Ministry of Power, Energy and Mineral Resources

People's Republic of Bangladesh

Preparatory Survey on Chittagong Area Coal Fired Power Plant Development Project in Bangladesh

Final Report

on

Power Plant / Port / Transmission Line / Access Road / Execution Survey of Natural Condition

Book 2

For Publishing

March 2015

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Services Co., LTD

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Chapter 15

Environmental and Social Consideration

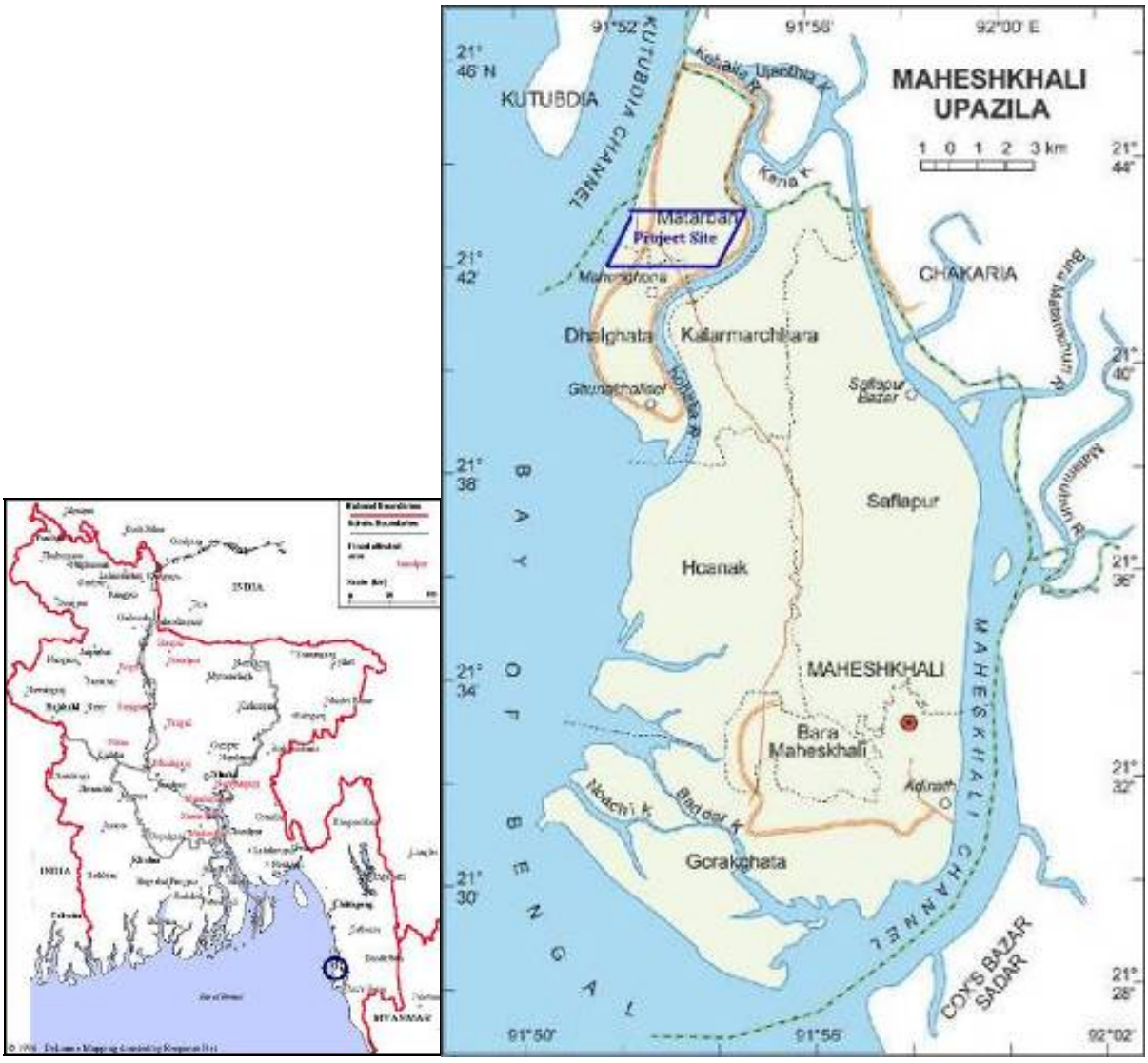
Chapter 15 Environmental and Social Consideration

15.1 Outline of the Proposed Site (Outline of Natural and Social Environment)

15.1.1 Location of the proposed site

(1) Power Plant and Port Facility

The proposed coal-fired power plant (CPCG; Matarbari Coal-Fired Power Plant, 2 x 600MW, "Power Plant") is located in Matarbari Union and Dhalghata Union in Maheshkhali Upazila, Cox's Bazar District, which is in the south-east area of Bangladesh (Figure 15.1-1).



(Source: http://www.in2bangla.com/upazilaMap.php?id=293)

Note: The location is 21 42'15" N, 91 53'16" E

Figure 15.1-1 Location of the Power Plant

(2) Transmission Line

The Power Plant will be connected to the substation facility in Anowara power plant which will be constructed in the south of Chittagong, with a 400kV transmission line of approximately 60km. The transmission line will take a route along the local road (R-170) as shown in Figure 15.1-2 and Table 15.1-1, the final route will be determined so as to avoid any residences. Land for construction of the transmission towers are stial areas, taking into account the firmness of the land foundation.

(Source: JICA Study Team)

Figure 15.1-2 Route of the Proposed Transmission Line

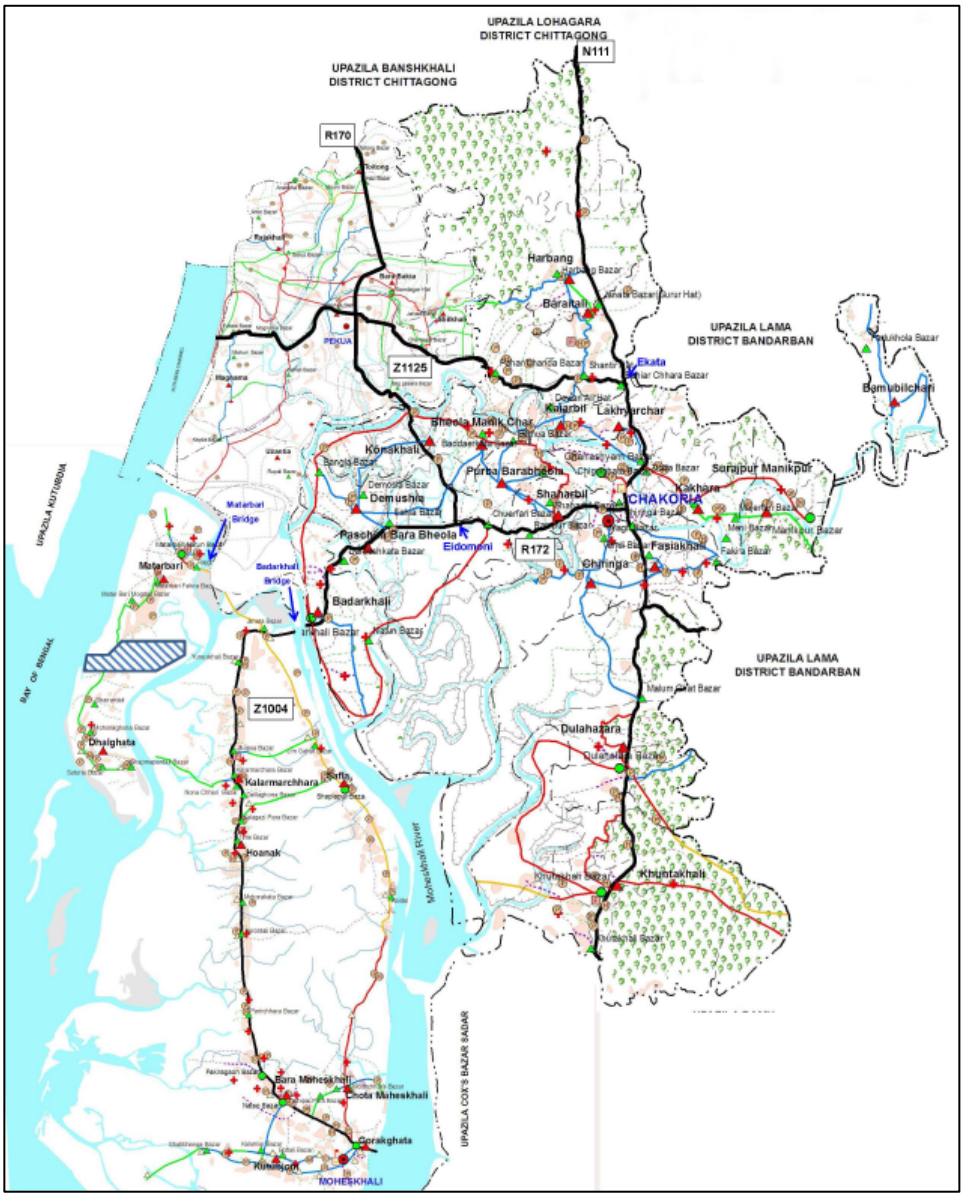
Table 15.1-1 Area Covered by the Proposed Transmission Line

District	Upazila	Union
Chittagong	Anowara	Gohira
		Burumchhara
	Banshkhali	Khankhanabad
		Baharchhara
		Kalikapur
		Boilchori
		Banshkhali
		Sheakerkhil
		Fulchari
Cox's Bazar	Pekua	Barobakia
		Pekua
		Ujantia
	Maheshkhali	Matarbari

(Source: JICA Study Team)

(3) Access Road

The location and route of access road is shown in Figure 15.1-3. The route of access road is in the area from the national highway running between Chittagong and Cox's Bazar to the Power Plant site. Basically, existing road facilities will be utilized wherever possible. It is expected that the route sections to join the national highway in the north and the route from heshkhali Island to the Power Plant site will require new road and bridge construction.



(Source: LGED, modified by JICA Study Team)

Figure 15.1-3 Location of the Access Road

15.1.2 Overview of natural environment (Climate)

The climate in Bangladesh is divided into three seasons: summer from March to June with high temperatures and high humidity, the monsoon season from June to October with high winds, and winter from October to March with low temperatures and low precipitation.

The meteorological observatories in the project area are Kutubdia Observatory, 10km north of the project site, and Cox's Bazar Observatory, 30km south of the site. The local meteorological observation results from 2000 to 2011 are shown below.

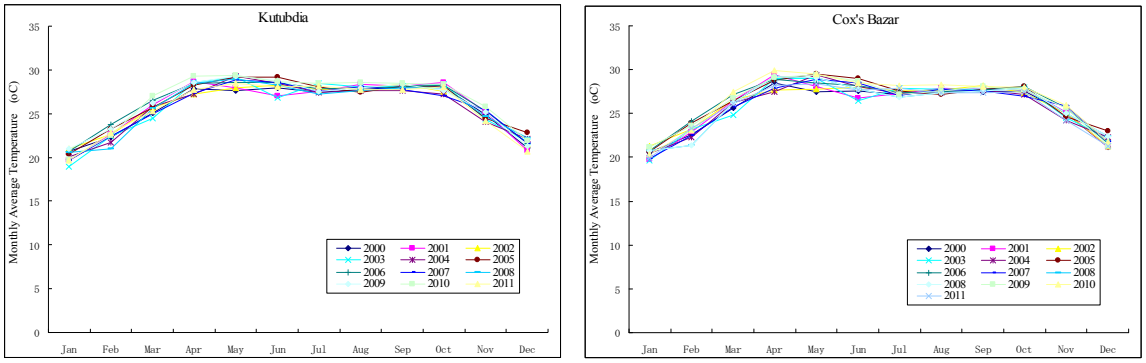
(Source: JICA Study Team)

Figure 15.1-4 Locations of Meteorological Observatories

(1) Temperature

The average monthly temperatures for Kutubdia and Cox's Bazar are shown in Figure 15.1-5. Climate fluctuations are stable every year in both areas in view of seasonal temperature change. The temperature in January is 19 - 21°C, then gradually rises toward April to 28 - 29°C. The high temperature of 27 - 29°C continues from April to October, while it is a little lower from July to October compared to April to June. The temperature drops in November and December, and the average temperature in December is 21 - 23°C.

The maximum monthly average temperatures were 29.4°C in Kutubdia observed in May 2010, and 29.9°C in Cox's Bazar observed in April 2010. The minimum monthly average temperatures were 18.9°C in Kutubdia and 19.6°C in Cox's Bazar, both recorded in January 2003.

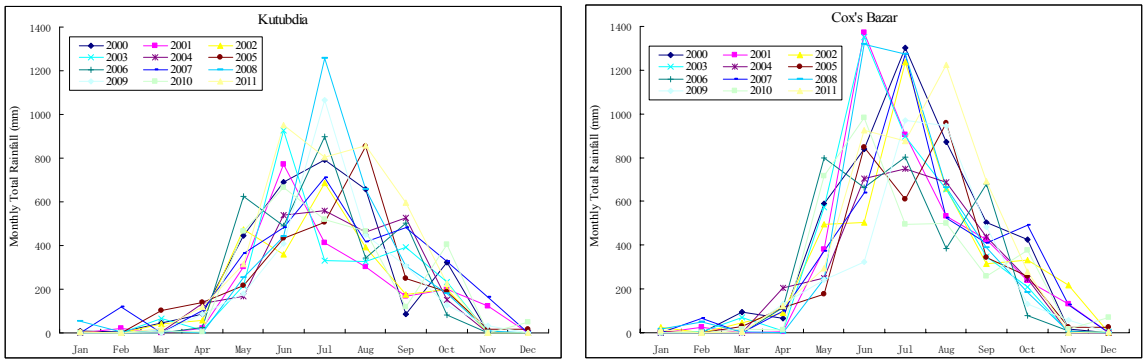


(Prepared based on the data of the meteorological observatories)

Figure 15.1-5 Monthly Average Temperature

(2) Rainfall

The total monthly rainfall in Kutubdia and Cox's Bazar is shown in Figure 15.1-6. The total annual rainfall is 4,321 - 5,905mm in Kutubdia, and 5,286 - 6,707mm in Cox's Bazar. Rainfall is concentrated between May and October, while very little or no rain is recorded from November to April. Consequently, there is a distinct difference in rainfall levels between the rainy season (monsoon season) and other seasons.



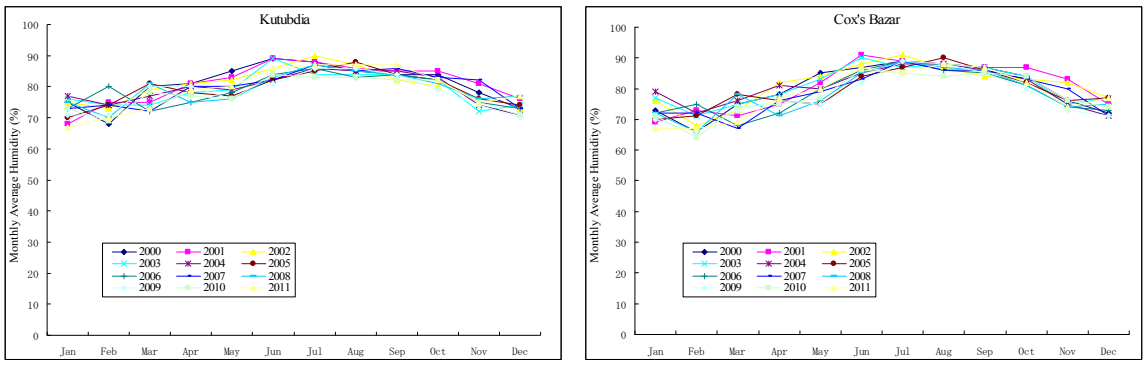
(Prepared based on the data of the meteorological observatories)

Figure 15.1-6 Monthly Total Rainfall

(3) Humidity

The average monthly humidity in Kutubdia and Cox's Bazar is shown in Figure 15.1-7. Seasonally, humidity fluctuations are stable every year in both areas. The difference in the

average humidity between respective months is rather small, in a range of 65 - 90%, while the average is 75 - 90% in the rainy season of May to October and 65 - 85% from November to April where little rain falls.

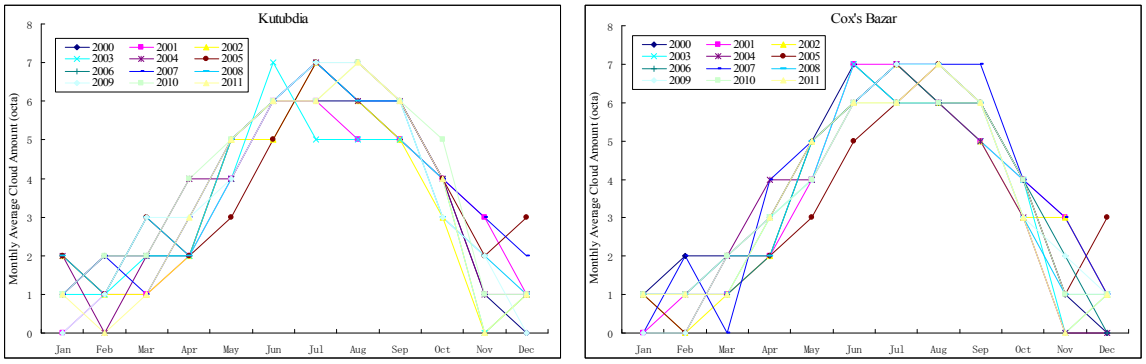


(Prepared based on the data of the meteorological observatories)

Figure 15.1-7 Monthly Average Humidity

(4) Cloud Amount

The monthly cloud amount in Kutubdia and Cox's Bazar is shown in Figure 15.1-8. Seasonally, the amount of cloud amount fluctuations are stable every year in both areas. The amount of clouds is larger in the rainy season of May to October compared to November to April where little rain falls.



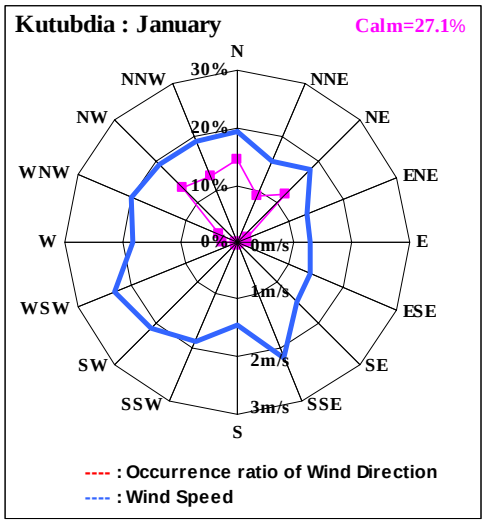
(Prepared based on the data of the meteorological observatories)

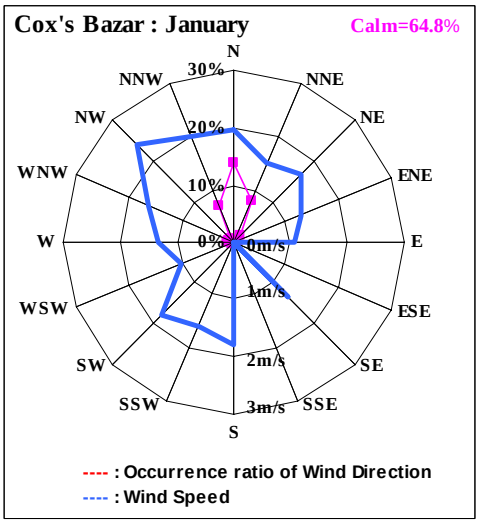
Figure 15.1-8 Monthly Average Cloud Amount

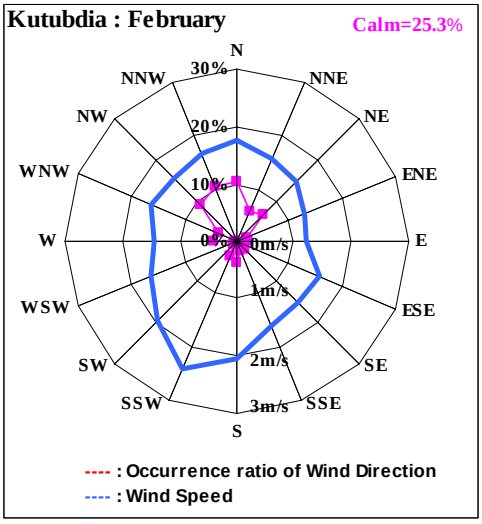
(5) Wind

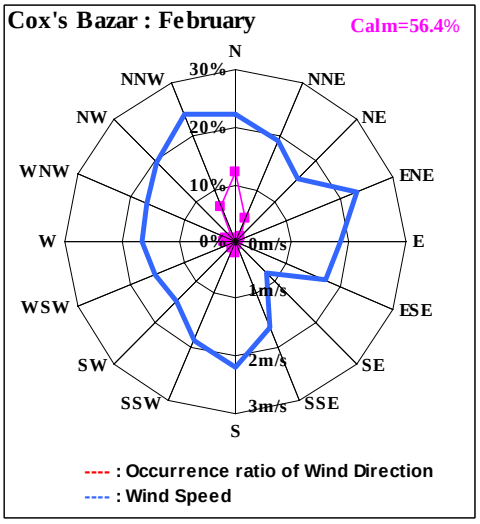
Figure 15.1-9 indicates the monthly frequency ratio of wind direction and the average wind speed for each wind direction in Kutubdia and Cox's Bazar. Note data not available in Kutubdia for 2006. In Cox's Bazar, "Calm (wind speed 0.5m/sec and lower)" occurs most

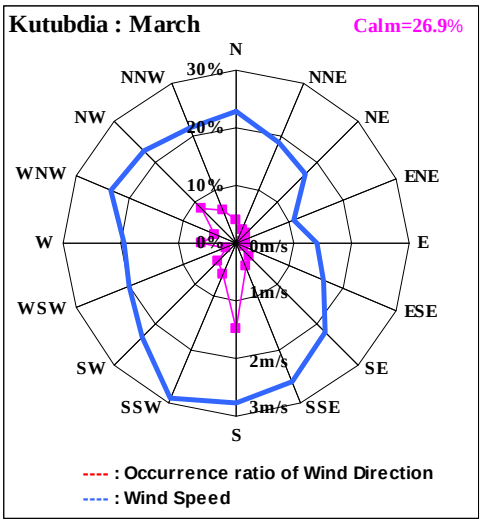
frequently, accounting for more than 50% from September to March. Except for this difference, the wind direction in both areas shows similar tendencies. Northerly winds are dominant in January and February, and no significant high wind speed was observed in specific wind direction. Southerly winds become dominant from March, especially from April to September. In July and August, there is a tendency of slightly higher wind speed in southwesterly winds, otherwise no significant high wind speed was observed in any specific wind direction. Wind direction shifts from southerly winds to northerly winds in October, and there is a tendency of high wind speed of southwesterly winds. Northerly winds are dominant in November and December, but high wind speed tends to occur in southwesterly winds.

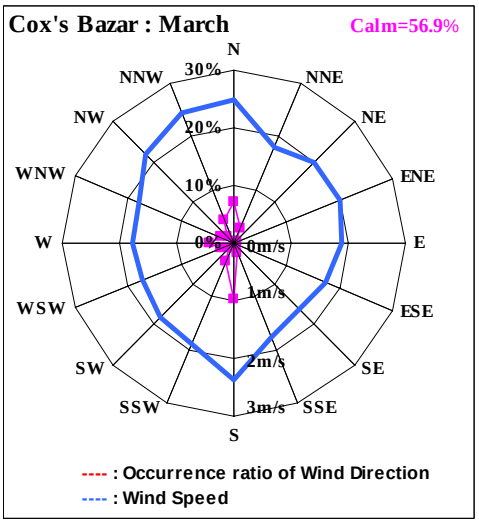


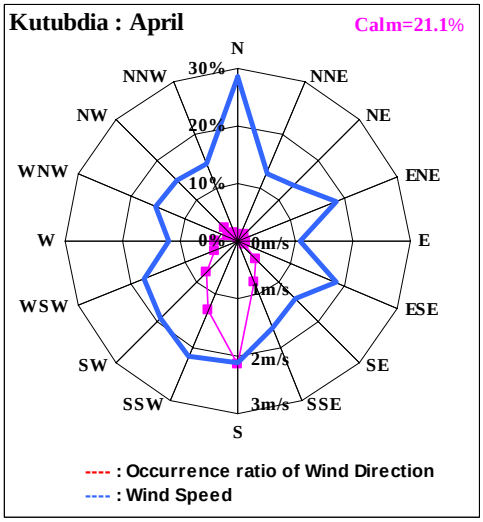


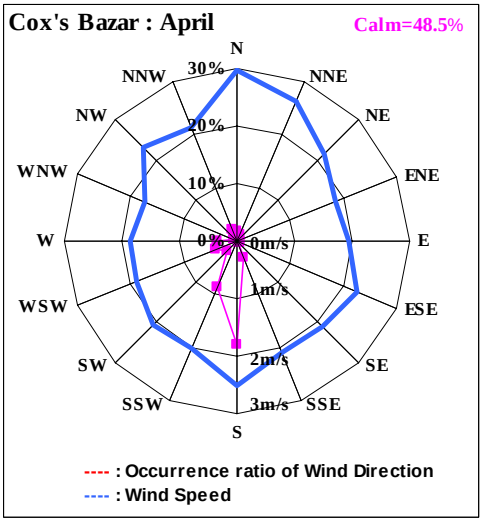


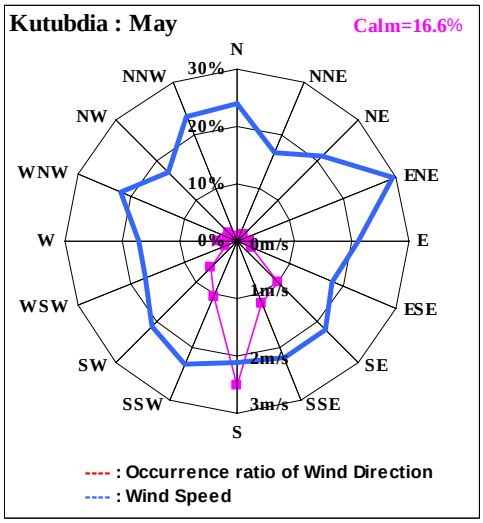


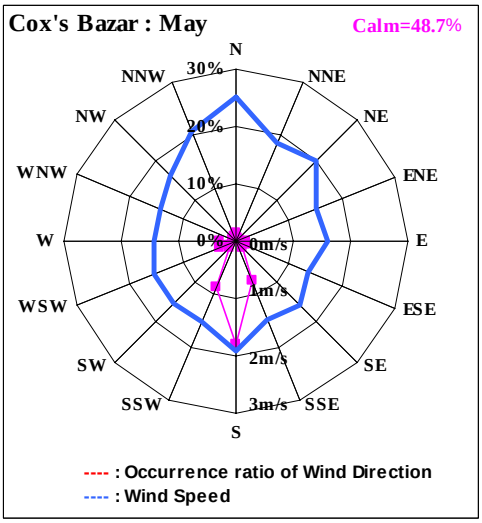

Kutubdia : March
Calm=26.9%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

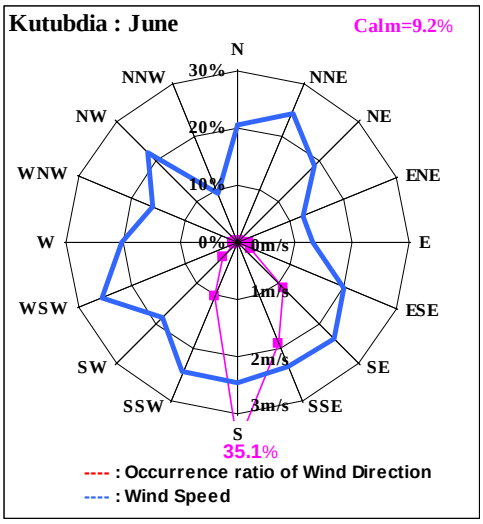

Cox's Bazar : March
Calm=56.9%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

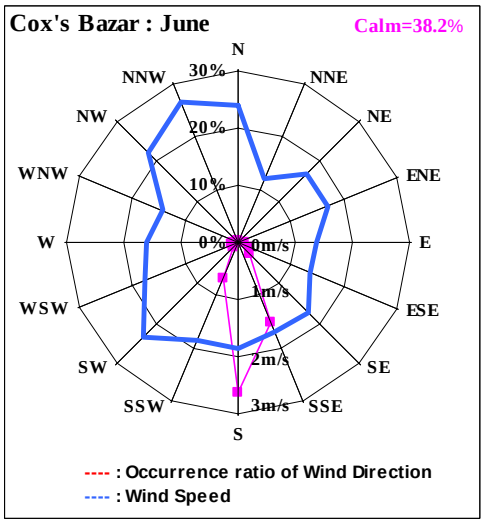

Kutubdia : April
Calm=21.1%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

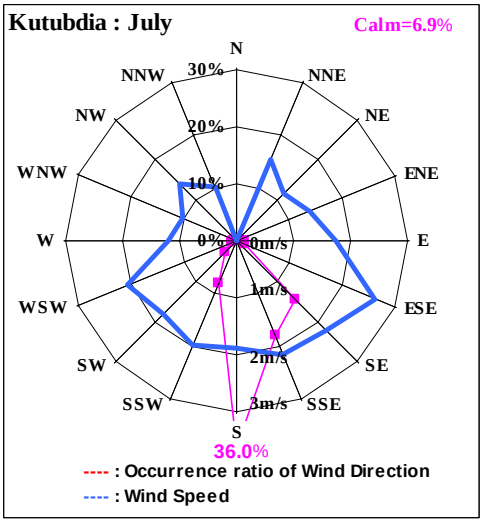

Cox's Bazar : April
Calm=48.5%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

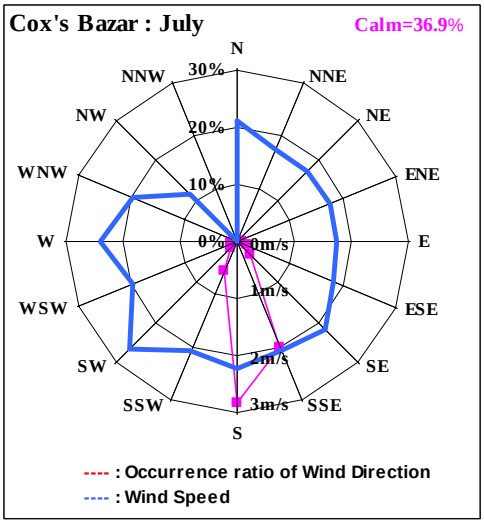

Kutubdia : May
Calm=16.6%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

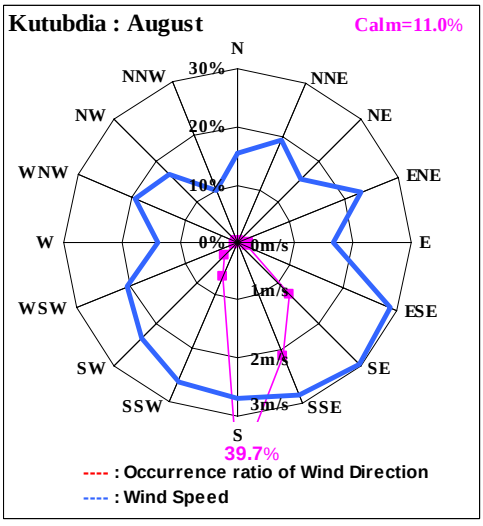

Cox's Bazar : May
Calm=48.7%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

