Chapter 20 Economic Analysis

20.1 Methodology

(1) Purpose

The purpose of the economic analysis in this chapter is to appraise the economic feasibility of the short-term plan for Takoradi Port in the target year (2010) from the viewpoint of the national economy. Accordingly, the economic benefits as well as the economic costs that will arise from this project was investigated, and whether the net benefits of the project exceed those that could be obtained from other investment opportunities in Ghana was evaluated.

(2) Methodology

An economic analysis was carried out applying the following method. Short-term plan for Takoradi Port was defined and it was compared to the "Without" case. All the benefits and costs accruing from the difference between "With" and "Without" cases were calculated in market prices and it was converted to economic prices.

There are various methods to evaluate the feasibility of this type of development project. Here, the economic internal return (EIRR) based on a cost-benefit analysis was used to appraise the feasibility of the project. The EIRR is a discount rate which makes the costs and the benefits of the project during the project life equal. The procedure used for this economic analysis is shown in Figure 20.1.1.

20.2 Prerequisites of Analysis

In order to estimate the costs and benefits, the following requisites are assumed for the analysis.

(1) Base Year

The "Base Year" here means the standard year in the estimation of costs and benefits. Taking into consideration the base year in cost estimation of the construction works, 2001 is set as the base year for this study.

(2) Project Life

Taking into consideration the depreciation period of the main facilities of 30 years and the construction period of 5 years including detail design, the period of calculation (project life) in the economic analysis is assumed to be 35 years from the beginning of construction.

(3) Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = 6,700 Cedi, the same rate as used in the cost estimation.

(4) “With” Case

In an economic analysis, benefits are mainly brought about by improvements and expansions in capacity. Therefore, the “With” case scenario includes all improvements in productivity and all expansions of port facilities for the short-term plan.

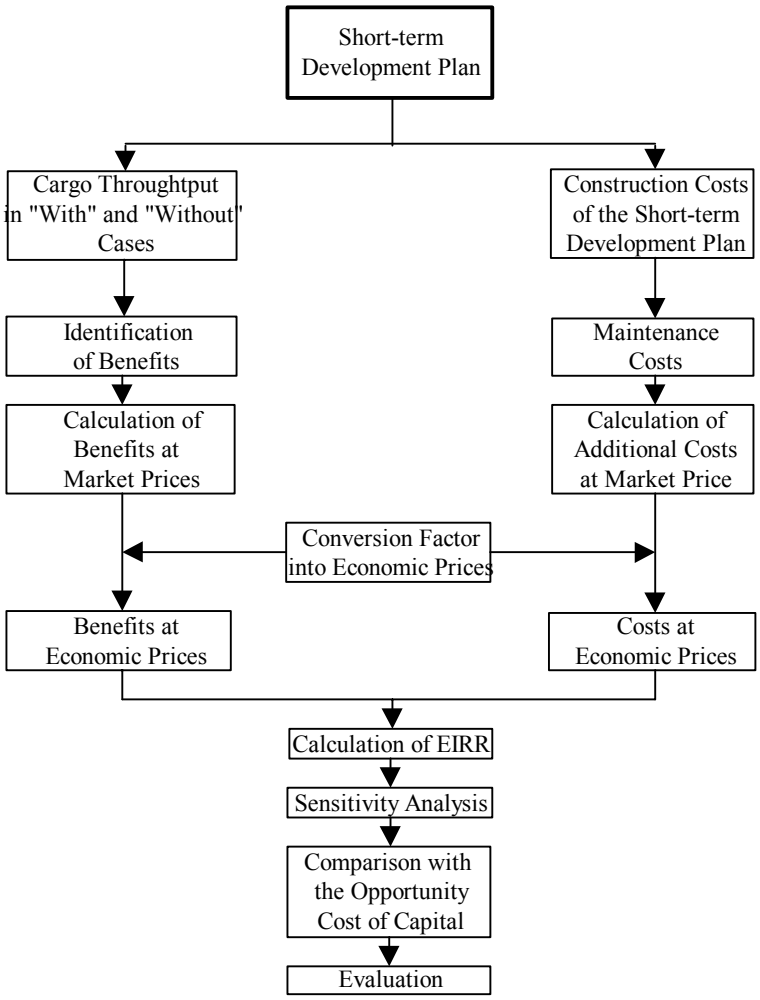

Figure 20.1.1 Procedure of the Economic Analysis

(5) “Without” Case

A cost-benefit analysis is conducted on the difference between the “With” and “Without” investment cases. In this study, the following considerations are taken into accounts to the “Without” case.

1) No investment is made for the port.

2) In the “Without” case, the distribution of ships and the working efficiency of cargo handling are the same as that in the year 2000. On the other hand, in “With” case, the distribution of

ships is almost same as the year 2000, but the working efficiency of cargo handling is assumed to be higher than the year 2000. (Table 20.2.1)

3) Berth assignment and cargo allocation by ship type are planned for W/O. case and W/. case categorizing the present conditions of Takoradi Port. (Table 20.2.2(1), (2), (3))

Table 20.2.1 Ave. Cargo Volume and Turnaround Time at Berth by Ship Type in Both Cases
Takoradi Port

Berth	Ship Type	W/O.			
		Ave.Ship Size (GRT)	Ave.Ship Size (DWT)	Ave. Cargo Vol/Ship (MT/Ship)	Time at Berth (Hrs/Ship)
Bauxite	BU(B)	23,292	38,987	33,832	178
Manganese	BU(M)	14,346	23,575	20,791	99
Clinker	BU(C)	24,884	42,924	20,971	78
Oil Berth	TK(O)	3,764	5,036	3,450	43
Others	GC/CM	11,095	16,643	1,412	47
	RO	30,575	24,460	2,075	47
	CO	14,162	20,813	1,765	35
	BU(W)	18,089	29,828	17,435	194

Berth	Ship Type	W/.			
		Ave.Ship Size (GRT)	Ave.Ship Size (DWT)	Ave. Cargo Vol/Ship (MT/Ship)	Time at Berth (Hrs/Ship)
Bauxite	BU(B)	25,000	40,000	38,000	63
Manganese	BU(M)	18,750	30,000	28,500	48
Clinker	BU(C)	25,000	40,000	19,000	32
Oil Berth	TK(O)	3,000	5,000	3,450	43
Others	GC/CM	11,000	16,500	1,836	28
	RO	30,000	24,000	2,698	39
	CO	13,000	20,000	3,936	16
	BU(W)	18,750	30,000	22,666	227

BU: DWT/GRT=1.6
TK: DWT/GRT=1.7
RO: DWT/GRT=0.8
Others: DWT/GRT=1.5

4) Berthing facility use models are made based on the above analysis. (Table 20.2.3) Model-0 is the prototype model assuming that all the berthing facilities are available to any calling vessels. Model-1 could be applicable to the short-term plan.

5) In the model-1, berthing facilities are divided into the 5 and 6 groups for W/O. and W/O. cases respectively. Berthing time and waiting time are estimated by the group.

6) In the “Without” case, it is assumed that the container cargoes, general cargoes and bagged cargoes are handled at the same berth group. However, in “With” case, increment container cargoes are assumed to be handled at the new container berth. The upper limit of berth occupancy ratio is assumed to be 0.82. The overflowed cargoes are to be handled in a foreign port and carried by land between Takoradi Port and a foreign port.

Table 20.2.2(1) Categorized Berth Assignment and Cargo Allocation by Ship Type (2000) - W/O. Case

Takoradi

Berth**	Ship Type	Ship Size(DWT)	Ship Nos.	Cargo (MT)	Ave. Cargo Vol. /Ship	BC, GC, CT						Dry Bulk		Crude Oil & Petro-products	
						Share*	Cargo (MT)	Share*	Cont.(MT)	Share*	Others(MT)	Ship Nos.	Cargo (MT)	Ship Nos.	Cargo (MT)
Bauxite	BU(B)	38,987	13	439,813	33,832							13	439,813		-
Manganese	BU(M)	23,575	45	935,608	20,791							45	935,608		
Clinker	BU(C)	42,924	40	838,835	20,971							40	838,835		-
Oil Berth	TK(O)	5,036	40	138,000	3,450								-	40	138,000
A	GC/CM	16,643	132	186,347	1,412	0.319	186,347	0.463	73,066	0.463	113,281		-		-
A	RO	24,460	104	215,778	2,075	0.370	215,778	0.537	84,606	0.537	131,171		-		-
A	CO	20,813	103	181,840	1,765	0.311	181,840	-	181,840	-	-		-	-	-
A	BU(W)	29,828	8	139,480	17,435							8	139,480		
Total		21,875	485	3,075,700	6,342	1.000	583,964	1.000	339,512	1.000	244,452	106	2,353,736	40	138,000

***Berth group A includes W.2, 3, 4, 5 and 6.*

** Shares are estimated by ship type assuming that cargoes are burdened proportionally to the transportation capacity of ship, i.e. Ship Size x Ship Nos.*

: *Input Data*

Planned Transshipment Cargo

Takoradi

Item	2000	2010	2020
Transit(MT):	-	23,743	31,909
GC(MT)	-	8,310	7,977
CO(MT)	-	15,433	23,932
(TEU)	-	1,169	1,812
Transsip(MT):	-	-	-
GC(MT)	-	-	-
CO(MT)	-	-	-
(TEU)	-	-	-
Total(MT):	-	23,743	31,909
GC(MT)	-	8,310	7,977
CO(MT)	-	15,433	23,932
(TEU)	-	1,169	1,812

583,964	339,512	244,452
-	-	-
583,964	339,512	244,452

Note: Transshipment cargoes are added to the original cargoes.

Table 20.2.2(2) Planned Berth Assignment and Cargo Allocation by Ship Type (2010) - W/O. Case

Takoradi

Berth**	Ship Type	Ship Size(DWT)	Ship Nos.	Cargo (MT)	Ave. Cargo Vol. /Ship	BC, GC, CT						Dry Bulk		Crude Oil & Petro-products	
						Share*	Cargo (MT)	Share*	Cont.(MT)	Share*	Others(MT)	Ship Nos.	Cargo (MT)	Ship Nos.	Cargo (MT)
Bauxite	BU(B)	38,987	30	1,000,000	33,832							30	1,000,000		-
Manganese	BU(M)	23,575	48	1,000,000	20,791							48	1,000,000		
Clinker	BU(C)	42,924	52	1,091,904	20,971							52	1,091,904		-
Oil Berth	TK(O)	5,036	65	224,787	3,450								-	65	224,787
A	GC/CM	16,643	374	528,535	1,412	0.319	528,535	0.463	370,115	0.463	158,419		-		-
A	RO	24,460	295	612,009	2,075	0.370	612,009	0.537	428,570	0.537	183,440		-		-
A	CO	20,813	292	515,751	1,765	0.311	515,751	-	515,751	-	-		-	-	-
A	BU(W)	29,828	10	166,626	17,435							10	166,626		
Total		21,163	1,166	5,139,612	4,408	1.000	1,656,295	1.000	1,314,436	1.000	341,859	139	3,258,530	65	224,787

***Berth group A includes W.2, 3, 4, 5 and 6.*

** Shares are estimated by ship type assuming that cargoes are burdened proportionally to the transportation capacity of ship, i.e. Ship Size x Ship Nos.*

: *Input Data*

Planned Transshipment Cargo

Takoradi

Item	2000	2010	2020
Transit(MT):	-	23,743	31,909
GC(MT)	-	8,310	7,977
CO(MT)	-	15,433	23,932
(TEU)	-	1,169	1,812
Transsip(MT):	-	-	-
GC(MT)	-	-	-
CO(MT)	-	-	-
(TEU)	-	-	-
Total(MT):	-	23,743	31,909
GC(MT)	-	8,310	7,977
CO(MT)	-	15,433	23,932
(TEU)	-	1,169	1,812

Note: Transshipment cargoes are added to the original cargoes.

1,632,552	1,299,003	333,549
23,743	15,433	8,310
1,656,295	1,314,436	341,859

Table 20.2.2(3) Planned Berth Assignment and Cargo Allocation by Ship Type (2010) - W/. Case

Takoradi

Berth**	Ship Type	Ship Size(DWT)	Ship Nos.	Cargo (MT)	Ave. Cargo Vol. /Ship	BC, GC, CT						Dry Bulk		Crude Oil & Petro-products	
						Share*	Cargo (MT)	Share*	Cont.(MT)	Share*	Others(MT)	Ship Nos.	Cargo (MT)	Ship Nos.	Cargo (MT)
Bauxite	BU(B)	40,000	26	1,000,000	38,000							26	1,000,000		-
Manganese	BU(M)	30,000	35	1,000,000	28,500							35	1,000,000		
Clinker	BU(C)	40,000	57	1,091,904	19,000							57	1,091,904		-
Oil Berth	TK(O)	5,000	65	224,787	3,450								-	65	224,787
A	GC/CM	16,500	118	217,430	1,835	0.319	217,430	0.463	59,011	0.463	158,419		-		-
A	RO	24,000	93	251,770	2,697	0.370	251,770	0.537	68,330	0.537	183,440		-		-
A	CO	20,000	54	212,171	3,936	0.311	212,171	-	212,171	-	-		-	-	-
A	BU(W)	30,000	7	166,626	22,666								166,626		
B	CO	20,000	248	974,924	3,936	-	974,924	-	974,924	-	-				
Total		21,514	705	5,139,612	7,292	1.000	1,656,295	1.000	1,314,436	1.000	341,859	119	3,258,530	65	224,787

***Berth group A includes W.2, 3, 4, 5, 6 and berth group B means a new container berth. It is assumed that the new berth will handle the increment of container cargo between 2000 and 2010.*

** Shares are estimated by ship type assuming that cargoes are burdened proportionally to the transportation capacity of ship, i.e. Ship Size x Ship Nos.*

: *Input Data*

Planned Transshipment Cargo

Takoradi

Item	2000	2010	2020
Transit(MT):	-	23,743	31,909
GC(MT)	-	8,310	7,977
CO(MT)	-	15,433	23,932
(TEU)	-	1,169	1,812
Transsip(MT):	-	-	-
GC(MT)	-	-	-
CO(MT)	-	-	-
(TEU)	-	-	-
Total(MT):	-	23,743	31,909
GC(MT)	-	8,310	7,977
CO(MT)	-	15,433	23,932
(TEU)	-	1,169	1,812

Note: Transshipment cargoes are added to the original cargoes.

1,632,552	1,299,003	333,549
23,743	15,433	8,310
1,656,295	1,314,436	341,859

Table 20.2.3(1) Facility Use Model (2010) (T) - W/O. (1)

Items	Unit	*Model-0*	*Model-1*				
		All Facilities	Oil Berth	Bauxite	Manganese	Clinker	Other Facilities W2,3,4,5,6
Nos. of Berth	Berth	7	1	0.5	1	0.5	4
Nos. of Calling Ships	Ship	1,166	65	30	48	52	971
Ave. Ship Size	DWT	21,163	5,036	38,987	23,575	42,924	20,408
Cargo Handling Volume	MT	5,139,612	224,787	1,000,000	1,000,000	1,091,904	1,822,921
Ave. Cargo Volume per Ship	MT/ship	4,408	3,450	33,832	20,791	20,971	1,877
Berthing Time per Ship	Hrs/ship	35.9	43.0	178.0	99.0	78.0	47.1
Berthing Time per Year	Days	1,744	117	219	198	169	1,906
		1,744	2,610				
Berth Occupancy Ratio	-	0.71	0.33	1.25	0.57	0.97	1.36
Waiting Time Factor ($M/E_2/n$)*	-	0.12	0.36	-	0.95	-	-
Waiting Time per Year	Days	209	42	-	188	-	-
		209	-				

** Random arrivals, Erlang 2-distributed service time*

Table 20.2.3(2) Facility Use Model (2010) (T) - W/O. (2)

Items	Unit	*Model-0*	*Model-1*				
		All Facilities	Oil Berth**	Bauxite	Manganese	Clinker	Other Facilities W2,3,4,5,6
Nos. of Berth	Berth	7	1	0.5	1	0.5	4
Nos. of Calling Ships	Ship	1,166	65	19	48	44	585
Ave. Ship Size	DWT	21,163	5,036	38,987	23,575	42,924	20,408
Cargo Handling Volume	MT	5,139,612	224,787	654,592	1,000,000	925,950	1,097,985
Ave. Cargo Volume per Ship	MT/ship	4,408	3,450	33,832	20,791	20,971	1,877
Berthing Time per Ship	Hrs/ship	35.9	43.0	178.0	99.0	78.0	47.1
Berthing Time per Year	Days	1,744	117	144	198	144	1,148
		1,744	1,750				
Berth Occupancy Ratio	-	0.71	0.33	0.82	0.57	0.82	0.82
Waiting Time Factor ($M/E_2/n$)*	-	0.12	0.36	3.45	0.95	3.45	0.68
Waiting Time per Year	Days	209	42	495	188	495	781
		209	2,001				
Navigation Time per Year	Days	81	5	1	3	3	41
		81	53				
Staying Time at Port per Year	Days	2,035	163	640	390	642	1,969
		2,035	3,804				

** Random arrivals, Erlang 2-distributed service time*

Table 20.2.3(3) Facility Use Model (2010) (T) - W/.

