7.7 Economic and Financial Evaluation

7.7.1 General

While the economic and financial evaluation methods are the same as those at the master plan stage (Section 6.6.8), more accurate quantitative evaluation will be conducted using data obtained by the surveys conducted after the formulation of the master plan.

Economic evaluation will be separately conducted for the Channel Improvement Plan and the Dredging Improvement Plan. Financial evaluation will then be conducted for those plans which are judged feasible by the economic evaluation.

Then, comprehensive evaluation will be conducted in regard to the proposed improvement plans, taking the results of the above evaluation and analyses into consideration.

7.7.2 Economic Evaluation

(1) Structural Measures

1) Economic Cost

As the estimated cost (see Section 7.3) of the structural measure proposed as a priority project is based on current market prices, it must be converted to economic prices for economic evaluation. The following shadow rates, i.e. conversion factors to economic prices, are used here to establish the economic prices.

- In the case of the material and equipment costs in the construction cost, a standard conversion factor for shadow prices (SCF) of 0.93 (see Supporting Report), estimated on the basis of the structure of current market prices in Venezuela, is adopted.

- In regard to the labor cost in the construction cost, a factor of 0.5 is adopted, taking the current labor supply-demand situation in the subject area into consideration.

- The shadow rate for the entire construction cost is 0.815 as the weighted average value based on the proportions of the material/equipment cost and labor cost in the construction cost. (proportions of the material/equipment cost and labor cost in the construction cost: 75% and 25%, thus 0.93 x 0.75 + 0.5 x 0.25 = 0.815).

The economic prices of the structural measure alternatives, estimated on the basis of the above shadow rates, are as follows.

- Alternative I (Complete Closing Dike)   US$ 74,882,000*0.815=US$ 61,028,830
- Alternative II (Submerged Closing Dike) US$ 95,627,000*0.815=US$ 77,936,005

The economic prices of the operation and maintenance cost (see Section 7.3) of the structural measure alternatives are as follows.

- Alternative I (Complete Closing Dike) US$ 374,000*0.815= US$ 304,810/year
- Alternative II (Submerged Closing Dike)US$ 478,000*0.815= US$389,570/year

2) Benefit (Reduced Dredging Cost due to structural measure)

A shadow rate of 0.9 is adopted for the dredging cost, taking the level of dredging skill of the labor involved into consideration, and the following economic costs are estimated for a reduced dredging cost for the structural measure plan. The reduced dredging amount is stabilizes four year later completing the construction works. (see Section 7.3).

- Alternative I (Complete Closing Dike) US$ 9,932,000*0.9=US$ 8,938,800/year
- Alternative II (Submerged Closing Dike)US$ 9,932,000*0.9=US$ 8,938,800/year

3) Evaluation

Assuming a project life of 30 years, economic evaluation is conducted by basing the cash flow for the Project on the implementation plan of structural measure (see Section 7.3 and Supporting Report).

a) Evaluation Based on Net Present Value (Cost Benefit Analysis)

The national parameter for the investment opportunity cost in Venezuela is judged to be 10 ~ 12%. Accordingly, the cash flow for both the project cost and benefit are discounted at a discount rate of 10% for comparison with the net present value (see Supporting Report for the calculation process).

- Alternative I _ Case _ Cost   :   Net present value: US$ 56,458,602
                          Benefit   :   Net present value: US$ 53,420,264
                          B/C = 0.946
- Alternative II _ Case _ Cost   :   Net present value: US$ 72,099,326
                          Benefit   :   Net present value: US$ 53,420,264
                          B/C = 0.741

b) Evaluation Based on Economic Internal Rate of Return (EIRR)

The fact that the cost-benefit analysis result, i.e. the B/C value, in the evaluation based on the net present value is lower than 1.0 means that the EIRR is far below 10%, indicating the economic non-viability of the structural measures. Therefore, evaluation based on the EIRR is not conducted as it is judged to be meaningless.