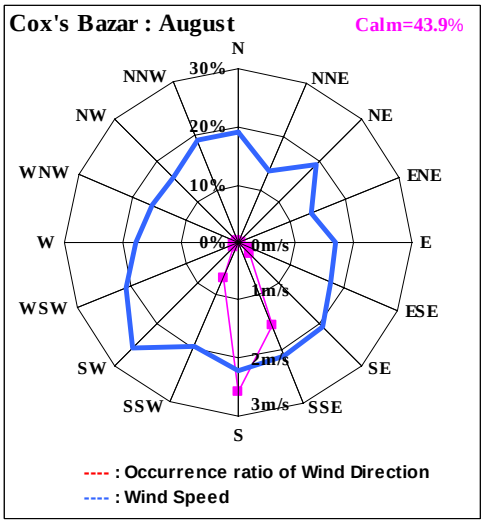

Kutubdia : June
Calm=9.2%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
35.1%
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

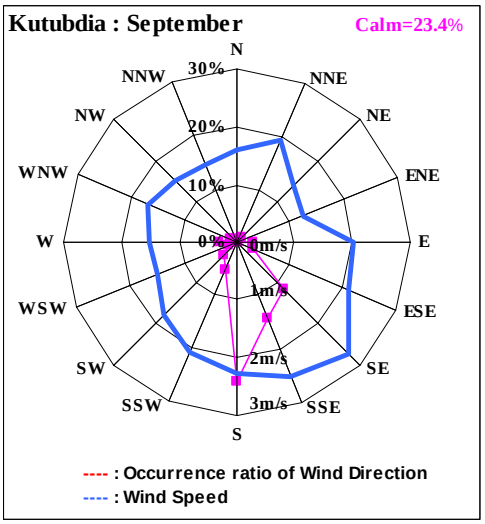

Cox's Bazar : June
Calm=38.2%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

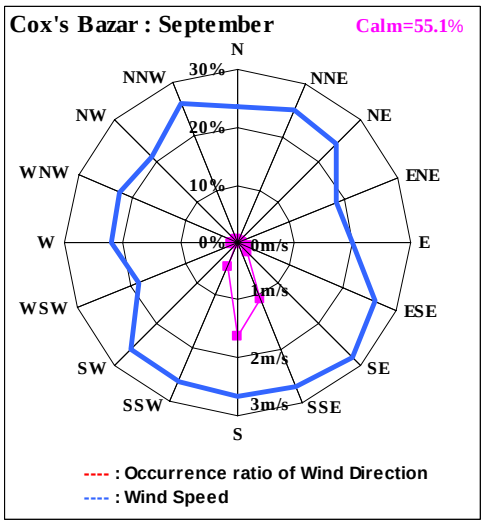

Kutubdia : July
Calm=6.9%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
36.0%
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

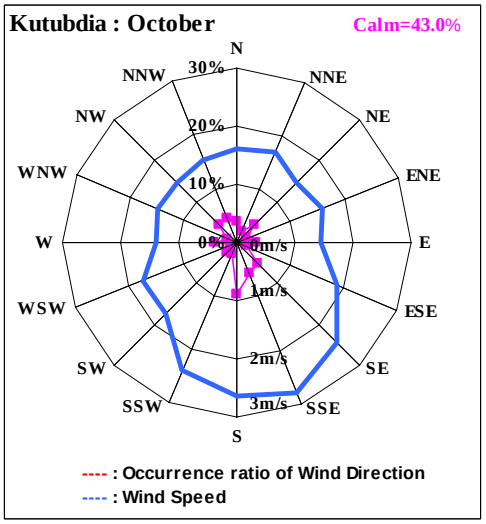

Cox's Bazar : July
Calm=36.9%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

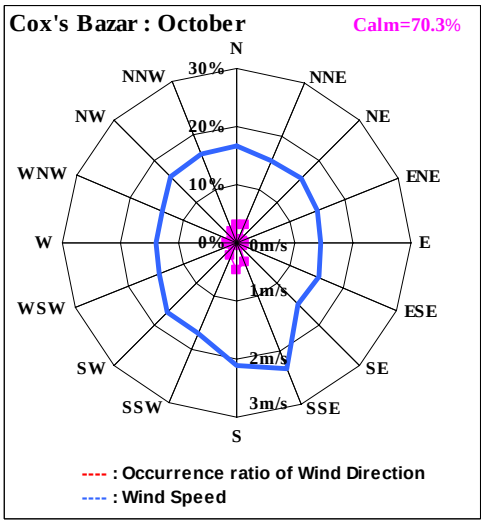

Kutubdia : August
Calm=11.0%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
39.7%
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

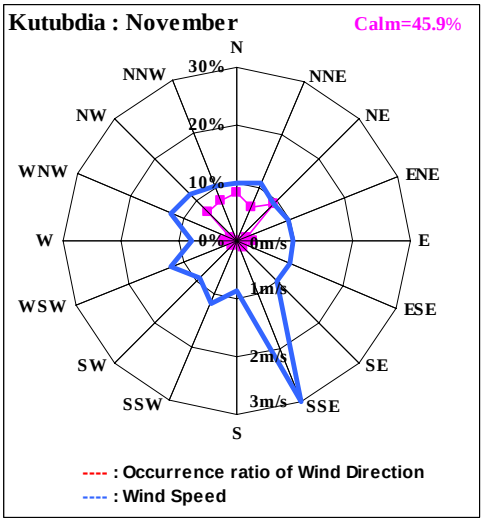

Cox's Bazar : August
Calm=43.9%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

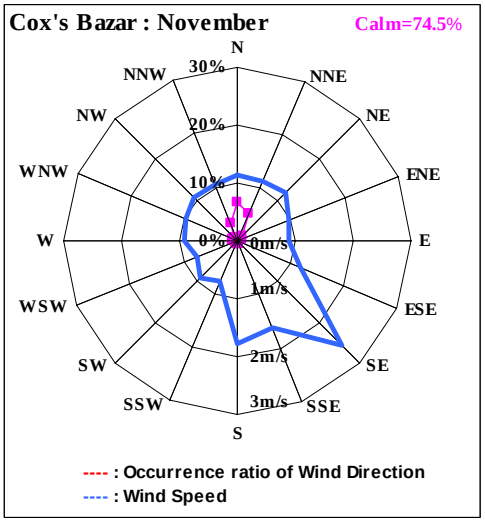

Kutubdia : September
Calm=23.4%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed

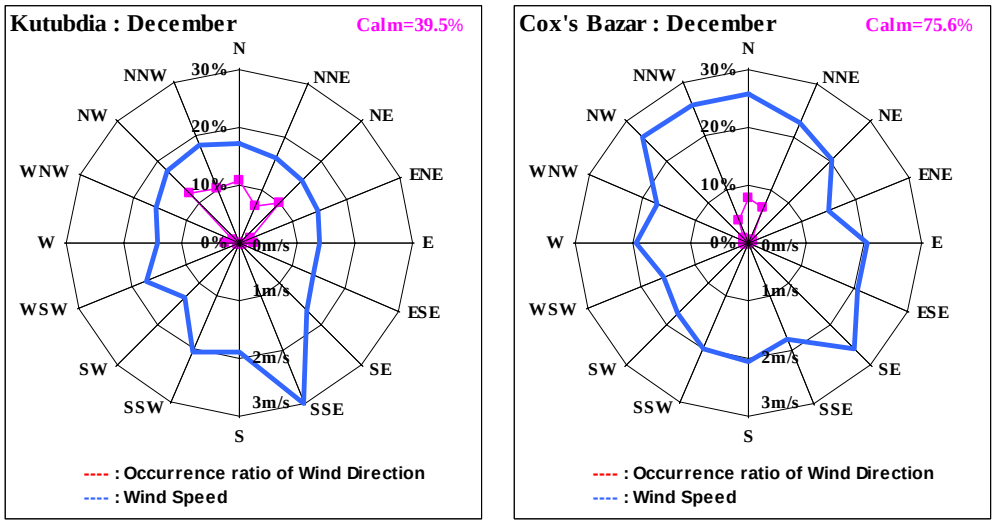

Cox's Bazar : September
Calm=55.1%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed


Kutubdia : October
Calm=43.0%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed


Cox's Bazar : October
Calm=70.3%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed


Kutubdia : November
Calm=45.9%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed


Cox's Bazar : November
Calm=74.5%
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
30%
20%
10%
0%
0m/s
1m/s
2m/s
3m/s
---- : Occurrence ratio of Wind Direction
---- : Wind Speed



(Prepared based on the data of the meteorological observatory)

Figure 15.1-9 Wind Rose

15.1.3 Overview of social environment

(1) Power Plant and Port Facility

1) Socio-economic Condition

The power plant and port facility site is located in two unions: Matarbari Union and Dhalghata Union of Maheshkhali Upazila. As of 2011, when the official census was conducted for the first time in ten years[1], there were 8,168 households (44,937 people: 5.5 persons per household) in Matarbari Union. The population density was 1,662 per square kilometer. In Dhalghata Union, there were 2,250 households comprised of 12,877 people (5.7 persons per household), and the population density was 6,441 per square kilometer.

The two tables below shows an outlook of power plant and port site by union (Matarbari Union and Dhalghata Union). The population in the affected villages of Matarbari Union is less literate (25.5% in Sairer Dail and 30.3% in Maiz Para) than those of Dhalghata Union (31.9% to 44.4% in four villages). As shown in all figures of school attendance rates from 6 to 10, from 11 to 14 and from 15 to 19 years of age, younger generation in the site villages of Dhalghata Union had better figures than the whole union. In the site villages of both unions, girls' schooling was more prevalent than boys.

Although the working population in the site villages of Matarbari was involved in either agriculture (52.6% in Maiz Para and 51.4% in Sairer Dail) or the service industry (41.6% and 48.6% respectively), majority of people of the site villages in Dhalghata were involved in agriculture industry (83.3% to 99.1%) comprised mainly of fishing, salt and shrimp cultivation.

[1] The result of the Population Census 2011 is still provisional (as of May 2013).

Inhabitants did not have necessary facilities for basic living conditions, in other words, they had one of the most deteriorated living conditions in both unions: 99.9% of the Sairer Dail population of Matarbari Union, for instance, had drinking water from tube wells, only 11.5% were connected to electricity, 70.2% lived in *kutcha* houses, and 72.6% had non-sanitary toilet facilities. In Dhalghata Union, 37.4% of the population in Uttar Mohiraghona and 16.2% of Nasir Mohammaddhil depend on other sources than tap water or tube wells, i.e., pond water, rain water and etc. Over half population of these two villages used non-sanitary latrine, and moreover, 37.4% of Nasir Mohammaddhil had no toilet facilities. Only a few people in Dhalghata Union lived in *pucka* or *semi-pucka* houses.

Table 15.1-2 Overview of the Power Plant Site

Union	Matarbari			Dhalghata				
Village		Maiz Para	Sairer Dail		Sutaria Para	Dakshin Mohiraghona	Uttar Mohiraghona	Nasir Mohammaddhil
Area	6,682 acres (2,700 ha)	-	-	4,940 acres (2,000 ha)	-	-	-	-
Population	8,168 HH (44,937 people)	716 HH (3,857 people)	782 HH (4,496 people)	2,250 HH (12,877 people)	560 HH (3,299 people)	40 HH (228 people)	211 HH (1,123 people)	99 HH (601 people)
Population Density	1,662 person/ km2	-	-	6,441 person/ km2	-	-	-	-
Average size of household	5.5	5.4	5.7	5.7	5.9	5.7	5.3	6.1
Population Below 15 years Old	44.30%	44.90%	48.4%	42.2%	38.7%	40.7%	42.2%	42.7%
Sex Ratio	103	99	99	108	112	113	101	105
Literacy Rate*1	27.7% (M26.1%, F29.4%)	30.3% (M28.9%, F31.6%)	25.5% (M21.6%, F29.3%)	31.7% (M29.8%, F33.8%)	31.9% (M29.7%, F34.5%)	44.4% (M42.2%, F46.8%)	36.0% (M35.7%, 36.4%)	32.2% (M34.3%, F30.1%)
School Attendance Rate								
Age 6-10	54.4% (M 52.1%, F 56.8%)	45.4% (M43.6%, F47.2%)	47.1% (M 41.0%, F 53.3%)	64.1% (M61.1%, F67.4%)	68.6% (M63.7%, F74.3%)	95.0% (94.7%, F95.2%)	46.8% (M46.1%, F47.6%)	59.0% (M46.5%, F68.4%)
Age 11-14	60.3% (M 49.2%, F 71.7%)	52.8% (M44.6%, F61.5%)	56.5% (M 39.2%, F 72.9%)	62.2% (M47.1%, F78.1%)	72.3% (M56.0%, F88.2%)	69.6% (M50.0%, F100.0%)	54.7% (M47.8%, F61.2%)	64.8% (M48.4%, F77.5%)
Age 15-19	25.8% (M 20.7%, F 31.4%)	27.1% (M24.0%, F30.8%)	23.2% (M 18.1%, F 27.5%)	29.0% (M21.8%, F38.0%)	28.4% (M23.6%, F33.5%)	38.5% (M35.7%, F41.7%)	47.1% (M36.4%, F59.2%)	29.6% (M18.4%, F42.4%)
Employment*2								
Agriculture	75.6%	52.6%	51.4%	96.1%	95.7%	83.3%	95.0%	99.1%
Industry	3.2%	5.8%	0.0%	1.0%	2.7%	0.0%	4.4%	0.9%
Service	21.3%	41.6%	48.6%	2.9%	1.6%	16.7%	0.6%	0.0%
Drinking Water								
Tap	0.2%	0.1%	0.0%	0.5%	0.0%	0.0%	2.8%	0.0%
Tube well	95.0%	93.2%	99.9%	92.3%	98.6%	100.0%	59.7%	83.8%
Others	4.8%	6.7%	0.1%	7.2%	1.4%	0.0%	37.4%	16.2%
Electricity Connection	27.9%	31.0%	11.5%	18.4%	19.6%	37.5%	14.7%	29.3%
Type of House Structure*3								
Pucka	4.4%	2.0%	3.3%	0.5%	0.2%	2.5%	0.5%	1.0%
Semi-pucka	4.8%	2.8%	3.8%	0.8%	0.5%	0.0%	0.5%	1.0%
Kutcha	71.7%	93.9%	70.2%	16.0%	11.3%	0.0%	0.5%	65.7%
Jhupri	19.1%	1.4%	22.7%	82.7%	88.0%	97.5%	98.6%	32.3%
Toilet Facilities								
Sanitary (water-sealed)	2.2%	1.3%	0.6%	1.4%	0.5%	2.5%	0.9%	0.0%
Sanitary (non water-sealed)	36.6%	32.5%	14.6%	21.7%	13.6%	45.0%	47.4%	8.1%
Non-sanitary	49.6%	47.8%	72.6%	69.6%	85.9%	52.5%	49.8%	54.5%
None	11.6%	18.4%	12.2%	7.3%	0.0%	0.0%	1.9%	37.4%

Note 1) Distribution of population aged 7 years and above who can write a letter.
2) Distribution of population aged 7 years and above who do not attend school but are employed.
3) *Pucka*: Made of inorganic materials such as brick and concrete, etc.
Semi-pucka: Made of mix with some organic and inorganic materials such as steel houses, wooden houses, etc.
Kutcha: Made of totally organic materials such as bamboo houses, mud houses, jute stick and catkin grass houses, etc.
Jhupri: Made of temporary materials. Often called 'shanties'.

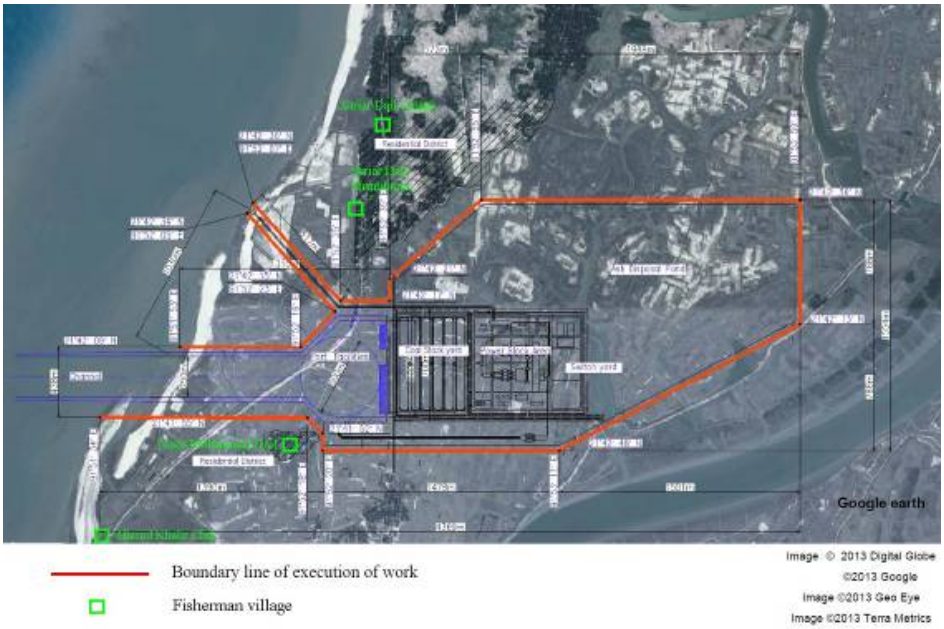
(Source: Bangladesh Bureau of Statistics, Population Census 2011 (provisional), 2012)

2) Fishery

Information on the current fishery situation around the project site was collected through interviews with the Environmental Officer of Maheshkhali Upazila in July, 2012, and with local fishermen in Matarbari Island and Kutubdia Island in November and December, 2012 (Figure 15.1-10).

A fish market survey was conducted in November, 2012, to collect information on major fish species handled at local fish markets around the project site.

According to information provided by local residents around the project site who were interviewed in July, 2012, shrimp cultivation is conducted inside the proposed project site in the rainy season from May to September.

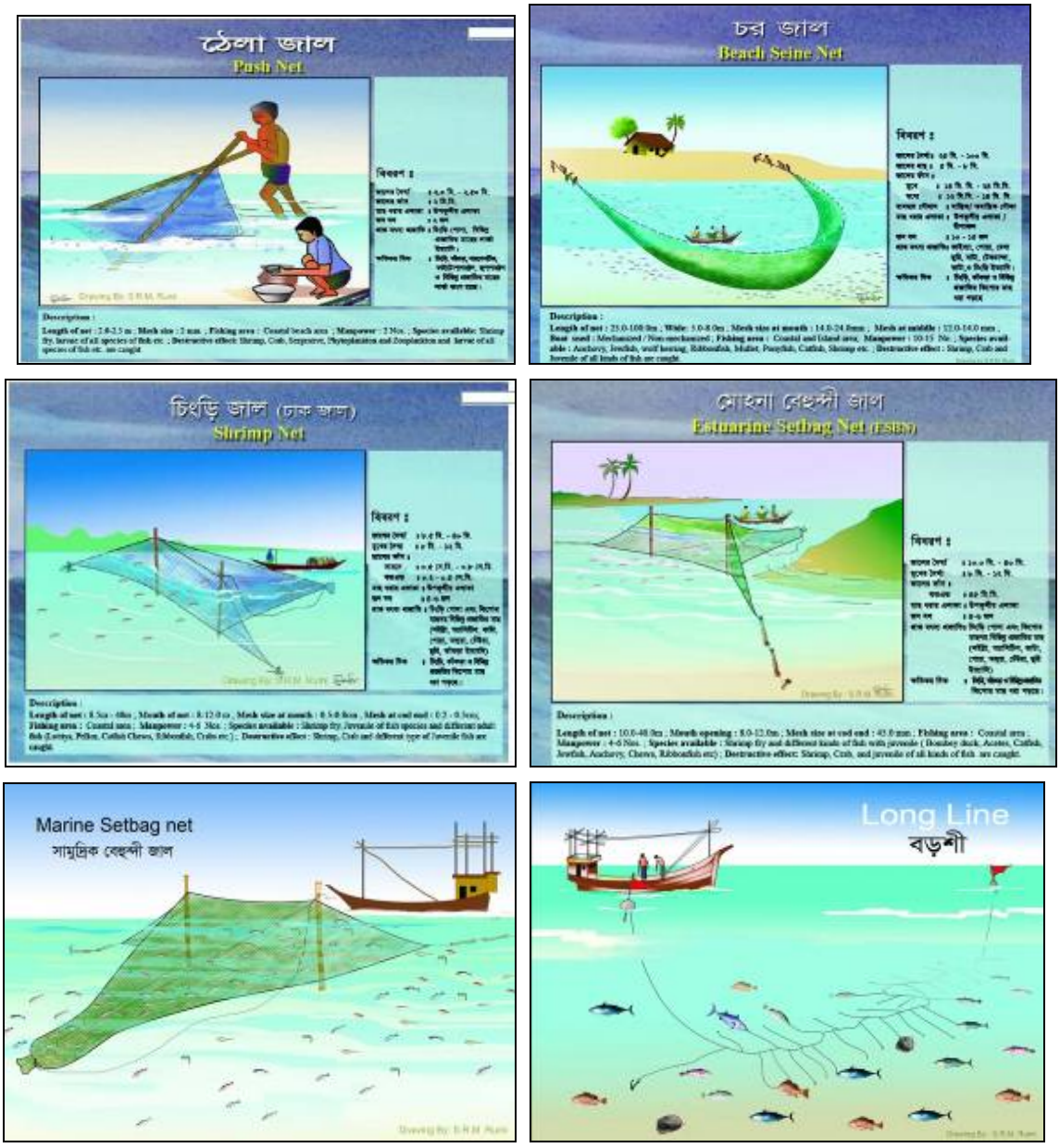


(Source; JICA Study Team)

Figure 15.1-10 Targeted Fishermen's Villages for Interviews

a) Fishing Gear

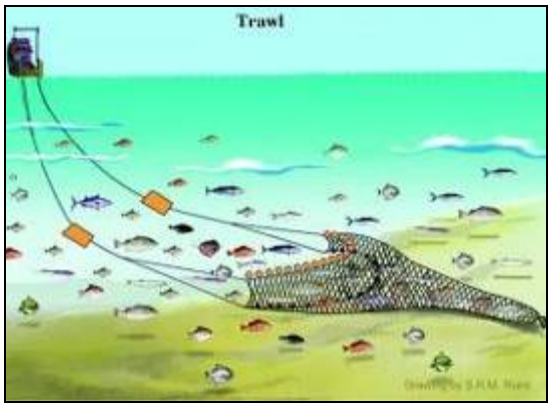
Fishing gears used by local fishermen in Bangladesh are described by the website of the Department of Fisheries (Figure 15.1-11). Interviews of local fishermen revealed that around the project site fishermen use push nets, beach seine nets, shrimp nets, estuary setbag nets, marine setbag nets and long lines. The structures of the three net types, i.e., shrimp nets, estuary setbag nets and marine setbag nets, are basically the same, although the water depths for those nets to be set up are different.

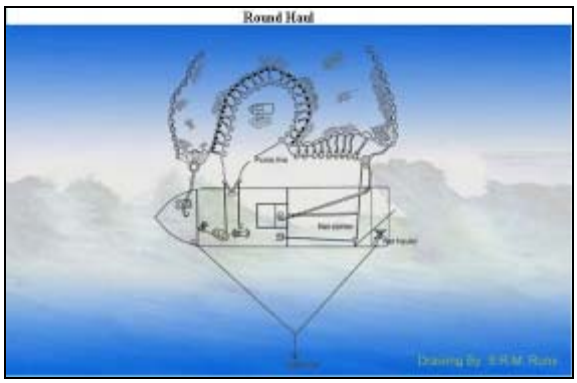


(Source: http://www.fisheries.gov.bd/album_details/507)

Figure 15.1-11 Fishing Gear Used by Local Fishermen in Matarbari Island and Kutubdia Island

In addition to the nets described above, fishermen in Maheshkhali Upazila use trammal nets, trawl nets and round hauls, according to the Environmental Officer of Maheshkhali Upazila (Figure 15.1-12).



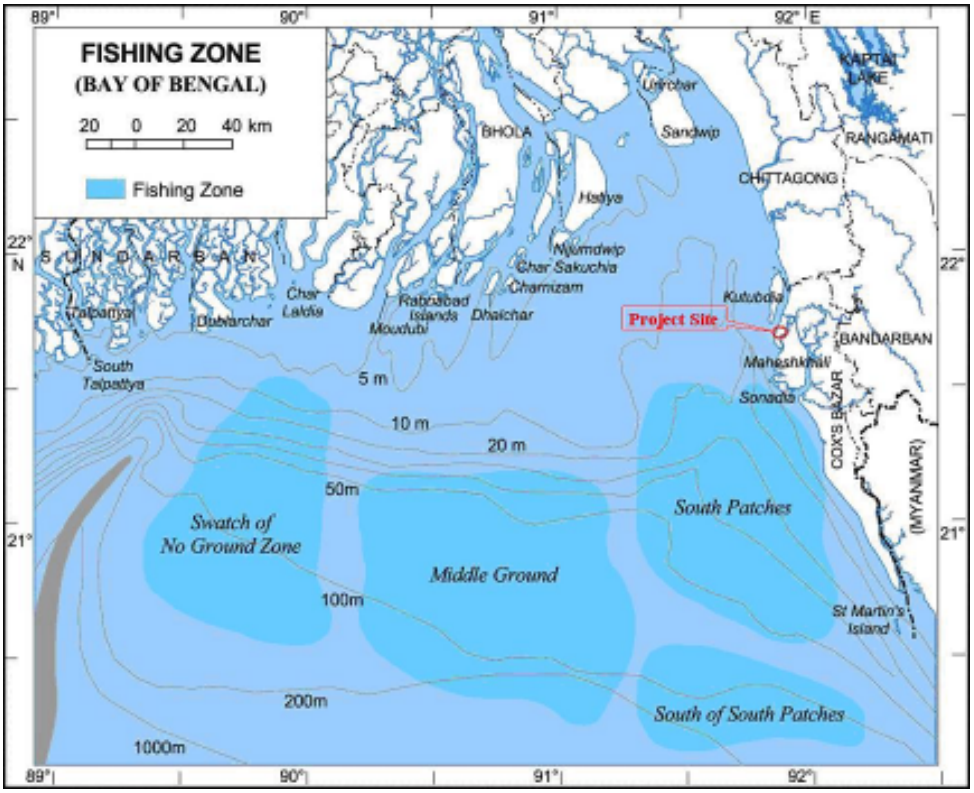


(Source: http://www.fisheries.gov.bd/album_details/507)

Figure 15.1-12 Fishing Gear Used in Maheshkhali Upazila

b) Fishing Grounds and Fishing Season

There are mainly four fishing zones in the Bay of Bengal as described in Figure 15.1-13. The nearest fishing zone from the proposed power plant site is South Patches, located south of Sonadia Island. Therefore, the seaside of the proposed power plant site is not a main fishing ground.



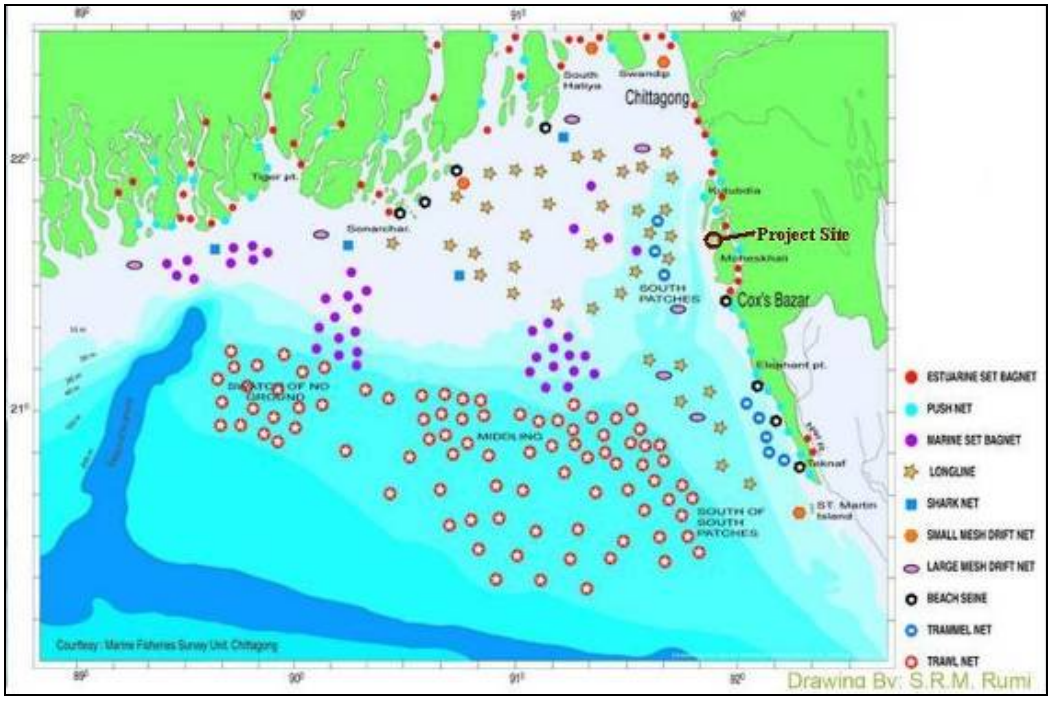
(Source: http://www.banglapedia.org/httpdocs/HT/B_0361.HTM)

Figure 15.1-13 Main Fishing Zones in the Bay of Bengal

a. Fishing Ground by Fishing Gear

The Department of Fisheries describes the types of fishing gear and operation areas as shown in Figure 15.1-14.

Trawl nets operate offshore at depths of 30 to 100 meters, whereas marine setbag nets operate at depths of 30 meters or shallower. Long lines operate in estuaries of the Ganges River as well as at depths of 20 to 30 meters south of Cox's Bazar. Trammel nets operate at depths of 10 to 20 meters. Coastal fishery, on the other hand, is conducted by push nets along the coast line of Bangladesh, and by estuary setbag nets in the coastal areas of Bangladesh, however excluding south of Cox's Bazar.



(Source: http://www.fisheries.gov.bd/album_details/507)

Figure 15.1-14 Fishing Areas and Types of Fishing Gear

According to the interview survey of local fishermen at Matarbari and Kutubdia Islands and the Environmental Officer of Maheshkhali Upazila, push nets, beach seine nets and shrimp nets are used in the coastal area near villages, whereas estuary setbag nets are used in the Kutubdia Channel, and marine setbag nets, long line fishing and trammal nets are used offshore (Table 15.1-3).