Items	Unit	*Model-0*	*Model-1*					
		All Facilities	Oil Berth	Bauxite	Manganese	Clinker	Other Facilities W2,3,4,5,6	New Berth
Nos. of Berth	Berth	8	1	0.5	1	0.5	4	1
Nos. of Calling Ships	Ship	705	65	26	35	57	272	248
Ave. Ship Size	DWT	21,514	5,036	40,000	30,000	40,000	18,647	20,000
Cargo Handling Volume	MT	5,139,612	224,787	1,000,000	1,000,000	1,091,904	847,997	974,924
Ave. Cargo Volume per Ship	MT/ship	7,292	3,450	38,000	28,500	19,000	3,118	3,936
Berthing Time per Ship	Hrs/ship	30.2	43.0	63.0	48.0	35.0	32.3	16.0
Berthing Time per Year	Days	887	117	69	70	84	366	165
		887	871					
Berth Occupancy Ratio	-	0.32	0.33	0.39	0.20	0.48	0.26	0.47
Waiting Time Factor ($M/E_2/n$)*	-	0.00	0.36	0.46	0.00	0.66	0.00	0.64
Waiting Time per Year	Days	0	42	32	0	55	0	106
		0	235					
Navigation Time per Year	Days	49	5	2	2	4	19	17
		49	32					
Staying Time at Port per Year	Days	936	163	103	73	143	385	288
		936	1,155					

** Random arrivals, Erlang 2-distributed service time*

20.3 Economic Prices

All the costs examined in the previous chapter have been calculated based on market prices. However, the values of goods and labors quoted at market price do not always represent the true value of those goods and labors from the viewpoint of the national economy. The local currency portion of the goods and materials at a market price often includes custom duties. The labor cost at market price is often influenced by a minimum wage system. Therefore, those market prices should be revised to economic prices (border prices) in an effort to determine a more rational valuation. In sum, the economic prices are intended to represent the international market value, or world prices, of these goods and services.

(1) Method for Converting to Economic Prices from Market Prices

In general, all the costs and benefits are divided into three categories: labor, tradable goods and non-tradable goods. And labor is further classified into skilled labor and unskilled labor. As for skilled labor, the economic price is determined by multiplying the market wage by the conversion factor for consumption. On the other hand, the economic price of unskilled labor is determined by multiplying the nominal wage by the shadow wage rate and the conversion factor for consumption. The prices of tradable goods are expressed in CIF and FOB value for import goods and export goods respectively.

These values show the actual economic prices. However, the economic price of non-tradable goods cannot be converted directly. Theoretically speaking, non-tradable goods should be divided repeatedly into labor, tradable goods, non-tradable goods and transfer items, which are the inputs required for the production of non-tradable goods. In this study, it is impossible to take these steps because of the lack of an I/O table in Ghana. Hence the local currency portion after deducting labor costs and transfer items is considered as non-tradable goods, the economic price of which is calculated by multiplying the standard conversion factor (SCF).

(2) Transfer Items

Import / export duties, other taxes and subsidies are merely transfer items which do not actually reflect any consumption of national resources. Therefore, these transfer items should be excluded in the calculation of the costs and benefits of the project for the economic analysis.

The foreign currency portion of the imported goods and services do not include taxes such as import duties, sales tax and income tax. On the other hand, the local currency portion of the construction costs includes such taxes. Therefore, these transfer costs should be excluded from the project. However, in this project, due to the sales tax exemption for construction works ordered by public bodies and the personal income tax exemption for lower wage workers, the tax to be imposed on this project are estimated to be very small and by this reason tax exclusion is not considered.

(3) Conversion Factors

Conversion factors for goods and labor are determined as follows:

1) Standard Conversion Factor (SCF)

The standard conversion factor is used to determine the economic prices of certain goods, which cannot be directly revalued at economic prices. These goods include most non-tradable goods and services. The standard conversion factor is expressed by the following equation:

$$SCF = \frac{I + E}{I + D_i + E - D_e}$$

Where, I: Total amount of imports
E: Total amount of exports
D_I: Total amount of import duties
D_e: Total amount of export duties

In this study, 0.97, the mean value of SCFs for the three years, is adopted according to the past records of trade and customs as shown in Table 20.3.1.

Table 20.3.1 Standard Conversion Factors (SCFs)
(Billion Cedi)

Items	1997	1998	1999
Imports (CIF)	4,921.47	7,366.28	9,740.45
Exports (FOB)	3,156.75	4,860.95	5,882.23
Import Duties	573.60	743.70	531.90
Export Duties	265.90	400.50	254.10
SCF	0.96	0.97	0.98

Source: Annual Report 1999, Bank of Ghana

2) Conversion Factor for Consumption (CFC)

This conversion factor is used to convert the market prices of consumption goods into the border prices. This is particularly required to convert domestic labor costs to the corresponding border prices. The CFS is usually calculated in the same manner as the SCF, replacing total Imports and total exports by those of consumption goods only. However, in this study, due to the lack of the required data such as detailed duty items, it is assumed that the CFC is equal to the SCF.

3) Conversion Factor for Skilled Labor

The cost of skilled labor is calculated based on actual market wages, assuming that the market mechanism is functioning properly. However, as these are domestic costs, they are converted into border prices by multiplying the market wages by the CFC.

The Conversion Factor for Skilled Labor
= (Market wage rate) x (CFC)
= *1 x 0.97 = 0.97*

4) Conversion Factor for Unskilled Labor

As the wages paid to unskilled labors by a project are usually far above the opportunity cost, these market wages should not be used for calculation of the economic value of the unskilled labors.

In Ghana, they have a minimum wage system set by the Tripartite Committee organized by Government, Labor Union and Employers Association. The minimum wage rate in 2001 was agreed by 5,500 cedis per day (8hrs). Considering the labor market, the labors are usually provided from the agricultural sector and the marginal rate could be calculated based on the labor wages in the agricultural sector. Therefore, in this study, it is assumed in a simplified manner that the economic cost of unskilled labor is equal to the wage rate of the agricultural sector. Average basic hourly earnings in Ghana by main job are given by the survey, which was carried out by the Ghana Statistical Service (GSS) over a 12-month period (April 1998 to March 1999). The conversion factor for unskilled labor is expressed by the following equation.

Table 20.3.2 Average Basic Hourly Earnings in Main Job
(Unit: Cedis)

Main Industry	Male	Female	All
Agriculture	598	381	512
Mining/Quarrying	1,505	832	1,484
Manufacturing	1,787	801	1,156
Utilities	1,199	600	1,105
Construction	1,062	512	1,019
Trading	2,554	1,123	1,411
Transportation/Comm.	1,196	920	1,187
Financial Services	1,478	1,257	1,454
Community/Social Ser.	1,126	896	1,035
All	1,070	785	928

Source: Ghana Living Standards Survey Report of the Fourth Round (GLSS 4)
Ghana Statistical Service, October 2000

The Conversion Factor for Unskilled Labor

$$= \frac{OpportunityCost}{Nominal Wage} \text{ x } CFC$$

$$= \frac{512x8}{10000} \; x\; 0.97 = 0.397$$

20.4 Costs of the Project

The items that should be considered as costs of the projects are construction costs, maintenance costs and renewal investment costs. These project costs must be converted from market prices into economic prices for the economic analysis.

(1) Construction Costs

Construction costs are divided into such categories as foreign currency portion and local currency portion that is broken into non-traded goods, skilled labor and unskilled labor. The cost of non-traded goods at market prices are converted to economic prices by multiplying by the standard conversion factor (SCF). The costs of skilled labor and unskilled labor at market prices are converted to economic prices by multiplying by the conversion factor for skilled labor and the conversion factor for unskilled labor respectively. Construction costs and investment schedule at economic prices are summarized in Table 20.4.1 and 20.4.2.

Table 20.4.1(1) Breakdown of Local Portion for Construction Works

(Unit: % of total)

Construction Works	Local Portion		
	Non-Traded Goods	Skilled Labor	Unskilled Labor
Dredging	50	40	10
Reclamation	50	40	10
Breakwater	75	20	5
Quaywall	70	20	10
Revetment	70	20	10
Other Civil Works	50	45	5
Building	50	30	20
Machine & Equip.	50	45	5
Engineering Cost	0	100	0

* Above figures are refered from rough cost estimate.

Table 20.4.1(2) Construction Costs at Economic Prices

Facilities	Construction Works	Construction Cost at Market Prices	Foreign Portion	Local Portion			Overall Conversion Factor	Construction Cost at Economic Prices
				Non-traded Goods	Skilled Labor	Unskilled Labor		
		('000 US$)	1.000	0.970	0.970	0.451	0.990	('000 US$)
Multi-purpose Berth	Dredging	14,815	14,074	359	288	33	0.996	14,754
	Quaywall	7,700	6,160	1,046	299	69	0.984	7,574
	Equipment	6,970	6,970	-	-	-	1.000	6,970
Container Berth	Quaywall/Revetment	12,300	9,984	1,573	449	104	0.985	12,110
	Dredging/Reclamation	12,522	11,781	359	288	33	0.995	12,461
	Other Civil Works	5,950	2,722	1,566	1,409	73	0.970	5,769
	Building/Utility	1,600	1,160	213	192	10	0.985	1,575
	Equipment	19,952	19,952	-	-	-	1.000	19,952
Bulk Berth	Quaywall	15,472	12,638	1,924	550	128	0.985	15,240
	Breakwater	11,800	6,490	3,863	1,030	120	0.975	11,503
	Dredging/Reclamation	13,891	13,197	337	269	31	0.996	13,834
Others	Engineering Survey	4,802	3,910	-	865	-	0.994	4,775
Total		127,774	109,038	11,240	5,639	602	0.990	126,519

Table 20.4.2 Annual Investment Schedule at Economic Prices

(Unit: '000 US$)

Item	2005	2006	2007	2008	2009	Total
Total(Market Price)	1,442	10,914	39,842	36,566	39,010	127,774
Total(Economic Price)	1,428	10,807	39,451	36,207	38,627	126,519

(2) Maintenance Costs

The costs of maintaining of port facilities and equipment per year are estimated as a fixed proportion (1 % for structures, 4 % for handling equipment) of the original construction costs excluding the costs of dredging and reclamation costs. Assuming that the maintenance costs by item consist of same
categories as construction costs, maintenance costs at economic prices could be calculated as shown in Table 20.4.3.

Table 20.4.3 Maintenance Costs at Economic Price – Takoradi Port

(Unit: thousand US$)

Item	Construction Costs at Market Price	Maintenance Costs at Market Price	Overall Conversion Factors	Maintenance Costs at Economic Price
Dredging/Reclamation	41,278	0	0.996	0
Breakwater	11,800	118	0.975	115
Quaywall/Revetment	35,472	355	0.985	350
Other Civil Works	5,950	60	0.970	58
Building/Utility	1,600	16	0.985	16
Machine & Equip.	26,922	1,077	1.000	1,077
Total	122,972	1,626	-	1,616

(3) Renewal Investment Costs

The renewal costs for cargo handling equipment after their economic durable periods should be considered. The economic durable periods of equipment are planned as follows. This investment will be done by foreign portion.

Table 20.4.4 Economic Durable Periods and Costs of Equipment

Equipment	Durable Periods	Costs('000US$)
Gantry Crane, Transfer Crane, Tug Boat	20 Years	24,000
Tractor, Trailer	10 Years	2,922

20.5 Benefits of the Project

In this section, benefits that are adopted for a cost-benefit analysis are defined and converted from market prices to economic prices.

(1) Benefit Items

As benefits brought about by the short-term plan of the study port, the following items are identified.

1) Savings in staying costs of ships

2) Savings in water transportation cost by increase of cargo volume per ship

3) Savings in land transportation costs

4) Earnings of foreign currency in cargo handling

5) Savings of costs in cargo handling

6) Savings in interest of cargo costs

7) Reduction of cargo damage and accidents at the port

8) Promotion of regional economic development

9) Increase in employment opportunities and incomes

Of the above, items from 1) to 4) are considered as measurable benefits in terms of the cost-benefit analysis in this study.

(2) Calculation of Benefits

1) Savings in staying costs of ships

In accordance with the implementation of the projects, the total ship staying time, namely ship waiting time for berthing and ship mooring time for unloading/loading in the port, will greatly decrease. The reduction of the ship staying time under the "With" case is one of the major benefits of the projects. The benefits that will accrue to Ghana from the projects can be calculated by the following formula.

Savings in ships' staying costs = Difference in staying time between "With" and "Without" cases x Ships' staying cost (unit cost) x Share of benefits accruing to Ghana (= 0.5)

Whereby,

Savings in ships' staying costs = *(3,804-1,155)days x 7,608$/day x 0.5 = 10,076,796US$*

Although it is conceivable to estimate ship cost based on charter rate, this rate has been fluctuating so much according to the market conditions that it is not appropriate for economic price of ship cost.

Table 20.5.1 and 2 show the ship cost estimated by the Study Team based on the estimation made by some Japanese shipping companies. These data are used as unit cost of ship staying.

Table 20.5.1 Ship Cost by Ship Size (General Cargo)

(Unit:US$ per day)

DWT	Tons	Navigation	Anchorage	Knot
5,000	4,500	7,442	6,067	13.0
8,000	7,200	7,883	6,533	13.0
10,000	9,000	8,100	6,775	13.0
20,000	18,000	8,925	7,608	13.0
30,000	27,000	9,550	8,183	13.0

Table 20.5.2 Ship Cost by Ship Size (Container Cargo)

(Unit:US$ per day)

DWT	TEUs	Navigation	Anchorage	Knot
4,500	200	9,042	7,917	12.0
5,900	300	10,800	9,475	13.0
8,800	500	15,008	12,975	15.0
22,000	1,200	29,250	23,433	20.0
35,000	2,000	40,258	32,450	22.0

The savings in staying costs of vessels are primarily realized by shipping companies. Since Ghana has no national shipping company at present, these benefits accrue to other countries. However, some portion of these benefits should be returned to Ghana after some time lag. It is possible for Ghana to acquire some of the benefits by, for instance, decreasing freight rates reflecting the reduced incidence of delays at the port. In this Study, it is assumed that 50% of the benefits attributed to foreign ship operators will be transferred to the Ghana economy.

The above savings are estimated to be foreign portion. So, these benefits are economic prices themselves.

2) Savings in water transportation cost by increase of cargo volume per ship

At present, calling ships at Takoradi Port cannot transport the cargoes fully loaded due to the shallow berths. When the deep-water berths are materialized in the short-term plan, they can call at Takoradi with full load. Therefore, average cargo volume per ship will increase resulting the lower water transportation cost. As of February 2001, water transportation cost between Tema and Rotterdam is 67.41 US$ per MT, which could be reduced to 51.85US$ (67.41/1.3). 20% of the differences excluding working expenses, fuels and so forth could be saved. These savings are applicable to all the cargoes at Takoradi Port as well. In this Study, it is assumed that 50% of the benefits attributed to foreign ship operators will be transferred to the Ghana economy by the cheaper freightage.

