to be supplied every year. However, it is not clear at present if the sand supply will continue for a long term. Therefore, it will be necessary to observe the sand accumulation at the offshore area less than 10 m deep south of Mata de Limón Inlet over a long period of time.

4. 3 Depth Model

4. 3. 1 Outline of the Model

The depth model is to estimate the water depth change caused by the sand which is rolled up from the sea bottom by wave action and transported by the tidal and longshore currents. The sand accumulates where the waves and currents are less. The outline of the model and the primary conditions are described in APPENDIX 6.

Two calculation areas are selected. One includes almost all of Caldera Bay, and the other only includes the harbour basin and its immediate area. The calculation procedure is shown in Fig.VI-24.

4. 3. 2 Estimation Method of Sand Sediment Volume

The calculation area is divided into several portions. The average water depth changes of each portion are calculated by the simulation model. The sand sediment volumes are calculated by multiplying each area by each annual depth change rate (cm/year).

4. 3. 3 Reconstruction of the Actual Water Depth Change

(1) Trend of the water depth change

The harbour basin and the area around the basin are divided into five areas as shown inFig.VI-15. The average depth change rates per year of each area are shown in Fig.VI-17.

(2) Reconstruction of the actual depth change

Calculated depth changes of each area are compared with the actual depth changes as shown in Fig.VI-25. It can be seen from this figure that the calculation results conform with the actual conditions. Thus, the future depth changes can be accurately estimated using this mathematical simulation model.

4. 3. 4 Future Estimation

The depth change rates and sand sediment volume under each breakwater extension length are estimated as shown in Table VI-7. It can be seen from this table that the sand sediment rates becomes less as the breakwater extension length increases. The sand sediment volumes of each breakwater extension length are as follows :

Breakwater Extension Length	Annual Sand Sediment Volume
200 m	12,000 m³/year
300 m	10,000 m³/year
400 m	8,000 m³/year

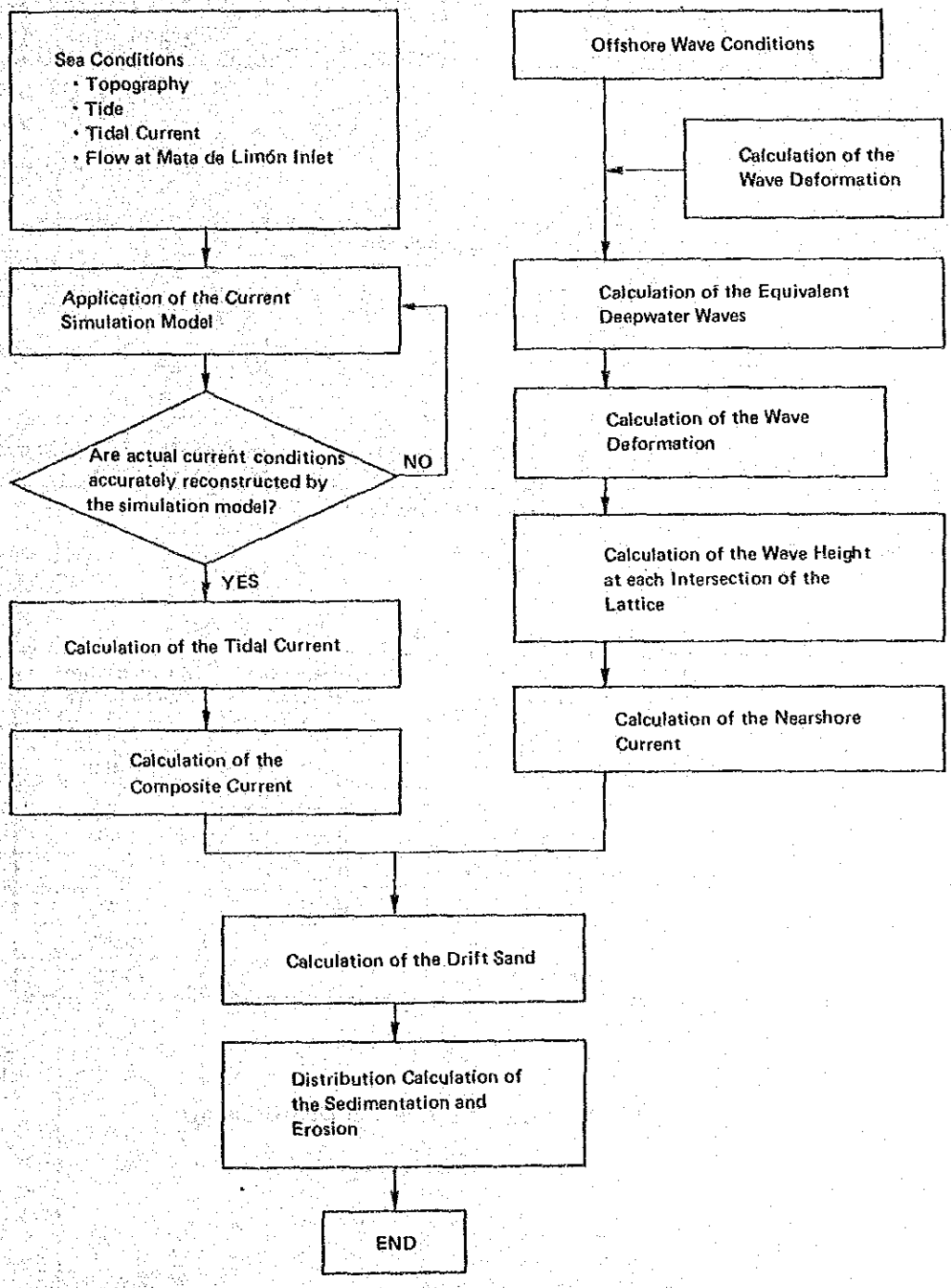
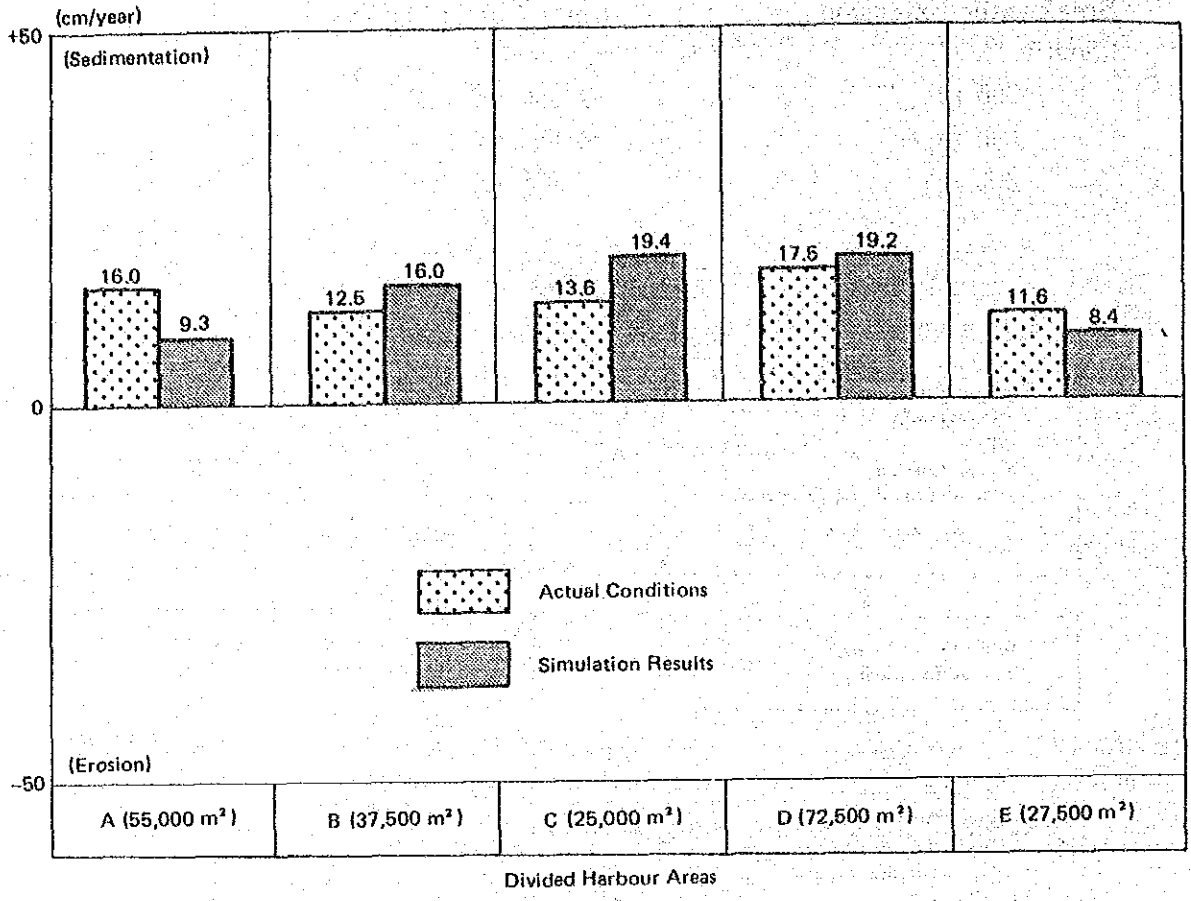


Fig. VI-24 Calculation Procedure of the Depth Change Using the Simulation Model



Zone	Area (m^2)	Actual or Simulation	Annual Sediment Rate (m/year)	Annual Sediment Volume (m^3/year)
A	55,000	Actual Conditions	0.160	8,800
		Simulation Results	0.093	5,100
B	37,500	Actual Conditions	0.125	4,700
		Simulation Results	0.160	6,000
C	25,000	Actual Conditions	0.136	3,400
		Simulation Results	0.194	4,900
Total	117,500	Actual Conditions	–	16,000
		Simulation Results	–	16,900

Fig. VI-25 Reconstruction of the Depth Change

Table VI-7 Simulation Results (Depth Model)

Case	Sedimentation Rates	Divided Harbour Area						
		A (55,000m²)	B (37,500m²)	C (25,000m²)	Sub Total (117,500m²)	D (72,500m²)	E (27,500m²)	Total (217,500m²)
Actual Conditions	Depth Change (cm/year)	16.0	12.5	13.6	—	17.5	11.6	—
	Annual Sediment Volume (m³/year)	8,800	4,700	3,400	16,900	12,700	3,200	32,800
Case 1 Reconstruction of the Actual Conditions	Depth Change (cm/year)	9.3	16.0	19.4	—	19.2	8.4	—
	Annual Sediment Volume (m³/year)	5,100	6,000	4,900	16,000	13,900	2,300	32,200
Case 2 Breakwater Extension $L=200$m	Depth Change (cm/year)	8.0	10.4	13.0	—	17.8	9.0	—
	Annual Sediment Volume (m³/year)	4,400	3,900	3,300	11,600	12,900	2,500	27,000
Case 4 Braekwater Extension $L=400$m	Depth Change (cm/year)	5.6	7.2	9.3	—	16.9	6.3	—
	Annual Sediment Volume (m³/year)	3,100	2,700	2,300	8,100	12,300	1,700	22,100

5. Optimum Urgent Countermeasures against Sand Sedimentation

5. 1 Optimum Breakwater Length

Now, it is possible to estimate the future sediment volume in the harbour basin by using the mathematical simulation results. Fig.VI-26 shows the estimated annual dredging volume of each year of each breakwater extension length. The required dredging volumes in the cases of 100 m and 500 m extensions in addition to the simulation cases are also included in this figure. The maintenance dredging volume when the breakwater is not extended at all is also included. In this figure, it is assumed that the sediment in the harbour basin except at the harbour side of the breakwater will be dredged once every five years.

The total dredging volume over 30 years for each breakwater extension length is shown in Table VI-8.

Table VI-9 shows the total cost over 30 years for the alternative countermeasures against sand sedimentation. Fig.VI-27 shows the breakwater construction costs, the dredging costs and the total costs of each breakwater extension length over the lifetime of this project, including the case where the breakwater is not extended at all. These costs are estimated assuming the most reasonable procedures for the breakwater construction and the dredging. The details are discussed in CHAPTERS. XI and X. From this figure, it is clear that the most economical countermeasure against sand sedimentation in the harbour basin is to extend the breakwater by a length of 200 m.

5. 2 Optimum Urgent Countermeasures

A new breakwater extension of 200 m in the same direction as the existing breakwater and the dredging of unavoidable sand sediment are recommended as the optimum countermeasures against sand sedimentation in the harbour basin.

The dredging includes not only the primary dredging which will be completed by the target year, but also the periodic maintenance dredging which will be continued after the target year.

As the sediment volume in the harbour area is somewhat uncertain, especially under rough sea conditions, an expedient dredging program will have to be executed. This must be considered when planning the construction of facilities for this Caldera Port maintenance project. Continuous site surveys concerning the sand drift over a long period of time will also be necessary for a more accurate estimation of the sand sedimentation in the future.