(2) Dredging Improvement Plan

1) Economic Cost

Two priority plans concerning dredging improvement have been proposed, i.e. the Additional GPS Plan (Alternative I) and the Barge Disposal System Introduction Plan (Alternative II). The market prices of their costs and the O/M cost are described in Section 7.4.3. The economic cost of each alternative, applying the current SCF (0.93) in Venezuela to such market prices, is shown below.

- Alternative I :   Project Cost: US$ 190,500*0.93 = US$ 177,165
                      O/M Cost: US$ 500*0.93 = US$ 465

- Alternative II: Project Cost: US$ (190,500 + 21,900,00)*0.93= US$ 20,544,165
                     O/M Cost: US$ (500+ 343,000)*0.93 = US$ 319,455

2) Benefit

The benefit of dredging improvement arises from the pinpointing of sites requiring dredging with the expanded GPS system (Alternative I). What can be quantified here is the benefit from the reduction of the iron ore transportation cost due to the navigability of larger vessels and the benefit in the form of a reduced dredging cost due to the improved dredging efficiency resulting from the introduction of the barge disposal system (Alternative II).
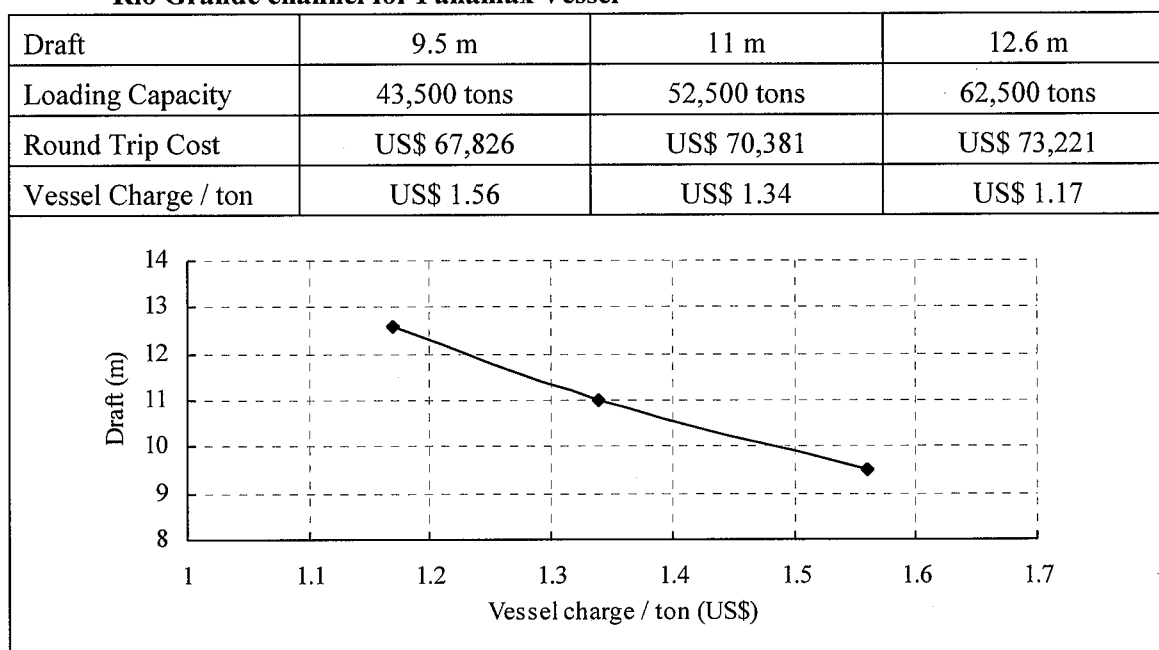
a) Benefit on reduced transportation cost

The purpose of dredging improvement is to maintain a deep average water depth of the Rio Grande Channel. While the current average water depth is believed to support a maximum draft of navigating vessels of 9.5 m, the installation of additional GPS (Alternative I) should increase the maximum draft to 11m. With the introduction of new style dredging boats (Alternative II), the maximum draft will be further increased to 12.6m. Such an increase of the permissible draft for navigating vessels means an increase of the loading weight per vessel. If the amount of cargo to be transported is constant, the required number of voyages can be reduced. The benefit of dredging

improvement is estimated, featuring changes of the transportation cost for iron ore as a result of the reduced number of necessary voyages.