Table 20.5.3 Sea Transportation Cost by Cargo Type, Tema-Rotterdam

Cost	General Cargo (per MT)	Container Cargo (per TEU)
Transportation Cost (EUR)	77.50	1,060.00
Transportation Cost (US$)	67.41	781.00

Source: Ghana Shippers' Council

Savings in water transportation costs = Difference in water transportation costs between "With" And "Without" cases (unit cost) x Total cargo volume x Share of benefits accruing to Ghana (= 0.5)

Whereby,

$$\text{Savings in water transportation costs} = (67.41 - \frac{67.41}{1.3})\$/MT \times 0.2 \times 3{,}903{,}314MT \times 0.5$$

$$= 6{,}072{,}055\ \$$$

The calculation of above savings is based on the charter rates quoted at world prices. So, these benefits are economic prices themselves.

3) Savings in land transportation costs

In the following case, it is assumed that the cargoes will be handled in other foreign ports and then be transported to Ghana by land.

- Cargo handling volume reaches the maximum volume with handling capacity of the port. (max. berth occupancy ratio = 0.82)

In accordance with the implementation of the projects, it will become unnecessary to transport the cargoes by land. The benefit that will accrue to Ghana from the projects can be calculated by the following formula.

Savings in land transportation costs = Difference in handling cargo volume between "With" and "Without" cases x Land transportation cost (unit cost)

Whereby,

Savings in land transportation costs = $(5{,}139{,}612 - 3{,}903{,}314)MT \times 9.14US\$/MT = 11{,}299{,}764\ US\$$

The unit cost of land transportation between Takoradi and Abidjan is estimated to be around 9.14 US$ per MT in the market price, which can be broken down into component costs such as depreciation, working expenses and fuel. These components could be roughly allocated to be 60%, 20% and 20% (10%: skilled labor, 10%: unskilled labor) of the total. Then, the economic pricing is applied to each component in estimating the economic price of land transportation costs. (See, Table 20.5.5)

Table 20.5.4 Land Transportation Cost by Distance

Cost	200 Km	800 Km
Transportation Cost (US$/MT)	4.00	9.14
Transportation Cost (US$/TEU)	60.00	137.10

Source: Ghana Shippers' Council

Table 20.5.5 Land Transportation Cost at Economic Price

Item	Cost at Market Price ('000US$)	Foreign Portion	Local Portion			Overall Conversion Factor	Cost at Economic Price ('000US$)
			Non-traded Goods	Skilled Labor	Unskilled Labor		
		1.000	0.970	0.970	0.397	0.937	
Land Trans-portation Cost	-	80%	-	10%	10%	100%	-
	11,300	9,040	-	1,096	449	-	10,585

4) Earnings of foreign currency in cargo handling

In "Without" case, overflowed cargoes will be handled in the competitive foreign ports due to the lack of sufficient facilities and the increase of waiting time. The benefit that will accrue to Ghana from the projects can be calculated by the following formula.

Earnings of foreign currency = Difference in handling cargo volume between "With" and "Without" cases x Cargo handling fee per MT(unit price)

Whereby,

Earnings of foreign currency = *(5,139,612-3,903,314)MT x 10.32$/MT = 12,758,595 US$*

Benefits of the projects at economic price are summarized in the following table.

Table 20.5.6 Benefits of the Projects for Short-term Plan – Takoradi Port

(Unit: thousand US$)

Items	Benefits
Ships' Staying Time	10,077
Water Transportation Cost	6,072
Land Transportation Cost	10,585
Earnings of Foreign Currency	12,759
Total	39,493

20.6 Evaluation of the Project

(1) Calculation of the EIRR

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the economic feasibility of the project.
The EIRR is the discount rate which makes the costs and benefits of a project during the project life equal. It is calculated by using the following formula.

$$\sum_{i=1}^{n} = \frac{B_i - C_i}{(1+r)^{i-1}} = 0$$

Where, n: Period of economic calculation (project life)
Bi: Benefits in I-th year
Ci: Costs in I-th year
R: Discount rate

The EIRR of the project at Takoradi Port is calculated as 22.7%. The results of calculation are shown in Table 20.6.1.

(2) Evaluation

It is generally recognized that the project is feasible if the EIRR exceeds the opportunity cost of capital. Usually, the opportunity cost of capital is considered to range from 8% to 10% according to the degree of development in each country. It is acceptable that a project with an EIRR of more than 8% is economically feasible for infrastructure or social service projects.
As for this project, even though the economic calculation only takes into account the items that are easily quantified, the EIRR is still 15.8% in the worst case. Therefore, this short-term development project is feasible from the viewpoint of the national economy.

Table 20.6.1 Cost/Benefit Analysis of Short-Term Plan for Takoradi Port

Name of Port :Takoradi
Table ____ (1/1)
Economic Evaluation
(In constant 2000 prices, 1000US$)

Year	Costs			Benefits	Net Benefits
	Investment	O&M	Total	Total	
2005	1,428	-	1,428	-	(1,428)
2006	10,807	-	10,807	-	(10,807)
2007	39,451	-	39,451	-	(39,451)
2008	36,207	-	36,207	-	(36,207)
2009	38,627	-	38,627	-	(38,627)
2010		1,616	1,616	39,493	37,877
2011		1,616	1,616	39,493	37,877
2012		1,616	1,616	39,493	37,877
2013		1,616	1,616	39,493	37,877
2014		1,616	1,616	39,493	37,877
2015		1,616	1,616	39,493	37,877
2016		1,616	1,616	39,493	37,877
2017		1,616	1,616	39,493	37,877
2018		1,616	1,616	39,493	37,877
2019	2,922	1,616	4,538	39,493	34,955
2020		1,616	1,616	39,493	37,877
2021		1,616	1,616	39,493	37,877
2022		1,616	1,616	39,493	37,877
2023		1,616	1,616	39,493	37,877
2024		1,616	1,616	39,493	37,877
2025		1,616	1,616	39,493	37,877
2026		1,616	1,616	39,493	37,877
2027		1,616	1,616	39,493	37,877
2028		1,616	1,616	39,493	37,877
2029	26,922	1,616	28,538	39,493	10,955
2030		1,616	1,616	39,493	37,877
2031		1,616	1,616	39,493	37,877
2032		1,616	1,616	39,493	37,877
2033		1,616	1,616	39,493	37,877
2034		1,616	1,616	39,493	37,877
2035		1,616	1,616	39,493	37,877
2036		1,616	1,616	39,493	37,877
2037		1,616	1,616	39,493	37,877
2038		1,616	1,616	39,493	37,877
2039		1,616	1,616	39,493	37,877
Total	**156,364**	**48,480**	**204,844**	**1,184,790**	**979,946**
Economic Internal Rate of Return (EIRR):					**22.7%**

Sensitivity Analysis

	EIRR	Increase in Investment Cost		
	22.7%	0%	10%	20%
Decrease Benefits	0%	22.7%	20.9%	19.4%
	10%	20.7%	19.1%	17.8%
	20%	18.7%	17.1%	15.8%

Chapter 21 Financial Analysis

21.1 Purpose and Methodology

21.1.1 Purpose

The purpose of the financial analysis is to appraise the financial feasibility of the Short-term Development Plan. The analysis focuses on the viability of the project itself and the financial soundness of the port management body during the project life.

21.1.2 Methodology

The procedure of the financial analysis is shown in figure 21.1.1.

(1) Viability of the project

The viability of the project is evaluated using the Financial Internal Rate of Return (FIRR). The FIRR is a discount rate which makes the cost and the revenue during the project life equal. The FIRR is calculated by the following formula.

$$\sum_{i=1}^{n} \frac{Ri - Ci}{(1+r)^{i-1}} = 0$$

n : Project life
Ri : Revenue in the *i* th year
Ci : Cost in the *i* th year
r : Discount rate

The revenues and the costs in the calculation of FIRR are summarized in Table 21.1.1.

Table 21.1.1 The Revenues and the Costs in the Calculation of FIRR

Revenues	Costs
1) Operating revenues by the project	1) Initial and renewal investment costs for the project 2) Operating expenses by the project such as maintenance, personnel and administration costs

The revenues and costs excluded from the calculation of FIRR are summarized in Table 21.1.2.

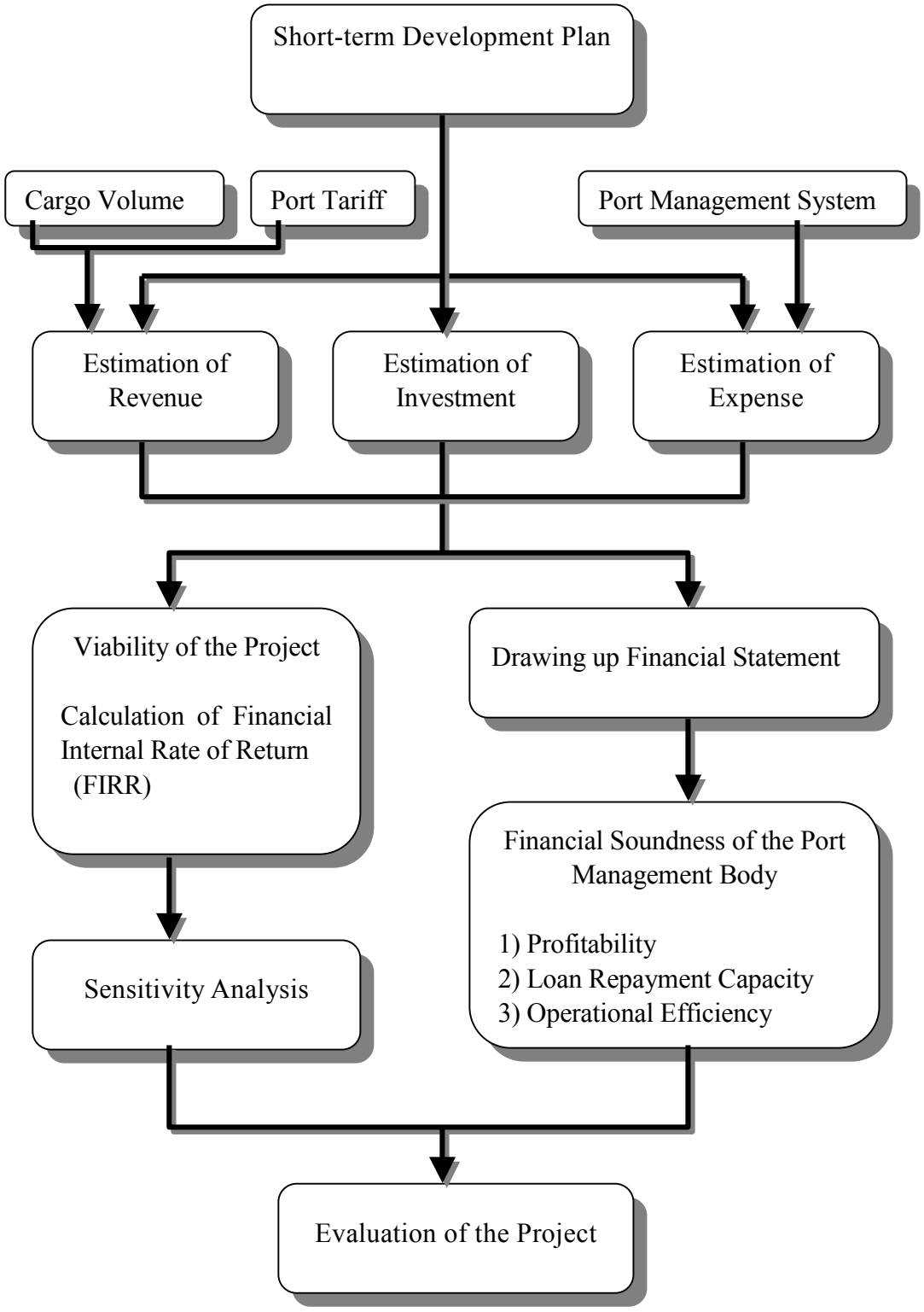

Figure 21.1.1 Procedure of Financial Analysis

Table 21.1.2 Revenues and the Costs Excluded from the Calculation of FIRR

Revenues	Costs
1) Fund management income	1) Repayment of the principal 2) Interest on loans

When the calculated FIRR exceeds the weighted average interest rate of the total funds for investment of the project, the project is regarded as financially feasible.

(2) Financial soundness of the port management body

The financial soundness of the port management body is appraised with its projected financial statements (Profit and Loss Statement, Cash Flow Statement and Balance Sheet). The appraisal is made from the viewpoints of profitability, loan repayment capacity and operational efficiency, using the following ratios.

1) Profitability

$$Rate\ of\ Return\ on\ Net\ Fixed\ Assets = \frac{Net\ Operating\ Income}{Total\ Fixed\ Assets} \times 100\,(\%)$$

The rate of return on net fixed assets shows the profitability of the investments that are presented as net total fixed assets. It is necessary to keep the rate higher than the average interest rate of the funds for investment.

2) Loan repayment capacity

$$Debt\ Service\ Coverage\ Ratio = \frac{Net\ Operating\ Income\ before\ Depreciation}{Repayment\ of\ Principal\ and\ Interest\ on\ Long\text{-}Term\ Loan}$$

The debt service coverage ratio shows whether the operating income can cover the repayment of principal and interest on long term loans. The ratio must be higher than 1.0 and it is generally preferable to be higher than 1.75.

3) Operational efficiency

$$Operating\ Ratio = \frac{Operating\ Expenses}{Operating\ Revenues} \times 100\,(\%)$$

The operating ratio shows the operational efficiency of the terminal management body, namely the ratio of port revenue that is consumed by operating expenses. Generally it must be less than 70-75%.

$$Working\ Ratio = \frac{Operating\ Expenses - Depreciation}{Operating\ Revenues} \times 100\,(\%)$$

Working ratio shows the efficiency of the routine operations of the port. Generally it must be less than 50-60%.

21.2 Prerequisites of the Financial Analysis

21.2.1 General

(1) Scope of the Financial Analysis

Scope of this financial analysis is the projects in the Short-term Development Plan. The specific projects are as follows.

1) Bulk Berth Project (Construction of New Bulk Berth for bauxite and clinker and improvement of present berth for manganese)
2) New Container Terminal and Multipurpose Berth Project

(2) ”With Case” and ”Without Case”

The viability of the project, namely FIRR, is analyzed based on the difference of revenues and costs between the “With Case” and the “Without Case”. Here, the “With Case” is the case in which the Short-term Development Plan is executed while the “Without Case” is the case which represents the existing situation. The financial soundness of the port management body is analyzed using the “With Case”.

21.2.2 Base Year

All costs and revenues are indicated in prices as of March 2001, when the price survey was conducted (US$1.00 = 6,700Cedis). We call this year the “Base Year”.

21.2.3 Project Life

Considering the long-term loans and the service lives of the port facilities, the project life in the financial analysis is assumed to be 35 years including the period of 5 years for detailed design and construction work. Neither inflation nor an increase in nominal wages is considered during the project life.

21.2.4 Fund Raising

Fund raising is divided into foreign and domestic funds. In this study, referring to funding conditions of soft loan by international financial institute including JBIC, the upper limit of finance for foreign funds is assumed to be the total amount of foreign portion or 85% of initial investment costs, whichever is higher. In the proposed projects, eighty-five percent of initial investment costs is assumed to be raised by foreign fund. The remaining initial investment costs (15%) and all renewal investment are assumed to be raised by domestic fund. Conditions of loans are assumed as follows.

