,156,818	2,314
	2012	509	5,447,009	3,144
South	1999	0	70,377	150
	2005	0	84,087	184
	2012	0	110,616	250
Total	1999	2,744,376	10,469,793	671,515
	2005	3,054,431	13,347,680	893,102
	2012	3,389,944	18,109,197	1,284,378

Source: JICA Study Team

(3) Fishery Product

Chile's 4,300 km coastline presents high potential for fishery development, offering an abundance of fish, shellfish, crustaceans and seaweed. The extractive fishing sector grew rapidly in the 1980s. At this time, the Government judged the annual catch had reached limits of sustainable exploitation and thus prohibited fishing operations of new boats since 1991. As a result, the production trend of extractive fishing has decreased. However, aquiculture production has grown significantly from 1,120 tons in 1985 to 141,377 tons in 1995. Salmon farming has become one of the most important fishery sectors of Chile's aquiculture, followed by trout, pelillo and oyster.

In the mid-1990s, Chile consolidated its position as the world's second largest producer of farmed salmon, followed by Norway and exceeding the United Kingdom, Canada and Japan. To attain this position, investment has been channeled into the fields of modern packing systems and strict quality control. Recently, salmon has been exported in the following forms: smoked, in portions, canned, salted and boned, and fillets. Japan and the United States are the main export markets for salmon.

Oyster and seaweed production has also significantly increased with most exports targeted at South East Asian countries. Other new export-oriented fishery products are turbot, abalone, salmon caviar, sea urchin and crab paté. These are also primarily exported to Asian markets.

In 1996, Chile's fish and seafood exports totaled US\$1,235 million, of which 68% was derived from extractive activities and 32% from aquiculture. Fishmeal represents approximately 50% of exports in the extractive fishing sector. It is produced by small-scale fishermen and is collected at specific ports for exportation, shipped principally to Japan (23% of fishmeal export), Taiwan, China and Germany. Fishery production in Regions I and VIII is outstandingly high, where the majority of their production is fishmeal. (Table 12.2.9)

Table 12.2.9 Past Trend of Fishery Production by Region (ton)

Province	1992	1993	1994	1995	1996	1997
I Tarapaca	1,632,985	1,477,172	1,824,469	1,468,347	1,021,383	1,381,363
II Antofagasta	484,357	566,046	709,349	578,436	418,386	362,467
III Atacama	234,156	254,883	298,290	374,620	252,355	235,889
IV Coquimbo	89,875	102,979	104,977	171,192	142,272	110,965
V Valparaiso	297,933	281,685	631,937	992,833	859,967	350,117
VI L.B.O'Higgins	3,125	5,547	3,300	1,675	1,655	1,666
VII Maule	8,428	10,495	8,431	1,805	5,751	4,282
VIII Bio Bio	3,519,019	3,156,297	4,065,780	3,831,098	3,997,203	3,333,571
IX La Araucania	2,638	2,375	2,047	1,971	1,310	967
X Los Lagos	212,859	188,715	234,403	303,757	364,309	391,297
XI Aisen del G.C.I. Del Campo	23,836	20,276	24,338	27,204	35,585	48,627
XII Magallanes y Antartica Chilena	12,738	11,133	16,499	13,248	14,412	19,372
TOTAL	6,521,949	6,077,603	7,923,820	7,766,186	7,114,588	6,240,583
Fish	6,239,718	5,788,946	7,609,636	7,345,692	6,663,870	5,828,800
Molluscs	131,998	108,548	104,650	90,302	96,106	93,269
Crustaceos	23,667	22,916	26,992	30,971	32,585	36,908
Algas	126,566	157,193	182,542	299,221	322,027	281,606

Source: Chilean Regional Statistics, 1999.

Regarding the future perspective of the Chilean fishery industry, the Chilean

Government (*Subsecretaria de Pesca*) expects that cultivated fish production will grow rapidly at a rate greater than 10% per annum between 2001 and 2006. However, extractive fishing will remain at similar levels as the year 2000, as shown in Table 12.2.10. By using the growth rate of this forecast, the export volumes of fishery products are extrapolated by the macro-region, as shown in Table 12.2.11. Here, the growth rates of cultivated fishery products are applied to the export of fish and shellfish, and the growth rate of natural fish extraction is applied to the export of fishmeal and others. Consequently, the export of fish and shellfish will increase 3.5 times in 12 years and fishmeal and others will maintain an export level of about one million tons.

Table 12.2.10 Forecast of fishery production by Subsecretaria de Pesca

Year	Cultivated		Extractively Fished		Total	
	(Million US\$)	Growth(%/Yr)	(Million US\$)	Growth(%/Yr)	(Million US\$)	Growth(%/Yr)
1995	552,474	-	1,229,866	-	1,782,340	-
1996	598,038	8.2	1,173,879	-4.6	1,771,917	-0.6
1997	729,009	21.9	1,143,576	-2.6	1,872,585	5.7
1998	762,024	4.5	911,727	-20.3	1,673,751	-10.6
1999	884,570	16.1	899,435	-1.3	1,784,005	6.6
2000	891,000	0.7	1,071,697	19.2	1,962,697	10.0
2001	1,035,000	16.2	1,071,697	0.0	2,106,697	7.3
2002	1,170,000	13.0	1,071,697	0.0	2,241,697	6.4
2003	1,332,000	13.8	1,071,697	0.0	2,403,697	7.2
2004	1,467,000	10.1	1,071,697	0.0	2,538,697	5.6
2005	1,620,000	10.4	1,071,697	0.0	2,691,697	6.0
2006	1,800,000	11.1	1,071,697	0.0	2,871,697	6.7
2007	1,975,500	9.7	1,071,697	0.0	3,047,197	6.1
2008	2,155,500	9.1	1,071,697	0.0	3,227,197	5.9
2009	2,344,500	8.8	1,071,697	0.0	3,416,197	5.9
2010	2,542,000	8.4	1,071,697	0.0	3,613,697	5.8
2011	2,756,000	8.4	1,071,697	0.0	3,827,697	5.9
2012	2,988,000	8.4	1,071,697	0.0	4,059,697	6.1

Source: Subsecretaria de Pesca, Chilean Government

Table 12.2.11 Forecast of Export of Fishery Products by Macro-region

Year	Metric Ton							
	Fish and Shellfish				Fishmeal and Others			
	North	Central	South	Total	North	Central	South	Total
1999	7,702	129,768	91,177	228,647	360,861	100,349	441,377	902,587
2005	15,000	275,000	127,000	417,000	429,000	119,000	525,000	1,073,000
2012	31,000	576,000	163,000	770,000	429,000	119,000	525,000	1,073,000

Source: Elaborated by the Study Team

(4) Forestry Products

Chile's territory accounts for approximately 75.5 million hectares of which 21% (16 million hectares) is covered by primarily native forest, 10% is plantation farm and 45% is considered suitable for forestation. Chile is endowed with much potential for forestry development. At present Chile is the only country among principal countries that produce forest-related products, where the area of timberland is increasing.

In 1996, the total harvest from artificial forests was about 20 million m³, while exploitation from native forests was 6 million m³. Six million m³ are used for firewood and 3 million m³ for industry. Therefore, the majority of products in the forestry industry, especially for export, are from plantation farms. Table 12.2.12

shows the artificial forest area by province as of 1997. The sum of Regions VI to X accounts for 95% of the total and Region VIII (Bío Bío Region) alone represents about half.

Table 12.2.12 Plantation Areas by Region in 1997

Province	Area (ha)	Composition(%)
1 Tarapaca	0	0.0
2 Antofagasta	71	0.0
3 Atacama	589	0.1
4 Coquimbo	4,233	0.4
5 Valparaiso	38,265	3.5
6 L.B.O'Higgins	66,218	6.1
7 Maule	106,699	9.8
8 Bio Bio	508,081	46.9
9 La Araucania	276,173	25.5
10 Los Lagos	74,281	6.9
11 Aisen del G.C.I. Del Campo	8,811	0.8
12 Magallanes y Antartica Chilena	0	0.0
TOTAL	1,083,421	100.0

Source: Chilean Regional Statistics, 1999.

The main plantation species is radiate pine, which was introduced more than a century ago and currently covers 1.4 million hectares. Eucalyptus comes in a distant second position, with 250,000 hectares. Another important species is *lenga*, a native hard tree used for making quality furniture.

Forestry products are exported in various commodity types. The most important one is pulp, followed by chips, sawn wood, logs and dressed lumber, laminated boards and newsprint. Table 12.2.13 shows the values and volumes exported in 1996 by commodity type.

Table 12.2.13 Export of Forestry Products by Type in 1996

Product	Value(FOB) US\$ Million	Volume	
		Unit	Volume
Logs	144.2	m ³	2,226.3
Lumber	222.9	m ³	1,238.1
Chemical Pulp	1,270.4	ton	1,625.1
Newsprint	111.3	ton	136.3
Board and Veneers	80.7	ton	197.6
Brushed Wood	32.3	m ³	83.2
Chips	232.8	ton	4,076.5
Furniture	33.0	ton	15.3
Others	241.7	-	-

Source: Guide to the Chilean Business Environment, 1998

The major ports for exporting forestry products are privately owned: San Vicente, Lirquén, Talcahuano, Coronel, Puchoco, Jureles and San Antonio. Several projects are being considered to improve access to these ports through concession schemes.

In 1997, Chile's Forestry Institute (*Instituto Forestal*) made a long-term forecast of

volumes of radiate pine and eucalyptus in accordance with sustainable deforestation. A simulation model was used composed of such factors as forestry resource stock, tree growth, investment, plantation and exploitation. Future volumes of sustainable deforestation deducted by the simulation are shown in Table 12.2.14, where the growth rate between 2000 and 2012 is estimated at 1.6 times for radiate pine and 2.6 times for eucalyptus. According to this forecast, total possible harvest will jump 1.7 times and will grow moderately thereafter.

Table 12.2.14 Forecast of Sustainable Deforestation

(Million Cubic Meter / Year)

Year	Radiate Pine				Eucalyptus
	for Pulping	for Sawing	for Pruning	Total	
1998 - 2000	9.01	10.15	0.39	19.55	3.61
2001 - 2003	10.38	16.97	3.16	30.51	6.33
2004 - 2006	10.89	16.87	2.50	30.27	7.69
2007 - 2009	10.28	17.50	2.65	30.43	8.47
2010 - 2012	10.19	17.80	2.41	30.40	8.86
2013 - 2015	10.29	17.59	2.42	30.30	8.94

Source: “Disponibilidad Futura de Pino y Eucaliptos” Instituto Forestal

Following the potential growth rates, the export of Chilean forestry products is estimated as shown in Table 12.2.15. Pulp will be made primarily from radiate pine trees, thus neglecting the use of eucalyptus pulp. By the year 2012, the export of wood and wood chips will increase by more than double, while paper and pulp export will increase slightly. Growth in the south macro-region, in particular, will be remarkable.

Table 12.2.15 Forecast of Forestry Products Export by Macro-Region

Metric Ton

Year	Wood and Chips				Paper and Pulp			
	North	Central	South	Total	North	Central	South	Total
1999	1,892	964,217	3,508,611	4,474,720	372	69,429	2,165,949	2,235,750
2005	3,617	1,297,468	7,254,177	8,555,263	450	55,245	2,648,061	2,703,755
2012	3,885	1,240,359	7,944,799	9,189,044	421	45,240	2,484,299	2,529,960

Source: JICA Study Team

(5) Fruits

Chile is endowed with good conditions for fruit production, including a varied climate, sanitary advantages and opposite seasons to the Northern Hemisphere. In Chile, more than 190,000 hectares are covered with fruit trees, generating employment for 4.4% of the total labor force.