Table 15.1-3 Fishing Ground by Fishing Gear

Fishing Gear	Fishing Ground
Push Net	Coastal area near villages
Beach Seine Net	Coastal area near villages
Shrimp Net	Coastal area near villages
Estuary Setbag Net	Kutubdia Channel
Marine Setbag Net	Offshore (3 - 50km, 13 - 15m depth)
Long Line Fishing	Offshore (around 5km, 15 - 17m depth)
Trammal Net	Offshore (5 - 20km)
Trawl	Offshore (10 - 25km)
Round Haul	Offshore (5 - 20km)

(Source: JICA Study Team)

b. Fishing Season by Fishing Gear

Fishing season corresponding to the use of each fishing gear is shown below in Table 15.1-4,

according to the information obtained from local fishermen in Matarbari and Kutubdia Islands and the Environmental Officer of Maheshkhali Upazila.

The push net is used to target shrimp fly for shrimp cultivation, therefore, push nets are not used during the dry season, which is when salt cultivation is conducted instead of shrimp cultivation. Most of the fishing gear is used throughout the year.

Table 15.1-4 Fishing Season by Fishing Gear

Fishing Gear	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Push Net												
Beach Seine Net												
Shrimp Net												
Estuary Setbag Net												
Marine Setbag Net												
Long Line Fishing												
Trammal Net												
Trawl												
Round Haul												

Note: Highlighted yellow areas indicate fishing season.

(Source: JICA Study Team)

c. Targeted Species by Fishing Gear

Fish species caught using each fishing gear is shown in Table 15.1-5, according to information from local fishermen in Matarbari and Kutubdia Islands. When interviewing local fishermen, they were asked to select the fish species that they catch from the photos of fish species presented to them by the JICA Survey Team, therefore the species without distinguishing characteristics are stated at the family level, but not species level.

The users of push nets target species that are different to those of fishermen using other fishing gears. Long line fishing catches a wide range of fish species, such as Plotosidae and Serranidae, due to the nature of the fishing. The structures of shrimp nets, estuary setbag nets and marine setbag nets are basically the same, however the water depths for the nets are different. Therefore, marine setbag nets, which are set up offshore, catch more varieties of fish species than shrimp nets which are set up in coastal areas. The use of estuary setbag nets is somewhere between those two types of nets.

According to the Environmental Officer of Maheshkhali Upazila, major targeted fish species are the following: Hilsha (*Tenualosa ilisha*), Yellowtail catfish (*Pangasius pangasius*), Bombay ducks (*Harpadon nehereus*), Silver pomfrets (*Pampus argenteus*), Poa Fish (*Otolithoides pama*), Black Tiger shrimps (*Penaeus monodin*) and White prawns (*Penaeus merguiensis*).

Table 15.1-5 Species Targeted for Fishery by Fishing Gear

Fishing Gear	Target Species
Push Net	Shrimp fly, larvae of all species of fish, etc.
Beach Seine Net	*Coilia* sp., Engraulidae, Mugilidae, Hemiramphidae, Platycephalidae, Latidae, Sillaginidae, Gerreidae, Sparidae, Eleutheronema tetradactylum, *Otolithoides pama*, Terapontidae, Scatophagidae, Cynoglossidae, *Penaeus merguiensis*, *Penaeus monodin*, etc.
Shrimp Net	*Scoliodon laticaudus*, *Coilia* sp., Engraulidae, *Tenualosa ilisha*, *Harpadon nehereus*, Mugilidae, Hemiramphidae, Sillaginidae, *Alepes* sp., Lutjanidae, *Eleutheronema tetradactylum*, *Otolithoides pama*, Terapontidae, Scatophagidae, Trichiuridae, Cynoglossidae, *Penaeus merguiensis*, *Penaeus monodin*, *Macrobrachium rosenbergii*, etc.
Estuary Setbag Net	*Scoliodon laticaudus*, *Coilia* sp., Engraulidae, *Tenualosa ilisha*, *Harpadon nehereus*, Mugilidae, Hemiramphidae, Platycephalidae, Latidae, Sillaginidae, *Alepes* sp., Carangidae, Lutjanidae, Sparidae, *Eleutheronema tetradactylum*, *Otolithoides pama*, Terapontidae, Scatophagidae, Sphyraenidae, Trichiuridae, *Pampus argenteus*, Cynoglossidae, Tetraodontidae, *Penaeus merguiensis*, *Penaeus monodin*, *Macrobrachium rosenbergii*, etc.
Marine Setbag Net	*Scoliodon laticaudus*, *Coilia* sp., Engraulidae, Chanidae, *Tenualosa ilisha*, *Pangasius pangasius*, *Harpadon nehereus*, Mugilidae, Hemiramphidae, Platycephalidae, Sillaginidae, Carangidae, *Secutor* sp., *Alepes* sp., Lutjanidae, Sparidae, *Eleutheronema tetradactylum*, Sciaenidae, *Otolithoides pama*, Terapontidae, Scatophagidae, Sphyraenidae, Trichiuridae, *Pampus argenteus*, Cynoglossidae, Tetraodontidae, *Penaeus merguiensis*, *Penaeus monodin*, *Macrobrachium rosenbergii*, etc.
Long Line Fishing	*Scoliodon laticaudus*, *Coilia* sp., *Pangasius pangasius*, Plotosidae, Platycephalidae, Latidae, Serranidae, Sillaginidae, Lutjanidae, Lobotidae, *Eleutheronema tetradactylum*, Sciaenidae, *Otolithoides pama*, Uranoscopidae, *Pampus argenteus*, Cynoglossidae, Tetraodontidae, *Penaeus merguiensis*, etc.

(Source: JICA Study Team)

d. Fishing Season by Targeted Species

Fishing seasons by the major targeted species in Maheshkhali Upazila are shown in Table 15.1-6, according to the Environmental Officer of Maheshkhali Upazila. Tenualosa ilisha, Pampus argenteus and Otolithoides pama are caught throughout the year.

Table 15.1-6 Fishing Season by Major Targeted Species

Target Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
River shad (*Tenualosa ilisha*)												
Yellowtail catfish (*Pangasius pangasius*)												
Bombay duck (*Harpadon nehereus*)												
Silver pomfret (*Pampus argenteus*)												
Poa Fish (*Otolithoides pama*)												
Black Tiger shrimp (*Penaeus monodin*)												
White prawn (*Penaeus merguiensis*)												

Note: Highlighted yellow areas mean fishing season.

(Source: JICA Study Team)

c) Fish Catch Amounts

a. Fish Catch Amount by Fishing gear

Fish catch amount by fishing gear is shown in Table 15.1-7, which is based on the information provided from local fishermen in Matarbari and Kutubdia Islands. There is a high and low season in fish catch amounts using each fishing gear, even though the fishing gears can be used throughout the year. Fish catch amounts by long line fishing is relatively high compared to other fishing methods, although this information is based only on the information provided by local fishermen.

According to the Maheshkhali Upazila Officer, push net targeting shrimp fly catches 100 to 200 individuals per day/ person.

Table 15.1-7 Fish Catch Amounts by Fishing Gear

Fishing Gear	Target Species
Beach seine nets	6 - 8 kg/ day
Shrimp nets	15 - 20kg/ day
Estuary setbag nets	3 - 35kg/ day
Marine setbag nets	30 - 200kg/ day
Long line fishing	20 - 2,400 kg/ day

b. Catch Amounts of Major Fish Species

Sixty four species of fish species are caught in Cox's Bazar District and unloaded at the Bangladesh Fisheries Development Corporation (BFDC), Cox's Bazar. There are four major fish species: Hilsa (*Tenualosa ilisha*), Pomfret (*Pampus argenteus*), Mackerel (Scombridae) and Catfish (*Pangasius pangasius*). Statistics recorded by the BFDC of these four species are shown in Table 15.1-8, and other types of species are counted as "Others". Species categorized in "Others" include fish caught in Maheshkhali Channel, in addition to fish caught offshore. According to the data, catch amounts of Hilsa have changed dramatically over the two years of 2010 and 2011. BFDC states that India is constructing a dam for the purpose of supplying water to Calcutta in the upstream of Padma River, which is the Hilsa's main spawning area. Water flow of Padma River has decreased due to restricted flow amounts for dam construction, resulting in water depths of the river's estuary becoming shallower than before. Thus, BFDC predicts that the Hilsa is moving its spawning area to rivers of India and Myanmar.

Table 15.1-8 Statistics of Fish Catch Amounts by BFDC

(Unit: ton)

Local Name	Hilsa (*Tenualosa ilisha*)	Promfret (*Pampus argenteus*)	Macarel (Scombridae)	Rita (*Pangasius pangasius*)	Others	Total
Jul 2010	46.88	-	-	-	320.48	367.37
Aug	292.50	2.45	2.70	1.98	328.38	628.01
Sep	311.33	12.14	0.36	0.36	235.79	560.62
Oct	228.25	15.35	29.22	18.52	362.30	653.64
Nov	258.70	36.80	32.00	2.70	436.00	766.20
Dec	892.00	37.00	13.50	15.00	308.50	1,266.00
Jan 2011	510.00	32.00	25.00	8.50	279.00	854.50
Feb	250.00	10.75	16.20	0.85	292.50	570.30
Mar	446.77	7.10	2.46	-	312.70	768.50
Apr	337.60	5.28	6.90	-	292.72	642.50
May	134.84	0.72	-	-	122.70	258.26
Jun	33.89	-	0.92	-	148.42	183.23
Total	3,742.76	159.59	129.26	47.91	3,439.49	7,519.13

Local Name	Hilsa (*Tenualosa ilisha*)	Promfret (*Pampus argenteus*)	Macarel (Scombridae)	Rita (*Pangasius pangasius*)	Others	Total
Jul 2011	6.29	-	-	-	168.88	175.17
Aug	233.65	1.35	-	-	271.17	506.17
Sep	90.70	1.63	-	-	165.21	257.54
Oct	161.19	20.05	6.03	-	386.50	573.72
Nov	181.83	17.87	21.81	4.80	311.08	536.39
Dec	259.57	10.15	22.48	3.75	290.73	586.68
Jan 2012	124.00	17.30	6.40	7.00	335.70	490.40
Feb	243.30	26.50	10.30	14.50	511.80	806.40
Mar	95.90	15.10	15.60	-	470.80	597.40
Apr	106.00	1.00	1.10	-	444.30	552.40
May	15.80	0.80	-	-	361.70	378.30
Jun	13.80	0.90	-	-	183.30	198.00
Total	1,532.03	112.65	83.72	30.05	3,901.17	5,658.57

(Source: BFDC data)

d) Fishermen's Villages and Fishermen

a. The Number of Fishermen's Villages and Fishermen around the project site

There is a total of 4 fishermen's villages around the project site, with 2 villages in the north of the site (Sairiar Dail Fisherman Village and Sariar Dail Shantibazar) and 2 villages in the south of the site (Nasir Mohammad Dail and Hamid Khalir Char). Focus Group Discussions (FGD) targeted fishermen in these villages. As a result, about 400 households, i.e., 2,240 fishermen, live in the two villages located at north of the project site, and about 255 households, i.e., 1,406 fishermen, live in the two villages at south of the project site.

b. Income by Fishery

The Focus Group Discussions conducted at the 4 fishermen's villages around the project site revealed that household income by fishing activities ranges from 250,000 taka to 1,452,000 taka per year.

c. Self Consumption

The Focus Group Discussions conducted at the 4 fishermen's villages around the project site showed that the amount of household fish self-consumption is from 540 kg to 1,080kg per a village and per year.

e) Market Price

Surveys of market prices of fish species were conducted around the project site (Table 15.1-9). Six fish markets were selected based on the scale of the market (Retail/ Wholesale) and location (Matarbari/ Cox's Bazar). The survey result shows that Rop Chanda (*Pampus argenteus*), Khala Ieha (*Penaeus monodin*) and Hilsha (*Tenualosa ilisha*) have higher prices per kg, whereas smaller scale of fish, such as Alua (*Coilia* sp.), Phasya (Engraulidae) and Kucha chingri (Acetes sp.), are relatively cheaper. According to the Maheshkhali Upazila Officer, shrimp fly is sold at local market with 40 to 50 taka per 100 individuals.

Table 15.1-9 Major Fish Species and Market Price

(Unit: taka/ kg)

Market & Type (Species)	Retail (Cox's Bazar)		Retail (Matarbari)		Wholesale /retail (Chokoria)	Wholesale (Cox's Bazar)	Market Price
Local Name: Loita (*Harpadon nehereus*)	100	80	50-60		40-50		40-100
Local Name: Jait Bata (Mugilidae)	200		120-130	140	250		120-250
Local Name: Hilsha (*Tenualosa ilisha*)	500	400			320-340	250	250-500
Local Name: Alua (*Coilia* sp.)	160	180	30-40		120		30-180
Local Name : Datina (Sparidae)		240	140				140-240
Local Name: Phasya (Engraulidae)			80		80		80
Local Name: Rop Chanda (*Pampus argenteus*)		400				1000	400-1000
Local Name : Kucha chingri (*Acetes* sp.)	80				200-230		80-230
Local Name : Sada Chingri (*Penaeus merguiensis*)	160	240	240		400		160-400

Market & Type (Species)	Retail (Cox's Bazar)		Retail (Matarbari)		Wholesale /retail (Chokoria)	Wholesale (Cox's Bazar)	Market Price
Local Name : Khala Ieha (*Penaeus monodin*)		650			600		600-650

(Source: JICA Study Team)

(2) Transmission Line

As described previously in the "outline of the proposed site", the transmission line will take a route along the local road (R-170) from Anowara Upazila to Maheshkhali Upazila.

As shown in the table below, Banshkhali Upazila had the largest population although the population density was the second lowest to Maheshkhali. Although males in Anowara and Banshkhali had a higher literacy rate than females, female school attendance rates were better in all four Upazilas. NGOs such as BRAC, provide children, particularly girls, with primary education where there is no public school nearby, which may explain the reason why girls have more education opportunities than boys. The agriculture sector had the largest working population in the four Upazilas.

In terms of living conditions, two Upazilas of Chittagong District were better provided with drinking water, electricity connection, and types of house structure as of 2011. Pekua took advantage of promoting sanitary toilet facilities.

Table 15.1-10 Overview of the Transmission Line Route

Union		Anowara	Banshkhali	Pekua	Matarbari
Area		40,551 acres (16,410 ha)	93,135 acres (37,690 ha)	34,500 acres (13,962 ha)	89,498 acres (36,219 ha)
Population		49,966 HH (259,022 people)	84,216 HH (431,162 people)	31,944 HH (171,453 people)	58,177 HH (321,218 people)
Population Density		1,578 persons / sq. km	1,144 persons /sq. km	1,229 persons / sq. km	887 person / km2
Population Below 15 years Old		39.0%	43.9%	45.7%	38.1%
Sex Ratio		96	97	101	107
Literacy Rate*1		51.9% (M 54.6%, F 49.5%)	37.4% (M 38.5%, F 36.3%)	35.3% (M 35.6%, F 35.0%)	30.8% (M 30.5%, F 31.1%)
School Attendance Rate					
	Age 6-10	80.0% (M 79.6%, F 80.5%)	71.2% (M 69.8%, F 72.8%)	69.5% (M 67.9%, F 71.3%)	62.7% (M 60.4%, F 65.2%)
	Age 11-14	82.3% (M 80.0%, F 84.7%)	74.5% (M 70.7%, F 78.6%)	70.0% (M 63.5%, F 76.8%)	61.7% (M 51.2%, F 72.8%)
	Age 15-19	42.1% (M 42.8%, F 41.4%)	23.2% (M 18.1%, F 27.5%)	32.9% (M 30.8%, F 35.1%)	27.1% (M 22.8%, F 32.0%)
Employment*2					
	Agriculture	64.7%	78.0%	83.4%	81.6%
	Industry	7.4%	5.6%	3.3%	3.0%
	Service	28.0%	16.4%	13.3%	15.4%
Drinking Water					
	Tap	3.5%	0.5%	0.5%	0.4%
	Tube well	89.2%	95.0%	97.7%	89.5%
	Others	7.3%	4.5%	1.8%	10.1%
Electricity Connection		63.8%	29.2%	19.2%	25.6%
Type of House Structure*3					
	Pucka	12.8%	6.4%	5.1%	2.8%
	Semi-pucka	14.6%	7.2%	5.6%	5.8%
	Kutcha	60.6%	69.5%	77.2%	77.9%
	Jhupri	12.1%	16.9%	12.0%	13.5%
Toilet Facilities					
	Sanitary (water-sealed)	14.6%	12.5%	33.4%	3.4%
	Sanitary (non water-sealed)	44.0%	35.0%	38.0%	24.6%
	Non-sanitary	36.3%	46.9%	22.4%	52.1%
	None	5.2%	5.5%	6.1%	19.9%

Note 1) Distribution of population aged 7 years and above who can write a letter.
2) Distribution of population aged 7 years and above who do not attend school but are employed.
3) *Pucka*: Made of inorganic materials such as brick and concrete, etc.
Semi-pucka: Made of mix with some organic and inorganic materials such as steel houses, wooden houses, etc.
Kutcha: Made of totally organic materials such as bamboo houses, mud houses, jute stick and catkin grass houses, etc.
Jhupri: Made of temporary materials. Often called 'shanties'.

(Source: Bangladesh Bureau of Statistics, Population Census 2011 (provisional), 2012)

(3) Access Road

The project area designated for the construction and improvement of the road which traverses through Cox's Bazaar District. Population and demographic characteristics of the District is shown in Table 15.1-11. The Table 15.1-11 shows that the population density per/sq. km. varies significantly among the different Upazilas and District. The project area is mostly agricultural land with scattered settlement. Most of the people are farmers.

Table15.1-11 Population and Demographic Characteristics Surrounding the Project Area

District	Cox's Bazaar	
Upzila	Chakaria	Maheshkhali
Area Sq. km	643.46	362.18
Union/ Ward	20	9
Mouza/ Mahalla	66	31
Village	335	170
Total Household	84434	43097
Size of H/H	6	6.02
Population		
Both Sex	503390	256546
Male	260146	135222
Female	243244	121324
Sex Ratio (M/F)	107	111
Literacy 7+ years	32.03	22.5
Density (Sq. Km)	782	708

(Source: Population Census 2001, February 2007, BBS)

Maheshkhali:

Communication facilities Roads: pucca 7 km, semi pucca 15 km and mud road 135 km. Traditional transport Bullock cart, coach, palanquin. These means of transport are either extinct or nearly extinct.

Chakaria:

Communication facilities Highway 37.5 km, pucca road 52 km, semi pucca road 190 km, mud road 560 km, embankment road 138 km. Traditional transport horse carriage and bullock cart are nearly extinct.

The fisheries resources of Bangladesh are among the richest in the world. The contribution of this sub-sector under the agricultural sector in terms of GDP is 10.33%, which is 3.3% of the total GDP (Bangladesh economic review, 1998). During 1996-97, total fish production both inland and marine was 1.373 MMT and the target for 1997-98 has been fixed as 1.491 MMT. Contribution of marine fisheries was 28.46% of the total production in 1996-97, which reveals that the inland fisheries production is still much higher than the marine fisheries production. This sub-sector provides an estimated 2 millions people comprises of full time fishermen, small fish traders, fish transporters, packers etc. Out of these 2 millions people 1.276 millions are engaged exclusively in fishing activities as prime source of income and hence termed as fulltime fishermen. Out of these fulltime fishermen, 40.43% are engaged in marine fisheries activities. In and around the project area there are twelve fishing catch composition points. These twelve land survey points the Department of Fisheries do the survey on fishing activities. Of them six land survey points fishermen are directly involved in the project areas socioeconomic activities.

15.2 System and Organization of Environmental and Social Consideration in Bangladesh (EIA and Land Acquisition)

15.2.1 EIA (Environmental Impact Assessment)

(1) EIA related Laws and Regulations

The following are the national strategies, policies, ordinances and regulations of Bangladesh.

- Environment Pollution Control Ordinance, 1977
- Environmental Standards in Bangladesh, 1991
- National Conservation Strategy (NCS), 1992
- Environmental Policy, 1992
- National Environmental Management Action Plan "NEMAP", 1995
- Environmental Conservation Act, 1995
- Environmental Conservation Rules, 1997

The basis for the Environmental Impact Assessment related laws and regulations is the Environmental Policy enacted in 1992, which is the major outline of the Policy Principles, stating the environmental policy, framework and system in 15 subject fields. It also stipulates the legal positions of the National Environment Committee and Department of Environment (DOE).

Bangladesh has also joined, ratified and signed major international agreements, treaties, and protocols regarding environmental protection and conservation of natural resources.

- Rio Declaration, 1992
- Convention on Biological Diversity, Rio de Janeiro, 1992
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1972
- United Nations Convention on the Law of the Sea, Montego Bay, 1982
- Convention related to the Preservation of Fauna and Flora in their Natural State, 1933
- International Convention for the Protection of Birds, 1950
- International Plant Protection Convention, 1951

(2) EIA Regulations and Procedures

The procedures and requirements for the power plant division indicated by the EIA come under the Environmental Conservation Act 1995, which stipulates the requirement of advance approval by DOE for all "industrial facilities or projects". Under the Environmental Conservation Act, DOE divides the intended projects for screening into 4 categories (i.e., Green, Amber-A, Amber-B and Red).

The construction of a power plant is categorized as Red which requires Initial Environmental

Examination (IEE) and subsequently a comprehensive EIA. Based on the assumption that sufficient review of the EIA has been conducted, approval for the implementation of the project will be issued by DOE.

Environmental Management Plan (EMP) is the main requirement of the EIA of the projects categorized as Amber-B and Red. The role of EMP is to provide an explanation to DOE about the ways of implementing mitigation measures stated in the EIA.

EMP must provide a detailed scope of responsibility of the organization and the management of the project, and the method of implementing the mitigation measures and monitoring. Even after obtaining approval from DOE, the project owner is required to comply with environmental regulations. Projects categorized as Red are required to implement IEE. The procedures of the IEE are as follows.

- Collecting baseline data in respect to the project and the environmental conditions of the project and its site
- Specifying significant items pertaining to IEE
- Suggesting mitigation measures, EMP, alternative sites or other project improvements
- Terms of Reference (TOR) for EIA

After the completion of an IEE report, the project owner shall apply to the DOE in the prescribed format for the application of a Location Clearance Certificate (LCC). The following documents shall be attached to the application.

- Report on the feasibility of the industrial unit or project
- Report on the IEE relating to the industrial unit or project
- Report on the Environmental Management Plan (EMP) for the industrial unit or project, and also the Process Flow Diagram, Layout Plan, design and information about the effectiveness of the Effluent Treatment Plan of the unit or project
- No Objection Certificate (NOC) from the local authority
- Emergency plan relating to adverse environmental impacts and plan for mitigation of the effects of pollution
- Outline of the relocation, rehabilitation plan (where applicable)
- Other necessary information (where applicable)

The LCC shall be issued along with comments from DOE on the TOR of the EIA within thirty days of the receipt of the application. The project owner shall submit the EIA report prepared on the basis of the program outlined in the TOR of the EIA to DOE for approval.

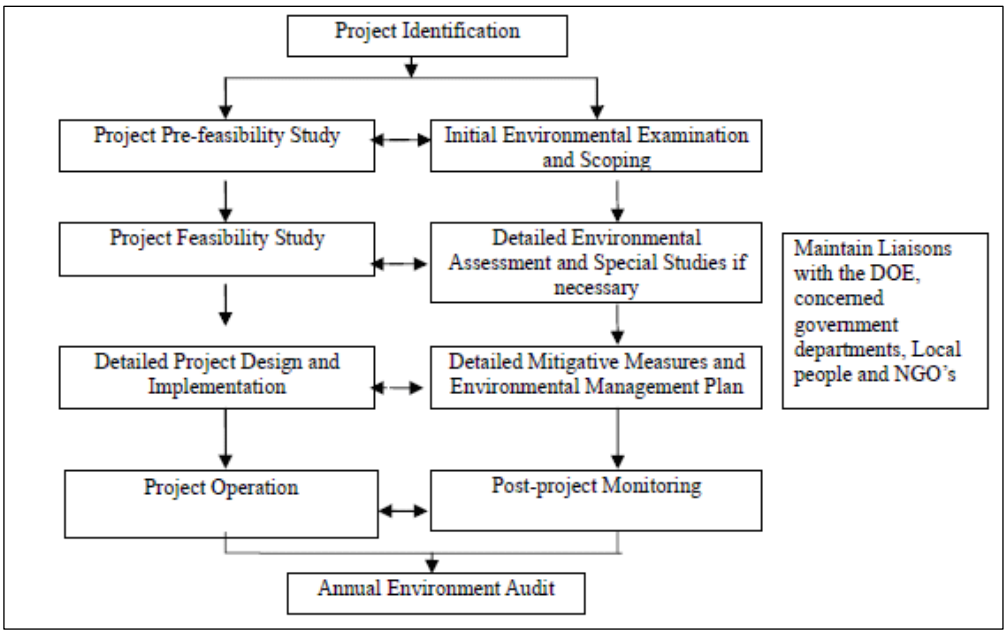
When preparing the EIA report, the general public should be involved as part of the decision-making process development, according to the EIA Guideline for Industries. To achieve effective public participation, it is necessary to communicate with as many people as

possible and through as many different ways as possible. Some of the methods for effective communication are as follows, according to the EIA Guideline for Industries.

- Radio and television
- News releases
- News letters
- Advertisements
- Sample polls
- Lobbying
- Workshops
- Public meetings
- Public hearings
- Information vans, and
- Citizen advisory committees

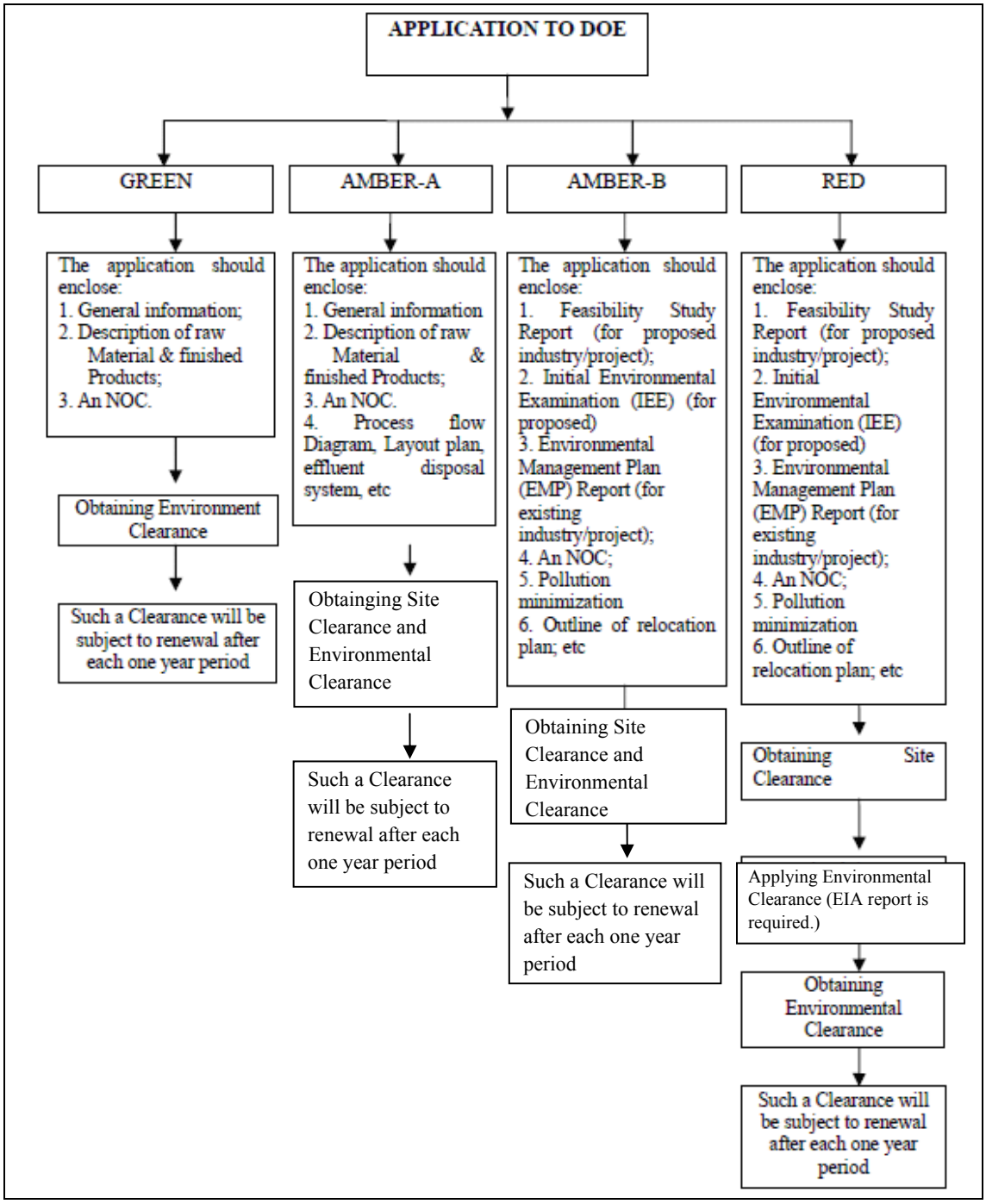
After obtaining approval for the EIA report, an Environmental Clearance Certificate (ECC) shall be granted to the project owner within fifteen working days. The project owner can commence project implementation after obtaining the ECC.

The validity period of the ECC is one year. The requirement for the renewal of the ECC is that the environmental standards required by the DOE as well as the on-site inspections are satisfied. The flow charts of EIA procedures are shown in Figure 15.2-1 and Figure 15.2-2.



(Source: EIA Process, EIA Guideline for Industries, Department of Environment, 1997)

Figure 15.2-1 Flow Chart of EIA Process



(Source: EIA Process, EIA Guideline for Industries, Department of Environment, 1997)

Figure 15.2-2 Flow Chart for Procedures on Each Category

Basicaly, new bridge construction/reconstruction which length is 200 m or more fall under the 'red' category according to ECR and therefore, need to conduct IEE and EIA studies to obtain site and environmental clearance from the DOE. But in this access road case, IEE submission and appraisal process were omitted according to an agreement between DOE and RHD.

Accordingly, the following activities have been carried out as IEE study under the EIA study for the access road.

- Identification of national legal obligations in relation to the interventions which will be required to review under the EIA study of the access road for the power plant;
- Exploration of the national legislative provisions and policy guidelines on environmental sectors;
- Identification of the international legal obligations and relevant provisions of multilateral environmental agreements related to the access road project;
- Exploration of national and international legal provisions on road and bridge sector; and
- Identification of the standard guidelines at regional and international level related to the road and bridge setup.