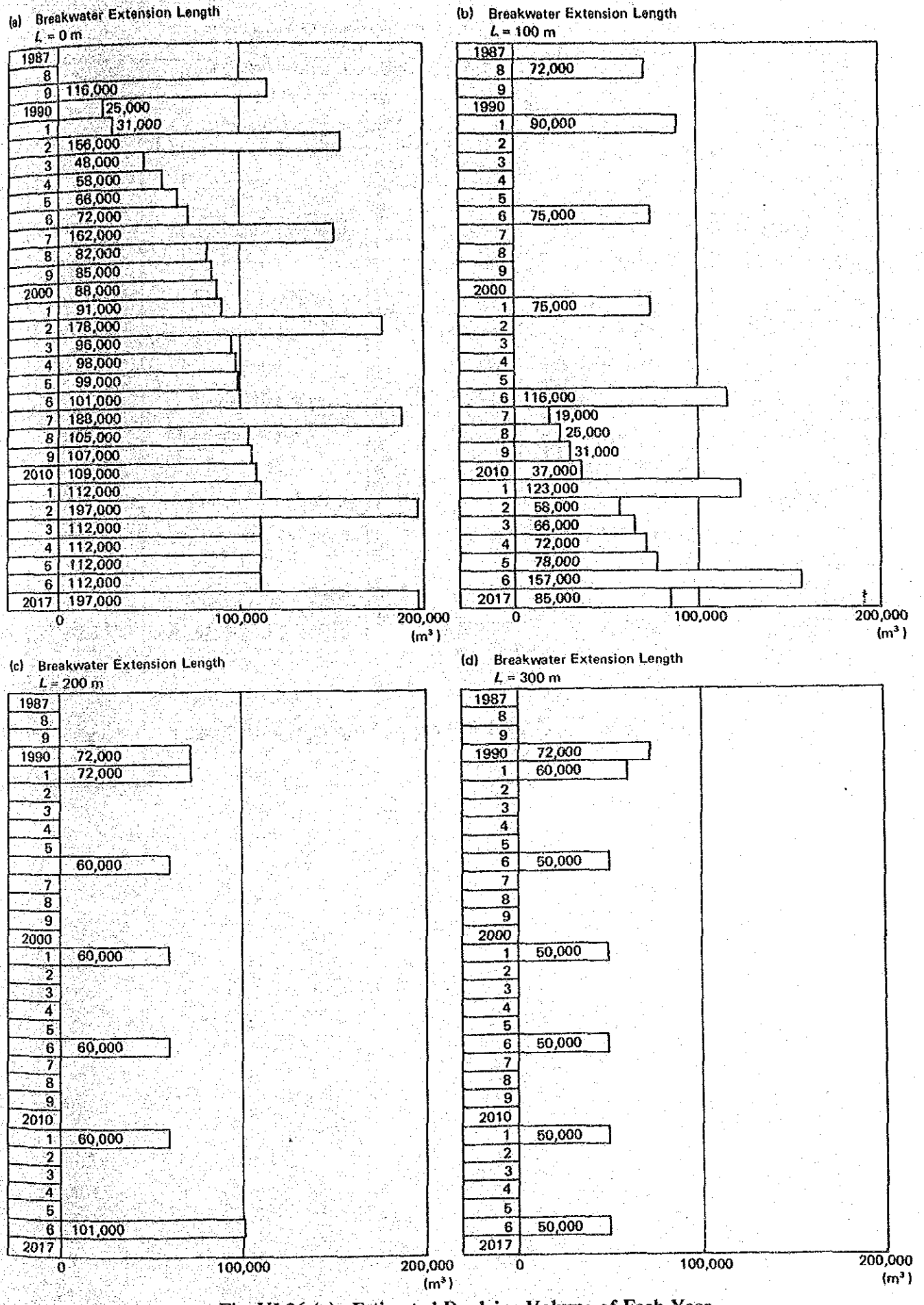


Fig. VI-26 (a) Estimated Dredging Volume of Each Year

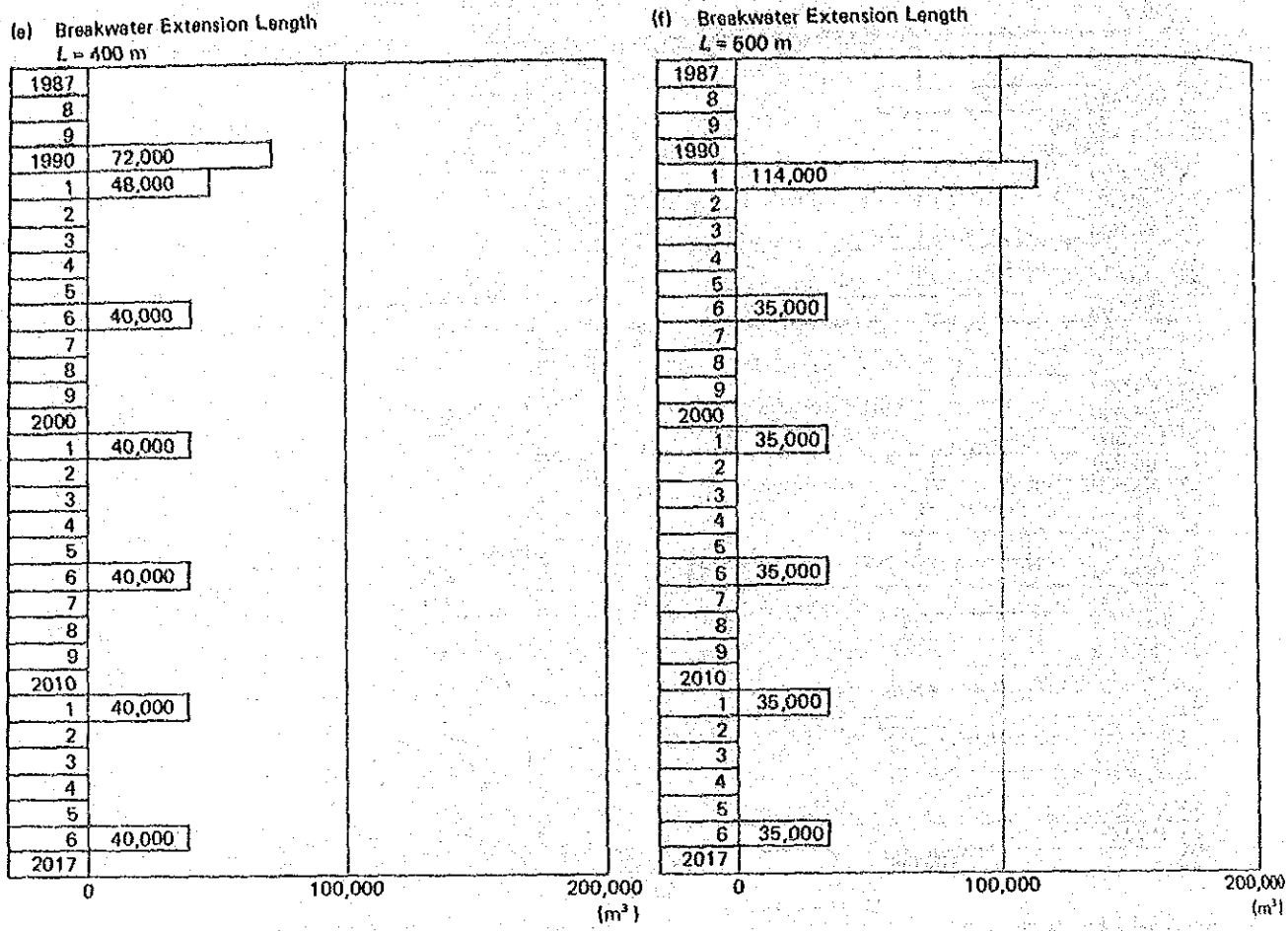


Fig. VI-26 (b) Estimated Dredging Volume of Each Year

Table VI-8 Total Amount of Dredging Volume for 30 Years

Breakwater Extension Length	Primary or Maintenance Dredging	Dredging Volume (m^3)		
		Harbour Side of the Breakwater	Harbour Basin	Total
0 m	Primary Dredging	0	0	0
	Maintenance Dredging	2,571,000	544,000	3,115,000
	Total	2,571,000	544,000	3,115,000
100m	Primary Dredging	72,000	0	72,000
	Maintenance Dredging	642,000	465,000	1,107,000
	Total	714,000	465,000	1,179,000
200m	Primary Dredging	72,000	0	72,000
	Maintenance Dredeging	41,000	372,000	413,000
	Total	113,000	372,000	485,000
300m	Primary Dredging	72,000	0	72,000
	Maintenance Dredging	0	310,000	310,000
	Total	72,000	310,000	382,000
400m	Primary Dredging	72,000	0	72,000
	Maintenance Dredging	0	248,000	248,000
	Total	72,000	248,000	320,000
500m	Primary Dredging	72,000	0	72,000
	Maintenance Dredging	0	217,000	217,000
	Total	72,000	217,000	289,000

Table VI-9 Total Amount of the Cost for 30 Years for Countermeasures against Sand Sedimentation

(Uuit:'000,000 Colones)

Breakwater Extension Length(m)	Remarks; Cost	Breakwater Construction Cost				Dredging Cost				Total Cost
		Construction Cost	Equipment Cost on Land	Equipment Cost on Sea	Sub Total	Primary Dredging Cost	Maintenance Dredging Cost	Equipment Cost on Sea	Sub Total	
0	Remarks	—	—	—	—	Volume: 0m³	Volume: 3,115,000(m³) @102.3¢/m³	Purchase and Maintenance of the Equipment	—	866.5
	Cost	0	0	0	0	0	318.7	547.8	866.5	
100	Remarks	Including Temporary Facilities	$2,861\times10^3$ ¢/Month 12.5 Months	$1,580\times10^3$ ¢/Month 12.5 Months	—	Volume: 72,000(m³) @148.0¢/m³	Volume: 1,107,000(m³)	1.58×10^6 ¢/Month 48 Months	—	619.3
	Cost	175.1	35.8	19.8	230.7	10.7	302.0	75.9	388.6	
200	Remarks	Including Temporary Facilities	18.5 Months	18.5 Months	—	Volume: 72,000(m³) @148.0¢/m³	Volume: 413,000(m³)	20 Months	—	524.4
	Cost	309.5	52.9	29.3	391.7	10.7	90.4	31.6	132.7	
300	Remarks	Including Temporary Facilities	27.5 Months	27.5 Months	—	Volume: 72,000(m³) @148.0¢/m³	Volume: 310,000(m³)	16 Months	—	669.8
	Cost	447.2	78.7	43.5	569.4	10.7	64.4	25.3	100.4	
400	Remarks	Including Temporary Facilities	35.5 Months	35.5 Months	—	Volume: 72,000(m³) @148.0¢/m³	Volume: 248,000(m³)	14 Months	—	822.5
	Cost	580.5	101.6	56.1	738.2	10.7	51.5	22.1	84.3	
500	Remarks	Including Temporary Facilities	42.5 Months	42.5 Months	—	Volume: 72,000(m³) @148.0¢/m³	Volume: 217,000(m³)	12 Months	—	978.7
	Cost	715.1	121.6	67.2	903.7	10.7	45.1	19.0	74.8	

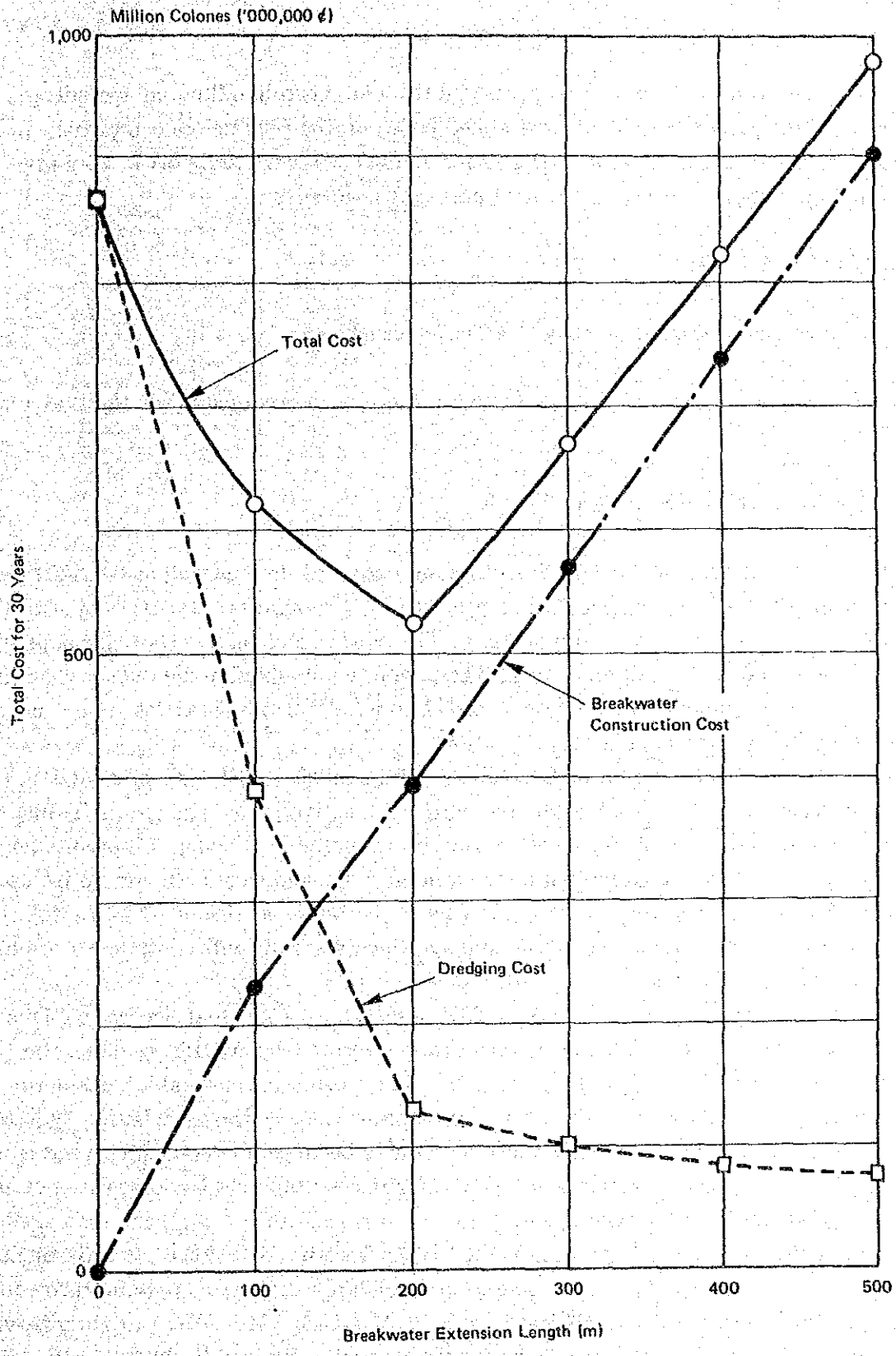


Fig. VI-27 Cost Comparison of Each Breakwater Length

CHAPTER VII PORT FACILITY IMPROVEMENT PLANNING

The required type and number of port facilites and cargo handling equipment and the target year of the project should be determined based on the port demand forecast. In this study, port traffic is forecast based on the socioeconomic forecast, and port facility improvement planning is studied based on the said port traffic forecast.

1. Port Traffic Forecast

1. 1 Socioeconomic Frame for the Traffic Forecast

The future population and GDP are forecast here as prerequisites for the port traffic projection.

1. 1. 1 Population Projection

Generally speaking, historical data over a long period of time as well as the most recent data are required for making population projections. Population statistics by DGEC as showm in Table I -1 are adopted in this study. The most recent figures show the population of Costa Rica as about 2.4 million in 1982. The population doubled in the twenty years from 1962 to 1982. Past population trends and projections by various agencies should be fully considered in making the population projection.

As for the future population of Costa Rica, two agencies, CELADE and MOPT, have made projections for the years 2025 and 2010, respectively, as shown in Table VII-1. Historically, the compound increase rate has been gradually decreasing. Generally, population increase rates decrease along with economic growth, and Costa Rica is no exception. The Costa Rican economy will continue to grow in the future as discussed in the following section. Thus, we can predict that the compound increase rate will continue to gradually decrease in the future.

The future increase rate projected by CELADE shows a gradual decrease. This tendency is reasonable. However, the increase rate projected by MOPT remains the same throughout the period from 1985 through 2010. This seems unreasonable considering the decreasing trend. CELADE made three population projections as shown in Table VII-1. Case B with a medium increase rate seems most reasonable because its decreasing trend is most consistent with the actual historical data. Therefore, the compound increase rate in Case B estimated by CELADE is adopted in this study.

However, the projection base year of the CELADE estimate is 1980. As rule, the latest data should be used as the base data whenever possible in making population projections. The latest population data available are from 1982 according to "Anuario Estadístico de Costa Rica, DGEC". Then, the base year for the projection should be 1982.

Thus, in this study the population is projected using the base year of 1982 and the medium compound increase rate of Case B estimated by CELADE. The results of the

projection are shown in Table VII-2 and Fig.VII-1. Population in 1990 is predicted to be about 3 million.

Table VII-1 Costa Rican Population Projected by CELADE and MOPT

Year	CELADE 1/						MOPT 2/	
	Case A (High increase rate)		Case B (Medium increase rate)		Case C (Low increase rate)			
	Population (persons)	Increase rate(%)	Population (persons)	Increase rate(%)	Population (persons)	Increase rate(%)	Population ('000 persons)	Increase rate(%)
1980	2,278,506		2,278,506		2,278,506		2,245.4	
1985	2,604,173	14.3	2,599,503	14.1	2,595,214	13.9	2,500.4	11.4
1990	2,952,474	13.4	2,936,983	13.0	2,921,733	12.6	2,787.9	11.5
1995	3,304,932	11.9	3,270,965	11.4	3,237,134	10.8	3,108.3	11.5
2000	3,657,485	10.7	3,595,947	9.9	3,534,437	9.2	3,465.6	11.5
2005	4,015,608	9.8	3,919,005	9.0	3,824,230	8.2	3,864.0	11.5
2010	4,381,177	9.1	4,239,367	8.2	4,103,482	7.3	4,308.1	11.5
2015	4,747,759	8.4	4,548,508	7.3	4,362,334	6.3	—	
2020	5,106,834	7.6	4,836,575	6.3	4,590,623	5.2	—	
2025	5,453,914	6.8	5,098,604	5.4	4,783,836	4.2	—	

Source 1/ : COSTA RICA, ESTIMACIONES Y PROYECCIONES DE POBLACION 1950-2025, CELADE
2/ : DGP/MOPT
Note : The increase rate figures denote the increase over previous five years.

Table VII-2 Projected Population

Year	Population (persons)	Compound increase rate (%)
1982	2,371,519	2.78
1985	2,569,597	2.58
1990	2,895,381	2.35
1992	3,027,731	2.23
1995	3,224,405	2.06
2000	3,545,017	1.38

Source : COSTA RICA, ESTIMACIONES Y PROYECCIONES DE POBLACION 1950-2025, CELADE

1. 1. 2 *GDP Projection*

Actual Costa Rican GDP is shown in Table I-4. The Costa Rican economy grew smoothly through 1979. Costa Rica suffered an economic recession from 1980 through 1982. However, the country is currently in a period of economic recovery. In the GDP projection, the recent economic situation should be fully considered.

