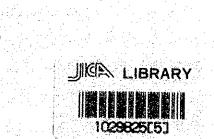
# FINAL REPORT

THE STUDY ON
THE MAINTENANCE PROJECT OF
THE PORT OF CALDERA IN
THE REPUBLIC OF COSTA RICA

JULY 1986

JAPAN INTERNATIONAL COOPERATION AGENCY



国際協力事業団 <sup>受入</sup> 86. 8. 22 605 <sup>登録</sup> 15212 5DF

> マイクロ フィルム作成

### **PREFACE**

In response to the request of the Government of the Republic of Costa Rica, the Government of Japan decided to conduct a study on the Maintenance Project of the Port of Caldera and entrusted the study to Japan International Cooperation Agency (JICA). JICA sent to Costa Rica a study team headed by Mr. Takashi Hazama, the Overseas Coastal Area Development Institute of Japan from September to November, 1985.

The team had discussion on the project with the officials concerned of the Government of the Republic of Costa Rica and conducted a field survey. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the authorities concerned of the Government of the Republic of Costa Rica for their close cooperation extended to the team.

July, 1986

Keisuke Arita

President

Japan International Cooperation Agency

### LETTER OF TRANSMITTAL

July 1986

Mr. Keisuke Arita
President
Japan International Cooperation Agency

Dear Sir:

It is my great pleasure to submit herewith a report on the Maintenance Project of the Port of Caldera, the Republic of Costa Rica.

This report describes the result of studies on the project carried out by the joint study team of the Overseas Coastal Area Development Institute of Japan (OCDI) and Central Consultant Incorporated (CCI) at the appointment of the Japan International Cooperation Agency (JICA). The study team started the study on September 20, 1985 and conducted a field survey on the project in Costa Rica, including a field survey on natural conditions at the site, for two months ending on November 22, 1985. This report describes the Maintenance Project and the economic and financial feasibility of the project studied based on the findings of the survey as well as on the data and information collected and analysed in Japan. The study shows that the project is extremely important for the development of Costa Rica. Therefore, we earnestly hope that the project will be implemented as soon as possible.

On behalf of the Japanese Study Team, I would like to express my deepest appreciation to the Government of the Republic of Costa Rica including the Ministry of Public Works and Transportation (MOPT) and the Costa Rican Pacific Ports Authority (INCOP), and to the other related agencies of the government for the unlimited cooperation and assistance and the warm hospitality they extended to the team during our stay in Costa Rica.

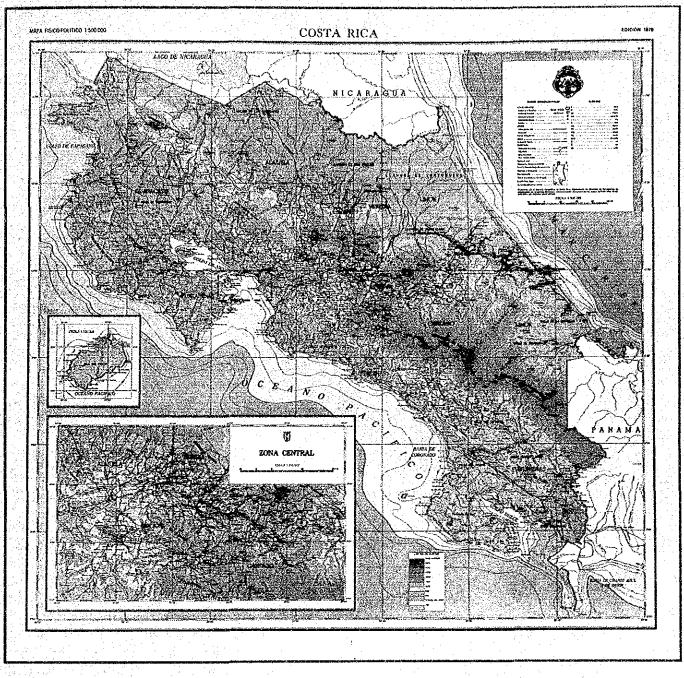
I am also greatly indebted to the Japan International Cooperation Agency, the Ministry of Transport, the Ministry of Foreign Affairs and the Japanese Embassy in Costa Rica for giving us valuable advice and assistance during the field survey and the preparation of this report.