(1) Foreign funds

Loan Period : 30 years, including a grace period of 10 years
Interest rate : 1.8%
Repayment : Fixed amount repayment of principal

(2) Domestic funds

Loan Period : 10 years
Interest rate : 8.0%
Repayment : Fixed amount repayment of principal

(3) Weighted average interest rate

2.73% (=1.8%×0.85+8.0%×0.15)

21.2.5 Revenue and Expenditure

(1) Bulk Berth Project

Operating revenues are estimated from the difference of revenues between the "With Case" and the "Without Case". All revenues are calculated by multiplying cargo volume and the number of calling vessels by present tariffs.

The companies handling manganese, bauxite and clinker are specific ones. They will be able to decrease ship berthing, navigation and land transportation cost after the Bulk Berth Project is executed. Therefore, as a beneficiary of the project, these companies will be requested to share a certain percentage of the benefit as a special charge during the project life.

Revenues)

1) Operating Revenues

a) Revenues from cargo and vessel services

A breakdown of revenues generated at the bulk berth is shown from Table 21.2.1 to 21.2.3.

Table 21.2.1 Revenue from Cargo Services at the Bulk Berth

Commodity	Unit Price (US$/ton)	Without Case		With Case		With - Without(US$)
		Cargo Volume(ton)	Revenue (US$)	Cargo Volume(ton)	Revenue (US$)	
Bauxite	0.58	654,592	379,663	1,000,000	580,000	200,337
Clinker	3.09	925,950	2,861,186	1,091,904	3,373,983	512,797
Manganese	0.90	1,000,000	900,000	1,000,000	900,000	0
Total		2,580,542	4,140,849	3,091,904	4,853,983	713,134

Table 21.2.2 Revenue from Vessel Services at the Bulk Berth

Commodity	Unit Price (US$/ship)	Without Case		With Case		With－Without(US$)
		No. of Vessels	Revenue (US$)	No. of Vessels	Revenue (US$)	
Bauxite	10,860.0	19	206,340	26	282,360	76,020
Clinker	10,260.0	44	451,440	57	584,820	133,380
Manganese	5,521.4	48	265,027	35	193,249	-71,778
Total		111	922,807	118	1,060,429	137,622

Table 21.2.3 Total Revenue Generated at the Bulk Berth

Unit : US$

Commodity	Without Case	With Case	With - Without
Bauxite	586,003	862,360	276,357
Clinker	3,312,626	3,958,803	646,177
Manganese	1,165,027	1,093,249	-71,778
Total	5,063,656	5,914,412	850,756

b) Special Charge

The parties that have interest in the project are the port authority (GPHA), shipping companies, producers and consumers. Therefore, it is assumed that the benefit obtained by executing the project will be distributed equally to these four parties. As a result, GPHA will get one-fourth of the benefit as a special charge.
The benefit that will be obtained by executing the project is as follows.

・Savings in staying costs of ships
By executing the project, the staying costs in the port can be reduced. Table 21.2.4 shows total saving cost between the “Without Case” and the “With Case”. Incidentally, as mentioned in chapter 20, it is assumed that overflowed cargoes are to be handled in a substitute (foreign) port and carried by land between Takoradi Port and the substitute port. In this analysis, a part of bauxite and clinker will overflow Takoradi Port, so they will be handled in the substitute port and carried to Ghana by land. Therefore ship staying cost at the substitute port should also be taken into consideration. Total ship staying time at a substitute port is calculated as follows. In this calculation, it is assumed that staying time per ship, that is cargo handling productivity, is the same level as the “With Case” in Takoradi Port.

Total ship staying time at a substitute port = Cargo handling volume in a substitute port / average cargo volume per ship × ship staying time per ship at Takoradi Port in the “With Case”.

Bauxite
Total ship staying time at a substitute port = (1,000,000－654,592)/38,000×4.0days=36days

Clinker

Total ship staying time at a substitute port = (1,091,904－925,950)/19,000×2.5days=22days

Table 21.2.4　Total Saving in Staying Costs of Ships

	Bauxite	Clinker	Manganese
Staying Time at Takoradi Port per year in the "Without Case" (days)	640	642	390
Staying Time at Substitute Port per year in the "Without Case" (days)	36	22	0
Total Staying Time at Ports per year in the "Without Case" (days)	676	664	390
Staying Time at Port per year in the "With Case" (days)	103	143	73
Difference between the "Without Case" and the "With Case" (days)	573	521	317
Unit Price of ship staying time (US$/day)	8,183	8,183	8,183
Total Saving Costs (US$/year)	4,688,859	4,263,343	2,594,011

・Saving in navigation costs of ships

By executing the project, the cargo volume per ship will increase and the number of ships will decrease（excluding the case of clinker）. As a result, navigation costs can be reduced. The cost savings between the "Without Case" and the "With Case" is calculated by the following formula.

(Number of Ships in the "Without Case" － Number of Ships in the "With Case")
× Navigation Time (round-trip) × Unit Navigation Cost

Here navigation times are as follows. (It is assumed that navigation time to a substitute port and Takoradi Port are the same because location of a substitute port is unknown.)

・Bauxite

Distance between Ghana and the main importing country (Canada) 5,130 n.m. ÷ 13.0 knot ÷ 24hours×2（round-trip）＝33 days

・Clinker

Distance between Ghana and the main exporting region (Europe) 4,130 n.m. ÷ 13.0 knot ÷ 24hours×2（round-trip）＝27 days

・Manganese

Distance between Ghana and the main importing region (Europe) 4,130 n.m. ÷ 13.0 knot ÷ 24hours×2（round-trip）＝27 days

Table 21.2.5 shows total saving cost between the "Without Case" and the "With Case".

Table 21.2.5 Total Savings in Navigation Costs of Ships

	Bauxite	Clinker	Manganese
Number of ships in the "Without Case" ①(Takoradi Port)	19	44	48
Number of ships in the "Without Case" ②(Substitute Port)	9	9	0
Total Number of ships in the "Without Case"	28	53	48
Number of ships in the "With Case"	26	57	35
Difference between the "Without Case" and the "With Case"	2	-4	13
Navigation Time (days/ship)	33	27	27
Unit Price of ship navigation (US$/day)	9,550	9,550	9,550
Total Saving Costs (US$/year)	630,300	-1,031,400	3,352,050

・Savings in land transportation costs

As mentioned in chapter 20, in the "Without Case" the overflowed cargoes are handled in a substitute port and transported to Ghana by land. Table 21.2.6 shows total savings in land transportation cost between the "Without Case" and the "With Case".

Table 21.2.6 Total Savings in Land Transportation Cost

	Bauxite	Clinker	Manganese
①Total cargo volume	1,000,000	1,091,904	1,000,000
②Cargo volume handled at Takoradi Port	654,592	925,950	1,000,000
③Cargo volume handled at Substitute Port (①－②)	345,408	165,954	0
Unit Price of land transportation (US$/ton)	9.14	9.14	9.14
Total Saving Costs (US$/year)	3,157,029	1,516,819	0

・Total Savings and Special Charges

It is assumed that half of the total cost savings calculated above shall be paid from users to GPHA as special charges during the project life. Results of calculation are shown in Table 21.2.7.

Table 21.2.7 Total Savings and Special Charges

	Bauxite	Clinker	Manganese	Total
Total Savings (US$/year)	8,476,188	4,748,762	5,946,061	19,171,011
Rate of sharing	0.25	0.25	0.25	0.25
Special Charges (US$/year)	2,119,047	1,187,191	1,486,515	4,792,753

Expenditures)

1) Project Costs

Project Costs are estimated in Chapter 19. According to the construction schedule, investment will be made. Table 21.2.8 shows a summary of the cost of the Bulk Berth Project.

Table 21.2.8 Summary of the Cost of Bulk Berth Project

Unit : US$'000

Currency	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Foreign	485	625	16,544	18,037	484	36,175
Local	133	525	3,886	5,222	167	9,933
Total	618	1,150	20,430	23,259	651	46,108

2) Personnel Costs

Stevedoring is being done by Private Companies and GPHA is getting a royalty fee from these companies now. Therefore there is no difference in personnel cost between the "With Case" and the "Without Case".

3) Maintenance Costs

The annual maintenance costs for the port facilities are calculated as follows.

Infrastructure : 1.0% of the original construction cost
Equipment : 4.0% of the original procurement cost

4) Administration Costs

Since there is no difference in personnel cost between the "With Case" and the "Without Case", there is also no difference in administration cost.

(2) New Container Terminal and Multipurpose Berth Project

Revenues)

1) Operating Revenues

Operating Revenues are estimated from the difference of revenues between the "With Case" and the "Without Case". All revenues are calculated by multiplying cargo volume and number of calling vessels by present tariffs.

As for the New Container Terminal, it is assumed that cargo volume in the "With Case" will increase to the level of Berth Occupancy level = 0.6 (150,000TEU) after the year 2010 because the

New Container Terminal has sufficient capacity.

As for the Multipurpose Berth, it is assumed that container cargo volume handled here in the "Without Case" and the "With Case" will remain at the level of the year 2000 for the following reasons.

- Container Cargo handled at Berth 2～6 is transported to a remote yard because of the narrow apron and limited space behind the berths.
- Cargoes except container cargoes are also forecasted to increase slightly.
- Consequently it might be unrealistic to expect to handle more container cargo than the present level.

A breakdown of revenues generated at the new container terminal and multipurpose berth is shown from Table 21.2.9 to 21.2.12.

Table 21.2.9 Revenue from Cargo Services at the Multipurpose Berth

Commodity	Unit Price (US$)	Without Case		With Case		With - Without (US$)
		Cargo Volume (ton)	Revenue (US$)	Cargo Volume (ton)	Revenue (US$)	
Import			709,417		1,305,219	595,802
DB	1.55	90,565	140,376	166,626	258,270	117,894
BC	3.69	28,176	103,969	51,839	191,286	87,317
GC	3.85	120,798	465,072	222,250	855,663	390,591
Export			121,258		223,099	101,841
BC	3.67	11,927	43,772	21,944	80,534	36,762
GC	3.80	20,391	77,486	37,517	142,565	65,079
Container			1,294,653		1,294,653	0
Stuffed	37.60	27,869	1,047,874	27,869	1,047,874	0
Empty	20.40	12,097	246,779	12,097	246,779	0
Total			2,125,328	0	2,822,971	697,643

Table 21.2.10 Revenue from Cargo Services at the New Container Terminal

Year	Cargo Volume (TEU)			Unit price (US$)		Revenue (US$)
	Stuffed	Empty	Total	Stuffed	Empty	
2010	78,392	17,838	96,230	100.3	66.2	9,043,593
2011	97,458	25,927	123,385	100.3	66.2	11,491,405
2012-	116,106	33,894	150,000	100.3	66.2	13,889,215

Table 21.2.11 Revenue from Vessel Services at the Multipurpose Berth and New Container Terminal

Ship Type	Unit Price(US$)	Without Case		With Case		With－Without (US$)
		No. of Vessels	Revenue (US$)	No. of Vessels	Revenue (US$)	
BU(W)	10,546.4	4	42,186	7	73,825	31,639
GC/CM	3,650.4	64	233,626	118	430,747	197,121
RO	6,518.4	51	332,438	93	606,211	273,773
CO	4,218.4	164	691,818	302	1,273,957	582,139
Total		283	1,300,068	520	2,384,740	1,084,672

Table 21.2.12 Total Revenue Generated at the New Container Terminal and Multipurpose Berth

Unit :US$

Commodity	Without Case	With Case	With - Without
2010	3,425,396	14,251,304	10,825,908
2011	3,425,396	16,699,116	13,273,720
2012-	3,425,396	19,096,926	15,671,530

Expenditures)

1) Project Costs

Project Costs are estimated in Chapter 19. According to the construction schedule, investment will be made. Table 21.2.13 and Table 21.2.14 show a summary of the construction and equipment cost of the New Container Terminal and Multipurpose Berth Project.

Table 21.2.13 Summary of the Construction Cost of the New Container Terminal and Multipurpose Berth Project

Unit : US$'000

Currency	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Foreign	689	9,407	20,127	13,585	8,390	52,198
Local	135	1,162	2,407	2,579	3,947	10,230
Total	824	10,569	22,534	16,164	12,337	62,428

Table 21.2.14 Summary of the Equipment Cost of the New Container Terminal and Multipurpose Berth Project

Unit :US$ '000

Currency	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Foreign	0	0	0	0	27,999	27,999
Local	0	0	0	0	0	0
Total	0	0	0	0	27,999	27,999

The equipment will be replaced after service life. Service lives are as follows

Gantry Carne	: 20 years
Transfer Carne	: 20 years
Tugboat	: 20 years
Top Lifter	: 10 years
Yard Tractor	: 10 years
Yard Trailer	: 10 years

2) Personnel Costs

a) New Container Terminal

While it is assumed that the New Container Terminal will be leased to a private company, we estimate newly required personnel cost including for cargo handling here.
The required staff is as follows.

Administration Section (in Terminal)
6 persons × 1 shift = 6 persons (Snr.-4, Jnr.-2)

Operation Section
Gantry Carne 2 Unit × 1.5 persons / Unit × 3 shift = 9 persons (Jnr.-9)
Transfer Carne 6 Unit × 1.5 persons / Unit × 3 shift = 27 persons (Jnr.-27)
Tractor & Trailer 8 Unit × 1 person / Unit × 3 shift = 24 persons (Jnr.-24)

Yard Control Section
3 persons × 3 shift = 9 persons (Snr.-6, Jnr.-3)

Gate Operation Section
2 gates (in and out) × 2 lane × 1 person / lane × 3 shift = 12 persons (Jnr.-12)

Documentation Section
2 persons × 2 (Import / Export) = 4 (Snr.-4)

Maintenance Section
Electrical 3 persons × 3 shift = 9 persons (Snr.-3, Jnr.-6)
Refrigeration 3 persons × 3 shift = 9 persons (Snr.-3, Jnr.-6)
Vehicle 3 persons × 3 shift = 9 persons (Snr.-3, Jnr.-6)

Total
Snr. Staff 23
Jnr. Staff 95

Required annual personnel costs for the New Container Terminal are calculated by multiplying number of staff by average unit wages estimated according to present level.

Snr. Staff = 23 persons × US$6,970 / person・year = US$160,310 / year
Jnr. Staff = 95 persons × US$2,750 / person・year = US$261,250 / year
Total US$421,560 / year

Required personnel cost for administration, security and marine services of GPHA with construction of New Container Terminal are estimated as follows.

GPHA is assuming the number of required personnel for present Takoradi Port following passage of the Landlord Port Bill as follows.

Snr. Staff – 110 , Jnr. Staff – 696

Assuming that the staff is provided to each present berth (Berth1～6, Oil Berth, Bauxite Berth, Clinker Berth : Total 9 Berths) equally, the required number for each berth is as follows.

Snr. Staff – 12/berth , Jnr. Staff – 77/berth

Required annual personnel costs per berth are calculated by multiplying number of staff by average unit wages estimated according to present level.

Snr. Staff = 12 persons / berth×$6,970 / person・year = $83,640 / year・berth
Jnr. Staff = 77 persons / berth×$2,750 / person・year = $211,750 / year・berth

Total $295,390／year・berth

Therefore required total personnel cost for the New Container Terminal are calculated as follows.

US$421,560 / year + US$295,390 / year = US$716,950 / year

b） Multipurpose Terminal

Since GPHA does not engage in stevedoring, there is no difference in personnel cost between the "Without Case" and the "With Case".

3) Maintenance Costs

The annual maintenance costs for the port facilities are calculated as follows.

Infrastructure : 1.0% of the original construction cost
Equipment : 4.0% of the original procurement cost

4) Administration Costs

Administration costs are assumed as follows according to the actual present level of GPHA.

Administration Costs = Total Personnel Costs × 0.2

21.3 Evaluation of the Project

21.3.1 Viability of the Project

(1) Calculation of FIRR

The result of the FIRR calculation is shown in Table 21.3.1. In all the projects, FIRR exceeds the weighted average interest rate of the funds (2.73%).