Table 12.2.16 shows estimated fruit production that indicates, by weight, the increase in production of 1.5 times over the past ten years. Among the many varieties of fruit, almonds, kiwi, cherry, avocado and pear, show an especially high growth of more than double. In terms of weight, apple, table grape and pear are dominant, together accounting for 68% of the total. There are 28 kinds of table grapes produced in Chile and 36 varieties of peach and nectarine.

In 1995/96, vegetable and fruit shipments totaled 167 million crates, equivalent to US\$1.3 million. The following year, 1996/97, the total export volume of these commodities reached 185 million crates, which were destined to more than 70 countries

(Table 12.2.17). The main markets for Chilean fruit are Europe and the United States. In 1997/98, Europe's share was 36% in value, while the share of the US was 33%. In 1998/99, however, the US share increased to approximately 40% and Europe's share dropped to about 20%, due to the devaluation of the Euro. Ten years ago, South America's share was minimal but has recently expanded and is now the third major market. The export of Chilean lemons to Japan began in June 1996. In August of the same year Chilean chirimoyas began to be sold in major Japanese supermarket chains. Producers expect Chilean medlars, plums, dates and berries will follow. The Chinese market is also growing at around 3 to 4% per annum. The Asian market is very far for Chilean fruit exports and its share remains low at 6 to 7%; however it is expected to grow to 10% within 10 years. Table 12.2.16 Past Trend of Fruit Production in Chile

Table 12.2.16 Forecast of fishery production by Subsecretaria de Pesca

(Metric ton)

Species	1989/90	1994/95	1995/96	1996/97	1997/98	1998/99'	1999/00'
Almond	2,240	4,200	5,200	5,800	6,100	7,400	8,140
Cherry	13,700	20,000	22,000	23,000	18,000	27,000	32,400
Plum	110,000	140,000	150,000	148,000	142,000	198,000	158,400
Apricot	19,450	30,000	30,000	32,000	21,000	35,000	33,250
Yellow Peach	112,000	170,000	180,000	185,000	164,000	180,000	153,000
Nectarine	84,000	105,000	135,000	120,000	105,000	130,000	104,000
Kiwi	37,300	115,000	145,000	140,000	146,000	105,000	110,250
Lemon	86,000	110,000	105,000	125,000	120,000	110,000	113,300
Apple	700,000	850,000	950,000	940,000	1,000,000	1,165,000	990,250
Orange	97,200	108,000	125,000	88,000	96,000	85,000	87,550
Walnut	8,350	10,000	11,000	10,500	10,200	10,800	11,124
Olive	6,500	9,000	8,000	12,000	6,000	12,000	12,000
Avocado	37,580	50,000	60,000	55,000	99,000	82,000	86,100
Pear	139,600	280,000	322,000	333,000	320,000	350,000	332,500
Table Grape	730,000	880,000	890,000	840,000	900,000	890,000	916,700
Subtotal	2,183,920	2,881,200	3,138,200	3,057,300	3,153,300	3,387,200	3,148,964
Others	50,000	87,200	109,300	110,100	125,300	133,500	142,213
TOTAL	2,233,920	2,968,400	3,247,500	3,167,400	3,278,600	3,520,700	3,291,177

Source: Elaborated by ODEPA, based on the fruits statistics of CIREN_SORFO, INE, and Agro-Industrial Production Studies of CORFO.

Table 12.2.17 Growth of Fruits Export in Ten Years

(1,000 crates)

	1986/87	1995/96
Table Grape	36,362	69,517
Kiwi	879	36,044
Apple	17,766	23,944
Pear	2,555	10,725
Plum	3,479	8,584
Nectarine	4,004	7,414
Peach	1,355	4,492
Raspberry	242	1,352
Cherry	224	1,075

Source: Guide to the Chilean Business Environment

The majority of fruit is exported by sea and about 10% by air. In the early season, fruits such as cherries, strawberries, grapes, pears and plums are transported by air to the US and Japan due to their high market price. As their price advantage drops, transportation means change to marine transport from the Ports of La Serena/Coquimbo, San Antonio and Valparaíso. Currently, the ports in Concepción have a small role in

fruit exports due to insufficient equipment and consequently, fewer fruit vessels enter these ports. Fruits destined to South American countries are generally transported by truck. Chile's Fruits Export Association (ASOEX) predicts that Chilean fruit exports will and should grow at a rather moderate rate of 3 to 4% per annum in the medium and long term. This is because producers are concerned that if growth is exceedingly high, the world market will be oversupplied and a price crash will result as exemplified by the banana. Considering the ASOEX scenario, the growth rate is estimated at 3% for 1999 – 2005 and 3.5% for 2005-2010. Future export volumes are estimated as shown in Table 12.2.18. The total fruit export volume will exceed 2.5 million tons in 2012.

Table 12.2.18 Forecast of Fruits Export by Macro-Region

Year	Metric Ton			
	Fruits and Vegetable			
	North	Central	South	Total
1999	71,725	1,558,098	14,517	1,644,340
2005	85,643	1,860,450	17,334	1,963,428
2012	108,962	2,367,013	22,054	2,498,029

Source: JICA Study Team

(6) Other Commodities

Other commodities include processed foods in canned, dried or liquidized forms. These include wines, other agricultural products such as grains, chemical products, miscellaneous manufacturing products such as plates, glasses, rubber tires, paperboards, sheep or lamb's wool, etc. Table 12.2.19 highlights the exports of other commodities from the macro region. Between 1991 and 1999, exports have more than doubled in terms of tonnage, with an average growth rate of 9.5% per annum.

Table 12.2.19 Export of Other Commodities

Macro Region	ton	
	1991	1999
North Zone	330,002	604,573
Central Zone	879,831	1,559,990
South Zone	1,027,153	2,444,812
Total	2,236,986	4,609,375

Source: estimated by JICA Study Team based on the data from Camara Maritima y Portuaria de Chile

In order to attain higher economic growth, Chilean industries have attempted to add higher value to their products by renovating technology and increasing the degree of material processing. Such efforts will continue to be undertaken in the future. Product diversification will inevitably increase and as a consequence, other commodities will increase in terms of volume and variety. Accordingly, estimations are made regarding future export volumes of other commodities using the GDP elasticity between 1990 and 1999 and the GDP projection (Refer to Appendices for GDP by industry in detail). As a result, other commodities will increase from 4.6 million tons in 1999 to 15.7 million tons in 2012 with an average annual growth rate of 9.9%, as shown in Table 12.2.20.

Table 12.2.20 Projection of Other Commodities

Macro Region	ton		
	1999	2005	2012
North Zone	604,573	1,126,000	2,479,000
Central Zone	1,559,990	2,715,000	5,710,000
South Zone	2,444,812	3,807,000	7,496,000
Total	4,609,375	7,648,000	15,685,000

Source: Estimated by JICA Study Team

12.3 Import of Main Commodities

The main imported commodities in terms of tonnage in 1999 are illustrated in Figure 12.3.1.

Among others, solid and liquid fuel, mainly petroleum, have the predominant share; accounting for more than half of total imports to Chile. The other main importing goods are cereal and flour meal, chemical products used for refining mineral products, fertilizers used for fruits and vegetables, and various manufacturing products. The commodity corresponding to the second largest share represents solely 10% of total imports.

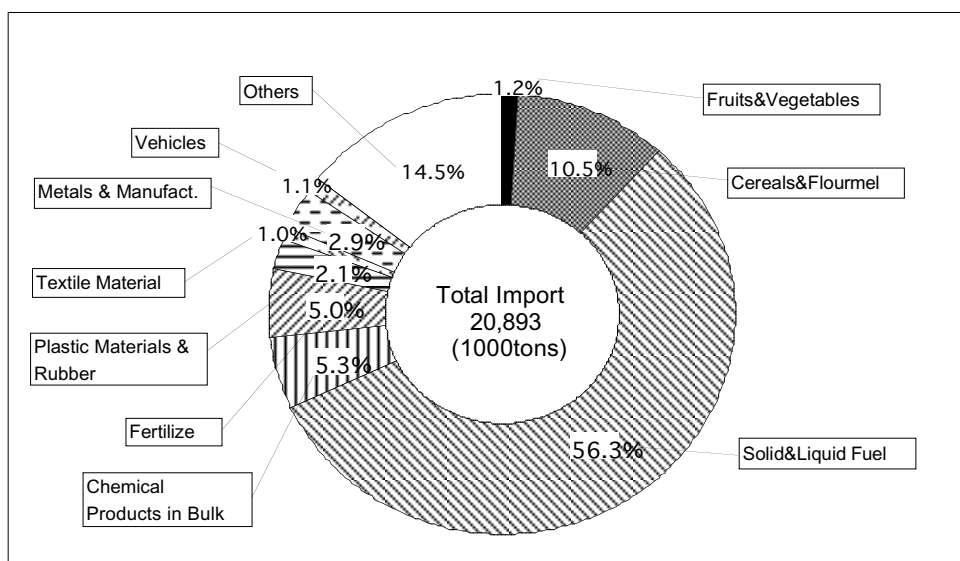


Figure 12.3.1 Main Importing Commodities in 1999

Source: Cámara Marítima y Portuaria de Chile, 1999

(1) Solid and Liquid Fuel

a. Crude Oil

In 1998, Chilean crude oil production was estimated at 2,669 Teracalories, while demand was 99,109 Teracalories. This large gap between oil production and demand forces Chile to rely heavily on imported oil. Chile's crude oil demand has almost doubled between 1988 and 1998, while production has declined from 11,659 Teracalories in 1988 to 2,669 Teracalories in 1998. Argentina supplies approximately 50% of Chile's oil import. The rest is imported from Venezuela, Colombia, Peru and some Arab countries. With Chile's inclusion in MERCOSUR and the subsequent reduction of tariffs, Argentina expects to increase its share of Chilean imports even further. Chile's crude oil refineries include Petrox-Talcahuano (100,640 barrels/day), Con Con (94,350 barrels/day) and ENAP-Gregorio (9,650 barrels/day). The total refinery capacity for crude oil is approximately 204,640 barrels/day.

b. Coal

Chilean coal has been identified as being of poor quality and expensive to extract.

However, the industry has survived due to massive subsidies that were provided to maintain employment in Arauco, located in Region VIII. Today, with national unemployment at a lower level, the government initiated personnel cuts of 50%, equivalent to approximately 6,000 personnel at the technically bankrupt coal company, *Empresa Nacional de Cargo* (ENACAR) in 1992. The result was a decrease in output from 2.58 million tons in 1991 to 1.58 million tons in 1993. Local production costs remain far above international prices, and the Chilean coal output is predicted to decline even more in future years. Coal is mainly imported from South American countries such as Venezuela, Colombia and Peru.

c. Future Perspectives

According to CNE, the future demand for primary energy is expected to increase about 1.7 times the present volume between 1999 and 2008, with a total demand of 250,920 Teracalories and 448,138 Teracalories respectively. The following table shows the projected consumption of primary energy between 1999 and 2008.

Table 12.3.1 Projection of Energy Consumption

Primary Energy	Consumption(teracalories)			Growth rate (1999 - 2008)
	1988	1999	2008	
Crude Oil	53,019	105,877	174,774	5.73%
Natural Gas	12,557	42,351	147,886	14.91%
Carbon	16,743	42,351	17,926	-9.11%
Hydro-electric	32,091	34,410	62,739	6.90%
Others	25,114	39,704	44,814	1.35%
Total Consumption	139,524	264,693	448,138	6.02%

Source: CNE

By utilizing several pipelines in Argentina, the import of natural gas is predicted to increase at nearly 15% per annum. However, coal is projected to decrease to levels registered 10 years ago due primarily to environmental problems.