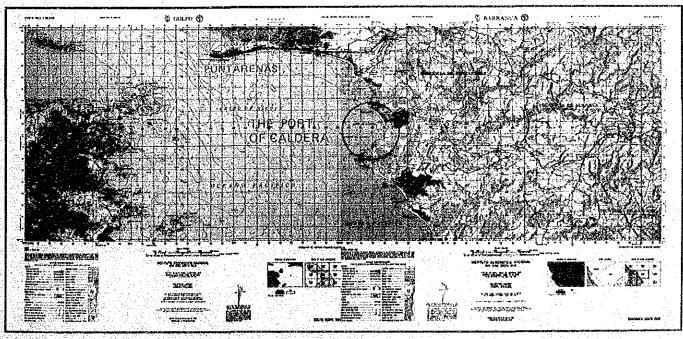
Sincerely yours,

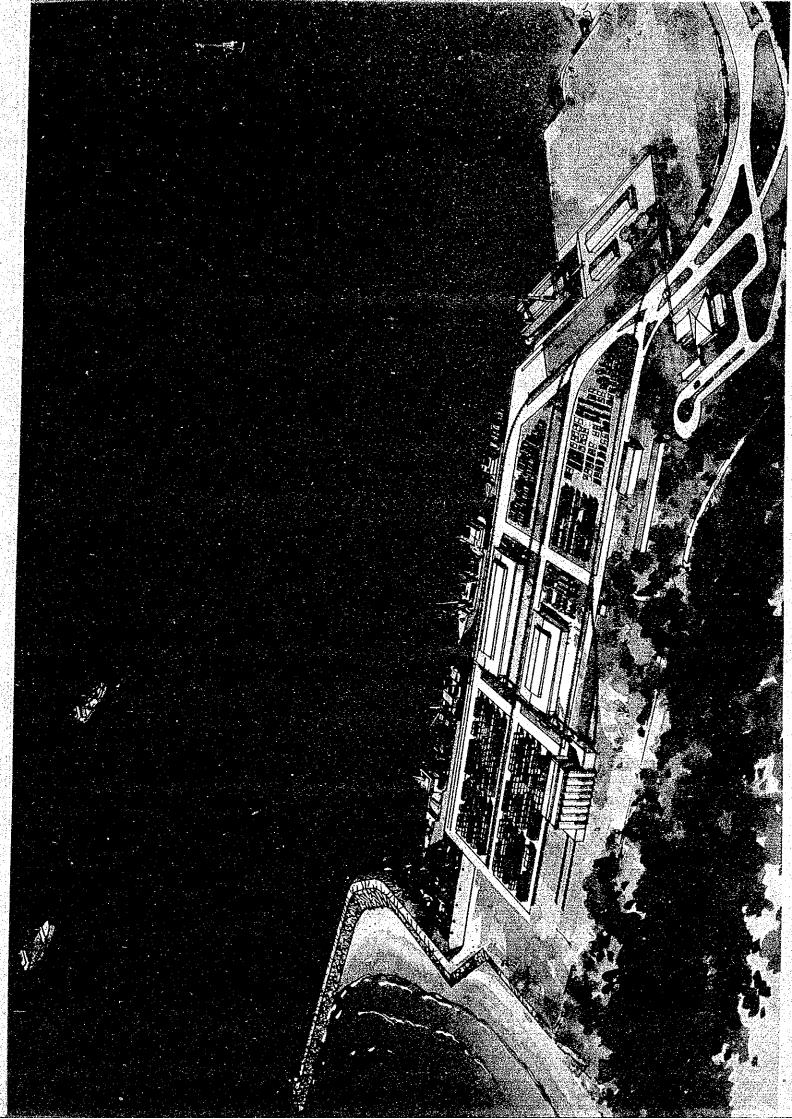
Takashi Hazama

Head

Japanese Study Team for the Maintenance Project of the Port of Caldera (Senior Executive Director, the Overseas Coastal Area Development Institute of Japan)







ABBREVIATIONS

In this report, the following abbreviations are used:

REPORTATION FILL NAME (SPANISH) FILL NAME (ENC

ABBREVIATION	FULL NAME (SPANISH)	FULL NAME (ENGLISH)
BCCR	Banco Central de Costa Rica	Central Bank of Costa Rica
CACM	Mercado Común Centroamericano (MCCA)	Central American Common Market
CCI		Central Consultant Incorporated
CELADE	Centro Latinoamericano de Demografía	Latin-American Center of Demography
CEMPA	Cementos del Pacífico, S.A.	Pacific Cement-manufacturing Corporation
CEMPRO	Centro de Promoción de Exportaciones e Inversiones	Export and Investment Promotion Center
CINDE	Coalición Costarricense de Iniciativa para el Desarrollo	Costa Rican Coalition of Initiative for Development
CNP	Consejo Nacional de Producción	National Council of Production
COCOSA	Constructora Costarricense S.A.	Costa Rican Construction Co., Ltd.
DGEC,	Dirección General de Estadis-	Bureau of Statistics and
MEIC	tica y Censos, Ministerio de Economía, Industria y Comercio	Census, Ministry of Economy, Industry and Commerce
DGOPF	Dirección General de Obras Portuarias y Fluviales, MOPT	Bureau of Port and River Works, MOPT
DGP	Dirección General de Planificación, MOPT	Bureau of Planning, MOPT
DGTM	Dirección General de Trans- porte Maritimo MOPT	Bureau of Maritime Transport, MOPT
FECOSA	Ferrocarriles de Costa Rica S.A. (el antepasado de INCOFE presente)	Costa Rican Railway Corporation (the predecessor of the present INCOFE)
FERTICA	Fertilizantes de Centroamerica (Costa Rica) S.A.	Fertilizers of Central America (Costa Rica) Corp.
IDB	Banco Interamericano de Desarrollo	Inter-American Development Bank
IECES	Instituto de Investigaciones de la Escuela de Ciencias Económicas y Sociales de la Universidad de Costa Rica	Investigation Institute of the Economic and Social Science College, University of Costa Rica

ABBREVIATIO IGN IMN INCOFE INCOP	Instituto Geográfico Nacional Instituto Meteorológico Nacional Instituto Costamicanae de Ferrocarriles Instituto Costamicanae de Puertos del Pacífico Instituto Nacional de Vivienda y Urbanismo	FULL NAME (ENGLISH)  National Geographic Institute  National Meteorological Institute  Costa Rican Railway Institute  Costa Rican Pacific Ports  Authority  National Institute for Housing
IGN IMN INCOFE INCOP	Instituto Geográfico Nacional Instituto Meteorológico Nacional Instituto Costamicense de Ferrocarriles Instituto Costamicense de Puertos del Pacífico Instituto Nacional de Vivienda	National Geographic Institute National Meteorological Institute tute Costa Rican Railway Institute  Costa Rican Pacific Ports Authority National Institute for Housing
IMN INCOFE INCOP	Instituto Meteorologico Nacional Instituto Costarricense de Ferrocarriles Instituto Costarricense de Puertos del Pacífico Instituto Nacional de Viviguda	National Meteorological Insti- tute Costa Rican Railway Institute Costa Rican Pacific Ports Authority National Institute for Housing
IMN INCOFE INCOP	Instituto Meteorologico Nacional Instituto Costarricense de Ferrocarriles Instituto Costarricense de Puertos del Pacífico Instituto Nacional de Viviguda	tute Costa Rican Railway Institute Costa Rican Pacific Ports Authority National Institute for Housing
INCOP	Instituto Costamicanse de Ferrocarriles Instituto Costarricense de Puertos del Pacífico Instituto Naciodal de Vivienda	Costa Rican Railway Institute  Costa Rican Pacific Ports  Authority  National Institute for Housing
INCOP	Ferrocarriles Instituto Costarricense de Puertos del Pacífico Instituto Naciodal de Viviencia	Costa Rican Pacific Ports Authority National Institute for Housing
· · · · · · · · · · · · · · · · · · ·	Puertos del Pacífico Instituto Nacional de Vivienda	Authority National Institute for Housing
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		and City Planning
JAPDEVA	Junta de Administración Portu- aria y de Desarrollo Económico	Authority for the Port Administration and Economic Devel-
	de la Vertiente Atlantica	opment of the Atlantic Coast
JAPOQ	Junta Administrativa Portuaria de Quepos	Council for the Administra- tion of the Port of Quepos
JICA	Agencia de Cooperación Inter- nacional de Japón	Japan International Cooperation Agency
JST	Misión Japonesa de Investiga- ción para el Estudio de Facti-	Japanese Study Team for the Feasidility Study on the Main-
	bilidad del Proyecto de Mante- nimiento del Puerto Caldera	tenance Project of the Port of Caldera
LAICA	Lìga Agricola Industrial de la Caña de Azúcar	Sugar-manufacturing Industry Corporation
MAG	Ministerio de Agricultura y Ganadería	Ministry of Agriculture and Stock Farming
MIDEPLAN	Ministerio de Planeación y Política Económica	Ministry of Economic Plan- ning
МОРТ	Ministerio de Obras Públicas y Transportes	Ministry of Public Works and Transports
OCDI	Instituto Japonés para el	그리다 그 사이에 가는 사람이 없는 그래 가는 그래 사람들이 없다.
	Desarrollo de Litorales en Ultramar	Overseas Coastal Area Develop- ment Institute of Japan
PHRI		Port and Harbour Research In-
		stitute, Ministry of Trans-
RECOPE	Poting to a C	port, Japanese Government
NECULE	Refinadora Costarricense de Petroleo S.A.	Costa Rican Oil Refinery
SENARA		Corporation
DUTAIN	Servicio Nacional de Aguas Subterráneas, Riego y	National Agency for Under-
	Avenamiento	ground Water, Irrigation and Drainage