Concering Costa Rican GDP, BCCR and DGP/MOPT have made projections. At the end of 1985, BCCR made a projection through 1990. Only the BCCR projection reflects the latest economic situation ; the projected values are shown in Table VII-3. To confirm the appropriateness of the BCCR projection, two other cases, Case 1 and Case 3, are added as

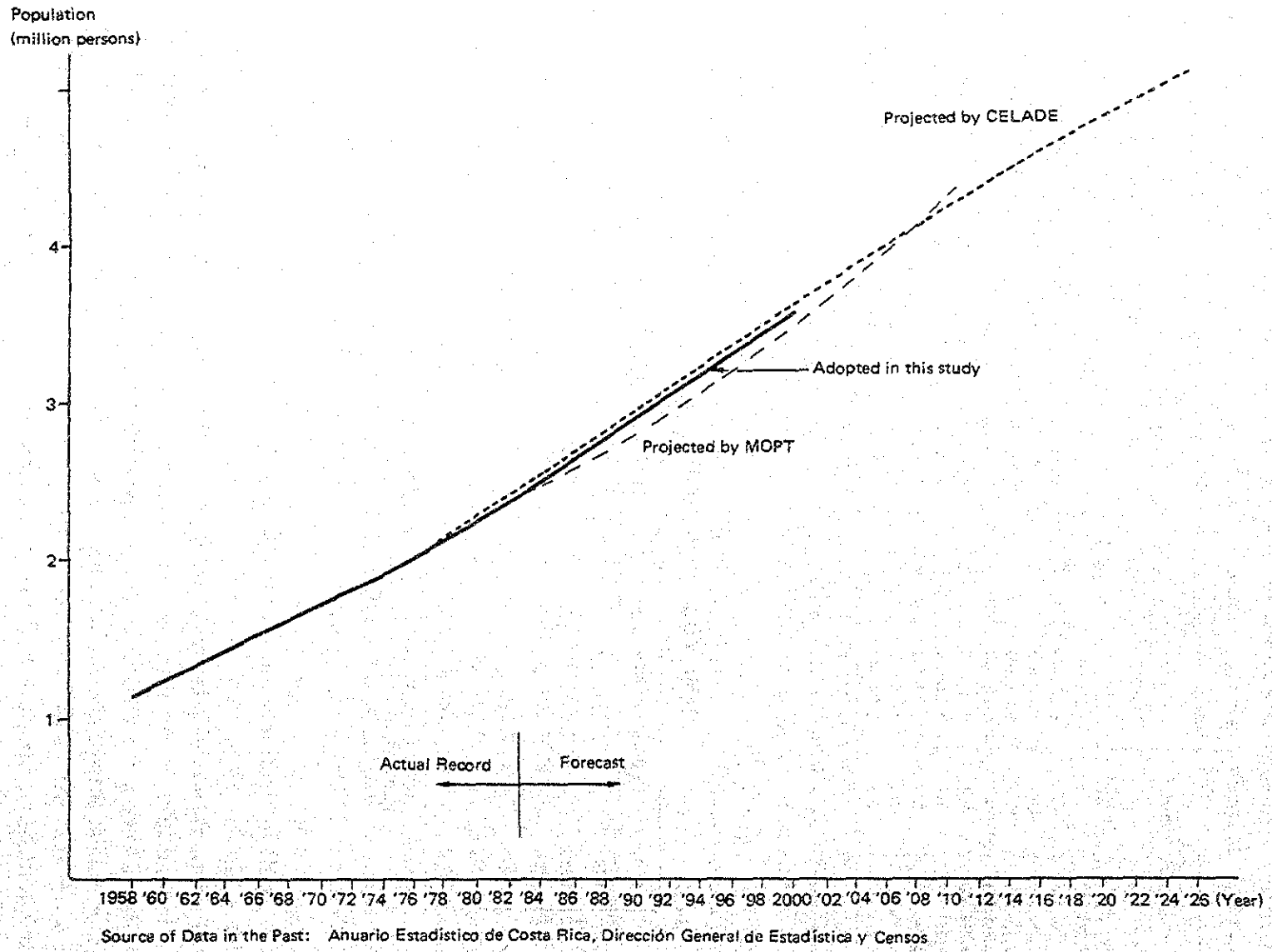


Fig. VII-1 (1) Population Data and Projections

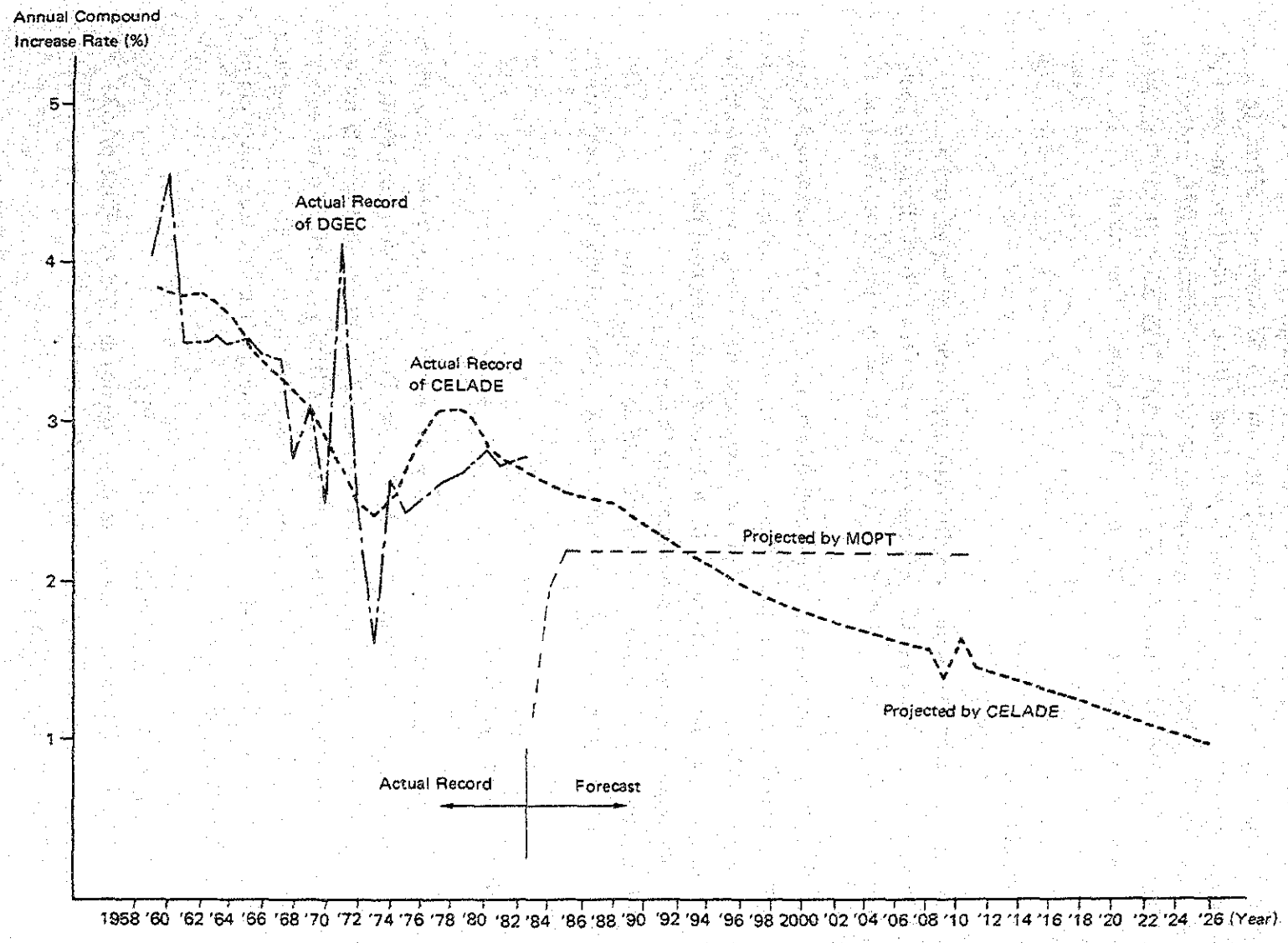


Fig. VII-1 (2) Population Data and Projections

alternatives as shown in Table Ⅶ-4, Fig.Ⅶ-2 and Fig.Ⅶ-3. In the table, Case 2 is the BCCR projection. The GDP compound growth rate after 1990 is assumed to be the same as in 1990 in all three cases. For instance, the GDP after 1990 in Case 2 is projected assuming a compound growth rate of 2.5% for the period from 1991 through 2000.

The BCCR projection is the most authoritative and up to date, and seems to most accurately reflect the current economic situation in Costa Rica. Therefore, in this study, Case 2 is adopted for the future national economic indicators. According to the projection, the Costa Rican economy should grow steadily in the future. Per capita GDP is projected based on the population projection in the previous section. The result is shown in Table Ⅶ-5.

1. 2 Port Traffic Forecast

In forecasting future cargo volume, two different approaches are used and an accurate cargo forecast is made by comparing the forecast results from the two methods. In general, the cargo volume handled at ports is closely linked with the economic activities in their hinterlands.

Following this, the first approach is a macroscopic method, namely, regression analysis on the basis of commonly used economic indices such as GDP. The second approach is a microscopic method, meaning that the throughput of selected major cargo items are individually forecast. In the microscopic approach, the following items are considered :

(1) Demand and supply balances of commodities in the region ;
(2) Trends in producing and consuming districts outside of the region ;
(3) Cargo movement and cargo distribution among major ports on the Pacific and Atlantic coasts.

1. 2. 1 Macroscopic Forecast

As mentioned above, regression analysis is generally applied in forecasting cargo volume. The historical total port cargo throughput at the Ports of Caldera and Puntarenas cannot solely be used for the regression analysis because it has fluctuated greatly by year. Instead, the total national port cargo throughput in Costa Rica is adopted in this analysis. The correlation between total port cargo volume in Costa Rica and GDP for the period from 1966 through 1984 is shown below, and the future total national port cargo throughput is estimated using the equation.

$$Y = 349.35\,X - 387{,}796.31 \quad (R = 0.975)$$

Where X : GDP in Costa Rica (unit : million colones at 1966 constant prices)
Y : Total cargo throughput in Costa Rica (unit : tons)
R : Correlation coefficient

Table VII-3 GDP Projected by Related Agencies

Unit : million colones

Year	BCCR[1]		DGP/MOPT[2]	
	GDP (at 1966 constant prices)	Annual Growth Rate (%)	GDP (at 1966 constant prices)	Annual Growth Rate (%)
1980			9,647.8	0.75
1981			9,429.6	−2.26
1982			8,742.6	−7.29
1983			8,947.7	2.35
1984	9,513.0	6.3	9,541.8	6.64
1985	9,426.2	−0.9	9,780.3	2.50
1986	9,540.9	1.2	10,024.9	2.50
1987	9,750.8	2.2	10,275.5	2.50
1988	10,014.1	2.7	10,532.4	2.50
1989	10,274.4	2.6	10,795.7	2.50
1990	10,521.0	2.4	11,065.6	2.50
1991			11,342.2	2.50
1992			11,625.8	2.50
1993			11,916.4	2.50
1994			12,214.3	2.50
1995			12,519.7	2.50
1996			12,832.7	2.00
1997			13,153.5	2.00
1998			13,482.3	2.00
1999			13,819.4	2.00
2000			14,164.9	2.00
2001			14,519.0	2.50
2002			14,882.0	2.50
2003			15,254,0	2.50
2004			15,635,4	2.50
2005			16,026.2	2.50
2006			16,426.9	2.00
2007			16,837.6	2.00
2008			17,258.5	2.00
2009			17,690.0	2.00
2010			18,132.2	2.00

Source 1) : BCCR
2) : DGP/MOPT

Table VII-4 Alternative GDP Projections

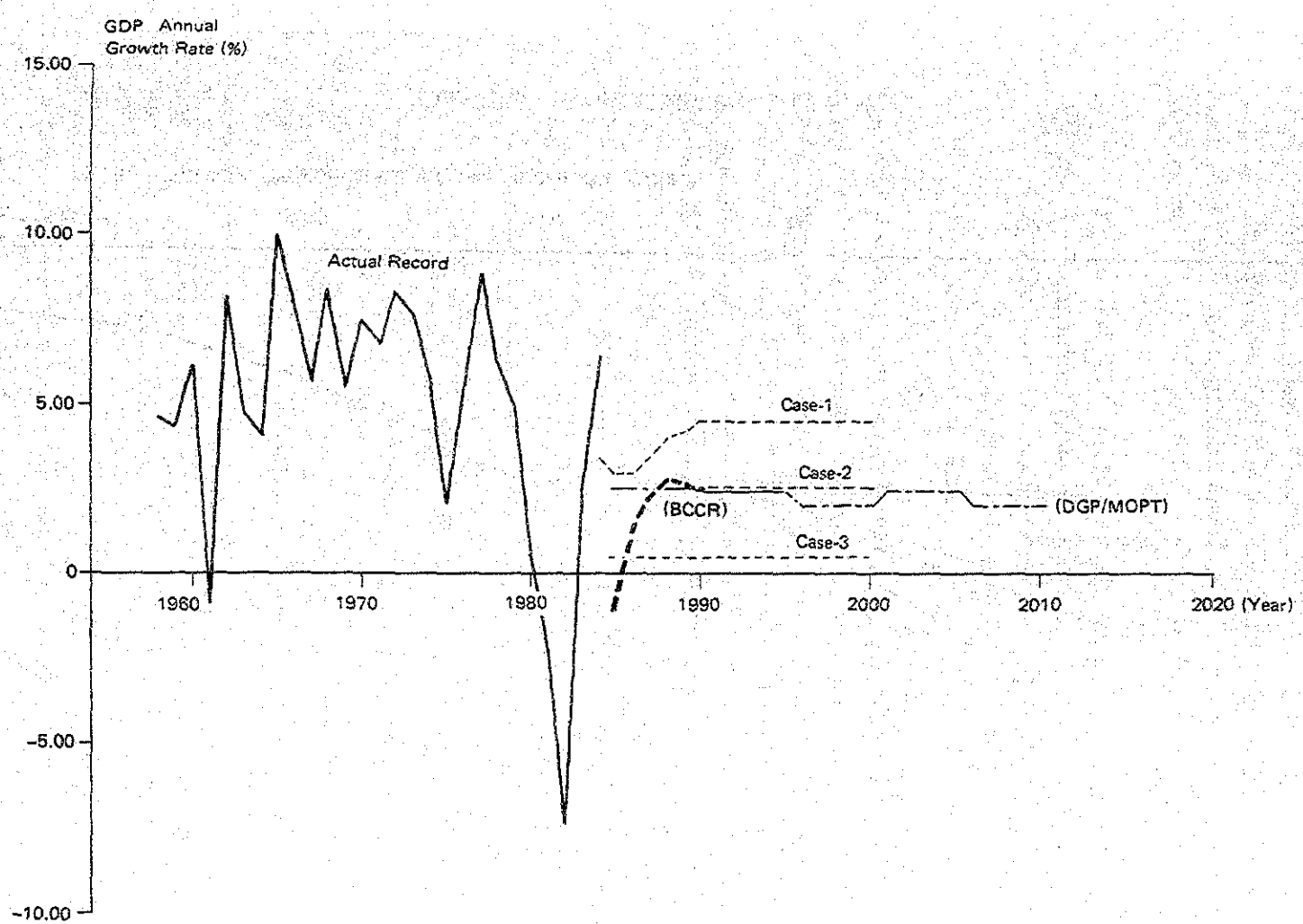
Unit : million colones

Year	Case-1		Case-2		Case-3	
	GDP (at 1966 constant prices)	Annual Growth Rate (%)	GDP (at 1966 constant prices)	Annual Growth Rate (%)	GDP (at 1966 constant prices)	Annual Growth Rate (%)
1983	8,947.7	2.4			8,947.7	2.4
1984	9,251.9	3.4	9,513.0	6.32	9,251.9	3.4
1985	9,529.5	3.0	9,426.2	−0.9	9,298.2	0.5
1986	9,815.4	3.0	9,540.9	1.2	9,344.7	0.5
1987	10,158.9	3.5	9,750.8	2.2	9,391.4	0.5
1988	10,565.3	4.0	10,014.1	2.7	9,438.3	0.5
1989	11,009.0	4.2	10,274.4	2.6	9,485.5	0.5
1990	11,504.4	4.5	10,521.0	2.4	9,532.9	0.5
1991	12,022.1	4.5	10,784.0	2.5	9,580.6	0.5
1992	12,563.1	4.5	11,053.6	2.5	9,628.5	0.5
1993	13,128.4	4.5	11,330.0	2.5	9,676.7	0.5
1994	13,719.2	4.5	11,613.2	2.5	9,725.0	0.5
1995	14,336.6	4.5	11,903.5	2.5	9,773.7	0.5
1996	14,981.7	4.5	12,201.1	2.5	9,822.5	0.5
1997	15,655.9	4.5	12,506.2	2.5	9,871.6	0.5
1998	16,360.4	4.5	12,818.8	2.5	9,921.0	0.5
1999	17,096.6	4.5	13,139.3	2.5	9,970.6	0.5
2000	17,866.0	4.5	13,467.8	2.5	10,020.5	0.5