The import of crude oil will increase at 5.7% per annum, which is comparably lower than the growth rate over the past decade. This is due to the increase in the natural gas supply from Argentina. Since the import of coal represented about 30% of the total import of solid and liquid fuel in 1999, the weighted average growth rate between 1999 and 2008 is calculated to be 1.3 times the present import volume of 3% per annum.

Following the year 2008, the demand for imported coal is assumed to remain constant. This is because some industries and plants may require coal energy given that it is the most economical energy source. Regarding crude oil, the same growth rate is assumed for the future demand projection.

As a consequence, the forecast of the total import of solid and liquid fuel is shown in Table 12.3.2. The import volume of fuel, excluding natural gas, will increase from 11 million tons in 1999 to 14 million tons in 2005 and to 19 million tons in 2012.

Table 12.3.2 Import of Solid and Liquid Fuel

Macro Region	1999	2005	2012
North Zone	4,102,292	4,898,351	6,688,897
Central Zone	7,008,236	8,368,200	11,427,117
South Zone	660,834	789,070	1,077,508
Total	11,771,362	14,055,621	19,193,522

Source: estimated by JICA Study Team

(2) Cereals and Flour Meal, Fruits and Vegetables

Cereals and flour meal, fruits and vegetables are mainly imported for the daily consumption of residents in Chile. For this reason, the import volume in the central zone makes up more than 90% of total imports. Accordingly, the future demand is expected to increase relatively according to population growth.

Therefore, the imports of these products are projected by assuming that they will grow at comparable rates to the population growth rates of the macro-region. Imports will increase by as much as 16% between 1999 and 2012, as shown in Table 12.3.3.

Table 12.3.3 Import of Cereals/Flour meal, Fruits/Vegetables

Zone	Cereals and Flourmeal			Fruits and Vegetables		
	1999	2005	2012	1999	2005	2012
North	96,805	105,227	116,785	9,465	10,288	11,419
Central	2,007,088	2,168,816	2,325,266	247,107	267,019	286,280
South	80,464	85,414	91,576	223	237	254
Total	2,184,357	2,359,457	2,533,627	256,795	277,544	297,953

Source: JICA Study Team

(3) Other Commodities

The demand for other commodities are for production purposes or personal use. For instance, chemical products are mainly used in the mining industry, including copper refining. For this reason, the north zone is the main importing area in Chile. On the other hand, fertilizers are mainly imported in the south zone, which is the main production area for fruits and agricultural products. Textiles and vehicles are used primarily for personal use.

The future perspectives of these commodities will be closely related to the growth of that related sector or per capita GDP. Accordingly, the other commodities are forecasted based on the following assumptions:

- GDP elasticity and the growth rate of the mining sector will be employed to forecast chemical products;
- GDP elasticity and the growth rate of the agricultural sector will be used for fertilizers;
- Per capita growth and elasticity will be used for vehicles;
- For other commodities including manufacturing products, plastic materials and rubber, the manufacturing sector growth rate and elasticity will be used.

As a result, estimations are provided for the imports of other main commodities as shown in Table 12.3.4.

Table 12.3.4 Import of Other Main Commodities

Macro Region	Year	ton			
		Chemical Products	Fertilizers	Textile Materials	Metals & Manufact.
North	1999	630,986	153,111	79,617	84,540
	2005	840,761	224,167	120,657	141,193
	2012	1,799,084	359,257	205,501	271,119
Central	1999	395,729	251,990	131,413	433,665
	2005	412,643	340,110	189,848	682,039
	2012	593,131	502,683	305,909	1,184,194
South	1999	84,299	637,913	2,577	74,560
	2005	94,711	917,902	3,427	107,399
	2012	127,514	1,422,428	5,522	187,931
Total	1999	1,111,014	1,043,014	213,607	592,765
	2005	1,348,116	1,482,179	313,932	930,631
	2012	2,519,729	2,284,369	516,932	1,643,244

Source: JICA Study Team

12.4 Trade with Neighboring Countries

(1) Trade with Argentina

Table 12.4.1 shows commodity volumes exported to and imported from Argentina over the past three years. The export volume has not been significant, ranging from 460,000 to 610,000 tons per annum, while imports have increased from 8 million tons to 18 million tons in three years. The main import commodities are crude petroleum and natural gas together accounting for 72% of total imports in 1997 and 74% in 1999. Both are imported via pipeline transport.

The other commodities are transported by truck across the Andes or by ship via the Magellan Strait. Some is transported by rail though this quantity is relatively low.

Table 12.4.1 Recent Trade with Argentina by Commodity

(1) Export to Argentina					(Metric ton)
	Commodity	1997	1998	1999	Remarks
1	Copper	28,382	37,495	26,096	
2	Cellulose and Paper	29,042	28,020	45,829	by Sea
3	Bags for Iron or steel	10,197	24,978	22,478	
4	Coniferous Chemical Paste	39,128	14,146	36,358	
5	Tomate	15,019	18,242	14,898	
6	Used Paper	0	15,559	14,754	
7	Paper and Carton	8,012	10,076	14,411	
8	Metanol	53,654	77,661	81,171	
9	Fresh Kiwi	15,601	13,253	12,060	
10	Others	313,939	373,271	191,116	
	Total	512,974	612,701	459,171	

(2) Import from Argentina					(Metric ton)
	Commodity	1997	1998	1999	Remarks
1	Crude Petroleum	5,008,257	6,126,091	5,853,279	Pipe line
2	Natural Gas	749,971	1,408,423	2,454,727	Pipe line
3	Corn	617,701	625,604	730,969	by Sea
4	Beef	61,425	36,282	41,165	
5	Sunflower Oil	75,824	69,512	61,787	
6	Gasoline	82,463	135,575	150,574	by Sea
7	Soya Bean Oil	72,682	79,565	64,727	
8	Flour or Pellet of Soya	70,588	88,791	193,138	
9	Rice	32,094	0	67,867	
10	Sugarcane	77,969	0	77,365	
11	Gas Oil	54,044	157,742	117,678	
12	Wheat	0	212,656	125,681	by Sea
13	Cotton	20,736	15,796	11,560	
14	Aluminium Alloy	11,809	12,025	10,143	
15	Polipropilen	13,993	0	20,340	
16	Propane gas	58,757	0	72,576	
17	Food for cats and dogs	0	16,030	16,702	
18	Soya bean	0	0	54,800	
19	Mixed Oil	0	15,673	11,239	
20	Others	996,401	1,125,073	1,069,612	
	Total	8,004,714	10,124,838	11,205,929	

Source: International Trade Statistics of Argentina, 1997, 1998 and 1998

For simplification, trading commodities are divided into five categories: (1) petroleum and petro-products; (2) minerals and mineral products; (3) forestry products; (4) agricultural products; (5) manufacturing products; and (6) others (not following this classification but "others" in Table 5.4.1). To make a viable projection, it is assumed that the volume of imports and exports will grow at rates equal to the value added in the related sector of the exporting country, as shown in Table 12.4.2. (Details of the value added or GDP projections are shown in the appendix).

Table 12.4.2 Future Economic Growth by Sector of Chile and Argentina

Country	Sector	1999-2006	2006-2012
Chile	Agriculture/Forestry/Fishing	6.0	6.0
	Mining	6.5	6.9
	Manufacturing Industry	6.0	7.6
	Services and Others	6.7	7.0
	Total (GDP)	6.4	7.1
Argentina	Agriculture/Forestry/Fishing	3.8	3.9
	Mining	8.3	7.4
	Manufacturing Industry	5.8	6.8
	Services and Others	5.1	6.0
	Total (GDP)	5.3	6.1

Source: JICA Study Team

Forecast results are shown in Table 12.4.3. By 2012, exports will grow 2.3 times the present export volume while imports will increase 2.5 times in the same period. Approximately 30% of total exports will be transported by ship and 70% by truck. In terms of imports, more than 90% of petroleum and gas will be transported by pipeline, while 20% of other commodities will be transported by ship and 80% by truck across the Andes.

Table 12.4.3 Forecast of Trade with Argentina

		(Metric Ton)				
	Commodity	1997	1998	1999	2006	1012
Export to Argentina	Ptro and gas	53,654	77,661	81,171	125,000	188,000
	Mining	28,382	37,495	26,096	40,000	60,000
	Agriculture	69,859	84,493	95,265	142,000	202,000
	Manufacturing	47,140	39,781	65,523	98,000	153,000
	Others	313,939	373,271	191,116	295,000	445,000
	Total	512,974	612,701	459,171	703,000	1,050,000
Import from Argentina	Ptro and gas	5,953,492	7,827,831	8,648,834	15,151,000	23,227,000
	Mining	11,809	12,025	10,143	17,000	27,000
	Agriculture	1,029,019	1,143,879	1,440,298	1,871,000	2,353,000
	Manufacturing	13,993	16,030	37,042	54,000	81,000
	Others	996,401	1,125,073	1,069,612	1,540,000	2,201,000
	Total	8,004,714	10,124,838	11,205,929	18,635,000	27,891,000

Source: Estimated by JICA Study Team

(2) Trade with Bolivia

Table 12.4.4 shows bilateral trade relations between Chile and Bolivia. In general, exports to Bolivia show an increasing tendency for the majority of products with an average annual growth rate of 10 to 12% over the past few years. Main exporting goods from Chile in order of tonnage quantity are mineral products, vegetables, chemical products and paper. The total exporting volume in 1999 was approximately 165,000 tons. However, imports from Bolivia to Chile have decreased over the last two years from 155,000 tons to 72,000 tons. This decrease resulted principally from the reduction in the import of soybeans, replaced by imports from other countries such as Argentina and Paraguay.

Among the trading goods mentioned above, refined petroleum is transported via the pipeline from Bolivia to Chile. Other products are mainly transported by truck via Tambo Quemado or Colchane. Transport by railway is limited to some mineral and chemical products. For future projection purposes, future economic growth rates were realized by assuming that exports and imports will grow at rates equal to the related

sector of that exporting country, such as trade with Argentina. The growth rates of Chile and Bolivia are shown in Table 12.4.5. (Refer to Appendix for more details)

Table 12.4.4 Trade between Chile and Bolivia

1) Export to Bolivia								Unit : ton/yr
Commodity	1992	1993	1994	1995	1996	1997	1998	1999
Vegetables	10,079	17,004	21,952	15,997	22,241	23,814	33,570	32,162
Mineral products	25,183	34,033	21,992	25,796	32,497	31,835	44,986	56,428
Chemical products	9,203	10,561	8,897	9,444	10,167	13,552	18,957	17,226
Papers	8,894	11,314	8,135	9,969	9,810	14,621	15,321	13,790
Other Products	25,319	29,971	33,208	35,455	37,054	38,698	58,056	45,853
Total	78,678	102,883	94,184	96,661	111,769	122,520	170,890	165,459

2) Import from Bolivia								Unit : ton/yr
Commodity	1992	1993	1994	1995	1996	1997	1998	1999
Agricultural	989	430	1,657	1,376	11,546	1,946	2,989	4,196
Mineral products	14,213	4,342	2,284	1,791	2,583	13,296	3,155	401
Processed Soybean	17,292	21,971	52,961	55,420	81,267	107,552	55,705	9,000
Refined Petroleum	87	12	24	1,162	960	1,742	5,923	17,456
Timber products	335	725	860	1,822	3,446	5,058	2,421	1,411
Other Products	10,382	5,367	4,438	6,118	14,623	25,774	20,539	39,275
Total	43,298	32,847	62,224	67,689	114,425	155,368	90,732	71,739

Source: Instituto Nacional de Estadística Bolivia

Table 12.4.5 Future Economic Growth by Sector of Chile and Bolivia

Country	Sector	1999-2006	2007-2012
Chile	Agriculture/Forestry/Fishing	6.0	6.0
	Mining	6.5	6.9
	Manufacturing Industry	6.0	7.6
	Services and Others	6.7	7.0
	Total	6.4	7.1
Bolivia	Agriculture/Forestry/Fishing	3.0	3.0
	Mining	3.5	5.0
	Manufacturing Industry	4.0	4.5
	Services and Others	4.5	5.5
	Total	4.1	5.0

Source: JICA Study Team

As a result, total exports will grow from 165,000 tons in 1999 to 378,000 tons in 2012, a growth of 2.3 times the present volume, as shown in Table 12.4.6. On the other hand, imports in 2012 will account to 1.7 times the existing tonnage. Approximately 10% of total trade will be transported by railway, while the rest will use primarily road transport. In the case of petroleum, however, 90% will be transported by pipeline.