BBREVIATION	FULL NAME (SPANISH)	FULL NAME (ENGLISH)
SEPSA	Secretaria Ejecutiva de	Executive Secretary's Office
	Planificación Sectorial,	for Sectoral Planning, Agri-
	Agropecuaria y de Recursos	culture and Renewable Natural
	Naturales Renovables	Resources
SYSTAN		System International Inc.
ZONA	Corporación Zona Franca de	Corporation of Free Zone
FRANCA	Exportaciones y Parques	for Exportation and
	Industriales	Industrial Parks
CIF	coste, seguro y flete	cost, insurance and freight
EIRR	tipo interno economico de	economic internal rate of
	retorno	return
FDD	dique flotante	floating dry dock
FIRR	tipo interno financiero de	financial internal rate of
	retorno	return
FOB	franco a bordo	free on board
GDP	producto domestico bruto	gross domestic product
Ro/Ro		roll on/roll off type sea
AT TY TY YES T		transportation
N.H.H.W.L.	la pleamar mas alta proxima-	nearly highest high water level
H.W.O.S.T.	mente pleamar media de marea viva	high water level of ordinary
n.w.o.s.r.	pieamai media de marea viva	spring tide
M.H.H.W.	pleamar media más alta	mean higher high water
M.H.W.	pleamar media	mean high water
H.W.O.N.T.	pleamar media de marea muerta	high water level of ordinary neap tide
M.S.L.	nivel medio del mar	mean sea level
L.W.O.N.T.	bajamar media de marea muerta	low water level of ordinary neap tide
M.L.W.	bajamar media	mean low water
M.L.L.W.	bajamar media más baja	mean lower low water
L.W.O.S.T.	bajamar media de marea viva	low water level of ordinary spring tide
N.L.L.W.L.	la bajamar más baja próxima-	nearly lowest low water level
M	mente	principal lunor countituest
$M_2$ $S_2$		principal lunar constituent principal solar constituent
$\mathbf{K_2}$		lunisolar semidiurnal consti-
		tuent
$N_2$		larger lunar elliptic consti-
		tuent

### **ABBREVIATION** FULL NAME (SPANISH) FULL NAME (ENGLISH) $K_1$ lunisolar diurnal constituent $O_1$ principal lunar diurnal constituent $P_1$ principal solar diuranl constituent $Q_1$ larger lunar elliptic constituent $M_4$ lunar quarter diurnal constituent MS<sub>4</sub> $M_2 + S_2$ A<sub>0</sub>

mean sea level

UNIT MARK  FULL NAME (ENGLISH)  QUANTITY  C degrees Celsius temperature velocity time days time dead weight tonnage dead weight of vessels Gal gals acceleration OWT dead weight tonnage volume of vessels Gal gals acceleration GRT gross registered tonnage volume of vessels h hours time ha hectare kgf/cm² kilogram weight per square centimeter kgf/cm² kilogram weight per cubic centimeter km/k kilometers per hour wind speed kWA kilowolt amperes power l liters volume m meters depth, distance m² square meters volume min minutes time min minutes time mm millimeters mon months time mm/s meters per second velocity PS horsepower s seconds tf ton weight per square meter tf/m³ ton weight per square meter tt/m³ ton weight per cubic meter TEU twenty-foot equivalent units y years degrees angle, latitude, longitude inches monetary unit of Costa Rica		ABBREVIATIONS	(UNIT)
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		colon	
\$P\$\$P\$ \$P\$\$P\$ \$P\$\$P\$\$P\$ \$P\$ \$P\$ \$P\$ \$P\$			