Table 21.3.1 Result of FIRR Calculation

	Bulk Berth Project	New Container Terminal and Multipurpose Berth Project	Whole
FIRR	9.1% (Table 21.3.2)	11.1% (Table 21.3.3)	10.4% (Table 21.3.4)

(2) Sensitivity Analysis

Sensitivity analysis is conducted to examine the impact of unexpected future changes such as cargo volume, construction cost, inflation or exchange rate. The following cases are envisioned.

- Case 1 : The investment costs increase by 10%
- Case 2 : The revenues decrease by 10%
- Case 3 : The investment costs increase by 10% and the revenues decrease by 10%

The results of the sensitivity analysis are shown in Table 21.3.5. In all the cases, FIRR exceeds the weighted average interest rate of the funds (2.73%).

Table 21.3.5 Sensitivity Analysis of FIRR

	Bulk Berth Project	New Container Terminal and Multipurpose Berth Project	Whole
Base Case	9.1%	11.1%	10.4%
Case 1	8.2%	10.1%	9.4%
Case 2	8.0%	9.6%	9.1%
Case 3	7.2%	8.7%	8.1%

(3) Evaluation

Judging from the above, this project is regarded as financially feasible under the assumptions in Chapter 21.2.

Table 21.3.2 FIRR of Bulk Berth Project

Unit : US$'000

Year		Revenue			Cost			Revenue − Cost	Net Present Value		
		Port Dues and Vessel Services	Special Charge	Total	Investment	Maintenance Cost	Total		Revenue	Cost	Difference
1	2005			0	618		618	-618	0	618	-618
2	2006			0	1,150		1,150	-1,150	0	1,054	-1,054
3	2007			0	20,430		20,430	-20,430	0	17,160	-17,160
4	2008			0	23,259		23,259	-23,259	0	17,905	-17,905
5	2009			0	651		651	-651	0	459	-459
6	2010	851	4,793	5,644	0	461	461	5,183	3,649	298	3,351
7	2011	851	4,793	5,644	0	461	461	5,183	3,345	273	3,071
8	2012	851	4,793	5,644	0	461	461	5,183	3,065	250	2,815
9	2013	851	4,793	5,644	0	461	461	5,183	2,809	229	2,580
10	2014	851	4,793	5,644	0	461	461	5,183	2,575	210	2,364
11	2015	851	4,793	5,644	0	461	461	5,183	2,360	193	2,167
12	2016	851	4,793	5,644	0	461	461	5,183	2,163	177	1,986
13	2017	851	4,793	5,644	0	461	461	5,183	1,982	162	1,820
14	2018	851	4,793	5,644	0	461	461	5,183	1,816	148	1,668
15	2019	851	4,793	5,644	0	461	461	5,183	1,665	136	1,529
16	2020	851	4,793	5,644	0	461	461	5,183	1,526	125	1,401
17	2021	851	4,793	5,644	0	461	461	5,183	1,398	114	1,284
18	2022	851	4,793	5,644	0	461	461	5,183	1,282	105	1,177
19	2023	851	4,793	5,644	0	461	461	5,183	1,175	96	1,079
20	2024	851	4,793	5,644	0	461	461	5,183	1,076	88	988
21	2025	851	4,793	5,644	0	461	461	5,183	987	81	906
22	2026	851	4,793	5,644	0	461	461	5,183	904	74	830
23	2027	851	4,793	5,644	0	461	461	5,183	829	68	761
24	2028	851	4,793	5,644	0	461	461	5,183	759	62	697
25	2029	851	4,793	5,644	0	461	461	5,183	696	57	639
26	2030	851	4,793	5,644	0	461	461	5,183	638	52	586
27	2031	851	4,793	5,644	0	461	461	5,183	585	48	537
28	2032	851	4,793	5,644	0	461	461	5,183	536	44	492
29	2033	851	4,793	5,644	0	461	461	5,183	491	40	451
30	2034	851	4,793	5,644	0	461	461	5,183	450	37	413
31	2035	851	4,793	5,644	0	461	461	5,183	412	34	379
32	2036	851	4,793	5,644	0	461	461	5,183	378	31	347
33	2037	851	4,793	5,644	0	461	461	5,183	346	28	318
34	2038	851	4,793	5,644	0	461	461	5,183	318	26	292
35	2039	851	4,793	5,644	0	461	461	5,183	291	24	267
Total		25,530	143,790	169,320	46,108	13,830	59,938	109,382	40,505	40,505	0

FIRR= **9.1%**

Table 21.3.3 FIRR of Container Terminal and Multiperpopse Berth Project

Unit : US$'000

Year		Revenue		Cost					Revenue − Cost	Net Present Value		
		Cargo Service and Vessel Service	Total	Investment	Personnel Cost	Maintenance Cost	Administration Cost	Total		Revenue	Cost	Difference
1	2005			824				824	-824	0	824	-824
2	2006			10,569				10,569	-10,569	0	9,513	-9,513
3	2007			22,534				22,534	-22,534	0	18,258	-18,258
4	2008			16,164				16,164	-16,164	0	11,789	-11,789
5	2009			40,336				40,336	-40,336	0	26,479	-26,479
6	2010	10,826	10,826	0	717	1,744	143	2,604	8,222	6,397	1,539	4,858
7	2011	13,274	13,274	0	717	1,744	143	2,604	10,670	7,060	1,385	5,675
8	2012	15,672	15,672	0	717	1,744	143	2,604	13,068	7,503	1,247	6,256
9	2013	15,672	15,672	0	717	1,744	143	2,604	13,068	6,754	1,122	5,632
10	2014	15,672	15,672	0	717	1,744	143	2,604	13,068	6,079	1,010	5,069
11	2015	15,672	15,672	0	717	1,744	143	2,604	13,068	5,472	909	4,563
12	2016	15,672	15,672	0	717	1,744	143	2,604	13,068	4,926	819	4,107
13	2017	15,672	15,672	0	717	1,744	143	2,604	13,068	4,434	737	3,697
14	2018	15,672	15,672	0	717	1,744	143	2,604	13,068	3,991	663	3,328
15	2019	15,672	15,672	3,039	717	1,744	143	5,643	10,029	3,592	1,294	2,299
16	2020	15,672	15,672	0	717	1,744	143	2,604	13,068	3,234	537	2,696
17	2021	15,672	15,672	0	717	1,744	143	2,604	13,068	2,911	484	2,427
18	2022	15,672	15,672	0	717	1,744	143	2,604	13,068	2,620	435	2,185
19	2023	15,672	15,672	0	717	1,744	143	2,604	13,068	2,358	392	1,966
20	2024	15,672	15,672	0	717	1,744	143	2,604	13,068	2,123	353	1,770
21	2025	15,672	15,672	0	717	1,744	143	2,604	13,068	1,911	318	1,593
22	2026	15,672	15,672	0	717	1,744	143	2,604	13,068	1,720	286	1,434
23	2027	15,672	15,672	0	717	1,744	143	2,604	13,068	1,548	257	1,291
24	2028	15,672	15,672	0	717	1,744	143	2,604	13,068	1,394	232	1,162
25	2029	15,672	15,672	27,999	717	1,744	143	30,603	-14,931	1,254	2,449	-1,195
26	2030	15,672	15,672	0	717	1,744	143	2,604	13,068	1,129	188	941
27	2031	15,672	15,672	0	717	1,744	143	2,604	13,068	1,016	169	847
28	2032	15,672	15,672	0	717	1,744	143	2,604	13,068	915	152	763
29	2033	15,672	15,672	0	717	1,744	143	2,604	13,068	823	137	687
30	2034	15,672	15,672	0	717	1,744	143	2,604	13,068	741	123	618
31	2035	15,672	15,672	0	717	1,744	143	2,604	13,068	667	111	556
32	2036	15,672	15,672	0	717	1,744	143	2,604	13,068	601	100	501
33	2037	15,672	15,672	0	717	1,744	143	2,604	13,068	541	90	451
34	2038	15,672	15,672	0	717	1,744	143	2,604	13,068	487	81	406
35	2039	15,672	15,672	3,039	717	1,744	143	5,643	10,029	438	158	280
Total		462,916	462,916	124,504	21,510	52,320	4,302	202,636	260,280	84,639	84,639	-0

FIRR= 11.1%

Table 21.3.4 FIRR of Whole Project

Unit : US$'000

Year		Revenue			Cost			Revenue − Cost	Net Present Value		
		Bulk	Container and Multi Purpose	Total	Bulk	Container and Multi Purpose	Total		Revenue	Cost	Difference
1	2,005	0	0	0	618	824	1,442	-1,442	0	1,442	-1,442
2	2,006	0	0	0	1,150	10,569	11,719	-11,719	0	10,614	-10,614
3	2,007	0	0	0	20,430	22,534	42,964	-42,964	0	35,243	-35,243
4	2,008	0	0	0	23,259	16,164	39,423	-39,423	0	29,289	-29,289
5	2,009	0	0	0	651	40,336	40,987	-40,987	0	27,580	-27,580
6	2,010	5,644	10,826	16,470	461	2,604	3,065	13,405	10,037	1,868	8,169
7	2,011	5,644	13,274	18,918	461	2,604	3,065	15,853	10,442	1,692	8,750
8	2,012	5,644	15,672	21,316	461	2,604	3,065	18,251	10,656	1,532	9,124
9	2,013	5,644	15,672	21,316	461	2,604	3,065	18,251	9,651	1,388	8,263
10	2,014	5,644	15,672	21,316	461	2,604	3,065	18,251	8,741	1,257	7,484
11	2,015	5,644	15,672	21,316	461	2,604	3,065	18,251	7,917	1,139	6,778
12	2,016	5,644	15,672	21,316	461	2,604	3,065	18,251	7,170	1,031	6,139
13	2,017	5,644	15,672	21,316	461	2,604	3,065	18,251	6,494	934	5,560
14	2,018	5,644	15,672	21,316	461	2,604	3,065	18,251	5,882	846	5,036
15	2,019	5,644	15,672	21,316	461	5,643	6,104	15,212	5,327	1,526	3,802
16	2,020	5,644	15,672	21,316	461	2,604	3,065	18,251	4,825	694	4,131
17	2,021	5,644	15,672	21,316	461	2,604	3,065	18,251	4,370	628	3,741
18	2,022	5,644	15,672	21,316	461	2,604	3,065	18,251	3,958	569	3,389
19	2,023	5,644	15,672	21,316	461	2,604	3,065	18,251	3,585	515	3,069
20	2,024	5,644	15,672	21,316	461	2,604	3,065	18,251	3,247	467	2,780
21	2,025	5,644	15,672	21,316	461	2,604	3,065	18,251	2,940	423	2,518
22	2,026	5,644	15,672	21,316	461	2,604	3,065	18,251	2,663	383	2,280
23	2,027	5,644	15,672	21,316	461	2,604	3,065	18,251	2,412	347	2,065
24	2,028	5,644	15,672	21,316	461	2,604	3,065	18,251	2,185	314	1,870
25	2,029	5,644	15,672	21,316	461	30,603	31,064	-9,748	1,979	2,883	-905
26	2,030	5,644	15,672	21,316	461	2,604	3,065	18,251	1,792	258	1,534
27	2,031	5,644	15,672	21,316	461	2,604	3,065	18,251	1,623	233	1,390
28	2,032	5,644	15,672	21,316	461	2,604	3,065	18,251	1,470	211	1,259
29	2,033	5,644	15,672	21,316	461	2,604	3,065	18,251	1,331	191	1,140
30	2,034	5,644	15,672	21,316	461	2,604	3,065	18,251	1,206	173	1,032
31	2,035	5,644	15,672	21,316	461	2,604	3,065	18,251	1,092	157	935
32	2,036	5,644	15,672	21,316	461	2,604	3,065	18,251	989	142	847
33	2,037	5,644	15,672	21,316	461	2,604	3,065	18,251	896	129	767
34	2,038	5,644	15,672	21,316	461	2,604	3,065	18,251	811	117	695
35	2,039	5,644	15,672	21,316	461	5,643	6,104	15,212	735	210	524
Total		169,320	462,916	632,236	59,938	202,636	262,574	369,662	126,427	126,427	0

FIRR= 10.4%

21.3.2 Financial Soundness of the Port Management Body

The projected financial statements and financial indicators (the rate of return on net fixed assets, debt service coverage ratio, operating ratio and working ratio of the port management body) with regard to the Short-Term Development Plan are summarized in Table 21.3.6.

1) Profitability

Throughout the project life, the rate of return on net fixed assets exceeds the weighted average interest rate of funds.

2) Loan Repayment Capacity

Through the project life, the debt service coverage ratio exceeds 1.0. This means that there will be no difficulty in repaying long-term loans from the annual operating revenues.

3) Operational Efficiency

Both the operating and working ratios maintain favorable levels. This shows that the operation will be efficient.

21.3.3 Possibility of Private Company Participation in the New Container Terminal

As mentioned above, these projects executed and operated by GPHA are regarded as financially feasible.
After the passage of the Landlord Port Bill, private company participation in the operation of the New Container Terminal will become a real possibility.

(1) Roles of GPHA and Private Company

There are several ways for private companies to participate in container terminal operations. Here, as mentioned in Chapter 23, roles of GPHA and private company are assumed below. These roles are based on the following objectives ; 1) Ensuring GPHA has the authority to make master plans and control development; 2) Reducing initial costs and project risks of private company; 3) Keeping up with any changes in the future.

(a) GPHA
- Construction, ownership and management of Infrastructure (Berth, Reclamation, Dredging and Pavement etc.)
- Marine services (Pilotage and Towage)

(b) Private company
- Procurement, ownership and management of cargo handling facilities
- Terminal operation

(2) Revenues and expenditures of GPHA and private company

(a) GPHA

Revenues ）

・Revenue from Port Dues
・Revenue from vessel services
・Rent for Container Terminal

Expenditures)

・Project Costs
Cost for construction of Berth, Dredging, Reclamation, Revetment, Pavement, Gate, Lighting facilities and Drainage.

・Personnel Costs
Cost of personnel in charge of Administration, Security and Marine services.

・Maintenance Costs
The annual maintenance costs for the port facilities are calculated as follows.

Infrastructure : 1.0% of the original construction cost
Equipment : 4.0% of the original procurement cost

・Administration Costs
Administration costs are assumed to be as follows according to the present level of GPHA.

Administration Costs = Total Personnel Costs × 0.2

(b) Private company

Revenues ）

・Revenue from Cargo handling (Present tariff is used in this study)

Expenditures)

・Project Costs (including renewal investment)
Costs for procurement of Office, Gantry Crane, Transfer Crane, Yard Tractor and Yard Trailer.

・Personnel Costs
Refer to 21.2.5.

・Maintenance Costs
The annual maintenance costs for the port facilities are calculated as follows.