(3) EIA Related Organizations

The main government agency for administration regarding the environment of Bangladesh is the Ministry of Environment and Forests (MOEF), handling all issues related to policies and regulations on the domestic environment. In response to increasing significance of environmental issues, MOEF was established in 1989 to replace the Ministry of Forests. It is now a permanent member of the executive committee for the National Economic Council. This council is a major decision making body for economic policy issues with responsibility to approve government funded projects. MOEF supervises the activities of the following organizations.

- Department of Environment (DOE)
- Department of Forestry (DOF)
- Forest Industries Development Corporation (FIDC)

The government enacted the Environmental Pollution Control Act, 1977, in order to expand the scope and enforce implementation of environmental management. Based on this act, plans to establish an Environmental Pollution Control Board were suggested. The aim of this board is to propose policy decisions and implementation measures.

In 1982, the name of the board was changed to the Department of Environmental Pollution Control (DEPC). Division offices were established in 6 areas which are Dhaka, Chittagong, Khulna, Barisal, Sylhet, and Rajshahi.

A name change from DEPC to the Department of Environment (DOE) was made by a special order by the Minister and the department came under the jurisdiction of MOEF in 1989. DOE is a department under MOEF, represented by the Director General (DG). The following are the authorities of the DG as stipulated by law.

- DG has the authority to cease any activities deemed to have a harmful effect on human lives or the environment. Business operators have the right to appeal, and procedures of the appeal are stipulated, although there is no opportunity for appeal unless an emergency is declared.
- DG has the authority to declare contaminated areas as nature preservation areas. DOE manages the activities and schedules in those areas.
- Upon development of any new projects, the project owner is required to obtain ECC from DOE. The procedures of obtaining those permits are previously noted.

Failure to comply with ECA 1995, is a maximum of 5 years in prison and/ or a maximum of 10 million Taka in penalties.

DOF under MOEF has the responsibility to protect and manage all protected national forests. The staff members of the DOE are spread widely in districts and unions, which have protected forests. An Agro forestry program has just recently been started. Board members of the DOF are also responsible for protection of wildlife within the forests.

Other organizations relating to the environmental are:

- Ministry of Land: Land Reform and Land Acquisition Directorate
- Bangladesh Water Development Board (BWDB)
- Ministry of Fisheries and Livestock: Directorate of Fisheries

(4) Comparison between JICA Guidelines and EIA Guidelines for Industries

EIA Guidelines for Industries, which was issued by DOE, stipulates the contents of EIA. Table 15.2-1 shows the comparison between JICA Guidelines for Environmental and Social Considerations and EIA Guidelines for Industries on the contents of EIA report. This comparison indicates that EIA Guidelines for Industries does not require considering “Analysis of Alternative” in EIA report.

Table 15.2-1 Comparison between JICA Guidelines and EIA Guidelines for Industries on the Contents of EIA Report

Content	JICA Guidelines on Environmental and Social Consideration	EIA Guidelines for Industries (Department of Environment, Ministry of Environment and Forest, Government of Bangladesh, June, 1997)	Gap between JICA Guidelines and Bangladesh Guideline/ Action to be taken
Introduction	N/A	Chapter 1 Introduction 1.1 Purpose of the Report 1.2 Relationship with Project Feasibility Study 1.3 EIA Team	JICA Guideline does not have any requirements for this section.
Executive Summary	Concisely discusses significant findings and recommended actions.	Chapter 6 Executive Summary (Summary, Conclusions and Recommendations)	No gap.
Policy, legal, and administrative framework	The framework within which the EIA report is to be carried out.	Chapter 4.3.1 Environmental Laws and Regulations or Applicable National Criteria	No gap.
Project Description	Describes the proposed project and its geographic, ecological, social and temporal context, including any off-site investments that may be required (e.g., dedicated pipelines, access roads, power plants, water supply, housing, or raw material and product storage facilities). It also indicates the need for any resettlement or social development plan. It normally includes a map showing the project site and the area affected by the project.	Chapter 2 Project Description 2.1 Location and Access ways 2.2 Type 2.3 Layout and Immediate Environment 2.4 Materials Utilized and Produced (mass balance) 2.5 Processes and Operations Involved in Manufacture 2.6 Requirements of Land, Water, Fuels and Other Natural Resources, (other than Raw Materials) and Their Sources 2.7 Generation of Solid, Liquid and Gaseous Wastes (water balance, steam balance, material balance and energy balance) 2.8 Transport Requirements and their Modes for Incoming and Outgoing Materials 2.9 Utilities and Facilities and Their Capacities 2.10 Labour Force during Construction Phase and Operational Phase 2.11 Investment Cost and Funding Arrangement	No gap.
Baseline Data	Assesses the dimensions of the study area and describes relevant physical, biological, and socio-economic conditions, including all changes anticipated to occur before the project commences. Additionally, it takes into account current and proposed development activities within the project	Chapter 3 Environmental Background 3.1 Environmental Base Maps (covering a minimum of 10km radius) 3.2 Describe the following features 3.2.1 Land Use 3.2.2 Natural Physical Resources (Air, Water, Soil) 3.2.3 Natural Biological Resources (including Forests) 3.2.4 Economic Development	No gap.

Content	JICA Guidelines on Environmental and Social Consideration	EIA Guidelines for Industries (Department of Environment, Ministry of Environment and Forest, Government of Bangladesh, June, 1997)	Gap between JICA Guidelines and Bangladesh Guideline/ Action to be taken
	area but not directly connected to the project. Data should be relevant to decisions about project site, design, operation, or mitigation measures, and it is necessary to indicate the accuracy, reliability, and sources of the data.	3.2.5 Socio-economic Status 3.2.6 Quality of Life Values 3.2.7 Environmentally Sensitive Areas of Special or Unique Scientific, Socio-economic or Cultural Value	
Environmental Impacts	Predicts and assesses the project's likely positive and negative impacts in quantitative terms, to the extent possible. It identifies mitigation measures and any negative environmental impacts that cannot be mitigated, and explores opportunities for environmental enhancement. It identifies and estimates the extent and quality of available data, essential data gaps and uncertainties associated with predictions, and it specifies topics that do not require further attention.	Chapter 4 Environmental Impacts and Mitigation 4.1 Major Findings of the Initial Environmental Examination (IEE) 4.1.1 Critical Issues (remaining unresolved during IEE Study) 4.1.2 Other Issues (Related to Public Perceptions, etc) 4.2 Detailed Examination of Unresolved Issues Related to: 4.2.1 Project Location 4.2.2 Design Criteria 4.2.3 Construction Stage 4.2.4 Operations Stage 4.3 Evaluation of Impacts (in the light of) 4.3.1 Environmental Laws and Regulations or Applicable National Criteria 4.3.2 Mitigation Measures for Eliminating or reducing significant Impacts 4.3.3 Benefit Cost Ratio 4.3.4 Public Opinion 4.3.5 Residual Impacts 4.4 Follow-up Studies 4.5 Critical Evaluation	No gap.
Analysis of Alternatives	Systematically compares feasible alternatives to the proposed project site, technology, design, and operation including the "without project" situation in terms of the following: the potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional,	N/A	There is a gap. Analysis of Alternatives will be stated.

Content	JICA Guidelines on Environmental and Social Consideration	EIA Guidelines for Industries (Department of Environment, Ministry of Environment and Forest, Government of Bangladesh, June, 1997)	Gap between JICA Guidelines and Bangladesh Guideline/ Action to be taken
	training, and monitoring requirements. For each of the alternatives, it quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. It also states the basis for selecting the particular proposed project design, and offers justification for recommended emission levels and approaches to pollution prevention and abatement.		
Environmental Management Plan	Describes mitigation, monitoring, and institutional measures to be taken during construction and operation in order to eliminate adverse impacts, offset them, or reduce them to acceptable levels.	Chapter 5 Environmental Management Plan 5.1 Technical Aspects of the Project 5.1.1 Final Design 5.1.2 Equipment 5.1.3 Construction Methods 5.1.4 Construction Contract Document 5.1.5 Construction and Operations of Pollution Control Measures (Air, Liquid, Solid) 5.1.6 Green-Belt, Landscaping 5.1.7 Reuse/Recycling of wastes 5.1.8 Schedule of Implementation of 5.1.5, 5.1.6 and 5.1.7 5.1.9 Estimates of Capital and Operational Costs of 5.1.5, 5.1.6, and 5.1.7 5.2 Management Organization 5.2.1 Personnel 5.2.2 Resources (equipment, labs, etc.) 5.3 Environmental Monitoring Programme (For Air, Water, Soil, terrestrial/aquatic biology, which ever applicable) 5.3.1 Ambient Environmental Quality Monitoring - Location - Parameters - Frequency 5.3.2 Effluent and Emissions Monitoring - Air Emissions (stacks, parameters and frequency) - Effluents (locations, parameters and frequency)	No gap.

Content	JICA Guidelines on Environmental and Social Consideration	EIA Guidelines for Industries (Department of Environment, Ministry of Environment and Forest, Government of Bangladesh, June, 1997)	Gap between JICA Guidelines and Bangladesh Guideline/ Action to be taken
		- Solid wastes (Quality and composition of each type of waste and frequency) 5.3.3 Monitoring of Environmentally Significant Parameters of Fuels and Raw Materials (e.g., Sulphur and Ash content in fuels, metal contents in mineral ores) 5.3.4 Data Presentation and submission of Reports 5.3.5 Estimate of annual costs of 5.2 and 5.3	
Community Consultation	Includes a record of consultation meetings (date, venue, participants, procedures, opinions of major local stakeholders and responses to them, and other items), including consultations for obtaining the informed views of the affected people, local NGOs, and regulatory agencies.	Chapter 4.3.4 Public Opinion	No gap.
Conclusion, Recommendation, Commitments	N/A	Chapter 6 Executive Summary (Summary, Conclusions and Recommendations)	JICA Guideline does not have any requirements for this section.
Annexes	N/A	- Data collected during field monitoring - Details of Air Quality and Water Quality Computer Modeling if undertaken - List of scientific and technical references cited in the next - Abstracts of selected references - Data sources - Experts/specialists consulted, their written opinions - Risk analysis study report (if applicable) - Resettlement and Rehabilitation (R&R) study report (if applicable) and estimated cost of R&R - Other	JICA Guideline does not have any requirements for this section.

15.2.2 Land acquisition

(1) Key Legislation

The Acquisition and Requisition of Immovable Property Ordinance of 1982 and its subsequent amendments in 1993 and 1994 provide the key legal instrument for the acquisition of private land for development activities in Bangladesh.

Salient provisions of the Ordinance which show tangible gaps with the JICA Guidelines are as follows:

Avoiding/ minimizing land acquisition: The Ordinance only implicitly discourages unnecessary acquisition as land acquired for one purpose cannot be used for a different purpose. There are, however, no mechanisms to monitor if this condition is actually adhered to.

Eligibility for compensation: The Ordinance stipulates compensation only for the persons who appear in the land administration records as the owners (i.e., titleholders). It does not recognize the rights of those without legal title to the land, who live in or make a living from it.

Compensation paid for: The Ordinance provides for compensation of land and other objects built and grown on it (structures, trees and orchards, crops and any other developments on the land like ponds, built amenities, etc.). There are no provisions to assess and restore lost income streams or income sources caused by the land acquisition to the PAPs.

Compensation standards: Landowners receive compensation under the law (CUL) as per the market value of the property at the publication date of the notice[2] with a premium of 50% on the assessed price. Any damage to standing crops or trees on the property, expenses incidental to compelled changes to the residence or place of business, and reduction of profits of the property in the acquisition period are also entitled to a sum of 50% on top of such market value[3]. The 1994 amendment made provisions for payment of crop compensation to tenant cultivators (*"bargadar"*).

Although the Ordinance stipulates 'market prices' of the acquired land as just compensation, the legal assessment method almost always results in prices far below the actual market prices. Certain pricing standards, which are regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, and crops, etc.

[2] The average value of the properties of similar description and with similar advantages in the vicinity during the last twelve months prior to the publication date of the notice. (Section 8 (1) of the Acquisition and Requisition of Immovable Property Ordinance 1982.)

[3] The market value thus determined does not always reflect the actual market value.

Relocation of homestead losers: There is no legal obligation to relocate, or assist with the relocation of, those whose homesteads have been acquired.

Ensuring payment/ receipt of compensation: Even with the given legal provision, the compensation process is time-consuming. There is, moreover, no certainty as to when an affected landowner will obtain the stipulated compensation or whether he will obtain it at all.
Land is legally acquired and handed over to the project proponent as soon as the acquisition authority identifies the owners ('awardees') by examining the records, and sends a legal notice advising them to claim compensation ('awards'). And it also turns out that it is an obligation of the PAPs to prove that the acquired land legally belongs to them.

Socio-economic rehabilitation: The provisions are so restricted that the Ordinance shows no concern about the long-term socio-economic changes the PAPs might undergo in the post-acquisition period. Except for the compensation at the legal 'market price', there are no other provisions in the acquisition or other-laws that require the government to mitigate the resultant adverse impacts caused by the acquisition. Socio-economic rehabilitation of the involuntarily displaced persons is absent in the legal regime of Bangladesh.

(2) JICA's Policy on Land Acquisition and Resettlement

The key principle of JICA policies on involuntary resettlement is summarized below.

a. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
b. When, population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
c. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
d. Compensation must be based on the full replacement cost as much as possible.
e. Compensation and other kinds of assistance must be provided prior to displacement.
f. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
g. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.

h. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
i. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows.

j. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.
k. Eligibility of Benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
l. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
m. Provide support for the transition period (between displacement and livelihood restoration.
n. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.
o. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

In terms of categories of PAPs and types of lost assets, the gaps in the existing legal framework of Bangladesh and requirements of the JICA Guidelines are identified as presented in the table below.

Table 15.2-2 Gap Analysis between Bangladeshi Laws and JICA Guidelines

No	Category of PAPs / Types of Lost Assets	Bangladesh Laws	JICA Guidelines
1	For all types of land and other assets for legal land	Acquired by DC as per legal requirements/ procedures	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based
2	Land tenants	Compensation for standing crops if harvesting of crops is not possible	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported.
3	Land Users	Squatters, encroachers and unauthorized users/ occupiers are not recognized	Ditto
4	Owners of temporary structures	Only compensation under law (CUL)	Compensation must be based on the full replacement cost as much as possible.
5	Owners of permanent structure buildings	Ditto	Ditto
6	Perennial crops	Market prices of the standing crops with value of plants	Compensation must be based on the full replacement cost as much as possible.
7	Timing for payment of entitled compensation to the PAPs	No concern on the part of the project proponent. Land is handed over to the project proponent as soon as the compensation funds are placed with the DC.	On the completion of payment of compensation to the PAPs, the land is to be vacated and handed over to the project proponent.
8	The issue of relocation and income generation activities	No concern about relocation and income generation activities.	People who must be resettled involuntarily and whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standards of living, income opportunities and production levels to pre-project levels.
9	Vulnerability of PAPs	No distinction between the PAPs	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, the landless, elderly, women and children, ethnic minorities, etc.
10	Role of DC, project proponent and PAPs	DC to acquire land, the project proponent to use the land, and PAPs to seek compensation from the DC.	DC and project proponent to assist the PAPs in getting the compensation, assist to collect the legal and required documents, and provide support for the transition period between displacement and livelihood restoration.

(Source: JICA Study Team)

(3) Procedures of land acquisition

Under the Ordinance of 1982, the DC at District level is entrusted to acquire land for agencies requiring land for any public or private infrastructure projects. The procedures of land acquisition will follow the following steps:

Step 1: After identifying and selecting the exact ground locations of the required land, the project proponent will carry out detailed engineering surveys and design the construction work and lay them out on mauza maps. The project proponent will prepare the land acquisition proposals to obtain administrative approval by the line ministry.

Step 2: The project proponent, after obtaining the approval of the administrative ministry, will make a request to the DC, with sufficient information including the amount of land to be acquisitioned from each plot, and the ownership status such as private and public lands, for the acquisition of the land as per the proposal.

Step 3: Within 90 days, the DC will appraise the application through a) site observation, b) consultation with local politicians and residents, c) develop project profiles, and d) cost estimates. The DC will then develop and submit a proposal on land acquisition to the Ministry of Land for an appraisal by the central government within 90 days.

- The DC will publish a notice as stipulated in Section 3 of the Ordinance of 1982 stating that there is a proposal for the property to be acquired. The persons to be displaced may submit an objection to the land acquisition to the DC within 15 days after the notice is served. All the legal titleholders will be advised to show their ID cards and other documents that verify their rights. For those with no registrations, the DC Office will call for circumstantial evidence from community leaders, local elites, and religious leaders, etc., to add these people to the list.
- The DC will consult with the Public Works Department (PWD), Forest Department (BFD), Department of Agricultural Marketing (DAM) and Department of Fisheries (DOF) to assess the value of structures, trees, crops and aqua products for their existing rates.
- Under Section 6, a second public notice will be served stating the GOB's decision on the land acquisition and taking possession thereof. The DC Office will confirm the PAPs, exact land area and size for acquisition, number of relocated houses, agriculture land, forestry and fishing areas that will be lost. The persons to be displaced will be requested to submit their statements of property, amounts and particulars of the claims to compensation after 15 days of the second notice being served. The DC Office will respond to any grievances made by the PAPs in order to agree to the assistance package.
- The project proponent shall deposit the estimated amount of the award of compensation with the DC within 60 days from the receipt of the estimate given by the DC.
- Upon serving the last notice (Section 7), the DC shall pay the amount to the owners of the acquired property within another 60 days from the date of deposit by the project proponent. The DC will take possession of the property after completion of the compensation payment to the PAPs and immediately declare this in the official gazette, and hand the property over to the project proponent.

15.3 Consideration of Alternatives (including Zero Option)

In the master plan of the coal-fired power plant project in Bangladesh, 16 locations have been examined as candidate construction sites, and 2 locations, southern Chittagong and Meghnaghat, were selected as the major proposed sites for their advantage in using imported coal. The follow-up investigation proved that Matarbari Island and Maheskhali Island located in the south of Chittagong and in the north of Cox's Bazar, respectively, are the most promising construction sites for the coal-fired power plant. Chapter 4 of this report describes the selection of the site, resulting in Matarbari Island being selected as the project site.

15.3.1 Non-implementation of the project (zero option)

The potential environmental impact in the case of non-implementation of the project is described in Table 15.3-1.

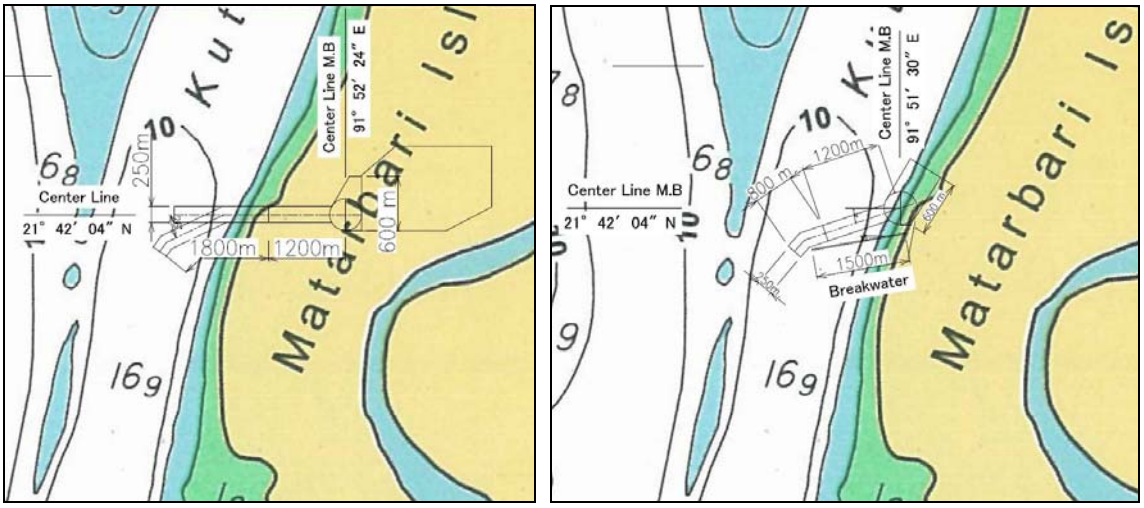
Table 15.3-1 Potential Environmental Impact in Case of Non-implementation

Items	Positive Effects	Negative Effects
Electricity power demand	- None	- To cope with power demand, a new thermal power plant will be built at another area using coal and not natural gas because of a shortage of gas
Pollution of environment	- No air pollution - No water pollution caused by cooling water - No waste - No noise problems - No continued dredging	- There are some apprehensions of air pollution because regulations on emission control of SO_X have not been enacted in Bangladesh
Natural environment	- No land clearing - No change of sea water current caused by a breakwater	- None
Social environment	- No resettlement - No acquisition of land	- No expected employment opportunities - No expected introduction of new business related to project
Other	- No greenhouse gas effect	- Increased amount of CO_2 gas will be emitted compared to this project as another project may not install equipment with state of the art technology efficiently reducing CO_2

(Source: JICA Study Team)

15.3.2 Facility design (existence or non-existence of breakwater)

There are two design proposals regarding the port facility as shown in Figure 15.3-1. One is an excavated type, which is a port constructed inland with a dredged canal, and the other is a conventional type which is a port constructed on the coast with a breakwater.



(Excavated type) (Conventional type)

(Source: JICA Study Team)

Figure 15.3-1 Alternatives of the Port Facility

(1) Consideration of the Port Design Technical Components from Technical and Economic Aspects

A comparison of the excavated type and the conventional type of port facilities was conducted from the technical and economic aspects (Table 15.3-2). The excavated type of port facilities needs dredging of a canal in addition to the construction of a breakwater, but the extent of dredging work will be less than the conventional type. The conventional type of port facilities, on the other hand, needs a larger extent of dredging work, but construction of a breakwater is not necessary.

Breakwater construction requires pavement materials for the foundation, which would be imported from India and other countries at certain transportation costs. Also, in the leveling work (landfill up to 8-12m above sea level) needed for the power plant to be protected against high tides and tidal waves, transportation of sand and soil is necessary for the conventional type (dredging soil from the canal will not be sufficient).

The excavation type does not involve the construction of a breakwater and therefore pavement material is not necessary. Also, a large amount of dredging sand from the canal may be used for leveling work.

Therefore, compared to the conventional type, construction costs will be lower for the excavation type.

Table 15.3-2 Technical Comparison of the Excavated Type and the Conventional Type

Items	Excavated Type		Conventional Type
Preparation of the site	Dredging work of the port facility and the canal will generate a huge amount of dredging soil, but sandy soil in the dredging material can be used for leveling work of the power plant as a flood countermeasure. The cost for buying leveling materials is decreased.	>	Pavement material for constructing a breakwater and a caisson type breakwater is needed, which is not available in Bangladesh. Large amount of dredging soil will be generated, but will not be sufficient for the leveling work of the power plant.
Maintenance dredging	Maintenance dredging is necessary for maintaining the port facility.	<	Maintenance dredging is not necessary.
Expansion of the port	Expansion of the canal is expected, involving dredging of a sand beach at the side of the canal. The dredging sediment can be used for leveling work of the expanded port facility.	>	Dredging soil will be generated, but will not be sufficient for leveling work of the expanded port facility. Soil for leveling work needs to be purchased.

(Source: JICA Study Team)

(2) Consideration of the Port Design from Environmental Aspects

Social-environmental impacts to both types of port design will be similar to each other. Natural environmental impact is assessed as follows.

1) Simulation of Ocean Waves and Tides

A simulation of ocean waves and tides was conducted, as in the case of the site selection, for the excavated type and the conventional type of port facilities, and a summary of the results is shown in Table 15.3-3.

Table 15.3-3 Summary of the Simulation of Ocean Waves and Tides

Items	Excavated Type	Conventional Type
Dredging	A little ✓ Periodical dredging is needed but fewer than the Conventional Type	None
Wave-height	A little (almost negligible) ✓ A small change of mud-sediment around dredging site	A little (but some areas serious) ✓ A small change of mud-sediment around breakwater
Tidal current	None	Notable ✓ Change of mud-sediment around breakwater and dredging site but limited to the site only

(Source: JICA Study Team)

2) Evaluation

The environmental impacts of the project on the habitat of flora and fauna were assessed from the results described above, with the same scoring methods used in the case of the site selection. Table 15.3-4 describes the scores of the total assessment results. Although the conventional breakwater type has a higher score, the difference was not considered to be critical.

Excavated type: -2
Conventional type: -3

Table 15.3-4 Environmental Impact of the Excavated Type/Conventional Type Breakwater on the Habitat and Flora and Fauna

Impact	Excavated Type		Conventional Type	
Impact on mudflats	(By waves, a little -1)	-1	(By waves, a little -1) (By current, significant -2)	-3
Impacts on migratory birds	None	0	None	0
Impacts on sea turtles	None	0	None	0
Impacts on dolphins	None	0	None	0
Impact on young fish	None	0	None	0
Impact on mangroves	None	0	None	0
Impact on sea grass	(By dredging, a little -1)	-1	None	0
Impact on Sonadia ECA (wave-height & tidal current)	None	0	None	0
Evaluation		**-2**		**-3**

(Source: JICA Study Team)

(3) Conclusion

Table 15.3-5 describes the total assessment results. The excavated type breakwater is considered to be more advantageous. The JICA Survey Team recommends the excavated type breakwater to the BPDB as a project item.

Table 15.3-5 Summary of a Comparison of the Two Breakwater Systems

Impact	Excavated Type		Conventional Type
Technical and economic aspects	Large amount of dredging soil will be generated, but sandy soil in the dredging material can be used for leveling work of the power plant. Costs for buying leveling material is decreased.	>	Pavement material is needed, which is not available in Bangladesh. A large amount of dredging soil will be generated, but will not be sufficient for leveling work of the power plant
Natural environment	The impact on the waves and tide is insignificant. Environmental impact due to maintenance dredging is predicted.	>	Impact of the breakwater on the waves and tide in the surrounding sea is predicted.

(Source: JICA Study Team)

15.3.3 Transmission line route

There were two candidates for transmission line routes, one along the National Highway No. 1 and the other along Regional Road No. 170. As a result of route selection described in Chapter 9, the route along local road No. 170 was selected as the transmission line route for this project.

15.3.4 Access road route

(1) Candidate Routes

The candidate routes of access road are in the area from the national highway running between Chittagong and Cox's Bazar to the Power Plant site. Basically, existing road facilities will be utilized wherever possible. It is envisioned that the route segments to join the national highway in the north and the route from Maheskhali Island to the Power Plant site will involve new road and bridge construction.

Candidate Route 1
From **Chakoria** via Regional Highway R172, Badarkhali Bridge and new road & bridge to the Power Plant Site
This route is the shortest route from the National highway to the Power Plant Site, and need new bridge construction.

Candidate Route2
From Chakoria via Regional Highway R172, Badarkhali Bridge, Upazilla road, Matarbari Road Bridge, Matarbari Bridge and Union road to the Power Plant Site.
This route is composed of existing roads only to be shorter from the national highway to the Power Plant Site.

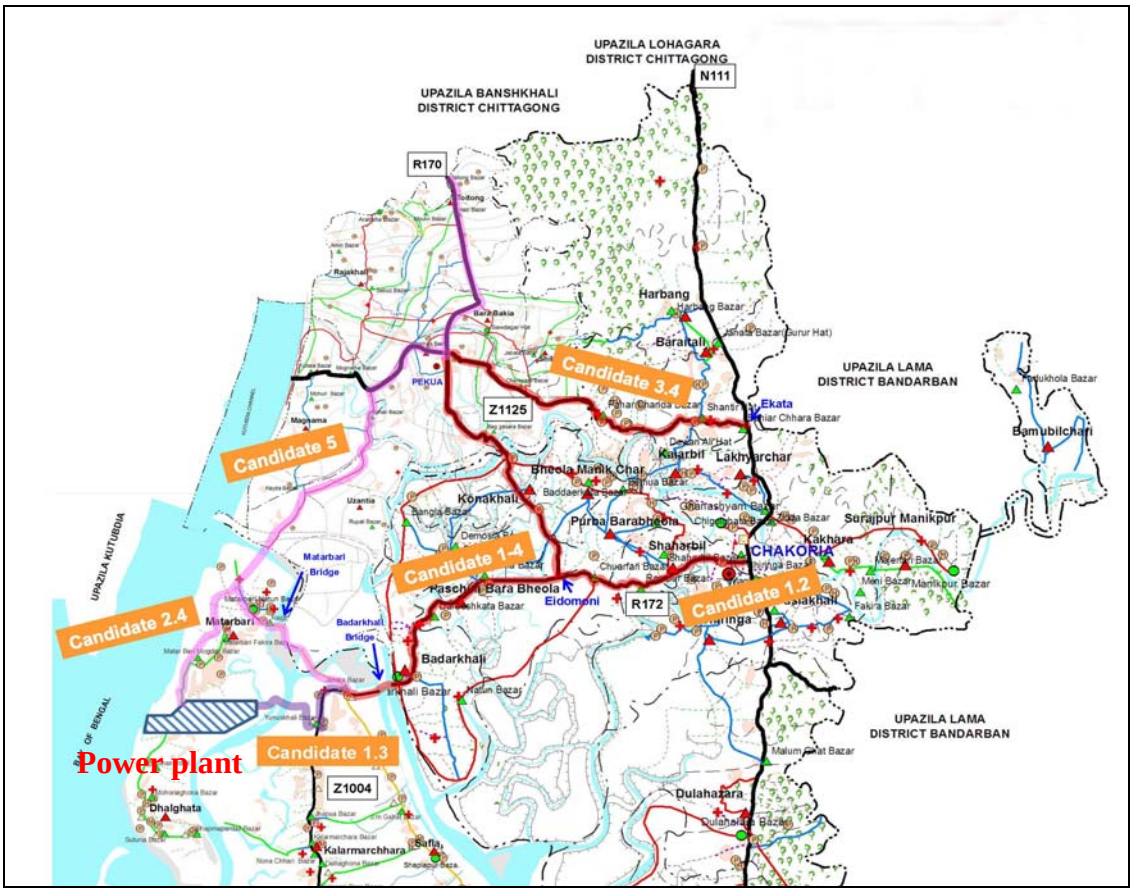
Candidate Route 3
From **Ekata Bazar** via Zilla road Z1125, Pekua Bazar, via R170, Eidmoni, R172, Badarkhali Bridge and new road & bridge to the Power Plant Site
This route is an alternative of Candidate 1 to avoid the congestion of Chakoria intersection and select good condition route.

Candidate Route 4
From **Ekata Bazar** via Zilla road Z1125, Pekua Bazar, R170, Eidmoni, R172, Badarkhali Bridge, Upazilla road, Matarbari Road Bridge, Matarbari Bridge and Union road to the Power Plant Site
This route is an alternative of Candidate 2 to avoid the congestion of Chakoria intersection and select good condition road.