Table 12.4.6 Forecast of Trade with Bolivia

1) Export to Bolivia						ton/yr
Commodity	1992	1995	1999	2006	2012	
Agricultural products	10,079	15,997	32,162	48,000	68,000	
Mining products	25,183	25,796	56,428	88,000	131,000	
Chemical products	9,203	9,444	17,226	26,000	40,000	
Manufacturing products	8,894	9,969	13,790	21,000	32,000	
Other Products	25,319	35,455	45,853	69,000	107,000	
Total	78,678	96,661	165,459	252,000	378,000	

2) Import from Bolivia						ton/yr
Commodity	1992	1995	1999	2006	2012	
Agricultural products	989	1,376	4,196	5,000	6,000	
Mining Products	14,213	1,791	401	500	700	
Refined Petroleum	87	1,162	17,456	22,000	30,000	
Manufacturing products	17,627	57,242	10,411	14,000	18,000	
Other Products	10,382	6,118	39,275	52,000	67,000	
Total	43,298	67,689	71,739	93,500	121,700	

Source: Estimated by JICA Study Team

12.5 Chilean Port Hinterland

(1) General

In order to assess the potential demand of Chilean seaports, their possible hinterland areas are analyzed by comparing transport costs from major cities in the Southern Cone countries. The main purpose of the analysis is to draw a line dividing the continent into two parts: the hinterland of the Pacific ports and that of the Atlantic ports. In other words, from any point on the line, the transport cost to the nearest Pacific port is equal to that of the nearest Atlantic port. The following ports are considered in this analysis.

<u>Ports on the Pacific Coast</u>	<u>Ports on the Atlantic Coast</u>
Camana (in Peru)	Rio de Janeiro (in Brazil)
Iro (in Peru)	Santos (in Brazil)
Arica	Port Alegre (in Brazil)
Iquique	Río Grande (in Brazil)
Antofagasta/Mejillones	Monte Video (in Uruguay)
Coquimbo	Buenos Aires (in Argentina)
Valparaíso	Bahía Blanca (in Argentina)
San Antonio	Rawson (in Argentina)
Ports in Concepción area	Comodoro Rivadavia (in Argentina)
Puerto Montt	

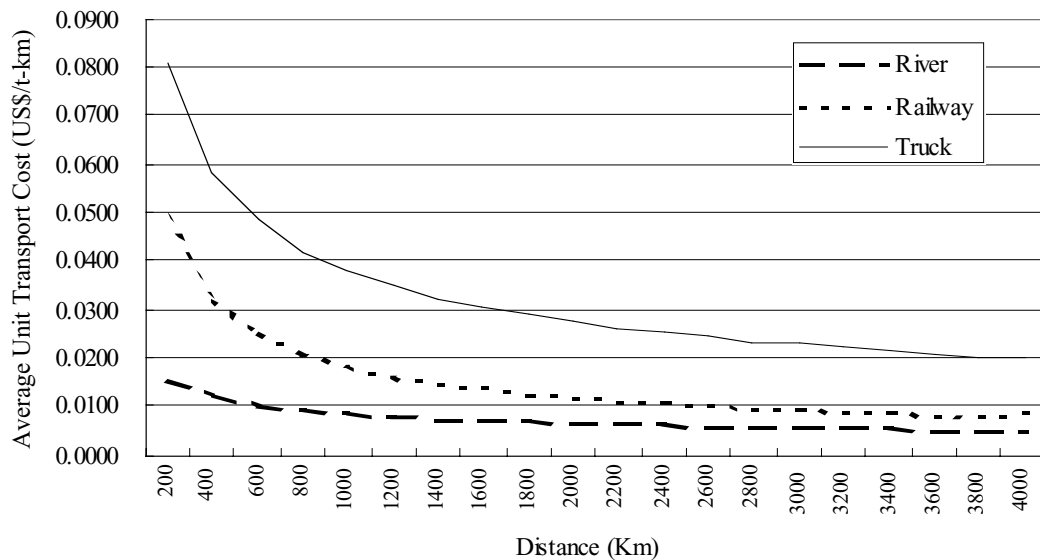
Transportation costs were estimated based on the main transport mode, or truck transport, as well as mixed modes including river transport along the Paraguay and La Plata Rivers. For river transport, the following river ports were added to the network for cost analysis: Puerto Suarez in Bolivia; Concepción and Asunción in Paraguay; and Corrientes/Resistencia, Santa Fe and Rosario in Argentina.

(2) Unit Transport Cost

Between 1998 and 2000, a comprehensive infrastructure survey was conducted, covering Grand North Argentina (Northeast and Northwest Argentina). In this survey, a detailed transport cost analysis was realized by primarily using unit cost data provided by Chile's MIDEPLAN (data that is also used in this analysis).

Figure 12.5.1 illustrates the unit transport cost utilized in the Study mentioned above. The cost is determined by using the average of different types of cargoes including grains, containers and general cargoes. Currently, there are considerable differences between unit costs according to cargo type, though for the purpose of this analysis, these differences are considered irrelevant. In each mode, the unit cost per ton-km decreases as the transport distance increases, especially in a distance of less than 1,000-kilometer. For all transport distances, truck costs are higher than other modes and generally, railway costs are equivalent to 40 – 50% of truck costs and 21 - 25% of river costs.

To transport cargoes from Argentina and Bolivia to Chilean ports, trucks must climb steep slopes in the Andes resulting in higher transport costs. According to data from MIDEPLAN/SECTRA, the unit cost of a vehicle operation ascending a 2% slope is 4 to 5% higher than a 0.5% slope. This is due to the high consumption rate of fuel and tires. (Table 12.5.1) There are many sections in the Andes with gradients higher than 2%. This analysis assumes that transport costs in the Andes Mountains area is 12% greater than other areas.



Source: Elaborated by Study Team with MIDEPLAN, Chile

Figure 12.5.1 Average Unit Cost of Cargo Transport

Table 12.5.1 Vehicle Operating Cost by Gradient

Horizontal Curvature (Degree/km)	Gradient (Meter/Km)	Light Truck (Capacity>6t)			Semi-Trailer			Full Trailer		
		Fuel Cost	Tire Cost	Total Cost	Fuel Cost	Tire Cost	Total Cost	Fuel Cost	Tire Cost	Total Cost
20	5.0	43.6	9.8	186.3	64.9	28.8	311.7	65.5	26.7	327.0
	12.5	44.0	10.3	187.2	66.7	31.2	315.9	67.2	29.1	331.2
	20.0	44.9	11.2	189.0	69.9	35.8	323.8	70.5	33.8	339.1
50	5.0	41.4	9.4	183.7	64.2	28.4	310.6	65.2	26.4	326.5
	12.5	42.0	10.0	184.9	66.3	31.1	315.4	67.3	29.1	331.2
	20.0	43.3	11.1	187.2	69.8	36.1	323.9	70.8	34.1	339.7
90	5.0	38.8	9.0	180.6	64.7	28.4	311.1	66.0	26.4	327.3
	12.5	39.7	9.6	182.2	66.9	31.2	316.2	68.2	29.3	332.3
	20.0	41.5	10.9	185.2	70.4	36.5	324.9	71.7	34.5	341.1
150	5.0	36.3	8.5	177.7	66.1	28.7	312.9	67.6	26.8	329.2
	12.5	37.5	9.3	179.7	68.3	31.7	318.0	69.7	29.8	334.4
	20.0	39.8	10.7	183.3	71.6	37.3	326.9	73.1	35.3	343.2

Source: Analisis Desarrollo Evaluación Sistema de Transporte Interurbano, IX Stage, SECTRA-MIDIPLAN

Transshipment costs for various modes, as estimated by MIDEPLAN, are summarized in Table 12.5.2. When river transport is taken into account the transshipment cost is added to the total cost.

(3) Potential Hinterlands of Chilean Ports

Based on the unit costs and assumptions demonstrated above, the median points in terms of transport costs are identified on several representative bi-oceanic corridors. By connecting these points, a watershed line compared to transport costs was drawn to divide the South Cone countries into two areas influenced by the Pacific and the Atlantic ports as shown in Figure 12.5.2.

Table 12.5.2 Unit Cost of Inter-modal Transshipment

(US\$/ton)

Mode	Bulk (Grain)	General Cargo	Container	Average
Truck / Railway	1.50	3.00	2.25	2.25
Raiway / River	2.10	4.20	3.15	3.15
Truck / River	1.80	3.60	2.70	2.70
Truck / Marine	3.00	6.00	4.50	4.50
Railway / Marine	3.30	6.60	4.95	4.95
River / Marine	3.60	7.20	5.40	5.40

Source: MIDEPLAN

The line runs 120 km south of Santa Cruz in Bolivia, continuing southward while grazing the eastern border of Paraguay, passing diagonally from the northeast to the southeast edge of Santiago del Estero Province in Argentina, changing course to the south-southwest, continuing 50 km west of San Luis, reaching the western foot of the Andes near Zapata City in Neuquen Province and finally continuing south along the Andes.

Roughly speaking, the potential hinterlands of Chilean seaports includes the most economically active part of Bolivia, the Northwest Region (NOA), the Central East Region (CUYO) the western part of the Southwest Region and the Austral of Argentina.

As seen in Figure 12.5.1, river transport is more economical than truck transport. If one considers the use of the Paraguay River, the line is shifted westward by 100 to 300 km (shown in a broken line), and the Bolivian area east of Santa Cruz and the Argentine area east of such cities as Salta, Jujuy and Tucuman will be incorporated into the hinterlands of the Atlantic ports. Although river transport is economical in terms of tariffs, it takes generally three to five times longer than truck transport. For this reason, river transport is used seldom with the exception of bulk cargoes such as grains and minerals in Argentina or some containers from/to Bolivia and Paraguay. The hinterland would vary, strictly speaking, according to origin and destination of those countries utilizing marine transport. However, the difference in marine transport costs according to distance is not significant suggesting that the hinterland area will not be greatly affected.

To understand the economic magnitude of the hinterland of Chilean ports in Bolivia and Argentina, their population and GDP are compared with those of Chile in Table 12.5.3. Total population of Bolivia, NOA and NEA is almost equal to that of Chile, while GDP of those regions is equivalent to 45% of the GDP of Chile. It is worth noting that if all trade activity in the hinterlands were done through Chilean ports, throughput would equal more than double its current amount.