Infrastructure : 1.0% of the original construction cost

Table 21.3.6 Financial Statements and Financial Indicators (1/2)

Profit and Loss Statement Unit : US$

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Operating Revenue	15,000,000	15,000,000	15,000,000	15,000,000	15,000,000	25,808,154	28,255,966	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106
Operating Expense	4,600,000	4,600,000	5,035,000	6,720,000	8,264,000	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084
Personnel Cost	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070
Maintenance Materials	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000
Admin. Expenses	600,000	600,000	600,000	600,000	600,000	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014
Depreciation	0	0	435,000	2,120,000	3,664,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000
Net Operating Income	10,400,000	10,400,000	9,965,000	8,280,000	6,736,000	13,205,070	15,652,882	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022
Non-Operating Expense	434,188	378,159	346,095	428,882	828,168	1,286,505	1,416,969	1,218,723	1,019,659	821,003	622,348	433,056	293,971	318,798	840,467	1,305,202
Interest of Long-Term Loans	434,188	378,159	346,095	428,882	828,168	1,286,505	1,416,969	1,218,723	1,019,659	821,003	622,348	433,056	293,971	318,798	840,467	1,305,202
Net Income Before Tax	9,965,812	10,021,841	9,618,905	7,851,118	5,907,832	11,918,565	14,235,913	16,833,299	17,032,363	17,231,019	17,429,674	17,618,966	17,758,051	17,733,224	17,211,555	16,746,820
Income Tax	3,488,034	3,507,644	3,366,617	2,747,891	2,067,741	4,171,498	4,982,569	5,891,654	5,961,327	6,030,856	6,100,386	6,166,638	6,215,318	6,206,628	6,024,044	5,861,387
Net Income After Tax	6,477,778	6,514,197	6,252,288	5,103,227	3,840,091	7,747,067	9,253,344	10,941,645	11,071,036	11,200,163	11,329,288	11,452,328	11,542,733	11,526,596	11,187,511	10,885,433

Cash Flow Statement

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cash Beginning	0	5,223,815	10,457,249	15,881,856	21,213,102	26,045,112	36,410,698	48,282,561	61,842,725	75,532,279	89,350,961	103,298,767	118,404,895	133,268,527	146,911,773	159,414,933
Cash Inflow	11,842,000	22,119,000	53,364,000	49,823,000	51,387,000	18,907,070	21,354,882	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022	26,793,022	23,754,022
Net Operating Income	10,400,000	10,400,000	9,965,000	8,280,000	6,736,000	13,205,070	15,652,882	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022
Depreciation	0	0	435,000	2,120,000	3,664,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000
Long-Term Loans	1,442,000	11,719,000	42,964,000	39,423,000	40,987,000	0	0	0	0	0	0	0	0	0	3,039,000	0
Cash Outflow	6,618,185	16,885,566	47,939,393	44,491,754	46,554,990	8,541,484	9,483,019	10,193,858	10,064,467	9,935,340	9,806,215	8,647,894	8,890,389	10,110,776	14,289,861	13,289,089
Investment	1,442,000	11,719,000	42,964,000	39,423,000	40,987,000	0	0	0	0	0	0	0	0	0	3,039,000	0
Repayment of Principal	1,253,963	1,280,763	1,262,681	1,891,981	2,672,081	3,083,481	3,083,481	3,083,481	3,083,481	3,083,481	3,083,481	2,048,200	2,381,100	3,585,350	4,386,350	6,122,500
Interest on Long-Term Loans	434,188	378,159	346,095	428,882	828,168	1,286,505	1,416,969	1,218,723	1,019,659	821,003	622,348	433,056	293,971	318,798	840,467	1,305,202
Income Tax	3,488,034	3,507,644	3,366,617	2,747,891	2,067,741	4,171,498	4,982,569	5,891,654	5,961,327	6,030,856	6,100,386	6,166,638	6,215,318	6,206,628	6,024,044	5,861,387
Cash Inflow - Cash Outflow	5,223,815	5,233,434	5,424,607	5,331,246	4,832,010	10,365,586	11,871,863	13,560,164	13,689,555	13,818,682	13,947,807	15,106,128	14,863,633	13,643,246	12,503,161	10,464,933
Cash Ending	5,223,815	10,457,249	15,881,856	21,213,102	26,045,112	36,410,698	48,282,561	61,842,725	75,532,279	89,350,961	103,298,767	118,404,895	133,268,527	146,911,773	159,414,933	169,879,866

Balance Sheet

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(Assets)																
Current Assets	16,082,412	21,315,846	26,740,453	32,071,699	36,903,709	47,269,295	59,141,158	72,701,322	86,390,876	100,209,558	114,157,364	129,263,492	144,127,124	157,770,370	170,273,530	180,738,463
Cash & Deposit	5,223,815	10,457,249	15,881,856	21,213,102	26,045,112	36,410,698	48,282,561	61,842,725	75,532,279	89,350,961	103,298,767	118,404,895	133,268,527	146,911,773	159,414,933	169,879,866
Other Current Assets	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597
Fixed Assets	1,442,000	13,161,000	55,690,000	92,993,000	130,316,000	124,614,000	118,912,000	113,210,000	107,508,000	101,806,000	96,104,000	90,402,000	84,700,000	78,998,000	76,335,000	70,633,000
Existing Fixed Assets	1,442,000	13,161,000	56,125,000	95,548,000	136,535,000	136,535,000	136,535,000	136,535,000	136,535,000	136,535,000	136,535,000	136,535,000	136,535,000	136,535,000	139,574,000	139,574,000
Accumulated Depreciation	0	0	435,000	2,555,000	6,219,000	11,921,000	17,623,000	23,325,000	29,027,000	34,729,000	40,431,000	46,133,000	51,835,000	57,537,000	63,239,000	68,941,000
Net Fixed Assets	1,442,000	13,161,000	55,690,000	92,993,000	130,316,000	124,614,000	118,912,000	113,210,000	107,508,000	101,806,000	96,104,000	90,402,000	84,700,000	78,998,000	76,335,000	70,633,000
Total Assets	17,524,412	34,476,846	82,430,453	125,064,699	167,219,709	171,883,295	178,053,158	185,911,322	193,898,876	202,015,558	210,261,364	219,665,492	228,827,124	236,768,370	246,608,530	251,371,463
(Liabilities and Capital)																
Liabilities	11,046,634	21,484,871	63,186,190	100,717,209	139,032,128	135,948,647	132,865,166	129,781,685	126,698,204	123,614,723	120,531,242	118,483,042	116,101,942	112,516,592	111,169,242	105,046,742
Long-Term Loans	11,046,634	21,484,871	63,186,190	100,717,209	139,032,128	135,948,647	132,865,166	129,781,685	126,698,204	123,614,723	120,531,242	118,483,042	116,101,942	112,516,592	111,169,242	105,046,742
Capital	6,477,778	12,991,975	19,244,263	24,347,490	28,187,581	35,934,648	45,187,992	56,129,637	67,200,672	78,400,835	89,730,122	101,182,450	112,725,182	124,251,778	135,439,288	146,324,721
Retained Earnings	6,477,778	12,991,975	19,244,263	24,347,490	28,187,581	35,934,648	45,187,992	56,129,637	67,200,672	78,400,835	89,730,122	101,182,450	112,725,182	124,251,778	135,439,288	146,324,721
Total Loabilities and Capital	17,524,412	34,476,846	82,430,453	125,064,699	167,219,709	171,883,295	178,053,158	185,911,322	193,898,876	202,015,558	210,261,364	219,665,492	228,827,124	236,768,370	246,608,530	251,371,463

Financial Indicators

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Rate of Return on Net Fixed Asset	721.2%	79.0%	17.9%	8.9%	5.2%	10.6%	13.2%	15.9%	16.8%	17.7%	18.8%	20.0%	21.3%	22.9%	23.6%	25.6%
Debt Service Coverage Ratio	6.16	6.27	6.46	4.48	2.97	4.33	4.75	5.52	5.79	6.08	6.41	9.57	8.88	6.08	4.54	3.20
Operating Ratio	30.7%	30.7%	33.6%	44.8%	55.1%	48.8%	44.6%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%
Working Ratio	30.7%	30.7%	30.7%	30.7%	30.7%	26.7%	24.4%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%

Table 21.3.6 Financial Statements and Financial Indicators (2/2)

Profit and Loss Statement Unit : US$

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Operating Revenue	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106	30,655,106
Operating Expense	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,603,084	12,168,084	10,483,084	8,939,084	8,453,084
Personnel Cost	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070	3,080,070
Maintenance Materials	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000	3,205,000
Admin. Expenses	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014	616,014
Depreciation	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,267,000	3,582,000	2,038,000	1,552,000
Net Operating Income	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,487,022	20,172,022	21,716,022	22,202,022
Non-Operating Expense	2,082,989	1,953,942	1,824,895	1,695,848	1,566,802	1,437,755	1,308,708	1,179,661	1,050,614	921,568	2,832,761	2,504,034	2,175,307	1,846,580	1,517,854
Interest of Long-Term Loans	2,082,989	1,953,942	1,824,895	1,695,848	1,566,802	1,437,755	1,308,708	1,179,661	1,050,614	921,568	2,832,761	2,504,034	2,175,307	1,846,580	1,517,854
Net Income Before Tax	15,969,033	16,098,080	16,227,127	16,356,174	16,485,220	16,614,267	16,743,314	16,872,361	17,001,408	17,130,454	15,219,261	15,982,988	17,996,715	19,869,442	20,684,168
Income Tax	5,589,161	5,634,328	5,679,494	5,724,661	5,769,827	5,814,993	5,860,160	5,905,326	5,950,493	5,995,659	5,326,741	5,594,046	6,298,850	6,954,305	7,239,459
Net Income After Tax	10,379,872	10,463,752	10,547,633	10,631,513	10,715,393	10,799,274	10,883,154	10,967,035	11,050,915	11,134,795	9,892,520	10,388,942	11,697,865	12,915,137	13,444,709

Cash Flow Statement

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Cash Beginning	169,879,866	179,839,237	189,882,489	200,009,621	210,220,634	220,515,526	230,894,300	241,356,953	251,903,488	262,533,902	270,752,197	277,728,216	284,765,658	291,427,022	297,761,659
Cash Inflow	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022	51,753,022	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022	23,754,022
Net Operating Income	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,052,022	18,487,022	20,172,022	21,716,022	22,202,022
Depreciation	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,702,000	5,267,000	3,582,000	2,038,000	1,552,000
Long-Term Loans	0	0	0	0	0	0	0	0	27,999,000	0	0	0	0	0	0
Cash Outflow	13,794,650	13,710,770	13,626,889	13,543,009	13,459,129	13,375,248	13,291,368	13,207,487	41,122,607	15,535,727	16,778,002	16,716,580	17,092,657	17,419,385	17,375,813
Investment	0	0	0	0	0	0	0	0	27,999,000	0	0	0	0	0	0
Repayment of Principal	6,122,500	6,122,500	6,122,500	6,122,500	6,122,500	6,122,500	6,122,500	6,122,500	6,122,500	8,618,500	8,618,500	8,618,500	8,618,500	8,618,500	8,618,500
Interest on Long-Term Loans	2,082,989	1,953,942	1,824,895	1,695,848	1,566,802	1,437,755	1,308,708	1,179,661	1,050,614	921,568	2,832,761	2,504,034	2,175,307	1,846,580	1,517,854
Income Tax	5,589,161	5,634,328	5,679,494	5,724,661	5,769,827	5,814,993	5,860,160	5,905,326	5,950,493	5,995,659	5,326,741	5,594,046	6,298,850	6,954,305	7,239,459
Cash Inflow - Cash Outflow	9,959,372	10,043,252	10,127,133	10,211,013	10,294,893	10,378,774	10,462,654	10,546,535	10,630,415	8,218,295	6,976,020	7,037,442	6,661,365	6,334,637	6,378,209
Cash Ending	179,839,237	189,882,489	200,009,621	210,220,634	220,515,526	230,894,300	241,356,953	251,903,488	262,533,902	270,752,197	277,728,216	284,765,658	291,427,022	297,761,659	304,139,867

Balance Sheet

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
(Assets)															
Current Assets	190,697,834	200,741,086	210,868,218	221,079,231	231,374,123	241,752,897	252,215,550	262,762,085	273,392,499	281,610,794	288,586,813	295,624,255	302,285,619	308,620,256	314,998,464
Cash & Deposit	179,839,237	189,882,489	200,009,621	210,220,634	220,515,526	230,894,300	241,356,953	251,903,488	262,533,902	270,752,197	277,728,216	284,765,658	291,427,022	297,761,659	304,139,867
Other Current Assets	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597	10,858,597
Fixed Assets	64,931,000	59,229,000	53,527,000	47,825,000	42,123,000	36,421,000	30,719,000	25,017,000	47,314,000	41,612,000	35,910,000	30,643,000	27,061,000	25,023,000	23,471,000
Existing Fixed Assets	139,574,000	139,574,000	139,574,000	139,574,000	139,574,000	139,574,000	139,574,000	139,574,000	167,573,000	167,573,000	167,573,000	167,573,000	167,573,000	167,573,000	167,573,000
Accumulated Depreciation	74,643,000	80,345,000	86,047,000	91,749,000	97,451,000	103,153,000	108,855,000	114,557,000	120,259,000	125,961,000	131,663,000	136,930,000	140,512,000	142,550,000	144,102,000
Net Fixed Assets	64,931,000	59,229,000	53,527,000	47,825,000	42,123,000	36,421,000	30,719,000	25,017,000	47,314,000	41,612,000	35,910,000	30,643,000	27,061,000	25,023,000	23,471,000
Total Assets	255,628,834	259,970,086	264,395,218	268,904,231	273,497,123	278,173,897	282,934,550	287,779,085	320,706,499	323,222,794	324,496,813	326,267,255	329,346,619	333,643,256	338,469,464
(Liabilities and Capital)															
Liabilities	98,924,242	92,801,742	86,679,242	80,556,742	74,434,242	68,311,742	62,189,242	56,066,742	77,943,242	69,324,742	60,706,242	52,087,742	43,469,242	34,850,742	26,232,242
Long-Term Loans	98,924,242	92,801,742	86,679,242	80,556,742	74,434,242	68,311,742	62,189,242	56,066,742	77,943,242	69,324,742	60,706,242	52,087,742	43,469,242	34,850,742	26,232,242
Capital	156,704,592	167,168,344	177,715,976	188,347,489	199,062,881	209,862,155	220,745,308	231,712,343	242,763,257	253,898,052	263,790,571	274,179,513	285,877,377	298,792,514	312,237,222
Retained Earnings	156,704,592	167,168,344	177,715,976	188,347,489	199,062,881	209,862,155	220,745,308	231,712,343	242,763,257	253,898,052	263,790,571	274,179,513	285,877,377	298,792,514	312,237,222
Total Loabilities and Capital	255,628,834	259,970,086	264,395,218	268,904,231	273,497,123	278,173,897	282,934,550	287,779,085	320,706,499	323,222,794	324,496,813	326,267,255	329,346,619	333,643,256	338,469,464

Financial Indicators

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Rate of Return on Net Fixed Asset	27.8%	30.5%	33.7%	37.7%	42.9%	49.6%	58.8%	72.2%	38.2%	43.4%	50.3%	60.3%	74.5%	86.8%	94.6%
Debt Service Coverage Ratio	2.89	2.94	2.99	3.04	3.09	3.14	3.20	3.25	3.31	2.49	2.07	2.14	2.20	2.27	2.34
Operating Ratio	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	41.1%	39.7%	34.2%	29.2%	27.6%
Working Ratio	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%

Equipment : 4.0% of the original procurement cost

・Administration Costs

Administration costs are assumed to be as follows according to the present level of GPHA.

Administration Costs = Total Personnel Costs × 0.2

・Rent for Container Terminal

(3) Calculation of FIRR

The result of FIRR calculation under variable rental conditions is shown in Table 21.3.7.

Table 21.3.7 Result of FIRR Calculation

Rent（US$'000 / year）	FIRR of GPHA	FIRR of Private Company
2,000	13.7%	28.7%
2,500	14.6%	26.2%
3,000	15.5%	23.7%
3,500	16.4%	21.2%
4,000	17.2%	18.6%
4,500	18.0%	16.0%
5,000	18.9%	13.4%

Judging from the above calculation and fund raising conditions of both parties, assuming that rent is set at US$3,000,000 / year, FIRR of GPHA and the private company are well-balanced.

(4) Sensitivity Analysis

Sensitivity analysis is conducted to examine the impact of unexpected future changes in cargo volume, construction cost, inflation or exchange rate. FIRR is checked on condition that rent is set at US$3,000,000 / year. The following cases are envisioned

- Case 1 : The investment costs increase by 10%
- Case 2 : The revenues decrease by 10%
- Case 3 : The investment costs increase by 10% and the revenues decrease by 10%

The results of the sensitivity analysis are shown in Table 21.3.8. In all cases, FIRR of GPHA exceeds the weighted average interest rate of the funds (2.73%) and FIRR of private company exceeds the general interest rate of domestic funds (8.0%).