UNIT MARK	FULL NAM	IE (ENGLISH) QUANTITY
\$	dollar	monetary unit of the
		United States of America
¥	yen	monetary unit of Japan

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(Wave Direction: SSW, T <sub>1/8</sub> = 10 s)  Fig.M-1(24) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SSW, T <sub>1/8</sub> = 12 s)  Fig.M-1(25) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SSW, T <sub>1/8</sub> = 14 s)  Fig.M-1(26) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SSW, T <sub>1/8</sub> = 16 s)  Fig.M-1(27) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SSW, T <sub>1/8</sub> = 18 s)  Fig.M-1(28) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SSW, T <sub>1/8</sub> = 20 s)  Fig.M-1(29) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: N 213.8°, T <sub>1/8</sub> = 8 s)  Fig.M-1(30) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: N 213.8°, T <sub>1/8</sub> = 10 s)  Fig.M-1(31) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: N 213.8°, T <sub>1/8</sub> = 12 s)  Fig.M-1(32) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: N 213.8°, T <sub>1/8</sub> = 14 s)  Fig.M-1(33) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: N 213.8°, T <sub>1/8</sub> = 16 s)  Fig.M-1(34) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: N 213.8°, T <sub>1/8</sub> = 18 s)  Fig.M-1(35) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: N 213.8°, T <sub>1/8</sub> = 10 s)  Fig.M-1(36) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SW, T <sub>1/8</sub> = 8)  Fig.M-1(37) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SW, T <sub>1/8</sub> = 12 s)  Fig.M-1(38) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SW, T <sub>1/8</sub> = 12 s)  Fig.M-1(39) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SW, T <sub>1/8</sub> = 14 s)  Fig.M-1(39) Wave Refraction Chart of the Mouth of the Gulf of Nicoya (Wave Direction: SW, T <sub>1/8</sub> = 14 s)	73' X4 1 (00)	(Wave Direction: SSW, $T_{1/3} = 8 \text{ s}$ )
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# **CONCLUSIONS AND RECOMMENDATIONS**

# CONCLUSIONS AND RECOMMENDATIONS

# [CONCLUSIONS]

# 1. Significance and Urgency of the Maintenance Project

The Port of Caldera is the major gateway for the international trade of Costa Rica on the Pacific coast, as well as the nearest port to the national capital, San José. The port leads the national economy and industry and supports the livelihood of the Costa Rican people through commodity supply. However, one of the three berths of the port, which is the deepest and most important, has not been fully available because of shoaling due to the sand sedimentation in the harbour. Furthermore, the pier at the Port of Puntarenas which handles all the grain imports for the nation has already become superannuated. Thus, the Port of Caldera is obliged to take over the function of handling grain imports in place of Puntarenas pier in the immediate future.

Accordingly, the Maintenance Project of the Port of Caldera is both serious and urgent.

# 2. The Maintenance Project

The target year of the Maintenance Project of the Port of Caldera should be 1992 considering the required construction period and the projected increase in port cargo volume. The project consists of the following three main programs:

(1) Countermeasures against sand sedimentation

1) Breakwater extension : 200 m long

2) Primary dredging in the harbour : Volume of 72,000 m<sup>3</sup>

3) Periodic maintenance dredging : Approximately 60,000 m³/five years

(2) Enlargement of mooring facility capacity in response to the necessity of handling grain imports and the progress of containerization in sea transportation

1) Shift of a section of the existing breakwater 50 m to the west: length 162 m

2) Restoration of the -3.0 m small craft basin : 50 m×90 m
 3) Construction of the -3.0 m quaywall : 110 m long
 4) Construction of the small pier (gangway) : 45 m long

5) Construction of the mooring dolphin : 1 dolphin  $(5 \text{ m} \times 5 \text{ m})$ 

(3) Reinforcement to cargo handling capacity in response to the necessity of handling grain imports and the multipurpose use of the terminal

1) Reinforcement of the cargo handling equipment

2) Payement of the open yards : Area of 42,000 m<sup>2</sup>

# 3. Construction Method

Construction works at the Port of Caldera consist of both primary works and maintenance works. To execute the planned construction works economically and rationally, the construction method should be as follows:

First, MOPT should obtain a new dredger fleet and construction machinery for the future maintenance dredging and other works after the primary construction works are completed.