Table 12.5.3 Population and GDP of the Hinterlands of Chilean Port

Country	Region	Population(1000)			GDP(Million US\$)			
		1998(*)	2006	2012	1998(*)	2006	2012	
1	Chile	14,822	16,307	17,372	78,025	119,494	179,834	
2	Argentina	NOA	4,095	4,679	5,049	11,920	18,974	27,067
3		CUYO	2,452	2,737	2,907	14,776	23,519	33,552
4	Bolivia	7,957	9,458	10,614	8,558	11,831	15,839	
5	Subtotal(2-4)		14,504	16,874	18,570	35,254	54,324	76,458

Note: GDP of Argentina is the value in 1997

Source: World Bank, Federal Investment Committee of Argentina, JICA Study Team

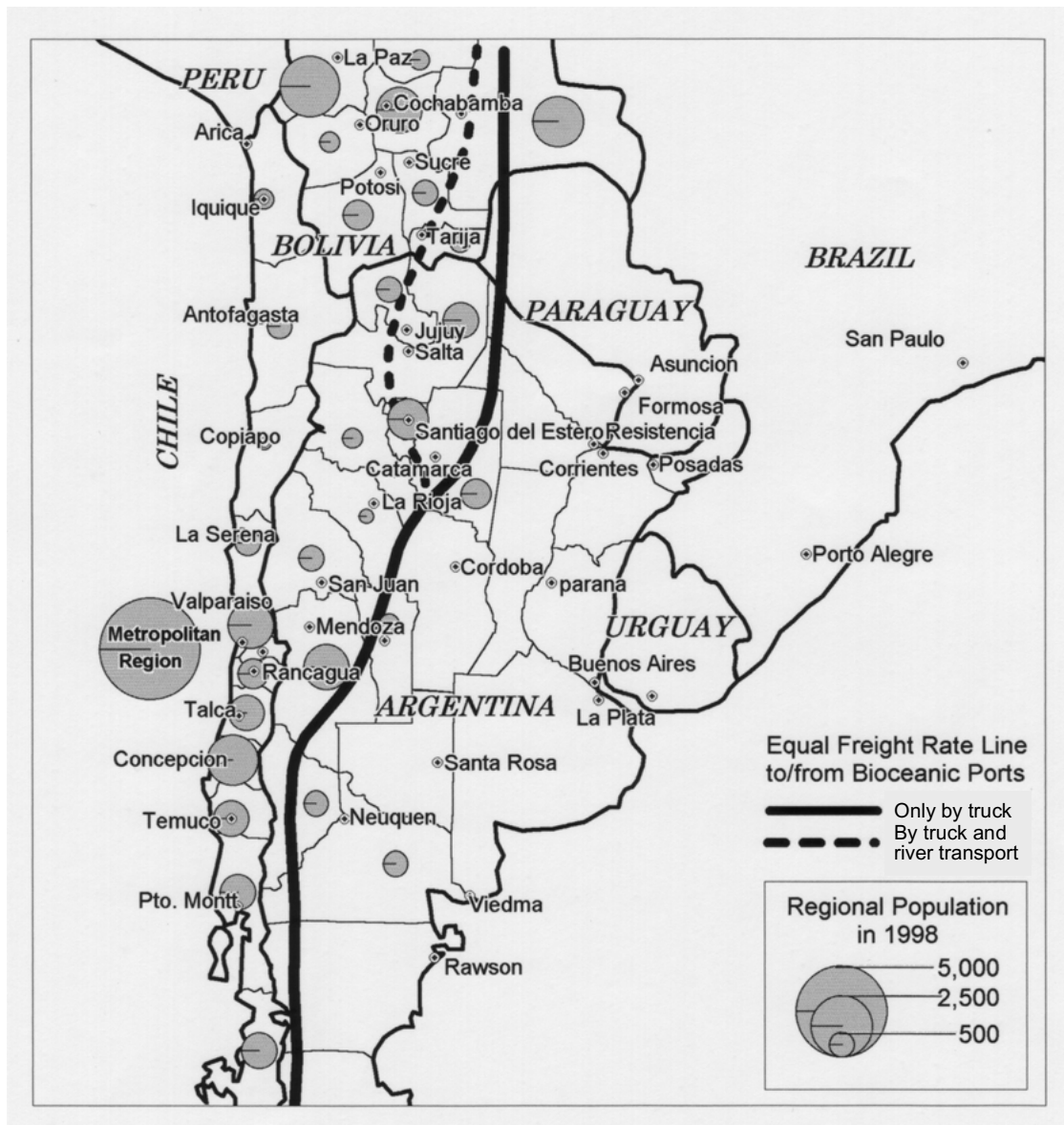


Figure 12.5.2 Potential Hinterlands of Chilean Ports

Source: JICA Study Team

12.6 Transit Cargoes from/to Neighboring Countries

(1) Argentina

The previous section suggests the high possibility that the Chilean port hinterland could expand to the Northwest (NOA) and Central West Regions (CUYO) of Argentina. Based on a possible scenario regarding future production and consumption of export commodities in these regions, transit cargoes exported to or imported from third countries via Chilean ports are expected to give a quantitative basis to plan the functioning of the Chilean gateway.

a. Present Situation of Transit Cargoes

At present, transit cargoes from Argentina via Chile are not significant in volume as shown in Table 12.6.1, though recently there has been an increase. In 1999, total exports were 123,000 tons while imports were 43,000 tons. These were mostly transported over the Andes by truck, however, some were transported by rail on the Salta – Socompa Line operated by Belgrano Railway in the Northwest. Railway transported commodities include borax and lithium chloride for export and nitrate and fertilizer for import.

Export commodities via Chile vary greatly while quantities are minimal. For example, total volume of the four principal commodities accounts for only 25% of total exports. In the case of Antofagasta, however, the trade structure is much simpler; mineral products are for export while chemical products (fertilizers) are for import. In contrast, dominant import commodities via Chile include fruits/vegetables and metal manufacturing products, representing 63% of the total.

Approximately 60% of transit cargoes arrive to the Port of San Antonio rather than the Port of Valparaíso. This is because the port conditions of San Antonio are quite superior as well as the road between Los Andes and San Antonio is of good quality.

Table 12.6.1 Transit Cargoes of Chilean Ports from/to Argentina as of 1999

(Unit:ton/year)

		Antofagasta	Valparaiso	San Antonnio	Total
Export from Argentina	Fruits and Vegetables		2,291	7,707	9,998
	Fishmeal		4,623	401	5,024
	Minerals	8,991		42	9,033
	Paper		6,280	95	6,375
	Others	693	14,507	77,185	92,385
	Total	9,684	27,701	85,430	122,815
Import to Argentina	Fruits and Vegetables		3,061	11,798	14,859
	Cereal and Flour		116	335	451
	Chemical Products	2,000	646		2,646
	Metal Manufacturing		2,641	9,634	12,275
	Vehicle		568	72	640
	Others	355	11,645	15,081	27,081
	Total	2,355	18,677	36,920	57,952

Source: Port Statistics,1999, EMPORCHI

b. Export Perspectives

Export levels from the Northwest Region (NOA) and the Central West Region (CUYO)

in Argentina were equivalent in the mid-90s. Thereafter, however, these have been rapidly growing at 25% per annum in NOA and 18% per annum in CUYO (Table 12.6.2).

Principal export commodities are agricultural products such as fruits (grapes, citrus, melon), tobacco, sugar and vegetables (onions and garlic), and primary products (mainly minerals). Agricultural products are mostly destined to neighboring countries, especially Brazil. Natural gas produced in Salta and oil/gas produced in Mendoza are exported to Chile.

Among agricultural products, citrus, grapes and derivatives, and wine have potential to be competitive in the markets of the western coast of the US and Asia. Citrus fruits produced in NOA are free from plant disease in Argentina. Their exports will grow at a moderate rate of 3 to 5% per annum.

Table 12.6.2 Export of the Northwest and the Central West Region in Argentina

(1) Export: 1994-1998

(Million of US\$ FOB)

		1994	1995	1996	1997	1998
NOA	Jujuy	70.7	107.1	148.6	156.5	119.9
	Salta	228.5	303.7	363.1	421.2	408.5
	Tucuman	223.7	387.4	362.5	416.6	383.4
	Santiago del Estero	62.0	133.5	174.0	142.9	143.1
	Catamarca	25.0	18.4	21.6	96.1	490.3
	La Rioja	69.9	136.0	114.3	145.6	124.6
	Subtotal	679.8	1086.1	1184.1	1378.9	1669.8
CUYO	San Juan	46.1	85.5	110.5	136.6	138.8
	San Luis	111.4	203.3	238.4	281.0	314.4
	Mendoza	460.5	728.2	657.0	867.7	759.0
	Subtotal	618.0	1017.0	1005.9	1285.3	1212.2

Source: Statistical Yearbook, INDEC

(2) Export by Commodity Group, 1998

(Million of US\$ FOB)

		Primary	Agriculture	Industrial	Fuel	Total
NOA	Jujuy	93.7	18.2	7.2	0.0	119.9
	Salta	258.4	31.5	41.8	76.7	408.5
	Tucuman	127.3	106.8	147.1	2.2	383.4
	Santiago del Estero	140.5	0.6	2.0	0.0	143.1
	Catamarca	462.0	10.1	18.2	0.0	490.3
	La Rioja	0.9	89.0	34.8	0.0	124.6
	Subtotal	1082.8	256.2	251.1	78.9	1669.8
CUYO	San Juan	35.5	47.7	55.5	0.1	138.8
	San Luis	16.6	171.5	126.3	0.0	314.4
	Mendoza	165.5	258.0	34.8	190.6	759.0
	Subtotal	217.6	477.2	216.6	190.7	1212.2

Source: Statistical Yearbook, INDEC

On the other hand, mineral products will show significant growth while the majority will be exploited and processed in the Andean regions far from the Atlantic coast. In the next decade, Argentine mineral products (in terms of weight) will have an overwhelming share of transit cargoes via Chile.

Since the mid-1990s, the Andean areas in Argentina have experienced a boom in exploration activities and investments in mineral resources. Table 12.6.3 highlights the main mines where exploitation activities have commenced or investments are on hold. The Subsecretaria de Minería in Argentina made a forecast regarding future production of metallic minerals. Two projections were realized: one is based on past investments made in the late 90s, and the other considers the investment plans of the main mining companies (Figure 12.6.1).

Table 12.6.3 Development of Metallic Mineral Mines in Argentina

Mine	Location	Kind of Metal	Deposit / Performance
1 Bajo de la Alumbreira	Farallon Negro, Catamarca Prov.	Gold, Copper, iron	Plan of Au(640,000 oz), Co(180,000 t) for 2000
2 Cerro Vanguardia	North of Santa Cruz Prov.	Gold, Silver	Operation started in 1999, Au(6t), Ag(60t) for 15 years
3 Mina Aguilar	Northeast of Jujuy Prov.	Lead, Zinc, Silver	Deposit of 40 million t. with 12% of Pb+Zn & 150gr/t of Ag
4 Valadero	Cura Valley, San Juan Prov.	Gold, Silver	Deposit of 4 million oz of gold equiv. (Au+Ag)
5 Lama	On the border with Chile	Various	under survey
6 Pirquitas	Altiplano of Jujuy Province	Silver	Doposit of 15.5 million t. with Ag(199g/t+96millionoz.)
7 El Pachon	150km of Calingasta, San Juan	Copper, Molybdenum	Deposit of 4.5 million t. with 0.5 - 0.6% Cu+0.014% Mo
8 Diablillos	200km southeast of Salta	Copper, Gold, Silver	Doposit of 30 million t. with Au(0.3 gr/t) +Ag(110gr/t)
9 San Jorge	90km northeast of Mendoza	Copper, Gold, Silver	Doposit of 146 million t. with Cu(0.5%) +Au(0.25gr/t)
10 Agua Rica	North of Andalgala, Catamarca	Copper, Gold, Mo	Deposit of 2600 million t. with Cu(0.4 - 1.3%)+Au(0.2 -0.3g/t)
11 Sierra Grande	North of Rio Negro	Iron	F/S by JICA

Source: Directorio de Empresas Mineras Argentinas, Feb.2000, Rojas & Asociados

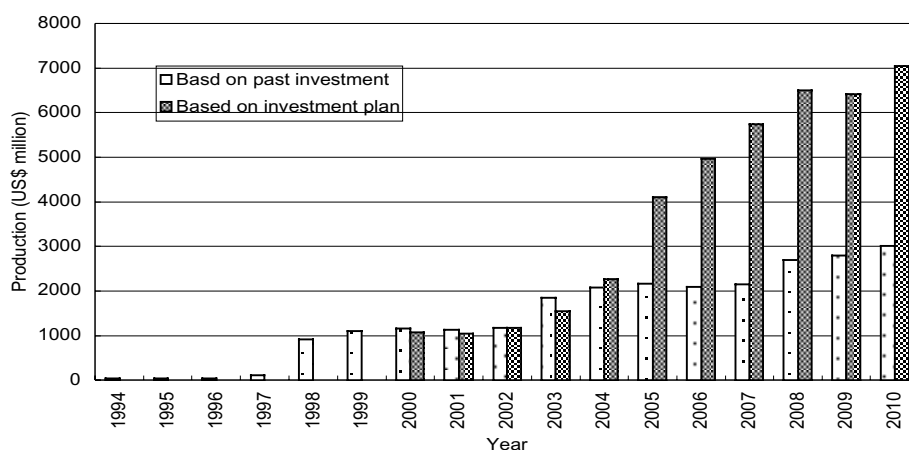


Figure 12.6.1 Forecast of Mineral Production in Argentina

Source: Elaborated by JICA Study Team based on data of Subsecretaria de Minería, Argentina

According to these projections, in the first case, production will increase by about three times the present level. In the latter case, production will increase by six times in terms of value by the year 2010. Mineral products include copper, gold, silver, molybdenum, lead and zinc, of which copper will have the greatest impact on transportation infrastructure. As these resources are developed, transit cargoes will also grow at approximately the same rate.