The relationship between the draft, cargo loading capacity and one round trip cost at the Rio Grande Channel for a Panamax vessel (65,000 ton class) are shown in the table below. (Refer to details in Supporting Report)

Table 7.7.1 Relationship between Draft, Cargo Loading Capacity and Round Trip Cost at the Rio Grande channel for Panamax Vessel

Draft	9.5 m	11 m	12.6 m
Loading Capacity	43,500 tons	52,500 tons	62,500 tons
Round Trip Cost	US$ 67,826	US$ 70,381	US$ 73,221
Vessel Charge / ton	US$ 1.56	US$ 1.34	US$ 1.17

According to the forecast for cargo transportation in Section 4.4.7.3, there will be a transportation demand of 4,000,000 tons of iron ore a year from 2003. The reduced transportation cost of such iron ore by a vessel with a draft of 11 m (after the implementation of Dredging Improvement Alternative I) or a vessel with a draft of 12.6 m (after the implementation of Dredging Improvement Alternative II) compared to transportation by a vessel with a draft of 9.5 m (present state) can be regarded as one of the benefit of each Dredging Improvement Alternative.

- Current annual transportation cost :
    4,000,000/43,500 x US$ 67,826 = US$ 6,236,900

- Annual transportation cost after implementation of Alternative I :
    4,000,000/52,500 x US$ 70,381 = US$ 5,362,400

- Annual transportation cost after implementation of Alternative II :
    4,000,000/62,500 x US$ 73,221 = US$ 4,686,200

The resulting annual benefit of each Alternative is as follows.

- Alternative $_I$: US$ 6,236,900 - US$ 5,362,400 = US$ 874,500
- Alternative $_{II}$: US$ 6,236,900 - US$ 4,686,200 = US$ 1,550,700

b) Benefit of Reduced Dredging Cost (Alternative $_{II}$ Case)

The introduction of the barge disposal system is expected to reduce the dredging cost from US$ 2.60/m³ to US$ 1.63/m³ which is a conservative estimate for the Boca Grande Channel (see Section 7.4). As the Boca Grande Channel is believed to require a dredging amount of 10,000,000 m³/year, the annual reduction of the dredging cost is enormous as shown below.

Annual dredging cost reduction under Alternative : US$ (2.60 – 1.63) x 10,000,000 = US$ 9,700,000

Based on the above estimation results, the dredging improvement plans are expected to have the following annual benefits.

Annual benefit of Alternative $_I$:   US$ 874,500 (reduction of the transportation cost)

Annual benefit of Alternative $_{II}$:   US$ 1,550,700 + US$ 9,700,000 = US$ 11,250,700 (reduction of the transportation cost + reduction of the dredging cost)

3) Evaluation

Assuming a project life of 25 years, the cash flow is prepared and evaluated as described below.

a)   Evaluation Based on Net Present Value (Cost Benefit Analysis) (Supporting Report for the net present value calculation process)

The method is the same as that used for the Channel Improvement Plan and the evaluation results are given below.

- Alternative $_I$:   Cost   :   Net present value: US$ 181,386
                             Benefit :   Net present value: US$ 7,937,871
                             B/C = 43.76

- Alternative $_{II}$:   Cost   :   Net present value: US$ 23,443,871
                             Benefit :   Net present value: US$ 102,123,054
                             B/C = 4.36

The evaluation results show a B/C value of 43.76 for Alternative I and 4.36 for Alternative II, indicating a far greater net present value of benefit that net present value of cost to underline the economic viability of the Project.

b) Evaluation Based on Economic Internal Rate of Return (EIRR)

The calculated EIRR for each of the proposed Dredging Improvement Plan Alternatives based on the cost and benefit cash flows is shown below (see Supporting Report for the calculation process).
- Alternative I : EIRR 493%
- Alternative II : EIRR 53%

The above results indicate that both alternatives are clearly viable from the economic viewpoint.