Source : Data for the period from 1984 through 1990 are from BCCR

Table VII-5 Projected per Capita GDP

Year	GDP at 1966 constant prices (million colones)	Population ('000 persons)	Per capita GDP ('000 colones/person)
1990	10,521.0	2,895.4	3.63
1992	11,053.6	3,027.7	3.65
1995	11,903.5	3,224.4	3.69
2000	13,467.8	3,545.0	3.80



Source of Data in the Past: Cifras de Cuentas Nacionales de Costa Rica, BCCR

Fig. VII-2 Trends and Projection of GDP Annual Growth Rate

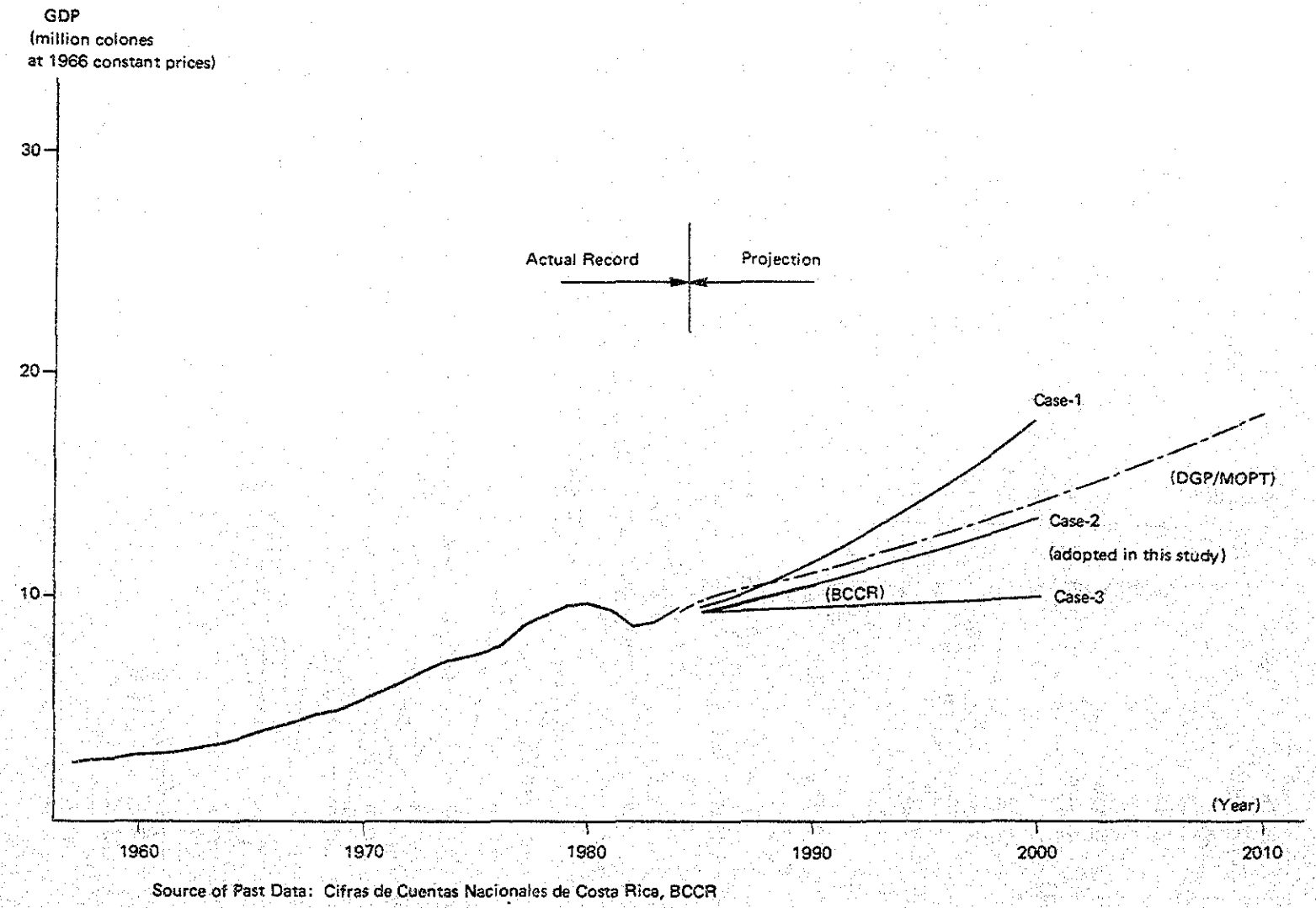


Fig. VII-3 Historical and Projected GDP

To divide the above total cargo volume into cargo volume on the Pacific and Atlantic coasts, the future share of the cargo volume on the Pacific coast is calculated. The following two cases are studied in this section.

Case－A : Where the share is the same as in 1984

Case－B : Where the share will grow until 1990 at the same rate as it did from 1982 through 1984, and then remain constant after 1990.

For Case－B, the correlation between the share of the Pacific coast ports and the year is shown below.

$$Y = 0.0857\,X + 51.15 \qquad (R = 0.961)$$

Where X ; Year minus 1900

Y : The share of cargo volume handled at ports on the Pacific coast (to the total cargo volume of Costa Rica)

R : Correlation coefficient

However, it seems that the share grows unrealistically in Case－B. Thus, as a moderate estimate in this report the average value of Case－A and Case－B is calculated and adopted. Accordingly, the total cargo volume on the Pacific coast is obtained as shown in Table VII-6. However, it should be noted that this table includes the cargo volume at the Ports of Punta Morales and FERTICA. These volumes should be deducted from this table to obtain the cargo volume at the Ports of Caldera and Puntarenas.

Table VII-6 Macroscopic Forecast

Year	GDP at 1966 constant prices (*million colones*)	Costa Rican Port Cargo Volume ('000 tons)	The Pacific Coast Ports			
			Share (%)			Total Cargo Volume ('000 tons)
			Case-A	Case-B	Average	
(Actual)						
1980	9,647.8	2,791.7			22.5	628.1
1984	9,513.0	3,017.7			23.8	717.0
(Projected)						
1985	9,426.2	2,905.2	23.8	26.0	24.9	723.4
1990	10,521.0	3,287.7	23.8	39.0	31.4	1,032.3
1992	11,053.6	3,473.8	23.8	39.0	31.4	1,090.8
1995	11,903.5	3,770.7	23.8	39.0	31.4	1,184.0
2000	13,467.8	4,317.2	23.8	39.0	31.4	1,355.6

Note 1) Share : The share of the cargo volume handled at the Pacific coast ports in the total cargo volume in Costa Rica.

2) Case-A : Where the share is the same as in 1984

3) Case-B : Where the share will grow until 1990 at the same rate as it did from 1982 through 1984, and then remain constant after 1990.

1. 2. 2 Microscopic Forecast

The cargo volumes of the major commodity items and commodity groups are forecast individually considering actual cargo volume and future port development in the future. The details are presented in the following sections.

(1) Grain

The procedure for projecting the volume of grain import for human consumption is shown in Fig.Ⅶ-4. The total import volume is determined based on the concept of balancing demand and supply, that is consumption and production in the nation. Grain consumption is divided into 1) such human consumption as cleaned rice, beans, white corn and wheat, and 2) such feed consumption as yellow corn and sorghum.

First, future human consumption is estimated using the following equation.

Future Human Consumption = Present Human Consumption × Increase Rate (C)

$$C = P + i \cdot E$$

Where C : Increase rate of human consumption

P : Population increase rate

i : Per capita GDP increase rate

E : Elasticity (the values of E according to IECES are as follows)

a)	for cleaned rice	0.05
b)	for wheat	0.05
c)	for beans	−0.30
d)	for white corn	−0.20

Second, feed consumpion is projected combining the JST projection from 1993 through 2000 with an average annual increase rate of 3.45% with the CNP projection from 1983 through 1992 (refer to Table Ⅶ-7).

Third, local production from 1993 through 2000 is estimated as shown in Table Ⅶ-8.

In the grain import projection, the CNP statistics by agricultural year are used in this study. The statistical period of port cargoes by MOPT are by calender year. However, there is little difference in cargo volume between CNP and MOPT data as for the past wheat import volume shown in Fig.Ⅶ-5. Thus, the CNP statistical data are used without any correction in this study.

The required grain import volume by year is then calculated using the following equation.

Required grain import = Human grain consumption
+ Feed grain consumption
− Local grain production

Consequently, grain import volume is projected as shown in Table Ⅶ-9. Past import volumes and future estimates are presented graphically in Fig.Ⅶ-5. The grain which is

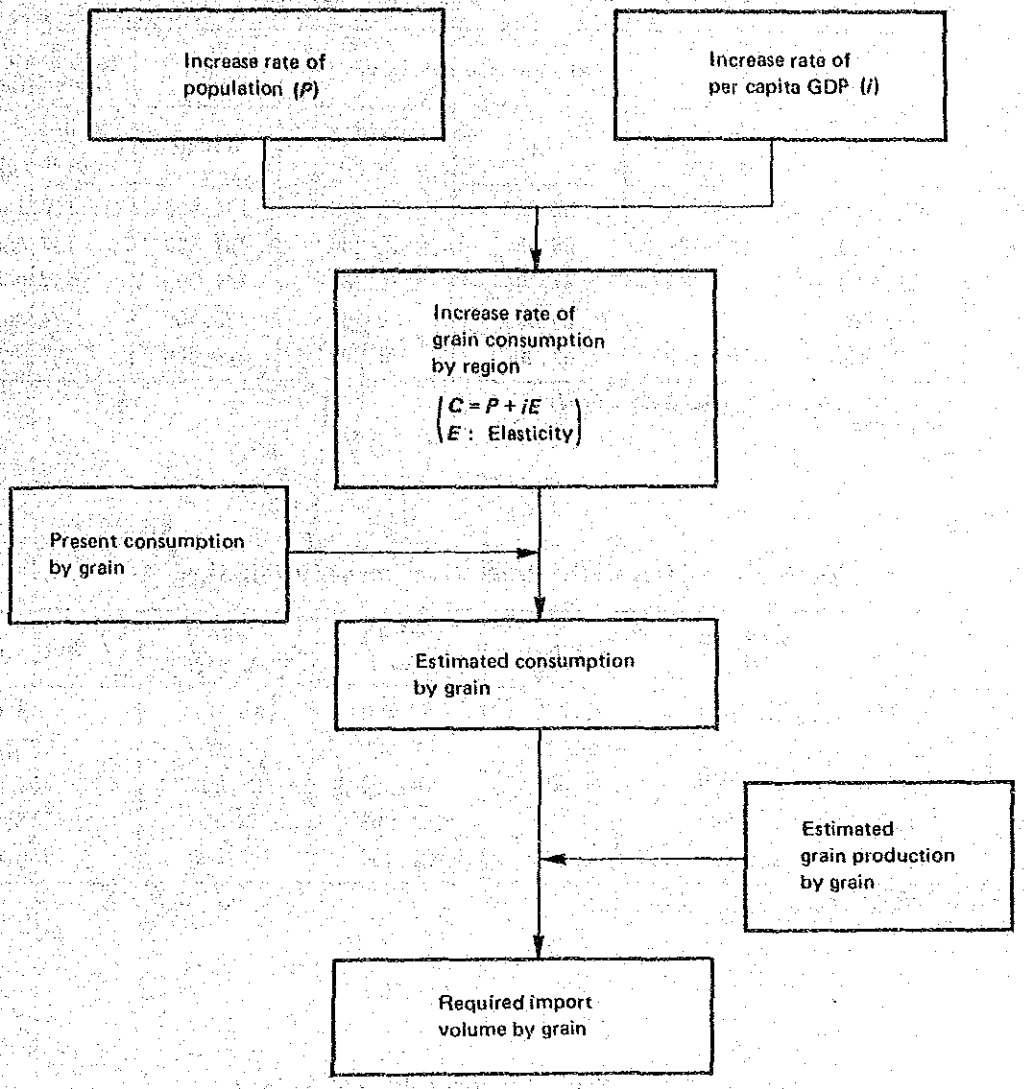


Fig. VII-4 Forecast Procedure of Grain Import for Human Consumption

Table VII-7 Grain Consumption Projection

Year	Total	Human Consumption				Feed Consumption
		Cleaned Rice	Beans	White Corn	Wheat	Yellow Corn and Sorghum
1984	426,400	115,100	22,900	63,400	104,600	120,400
1990	502,100	133,500	26,500	73,200	121,300	147,600
1992	528,600	139,800	27,700	76,200	127,000	157,900
1995	569,300	149,000	29,400	80,700	135,400	174,800
2000	640,900	164,300	32,300	87,900	149,200	207,200

Source 1984-1992 : Dirección de Planificación del CNP
1993-2000 : JST

Table VII-8 Net Grain Production Volume Projection

Year	Total	Cleaned Rice	Beans	White Corn	Yellow Corn	Sorghum
1984	280,600	129,000	21,700	63,300	18,100	48,500
1990	159,200	151,700	25,600	72,500	26,200	83,200
1992	382,700	160,000	26,600	76,100	27,500	92,500
1995	434,500	172,200	29,500	81,500	32,500	118,800
2000	544,000	194,500	34,900	91,400	42,600	180,600

Source 1984-1993 : Dirección de Planificación, CNP
1994-2000 : JST

Table VII-9 Projected Grain Import Volume

Year	Total	Human Consumption				Feed Consumption
		Cleaned Rice	Beans	White Corn	Wheat	Yellow Corn and Sorghum
1984	159,700	—	1,200	100	104,600	53,800
1990	161,100	—	900	800	118,500	38,000
1992	166,100	—	1,100	100	127,000	37,900
1995	158,900	—	—	—	135,400	23,500
2000	149,200	—	—	—	149,200	—