Similar to metallic minerals, high growth is expected of non-metallic mineral resources such as limestone for cement, lithium, potassium, bentonite, clay, borax, marble and gypsum. However, most of these will be domestically consumed or exported to neighboring countries. One exception is borax which is exported to Japan, the EU and other countries, as production of this mineral is limited to only three other countries including Turkey, the US and Argentina.

c. Import Perspectives

As shown in Table 12.6.1, import transit cargoes represent one third of total exports, in terms of volume. Growth will be rather modest because imported consumption goods will be transported primarily from Buenos Aires to the NOA and CUYO regions, as currently is the case. Importation via Chile will be limited to certain selected commodities such as transport cost sensitive ones including mining equipment and vehicles, and time sensitive ones including fruits. Therefore, the growth rate of transit cargoes will be equivalent to regional growth of GDP, at most.

d. Projection of Transit Cargoes from/to Argentina

Based on the information mentioned above, future transit cargoes via Chilean ports are predicted as shown in Table 12.6.4. Some mineral products will be transported to Chile in mineral ore or concentration form to be processed before export, classified as export to Chile. The projections are determined due to the following assumptions:

- Mineral product exports will grow at the projected rate as shown in Figure 12.6.1 (higher case inclusive of future investment).
- Mineral product exports from CUYO will be about one third of NOA exports in 2006.
- The export of agricultural and manufacturing products will grow at the same growth rate as regional GDP of the respective sector.
- Mineral product imports will grow at the same growth rate as regional GDP in the manufacturing sector.
- The import of agricultural and manufacturing products will grow at the same growth rate as GDP of the respective region.

Table 12.6.4 Forecast of Transit Cargoes from Argentina via Chilean Port

(Unit:ton/year)

Region		Commodity	1999	2006	2012
Export from Argentina	NOA	Mineral Product	8,991	40,236	57,235
		Agriculture	208	241	288
		Manufacturing	485	574	769
		Subtotal	9,684	41,051	58,292
	CUYO	Mineral Product	42	12,071	17,171
		Agriculture	42,530	55,966	70,815
		Manufacturing	70,559	93,744	125,626
		Subtotal	113,131	161,781	213,612
	Total	Subtotal	122,815	202,832	271,904
	Import to Argentina	NOA	Mineral Product	36	42
Agriculture			107	143	198
Manufacturing			2,213	2,970	4,121
Subtotal			2,355	3,155	4,375
CUYO		Mineral Product	2,673	3,551	4,758
		Agriculture	23,328	32,466	44,912
		Manufacturing	29,597	41,191	56,981
		Subtotal	55,597	77,208	106,651
Total		Subtotal	57,952	80,362	111,027

Note: Fuels are omitted because they are mostly transported by pipeline

Source: JICA Study Team

(2) Bolivia

a. Present Situation

Regarding Bolivia, transit cargoes are more important than bi-lateral trade with Chile in terms of tonnage. The ports of Arica and Antofagasta handle the majority of Bolivian

transit cargo. As shown in Table 12.6.5, major exporting products through these two ports in terms of tonnage are mineral products, timber and processed soybeans, with tonnage reaching about 380,000, 18,000 and 220,000 in 1999 respectively. Among these, mineral products are the most important for gaining foreign currencies, representing more than half of total exports in terms of total weight. The main mining production area is concentrated in Potosi and Oruro. This entails that currently all products are exported through either Arica or Antofagasta with destination to England, the US and Asia.

Between 1991 and 1999, total transit cargo for export increased by as much as 80%, while the growth of mineral products increased slightly. Processed soybeans, for example, showed a significant increase, reflecting rapid growth in the cropping area. On the other hand, timber products decreased by less than half, due mainly to policy changes based on environmental laws implemented by the Bolivian Government, as described ahead.

Total transit cargo for import has remained at basically the same level during the said period: 350,000 to 370,000 tons per year. The main importing goods are cereal (mostly wheat), manufacturing and chemical products. The decrease in vehicles can be explained by new government policies prohibiting the import of used cars. Furthermore, cereal goods have decreased while import transit as a whole shows an increasing trend in terms of variety, particularly for various manufacturing products.

Table 12.6.5 Bolivian Transit Cargo through Chilean Ports

Export from Bolivia Commodities	1991			1999		
	Arica	Antofagasta	Total	Arica	Antofagasta	Total
Fruits/Vegetables				20		20
Salt				60		60
Minerals	173,083	131,313	304,396	150,216	228,082	378,298
Nitrate/Fertilizer		4,617	4,617		1,025	1,025
Wood	38,757		38,757	15,977		18,185
Processed soybean	16,462		16,462	219,429		219,429
Agroproducts	9,265		9,265	16,273		16,273
Industrial prod.	478		478	19,423		19,423
Others	18,971	4,077	23,048	64,753	1,702	66,455
Total	257,016	140,007	397,023	486,151	230,809	719,178
Improt to Bolivia Commodities	1991			1999		
	Arica	Antofagasta	Total	Arica	Antofagasta	Total
Fruits/Vegetables				77		77
Cereal/Flourmeal	120,987	78,837	199,824	117,413	30,000	147,413
Solid/liquid Fuel				77		77
Chemical Prod.(Bulk)				32,134		32,134
Metal/Manufacturing	35,929		35,929	77,386		77,386
Vehicles	15,140		15,140	3,046		3,046
Others	67,366	30,396	97,762	110,116	3,748	113,864
Total	239,422	109,233	348,655	340,249	33,748	373,997

Source: Port Statistics, EMPORCHI

b. Future perspectives

The production of main commodities is shown in Table 12.6.6. Regarding mineral products, the past production trend shows only a slight increase. However, there are several new exploration projects, particularly a large, costly mining project made by a US company in San Cristobal, located in the Uyuni area. Here, large quantities of zinc, lead and silver are expected.

Table 12.6.6 Production of Main Transit Cargo in Bolivia

Commodity	Unit: ton/yr								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
Zinc	129,777	143,936	122,638	100,741	146,131	145,092	154,491	152,110	146,144
Lead	20,810	20,010	21,220	19,678	20,387	16,538	18,608	13,848	10,152
Tin	16,829	16,516	18,634	16,026	14,419	14,802	12,898	11,308	12,417
Sugar cane	3,880,186	3,408,106	2,954,243	3,368,295	3,898,760	4,263,629	3,927,832	3,445,583	3,358,495
Soybean	393,618	342,463	491,451	708,968	870,074	867,488	1,040,365	1,151,626	800,812

Source: Instituto Nacional de Estadística Bolivia

According to the *Viceministro de Minería de Bolivia* (Bolivia's Deputy Mining Minister), the future production of tin will remain at equivalent levels, however zinc and lead will increase to 300,000 and 18,000 ton/yr respectively in 2005. Between 2006 and 2012, it is expected to grow at a growth rate similar to Bolivia's mining sector. Hence, total exporting transit in the mining sector is expected to increase from 378,000 tons in 1999 to 558,000 tons in 2006 and 748,000 tons in 2012.

Forest production in Bolivia has experienced a drastic decrease due to the introduction of a new environmental law in 1997 concerning forestry protection. The production area has sharply dropped from 22 million ha in 1996 to approximately 5 million ha in 1997. There has been an obvious decrease in production and exports since then. Total production in 1999 was about 600,000 m³, of which 12% was exported mainly to European and North American countries through Arica and Buenos Aires. To increase the export of forestry products under the new policy, the Bolivian government has introduced new strategies such as the promotion of forest plantations, enhancing the value of production by certifying products, increasing the producing forest area, etc.

According to the *Cámara Forestal de Bolivia* (Bolivia's Forestry Chamber), the export of forestry products has a potential to increase from US\$109 million in 1999 to US\$400 million in 2005 and to US\$1,000 million in 2010 or 2015. However, such a high increase cannot be expected for exports in terms of tonnage. Rather, it is assumed to grow at the same rate as the past growth in the forestry sector in Bolivia.

Regarding soybeans, the increase in production in the past decade is mainly attributed to the expansion of the harvest area. There are, in fact, many land areas to expand, particularly in the northeast part of Santa Cruz. This will only be beneficial, however, if infrastructure is developed that is equivalent to international standards. Most of the soybeans are exported through Rosario, while only 20 to 30% are exported via the Pacific coast, principally the Port of Arica. Since the main exporting market is the north part of South America such as Colombia and Venezuela, there is a possibility to increase exports through Arica if transport costs decrease. This may be achieved by improving the transport system particularly in the section between Santa Cruz and Oruro and the feeder transport system in the Santa Cruz region.

To estimate the future export volume of soybeans, GRP elasticity between 1991 and 1999 was employed. Likewise, the GRP elasticity was used for the projection of other manufacturing products.

Regarding transit cargo for import, growth between 1991 and 1999 was much less compared with transit cargo for export. This is because the main importing cargoes are daily consumption goods related to the growth in population, a figure that is much lower

than economic growth. As a result, total imports in 1999 was only about half of exporting cargo.

Future growth is also likely to be modest since a drastic population change is not anticipated. Accordingly, it is assumed that consumption goods will grow at the same rate as the population growth rate. It is also assumed that manufacturing goods will grow in correlation with GDP in the corresponding sector, taking into account the GDP elasticity in past years.

As a result, Bolivian transit cargo estimates are shown in Table 12.6.7.

Table 12.6.7 Bolivian Transit Cargo through Chilean Ports

		(unit:ton/yr)		
Commodity		1999	2006	2012
Exporting Transit from Bolivia	Mineral products	378,685	558,605	748,810
	Forestry products	18,603	23,060	27,836
	Soya	219,429	322,176	447,778
	Agricultural products	16,293	23,917	33,238
	Industrial products	20,030	33,173	54,139
	Others	66,455	112,027	191,661
Total		719,495	1,072,957	1,503,461
Importing Transit to Bolivia	Cereal/Flourmeal	147,413	171,669	192,193
	Chemical products	32,134	44,031	64,520
	Manufacturing	80,432	115,198	162,875
	Others	114,018	164,935	241,294
	Total	373,997	495,834	660,882

Source: JICA Study Team

(3) Mato Grosso

a. Present Condition

The Mato Grosso area in Brazil should be recognized as providing potential transit cargo for Chilean ports due to the large quantity of products for export in this area. The major export commodities are agro-industrial products such as processed soybeans, sugar, meat and processed wood products. Although major destination countries are in Europe and the US, trade with Asian countries has increased in recent years. Transit cargo from the Mato Grosso area is mostly transported through the Santos or Paranagua Ports in Brazil irrespective of the destination country. For this reason, transit cargo through Chilean ports is negligibly small at present. The production of the main exporting goods in Mato Grosso is shown in Table 12.6.8.