Candidate Route 5

From (**Chittagong** via Regional Highway R170 or via National highway NH1, Ekata Bazar, Z1125) **Pekua Bazar** and, Upazilla road (Pekua), new bridge, Upazilla road (Maheshkhali), and Union road to the Power Plant Site.

This route is an alternative of the section between Pekua and Power Plant Site considering the transmission line route and connection with Regional road 170 instead of the national highway.



(Source: LGED, modified by JICA Study Team)

Figure 15.3-2 Candidate Routes of the Access Road

(2) Comparison of Canndidate Routes

1) Environemntal and Social Aspects

Table 15.3-6 shows a comparison of environmental and social aspects on each candidate route. Based on this comparison, Candidate 3 is the most suitable route which is less congested in traffic, less condenced in residence, the least land acquisition and no resettlement, if the impact on mangrove forest in Kohelia River is avoidable.

Table 15.3-6 Comparison of Environmental and Social Aspects on Each Candidate Route

Candidate Route	Candidate 1	Candidate 2	Candidate 3	Candidate 4	Candidate 5
1. Environmental Aspect					
1.1 Living Environment	In the section between Chakoria and Eidmoni the impact of construction works and traffic will be significant.		In the section between Ekata and Eidmoni the impact of construction works and traffic will not be so significant		In the section between Pekua and Matarbari impact of construction works and traffic will be significant.
	In the section between Janata Bazar and Yunushkhali the impact of construction works and traffic will not be so significant.	In the section between Janata Bazar and Matarbari the impact of construction works and traffic will be significant.	In the section between Janata Bazar and Yunushkhali the impact of construction works and traffic will not be so significant.	In the section between Janata Bazar and Matarbari the impact of construction works and traffic will be significant.	
1.2 Natural Environment	Along the all road section any important natural environment is not observed.	A Along the all road section any important natural environment is not observed.	Along the all road section any important natural environment is not observed.	Along the all road section any important natural environment is not observed.	Along the all road section any important natural environment is not observed.
	Mangrove forest is observed along the Kohelia River near the expected point of new bridge.	No sensitive biota is observed near Matarbari Bridge which will be rehabilitated.	Mangrove forest is observed along the Kohelia River near the expected point of new bridge.	No sensitive biota is observed near Matarbari Bridge which will be rehabilitated.	No sensitive biota is observed near the expected point of new bridge.
2. Social Aspect					
2.1 Land Acquisition (m^2)	134,782 Land acquisition will not be significant.	248,530 Land acquisition will not be significant, but more than Candidate 1.	118,532 Land acquisition will be least.	242,280 Land acquisition will not be significant, but more than Candidate 3.	272,500 Land acquisition will be most.
2.2 Resettlement (PAPs)	Approx. 500 In Chakoria area, resettlement will be required, but not significant comparing with Candidate 2, 4, 5.	Approx.4,100 In Chakoria and Matarbari area huge resettlement will be required,	None	Approx.3,500 In Matarbari area huge resettlement will be required,	Approx.4,200 In Pekua and Matarbari area huge resettlement will be required,
2.3 Benefit to Local People	New bridge construction will increase safety, communication capacity and broad economic effect.	Economic effect will be highest, but restrictive in Matarbari.	New bridge construction will increase safety, communication capacity and broad economic effect.	Economic effect will be highest, but restrictive in Matarbari.	New bridge will increase travel convenience, but restrictive in Matarbari.

(Source: JICA Study Team)

2) Construction Aspects

Table 15.3-7 shows a comparison of construction aspects on each candidate route.

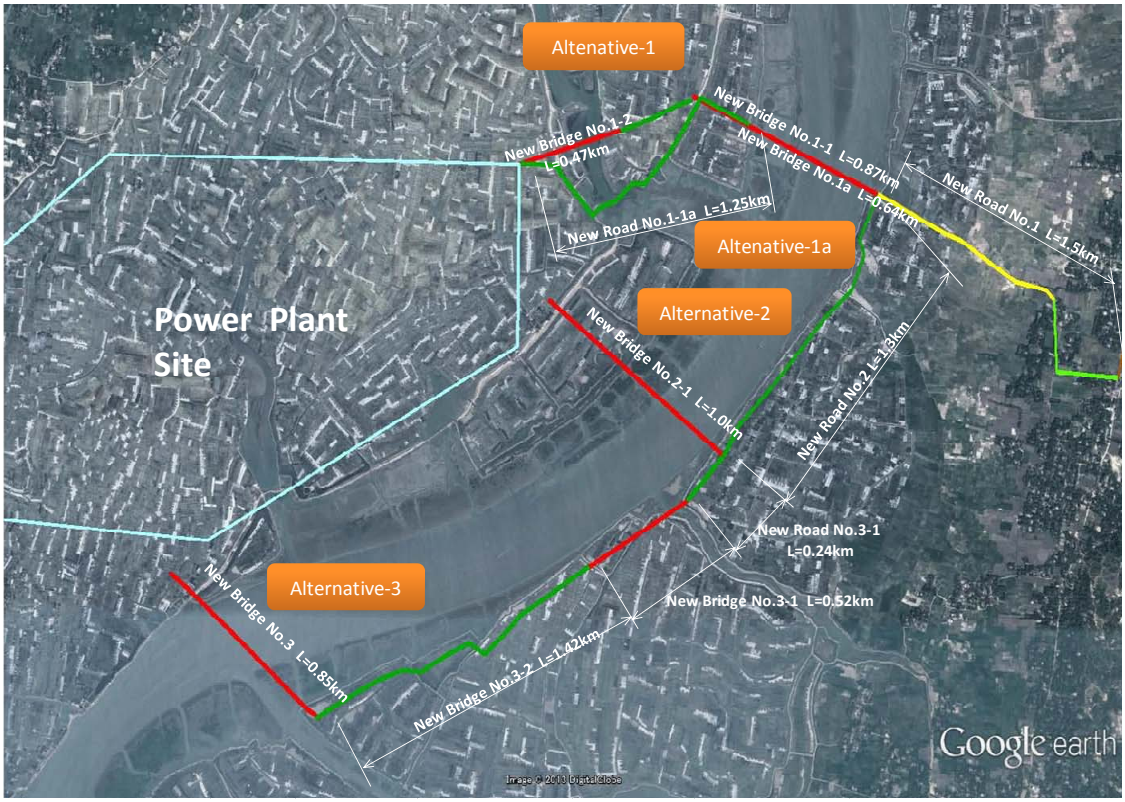
Table 15.3-7 Comparison of Construction Aspects on Each Candidate Road Route

Candidate Route	Candidate 1	Candidate 2	Candidate 3	Candidate 4	Candidate 5
1. Total length (km)	31.44km Maintenance will be least.	36.15km	36.94km	41.85km Maintenance will be most.	27.50km +11.80 km =39.30 km (from Ekata)
2. New or reconstructed road (km)	2.95 km The construction period will be shortest and the impact of construction will be the least.	9.3 km The construction period will be longer than Candidate 1	2.95 km The construction period will be shortest and the impact of construction will be the least.	9.3 km The construction period will be longer than Candidate 1	23.17 km The construction period will be the longest.
3. New or reconstructed bridge	0.64 km (minimum) -1.370 km (maximum)	0.44 km	0.64 km (minimum) -1.370 km (maximum)	0.44km	0.50 km

(Source: JICA Study Team)

Regarding the new bridge on Candidate 1 and 3, the length will influence not only the bridge cost, but also total cost. And the bridge location will influence the mangrove forest and tidallat. Therefore the following bridge locations shown in Figure 15.3-3 have been considered, and the comparison of altanatives are shown in
Table 15.3-8.

1) Alternative-1 is to avoid impacts on the mangrove forest, but it needs two bridges.
2) Alternative-1a is to avoid impacts on the mangrove forest, and to minimize bridge length, land acquisition and cost by utilizing BWDB embankment.
3) Alternative-2 is the shortest bridge with minimized new road, but it passes between mangrove forests.
4) Alternative 3 is another way to avoid impacts on mangrove forest, but it also needs two bridges and long road.



(Source: JICA Study Team)

Figure 15.3-3 New Bridge Alternatives over Kohelia River for Candidate 1 and 3

Table 15.3-8 Comparison of Construction Aspects on Each Candidate Bridge Route

Candidate Route	Alternative -1	Alternative-1a	Alternative-2	Alternative-3
1. Total bridge length (m)	1,340 m	640 m	1,000 m	1,370 m.
2. New road between the jetty and Power Plant (km)	2.56 km	1.25 km	1.4 km	3.06 km
3. Impact on the mangrove forest	Avoidable	Avoidable	Not avoidable	Avoidable
4. Social aspect		Land acquisition will be the least		Land acquisition will be the most.
5. Technical issue				Soft ground measures will be the most
6. Ascending order of cost	4	1	3	2
EVALUATION		Most suitable		

(Source: JICA Study Team)

Table 15.3-9 shows comparison of rough estimation of total construction cost. The total construction cost is lowest in Candidate 3, because of well-ballanced cost among road, bridge and other structure portion.

Table 15.3-9 Comparison of Total Construction Cost (Unit: ratio to the lowest)

Candidate Route	Candidate 1	Candidate 2	Candidate 3	Candidate 4	Candidate 5
1. Road	1.00	1.18	1.56	1.74	1.54
2. Bridge	1.67	1.40	1.27	1.00	1.19
3. Other Structure	1.00	1.57	1.06	1.57	2.25
Total	1.05	1.06	1.00	1.28	1.15

(Source: JICA Study Team)

3) Conclusion

According to the comparison of environmental, social and construction aspects and cost, Candidate 3 is the most suitabel for the access road. Table 15.3-10 shows the inventory of selected route.

Table 15.3-10 Inventory of Selected Route

Section	Managed by	Distance	Current condition
Existing Road		35.05 km	
Ekata – Pekua	RHD (Zilla road Z1125)	11.80km	Well maintained
Pekua - Eidmoni	RHD (Regional highway R170)	10.90km	Spot holes, cracks, etc.
Eidmoni – Badarkhali Bridge	RHD (Regional highway R172)	7.40km	Spot holes, cracks, etc.
Badarkhali Bridge – Janata Bazar	RHD (Zilla road Z1004)	1.35km	
Janata Bazar – Thallatoli Intersection		0.30km	Damaged all through the road
Thallatoli Inter. – Yunuskhali Intersection		1.60km	
Yunuskhali Intersection – Jetty	LGED (Village road 4013)	1.70km	Out of Requirement
New road		1.25 km	
Government land between two embankments in Matarbari	Government (DC Office)	0.24km	Salt field/ Shrimp farm
Embankment	BWDB	0.60 km	
Partial dyke	BWDB	0.24 km	
Private land	Private	0.17 km	Salt field/ Shrimp firm
New Bridge		0.64 km	
New Bridge (Fly-over Kohelia River)	Government (River)	0.64km	Jetty built by community (Maheshkhali side)
TOTAL		36.94 km	

(Source: JICA Study Team)

15.4 Scoping and TOR for the Survey on Natural and Social Environment

15.4.1 Power plant and port facility

(1) Power Plant

1) Scoping Results

Table 15.4-1 shows the scoping results prepared based on the field surveys and the results indicate the generally expected impacts by constructing a coal-fired thermal power plant.

Table 15.4-1 Results of Scoping for the Power Plant

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	A-	**Construction phase:** - Production of dust is expected by land preparation and other construction work, but the impact will be temporary. - Generation of air pollutants (SOx, NOx, etc.) is predicted from the operation of heavy machinery and trucks, but the impact will be limited to only the surrounding area. **Operation phase:** - SOx, NOx, PM, and dust will be generated by the operation of the power plant.
	2	Water Quality	A-	A-	**Construction phase:** - Water turbidity is anticipated by excavation work, but the impact will be temporary. - The impact of concrete wastewater and oil-containing wastewater is anticipated. **Operation phase:** - The impact of plant wastewater, oil-containing wastewater, domestic wastewater, thermal wastewater, etc., are expected by the plant operation.
	3	Wastes	B-	B-	**Construction phase:** - General waste and hazardous waste are generated by the construction work. **Operation phase:** - General waste and hazardous waste are generated
	4	Noise and Vibration	B-	A-	**Construction phase:** - Impact of noise and vibration is predicted caused by the operation of heavy machinery and trucks, but will be limited to the surrounding area. **Operation phase:** - Impact of noise and vibration is predicted caused by plant operation.
	5	Subsidence	C-	C-	**Construction and Operation phases:** - The impact is unknown

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
	6	Odor	B-	B-	**Construction and Operation phases:** - If domestic waste from the workers' camp is not appropriately treated, foul odors may emanate from the rotten waste.
	7	Soil Quality	B-	B-	**Construction phase:** - Possibility of soil pollution caused by leakage of lubricants and fuel oil from construction vehicles and machinery. **Operation phase:** - Possibility of soil pollution caused by leakage of lubricants and fuel oil used for the unit operation.
	8	Sediment	B-	B-	**Construction phase:** - Possibility of sediment pollution in case construction wastewater flows into the sea and the surrounding rivers. **Operation phase:** - Possibility of sediment pollution in case plant wastewater and domestic wastewater flows into the sea and the surrounding rivers.
Natural Environment	9	Protected Areas	C-	C-	**Construction and Operation phases:** - Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, located 15km south of the proposed project site.
	10	Ecosystem	A-	A-	**Construction phase:** - Project site is used for salt and shrimp farms and not primeval forests or tropical rain forests. - A sandy beach is located in front of the proposed project site, with no mangrove forests and tidal flats. The area is the presumed habitat of birds, dolphins, and sea turtles of IUCN (International Union for Conservation of Nature and Natural Resources) Red list (endangered species, etc.), and there is the possibility of impact caused by construction on the rare species and ecosystem. **Operation phase:** - Project site is used for salt and shrimp farms and not primeval forests or tropical rain forests. - A sandy beach is located in front of the proposed project site, with no mangrove forests and tidal flats. The area is the presumed habitat of birds, dolphins, and sea turtles on the IUCN red list (endangered species, etc.). - Intake of organisms by cooling water intake, adverse impact of plant wastewater, oil-contained wastewater, and thermal effluents on organisms in rivers, ocean and other operation activity may occur.
Social Environment	11	Land acquisition	A-	D	**Pre-construction phase:** - It is anticipated that approximately 20 households

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					currently living on the site without permission have to move out due to the land acquisition for the construction of the power plant. - Land owners will lose their land. Employers/ employees of salt farms, shrimp farms, and fishermen will lose their means of livelihood. - Those people who run business, employers or employees at salt farms, shrimp farms and fishermen in the site will lose their livelihood means. (Note) Site selection was reconsidered to the present site from the previous one (2 km south), where large settlements were found on private land, in order to avoid a large-scale resettlement.
	12	Disturbance to Poor People	A-/B+	A-/B+	**Pre-construction phase:** - There are poor households among those to be resettled and/or lose their livelihood means. **Construction phase:** - There are poor households among those to be resettled and/or lose their livelihood means. However, their living conditions will not deteriorate compared to their current ones, and they will have job opportunities at the construction site. **Operation phase:** - Resettled people may experience the deterioration of their household economies and loss of livelihood following relocation if appropriate measures are not taken. - Poor people, who currently have their living standards deteriorated without proper facilities, will have better access to social services throughout the year if roads are improved along with the construction of the power plant, especially access during the rainy season.
	13	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	- There are no ethnic and indigenous people found in or around the project site.
	14	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	A-	A-/B+	**Pre-construction phase:** - It is anticipated that employers/ employees of salt farms, shrimp farms, and fishermen will lose their means of livelihood. - Fishing activities around the site will also be affected due to a rise of water temperature and restriction of fishing. **Construction phase:** - Local people will be employed for construction work. The sandy beach will disappear due to the dredging activities for the port's construction and maintenance,

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					resulting in the loss of fishing ground for push nets. **Operation phase:** - There will be permanent losses or reduction of livelihood for those involved in salt farming, shrimp farming and fishing activities. - Employment opportunities will be provided at the power plant for local people.
	15	Land Use and Utilization of Local Resources	A-	A-	- The implementation of this project will change the traditional land use pattern and utilization of local resources, which may have a large impact on the existing local economy.
	16	Disturbance to Water Usage, Water Rights, etc.	A-	B-	**Construction phase:** - Local economy may be affected by the turbid water discharged from the construction site. - Outflows of street dust and oil while it rains, may also cause certain effects. **Operation phase:** - Local economy may be affected by the discharged water from the power plant into the sea.
	17	Disturbance to the Existing Social Infrastructure and Services	B-	B-/B+	**Construction phase:** - Material and equipment transportation will be mainly conducted by ship, so that increased marine traffic may disturb the existing marine traffic including fishing boats. - In addition, commuting of power plant workers will increase the traffic volume of the surrounding roads, possibly leading to traffic jams. **Operation phase:** - Traffic volume will increase. Road improvement will increase local access to social services and markets throughout the year, especially during the rainy season.
	18	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	B-	D	**Pre-construction phase:** - The Deputy Commissioner's Office of Cox's Bazar District is responsible for taking the initiative to conduct local consultations and detailed measurement surveys for land acquisition and resettlement, and these actions will effect social infrastructure and local decision-making institutions.
	19	Misdistribution of Benefits and Compensation	B-	B+	- There may be feelings of resentment, because people living around the project site will benefit through the improvement of social infrastructure and services. People to be resettled and those who lose their means of livelihoods will receive certain compensation.
	20	Local Conflicts of Interest	B-	B-/B+	**Pre-construction phase**: - People to be resettled and those who will lose their means of livelihoods will receive certain compensation.

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					- Local conflicts of interest may occur between residents, and between local administration bodies and local political leaders. **Construction phase:** - Conflicts between local residence and external workers may occur because of changes in local customs if the external workers cannot understand local customs. - People living around the project site will benefit through improvement of social infrastructure and services. - People to be resettled and those who will lose their means of livelihoods will receive certain compensation. - Local conflicts of interest may occur between employers and employees of salt farms, shrimp farms and the fishing industry, and between local administration bodies and local political leaders. **Operation phase:** - There may be feelings of resentment and reconciliation, because people living around the project site will benefit through the improvement of social infrastructure and services. - People to be resettled and those who lose their means of livelihoods will receive certain compensation. - Conflicts among local residents may occur if such benefits were misdistributed.
	21	Cultural Heritage	D	D	- There is no historical, cultural and archaeological property and heritage existing on or around the site.
	22	Landscape	D	D	- There is no picturesque scenery existing on or around the site.
	23	Gender	B-/B+	B+	**Pre-construction phase:** - There are women among those to be resettled and/or lose their livelihood means. - Wives of men who lose their land or jobs may suffer from adverse effects on their household economy. **Construction phase:** - There are women among those to be resettled and/or lose their livelihood means. **Operation phase:** - Residents will have better access to social services throughout the year if roads are improved along with the construction of the power plant, especially access during the rainy season.
	24	Children's Rights	B-	B-/B+	**Pre-construction phase:** - There are children among those to be resettled and/or lose their livelihood means. - Children from households losing their land or jobs

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					may suffer from adverse impact on their household economy, such as dropping-out of school. **Construction phase:** - Children's ability to go to school may further deteriorate if access way to their school is physically blocked by the construction site. - The number of children who drop out of school may increase because of the huge demand for unskilled workers at the construction site. **Operation phase:** - The number of children who drop out of school may increase if there are no age restrictions of unskilled workers at the power plant site. - Children will have better access to social services throughout the year if roads are improved along with the construction of the power plant, especially access during the rainy season.
	25	Infectious Diseases such as HIV/AIDS	B-	D	**Construction phase:** - A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc.
	26	Work Environment (Including Work Safety)	B-	B-	**Construction phase:** - High risk rate of accidents is predicted in construction work. **Operation phase:** - Work accidents of workers may occur.
Others	27	Accidents	B-	B-	**Construction phase:** - Marine traffic and land traffic accidents may occur if there is no proper safety education. **Operation phase:** - Marine traffic and land traffic accidents may occur. Fire caused by spontaneous ignition of stored coal may occur, and traffic accidents due to increased traffic may occur.
	28	Cross-boundary Impact and Climate Change	B-	B-	**Construction phase:** - CO_2 will be produced by construction work. **Operation phase:** - USC will be adopted, which will produce less CO_2 of approximately 480 thousand tons compared to a subcritical coal-fired power plant.

Notes; A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.

(Source: JICA Study Team)

2) TOR

The survey will be implemented according to the Environmental Conservation Act (1995) determining the EIA procedure and requirements, and the related Environmental Conservation Rules (1997). In addition, the JICA Guidelines (April 2010) will also be taken into consideration in order to satisfy the requirements for a yen-loan-financed project. The survey items, methods and assessment procedures concerning the power plant survey are shown in Table 15.4-2.

Table 15.4-2 Survey Items, Method, Prediction Assessment and Countermeasures (Power Plant)

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
Air Quality	- Relevant environmental standards - Meteorology - Current status of air quality	- Obtain ambient air quality standards and emission gas standards. - Obtain meteorological data (temperatures, moisture, wind directions, wind speeds, etc.) from the nearby weather centers. - Measurement of air pollutants (SO_2, NO_2, PM_{10}, etc.): conducted in the rainy and dry seasons to reflect seasonal change.	**Construction phase** - Taking preventive measures for air pollution. **Operation phase** - Satisfying exhaust gas standards by installing pollution prevention facilities - Predicting atmosphere diffusion by using simulation models and confirming that they meet air quality standards.
Water Quality	- Relevant environmental standards - Geographical features of the sea bottom - Current status of tidal current - Current status of water quality	- Obtain water quality standards and effluent standards. - Water depth measurement - Survey of tidal current (tidal direction, current speed): conducted in the rainy and dry seasons to reflect seasonal change. - Measurement of marine water quality (temperatures, salinity, COD, nutrients): conducted in the rainy and dry seasons to reflect seasonal change.	**Construction phase** - Taking preventive measures for water pollution **Operation phase** - Satisfying effluent standards by installing wastewater treatment facility for domestic and other types of water. - Predicting thermal effluent diffusion by using simulation models and confirming the range of the diffusion.
Wastes	- Relevant environmental standards	- Obtain waste handling standards/ manuals/ guidelines.	**Construction phase** - Establishing a disposal plan for industrial, domestic, and hazardous waste **Operation phase** - The same as those addressed in “Construction phase”
Noise and Vibration	- Relevant environmental standards - Current status of noise and vibration	- Obtain noise level standards - Measurement of noise and vibration levels: conducted in the rainy and dry seasons to reflect seasonal change.	**Construction phase** - Taking preventive measures for noise and vibration **Operation phase** - Taking preventive measures for noise and vibration - Predicting noise levels by using simulation models and confirming that they meet the

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
			noise standard.
Subsidence	- Current status of soil conditions	- Soil quality survey	**Construction phase** - The amount of groundwater used should be measured. **Operation phase** - The same as those addressed in "Construction phase"
Odor	- Relevant environmental standards	- Obtain environmental standards for smell sources (odor).	**Construction phase** - Taking preventive measures for handling domestic waste **Operation phase** - In case a de-nitration system using ammonia is introduced, ammonia handling plan should be developed.
Soil Quality	- Relevant environmental standards - Current status of groundwater	- Measurement of ground water quality (turbidity, BOD, heavy metals): conducted in the rainy and dry seasons to reflect seasonal change.	**Construction phase** - Oil contamination countermeasures shall be developed **Operation phase** - The same as those addressed in "Construction phase"
Sediment	- None	- None	**Construction phase** - The amount of groundwater used should be measured. **Operation phase** - The same as those addressed in "Construction phase"
Protected Areas	- Current habitat status of flora, mammals, birds, reptiles, amphibians, fish, tidal land organisms, precious species (migrant birds, sea turtles, dolphins)	- Survey the distribution of flora and fauna.	**Construction phase** - Evaluation of diffusion of air pollutants and water pollutants should be conducted to assess the environmental impact on the protected area **Operation phase** - The diffusion simulation of air pollutants and thermal effluents should be conducted to assess the environmental impact on the protected area
Ecosystem	- Current habitat status of ecologically valuable habitat (coral reefs, mangrove forests, and/or tidal flats). - Current habitat status of flora, mammals, birds, reptiles, amphibians, fish, tidal land organisms,	- Survey the distribution of flora and fauna.	**Construction phase** - Estimating the degree of the impact on ecologically important habitat (mangroves, coral reefs, mudflats), and taking preventive measures if significant impact on the habitat is expected. **Operation phase** - Estimating the degree of the impact on endangered

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
	precious species (migrant birds, sea turtles, dolphins)		species, and taking preventive measures if significant impact on species is expected.
Resettlement	- Residents affected by land acquisition and involuntary resettlement. - Property of the affected residents. - Lives and livelihoods of the affected residents.	- Collect relevant laws and regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	**Pre-Construction phase** - Establishing an appropriate "Land acquisition and resettlement action plan (LARAP)".
Disturbance to Poor People	- Poor households among the affected residents	- Collect relevant laws and regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	**Pre-Construction phase** - Developing "Livelihood restoration program" **Construction phase** - The same as those addressed in "Pre-Construction phase" **Operation phase** - The same as those addressed in "Pre-Construction phase"
Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Current status of occupation and livelihoods of the potentially affected households - Local economic development plan	- Collect material on local people's employment and income - Interview the affected households - Collect a local economic development plan	**Pre-Construction phase** - Establishing an appropriate LARAP. **Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"
Land Use and Utilization of Local Resources	- Current land use - Current status of occupation and livelihood of the potentially affected households	- Collect material on local peoples` employment and income - Interview the affected households - Collect a local economic development plan	**Pre-Construction phase** - Developing mitigation measures. **Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"
Disturbance to Water Usage, Water Rights, etc.	- None	- None	- Same as those addressed in "Water quality"
Disturbance to Existing Social Infrastructure and Services	- Current traffic volume	- Obtain statistical data on traffic volume	**Construction phase** - Developing mitigation measures **Operation phase** - Construction of roads available also to local people
Social Institutions such as Social Infrastructure and Local	- None	- None	- Same as those addressed in "Land acquisition"

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
Decision-making Institutions			
Misdistribution of Benefits and Compensation	- Occupation and livelihood of the potentially affected households	- Collect materials on local peoples` employment and income - Interview the affected households	- Same as those addressed in "Land acquisition"
Local Conflicts of Interest	- Occupation and livelihood of the potentially affected households	- Collect materials on local people's employment and income - Interview the affected households	- Same as those addressed in "Land acquisition"
Gender	- Gender of the affected people	- Collect the relevant laws, regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	**Pre-Construction phase** - Developing "Livelihood restoration program" **Construction phase** - The same as those addressed in "Pre-Construction phase" **Operation phase** - Construction of roads available also to local people
Children's Rights	- Number of children among the affected people - Education rate - Access to medical facilities - Vaccination rate	- Collect the relevant laws, regulations and case studies - Population census survey - Socioeconomic survey	**Pre-Construction phase** - Developing mitigation measures **Construction phase** - The same as those addressed in "Pre-Construction phase" **Operation phase** - Construction of roads available also to local people
Infectious Diseases such as HIV/AIDS	- None	- None	**Construction phase** - Developing mitigation measures
Work Environment (Including Work Safety)	- None	- None	**Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"
Accidents	- None	- None	**Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"
Cross-boundary Impact and Climate Change	- None	- None	**Construction phase** - Reduce CO_2 emission as much as possible **Operation phase** - The same as those addressed in "Construction phase"

(Source: JICA Study Team)

(2) Port Facility

1) Scoping Results

Table 15.4-3 shows the results of scoping for the port facility. The impact on the social environment, excluding marine traffic, is included in the scoping for the power plant (Table 15.4-1), since the port facility is constructed as an auxiliary facility of the power plant.

Table 15.4-3 Results of Scoping for the Port Facility

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	B-	**Construction phase:** - Production of dust is expected from land preparation and other construction work, but the impact will be temporary. **Operation phase:** - Air pollution is predicted caused by exhaust gas generated from the vessels using the port. Dust is also predicted, produced from loading-unloading of coal.
	2	Water Quality	A-	A-	**Construction phase:** - Turbid water is expected to be produced from the dredging activity. - Also, concrete wastewater and oil-containing wastewater are expected to have an effect, albeit only temporary. **Operation phase:** - Turbid water is expected to be produced from the maintenance dredging of the navigation channel. - Water pollution is also expected from the wastewater discharged from vessels using the port; however, the number of days that coal vessels enter and leave the port is about 50 days per year, which is relatively few.
	3	Waste	A-	A-	**Construction phase:** - In order to make the water way, beach sand will be dredged. Part of the dredged materials will be used for raising the base of the project site, while the remaining use has not been determined yet. - General waste and hazardous waste will be generated by the construction work, but the impact will be temporary. **Operation phase:** - Dredging will be periodically conducted because of maintenance of the water way. The disposal area of the dredged material is not determined yet, either onshore or offshore. - Waste will be generated from the vessels using the

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					port.
	4	Noise and Vibration	B-	B-	**Construction phase:** - Impact of noise and vibration from the construction work is predicted but will be temporary. **Operation phase:** - Impact of noise and vibration from the loading-unloading of coal is predicted.
	5	Subsidence	C-	C-	**Construction and Operation phases:** - The impact is unknown.
	6	Odor	D	D	**Construction and Operation phases:** - No usage of substances that may be a potential source of foul odors is anticipated.
	7	Sediment	D	D	**Construction and Operation phases:** - No hazardous waste will pollute the sediment, so no discharge or disposal will be necessary.
Natural Environment	8	Protected Areas	C-	C-	**Construction and Operation phases:** - Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, located 15km south of the proposed site.
	9	Ecosystem	A-	A-	**Construction phase:** - Tidal zones of the sandy beach will disappear due to the dredging activities for the port construction and maintenance. - A sandy beach is located in front of the proposed project site, although there are no mangrove forests or sand dunes. The area is the presumed habitat of birds, dolphins, and sea turtles of the IUCN Red list (endangered species, etc.), and construction is expected to effect the rare species and ecosystem. **Operation phase:** - A sandy beach is located in front of the proposed project site, although there are no mangrove forests or sand dunes. The area is the presumed habitat of birds, dolphins, and sea turtles of the IUCN Red list (endangered species, etc.), and there is an expected impact by the wastewater discharged from the vessels using the port on the rare species and ecosystem. - The coastline may be affected by stern waves caused by the sailing of large-sized coal vessels.
	10	Hydrology	B-	B-	**Construction and Operation phases:** - The construction of the port facility may alter the hydrology of the surrounding area.
	11	Topography and Geology	B-	B-	**Construction and Operation phases:** - The construction of the port facility may alter the geography and geology of the area around the

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					proposed site, and cause the natural seashore to disappear.
Social Environment	12	Disturbance to the Existing Social Infrastructure and Social Services	B-	B-	**Construction and Operation phases:** - Increased marine traffic may disturb the existing marine traffic (traffic of fishing boats).
	13	Work Environment (Including Work Safety)	B-	B-	**Construction phase:** - Accidents may be caused by construction work. **Operation phase:** - Accidents may be caused by the entry and departure of vessels and loading-unloading of coal.
Others	14	Accidents	B-	B-	**Construction phase:** - Accidents may be caused by construction work. **Operation phase:** - Accidents may be caused by increased marine traffic.
	15	Cross-boundary Impact and Climate Change	D	D	**Construction phase:** - CO_2 will be produced from construction work, but no impact on climate change is expected. **Operation phase:** - CO_2 will be produced by entry and departure of vessels, but no impact on climate change is expected.