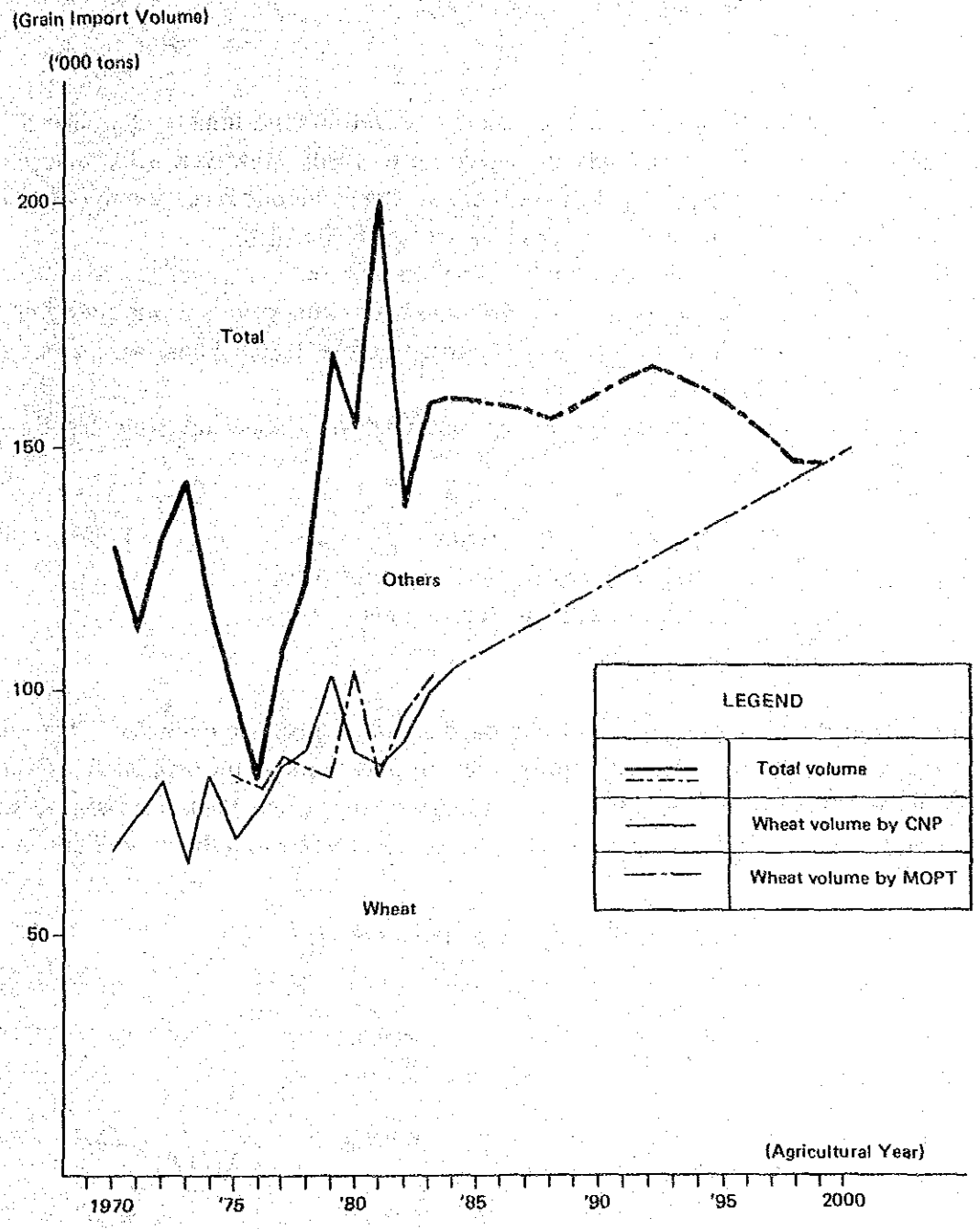


Fig. VII-5 Grain Import Forecast

currently imported through the Port of Puntarenas will be imported through the Port of Caldera due to the superannuation of Puntarenas pier.

(2) Automobiles

Total automobile imports in Costa Rica including automobile imports handled at the Ports of Caldera and Puntarenas rapidly increased up to 1980. However, after that, Costa Rican automobile imports drastically decreased due to the economic recession and the large customs duties imposed on imported automobiles (refer to Fig.VII-6).

However, Costa Rica is presently undergoing an economic recovery, and when the domestic economy recovers the large customs duties on imported automobiles may by reduced to the lower tariff levels which were charged before 1980. Thus, we assume that automobile imports will increase in the future.

The correlation between automobile imports and GDP for the period from 1969 through 1980 can be shown as follows :

$$Y = 4.925X - 21,821 \quad (R = 0.906)$$

Where X : GDP (unit: '000 colones at 1966 constant prices)

Y : Automobile import volume (unit : tons)

R : Correlation coefficinet

In calculating the above equation, of course, data after 1980 are excluded. The future share of the Port of Caldera in the total automobile import volume in Costa Rica is assumed to be the average share of 67.1% of the period from 1969 through 1980. Consequently, the future automobile import volume at the Port of Caldera is forecast as shown in Table VII-10.

Table VII-10 Automobile Import Forecast

(Unit : tons)

Year	Caldera and Puntarenas (share %)	Limón and Moin	Total
(Actual)			
1970	5,467 (83.1)	1,110	6,577
1975	8,019 (57.2)	5,993	14,012
1980	15,279 (75.5)	4,953	20,232
1984	4,816 (65.8)	2,507	7,323
(Projected)			
1990	20,100 (67.1)	9,900	30,000
1992	21,900 (67.1)	10,700	32,600
2000	29,900 (67.1)	14,600	44,500

Source of Actual Data : CUADROS ESTADISTICOS SOBRE SECTOR TRANSPORTES, DGP/MOPT

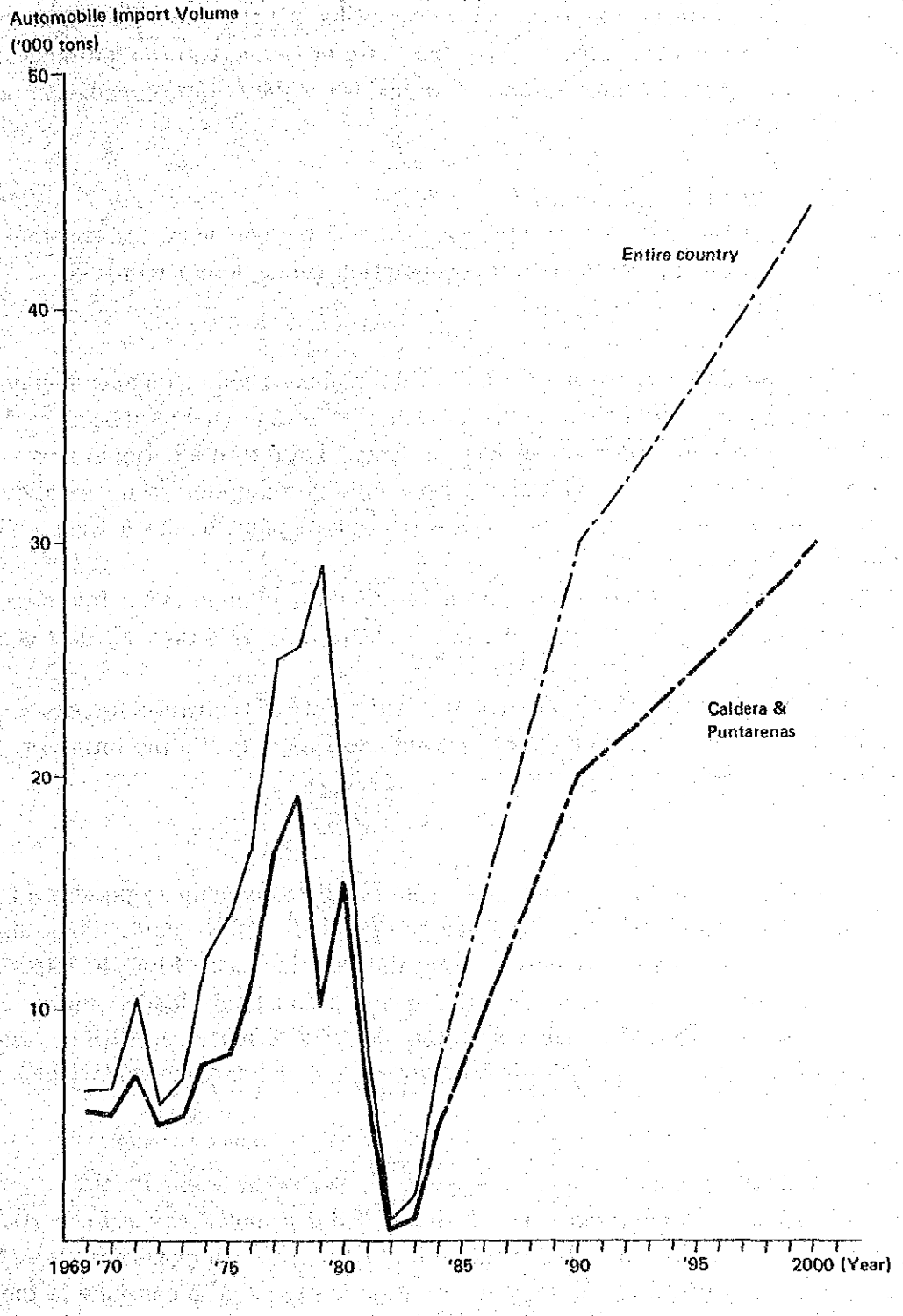


Fig. VII-6 Automobile Import Volume

(3) Iron and Steel

The flow chart for the iron and steel import forecast is shown in Fig.Ⅶ-7. As seen in this figure, first, the national iron and steel consumption is estimated. The import volume at the Port of Caldera is then forecast using the share of the port in the national imports.

National iron and steel consumption is obtained using the following equation based on Fig.Ⅶ-8 and Table Ⅶ-11.

$$Y = 22.64X - 32.32 \quad (R = 0.765)$$

Where X : Per capita GDP (unit : thousand colones per person at 1966 constant prices)
Y : Per capita iron and steel consumption (unit : kgf/person)
R : Correlation coefficient

To analyse the relation between per capita GDP and per capita iron and steel consumption, data from 1969 through 1980 are used and data after 1980 are not used because these are influenced by the economic recession during that time. Total future national iron and steel consumption can be obtained by multiplying per capita consumption from the above equation by the future national population. There is no steel plant in Costa Rica. Thus, all consumption must be imported.

The share of the Port of Caldera in national iron and steel imports has fluctuated in the past. The average share of 54.5% for the last 16 years from 1969 through 1984 is adopted in this study.

Consequently, iron and steel import volume at the Port of Caldera is forecast as shown in Table Ⅶ-12. The historical volume of iron and steel imports and the future projections are presented graphically in Fig.Ⅶ-9.

(4) Fertilizer

FERTICA which is one of the two Costa Rican fertilizer companies operates a fertilizer plant at Puntarenas. Most Costa Rican fertilizer is produced at this plant. Thus, almost all the country's fertilizer exports are shipped from the Pacific coast. FERTICA has its own private wharf facilities where fertilizer materials and products are loaded and unloaded.

As large vessels cannot dock directly at the FERTICA wharf, fertilizer cargoes are carried by barges between the FERTICA facilities and the large vessels which anchor offshore.

1) Imports

In the past, fertilizer imports have rarely been handled at the public Ports of Caldera and Puntarenas. Such imports have sometimes been handled in a spotty way at the ports, but the volume has not been significant. Thus, almost all of the fertilizer imports have been handled at the private wharf of FERTICA, and this situation is expected to continue in the future. Nonetheless, the fertilizer handled at the FERTICA facilities results in tariff income to INCOP. The future fertilizer import cargo volume is forecast below.

In estimating future fertilizer import volume, it is assumed that fertilizer imports will increase along with the production increase of such basic grains as rice, beans, sorghum and yellow and white corn. SEPSA has a plan to increase the domestic production of these basic

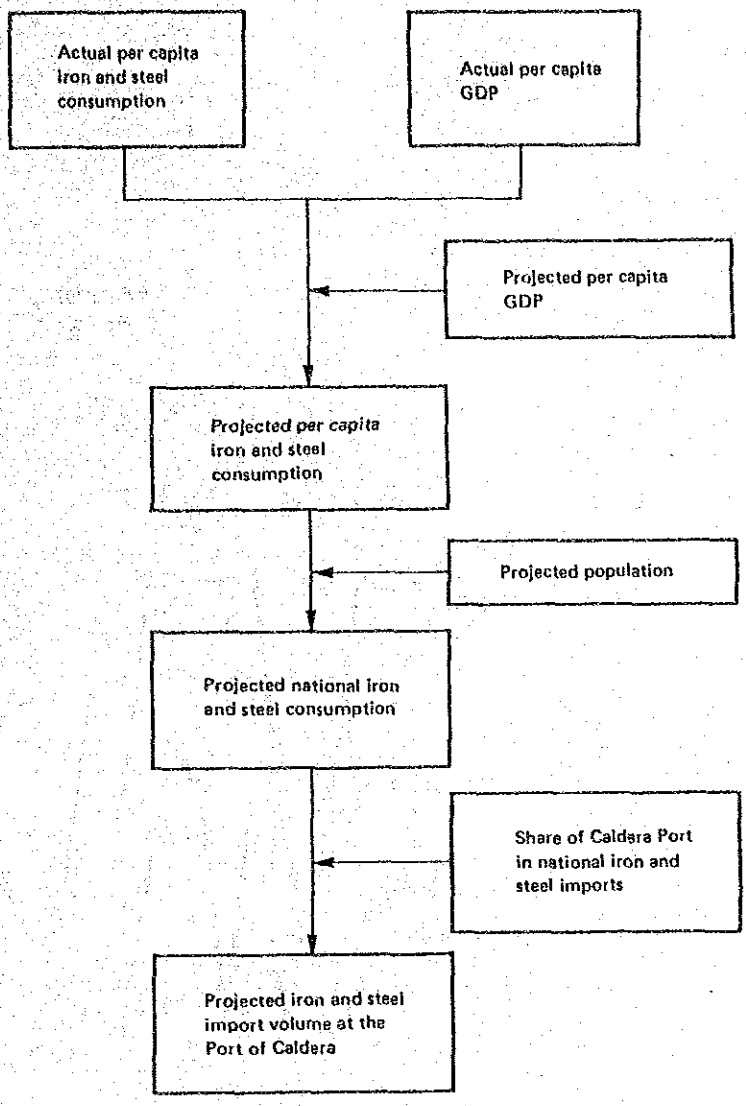


Fig. VII-7 Flow Chart of Iron and Steel Import Volume Projection

Table VII-11 Actual Iron and Steel Imports

Year	National Iron and Steel Import Volume[1] (tons)	Per capita Steel Consumption (kgf/person)	Per capita GDP (at 1966 constant prices) ('000 colones)	Imports through Caldera and Puntarenas (tons) (share %)
1970	85,915	49.74	3.23	45,023 (52.4)
1975	87,182	44.29	3.80	43,072 (49.4)
1980	134,765	60.02	4.30	90,190 (66.9)
1984	132,677	53.11	3.81	53.185 (40.1)

Source 1) : CUADROS ESTADISTICOS SOBRE SECTOR TRANSPORTES, DGP/MOPT

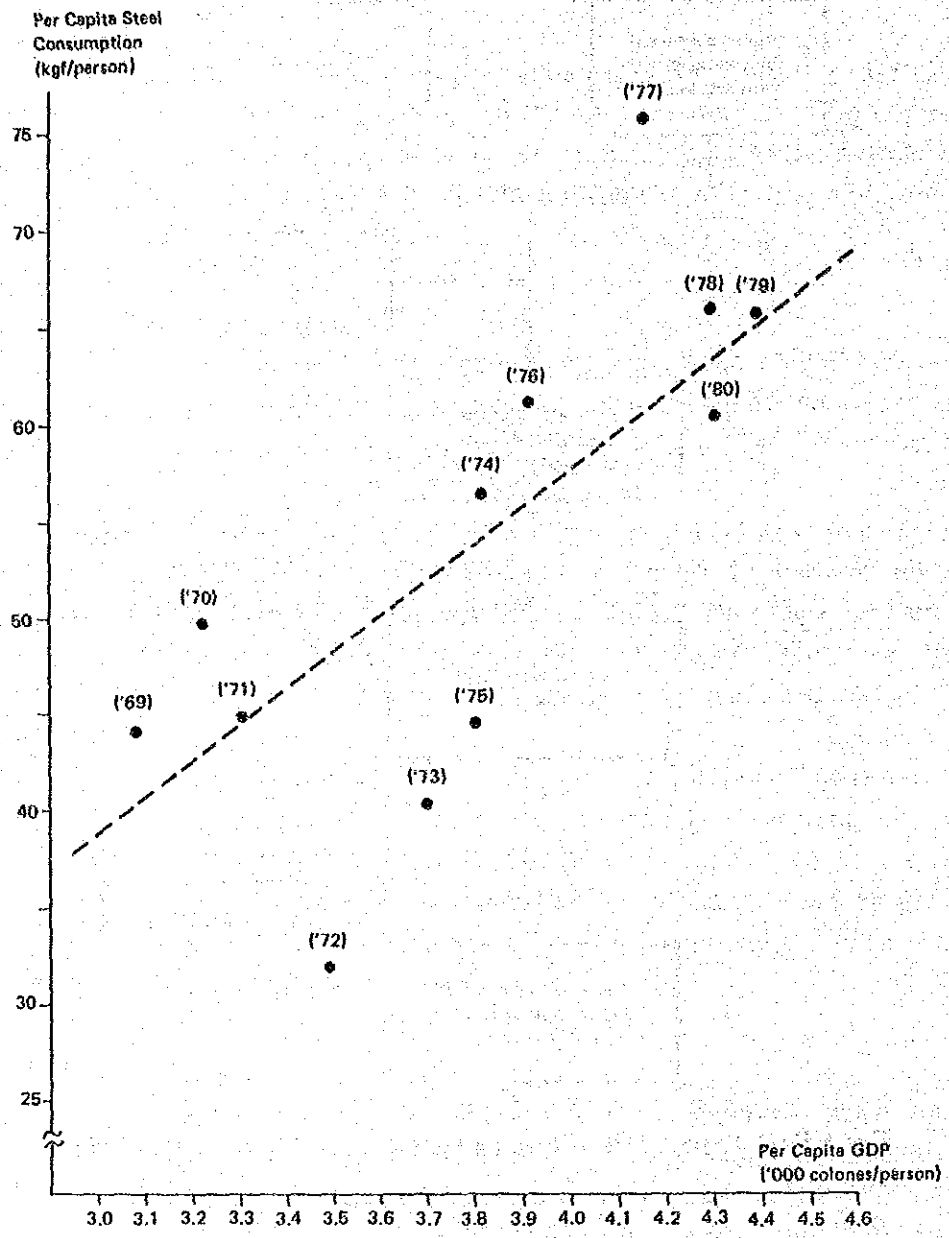


Fig. VII-8 Per Capita Iron and Steel Consumption

Table VII-12 Projected Iron and steel Imports

Unit : tons

Year	The entire nation	The Port of Caldera
1990	144,000	78,700
1992	152,000	83,000
1995	165,000	90,000
2000	190,000	103,800