Table 21.3.8 Sensitivity Analysis for FIRR

	FIRR of GPHA	FIRR of Private Company
Base Case	15.5%	23.7%
Case 1	14.4%	21.7%
Case 2	14.0%	19.3%
Case 3	13.0%	17.5%

(5) Evaluation

Judging from above analysis, it is financially feasible for a private company to participate in the operation of the New Container Terminal.

There are several methods to set the rent. One method is to fix the annual rent, as stated above. Another method is to divide the rent into a fixed part and variable part which increases progressively by cargo volume. The latter method has the following merits. 1) In case cargo volume is less than estimated cargo volume, risk of lessee (private company) will be reduced. 2) In case cargo volume increases beyond the estimated level, the lessor (GPHA) can obtain a part of the additional benefit.

Furthermore, given the lessee can set tariffs independently, it might be possible to strengthen the position of the terminal among competing terminals.

21.3.4 Conclusion

Judging from the above analysis, all the projects are regarded as financially feasible. However, the port management body should make continuous efforts to secure forecast cargo volume, to improve cargo handling efficiency and to reduce operating expenses.

Chapter 22 Port Management and Operation

22.1 Proposal for Efficient and Reliable Port Management

22.1.1 General Problem for Privatization of Takoradi Port

Under the Landlord Port Bill, GPHA is going to change from a service port to a landlord port. Final amendments to the Landlord Port Bill are now being made and it is expected to pass the Parliament soon.

GPHA has already introduced privatization to same extent, namely;
- Cargo handling operation (stevedoring and shorehandling) with private companies
- Offdock terminal operation by private company
  (at Tema port, TCT: Tema Container Terminal LTD operated by ANTRAK)

The biggest change by this privatization is cargo handling operations. At present, cargo handling operations are implemented by GPHA and 3 private companies. But there is no actual competition because GPHA decided to allocate the amount of works (See Chapter 5.3.1). After the privatization, principle of competition will be introduced and more efficient cargo handling operation will be expected. And as the landlord, GPHA is required to take the initiative to further increase operational efficiency at Ghana Sea Ports.

However, it is desirable that workers currently employed by GPHA for stevedoring activities be hired by the private companies or retained by GPHA. Following systems will be required to increase workers' skill, knowledge and early retirement;

- Introduction of training center for workers
- Introduction of three-shift working system
- Assistance for replaced workers of looking for new job
- Introduction of early retirement benefit or retirement pension

The introduction of early retirement benefit or retirement pension, outplacement to urge early retirement is also necessary steps.

22.1.2 Privatization of Port Management and Operation

For Ghana Sea Ports, it is recommended to select the D-type form of privatization. (See Chapter 15.1.2. and Table 15.1.1.) Different approaches should be taken in some instances. Details for Takoradi port are as follows.

(1) New Container Terminal

New container terminal at the inner port area is desired to be leased to a single operator as a public berth because many companies will utilize this single container terminal. GPHA constructs the basic facilities while the operation company is responsible for equipment procurement and

operation. However, there are plural possibilities concerning the make-up of that single operator.

- One private company such as shipping company, stevedoring company
- One joint venture company of private companies
- One joint venture company of these private companies and GPHA

Under the Landlord Port Bill, GPHA will mainly have the function of port administration and management such as to prepare and update a port master plan, to regulate and control the development within ports, to regulate navigation, dredging, and operations on ship, cargo handling and passengers, to promote the use, improvement and development of the port and participate in the activities and meeting on ports, etc.

Terminal operator and port authority (landlord GPHA) are required to cooperate for efficient port operation. While risk and benefit will be properly shared, it is also important to cooperate for efficient vessel operation. It will be important work for GPHA to ensure that all terminal users are fairly treated. It is also required to monitor the tariff structure, performance of operations such as effective use of facilities and productivity of cargo handling. (GPHA should make some criteria for the monitoring such as minimum amount of cargo handling per annual.)

Container cargo will be handled at both the new container terminal and the new multipurpose berth. New multipurpose berth is appropriate to be managed by GPHA and operated by private companies. But to promote efficient port management, these two container operators should compete with each other. In the short-term stage, it is recommended that GPHA gives priority of the utilization of NCP (New Container Platform) and KAMPIHL Container Yard to users of the new multipurpose berth because of the lack of yards.

Container terminal lease systems at selected international ports are shown in Table 22.1.1.

Table 22.1.1 Container Terminal Lease System in Selected Foreign Ports

County	USA	Japan	South Korea	Sri Lanka
Port	Los Angeles	Kobe	Pusan	Colombo
Throughput (1,000 TEUs)	3,829	1,992	6,440	1,704
Operator				
Shipping Company	**	**	*	
Stevedoreing Company	*	*	*	
JV (Public + Private)			*	*
Lease Fee Structure				
Minimum Guarantee	*			
Fixed fee		*	*	
Propotional to throughput	*			*
Incentives	*			*
Lease Fee Unit	US$/Acre/Year	Yen/Berth/Year	Won/Berth/Year	US$/TEU
Lease Fee Level	170 thousand US$	9.0 million US$	5.3 million US$	3-5 US$ / TEU#
Remark		Lease level is the avarage of main 4 ports	Lease fee sysem changed from propotional type to fixed type in 1999	# Royalty under the BOT scheme, South Asia Gateway Terminal

(2) New Multipurpose Berths (Berths 5-6)

Since berths 5-6 will function as the multipurpose berths, it is appropriate for them to be managed by GPHA, including facilities and equipment such as quay side gantry cranes. Maintenance of facilities and equipment will be done by GPHA or contracted to private company. Private companies can also provide other cargo handling equipment and do handling operations.

Prior to the opening of the container yard behind the new multipurpose berth, container should be moved outside the berth within 24 hours (the same as at present) to avoid congestion in the yard. And due to the lack of yard space at the new multipurpose berth, it is recommended that GPHA should give users of those berths priority to use the container yard. GPHA gives priority of the utilization of NCP (New Container Platform) and KAMPIHL Container Yard.

(3) New Bulk Berth, Improved Manganese Berth

Management and operation of the new bulk berths for manganese, bauxite, clinker would be the responsibility of private companies. Private companies can be expected to adopt the most efficient way of providing services and handling cargoes in these berths.

At present, mining companies are already participating in bulk handling operations. Privatization at the new bulk berths will be done smoothly.

(4) Others

Berths 2-4 for other cargoes (Ro-Ro cargo, general cargo, bagged cargo) are desired to be managed by GPHA and operated by private companies. Maintenance of facilities will be done by GPHA or private companies by contract with GPHA. Cargo handling equipment will be provided by private companies.

Management and operation of oil handling berth would be the responsibility of private companies. Private companies can be expected to adopt the most efficient way of providing services and handling cargoes in this berth.

22.1.3 Monitoring the Performance of Operation

As mentioned in the Landlord Port Bill, private companies are allowed to perform cargo-handling activities. GPHA should monitor the performance of operators and recommend the improvement of productivity if the performance is poor and reject the renewal of lease contract if improvement is not expected. GPHA needs to put pressure on port operators to improve the productivity of operation.

If GPHA participates in the joint venture with private companies in future, GPHA is required to keep its monitoring section independent from the operating section. Operation activities within

landlord GPHA and private companies need to be closely monitored.

22.1.4 Maintenance of Cargo Handling Equipment

Port facilities and cargo handling equipment must be well maintained so that port users can make full use of facilities and equipment. Breakdown time of equipment has to be minimized. Storage facilities should be properly designed to prevent cargo damages. Security measures for cargoes or countermeasures against pilferage must be taken effectively. Cargo handling operation must be precise, careful and safe.

To generate the maximum income from port service, cargo handling must be done continuously, and this requires well-maintained cargo handling equipment. Reservation of back up equipment and sufficient amount of parts are required, and periodic maintenance of cargo handling equipment is also required.

Especially for containers, it is essential to minimize the breakdown time of container handling equipment to achieve the targeted productivity. Maintenance of equipment will be done efficiently by private terminal operators.

Maintenance of equipment owned by GPHA will be done by GPHA or contracted to private company.

22.1.5 Three-Shift Working System

Two-shift working schedule for dock workers is now adapted, that is from 7:30 to 19:30 for the 1st shift and from 19:30 to 7:30 for the 2nd shift (with overtime period 17:00 to 19:30 for 1st shift, 3:30 to 7:30 for 2nd shift). It is difficult to realize continuous works under this system. The introduction of a third-shift (for 8 hours) is required to achieve more effective cargo handling by workers. Continuous 24 hours cargo handling needs to be maintained.

To effectively utilize new equipment such as cargo handling machines (gantry crane, transfer crane, etc.) and the computer system for container handling, periodic training for workers is desirable. This will help to prevent accidents as well as enhance the skill level of workers.

22.1.6 Port EDI System

Refer to Chapter 15.1.4.

22.1.7 Port Promotion Activity for Takoradi Port

To increase cargo volume and number of vessels calling in Ghana Sea Ports, port promotion activity is important. In West Africa, Ghana Sea Ports enjoy a reputation for reliability thanks to the stability of the Ghanaian government. Recently, some seaports in neighbouring countries have problems concerning reliability, and some shipping companies plan to shift their cargo-handling to Ghana Sea ports. Important points for promoting Ghana Sea Ports in future are below:

・To emphasize the high stability and reliability of Ghana Sea Ports.
・To emphasize the greater convenience and performance of Ghana Sea Ports that can be effected once the Landlord Port Bill is passed.

It is vital to increase trade visits to potential customers for Takoradi Port to attract more cargoes, especially import cargoes at the hinterland of Takoradi Port such as Western Region, Ashanti Region (Kumasi), Brong-Ahafo Region (Sunyani) , Northern Region (Tamale).

To become competitive with other ports, rectifying the imbalance between import and export containers (including container size) is also an important task for Takoradi Port. Container freight for Takoradi Port is higher than at neighbouring ports. For example, the freight for Takoradi Port is 20% higher than at Tema Port because of the container inventory activity, mainly transfer of empty containers for export from other ports to Takoradi Port.

To have periodic meetings with port users such as shipping companies and agents is also important to identify their problems and propose measure to resolve them. By these activity, Takoradi Port will be a more useful and more competitive port.

22.1.8 Port Tariff

Port charges should be competitive but must cover the cost of construction, management and maintenance of port facilities. Furthermore, tariff structure should encourage port users to use port facilities efficiently.

The following points should be considered in terms of the tariff structure.

・The revenue from the tariff can cover costs for construction, management, maintenance and repair.
・The tariff should be rational in correspondence with the service provided.
・The tariff structure should include a system which leads to more effective management and operation of the port. This implies that an incentive should be provided for vessels and cargo to move efficiently through the port.
・Tariff structure and the way of imposition should be as simple as possible.

The tariff for the new container terminal and the new multipurpose berth will be set in view of the above points. Tariff for the new multipurpose berth is appropriate to be lower than the new container terminal because of its limitations (container yard is far from berth side, container cargo should be moved outside the multipurpose yard in a day etc.).

Chapter 23 Environmental Impact Assessment

The Study Team carried out the environmental analysis for formulate the draft EIS for the short-term development plan of Takoradi Port. Formal EIS should be made by a project proponent following the EIA guidelines of Ghana. This draft EIA provides the project proponent with technical support to compile the EIS. This chapter summarizes the results of environmental analysis. Full description is included in Appendix A.

23 1 Introduction

23.1.1 Project Background and Objectives

(1) Background

The original Takoradi Port was constructed in the 1920s as the base of navy operations and trade (1st Stage). From 1947-1953, major parts of the present breakwaters were constructed (2nd Stage). From 1953-1958, breakwaters together with berths were extended to complete the present framework of the Port.

Takoradi Port is located about 250km west of Accra, and has played an important role as an export gateway of Ghana. Most of the main export products of Ghana such as bauxite, manganese, wood, and cocoa are shipped from this port.

Main port facilities of Takoradi Port include 9 berths, Berth No.1 to No.6, an Oil Berth, a Bauxite Berth and a Clinker Jetty. There are two (2) public sheds and one private shed for the export of the bulk cocoa beans on Lee Breakwater, and two (2) Cocoa sheds, two (2) Timber sheds and one shed in the inner port area. The existing port layout plan of the Takoradi Port is shown in Figure 6.2.1.

Increasing cargo handling volume requires a considerable scale of expansion of capacity of the Port. The cargo handling volume will reach to 5 million tons and 9 million tons in 2010 and 2020, respectively, while it remains around 3 million tons at present. In particular, container cargo is estimated to increase more than 4 times and 10 times in 2010 and 2020(see Table 13.1.1).

In order to respond to the increasing demand of cargo volume, the provision of deep berths is indispensable and urgent. At the same time, the space for the cargo handling operation should be provided considering the requirement from the local residents.

(2) Objectives

JICA Study Team proposed a development plan of Takoradi Port, in response to the request from the Government of Ghana to Government of Japan, to accelerate and support the economic development of Ghana. Based on the Scope of Works signed by JICA and Government of Ghana on July 20th, 2000, the study team carried out an EIA study for the short-term development plan of Takoradi Port with a target year of 2010.

Takoradi short-term development plan comprised of the following components:

• Creation of new berths through reclamation replacing the existing lee breakwater
• Extension of main breakwater
• Reclamation at head of the existing port basin
• Dredging in the existing port basin and entrance area
• Container and other cargo handling operation on the reclaimed land
• Increase in the cargo transportation

In compliance with the Environmental Protection Agency (EPA) Act, Act 490 of 1994, the plan must be registered with the EPA by GPHA, the project proponent. Under the Ghana Environmental Assessment Regulations, 1999 (LI 1652), port expansion projects with the increase of cargo handling volume of 25 % or more fall within the category of Environmental Critical Undertakings for which EIA is mandatory.

The objective of the environmental study in this report is to prepare the technical parts of the EIS for the short-term development plan of Takoradi Port, which in due course, GPHA will complete for the implementation of the plan.

23.1.2 Legal, Administrative and Policy Consideration

The relevant policies and the regulatory conditions that must be considered for the successful implementation of the project have been reviewed and are discussed below.

The laws considered include:
- Environmental Protection Agency Act, 1994 (Act 490)
- Environmental Assessment Regulation, 1999 (LI 1652)
- Ghana Ports and Harbours Authority Law, 1986 (PNDC Law 160)
- Merchant Shipping Act, 1963 (Act 183)
- Port Regulations, 1964 (LI 352)
- Ghana Free Zones Act, 1995 (Act 504)

In addition, the followings were considered, though under consideration of the Government of Ghana:
- Draft National Maritime Authority Act, 2000
- Draft Landlord Ports Act, 2000
- Draft Port Regulations, 2000

The Environmental Assessment Regulations, 1999 (LI 1652) enacted under the provisions of the EPA Act, set out the procedures governing EIA in Ghana. Under Schedule 2 Regulation 3 (10) of these regulations, the proposed port development project falls under the undertakings for which EIA is mandatory as it is expected to result in an appreciable increase in port handling capacity.

Section 5 of the Ghana Ports and Harbours Authority Law, empowers the GPHA to build, develop, manage, maintain, operate and control all ports in Ghana. The law also charges the Authority to maintain and deepen as necessary the approaches to the port and also to provide cargo storage/handling facilities such as warehouses etc.

The Ministry of Road and Transport is responsible for Government policy issues related to the

Maritime sector. Currently the Merchant Shipping Act, 1963 (Act 183) and the Port Regulations, 1964 (LI 352) have been revised as part of an overall restructuring of the Maritime Administration in Ghana. These revised laws are yet to be approved by Parliament.

Apart from the administrative and policy issues, various legislation and guidelines concerning safety, pollution etc. have also been considered. Among these are:
- EPA Quality Guidelines (Effluents, Air Quality and Noise)
- Radiation Protection Instrument, 1993 (LI 1559)
- National Oil Spill Contingency Plan
- Various international maritime conventions (MARPOL, SOLAS, OPRC, IMDG codes etc.)

These are discussed in relevant details in the sections later where they are applicable.