Note: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.

(Source: JICA Study Team)

2) TOR

Table 15.4-4 shows the survey items, methods and assessment procedures concerning the port facility.

Table 15.4-4 Survey Items, Method, Prediction Assessment and Countermeasures (Port Facility)

Environmental Items	Survey Items	Survey Method	Prediction assessment and countermeasures
Air Quality	- Relevant environmental standards	- Collect the relevant laws, regulations and treaties	**Construction phase** - Taking preventive measures for air pollution **Operation phase** - Establishing preventive measures against air pollution

Environmental Items	Survey Items	Survey Method	Prediction assessment and countermeasures
			by vessels
Water Quality	- Relevant environmental standards	- Collect the relevant laws, regulations and treaties	**Construction phase** - Taking preventive measures for water pollution by dredging and landfill activity **Operation phase** - Establishing preventive measures against water pollution by vessels
Waste	- Relevant environmental standards - Current status of tidal current - Current status of water quality - Current status of sea bottom	- Collect the relevant laws, regulations and treaties - Survey of the tidal current (tidal direction, current speed): conducted in the rainy and dry seasons to reflect seasonal change. - Measurement of marine water quality (temperatures, salinity, COD, nutrients): conducted in the rainy and dry seasons to reflect seasonal change. - Measurement of sea bottom sediment (sediment temperatures, sulfide, heavy metals): conducted in the rainy and dry seasons to reflect seasonal change.	**Construction phase** - Development of handling plan for industrial waste and domestic waste. - Estimate volume of dredging material for the channel and development of disposal plan **Operation phase** - Development of disposal plan for waste from vessels - Estimate volume of dredging material for maintenance of the channel and development of disposal plan
Noise and Vibration	- Relevant environmental standards	- Obtain noise standards	**Construction phase** - Taking preventive measures for noise and vibration **Operation phase** - Taking preventive measures for noise and vibration - Predicting noise levels by using simulation models and confirming that they meet the noise standards.
Subsidence	- Usage of ground water by project activity	- Design of usage of ground water	**Construction phase** - Predicting ground water volume used by project activity **Operation phase** - The same as those addressed in “Construction phase”
Protected areas	- Current habitat status of flora, mammals, birds, reptiles, amphibians, fish, tidal land organisms, rare species (migrant birds, sea turtles, dolphins)	- Survey the distribution of flora and fauna. - Survey the operation of large vessels.	**Construction phase** - Predicting air pollutant and water pollutant diffusion, and noise. Assessing the environmental impact on the protected area. **Operation phase** - The same as those addressed in “Construction phase”
Ecosystem	- Current habitat status	- Survey the distribution of flora and	**Construction phase**

Environmental Items	Survey Items	Survey Method	Prediction assessment and countermeasures
	of ecologically valuable habitats (coral reefs, mangrove forests, or tidal flats). - Current habitat status of flora, mammals, birds, reptiles, amphibians, fish, tidal land organisms, precious species (migrant birds, sea turtles, dolphins)	fauna.	- Estimating the degree of the impact on endangered species living near the port facility, and taking preventive measures if significant impact on the species is expected **Operation phase** - The same as those addressed in "Construction phase"
Hydrology	- Sea bottom topography - Current status of tidal current	- Water depth measurement - Survey of tidal current (tidal direction, current speed): conducted in the rainy and dry seasons to reflect seasonal change.	**Construction phase** - Conducting tidal current simulation to understand change in tidal current **Operation phase** - The same as those addressed in "Construction phase"
Topography and Geology	- Terrestrial topography - Sea bottom topography - Tidal current	- Acquisition of information about terrestrial topography - Water depth measurement - Survey of tidal current (tidal direction, current speed): conducted in the rainy and dry seasons to reflect seasonal change.	**Construction phase** - Conducting tidal current simulation to understand drift sand behavior. **Operation phase** - The same as those addressed in "Construction phase"
Disturbance to the Existing Social Infrastructure and Social Services	- Operation of large vessels	- Survey the operation of large vessels.	**Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"
Work environment (including work safety)	- None	- None	**Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"
Accidents	- None	- None	**Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"

(Source: JICA Study Team)

15.4.2 Transmission line

(1) Scoping Results

Table 15.4-5shows the result of scoping for the transmission line.

Table 15.4-5 Results of Scoping for the Transmission Line

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	D	**Construction phase:** - Production of dust is expected from land preparation and other construction work, but the impact will be temporary. - Generation of air pollutants (SO_2, NO_2, etc.) from the operation of heavy machinery and trucks is predicted, but the impact will be limited to only within the surrounding area. **Operation phase:** - No specific air pollution is expected.
	2	Water Quality	B-	B-	**Construction and Operation phase:** - Soil runoff may occur from the exposed soil of the embankments and cut slopes, and water pollution of the downstream area of the surrounding river is predicted.
	3	Noise and Vibration	B-	D	**Construction phase:** - Impact of noise and vibration is predicted caused by the operation of heavy machinery and trucks, but will be limited to the surrounding area. **Operation phase:** - No specific noise and vibration is expected.
Natural Environment	4	Protected areas	A-	D	**Construction phase:** - There is a possibility that the transmission line will pass by conservation forests, and the impact of air pollution, noise and vibration due to construction work is expected. **Operation phase:** - No specific impact on the protected areas is predicted.
	5	Ecosystem	A-	B-	**Construction phase:** - There is a possibility that the transmission line will pass by conservation forests, and there is the possibility of impact caused by construction on the rare species and ecosystem. **Operation phase:** - Birds striking the lines and other impacts are expected.
	6	Topography and Geology	C-	C-	**Construction phase and Operation phase:** - Soil runoff may occur from the exposed soil of the

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					embankments and cut slopes. However, the impacts are unknown.
Social Environment	7	Land Acquisition and Compensation	B-/C	D	**Pre-construction phase:** - Construction of one tower base requires 2m x 4m = 8m^2 of land. The construction of 157 transmission towers including angle towers and suspension towers is planned and this requires 1,256m^2 of land acquisition in total. - Land acquisition is conducted with compensation for replacement cost. - During construction, people will be kept outside the construction zone. - Trees and buildings will be removed if they are within clearance distance from cables. - However, the extent of the impact is unknown.
	8	Disturbance to Poor People	B-/C	A-/C	**Pre-construction phase:** - The affected people may include poor people. However, the extent of the impact is unknown. **Operation phase:** - Poverty resulting from resettlement and loss of livelihood may occur if appropriate measures are not taken.
	9	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	- There is no possibility that any ethnic minority groups or indigenous people live within the surrounding hill area of the present route. (Note: Route selection was considered from two alternatives: one along the CHT and the other the present route. Due to the longer distance, possible adverse impact on forest areas and indigenous population of neighboring Myanmar along the CHT route, the present route was selected to avoid any problems.)
	10	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	B-/B+	B-	**Pre-construction phase:** - Farm lands located at the base of the towers will be lost, although the total area is small, resulting in a loss of means of livelihood. - Tall trees will be cut down. **Construction phase:** - Land owners and users of tower locations will be tentatively affected during the construction period resulting in a temporary loss of means of livelihood. - Tall trees will be cut down. However, local people will be employed for construction work. **Operation phase:** - Farm lands located at the base of the tower will be lost, although the total area is small, resulting in a loss of means of livelihood.
	11	Land Use and	B-	D	**Pre-construction phase:**

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
		Utilization of Local Resources			- Land located at the base of the tower will be unusable, although the total area will be small. - The land located under the transmission lines will decline in value.
	12	Disturbance to Water Usage, Water Rights, etc.	B-	C-	**Construction and Operation phases:** - Soil runoff may occur from the exposed soil of the embankments and cut slopes, resulting in water pollution of the downstream area of the surrounding rivers and alteration of water use.
	13	Disturbance to Existing Social Infrastructure and Services	D	D	**Construction phase:** - Since volume of increased traffic will be small, a significant impact is not anticipated. **Operation phase:** - No specific adverse effect is predicted on the existing social infrastructure.
	14	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	B-	D	**Pre-construction phase:** - The Deputy Commissioner's Office of the district will take the initiative to conduct local consultations and detailed measurement surveys for land acquisition, which will have certain impact on the social infrastructure and local decision-making institutions. **Operation phase:** - No specific impact is predicted concerning the social infrastructure and local decision-making institutions.
	15	Misdistribution of Benefits and Compensation	D	D	- No specific impact is predicted concerning the misdistribution of benefits and compensation.
	16	Local Conflicts of Interest	D	D	- No specific impact is predicted concerning local conflicts of interest.
	17	Cultural Heritage	C-	D	**Construction phase:** - The existence of any historical, cultural and/or archaeological property and heritage around the transmission line construction site is unknown. **Operation phase:** - No specific impact is predicted concerning cultural heritage.
	18	Landscape	B-	B-	- Negative impact of the construction of the transmission line on landscape is predicted.
	19	Gender	D	D	- There is no specific negative impact expected.
	20	Children's Rights	D	D	**Construction phase:** - In the construction of transmission lines, the use of heavy equipment is the main, there is almost no simple work that requires child workers. Therefore, child wokers are not expected. **Operation phase:** - There is no specific negative impact expected.
	21	Infectious Diseases	B-	D	**Construction phase:**

Item	No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
		such as HIV/AIDS			- A temporary influx of migrant labor during the construction period may increase the risk of transmitted diseases. **Operation phase:** - There is no specific negative impact expected.
	22	Work Conditions (Including Work Safety)	B-	B-	**Construction phase:** - High risk rate of accidents is predicted in construction work. **Operation phase:** - There is a risk of accidents such as electrification and workers falling during maintenance work.
	23	Electro-magnetic Fields	D	B-	**Operation phase:** - Negative impact of electro-magnetic fields on human health is expected.
Other	24	Accidents	B-	B-	**Construction and Operation phases:** - Accidents may occur including soil runoffs caused by floods, tower breakages caused by cyclones, etc.
	25	Cross-boundary Impact and Climate Change	D	D	- Cross boundary and CO_2 emissions are not anticipated in relation to the transmission line.

Notes; A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.

(Source: JICA Study Team)

(2) TOR

Table15.4-6 shows the survey items, methods and assessment procedures concerning the transmission line

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Table15.4-6 Survey Items, Method, Prediction Assessment and Countermeasures (Transmission Line)

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
Air Quality	- None	- None	**Construction phase** - Taking preventive measures for air pollution
Water Quality	- None	- None	**Construction phase** - Taking preventive measures for water pollution **Operation phase** - Taking preventive measures for soil runoff
Noise and	- None	- None	**Construction phase**

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
Vibration			- Taking preventive measures for noise and vibration
Protected Areas	- Relevant laws and regulations.	- Confirmation of the extent of the protected area	**Construction phase** - In case a protected area exists near the transmission line route, the modification of the route should be considered. - Appropriate construction activity time and method should be selected in consideration of the behavior of rare species.
Ecosystem	- Current status of ecologically valuable habitat. - Current habitat status of organisms.	- Survey the distribution of flora and fauna - Acquisition of data on rare species	**Construction phase** - Estimating the degree of the impact on endangered species if their habitat is around the transmission line route and taking preventive measures if significant impact on the species is expected. - Taking protective measures if the habitat of large birds is distributed around the route. **Operation phase** - Conducting monitoring of bird strikes and taking preventive measures if bird strikes occurred.
Topography and Geology	- Geological condition	- Obtain geological information	**Construction phase** - Geological survey should be conducted prior to construction to select the location of the towers **Operation phase** - Conducting mitigation measures
Land Acquisition & Compensation	- Residents affected by land acquisition - Property of the affected residents - Lives and livelihoods of the affected residents	- Collect the relevant laws, regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	**Pre-Construction phase** - Compensate based on replacement cost when land acquisition is needed.
Disturbance to Poor People	- Poor households among the affected people	- Collect the relevant laws, regulations and case studies - Population census survey - Survey of assets inventory. - Socioeconomic survey	**Construction phase** - Establishing a life support plan if there are any poor people among the affected inhabitants. **Operation phase** - The same as those addressed in “Construction phase”
Deterioration of	- Current status of	- Collect materials on local peoples`	**Construction phase**

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
Local Economy such as Losses of Employment and Livelihood Means	occupation and livelihoods of the potentially affected households - Local economic development plan	employment and income - Interview the affected households - Obtain the local economic development plan	- Establishment of a livelihood restoration plan for the households whose livelihoods are seriously affected by the construction of the transmission line. **Operation phase** - The same as those addressed in "Construction phase"
Land Use and Utilization of Local Resources	- Current land use - Current status of occupation and livelihoods of the affected households	- Interview the affected households - Obtain the local economic development plan	**Construction phase** - Establishment of a livelihood restoration plan for the households whose livelihoods are seriously affected by the construction of the transmission line.
Disturbance to Water Usage, Water Rights, etc.	- None	- None	**Construction phase** - Taking preventive measures for water pollution **Operation phase** - Taking preventive measures for soil runoff
Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- None	- None	**Construction phase** - Compensate based on replacement cost when land acquisition is needed. - Establishing an appropriate compensation plan
Cultural Heritage	- Status of historical, cultural and archaeological property and heritage	- Obtain information about historical, cultural and archaeological property and heritage	**Construction phase** - If potential impact of the project on historical, cultural and archaeological property and heritage is predicted, protective measures should be taken.
Landscape	- Current status of scenic sites	- Obtain information about scenic sites	**Construction phase** - The route avoids scenic areas as much as possible. **Operation phase** - If potential impact of the project on scenic sites is predicted, mitigation measures should be taken.
Infectious Diseases such as HIV/AIDS	- None	- None	**Construction phase** - Developing mitigation measures
Work Environment (Including Work Safety)	- None	- None	**Construction phase** - Developing mitigation measures **Operation phase** - Ditto
Electric-magnetic	- None	- None	**Operation phase**

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
Fields			- The route avoids scenic areas as much as possible.
Accidents	- None	- None	**Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"

(Source: JICA Study Team)

15.4.3 Access road

(1) Scoping Results

Field reconnaissance and secondary data analysis were conducted for scoping identifying environmental parameters which are expected to be affected by the access road project.
Table 15.4-7 shows the result of scoping for the access road. No significant impact is expected.

Table 15.4-7 Results of Scoping for the Access Road

Item	Impact		Rating		Results
			Design/construction Phase	Operation Phase	
Pollution Control	1	Air Pollution	B-	B-	**Construction phase**: Production of dust is expected from land preparation and other construction work, but the impact will be temporary. Generation of air pollutants (So_x, NO_X,etc.) from the operation of heavy machinery and trucks is expected , but the impact will be limited to only within the surrounding area. **Operation phase**: Exhaust gas will be generated by vehicles.
	2	Water Pollution	B-	B-	**Construction phase**: Water turbidity is expected from construction work in/around the river , but the impact will be temporary. Effects from concrete wastewater and oil-containing wastewater are expected. **Operation phase**: Runoff of exposed soil surfaces into rivers is expected.
	3	Soil Pollution	B-	B-	**Construction phase**: Possibility of soil pollution caused by leakages of lubricants and fuel oil from construction vehicles and machinery. **Operation phase**: Salt/paddy field soil will be affected by traffic.
	4	Noise and Vibration	B-	B-	**Construction phase**: Impact of noise and

Item	Impact		Rating		Results
			Design/construction Phase	Operation Phase	
					vibration is expected caused by the operation of heavy machinery and trucks, but it will be temporary and limited to the surrounding area. **Operation phase**: Noise and vibration is expected from vehicles.
	5	Odor	B-	D	**Construction phase**: In case domestic waste from workers' rooms are not appropriately treated, there may be bad smells from rotten waste. **Operation phase**: No bad smells are predicted.
	6	Waste	B-	D	**Construction phase**: Waste, including hazardous waste, will be generated by the construction work. **Operation phase**: Generation of waste is not expected.
Natural Environment	7	Hill side forests	B-	B-	**Construction phase**: Some trees along the village road in the Hill side forest area will be cut. **Operation phase**: Compensation measure will be required.
	8	Ecosystem	B-	B-	**Construction phase:** Planted mangrove forest is distributed along the river shore in front of Power Plant site. The impact will be avoided/minimized by design of road and bridge alignment. And mud flat which birds come to feed is also distributed in the river shore. The impact on the mud flat will be limited. **Operation phase:** The decrease of cross section by bridge structure will be very small, so the impact on hydrological future will not be significant.
	9	Topography and Geology	B-	B-	**Construction phase:** Although filling and cutting works will affect topography and geology, the impacts will not be significant, because the most part of the road are used exiting road and embankment, and the entire topography of project site is very flat. **Operation Phase:** Although erosion of slope is expectd, the affects will be minimized by some protection works.
Social Environment	10	Resettlement	D	D	**Design phase:** There will be land acquisition along the village road, including gardens of several houses and salt/paddy fields, and a small portion of salt/paddy field areas, but no resettlement is expected.

Item	Impact		Rating		Results
			Design/construction Phase	Operation Phase	
	11	Disturbance to Poor People	B-	B-/B+	**Design phase:** Land acquisition will be limited to along the village road, and the impact on land owners and tenants will not be significant. **Operation phase:** Resettlement and loss of livelihood may generate poverty if appropriate mitigation measures are not taken. The construction of new roads and a bridge connected to existing roads will benefit the lives of local people, e.g., better access to social services and economic activities throughout the year (especially access during the rainy season), and increased job opportunities.
	12	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	There are no ethnic and indigenous people acknowledged along and around the route.
	13	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	B-/B+	B-/B+	**Design phase:** It is not expected that employers/ employees of salt farms, shrimp farms, fishermen, and farmers will lose their means of livelihood, but some ferry boat workers may lose their jobs. **Construction phase:** Local people will be employed for construction work. **Operation phase:** There is the possibility of reductions of means of livelihood in salt farming, shrimp farming and rice farming activities, may be resulting in poverty. The construction of roads and a bridge will benefit the lives of local people, e.g., better access to social services and economic activities throughout the year (especially access during the rainy season), and increased job opportunities.
	14	Land Use and Utilization of Local Resources	B-	B-/B+	**Design phase:** Land acquisition will be limited to along the village road. **Construction phase:** Land acquisition will be limited to along the village road, but the impact of construction work is expected to affect land use and utilization of local resources. **Operation phase:** There is the possibility of a change of traditional land use patterns and utilization of local resources, but this will be minimized by using existing roads. New roads and a bridge will benefit land use and utilization of local resources.
	15	Disturbance to Water Usage, Water Rights , etc.	B-	D	**Construction phase:** Construction work may affect the water usage of salt/paddy fields, but it will only be temporary. Street dust and oil

Item	Impact		Rating		Results
			Design/construction Phase	Operation Phase	
					leakages while it rains may cause pollution and impact agriculture. **Operation phase:** No impact on water usage and water rights are expected.
	16	Disturbance to the Existing Social Infrastructure and Services	B-	B-/B+	**Construction phase:** Construction work may disturb both road traffic and navigation, and vehicle volume will increase. **Operation phase:** Traffic volume will increase. Road improvements will increase local access to social services and markets throughout the year, especially during the rainy season.
	17	Social Institutions such as Social Infrastructure and Local Decision Making Institutions	B-	B-	**Design phase:** The Deputy Commissioner's Office of Cox's Bazar District will take the initiative to conduct local consultations and detailed measurement surveys for land acquisition, which will have an impact on social infrastructure and local decision-making institutions.
	18	Misdistribution of Benefits and Compensation	B-	B-	**Construction phase:** Feelings of unfairness may arise between people living around the road and far from the road because of inconvenience during construction. **Operation phase:** Feelings of unfairness may arise between people who own land near the road and those who do not own land near the road.
	19	Local Conflicts of Interest	B-	B-	People living around the road will benefit through the improvement of social infrastructure and services, but people living far from the road will not benefit much. Local conflicts of interest may occur between local administration bodies and local political leaders.
	20	Cultural Heritage	D	D	There are no historical, cultural and archaeological properties and heritage sites existing along and near the route.
	21	Landscape	D	D	There is no picturesque scenery existing along and near the route.
	22	Gender	D	B+	**Design and construction phases:** There is no specific negative impact anticipated. **Operation phase:** Residents will have improved access to social services and markets throughout the year from the construction of paved road, especially during the rainy season.
	23	Children's Rights	D	B+	**Design and construction phases:** In the construction of a road, the use of heavy equipment is the main, there is almost no

Item	Impact		Rating		Results
			Design/construction Phase	Operation Phase	
					simple work that requires child workers. Therefore, child wokers are not expected. **Operation phase:** Children will have better access to social services and markets and improved educational opportunities throughout the year from the construction of new roads, especially during the rainy season.
	24	Infectious Disease such as HIV/AIDS	B-	D	**Construction phase:** A temporary influx of migrant labor during the construction period may increase the risk of infectious diseases.
	25	Work Conditions (Including Work Safety)	B-	D	**Construction phase:** High risk rate of accidents predicted in the construction work. A temporary influx of migrant labor may increase the risk of infectious diseases. **Operation phase:** There is no specific negative impact anticipated.
Other	26	Accidents	B-	B-	**Construction phase:** Accidents during construction work may occur. **Operation phase:** Traffic accidents due to increased traffic may occur.
	27	Cross-boundary Impacts and Climate Change	D	D	**Construction phase:** CO_2 will be produced by construction work, but no impact on climate change is expected. **Operation phase:** CO_2 will be produced by maintenance work, but no impact on climate change is expected.

Note:A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.

(Source: JICA Study Team)

(2) TOR

Table15.4-8 shows the survey items, methods and assessment procedures concerning the access road.

Table 15.4-8 Survey Items, Method, Prediction Assessment and Countermeasures(Access road)

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
Air Quality	Relevant environmental standards	- Obtain ambient air quality standards and emission gas standards.	**Construction phase** - Taking preventive measures

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
	Meteorology Current status of air quality	- Obtain meteorological data (temperatures, moisture, wind directions, wind speeds, etc.) from the nearby weather center. - Measurement of air pollutants (SOx, NOx, PM_{10}, CO, O_3): conducted in the dry season and rainy season to reflect seasonal change.	for air pollution by vehicles **Operation phase** - Taking preventive measures for air pollution by vehicles
Water Quality	Relevant environmental standards Geographical features of the river Current status of water quality	- Obtain water quality standards. - Water depth measurement - Measurement of river water quality **On-site observation:** - Clarity, Colour, Water temperature, Salinity (vertical), pH, Turbidity **Laboratory analysis:** - Suspended Solid, Dissolved Oxygen, COD, BOD_5, Ammonium Nitrogen (NH_4-N), Nitrate Nitrogen (NO_3-N), Total Nitrogen, Phosphate (PO_4-P), Total Phosphorus, Total Coliform, Oil and Grease content, Mercury, Arsenic, Lead, Chromium, Cadmium, Copper, Nickel, Zinc. conducted in the dry season and rainy season to reflect seasonal change	**Construction phase** - Taking preventive measures for water pollution **Operation phase** - Taking preventive measures for water pollution
Sediment Quality	Geographical features of the river Current status of water quality	- Water depth measurement - Measurement of river sediment quality - Appearances, Odor, Colour, Grading Analysis, Density, Water content, Ignition loss, COD, Mercury, Arsenic, Lead, Chromium, Cadmium, Copper, Nickel, Zinc conducted in the dry season and rainy season to reflect seasonal change	**Construction phase** - Taking preventive measures for water pollution
Waste	Relevant environmental standards	- Obtain waste handling standards/ manuals/ guidelines	**Construction phase** - Establishing a disposal plan for industrial, domestic, and hazardous waste **Operation phase** - The same as those addressed in “Construction phase”
Noise and Vibration	Relevant environmental standards Current status of noise and vibration	- Obtain noise level standards - Measurement of noise and vibration levels: conducted in the rainy season and dry season to reflect seasonal change.	**Construction phase** - Taking preventive measures for noise and vibration **Operation phase** - Taking preventive measures for noise and vibration
Soil Quality Groundwater	- Relevant environmental	- Obtain environmental standards for ground water	**Construction phase** - Machine and fuel

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
quality)	standards - Current status of groundwater	- Measurement of ground water quality On-site observation: Clarity, Colour, Water temperature, Salinity, pH, Turbidity - Laboratory analysis: Dissolved Oxygen, COD, BOD_5, Ammonium Nitrogen (NH_4-N), Nitrate Nitrogen (NO_3-N), Total Nitrogen, Phosphate (PO_4-P), Total Phosphorus, Total Coliform, Mercury, Arsenic, Lead, Chromium, Cadmium, Copper, Nickel, Zinc: conducted in the rainy season and dry season to reflect seasonal change.	management rule shall be developed **Operation phase** - The same as those addressed in "Construction phase"
Hill side forest	- Current status of flora and fauna	Research relevant laws and regulations, and management conditions Survey the distribution of flora and fauna	**Construction phase** - Compare with similar projects **Operation phase** - None
Ecosystem	- Current habitat status of ecologically valuable habitat (mangrove forests and mud flats). - Current habitat status of flora, fauna, tidal flat organisms, precious species	- Survey the distribution of flora and fauna	**Construction phase** - Estimating the degree of the impact on ecologically important habitat (mangroves, mud flats), and taking preventive measures if significant impact on the habitat is expected. **Operation phase** - The same as those addressed in "Construction phase"
Topography and Geology	- Geological condition	- Obtain geological information	**Construction phase** - Geological survey should be conducted prior to construction **Operation phase** - Conducting mitigation measures
Resettlement	- Residents affected by land acquisition and involuntary resettlement. - Property of the affected residents. - Lives and livelihoods of the affected residents.	- Collate relevant laws and regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	**Pre-Construction phase** - Establishing an appropriate LARAP
Disturbance to Poor People	- Poor households among the affected residents	- Collate relevant laws and regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	**Pre-Construction phase** - Developing "livelihood restoration program" **Construction phase** - The same as those addressed

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
			in "Pre-Construction phase" **Operation phase** - The same as those addressed in "Pre-Construction phase"
Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Current status of occupation and livelihoods of the potentially affected households - Local economic development plan	- Collate material on local peoples' employment and income - Interview the affected households - Collate a local economic development plan	**Pre-Construction phase** - Establishing an appropriate LARAP **Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"
Land Use and Utilization of Local Resources	- Current land use - Current status of occupation and livelihood of the potentially affected households	- Collate material on local peoples` employment and income - Interview the affected households - Collate a local economic development plan	**Pre-Construction phase** - Developing mitigation measures **Construction phase** - The same as those addressed in "Pre- Construction phase" **Operation phase** - The same as those addressed in "Pre-Construction phase"
Disturbance to Water Usage, Water Rights, etc.	- Current condition of water usage and water rights	- Interview survey	**Construction phase** - Developing mitigation measures **Operation phase** - None
Disturbance to Existing Social Infrastructure and Services	- Current traffic volume	- Obtain statistical data on traffic volume	**Construction phase** - Developing mitigation measures **Operation phase** - Construction of roads available to the local people
Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- None	- None	- Same as those addressed in "Land acquisition"
Misdistribution of Benefits and Damages	- Occupation and livelihood of the potentially affected households	- Collate materials on local peoples` employment and income - Interview the affected households	- Same as those addressed in "Land acquisition"
Local Conflicts of Interest	- Occupation and livelihood of the potentially affected households	- Collate materials on local people's employment and income - Interview the affected households	- Same as those addressed in "Land acquisition"
Gender	- Gender of the affected people	- Collate the relevant laws, regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	**Operation phase** - Construction of roads available to the local people

Environmental Items	Survey Items	Survey Method	Prediction Assessment and Countermeasures
Children's Rights	- Number of children among the affected people - Education rate - Access to medical facilities - Vaccination rate	- Collate the relevant laws, regulations and case studies - Population census survey - Socioeconomic survey	**Construction phase** - None **Operation phase** - Construction of roads available to the local people
Infectious Diseases such as HIV/AIDS	- None	- None	**Construction phase** - Developing mitigation measures
Work Environment (Including Work Safety)	- None	- None	**Construction phase** - Developing mitigation measures **Operation phase** - None
Accidents	- None	- None	**Construction phase** - Developing mitigation measures **Operation phase** - The same as those addressed in "Construction phase"
Cross-boundary Impact and Climate Change	- None	- None	**Construction phase** - Reduce CO_2 emission as much as possible **Operation phase** - The same as those addressed in "Construction phase"

(Source: JICA Study Team)

15.5 Results of the Survey on Natural and Social Environment

15.5.1 Power plant and port facility

(1) Pollution Control

1) Air Quality

a) Sampling Points

The residential areas within the site and at the north of the site were selected as sampling points for air quality and noise measurement (Figure 15.5-1). The survey was conducted in the rainy season (19 to 20 of October 2012) and in the dry season (29 to 30 of January 2013) to reflect the influence of precipitation in the fluctuation of air quality.

Sampling Point	Latitude (North)	Longitude (East)
AN-1	21°43’19”	91°53’03”
AN-2	21°43’56”	91°53’28”
AN-3	21°42’28”	91°52’43”

(Source: JICA Study Team)

Figure 15.5-1 Locations of Air Quality and Noise Survey

b) Results

The main industries of Matarbari Island are agriculture and fishery, and it is not an industrial area. The air quality survey results indicated overall that the air qualities in the

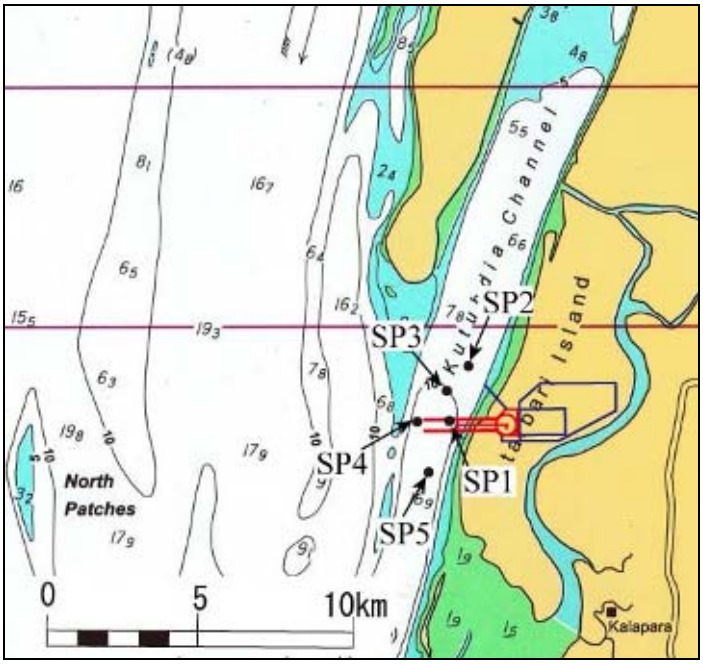
rainy season and the dry season are clean, with a slightly high concentration of dust (SPM) and a low concentration of SOx and NOx (Appendix C-15.5-1 Table-1).