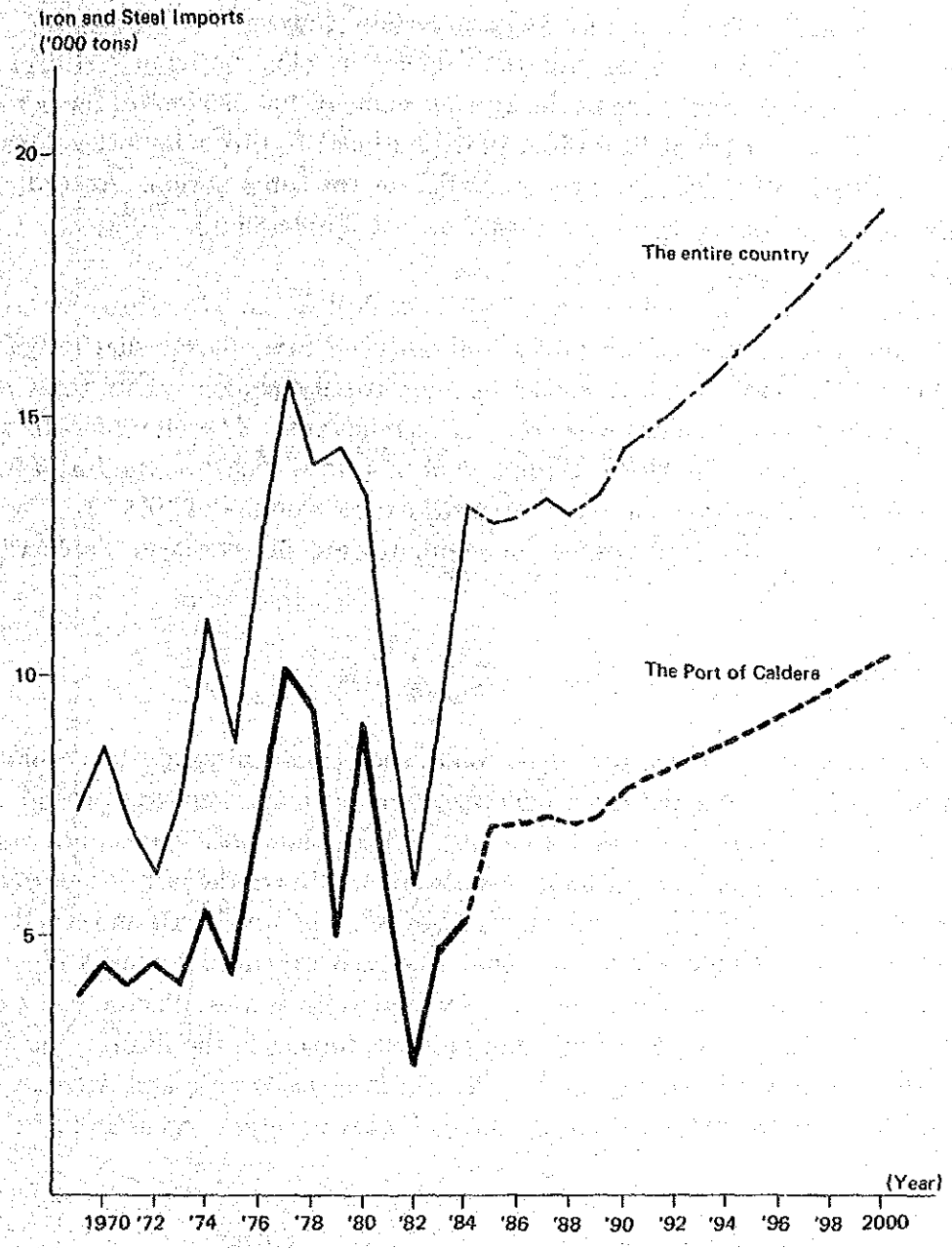


Fig. VII-9 Iron and Steel Import Volume

grains at an annual increase rate of 3.61 for the period from 1983 through 1992. This rate of increase is estimated to continue through 2000 in this study.

1982 is selected as the base year for the projection. The national fertilizer import volume in the base year is assumed to be the average value of 100,000 tons of the period from 1980 through 1984. The share of FERTICA in the national fertilizer import volume in the base year is assumed to be 82%, the average value for the same period. Accordingly, the fertilizer import cargo volume is projected as shown in Table Ⅶ-13.

2) Exports

Fertilizer exports have seldom been handled at the Port of Caldera. However, according to the Final Report of the Feasibility Study of the Second Stage Expansion Project at the Port of Caldera, JICA, FERTICA intends to export twenty percent of its total fertilizer exports through the Port of Caldera when the port is renovated. Therefore, fertilizer export volume through the Port of Caldera is estimated in this study based on the FERTICA plan. Furthermore, it is assumed that the total fertilizer export volume of FERTICA will reach eighty thousand tons in the year 2000. The estimates are presented in Table Ⅶ-14 and Fig.Ⅶ-10.

(5) Other general cargoes

1) Imports

Other general cargoes include processed foods, such chemical products as rubber products, chemical medicines and plastic products, paper products, bagged corn, glasswares, metals other than iron and steel, and automobiles. There has been a comparatively close correlation between national other general cargoes and GDP over the last sixteen years. The future volume of national other general cargoes can be estimated based on this correlation. The share of the Port of Caldera in the national other general cargo volume will increase in the future because international trade with Asian countries and the Pacific coast of American countries is currently increasing and will progress further in the future. The projected national other general cargo volume is thus divided into the Pacific and Atlantic shares.

The correlation between the national volume of other general cargoes and GDP is shown below.

$$Y = 158.29\,X - 239.338 \qquad (R = 0.938)$$

Where X : GDP in Costa Rica (unit : million colones at 1966 constant prices)

Y : National other general cargo volume (unit: tons)

R : Correlation coefficient

The future share of cargo volume on the Pacific coast in the nationl other general cargo volume is calculated based on the data from 1976 through 1984. The correlation equation is shown below.

Table VII-13 Fertilizer Import Forecast

(unit : tons)

	Costa Rica	The Pacific coast
(Actual)		
1980	130,590	72,179
1984	86,214	83,620
(Projected)		
1990	132,800	108,900
1992	142,600	116,900
1995	158,600	130,100
2000	189,300	155,200

Table VII-14 FERTICA Fertilizer Export Forecast

(unit : tons)

Year	FERTICA Fertilizer Export Volume	
	Total	The Port of Caldera
(Actual)		
1976	92,261	—
1981	68,016	—
1984	27,470	—
(Projected)		
1990	48,000	10,000
1992	53,000	10,000
1995	62,000	12,000
2000	80,000	16,000

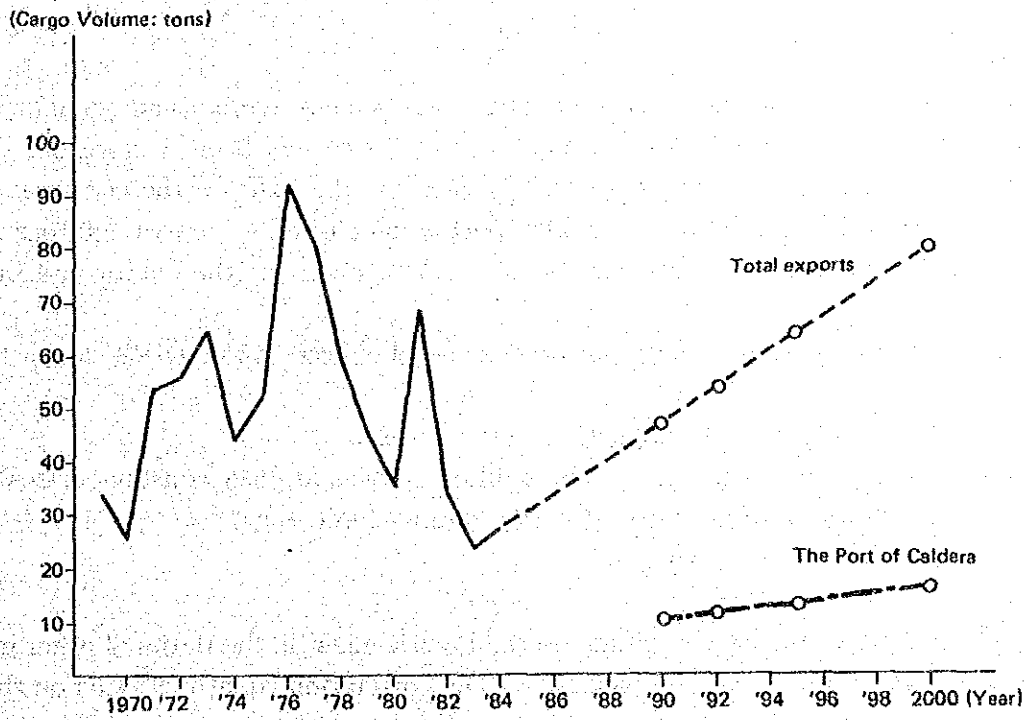


Fig. VII-10 Fertilizer Export Forecast

$$Y = 0.572X - 30.83 \quad (R = 0.526)$$

Where X : Year minus 1900

Y : The share of other general cargo volume on the Pacific coast, that is at the Port of Caldera

R : Correlation coefficient

Consequently, the other general cargo import volume at the Port of Caldera is obtained as shown in Table VII-15 and Fig.VII-11.

Table VII-15 Other General Cargo Import Forecast

Year	National Total (tons)	The port of Caldera	
		Share (%)	Cargo Volume (tons)
(Actual)[1]			
1970	668,526	30.6	204,851
1975	898,881	14.8	133,203
1980	1,345,962	16.5	221,661
1984	1,175,471	16.9	198,157
(Projected)			
1990	1,426,000	20.7	294,000
1992	1,510,000	21.8	329,000
1995	1,645,000	23.5	387,000
2000	1,892,000	26.3	498,000

Source 1) : CUADROS ESTADISTICOS SOBRE SECTOR TRANSPORTES, DGP/MOPT
Note : Cargo volume at the Port of Caldera includes that handled at the Port of Puntarenas in the past.

2) Exports

Other general cargoes include coffee, bananas, rice, cement, lumber and wood products, fruits and vegetables, beef and other animal meat. There has been a close correlation between the national exports of other general cargoes and the GDP for the last three years. Based on the correlation, the future national export volume of other general cargoes can be estimated. The estimated national volume is then broken down into the Pacific and Atlantic shares.

The correlation between the national other general cargoes and GDP is shown below.

$$Y = 297.6X - 1{,}567{,}280 \quad (R = 0.995)$$

Where X : GDP in Costa Rica (unit : million colones at 1966 constant prices)

Y : National other general cargo volume (unit: tons)

R : Correlation cofficient

The future share of the cargo volume on the Pacific coast in the national other general caego volume is calculated based on past data. The correlation equation, based on the past

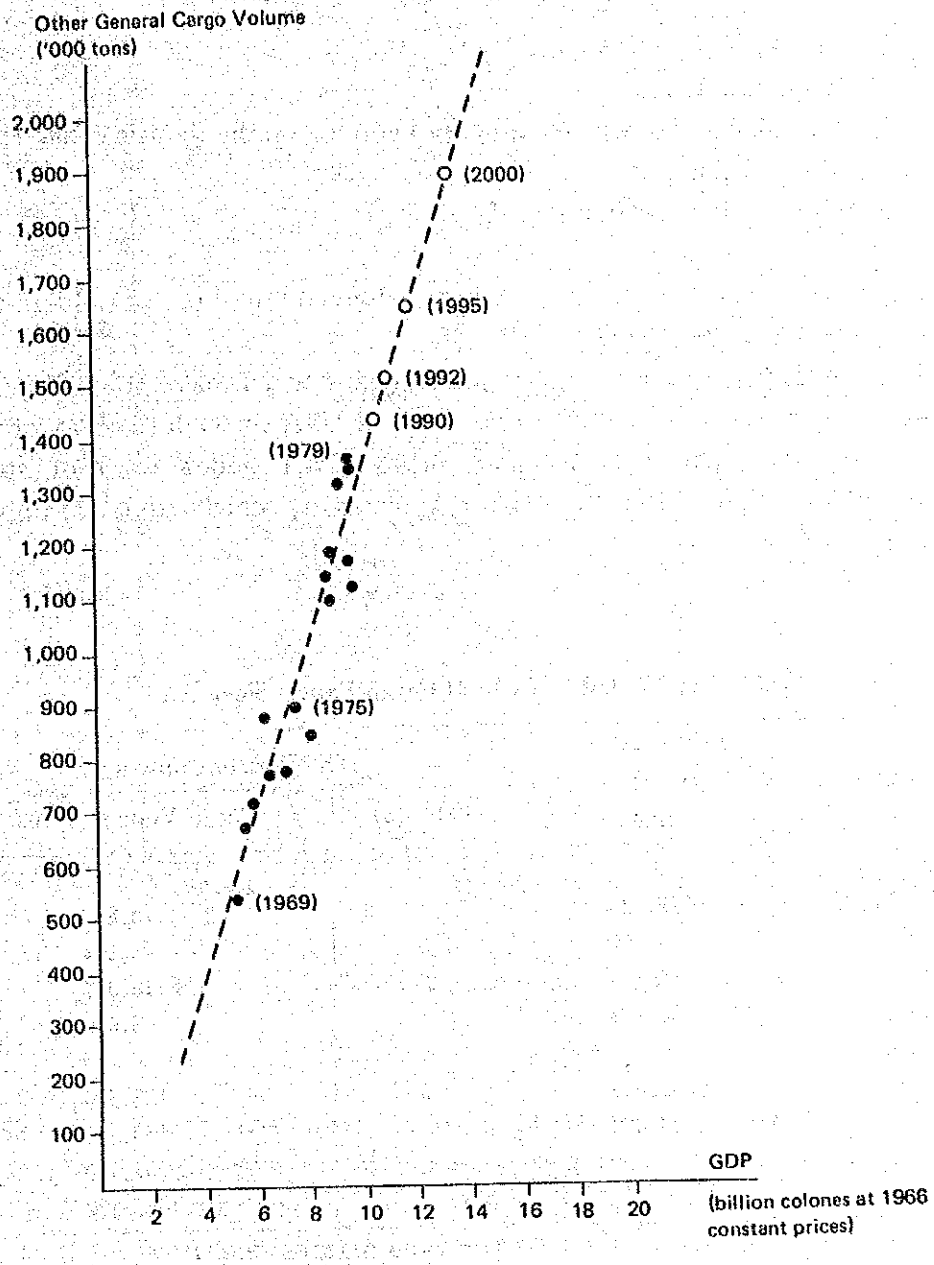


Fig. VII-11 Other General Cargo Import Forecast

trend for the period from 1979 through 1984, is shown below.

$$Y = 0.531X - 39.95 \qquad (R = 0.652)$$

Where X : Year minus 1900

Y : The share of other general cargo volume on the Pacific coast, that is at the Port of Caldera

R : Correlation coefficient

Accordingly, the other general cargo export volume at the Port of Caldera is obtained as shown in Table VII-16 and Fig.VII-12.