Second, the dredger fleet and construction machinery purchased by MOPT should be lent to a foreign contractor to execute the primary works. MOPT personnel should also take part in the primary construction works which will be executed by the foreign contractor as a type of on the job training.

Finally, after the primary works are completed and the dredger fleet and machinery have been returned to MOPT, MOPT should execute periodic maintenance works including maintenance dredging itself, using its own dredger fleet and machinery.

# 4. Grain Import Function

It is crucial to transfer the function of handling imported grain from the superannuated Puntarenas pier to the Port of Caldera as smoothly and as promptly as possible. As the grain will be handled at a multipurpose terminal at the Port of Caldera, a new mechanized and rationalized cargo handling system for grain will have to be implemented to increase the cargo handling efficiency so as to minimize the effects of the handling of grain on the handling of other cargoes.

# 5. Required Amount of Investment and Construction Period

The total investment for the Maintenance Project including the purchase cost of the dredger fleet, construction machinery and cargo handling equipment is estimated as approximately 1,268 million colones at December 1985 prices. About 80.4% of the investment will be made using foreign currency. The total construction period for the Maintenance Project will be four years including the preliminary contract procedures and the purchase of a dredger fleet, construction machinery and cargo handling equipment.

# 6. Economic and Financial Analyses of the Maintenance Project

# (1) Economic Analysis

The Maintenance Project is evaluated using the Economic Internal Rate of Return (EIRR) which is calculated based on a cost-benefit analysis from the viewpoint of the national economy. The main tangible benefit considered is the reduction in ships' staying cost at the port, while main costs are the construction, purchase, maintenance and administrative costs. The EIRR is calculated to be 23.7% using 30 years as the period of economic calculation. This shows that the Maintenance Project is advantageous from the viewpoint

of the national economy.

# (2) Financial Analysis

The analysis covers the costs of the newly improved facilities and procured equipment which will produce additional revenue, and the amount of the additional port revenue which will be generated by the improvements and procurements. The profitability of the project itself is analyzed based on the Financial Internal Rate of Return (FIRR) using the Discount Cash Flow Method. Domestic funds are assumed to come from government funds, and foreign funds from soft loans (annual interest rate: 4.75%, term of repayment: 25 years, grace period: 7 years). Revenues are assumed as port dues, wharfages and stevedoring charges according to the current Costa Rican tariffs. The analysis shows that the project is profitable with an FIRR of 8.26%. This exceeds the weighted average interest rate of the procured funds (3.62%).

Judging from the above, it can be concluded that the Maintenance Project with the target year of 1992 is feasible both economically and financially.

# [RECOMMENDATIONS]

# 1. Necessity of Investment by the National Government

Such basic port facilities as the breakwater, the quaywall, the small craft basin and the turing basin should be constructed at the expense of the Costa Rican national government considering that all these items require a large amount of investment at one time and that other than the quaywall none of them will directly produce additional port income.

These basic facilities are all essential for the actual functioning of the port, and the entire port itself is a basic socioeconomic infrastructure which contributes both directly and indirectly to economy of Costa Rica and the livelihood of the Costa Rican people:

### 2. Future Reviews

The Maintenance Project with the target year of 1992 is formulated based on the projected socioeconomic frame. However, the economy is subject to constant flux, and the demand at the port may be greatly influenced by changes in the domestic and world economy. Thus, it is important to review the project along with any major future changes in the socioeconomic frame as needed.

# 3. Construction of Grain Silos with a Sufficient Storage Capacity

As grains will begin to be imported through the Port of Caldera, grain silos with a sufficient capacity of 20,000 tons should be constructed at the Port of Caldera by the agencies concerned by the target year of the Maintenance Project.

### 4. Conducting Regular Field Surveys

To accurately estimate the future sand sedimentation volume and to implement an economical and effective maintenance dredging program as a countermeasure against sand sedimentation, it will be necessary to periodically conduct field surveys related to sand sedimentation such as depth soundings, topographic surveys along the shoreline and wave observations as in the past.