Table 12.6.8 Production of Main Products in Mato Grosso

Products	1990	1998	1999
Soybean (1000ton)	3,065	7,102	7,466
Sugar cane (1000ton)	3,468	1,071	1,038
Corn (1000ton)	619	1,138	1,454
Cotton (1000ton)	56	254	558
Cattles (1000 head)	9,041	16,914	17,142
Chicken (1000 head)	6,675	11,409	16,352
Timber (1000m3)	n.a.	n.a.	4,000

Source: IBGE

There is a possibility to export these products through Chilean Ports if transport costs

are reduced. This may be achieved by improving the transport system between Mato Grosso and Chilean ports, particularly the Mato Grosso - Santa Cruz section where the conditions of transport facilities from Mato Grosso to Brazilian ports are unsatisfactory. Exports from Mato Grosso according to destination for the three principal products in 2000 are shown in Table 12.6.9 – Table 12.6.11. It should be noted that East Asia consists of Japan, China, Korea, Taiwan and Hong Kong.

Table 12.6.9 Export of Soybean from Mato Grosso Including Processed Soybean

Destination	1000US\$	ton	%
America	35,208	218,474	4.9%
East Asia	93,962	478,517	10.7%
West Asia	35,663	138,268	3.1%
Europe	684,492	3,632,757	81.2%
Africa	2,548	8,259	0.2%
Total	851,873	4,476,276	100.0%

Source: MDIC/SECEX/DECEX/GEREST

Note: East Asia: Japan, China, Korea, Taiwan

Table 12.6.10 Export of Wood Products from Mato Grosso

Destination	1000US\$	ton	%
South America	10,343	21,901	15.9%
Central America	3,705	6,519	4.7%
North America	8,290	13,712	9.9%
East Asia	9,628	15,184	11.0%
West Asia	579	1,199	0.9%
Europe	40,384	79,026	57.2%
Others	229	600	0.4%
Total	73,156	138,140	100.0%

Source: MDIC/SECEX/DECEX/GEREST

Table 12.6.11 Export of Cattle Meat from Mato Grosso

Destination	1000US\$	ton	%
South America	2,340	1,367	4.6%
Central America	37	50	0.2%
North America	1,525	536	1.8%
East Asia	12,635	10,262	34.4%
West Asia	3,652	1,530	5.1%
Europe	50,749	15,257	51.2%
Others	1,320	799	2.7%
Total	72,258	29,800	100.0%

Source: MDIC/SECEX/DECEX/GEREST

Regarding transit goods for import through Chilean ports, some manufacturing products and processed foods have been recorded reaching 20,000 to 30,000 tons per year.

b. Future Perspectives

Based on the above information, estimations regarding future transit cargo through Chilean ports have been made. Since the flow of transit cargo today is extremely low, the estimation should be regarded only as a potential demand assuming that transport costs will be reduced by improving the transport system from Mato Grosso to Chilean ports. The projection was made on the basis of the following assumptions.

- Considering past trends, the future productions of the above commodities, such as soya or other agricultural products, meat and wood, are assumed to grow at 7%, 5% and 3% per annum respectively.
- Transit cargo through Chilean ports will be limited to only that cargo with destination to East Asia.
- Considering economies of scale of the ports on the Atlantic coast, transit through Chilean ports will only account for half of total exports to East Asia, at most.
- Transit demand for imports, such as manufacturing products and processed food, will grow at the same rate as GDP.

As a result, potential transit cargo related to the Mato Grosso area is projected to be approximately 650,000 tons in 2012 as shown in Table 12.6.12.

Table 12.6.12 Potential Transit Cargo through Chilean Ports

	Commodity	1999	2006	2012
Export	Soybean/agricultural	n.a.	384	577
	Wood products	n.a.	9	11
	Cattle meat	n.a.	7	10
	Total	n.a.	401	597
Import	Manufacturing products	23	29	37
	Food processing products	1	1	2
	Others	5	6	8
	Total	29	37	47

Source: JICA Study Team

12.7 Total International Cargo Movements and Need for Capacity Expansion

12.7.1 International Cargo Movements

The total volumes of international cargo movements in terms of tonnage today as well as in 2012 are illustrated in Figure 12.7.1 and Figure 12.7.2 respectively. Due to changes in the demarcation of the macro-regions, in addition to misunderstandings regarding statistics, there are some discrepancies from the last Progress Report regarding trade volumes.

In 1999, the greatest volumes of imports are observed in the central zone, while the north zone holds the largest share of exports. Referring to the north zone, the concentration of mineral products accounts for the greatest tonnage among products for export. The principal commodities for import such as liquid or solid fuel and various manufacturing products are mainly utilized in the central zone. In addition to bi-lateral trade with Argentina accounting for approximately 2.5 million tons, there exists transit cargo of about 250,000 tons from/to Argentina. Included in this figure is cargo from/to Brazil and Paraguay transported through Chilean ports. A higher volume of transit cargo is found in the north zone where Bolivian cargoes of about 1.1 million tons are exported/imported through Chilean ports.

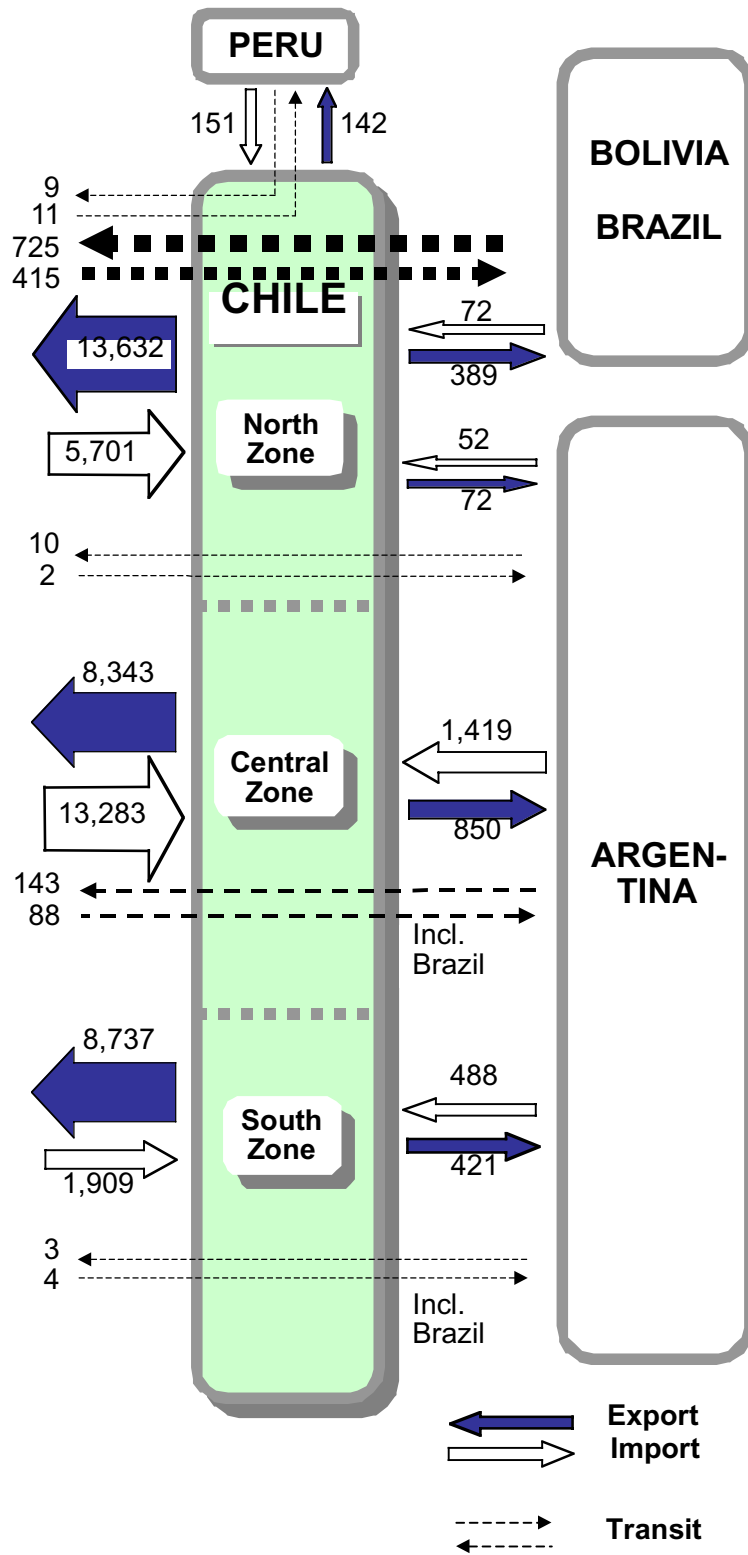
As for the demand in 2012, international cargo will grow more or less double the present total volume. (Refer to Table 12.7.1) The greatest quantities of cargo for export will continuously be found in the north zone owing to further expansion of the mining sector. However, increased growth of exports is anticipated in the central and south zones. The central zone may experience a change from traditional to more diversified products, while further expansion of methanol production can be expected in the south zone using the ample natural gas supply from Argentina.

Table 12.7.1 Projection of Chilean Port Cargo

	1000 ton					
	Exporting Cargo		Importing Cargo		Total	
	1999	2012	1999	2012	1999	2012
Chilean cargo through ports	30,712	60,663	20,893	39,841	51,605	100,504
Transit Cargo through Chilean ports	890	2,453	520	917	1,410	3,370
Total	31,602	63,116	21,413	40,758	53,015	103,874

Source: JICA Study Team

Regarding transit cargo through Chilean ports, it is expected to grow from 1.4 million tons in 1999 to 3.4 million tons in 2012. This estimation includes potential exports that may be expected as the result of improvements in the Trans-Andes routes and investments directed towards multiple industrial sectors particularly near the Andes. This estimation also includes transit cargo from/to Matto Grosso, which is a negligibly small amount at present. Transit cargo in the north zone is expected to grow from 1.2 million tons in 1999 to 2.9 million tons in 2012, which is about six times greater than the flow of transit in other parts of the country. In this sense, the Chilean ports in the northern zone may have greater potential to act as a major gateway.