2) Water Quality

a) Sea Water

a. Sampling Points

Five sampling points were selected in the sea front area of the power plant site in consideration of the discharge outlet of thermal wastewater and dredging the canal (Figure 15.5-2). The sampling was conducted in three layers, Surface (0.5m), Middle (1/2 depth), and Bottom (1m up from the bottom) in consideration of submerged discharge of thermal wastewater. Also, the survey was conducted in the rainy season (19 to 20 of October 2012) and in the dry season (29 of January 2013) to reflect the wide seasonal fluctuation of precipitation in Bangladesh.



Sampling Points	Latitude (North)	Longitude (East)
SP1	21°41'58.92”	91°51'04.99"
SP2	21°43'00.57”	91°51'32.44”
SP3	21°42'33.74”	91°51'08.55”
SP4	21°41'56.99”	91°50'29.11”
SP5	21°40'56.65”	91°50'43.90”

(Source: JICA Study Team)

Figure 15.5-2 Locatins of Sea Water Quality Survey

b. Results

<Rainy season>

The water temperature was in the range of 28.5 to 30.5^{o}C, with the tendency of higher temperatures near the surface layer and becoming lower towards the deeper layer. The salinity was in the range of 15.8 to 21.6, tending to be lower in the surface layer and becoming higher toward the deeper layer. It should be noted that, according to the database of the Japan Oceanographic Data Center[4], salinity in the surface layer in the sea areas of 21 - 22^{o}N and 91 - 92^{o}E are within the range of 23.95 to 31.93. The salinity in the sea front area of the project site is assumed to be influenced by the Padma River and other rivers. SS (suspended solids) concentration is very high (640 - 910mg/L) due to the strong effects of river water. COD is also very high (160 - 197mg/L), while BOD is not at a high level (0.6 - 1.1mg/L) (the water quality standard for surface water is 2mg/L or less). Concentration of heavy metals, with the exception of a rather high concentration of Iron (Fe), was not high (Appendix C-15.5-1 Table-2(1)).

<Dry season>

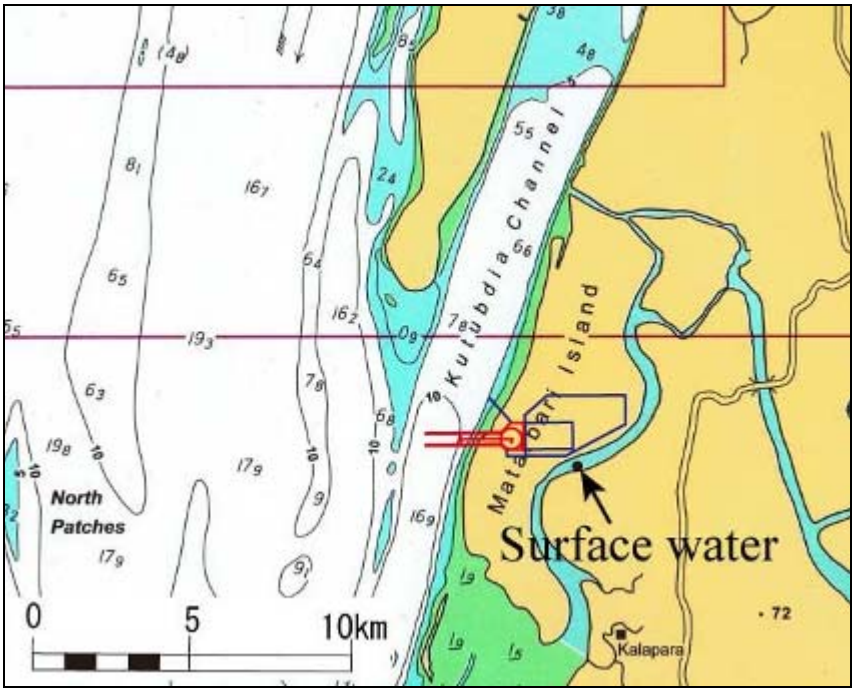
The water temperature was in the range of 18.0 to 19.0^{o}C, and temperature differences by water depths were not observed. The salinity was in the range of 34.3 to 37.3 with no big difference between water depths, the same as the water temperature. The salinity in the sea front area of the project site is assumed to be influenced by the Padma River and other rivers. Suspended solids (“SS”) concentration is very high (46 - 329 mg/L) due to the strong effects of river water, especially at the bottom layer. COD is also very high (203 - 235 mg/L), while BOD is not at a high level (0.2 - 0.6 mg/L). Concentration of heavy metals, with the exception of a rather high concentration of Iron (Fe), was not high (Appendix C-15.5-1 Table-2(2)).

b) Surface Water

a. Sampling Point

The river water quality of the river (Koheli River) near the power plant site was surveyed (Figure 15.5-3). The survey was conducted in the rainy season (7 of October 2012) and in the dry season (30 of January 2013) to reflect the seasonal changes of surface water, as is the case for sea water quality.

[4] http://www.jodc.go.jp/index_j.html



Sampling Point	Latitude (North)	Longitude (East)
Surface water	21°41'35"	91°53'17"

(Source: JICA Study Team)

Figure 15.5-3 Location of Surface Water Quality Survey

b. Results

The results of the surface water quality survey are shown in Appendix C-15.5-1 Table-3. The value of salinity suggests that the surveyed area has brackish water that is under the influence of sea water in the rainy season. SS (only in the rainy season) and COD showed high concentration levels similar to the sea water quality survey results.
Environmental standards for surface water quality are determined by 6 criteria in Bangladesh, and the survey results satisfied even the highest criteria except for DO.

c) Ground water

a. Sampling point

The water quality of well water around the power plant site was surveyed. The river water quality of the rivers near the power plant site was also surveyed. The survey was conducted in the rainy season (7 of October 2012) and in the dry season (30 of January 2013) to reflect the seasonal change of well water quality, as in the case of sea water quality.

Sampling Point	Latitude (North)	Longitude (East)
Ground water	21°42'42"	91°52'50"

(Source: JICA Study Team)

Figure 15.5-4 Location of Ground Water Quality Survey

b. Results

The results of the ground water quality survey are shown in Appendix C-15.5-1 Table-4. The results of both the rainy and dry seasons satisfied the drinking water standards of Bangladesh.

3) Noise

a) Sampling Points

The residential areas within the site and at the north of the site were selected as the sampling points for the noise survey (Figure 15.5-1), as is in the case of air quality. The survey was conducted in the rainy season (19 and 20 of October 2012) and in the dry season (29 to 30 of January 2013) to reflect the seasonal changes of noise levels.

b) Results

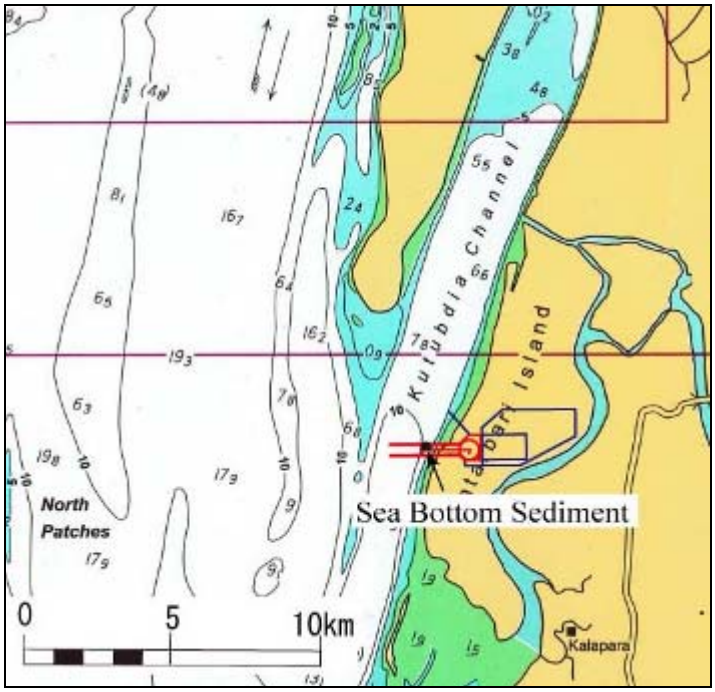
The noise measurement results indicated that the day time noise level was above the

environmental standards for residential areas at one sampling point (Appendix C-15.5-1 Table-4). Matarbari Island is, as cited above, not an industrial area and therefore vehicles used for local transportation were the noise source. These vehicles are not used during the night.

4) Sea Bottom Sediment (Heavy Metals)

a) Sampling Point

The sampling point for the sea bottom sediment survey was established on the coastal side of SP-1 for the water quality survey (Figure 15.5-5), in consideration of sediment contamination resulting from dredging of the canal.



Sampling Point	Latitude (North)	Longitude (East)
Sea bottom sediment	21°41'59.00”	91°51'20.52"

(Source: JICA Study Team)

Figure 15.5-5 Location of Sea Bottom Sediment Survey

b) Results

There are no standard values for heavy metals contained in sea bottom sediment in Bangladesh. Globally, ERL (Effects Range-Low) and ERM (Effects Range-Median) are proposed by the NOAA (National Oceanic and Atmospheric Administration, U.S.) as the

guidelines to help categorize the range of concentrations of heavy metals and organic chloride compounds in sediment which affect benthic organisms.

In a series of data of ascending levels of contaminants and their toxicity effects, the 10th percentile and the 50th percentile (median) of the effects database were identified for each substance. The 10th percentile values were named as the "Effects Range-Low" (ERL), indicative of concentrations below which adverse effects rarely occur. The 50th percentiles values were named as the "Effects Range-Median" (ERM) values, representative of concentrations above which various effects frequently occur.

The measurement results indicated that ERL was not exceeded in any of the parameters except for mercury (Hg), and even then it did not exceed ERM (Appendix C-15.5-1 Table-6).

(2) Natural Environment

1) Protected Area and Ecologically Valuable Habitats

a) Protected Area

Under the Environmental Conservation Act (ECA), ecologically sensitive and precious areas are designated as ECAs (Ecologically Critical Areas) by Department of Environment in Bangladesh in cases where an ecosystem or biodiversity area is considered to be threatened to reach a critical state. On the other hand, protected areas such as national parks and protected forests are designated by Department of Forest under the Wildlife Order and Forest Act as shown on Table 15.5-1.

Table 15.5-1 Protected Areas in Bangladesh

Classification		Competent Authority	Governing Law
A	National Parks	Department of Forest	Wildlife (Preservation) Order
B	Wildlife Sanctuaries		
C	Game Reserves		
D	Botanical Gardens, Eco-parks		
E	Reserved Forests, Protected Forests		Forest Act
F	Ecologically Critical Areas	Department of Environment	Environmental Conservation Act

(Source: Power System Master Plan 2010)

ECAs focus more on the importance and diversity of species and ecosystem and target any ecologically sensitive areas except for the protected areas designated by Department of Forest.

Along with the ECAs declaration, each ECAs has notifications declared by Department of Environment in which specific activities to be restricted in that ECA are specified.

ECAs are actually a new category of Protected Area in Bangladesh and not formally acknowledged in Bangladesh law, in reality all the ECA management enforcement could become ineffective[5]. According to Department of Environment, enforcement of laws and regulations regarding ECAs are not clearly scheduled at this moment.

The closest ECA to the project site is Sonadia ECA located 15km from the project site (Figure 15.5-6). The area of Sonadia ECA is 49.2km^2. The following is a list of restricted activities specified in the notification of Sonadia ECA[6]:

- Natural forest and tree felling and harvesting
- Wildlife or game killing
- Catching or collecting corals, bivalves, turtles and other wild life
- Destruction or alteration of habitats for flora and fauna
- Any activities that relate to the destruction of the natural characteristics of land and water
- Establishment of industries that might pollute the land, water, air and make sound pollution
- Any activity that might harm fish and other aquatic lives

[5] Sonadia Island ECA Conservation Management Plan -DRAFT-, 2006.
[6] Ibid

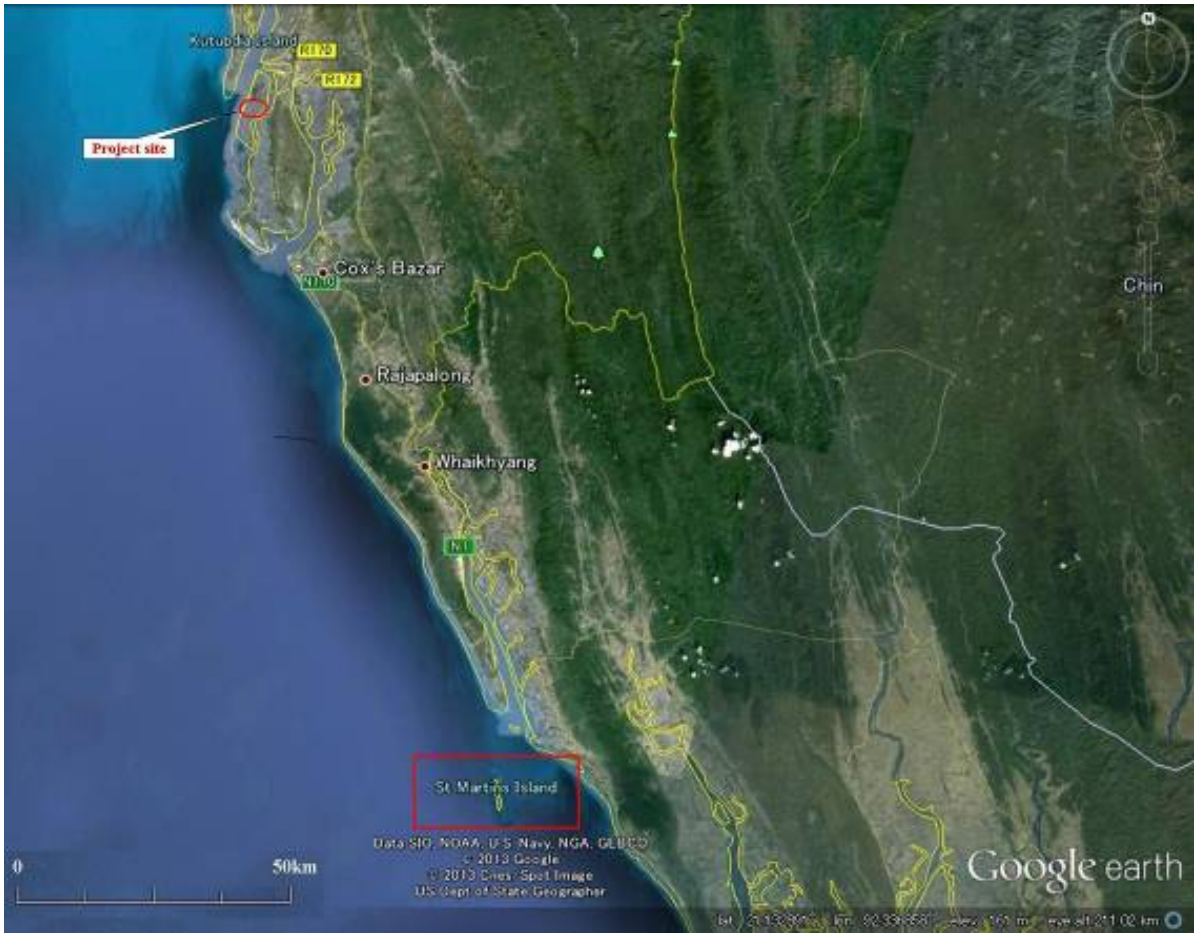
(Source: Sonadia Island ECA Conservation Management Plan -DRAFT-, 2006.)

Figure 15.5-6 Project Site and Sonadia ECA Boundary

b) Ecologically Valuable Habitats

a. Coral Reef

According to the Chief Scientific Officer[7] of the Bangladesh Fisheries Research Institute in Cox's Bazar, there is no coral reef habitat around the project site, and the closest coral reef to the project site is St. Martins Island located approximately 120km from the project site (Figure 15.5-7).



(Source: Google earth)

Figure 15.5-7 Project Site and St. Martins Island

b. Seaweed

According to the Chief Scientific Officer of the Bangladesh Fisheries Research Institute in Cox's Bazar, seaweed does not grow around the project site because the transparency of the sea water is low.

[7] Personal note from Mr. Muhammad Zaher (Bangladesh Fisheries Research Institute in Cox's Bazar)

c. Mangrove Forest

There are no mangrove forests around the proposed port facility site or along the coastline where the outlets for thermal effluents will be constructed. They are only scattered at the riverside of the Kohalia River, which flows between Matarbari and Maheshkhali Islands. There is a mangrove forest, which is large scale and artificially established, at the south side of Matarbari Island and its opposite bank is Maheshkhali Island.

d. Mud Flats

The coastline of Matarbari Island is a long sandy beach, and the sea side of the project site, where a port facility and outlets for thermal effluents will be constructed, is also part of the beach. The slope of the sandy beach is steep, and the area of its inter-tidal zone is relatively small.
On the other hand, a sand bar and shallow sea area lie in the estuary of the Kohalia River located south of Matarbari Island due to sedimentation.

2) Marine Organisms

a) Phyto-plankton

a. Sampling Points

The phyto-plankton survey was conducted at five sampling points similar to the water quality survey (Figure 15.5-2), at three water layers, Surface (0.5m), Middle (1/2 depth), and Bottom (1m up from the bottom), as in the case of the sea water quality survey.

b. Method

Water samples from different depths (pre-selected) were collected by using Nenson bottles and were immediately transferred to 15 commercially available plastic bottles as is the recommended method by Sourna (1978) to obtain an accurate depiction of the quantitative composition of phyto-plankton.
The collected samples were preserved with 3% neutralized formalin. Immediately after collection, the bottles were labeled and transferred to a laboratory for further analysis.

c. Results

<Rainy season>
Fifteen species of phyto-plankton were observed, and Diatom was the largest in number of

species (Appendix C-15.5-2 Table-1(1)). *Thalassiothrix* sp. was the species that emerged most frequently, followed by *Biddulphia* sp. The emergence of Pleurosigma sp., which is a freshwater species, indicates the strong influence of river water inflow in the sea front area of the power plant site, as described above in the results of the sea water quality survey.

<Dry season>
Eight species of phyto-plankton were observed, and Diatom was the largest in number of species (Appendix C-15.5-2 Table-1(2)). *Biddulphia* sp. and *Thalassiothrix* sp. were the species that emerged most frequently, followed by *Coscinodiscus* sp. and *Rhizosolenia* sp.

b) Zoo-plankton

a. Sampling Points

The zoo-plankton survey was conducted at five sampling points similar to the water quality survey (Figure 15.5-2), at two water layers, between 5m depth and the Surface (0.5m), and between the Bottom (1m up from the bottom) and 5m depth.

b. Method

Zoo-plankton samples were collected from the subsurface water using a Zooplankton net with mesh size 300μm and metallic circular frame with a 25cm mouth opening. A flow meter (FMC-0.3) was used at the mouth of the net to record the quantity of the water filtered through the net. Precaution was taken for clearing the net and bucket before every sampling to avoid any possible contamination. After collecting the samples, they were put into 200ml plastic jars and preserved with 5% formalin.

c. Results

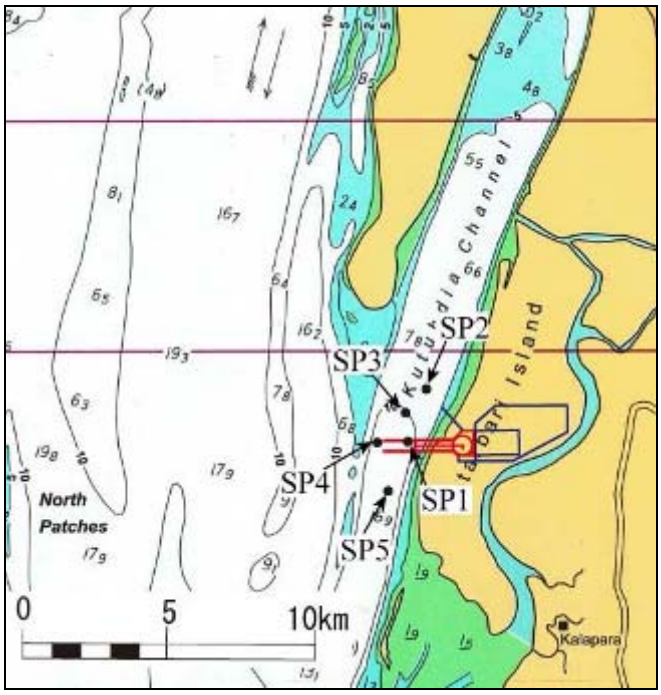
<Rainy season>
Eleven species of zoo-plankton were observed, and ARTHROPODA was the largest in number of species (Appendix C-15.5-2 Table-2(1)). Copepoda was the species that emerged most frequently, followed by *Sagitta* sp.

<Dry season>
Twelve species of zoo-plankton were observed, and ARTHROPODA was the largest in number of species (Appendix 15.1.5-2 Table-2(2)). Copepoda was the species that emerged most frequently, followed by *Sagitta* sp.

c) Benthos (Sea Bottom)

a. Sampling point

The macros-benthos survey was conducted at one sampling point similar to the sea bottom sediment survey (Figure 15.5-8) and at four other sampling points similar to the sea water quality survey (Figure 15.5-2).



Sampling Point	Latitude (North)	Longitude (East)
SP-1	21°41'59.00”	91°51'20.52"
SP-2	21°43'00.57”	91°51'32.44”
SP-3	21°42'33.74”	91°51'08.55”
SP-4	21°41'56.99”	91°50'29.11”
SP-5	21°40'56.65”	91°50'43.90”

(Source: JICA Study Team)

Figure 15.5-8 Locations of Macro-benthos on the Sea BottomSurvey

b. Method

For macro-benthos, samplings were collected at the selected points for bottom sediments. Samples for macro benthos for bottom sediments were collected randomly using a grab sampler of 20cm × 20cm with 10cm depth.

The collected sediments were then placed in plastic buckets and washed through a sieve of mesh size 0.5mm and 0.25 mm to retain all benthic fauna. The fauna from the sieves were

preserved in a pre-labeled plastic container containing 5% formaline.

c. Results

<Rainy season>

The population was scarce, with only 3 individuals/m^2 in SP-1, and 16 to 18 individuals/m^2 in SP-2 to SP-4. On the other hand, 306 invidiuals/m^2 of Bivalvia and 30 invidiuals/m^2 of Gastropod were observed in SP-5 (Appendix C-15.5-2 Table-3(1)).

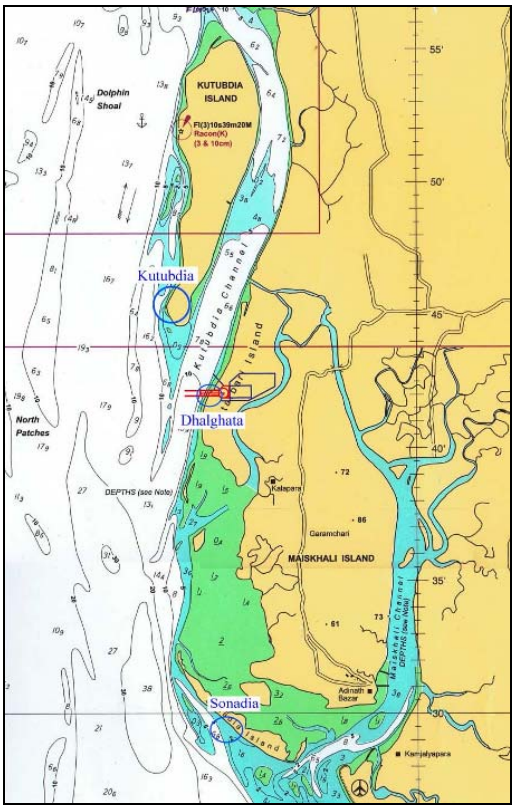
<Dry season>

A lot of Bivalvia was observed in SP-5 during the rainy season, but was not observed in the dry season (Appendix C-15.5-2 Table-3(2)).

d) Benthos (Mudflat)

a. Sampling point

The sampling of benthos of the intertidal mudflats was conducted at Sonadia Island, in the sea front area of the power plant site and the surrounding sea (Figure 15.5-9).



(Source: JICA Study Team)

Figure 15.5-9 Location of Macro-benthos of Intertidal Mudflats Survey

b Method

For macro-benthos, samplings were carried out at the selected study stations for intertidal mudflats. A permanent plot with an area of 50m × 50m was selected at the two sampling stations for the collection of macro benthos. During the visit, samples for macro benthos were collected randomly from the permanent plot using a quadrate with an area of 20cm × 20cm with 10cm. For macro benthos of intertidal mudflats, one square meter quadrate was used with 25cm depth. Macro benthos were collected manually from 10cm depth of sediment.

The collected sediments were then placed in plastic buckets and washed through a sieve of mesh size 0.5mm and 0.25 mm to retain all benthic fauna. The fauna from the sieve were preserved in a pre-labeled plastic container containing 5% formaline.

c. Results

<Rainy season>

The bottom sediment of each sampling points was sand and only a small population was observed. Twenty eight individuals per m^2 were observed in Dhalghata, which is 2/3 of Sonadia, in the sea front area of the power plant site. The dominant species were different in Sonadia and Dhalghata, and no dominant species was observed in Kutubdia (Appendix C-15.5-2 Table-4(1)).

<Dry season: January/2013>

In the dry season, 115 invidiuals/m^2 of Benthos was observed in Dhalghata in the sea front area of the power plant, which was more than the number of individuals observed in Kutubdia and Sonadia. Many species of Mollusk species such as Gastropod and Bivalve were observed in Dhalghata, but only a few or even none of Mollusk were observed in Kutubdia and Sonadia (Appendix C-15.5-2 Table-4(2)).

<Dry season: March/2013>

During the surveyed period, 452 invidiuals/m^2 of Benthos were observed in Sonadia, which was more than the number of individuals observed in Kutubdia and Dhalgata. Species of Gastropod and Bivalve were observed most often in Dhalgata, on the other hand, species of Polychete was observed at most in Sonadia. Larva of cuttlefish was also observed in Sonadia (Appendix C-15.5-2 Table-4(3)).

e) Fish and Nekton

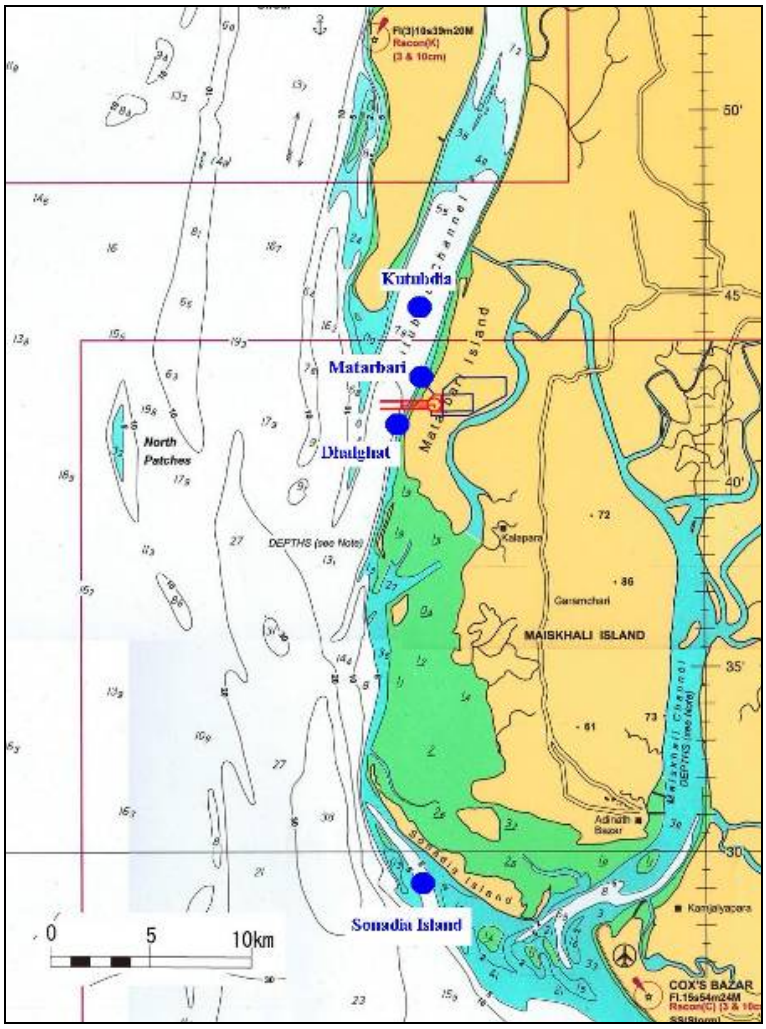
a. Sampling Points

The fish samples for assessment were collected from set bag nets of the Kutubdia channel, Sonadia Island and Dhalghata Union of Matarbari Island. One sample was collected from a local fish farm (Ghona) of Matarbari Island. A brief introduction of the sampling areas is as below (Figure 15.5-10):

Kutubdia Channel: The Kutubdia Channel is situated in the south eastern part of the Bay of Bengal. It lies between 21º45′ N to 21º55′ N latitude and 91º53′ E to 91º55′ E longitude. Kutubdia Channel is an important spawning and nursery ground for several species of fin fish and shrimps.

Project site: Matarbari Island is situated in the north western part of Maheshkhali Island. Many parts of this island are at stake because of unplanned shrimp farming and natural disasters. This island is rich in shrimp farming and solar salt pans. There are also many fish farms (local name: *ghona*) scattered on this island. The island lies between 21º41′ N to 21º44′ N latitude and 91º46′ E to 91º52′ E longitude. The survey in front of the project site was conducted at 2 sampling points (Matarbari and Dhalghata).

Sonadia Island: Sonadia Island is an island situated in the northern part of Maheshkhali Island. It lies between 21º23′ N to 21º28′ N latitude and 91º48′ E to 91º52′ E longitude. Sonadia Island is a biodiversity hotspot and a proposed area for a future deep sea port of Bangladesh.