23.1.3 Scope of Study

In prior to the preparation of the short-term plan, the study team made a master plan for Takoradi Port development (see Interim Report (1)). In accordance with the EIA procedure in Ghana, Scoping work was also done to identify the environmental elements with possible impact, and in due course of the said procedure, TOR for EIA on the master plan prepared (Appendix A).

Here, the Study Team applies the TOR for EIA on the master plan to the EIA on the short-term plan, since the master plan's components of construction work and operational activity entirely contain those of the short-term plan. Hence it can be said that the TOR for EIA on the master plan cares all of the possible environmental impacts of the short-term development plan of Takoradi Port.

In accordance with the Environmental Assessment Regulations, 1999, the EIA of the Takoradi Port short-term development plan include:
• A description of the proposed undertaking and an analysis of the need/reason for the undertaking;
• Objectives of the undertaking;
• Other options for carrying out the undertaking;
• Alternatives to the undertaking;
• A description of the present environment that would be affected, directly, or indirectly;
• A description of the future environment, predicting its condition if the undertaking did not take place;
• Impacts that may be caused to the environment by the undertaking;
• Proposed measures to prevent or mitigate all adverse impacts;
• Evaluation of opportunities and constraints to the environment of the undertaking;
• Proposal for an environmental management program to cover constructional, operational and decommissioning stages of the undertaking;
• Proposal for a program of public information

23.2 Description of Proposed Development Plan

The short-term development plan of Takoradi Port comprised of the following components:
• Dredging in the port basin and entrance area

• Extension of bauxite and clinker jetty
• Extension of main breakwater
• Reclamation at head of the existing port basin

23.2.1 Preparation Phase

Since GPHA has already owned the necessary areas for the port expansion, it will not need further land acquisition and relocation of facilities.

23.2.2 Construction Phase

The short-term development plan of Takoradi Port is drawn as in Figure 16.3.1. The schedule of the construction works is planned as in Figure 18.3.2.

(1) Dredging

The port entrance channel and turning basin will be deepened to 12 – 13 m. The dredging will be carried out by a dredge cutter boat and a pump-dredge boat.

The dredged materials will be used for the reclamation in the proposed plan. The materials to be dredged is estimated to be about 1.66 million m^3, while the area to be reclaimed will require about 1.14 million m^3. Considering a loss of dredged material of 30 % during the operation, the volume of dredged material will meet the demand of landfill.

(2) Extension of Bauxite/Clinker Jetty

The existing bauxite/clinker jetty will be extended offshore to obtain a deeper berth. The new berth of 260 m long will employ the pile structure, similarly to the existing one, and will be sheltered by a breakwater to be extended.

(3) Extension of Breakwater

The breakwater will be extended 400 m to ensure a calm and wide port area and consequent safe navigation at the port entrance. The structure will be same as the existing breakwater, using rocks which are available from the quarry site.

(4) Reclamation for New Container Yard

The head of the existing port basin will be reclaimed with materials both dredged in the port area and transported from the quarry site. The reclamation of the area of 140,000 m^3 requires 1.14 million m^3 of filling materials. The reclaimed area will be used for berths and a yard for container handling.

(5) Demolishing Existing Facility

North and West Lighter Wharves and neighboring Docks No. 1 and 2 will be demolished to create

a new container yard. The loading/unloading facility on the clinker/bauxite jetty will also be shifted offshore.

23.2.3 Operation Phase

(1) Extended Bauxite/Clinker Jetty

A new clinker/bauxite jetty will handle 1.0 and 0.99 million $m^3$of bauxite and clinker, respectively, while the existing facility treats 0.44 and 0.76 million m^3 per year only. Loading/unloading site will be shifted 300 m offshore from the location of the existing facility.

(2) Container Berth/Yard

The new container berths and yard which would be constructed through reclamation will handle a total of 150,000 TEU of containers. Cranes and other container handling equipment will be introduced. Light facility will also be set up to ensure the safe work and the security.

More port workers will be needed to carry out an efficient container handling.

(3) Deepened Multi-purpose Berth

Deepening the port basin and berth enable to accommodate the larger ship and larger volume of cargoes. This will achieve 16 % of increase of cargo-handling volume to reach 935,000tons.

(4) Ship Berthing/Navigation

Pilots and tugboats will work properly for navigation in the port area and berthing, as same as at present.

23.2.4 Demolition Phase

The port structures should be long-life assets and will form the basement for future expansion of the port. Therefore, demolishing port is not reality, though the future port development work may demolish partly some port structure.

23.3 Existing Environmental Condition

The existing environmental conditions of Takoradi Port and its surrounding area were studied based on field surveys, literature survey and interviews. Chapter 4 summarised it. Full description is included in Appendix A.

The following environmental problems were identified.
- Dust dispersal in certain areas of the port
- Water quality (Concentration of oil and organic matter)
- Bottom sediment quality (Concentration of lead and mercury)
- Noise due to road traffic

- Waste treatment

23.4 Assessment of Impact

Fourteen (14) environmental elements needed to be assessed on the impacts, as shown in the TOR for EIA. The impacts on these elements were identified for every phase of the project, i.e. preparation phase, construction phase and operation phase. Every activity likely to have impacts on the environment was listed up and its environmental impacts were evaluated. The result is summarized in Table 23.4.1

It is not reality for the port development to assume demolishing port structure. When demolition becomes necessary, it will be to implement the further development of the port. In the present study, therefore, the demolition phase was not considered. Instead, impacts of the demolition of existing facilities during the construction phase were taken into account.

In Table 23.4.1, the significance of the environmental impact was evaluated from the viewpoint of "Importance" and "Magnitude". "Importance" was classified into five (5) ranks positively or negatively (second row of Table 23.4.1). The classification was based on the following points of view:

- How local people and/or port workers value the environmental element to be affected.
- Whether or not the environmental element has a value of national/regional/global level which the local people are not aware of.
- Whether or not improving the situation of the environmental element leads the poverty reduction in the local community.

Thus, "Importance" is the property of the environmental elements for local people, port workers and other relevant persons/parties/organizations, regardless of the contents and scale of the development activity involved.

"Magnitude" was also classified into five (5) ranks (top of each cell of Table 23.4.1). Criteria for the classification include the followings:

- Degree and/or scale of the impact on the environmental element
- Whether the impact is temporal, residual or permanent.
- Whether the impact is reversible or irreversible.

Thus, "Magnitude" is determined through the extent of the environmental alteration by the proposed development activity.

Finally, the evaluation of the significance of the environmental impact was made multiplying "Importance" by "Magnitude". The obtained values were put on the bottom of each cell of Table 23.4.1

Justification on the ratings for each element is shown below.

- Progress of air pollution (AP): Although, Ghana has an Environmental Quality Standard for air quality, air pollution is still causing various health hazards and nuisance and is a major concern for the local people.

- Progress of water pollution (WP): Despite the poor water quality in the Takoradi port basin and the surrounding coastal waters, no Environmental Quality Standards for recipient water has yet been established in Ghana. Local people do not show the concern on the seawater quality.
- Bottom sediment pollution (SP): Though the local people might be unaware of sediment pollution, high concentration of heavy metal substances have been recorded in the port area, which could potentially have an adverse affect on the health of local residents through biological accumulation.
- Noise generation (Noi): Noise is not a major concern for the local people as yet, with GPHA receiving no noise complaints so far. However, noise level in the port area sometimes exceeded the Ghana Environmental Quality Standards.
- Odor generation (Odr): Despite the unique smell emitted from cacao beans, odor complaints from local residents and port workers are uncommon. Future import or export commodities are not expected to emit any odor.
- Progress of Erosion (Ero): Erosion is occurring along the seaward side of the lee breakwater and up towards the industrial zone.
- Deterioration of Fauna/Flora (F/F): Natural vegetation is scarce and no significant fauna is observed in Takoradi area.
- Promotion of Economic Activities (EA): The livelihood of the local people is intimately linked to the presence of the port. The local people are engaged in various forms of port related activities, which could either be directly or indirectly related. Indirect port related activities include manufacturing, repairing, transportation and fishing. Increased port activity will lead to the poverty reduction in Takoradi.
- Resettlement (RES): Resettlement of port facilities could disturb the efficiency of port workers.
- Development of Infrastructure (INF): With many unpaved roads and inadequate sewage systems, improvement of infrastructure is a key issue among the local people. Improvement in the infrastructure will lead to the poverty reduction.
- Promotion of Fisheries (Fsh): Fisheries is an important industry for Takoradi and has contributed to the poverty reduction. A strong interest in fisheries exists among the local people.
- Rational Land Use (LU): Land use must be carefully planned, due to the limited land area in Takoradi.
- Waste generation (Wst): The importance of waste management is strongly emphasized in the Ghana EIA guideline, since many disposal sites are approaching its full capacity.
- Promotion of Public Health and Safety (HS): There is a strong interest in Public Health and Safety among the local people, but poverty reduction is their first priority.

Table 23.4.1 Environmental Impact Matrix

Element	AP	WP	SP	Noi	Odr	Ero	F/F	EA	Res	Inf	Fsh	LU	Wst	HS
Importance	-3	-1	-3	-1	0	-2	0	+5	-3	+5	+1	+1	-3	+2
Activity														
Preparation Phase (no activity)														
Construction Phase														
Dredging & other marine works		2 -2	-2 +6	1 -1							0 0		1 -3	
Construction machines, and vehicles/vessels	1 -3	0 0		1 -1				1 +5			0 0		1 -3	-1 -2
Reclamation	1 -3	1 -1					0 0				0 0		-1 +3	
Demolition of existing facilities	1 -3			1 -1					0 0				1 -3	
Employing construction workers		1 -1						2 +10					2 -6	
Operation Phase														
Altered port configuration		0 0	1 -3			-2 +4					0 0			
Increased ship-call		0 0						2 +10			0 0		2 -6	
Increased cargo-handling	2 -6	0 0		3 -3	0 0			2 +10					2 -6	-1 -2
Increased port workers		0 0						3 +15					2 -6	
Port-associated development										2 +10				
Rearrangement of facilities							0 0					0 0		
Increased land transportation	1 -3			3 -3			0 0	2 +10						-2 -4
Demolition Phase (not applicable)														

AP: Progress of air pollution
WP: Progress of water pollution
SP: Bottom sediment pollution
Noi: Noise generation
Odr: Odor generation
Ero: Progress of Erosion
F/F: Deterioration of Fauna/Flora
EA: Promotion of Economic Activities
Res: Resettlement
Inf: Development of Infrastructure
Fsh: Promotion of Fisheries
LU: Rational Land Use
Wst: Waste generation
HS: Promotion of Public Health and Safety

top: Magnitude of impact
bottom: Significance of impact
(importance × magnitude)

Detailed analysis on the magnitude of the impact is described in Appendix A.

23.5 Mitigation of Impact

23.5.1 Air Quality

The dust pollution in the operation phase will become more serious than the present at sites that operate the bulk cargo-handling, such as clinker, manganese and bauxite, using the belt conveyor system. Measures to reduce the spillage of dust should be accelerated. Simple pavement is recommended at the road along the belt conveyor for the clinker, together with a side gutter and a sedimentation ditch to recover the spilled materials. The new clinker and bauxite berth should be located in the leeward direction of the prevalent SW wind so that the clinker dust does not blow towards the port and residential area. When the occasional NE wind (Harmattan) blows, the clinker dust could be effectively prevented from spreading towards the leebreakwater through plantation or construction of a simple fence on the seaside of the road. Sprinklers are also effective to reduce dust.

23.5.2 Water Quality

In the construction phase, a silt protection curtain should be employed to surround the dredging site and the water way from the reclamation to reduce the SS dispersion. Coagulant may be introduced to the reclamation area to facilitate the sedimentation of the mud contaminated with heavy metals.

23.5.3 Bottom Sediment Quality

Severely contaminated mud to be dredged should be contained in the reclamation area, particularly in the existing dock water area because of the reason of the hard structure there, and should be sealed securely.

23.5.4 Noise

The vicinity of North Gate Road and Main Gate Road will suffer from the traffic noise in the future. Road expansion and improvement should be done on these roads. Installation of fence or plantation to alleviate the noise is recommended. Setting a buffer zone along the road would be most effective, where possible.

23.5.5 Erosion

The apertures between rocks of the main breakwater seem to be allowing sand particles to intrude the port basin. To fill the aperture will greatly contribute the maintenance of the port basin.

23.5.6 Economic Activity

In order to enhance the positive impact to local community, it is expected that, apart from the foreign workers, most of the labor that would work on the port projects would be recruited from

the residents of the local communities. This should help to control the influx of non-resident job seekers and reduce the slums.

23.5.7 Infrastructure

To maximize the benefit to the local community, it is desirable to facilitate the development of infrastructure in accordance with port expansion. The improvement of the road would be the first priority to meet the purpose of the promotion of the public safety.

23.5.8 Waste Management

Wastes from operational activities will be transported to the approved municipal landfill sites in Takoradi. The waste collection bins in the ports are of the covered type. In addition, all other trucks carrying wastes will be adequately covered to prevent spillage on the way to the landfill sites.

It is recommended that the development plans should allow for existing waste management facilities to be expanded to cater for the increased levels of activity in the port.

It is also recommended that reception facilities for oily/liquid waste should be provided within Takoradi Port as part of the Port State Control regime to be implemented under the auspices of the Shipping and Navigation Division of the Ministry of Roads and Transport.

23.5.9 Public Health and Safety

During the construction phase, inspection should be made to ensure that truck drivers would comply with the safety guidelines which should be established by GPHA.

During the operation phase, traffic signal lights will be located at the junctions of three (3) access roads to the Port and the existing trunk roads. Speed limit signs and directional signs will be located at vantage points along these roads to guide road users.

23.6 Evaluation

The evaluation was made for the short-term development plan of Takoradi Port from the environmental point of view. Table 23.6.1 summarizes the results of impact assessment shown in Table 23.4.1. The principal environmental problems in future would involve:

- Waste generation
- Dust dispersion
- Noise generation

The magnitude of impacts will be generally small (1 or 2 in the five-rank rating) and it is not likely that severely adverse effects would occur as a consequence of the port development.

It was also estimated that the plan would give positive impacts mainly on the socio-economic environment of Takoradi. The magnitude of positive impact was not large either (1 to 3 in the five

–rank rating), because the public involvement in the planned project was not so extensive. These impacts should be amplified to contribute to the poverty reduction of the area.

After all, the short-term development plan of Takoradi Port was evaluated to be proceeded. Provided with the coordination with other infrastructure planning, such as waste management system, sewage treatment system and road network, the development of Takoradi Port will largely improve the situation of local community.

Since the alternative plans were prepared and evaluated in the phase of Master Plan study (see Section 13.8), the short-term plan did not have the alternatives. Therefore, comparative evaluation with alternatives was not done.

Table 23.6.1 Summary of Evaluation of Environmental Impact

Phase	Impact	Mitigation	Positive effect	Negative effect	Total
Preparation	No activity	-	-	-	-
Construction	Dredging & other marine works	Silt protection curtain	Sediment quality	Waste Water quality Noise	0
	Construction machines, vehicles, and vessels	Setting signals Announcement to local residents	Local economy	Waste Dust Safety Noise	-4
	Reclamation	Carefully designed containment	Waste	Dust Water quality	-1
	Demolition of existing facility	Enhanced waste handling capacity	-	Waste Dust Noise	-7
	Employing construction workers	Local employment and vocational training	Local economy	Waste	+4
Operation	Altered port configuration	Announcement to fishermen	Erosion	Sediment quality	+3
	Increased ship-call	Waste reception facility	Local economy	Waste	+4
	Increased cargo-handling	Dust protection fence or plantation Proper waste management program	Local economy	Waste Dust Noise Safety	-7
	Increased port workers	Proper waste management program	Local economy	Waste	+9
	Port-associated development	Improvement of road Coordination with city planning	Infrastructure	-	+10
	Rearrangement of facilities	-	-	-	0
	Increased land transportation	Setting signals Soundproof fence	Local economy	Safety Dust Noise	0
Demolition	Not applicable	-	-	-	-
Total					+8