7.7.3 Financial Evaluation

(1) Structural Measures

The economic evaluation results clearly indicate that each alternative lacks economic viability. Consequently, it is judged that financial evaluation of the structural measure plan is meaningless.

(2) Dredging Improvement

1) Alternative I (Additional GPS)

As the INC (Institute National de Canalizacion), the implementation body of the Project, cannot expect any increase of its income following the implementation of this alternative, exploration of the financial viability is difficult. As estimated earlier, however, the transportation cost of iron ore will be reduced by US$ 874,500 a year with the implementation of this alternative and it should be possible for consignors of iron ore to pay some 10% of the above savings to the INC as an additional fee. Such payment is also rational from the economic point of view. To be more precise, the reduced amount of the transportation cost can be translated to US$ 0.219 per ton (US$ 874,500/ 4,000,000), of which 10% is US$ 0.0219. The envisaged increase from the present US$ 1.3511 per ton to US$ 1.373 will only represent an increase of 1.6%.

The following FIRR is calculated based on the assumption that the above-mentioned increase of the toll fee is feasible and that the income of the INC will increase accordingly (US$ 87,450/year) (see Supporting Report for the calculation process).

- Alternative I : FIRR 46%

2) Alternative II (Introduction of Barge Disposal System)

While the implementation of the dredging improvement plan will not directly increase the revenue of the INC, the project implementation body, a reduction of the dredging cost can be anticipated. When this cost reduction (US$ 9,700,000) is considered to be the financial profit, the financial analysis produces an FIRR of 42%, suggesting that the dredging improvement plan is financially feasible.

The FIRR for the case where the procurement cost of the barge disposal system is assumed to be met by a foreign loan (JBIC case) is still 40%, illustrating the financial feasibility of this alternative (see Supporting Report I for the FIRR calculation process).

Alternative II: FIRR 42%
FIRR 40% (loan case)

As financial data was unavailable for the Study, it is unclear whether or not the reduced dredging cost can be entirely accounted for as a benefit in the account of the INC. Assuming the continuation of the present situation under which the annual budget of the INC is insufficient to allocate sufficient funds to completely conduct the necessary amount of dredging, some type of government subsidy will be required to cover part of the project cost. To be more precise, a government subsidy for the introduction cost of the barge disposal system (US$ 21,900,000) and an increase of the present iron toll charge of US$ 1.3511/ton by 7% will be required. [US$ 0.094577 9 (= US$ 1.3511 x 0.07) is only some 25% of US$ 0.387675 (= US$ 1,550,700/4,000,000 tons) which is the reduced amount of the transportation cost due to the implementation of this alternative.] The FIRR of this case is 18%. (See Supporting Report for the calculation process).

Based on these estimation results, both the additional GPS plan (Alternative I) and the barge disposal introduction plan (Alternative II) are also judged to be financially feasible.

7.7.4 Comprehensive Evaluation

The comprehensive evaluation results of the Structural Measure Plan and the Dredging Improvement Plan, both of which are proposed as priority projects, are described below based on the economic evaluation as well as the financial evaluation of these plans.

(1) Structural Measures

Both the Complete Closing Dyke Plan and the Submerged Closing Dyke Plan indicate that the benefit arising from the investment cost fails to show feasibility from the viewpoint of the national economy. Needless to say, the financial feasibility of both projects is judged to be difficult. The implementation of these projects should, therefore, be suspended.

(2) Dredging Improvement Plan

Both the additional GPS plan and the barge disposal system introduction plan clearly show economic feasibility due to the improved precision and efficiency of dredging work. As the project implementation body, therefore, the INC should urgently install dredges with additional GPS units. The barge disposal system should be implemented if it is found necessary to solve the financial problems based on a national consensus.