Unit: 1000 ton/year

Figure 12.7.1 International Cargo Movements in 1999

Source: Cámara Marítima y Portuaria de Chile A.G., Aduana in Valparaíso, Tráfico Terrestre Avanzadas Fronterizas

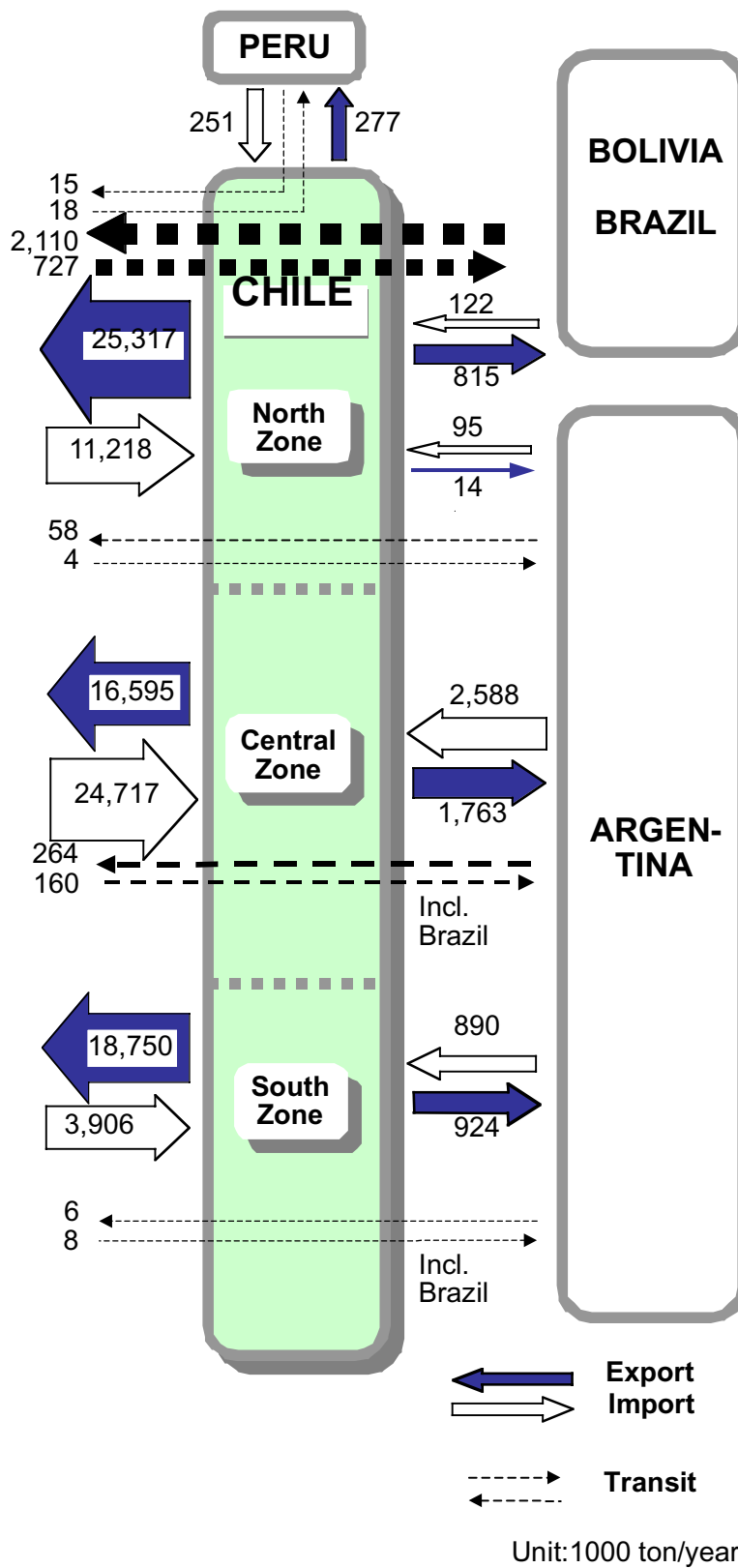


Figure 12.7.2 International Cargo Movements in 2012

Source: Cámara Marítima y Portuaria de Chile A.G., Aduana in Valparaíso, Tráfico Terrestre Avanzadas Fronterizas

Table 12.7.2 Projection of Trans-Andes Cargo

	Exporting Cargo		Importing Cargo		Total	
	1999	2012	1999	2012	1999	2012
Bi-lateral Trade	1,732	3,644	2,031	3,695	3,763	7,339
Transit Cargo through Chilean ports	881	2,438	509	899	1,390	3,337
Total	2,613	6,082	2,540	4,594	5,153	10,676

Note: excluding the trade with Peru

Source: JICA Study Team

12.7.2 Need to Expand Capacity

(1) Port Capacity

Future transport cargo through Chilean ports is projected to be approximately double the current volume. In order to accommodate this demand, port facilities must be improved. In addition to the major ports administrated by Empresa Portuaria, there are many public and private ports in all of the three zones. Based on the assumption that those ports will be expanded according to the growth in handling volume, only the capacities of major ports will be examined in this Report. The following table shows present port capacity and the forecasted demand to be handled at the major ports. Therefore, the future demand of the major ports (sub-total of each zone) should be regarded as the minimum requirement, since the development of the other ports may have some difficulties in financing. Under extreme circumstances, the incremental volumes could be handled at only the major ports in the corresponding zone.

It can be said that future demand will exceed present port capacity in every zone. In the north zone, the new Mejillones Port is to be constructed with an annual handling capacity of 3.5 million tons in the first phase. The Port of Iquique is in the process of expanding its handling capacity through the improvement of facilities and equipment by means of the concession scheme. Arica Port must also be improved since it is the natural exit/entrance way for transit cargo from Bolivia and Mato Grosso, predicted as most likely being two high demand areas.

In the central zone, the Valparaíso and San Antonio Ports began their concession schemes during the period 1999 - 2000. According to the *Empresa Portuaria*, the handling capacity of Valparaíso has already expanded to 7.3 million tons/yr by attaining a higher handling efficiency of about 180 tons/hr. However, according to the estimations regarding future demand, it is apparent that further port capacity expansion will be required for the Ports of Valparaíso and San Antonio. This is due principally because they will have to accommodate the majority of transport demand in the central zone. When considering the incremental amount, the handling capacities of both ports should expand to almost double the present capacity by the year 2012.

In the south zone, the Port of San Vicente will be improved in terms of facilities and handling efficiency through the concession scheme initiated in the year 2000. The annual handling capacity is then expected to increase to nearly 10 million tons. Since the current handling systems of most ports in the south zone are not suitable to manage the increasing demand in container cargo, improvements in this regard will be necessary.

Table 12.7.3 Port Capacity and Projected Future Cargo

Name of Port	1999				2012
	Total Cargo (ton)	No. of Berth	Port Efficiency (ton/hr)	Handling Capacity (ton/yr)	Total Cargo (ton)
1 Arica	1,355,880	6	68	2,000,000	
2 Iquique	985,918	6	51	1,500,000	
3 Antofagasta	2,702,826	7	145	5,000,000	
sub-total	5,044,624	19	-	8,500,000	9,710,000
4 Mejillones	1,365,226			n.a.	
5 Other ports	14,095,064			n.a.	
Total of North	20,504,914			n.a.	39,468,000
6 Coquimbo	242,721	2	102	1,000,000	
7 Valparaiso	3,718,271	8	140	5,500,000	
8 San Antonio	6,490,186	9	183	8,100,000	
sub-total	10,451,178	19	-	14,600,000	19,960,000
9 Other ports	11,405,506			n.a.	
Total of Central	21,856,684			n.a.	41,737,000
10 Talcahuano	273,510	2	137	700,000	
11 San Vicente	2,830,719	2	137	2,000,000	
12 Puerto Montt	461,415	2	102	1,000,000	
13 Punta Arenas	115,417	2	81	800,000	
sub-total	3,681,061	8	-	4,500,000	7,830,000
14 Other ports	6,972,022			n.a.	
Total of South	10,653,083			n.a.	22,670,000
Total Chile	53,014,681			n.a.	103,875,000

Note: 1) Coastal shipping is not included in the Total cargo

2) Port efficiency and Capacity are based on the data from MOP in 1998

Source: estimated by JICA Study Team based on the following information

1) Camara Martima Partuaria de Chile: Maritime Transport Statistics 1999

2) Directimar Armada de Chile: Boletin Estadistico Maritimo 1999

3) MOP

(2) Capacity of Trans-Andes Routes

The Trans-Andes routes are fundamental as they account for more than forty roads and three railway lines connecting Chile to neighboring countries. By comparing the current capacity of these routes together with the future demand for transport, the need to expand overall capacity is discussed based on the assumption that the current modal share will be maintained in the future.

a. Road

Cargo traffic volumes as well as the capacity of major Trans-Andes roads are illustrated in Table 12.7.4. Since it is difficult to estimate the capacity of roads with poor conditions or bottleneck sections, for example where it may be too steep and/or narrow for heavy vehicles to pass, the estimated capacities for these roads are overlooked.

In general, future transport demand will increase approximately 2 to 2.5 times present traffic. The roads connecting to Bolivia in the north zone and traffic capacity are seen as being satisfactory except for Colchane noted for high congestion at the bordering pass. Regarding the roads connecting to northern Argentina, Jama will be completed within the next few years. With this improvement, the capacity of the corridor should be able to

satisfy future demand in the year 2012.

Table 12.7.4 Future Demand and Capacity of Trans-Andes Roads

Trans-Andes Roads	Origin / Destination	Cargo (1000 ton/yr)		Traffic(1999) (pcu/day)	Capacity (pcu/day)
		1999	2012		
1 Tambo Quemado	Arica - La Paz	956	2,544	1050	6,000
2 Colchane	Iquique - Oruro	72		70	
3 Jama	Antofagasta - Jujui	79	177	70	1,000
4 Sico	Antofagasta - Salta	2		-	
5 Others in the North Zone		42		40	
Total in the North Zone		1,151	2,720	1,230	7,000
6 Agua Negra	Coquimbo - San Juan	-	4,776	-	
7 Cristo Redentor	Valparaiso - Mendoza	2,500		2,350	6,000
8 Others in the Central Zone		-		-	
Total in the Central Zone		2,500	4,776	2,350	6,000
9 Pehuenche	Talca - Malargue	-		-	
10 Pino Hachado	San Vicente - Zapala	29		160	
11 Cardinal Samoe	Purto Montt - Baliloche	179	1,828	720	3,000
13 Integracion Austral	Punta Arenas - Rio Gallegos	367		520	3,000
14 Others in the South Zone		342		460	
Total in the South Zone		917	1,828	1,860	6,000

Note: Traffic Volume (pcu/day) includes passenger cars, assuming that the truck be 3.5 pcu.

Source: Aduana in Valparaiso, Chile. Trafico Terrestre Avanzadas Fronterizas, Enero a Diciembre 1999

In the central zone, it is necessary to solve problems associated with winter conditions along the Cristo Redentor Road. Only in this way will it have sufficient capacity to accommodate traffic demand in 2012. Even so, however, Agua Negra should be improved as an alternative route, being aware of the unpredictable accidents on Cristo Redentor.

In the south zone, a completely paved road does not yet exist. Pino Hachado, however, has been given highest priority for development based on an agreement between Chile and Argentina. On the other hand, the Cardenal Samore Route appears to be more important regarding traffic volume. Although the present cargo demand is not so high, road traffic volume jumps to double that of AADT during the summer tourist season. Accordingly, the capacity will be insufficient for transport demand in 2012 if improvements are not realized. Regardless, the pavement of both roads should be completed by 2012.

b. Railway

There are three Trans-Andes railway lines as shown in Table 12.7.5 all of which cross the international borders in the north zone. Among them, the transport demands of the two lines connecting to Bolivia are anticipated to exceed current capacity. It is suggested that the purchase of locomotives with greater power and/or improving the alignment would satisfy such need regarding capacity expansion.

The railway line connecting northern Argentina will have sufficient capacity in 2012 due to current expansion programs initiated by the co-operation of two railway companies. Such expansion is being realized by transferring those Chilean locomotives

with higher traction power to Argentine territory.

Table 12.7.5 Future Demand and Capacity of Trans-Andes Railways

Trans- Andes Railways	Origin / Destination	Cargo (1000 ton/yr)		Capacity (1000ton/yr)
		1999	2012	
Arica - La Paz	Arica - La Paz	259	1230	500
Ollague - FF.CC.	Antofagasta -Oruro/Potosi	259		400
Socompa - FF.CC.	Antofagasta -Salta	55	123	200
Total		573	1353	1100

Source: Aduana in Valparaiso, Chile. Trafico Terrestre Avanzadas Fronterizas, Enero a Diciembre 1999, Study Team