Part of the rapidly increasing exports are bananas which have started to be shipped from the east coast of Casta Rica to the west coast of USA through the Port of Caldera by refrigerator ship with a ship size of about 14,000 DWT and a draft of about 8.8 m. According to INCOP, about 92 thousand tons of bananas are scheduled to be shipped through the port within 1986.

Table VII-16 Other General Cargo Export Forecast

Year	National Total (tons)	The Port of Caldera	
		Share (%)	Cargo Volume (tons)
(Actual)[1]			
1970	671,425	11.3	75,887
1975	973,610	4.5	43,934
1980	948,990	2.0	18,972
1984	1,260,112	6.2	78,668
(Projected)			
1990	1,563,000	7.9	123,500
1992	1,722,000	8.9	153,300
1995	1,975,200	10.5	207,400
2000	2,440,000	13.2	322,100

Source 1): CUADROS ESTADISTICOS SOBRE SECTOR TRANSPORTES, DGP/MOPT
Note : Cargo volume at the Port of Caldera includes that handled at the Port of Puntarenas in the past.

(6) Containerized Cargo

Part of the general cargoes are transported in containers. In this section, the containerized cargo volume of general cargoes is projected. Port cargoes other than grain bulk and automobiles are taken to be general cargoes in this study.

The flow chart of the containerized cargo volume forecast is shown in Fig.VII-13. Detailed past data concering individual commodity items and their respective containerized cargo volume are not available. However, containerized cargoes totalling 28,452 tons for import and 26,760 for export were handled at the Ports of Caldera and Puntareas in 1984.

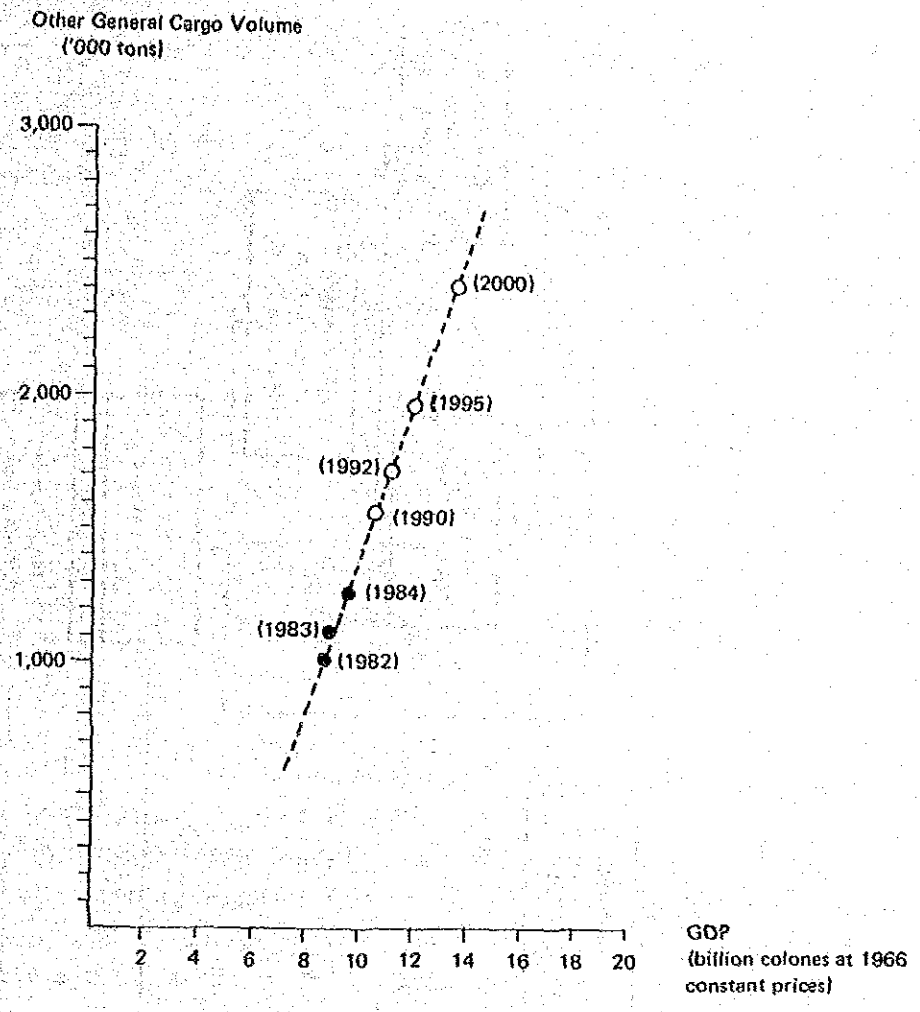


Fig. VII-12 Other General Cargo Export Forecast

For the container forecast, first the ultimate containerizability ratio P_m is calculated. Base cargoes for the projection of containerized cargoes, which are part of general cargoes, are shown in Table VII-18. The containerization suitability of each commodity is classified according to the following classification.

A : Cargo suited for containerization

B : Item containing both cargo suited for containerization and cargo not suited for containerization

C : Cargo not suited for containerization

The likelihood that individual cargo items will be containerized also varies by cargo route. Thus, the commodities are also classified by trade route as follows.

A : Cargo traded mainly with North America, Europe and the Far East ;

B : Cargo unable to be classified as either A or C ;

C : Cargo traded mainly with Central American countries.

The base cargoes are evaluated in Table VII-18 based on their suitability for containerization and their trade routes. The overall containerizability of each commodity is based on

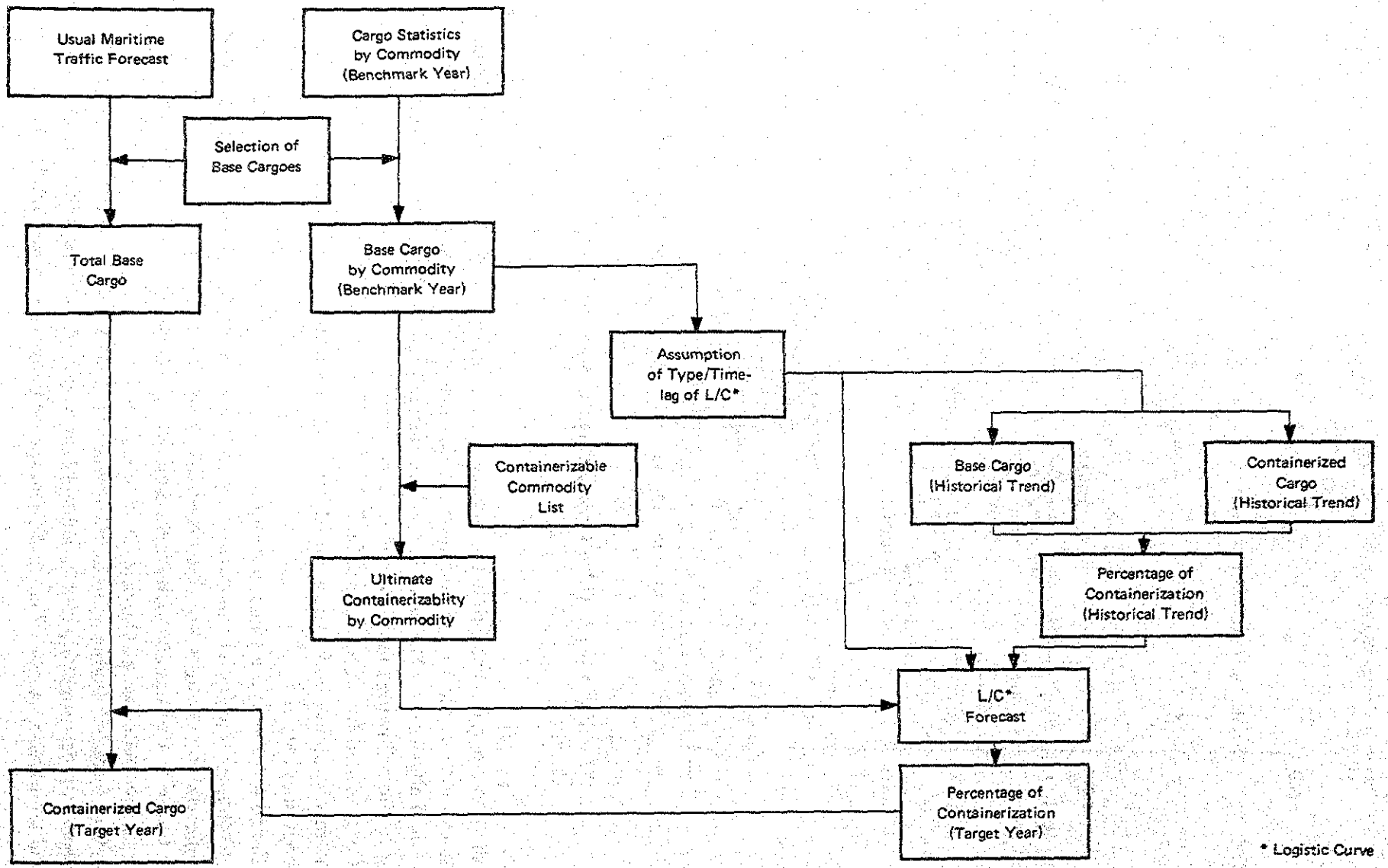


Fig. VII-13 Flow Chart of Containerized Cargo Forecast

Table VII-17 Actual Containerized Cargo Volume

(Imports)

Year	General Cargo Volume (tons)	Containerized Cargo		
		Cargo Volume (tons)	Containerized Ratio (%)	Number of Contatiners (TEU)
1983	202,732	15,743	7.8	1,452
1984	251,342	28,452	11.3	2,406

(Exports)

Year	General Cargo Volume (tons)	Containerized Cargo		
		Cargo Volume (tons)	Containerized Ratio (%)	Number of Containers (TEU)
1983	139,922	28,486	20.4	1,764
1984	183,892	26,760	14.6	1,678

Source : DGOPF/MOPT

a combination of these two evaluations as shown in Table Ⅶ-19. If this table is applied to commodity composition at the port in 1983, the ultimate containerizability ratio P_m of general cargoes in total is approximately 75% for imports and 60% for exports.

Next, the future containerization ratio at the port is calculated based on the ultimate containerizability ratio P_m calculated above using a logistic curve. The basic equation for the logistic curve approximation of the growth of containerization is as follows :

$$P = \frac{P_m}{1 + C^{(t - t_0)}}$$

Where P : Percentage of containerization by route at year t

P_m : Ultimate containerizability by route which is defined as "percent age of containerization by route at the fully containerized stage"

C : A parameter

t : Year

t_0 : Time lag in years

Usually, the values of parameters C and t_0 and the starting point of t are obtained based on regression analysis of containerization in the past. However, such exceptional circumstances as shown below should be fully considered at the Port of Caldera.

1) Data on past containerization is available for only two years.
2) The containerized ratio for export unexpectedly decreased from 1983 to 1984.
3) The tendency of containerization in the past cannot be assumed to continue in the future without any change because the operation of full-container ships between the Port of Caldera and Europe has been suspended.

Table VII-18 Suitability of Containerization and Trade Routes

IMPORTS		
Commodity Groups	Suitability	Route
Agricultural and Food Products	A	C
Rubber Products and Cement	A	B
Chemical Products	A	A
Machinery and Parts	A	A
Vehicles and Construction Machinery	B	B
Paper and Cartons	A	A
Manufactured Metal	A	A
Clothes, Glass Products and Pulp	B	B
Others	A	A

EXPORTS		
Commodity Groups	Suitability	Route
Processed and Agricultural Products	A	A
Fruits and Vegetables	A	C
Lumber, Wood Products and Pulp	A	C
Others	A	C

Table VII-19 Containerizability corresponding to Suitability and Trade Routes

IMPORTS			EXPORTS		
Suitability	Trade Route	Containerizability (%)	Suitability	Trade Route	Containerizability (%)
A	A	95	A	A	95
A	B, C	50	A	C	20
B	A, B, C	10	B	C	10
C	A, B, C	0	C	A, C	0

Thus, the following approach is adopted in this study.

1) The study mainly aims at the projection of containerization after 1990. Calculated containerized ratios from 1985 through 1989 can be considered imaginary.
2) Values in Table VII-20 which are calculated by regression analysis based on the past data on the containerized shipping routes between Japan and various developing countries are adopted for parameters C and t_0 in this study.
3) The starting point of t is set as 1980 considering the fact that the operation of full -container ships has been suspended. Subsequently, the suspension will delay the containerization at the Port of Caldera by about five years in the future compared to the imagingary containerization ratios.

Table VII-20 Values of Parameters C and t_0

	C	t_0 (years)
Imports	0.72	13
Exports	0.64	13

The time progression of the calculated containerizability is shown in Fig.VII-14. Consequently, the future containerized ratios, containerized cargo volume and the number of containers at the Port of Caldera are projected as shown in Table VII-21 and Table VII-22, respectively.

(7) Sugar

The sole Costa Rican sugar plant, LAICA, is located at the Port of Punta Morales. The plant has its own private pier for sugar exportation. Sugar exports will also be handled at the port in the future. The estimation equation is as follows :

Sugar export volume = Sugar cane area (ha)
× Export volume per hectare (tons/ha)

The crop area is estimated using the correlation with the year. The correlation equation is as follows :

$$Y = 0.381\,X + 2.122 \qquad (R = 0.928)$$

Where X : Year minus 1900
Y : The sugar cane crop area ('000 ha)
R : Correlation coefficient

The projected exports are shown in Table VII-23.

Table VII-21 Projected Containerized Cargo Volume

EXPORTS				
Year	General Cargo Volume (tons)	Containerized Ratio (%)	Containerized Cargo Volume (tons)	Number of Containers (TEU)
(Actual)				
1983	139,922[1)]	20.4	28,486[2)]	1,761
1984	183,892	14.6	26,760	1,678
(Projected)				
1992	163,300	25.1	41,000	3,340
1995	219,400	39.5	86,700	7,050
2000	338,100	54.6	184,600	15,010

	IMPORTS			
Year	General Cargo Volume (tons)	Containerized Ratio (%)	Containerized Cargo Volume (tons)	Number of Containers (TEU)
(Actual)				
1983	202,732[1)]	7.8	15,743[2)]	1,452
1984	251,342	11.3	28,452	2,406
(Projected)				
1992	412,000	29.3	120,700	10,680
1995	477,000	53.2	253,800	22,460
2000	601,800	71.8	432,100	38,240

Source 1) : CUADROS ESTADISTICOS SOBRE SECTOR TRANSPORTES, DGP/MOPT
2) : DGOPF/MOPT

Table VII-22 Number of Loaded and Empty Containers

Unit : TEU

Year	Export/Import	Loaded	Empty	Total
1992	Export	3,340	7,340	10,680
	Import	10,680	—	10,680
	Total	14,020	7,340	21,360
2000	Export	15,010	23,230	38,240
	Import	38,240	—	38,240
	Total	53,250	23,230	76,480

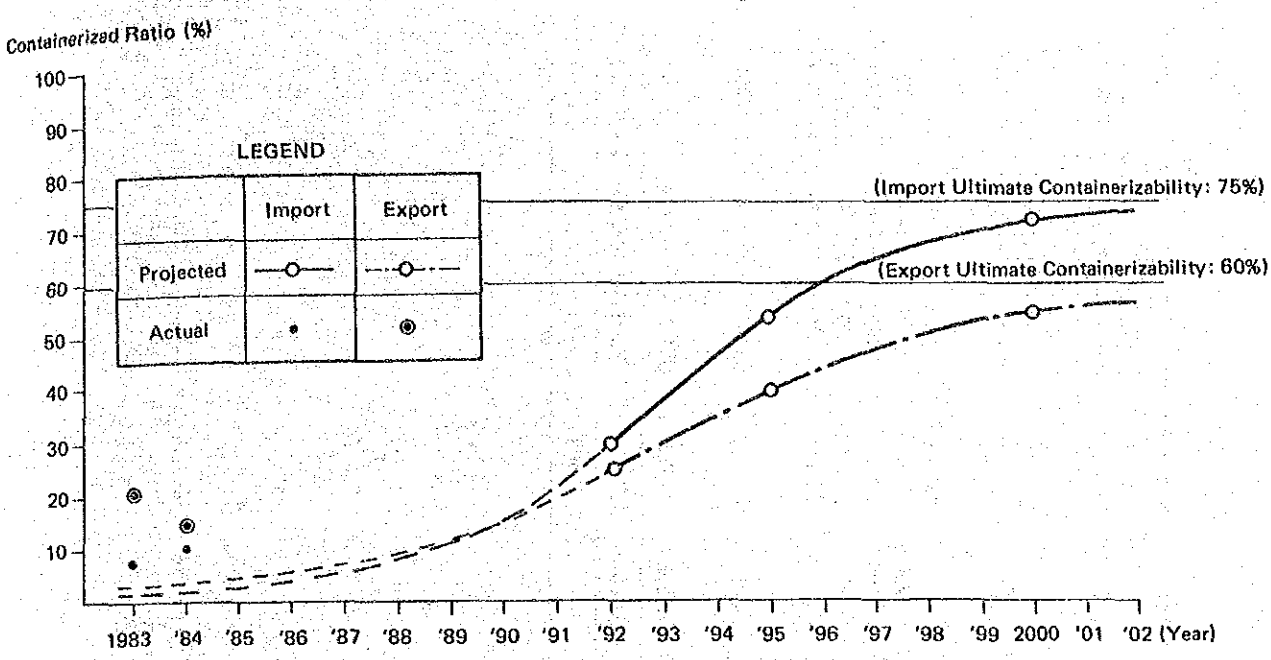


Fig. VII-14 Containerizability Time Progression

Table VII-23 Sugar Export Forecast

Year	Export Cargo Volume (tons)	Sugar Cane Crop Area ('000 ha)
(Actual)[1]		
1980	72,430	32.2
1984	58,000	34.1
(Projected)		
1992	85,300	37.1
1995	88,100	38.3
2000	92,500	40.2

Source 1): CUADROS ESTADISTICOS SOBRE SECTOR TRANSPORTES DGP/MOPT

1. 2. 3 Cargo Forecast Summary

As a conclusion, Table VII-24 shows a summary of the cargo forecasts. Fig.VII-15 is a comparison of the cargo volumes obtained by the macro and micro forecast methods described in Section 1. 2. There is scarcely any discrepancy between the macro and micro forecasts. Hereafter, in this study, the total cargo volumes handled at the Port of Caldera in the target years as forecast by the micro method are adopted.

Table VII-24 Projected Cargo Volume at the Port of Caldera

(Unit : tons)

	IMPORTS				EXPORTS				TOTAL			
	1984 [1]	1992	1995	2000	1984 [1]	1992	1995	2000	1984 [1]	1992	1995	2000
〔The Port of Caldera〕												
Grain	131,167	166,100	158,900	149,200	—	—	—	—	131,167	166,100	158,900	149,200
Automobiles	4,816	21,900	24,700	29,900	—	—	—	—	4,816	21,900	24,700	29,900
General Cargo												
Iron and Steel	53,185	83,000	90,000	103,800	—	—	—	—	53,185	8,300	90,000	103,800
Fertilizer	—	—	—	—	5,500	10,000	12,000	16,000	5,500	10,000	12,000	16,000
Others	198,157	329,000	387,000	498,000	78,668	153,300	207,400	322,100	276,825	482,300	594,400	820,100
(Containerized)	(28,452)	(120,700)	(253,800)	(432,100)	(26,760)	(41,000)	(86,700)	(184,600)	(55,212)	(161,700)	(340,500)	(616,700)
Sub-Total	387,325	600,000	660,600	780,900	84,168	163,300	219,400	338,100	471,493	763,300	880,000	1,119,000
〔FERTICA〕												
Fertilizer	83,620	116,900	130,100	155,200	21,970	43,000	50,000	64,000	105,590	159,900	180,100	219,200
〔Punta Morales〕												
Sugar	—	—	—	—	139,950	85,300	88,100	92,500	139,950	85,300	88,100	92,500
Micro Forecast TOTAL	470,945	716,900	790,700	936,100	246,088	291,600	357,500	494,600	717,033	1,008,500	1,148,200	1,430,700
Macro Forecast									717,033	1,090,800	1,184,000	1,355,600

Source 1) : CUADROS ESTADISTICOS SOBRE SECTOR TRANSPORTES 1984, DGP/MOPT
Note : Cargo volume at the Port of Caldera includes that handled at the Port of Puntarenas in the past.

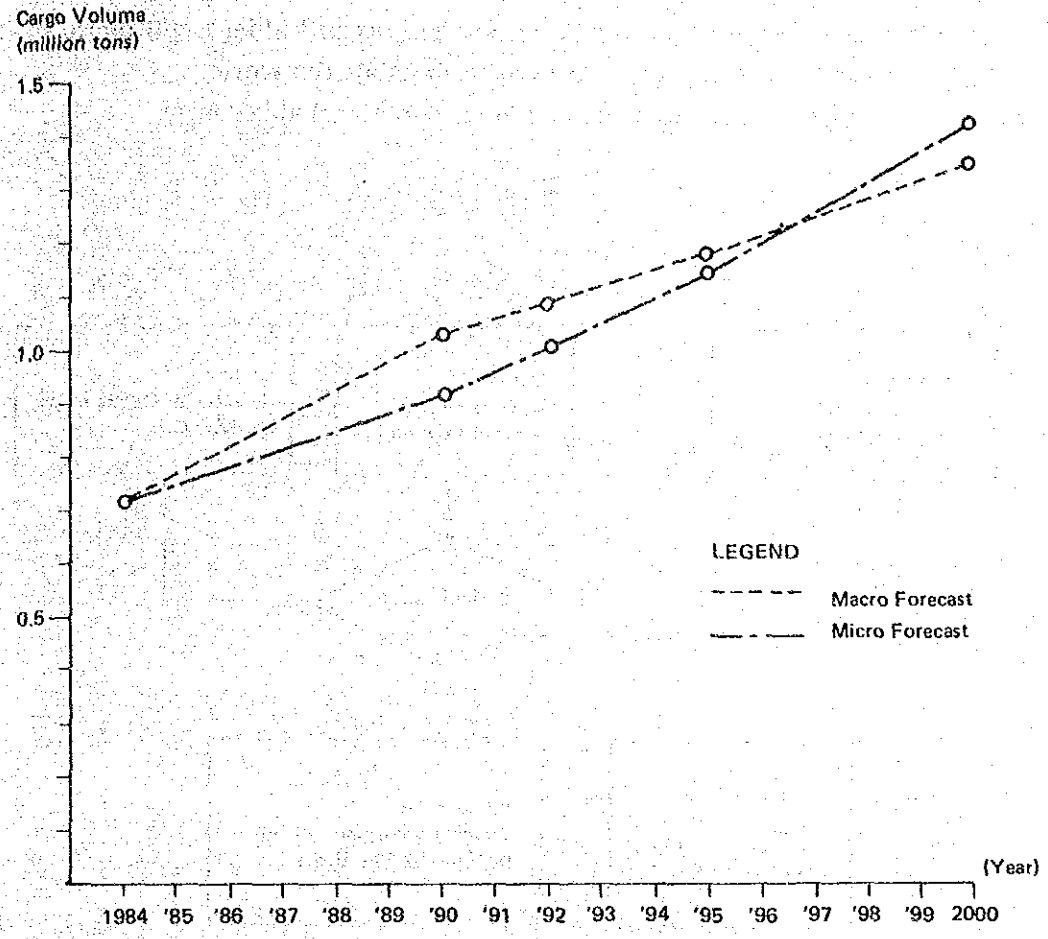


Fig. VII-15 Comparison between Macro and Micro Forecast Results

1. 3 Estimation of Calling Ships

The number of calling ships is estimated according to the procedure shown in Fig.VII-16. In the analysis of the existing statistical data, we made the following three simplifications :

(1) Ships are classified into the ship groups shown in Table VII-25.

(2) Ships that call at the Port of Caldera are classified by individual commodity despite the fact that many of them actually carry a variety of commodities.

(3) Ships are assumed to load or unload a sole specialized commodity although most of them actually load or unload a variety of commodities.

The actual number of calling ships in 1984 is shown in Table VII-25 based on the monthly statistical reports of INCOP. The actual loading/unloading volume per ship is obtained analyzing the data of the MOPT statistical reports in conjunction with the above data. The results are shown in the same Table VII-25. The past loading/unloading volume per ship has been too small ; however, it is tending to increase. The increase rate from 1983 to 1984 is about 11.6%. This point be should considered. The ship size of cargo ships all over the world has not changed drastically over a long period as shown in Table VII-26. Thus, we

assume that the ship size of the ships which call at the Port of Caldera will increase at the same rate that cargo ships are increasing in size throughout the world.

The projected number of calling ships in 1992 is show in Table VII-27.

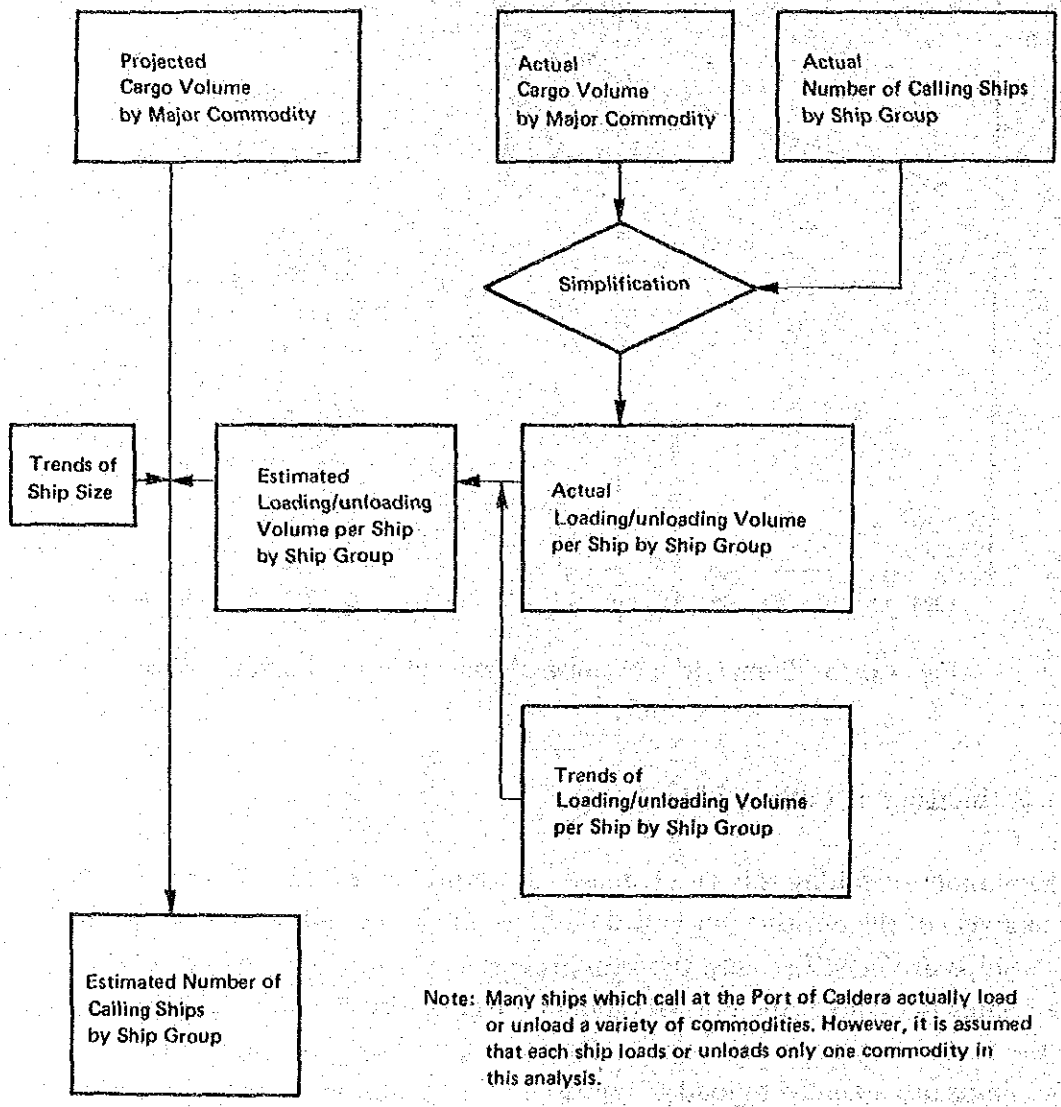


Fig. VII-16 Estimation Procedure of the Number of Calling Ships

Table VII-25 Actual Calling Ships at the Ports of Caldera and Puntarenas in 1984

Ship Group Number	Ship Type[3]	Ship Size Rank ('000 DWT)	Number of Calling Ships[1]	Average Ship Size[1]		Loading/unloading Volume per Ship[2]	
				DWT	GRT		
1	General Cargo Ships	~ 5	34	2,339	1,450	860	tons
2		5 ~ 10	38	7,942	5,177	1,160	tons
3		10 ~ 20	93	14,597	10,001	2,020	tons
4		20 ~	8	20,996	14,468	1,750	tons
5	Automobile Carriers	~ 10	8	7,899	9,338	250	tons
6		10 ~ 20	12	11,726	10,657	240	tons
7	Container Ships	~ 20	2	3,549	3,694	50	TEU
8		20 ~ 30	44	24,118	28,086	107	TEU
9	Grain Cargo Carriers	~ 10	12	6,713	4,633	4,030	tons
10		10 ~ 20	6	13,837	10,218	7,410	tons
11		20 ~ 30	4	26,045	15,141	6,430	tons
12		30 ~	1	30,130	17,250	12,670	tons
13	Fertilizer Cargo Ships	~ 10	5	7,856	4,703	1,100	tons
14	Passenger Cruisers		15	n.d.	n.d.	n.d.	

Source 1) : *INFORME ESTADISTICO MENSUAL, INCOP*
2) : CUADROS ESTADISTICOS SOBRE SECTOR TRANSPORTES 1984, DGP/MOPT
Note 3) : Almost all ships actually load or unload a variety of commodities. However, they are assumed to handle a sole commodity in this table.

Table VII-26 Worldwide Trends of Ship Size

Year	Number of Ships	Total Gross Tonnage ('000 GRT)	Average Ship Size (GRT/ship)	Increase Rate (1975 : 1.000)
1950	28,694	67,409	2,349	1.168
1955	28,917	74,114	2,563	1.274
1960	31,768	88,305	2,780	1.382
1965	35,155	86,589	2,463	1.225
1970	43,813	94,698	2,161	1.075
1975	52,989	106,557	2,011	1.000
1980	62,014	135,311	2,182	1.085
1984	64,192	142,885	2,226	1.107

Source : LLOYD Statistical Tables
Note : Present ships include cargo and fishing boats other than oil tankers and ore bulk carriers.

Table VII-27 Estimated Calling Ships in 1992

Ship Group Number	Ship Type	Ship Size Rank ('000 DWT)	Number of Calling Ships
1	General Cargo Ships	~ 5	26
2		5 ~ 10	27
3		10 ~ 20	70
4		20 ~	6
5	Automobile Carriers	~ 10	19
6		10 ~ 20	29
7	Container Ships	~ 20	5
8		20 ~ 30	103
9	Grain Cargo Carriers	~ 10	8
10		10 ~ 20	4
11		20 ~ 30	2
12		30 ~	1
13	Fertilizer Cargo Ships	~ 10	5
14	Passenger Cruisers		18