(Source: JICA Study Team)

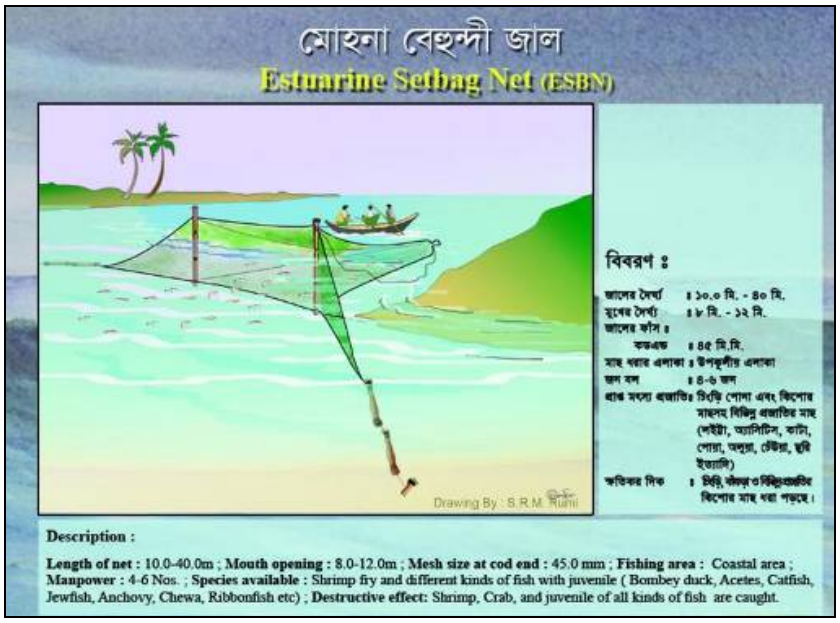
Figure 15.5-10 Locations of Fish and Nekton Survey

b. Method

The sampling gear of fish was an estuarine set bag net, locally known as "*Behundi Jal*" (Figure 15.5-11). The set bag net is a fixed tapering net, resembling a trawl net, set in the tidal stream by attaching it to hold-fasts. It has a rectangular mouth kept open by two vertical bamboo poles. The net is held in a fishing position against the current by linking the extended sides of the net (wing tips) to hold-fasts by means of long bamboo poles and steel wires. The hold-fasts are two wooden stakes embedded some distance apart in the sea bed, so that the net is parallel to the direction of the current. The set bag net catches species of fish which drift with the current or do not swim fast enough to stem the current and maintain a fixed position in relation to the sea bed. At each slack water period, the net comes to the surface (by means of the bamboo poles used for opening of the net, the

bamboos serving as sweep lines) when it is emptied; it is then reversed in the opposite direction ready for fishing.

The survey was conducted from high tide in one evening up to high tide in the morning of the following day. Set bad nets at every sampling point were set up at depths of 8 to 12 meters.



(Source: http://www.fisheries.gov.bd/album_details/507)

Figure 15.5-11 Estuarine Set Bag Net

c. Results

<Rainy season>

For fish and nekton, the highest number of species was observed at the sampling point in Sonadia, which had 22 species, followed by 21 species in Dhalghata and 20 species in Matarbari where the proposed power plant will be located, and 14 species in Kutubdia. The only common species observed in all of the 4 sampling points was "*Loligo* sp." under DECAPODIFORMES.

The dominate species in the 2 sampling points near the power plant site were different from the dominate species in Sonadia and Kutubdia; the dominate species near the power plant site were "*Metapenaeus monoceros*" and "*Exopalaemon styliferus*" under DECAPODA, "Stolephorus tri" under Engraulidae, "*Glossogobius giuris*" and "*Odontamblyopus rubicundus*" under Gobiidae and "Terapon jarbua" under Terapontidae; whereas, in Sonadia and Kutubdia, "*Squilla* sp." under STOMATOPODA, "*Acetes* sp." under DECAPODA, "*Charybdis natator*" under BRACHYURA and "*Harpadon nehereus*" under Synodontidae

were the dominate species (Appendix C-15.5-2 Table-5(1)).

<Dry season: January/2013>

The highest number of species was observed at the sampling point in Matarbari, which had 29 species, followed by 26 species in Dhalghata, 25 species in Kutubdia, and 17 species in Sonadia. The only common species observed in all of the 4 sampling points was "*Acetes* sp." under DECAPODA and "*Cynoglossus*" under Cynoglossidae.

The dominate species near the power plant site were "*Metapenaeus monoceros*" under DECAPODA, "*Harpadon nehereus*" under Synodontidae, "*Coilia dussumier*" under Engraulidae, "*Johnius argentatu*" under Sciaenidae, and "*Otolithoides pama*" under Sciaenidae; whereas, in Sonadia and Kutubdia, "*Metapenaeus brevicornis*" and "*Metapenaeus lysianassa*" under DECAPODA were the dominate species (Appendix C-15.5-2 Table-5(2)).

<Dry season: March/2013>

The highest number of species was observed at the sampling point in Matarbari, which had 24 species, followed by 23 species in Dhalghata, 21 species in Sonadia, and 16 species in Kutubdia. The common species observed in all of the 4 sampling points were "*Squilla* sp." under STOMATOPODA, "*Acetes* sp." under DECAPODA, "*Stelopherus tri"* under Engraulidae, and "*Lepturacanthus savala*" under Trichiuridae.

"*Acetes* sp." was the dominate species in all the 4 sampling points. Other than "*Acetes* sp.", the dominant species near the power plant site were "*Coilia desumeri*" under Engraulida and "*Harpadon nehereus*" under Synodontidae, whereas, in Sonadia, "*Squilla* sp." and "*Thryssa hamiltoni*" under Engraulidae were the dominate species (Appendix C-15.5-2 Table-5(3)).

3) Terrestrial Wildlife

The aim of the survey is to provide information on fauna and flora for the preparation of the EIA report in connection with the Coal-Fired Thermal Power Plant Construction Project and its transmission (power) line extension areas (PLA). The information should cover the issues of threatened species including critically endangered (CR), endangered (EN), and vulnerable species (VU) listed in the Red list. Every potential impact on and risk to those species has to be mentioned in the report. If the impacts are seriously negative, and the risks are quite high, appropriate countermeasures should be taken to minimize those impacts and risks.

The survey was conducted twice during different seasons of the rainy season (September to October, 2012) and the dry season (middle of January, 2-13)

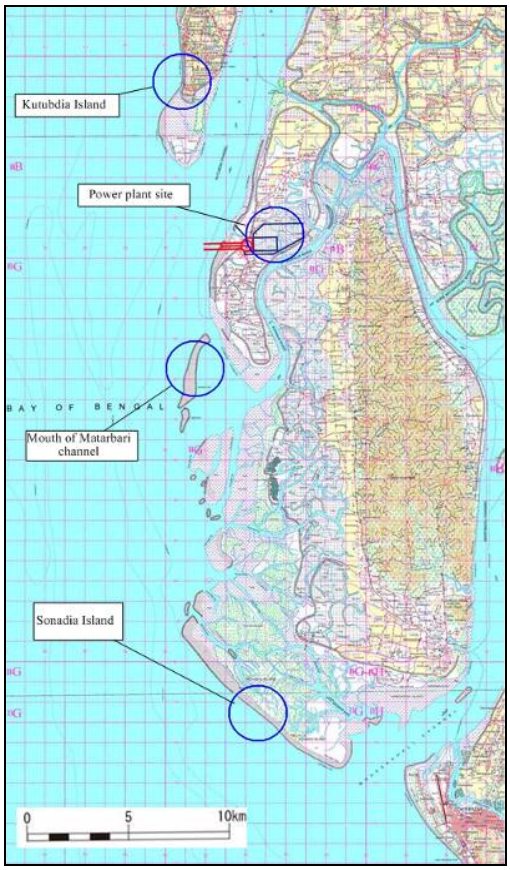
a) Location of Power Plant

The power plant site will be located at the middle part of Matarbari Island (Figure 15.1-1). The site is a low lying area with facilities of salt cultivation in the winter season and shrimp cultivation in the rainy season. There is the Bay of Bengal on the West of the site, Kohelia River on the East, Dhalghata Union on the South, and Sairiar Dail fisherman's village on the North of the site.

b) Locations of Survey

Four survey points were identified by the JICA Study Team to survey the flora and fauna of the area. The survey points are as follows (Figure 15.5-12):

1. Southern part of Kutubdia Island
2. Inside the power plant area
3. Mouth of Matarbari Channel (Kohelia River)
4. Sonadia Island



(Source: JICA Study Team)

Figure 15.5-12 Locations of Terrestrial Wildlife Survey

c) List of Flora and Fauna identified by the survey

A list of flora and fauna identified during the rainy and dry seasons at the 4 survey points is provided in Appendix C-15.5-3.

d) Results

a. Flora

Humans have impacted much of the land area of the Power Plant site, particularly by shifting shrimp farming and salt pans to the area over several generations. The project area now has species generally associated with secondary and pioneer communities, secondary scrubs, grasslands, poor vegetation cover, and little cash crop in its fringe areas.

In all, 77 species in the rainy season and 71 species in the dry season were recorded at the power plant site, the majority of which are angiosperms. No threatened species, as designated by IUCN status declaration of 2012, were recorded. Three species (*Calamus guruba* Buch-Ham, *Trihosanthes cordata* Roxb, and *Lepisanthes rubiginosa*) which are considered as threatened species under local status by scientist groups in Bangladesh were recorded, but these species have wide distributions and are common in the region (Biologist-group's views of Chittagong University).

b. Fauna

<Insects>

A total of 23 species of 22 families under 10 orders in the rainy season and 32 species of 27 families under 13 orders in the dry season were recorded in the proposed project area. All of these species have Not Threatened (NO) status as per the IUCN status declaration of 2012.

<Amphibians>

A total of 4 species of 2 families under 1 order in the rainy season and 5 species of 2 families under 1 order in the dry season were recorded in the proposed project area, all of which are Not Threatened (NO) status by IUCN.

<Reptiles>

A total of 13 species of 7 families under 2 orders in the rainy season and 10 species of 5 families under 2 orders in the dry season were recorded in the study area.

Among these reptiles, 1 Turtle species (*Eretmochelys imbricate*) was identified as being designated as Critically Endangered (CR) as per the IUCN Red list category.

Three Turtles species (*Geoclemys hamiltonii*, *Chelonia mydas*, and *Caretta caretta*) were identified as being designated as Endangered (EN) and another Turtle species

(*Lepidochelys olivacea*) was identified as being designated as Vulnerable (VU) as per the IUCN Red list category.

Five species (*Calotes versicolor*, *Mabuya mabuya*, *Gekko gecko*, *Panghura tentoria*, and *Naja naja*) which are considered as threatened species under local status by scientist groups in Bangladesh were recorded, but these species have wide distributions and are common in the region (Biologist-group's views of Chittagong University).

<Birds>

A total of 77 species of birds in the rainy season and 129 species of birds in the dry season were recorded in the proposed project area. Among these birds, 1 species (Eurynorhynchus pygmeus, Spoon-billed Sandpiper) was identified as being designated as Critically Endangered (CR) by the IUCN status declaration of 2012. Two species (Arachnothera magna and Ketupa zeylonensis) which are considered as threatened species under local status by scientist groups in Bangladesh were recorded, but these two species have wide distributions and are common in the region (Biologist-group's views of Chittagong University).

<Mammals>

A total of 11 species of 8 families under 4 orders in the rainy season and 8 species of 6 families under 5 orders in the dry season were recorded in the proposed project area. All of these species have Not Threatened (NO) status as per the IUCN status declaration of 2012.

c. Threatened Species in Project Areas

The threatened species in the project areas will be described in Chapter 15.5.2 (1) c) c., together with the threatened species along transmission line.

(3) Social Environment

A household survey targeting over 300 household heads as well as focus group discussions targeting women, children, salt workers and shrimp workers were conducted in December 2012 for comprehensive apprehension of the socio-economic profile of the project affected people. The project site is home to the local residents over generations. The maximum length of time found among them reached 300 years. The household size typically found at the site is 6 people, and over 70% of the interviewed household heads were illiterate or could only write their own names. 35% of the interviewed households received between 10,000 and 20,000 taka, and the average household monthly income was approximately 26,500 taka, 45.5% of the households spent between 10,000 and 20,000 taka per month,

and the average household monthly expenditure was approximately 18,000 taka. Based on the incidence of poverty by the cost of basic needs (CBN) method defined by the Bangladesh Bureau of Statistics, 9% of them were categorized as poor households on income basis, and 13% on expenditure basis.

Most of the land in the power plant site is used for salt cultivation during the dry season (November to April), and shrimp cultivation during the rainy season (May to October). Shrimp laborers often come from Matarbari Island: Saliari Dail, Mogdai Bazar, Sardar Para, Honsho Meage Para, and Nasir Mohammaddhil villages. Salt laborers are mainly collected at the labor market in Santair Bazar, and also come from Natur Bazar, Puran Bazar, Rajghat, Matarbari, Saliari Dail, Mogdai Bazar, Nutur Para, Sardar Para, Honsho Meage Para, Nasir Mohammaddhil, and Uttar Hohoraghora.

(Source: Taken by the JICA Study Team)

Figure 15.5-13 Power Plant and Port Facility Site

There are mainly four kinds of people involved in salt and shrimp cultivations: cultivator, laborer, mazi, and businessman. Among the households interviewed at the project site in December 2012, cultivators were comprised of over 30% among them, are the owners of salt field of shrimp field (by owning or leasing the land). They invest money for cultivation. Laborers are those people who sell their labor under the instruction given by the cultivators. They prepare and make the salt bed, for instance. They receive wages from cultivators. Due to the fact that their households have not been financially privileged, they do not have sufficient opportunities for education. Many of them have to drop out of school while they were children even before they completed primary education. They have fewer job opportunities because of their low education and literacy levels. They also shared around 30 % in the interview survey. Maziz, comprised of 10 % among the interviewed households, coordinate between cultivators and laborers. They find laborers and allocate them at salt/shrimp fields that belong to the owners or lessees who need laborers. Businessmen, around 10 % as well, are those who are involved in purchasing salt (or shrimp) from the field and local market, and sell them at markets in Chittagong, Dhaka or

Narayanganj.

One of the salt factories located within the site has 70 to 80 workers throughout the year, 20 to 30 of whom live together in a terrace house. Laborers come from other districts for shrimp cultivation during the rainy season. All salt taken at the site is sent to Chittagong as there is no salt market in Cox's Bazar.

(Source: Taken by the JICA Study Team)

Figure 15.5-14 Power Plant and Port Facility Site (East Edge)

Almost all the interviewed households used firewood for cooking, and majority of them used kerosene for lighting. All of them depended on tube wells for water. Local residents used alum (phitkari) for purifying water instead of boiling water. They have to travel to the nearest market to see quack doctors and other sources for medical and health treatment. They often suffer from general fever, respiratory infection (such as cold), diarrhea and stomachache.

Not many of them collect information from TV or radio as they do not have these items at home. They often listen to radio or watch TV at tea stands or in the local markets for collecting information, apart from which they hear news from neighbors and friends.

The survey details and results are found in the Land Acquisition and Resettlement Action Plan as attached in the ANNEX.

(4) Stakeholder Meeting

1) 1st Stakeholder Meeting

a) Objective

The 1st Stakeholder Meeting is aimed at hearing the opinions and/or comments of individuals and organizations regarding the project, and understanding the needs of local residents, as well as appropriately reflecting those needs into the relevant survey.

b) Implementation Methodology

In accordance with JICA Guidelines for Environmental and Social Consideration, the first stakeholder meetings for both the power plant and transmission line were held at the scoping stage of the Feasibility Study of the Coal-fired Power Plant Development Project (2 x 600MW) at Matarbari, Cox's Bazar. The project owners, the Coal Power Generation Company Bangladesh LTD. (CPGCBL) for the power plant, hosted the meetings assisted by the JICA Study Team.

c) Notification

A notification letter was distributed to all key stakeholders prior to the meeting.

d) Results

Date: November 12, 2012
Time: 10am to 2pm
Venue: Yunus Khali Government Primary School, Kalarmarchhara, Maheshkhali, Cox's Bazar District
Host and Chair: Managing Director of CPGCBL
Participants: Local government officers, Community leaders, Local NGOs, Local elite people, Local affected residents, etc., a total of 66 participants.

Agenda:
- Registration
- Recitation of Quran
- Welcome Speech by MD, CPGCBL
- Background of the project by EAL
- Presentation on Environmental and Social aspects of the project by EAL
- Question & Answer Session
- Closing Speech by CPGCBL
- Lunch

At the meeting, a power-point presentation was given to the local participants in their local language (Bengali) (Appendix C-15.5-8), with a full explanation of the project and environmental impacts in addition to the mitigation measures to be taken, to allow the audience to fully understand the project and contribute valuable comments. The main comments raised by the participants and the responses made by CPGCBL are as follows, as per the meeting minutes and list of participants attached in Appendix C-15.5-9.

Table 15.5-2 Main Comments, Responses, and Reflected in Environment Management Plan (Scoping Stage)

Comments	Responses	Reflected in Environment Management Plan
A business man and local politician, requested the project authority to provide employment to the local people in the project.	The project owner gave assurances that priority will be given to local people for employment in the project.	**Employment** - Employ local residents as much as possible.
School teacher, wanted to know the amount of vibration and noise to be caused by the power plant. Also, he was very annoyed that fly ash may cause respiratory problems to people in the surrounding areas of the project.	The project owner replied that as this is a high tech power plant, there would not be much noise outside the power plant. No fly ash will be produced as only ultra super critical technology will be used in the power plant. Flue gas will contain only 0.02% ash and moreover it will be discharged into the atmosphere through an approximately 275m high stack. Therefore it will not affect human beings around the power plant	**Noise** - Maintenance of equipment. - Installation of low noise/ low vibration type equipment's - Adequate basis of equipment to reduce vibration - Adequate enclosure of equipment to reduce noise **Air pollution** - To reduce PM emissions, Electrostatic Precipitator (EP; around 99.8% efficiency) will be installed. - Duct will be provided with CEMS (Continuous Emission Monitoring System) with the supported infrastructure as required under the gas emission standards and IFC guideline
Businessman, Matarbari, is a local resident in favor of the construction of the power plant in Matarbari. However, he raised the following points to take into consideration for the wellbeing of the people of Matarbari. a. Priority should be given to local people for employment in the project. b. Roads, schools, colleges, madrashas, health centers, bazars and fisheries ghats, etc., should be developed. All roads of Matarbari island and roads along the east and west side of the island should be made of pucca. c. The protective structures along the west coast of Matarbari island should be very strong and permanent to protect the island from cyclones, tidal waves and erosion. d. The compensation for land should be three times the registered rate. e. Proper compensation should be provided to the affected	The project owner assured them that all the above points would be taken into consideration. They also mentioned that there are some points subject to government policy, so these points will be raised to the government level for consideration.	**a. Employment** - Employ local residents as much as possible. - Developing an appropriate "land acquisition and resettlement action plan", including "livelihood restoration program" **b. Road** - Construction of the access road, community road, and road around the power plant boundary. These roads will be built with heights so that it can be used even in the rainy season. **c. Protective structure** - Coordination will be continuously made with local authorities to improve the local infrastructure. **d. & e. Compensation (LARAP)** - Compensation under the Law (CUL) for all the private land as stipulated by the Ordinance 1982: average of last 12 months' sales values of same kind of

Comments	Responses	Reflected in Environment Management Plan
fishermen and salt farmers, etc. These affected people should be rehabilitated with appropriate employment opportunities. f. Road to Chittagong from Matarbari should be improved. g. Electricity should be supplied to the Matarbari area at a reduced rate (tariff).		land x 1.5 (50% premium) - Cash grant that covers the difference between CUL and the replacement value (RV) - Provision of stamp duty, land registration fee, capital gains tax and value added tax incurred for replacement land **f. Road** --- **g. Electricity** - Electrification of surrounding area will be examined.

(Source: JICA Study Team)

2) 2nd Stakeholder Meeting

a) Objective

The 2nd stakeholder meeting is aimed at disclosing the survey and evaluation results of environmental and social consideration to the participants (stakeholders) and receiving the comments on the results from the participants, in order to reflect them into the final report.

b) Implementation Methodology

In accordance with JICA Guidelines for Environmental and Social Consideration, the second stakeholder meetings for both the power plant and transmission line were held at the finishing of the draft final report of the Feasibility Study. CPGCBL hosted the meetings assisted by the JICA Study Team.

c) Notification

Same as 1st Stakeholder meeting

c) Results

Date: April 16, 2013
Time: 11:30am to 15:30pm
Venue: Moheshkhali Upazila Parishad Auditorium, Cox's Bazar
Host and Chair: Managing Director of CPGCBL
Participants: Local government officers, Community leaders, Local NGOs, Local elite people, Local affected residents, etc., a total of 133 participants.

Agenda:

- Registration
- Recitation of Quran
- Welcome Speech by Managing Director of CPGCBL
- Presentation on Environmental and Social aspects of the project by EAL
- Question & Answer Session
- Speech by MD of CPGCBL, Chairman of Matarbari Union, Upazila Chairman of Moheshkhali Upazila, Chairman of Dholghata Union, and UNO of Moheshkhali
- Lunch

At the meeting, a power-point presentation was given to the local participants in their local language (Bengali) (Appendix C-15.5-8), with a full explanation of the project and environmental impacts in addition to the mitigation measures to be taken, to allow the audience to fully understand the project and contribute valuable comments. The main comments raised by the participants and the responses made by CPGCBL are as follows, as per the meeting minutes and list of participants attached in Appendix C-15.5-9.

Table 15.5-3 Main Comments, Responses, and Reflected in Environment Management Plan (Draft Final)

Comments	Responses	Reflected in Environment Management Plan
Majidia Alim Madrasa, Matarbari stated that the first stake holder meeting was held back in November at Matarbari. In that meeting attendees decided to hold the second stake holder meeting at Shariar Dail. But the second stakeholder meeting was being held at Moheshkhali Upazila Complex because Shariar Dail is not a safe place. He therefore became very upset and felt insulted. He also said that nothing has been specifically mentioned about female workers in regard to the employment of local people. So, he requested to hold another stakeholder meeting at Matarbari site in the future to enable more local people to participate in the meeting. He mentioned that he would be in favor of establishing the power plant at Matarbari if the local people are in favour of the power plant at Matarbatri.	There are not enough people out at night, making Matarbari an unsafe place at night. However, CPGCBL thinks that next the stakeholder meeting would be held at Matarbari. In regard to the employment of female workers, he mentioned that there will be no discrimination with female workers. Workers of all genders will have equal opportunity	(N/A)

Comments	Responses	Reflected in Environment Management Plan
One of the participants asked whether JICA has decided to finance this project or not. He asked how the compensation will be provided to the affected people. He also requested to hold another stakeholder meeting at Matarbari site	JICA will take the decision for funding this project based on the discussions of these meetings and also from the results of social and environmental studies. JICA has not yet taken any decision. But, it is understood that JICA is interested in financing this project. Normal compensation will be provided to the affected people as per government law. However, additional compensation may be provided to the affected people as per JICA's guidelines if the project is financed by JICA. He also promised to hold another stakeholder meeting at Matarbari if possible.	(N/A)
Upazilla Women Vice Chairman also reiterated that no power plant shall be constructed unless the local people are fully confident in terms of their compensation, equal rights for both genders and assurance of no negative impacts on environment. So, she requested to hold a meeting at a much larger scale at Matarbari and Dholghata and gather the opinions of the people living in these areas.	It is not possible to listen to each and every person's opinion. The outcome of any stakeholder meeting is disseminated to concerned people to develop awareness among them. He also affirmed that people of both genders will enjoy equal opportunity in terms of employment and compensation etc.	(N/A)
Upazilla Freedom Fighter Commander, Moheshkhali, Cox's Bazar was very overwhelmed with the decision of the Bangladesh Government to build this power plant at Matarbari by the end of 2012. He welcomed this project on behalf of local people and also welcome the organizations associated with this project. He would also like to add that the main vision after the independence was urbanization of villages. For this foreign aid is required for rapid urbanization. However, he mentioned that local workers, both men and women will take part equally for this project. He also demanded that electricity must be provided to the people of Moheshkhali on priority basis if the	Local workers will be given priority in terms of available work. But since this project is very big, workers from outside also have to be employed even after employing local workers. The main purpose of this power plant is to satisfy the demand for electricity; certainly the local people will get their necessary supply of electricity.	**Employment (LARAP)** - When employing local residents at the construction site as well as power plant and associated facilities when the power plant starts operation, local residents will receive priority when they have the required skills.

Comments	Responses	Reflected in Environment Management Plan
power plant is established.		
One of the participants from Dholghata mentioned that the embankment is very necessary to protect the proposed power plant from cyclonic storms and tidal surge. He understood that the existing embankment will be further developed to protect the power plant. Dhalghata union may be protected from the cyclonic storms and tidal surge if the embankment is further extended up to Dhalghata. So, He requested to develop the existing embankment along Dhalghata Union	CPGCBL assured the attendees that it would develop the existing embankment to protect the power plant and Dhalghata union as well.	**Embankment** - Construction of an embankment along the navigation channel and revetment in the port for the prevention of flood by cyclone.
A teacher and journalist, was very optimistic to see this power plant being implemented very soon for development of Dhalghata union. So, he requested to start construction work before the forthcoming rainy season.	The project is a large one. So, it is not possible to start construction of this project so early. If JICA finds that this project is feasible, a loan agreement will be signed between JICA and GOB by March, 2014. Then consultants will be employed for this project. An EPC Contractor will be subsequently employed. It will take 6 months to design the plant. Construction may be start by 2016-2017 and the plant commissioned by 2023.	---
Member of the Kalarmar Chora Union, leader of Krishok League and a businessman, mentioned that if a power plant is established at the boundary of Matarbari and Dholghata unions, surrounding areas e.g. Kalarmar Chora union will also be affected as effluents and other chemicals will be discharged within a three mile radius from the power plant. It was learnt that smog due to flue gas will cover up the sky around a radius of 3 miles and the sun won't be visible for at least 4 hours after the morning sunrise. The people of Moheshkhali rely highly on the sun since they are shrimp farmers of shrimp, betel leaves and salt. As a result, they will lose their source of income. So, he requested to use such technology that will not	There won't be any smog to block the sunshine. A similar coal based power plant is now in operation at Boropukuria in Dinajpur, where no smog is produced. BPDB invited the interested people to see the situation in Boropukuria for themselves	**Air quality** - To reduce PM emissions, Electrostatic Precipitator (EP; around 99.8% efficiency) will be installed - To reduce NO_2 emissions, firing system will use low combust technology - To reduce SO_2 emissions, sea water FGD equipment (FGD; around 70% efficiency) will be installed - For stack design, the height is 275m

Comments	Responses	Reflected in Environment Management Plan
affect the project site and the surroundings as well.		
One of the participants asked why imported coal will be used for this proposed power plant in spite of the availability of domestic coal.	There is a huge reserve of coal at the northern region of Bangladesh. But due to lack of coal policy, extraction of domestic coal has been halted. In addition, coal needs to be transported to the project site. In order to generate 1200 MW electricity, 10,000 metric tone of coal will be required each day. It is quite difficult to transport this huge amount of coal from Dinajpur to the project site given the poor roads and highways. So, it will be best to import coal from other countries.	(N/A)
Member: Dholghata Union Parishad said that there were at least one thousand families in total at Matarbari and Dholghata union whose land will be acquired for the project. Moreover they will also lose their means of livelihood. From other projects it has been observed that the affected people don't get proper compensation for land and proper resettlement. So, he urged JICA to take necessary steps for proper compensation to the affected people and their proper resettlement with adequate means of securing their livelihood.	Only twenty one houses will be affected. The proposed site has been selected in the area where very few houses will be affected. The affected people will be properly resettled and as far as their income is concerned, they will be supervised in finding their means of livelihood before/after their resettlement.	**Resettlement** - Developing an appropriate "land acquisition and resettlement action plan" - Land acquisition should be conducted in compliance with the relevant laws and regulations - The cost related to relocation will be given to relocated residents
Secretary, Moheshkhali, Press club mentioned that it is necessary to construct new power plants for development of Bangladesh. A land of 455hactare will be required for this proposed power plant. Most of the cases it was found that compensation for the land goes to the wrong hands. So, he wanted proper compensation to the actual owners of the lands. He also wanted proper resettlement of the people who will lose their houses. He wanted the equal opportunity for both male and female workers at the project site.	Only the affected people will be compensated, and they will not have trouble receiving compensation. Care will be taken to ensure the equitable treatment of male and female workers at the power plant site equally.	The same as those addressed in "Md. Akhtaruzzaman"

(Source: JICA Study Team)

3) Focus Group Discussion

For the purpose of hearing the opinions and comments of local residents, a series of focus group discussion were conducted at the same phase where the stakeholder meetings were held. The targeted groups of people for the focus group discussions were woman, children, salt laborers, shrimp cultivators and fishermen.

a) Scoping Stage

Table 15.5-4 Main Comments and Reflected in Environment Management Plan (from 18 to 25 December of 2012)

Target	Comment	Reflected in Environment Management Plan
Woman	a. Nine out of 25 interviewed women were literate, only twelve could write their own names, three were illiterate, and the literacy of the others was unknown. b. Eleven of them said they had suffered from malaria. Fifteen of them saw unskilled doctors when they get ill. Ten saw private doctors, and one went to the community clinic. Two of them said they also went to private doctors in Chakaria Upazila. c. None had jobs. They said that there were no job opportunities for women in this area. They said they did not look for jobs because of religious barriers and poor qualifications, which reduced their ability to negotiate with others. d. They said that they were very much interested in skill training such as tailoring, puppet making and Nakshi Katha (bed cover with hand-stitch design) even though no job opportunities were available in their locality. e. 18 of their fathers were involved in salt cultivation as laborers, businessmen and cultivators. One had a father who was a shrimp cultivator, one had their father as a grocer, and the other had father who was a policeman. f. Nine had husbands who work as salt laborers. Four of their husbands were day laborers involved in agriculture, vegetable cultivation and civil works etc. Six of their husbands were salt cultivators. Others were: one salt mazi, one salt businessman, one fisherman,	**b. Health (LARAP)** - Health facilities at power plant will be shared with the local residents. **c. Employment (LARAP)** - When employing local residents, local women will be given priority when they have the required skills. - Enrollment in vocational training courses based on assessment of skills **d. Education (LARAP)** - School facilities at power plants will be shared with the local residents. **i. Water and sanitation** - Water quality of tube wells and others will be checked periodically for the safety of local residents.

Target	Comment	Reflected in Environment Management Plan
	one fish laborer, one widow, and one abroad. They said there were many men who worked abroad. g. Their husbands' income varied from Tk 3,500 to 15,000. h. Only two of them had solar panels at home provided by Rahimafrooz Ltd. Others have no lights at home. i. Eight of them said they used pond water and the rest got water from tube wells.	
Children	a. Except one child, all 21 children were literate. b. All of them saw unskilled doctors when they get ill. Four of them said they also went to private doctors in Chakaria Upazila. c. Two of 21 children worked: one had worked for three years up to present (he was ten years old when interviewed), and the other had worked for five years (he was eleven years old) d. Three of them went to Islamic school. e. Seven of them had solar panels at home provided by Rahimafrooz Ltd. Others had no lights at home. f. Six of them said they used pond water and the rest got water from tube wells. Six said they used alum to purify water before drinking. g. 18 of their fathers were involved in salt cultivation as laborers, businessmen and cultivators. One had a father who was a shrimp cultivator, one had a father who was a grocer, and the other had a father who was a policeman.	**b. Health (LARAP)** - Health facilities at the power plant will be shared with the local residents. **c. Employment (LARAP)** - When employing local residents at the construction site as well as power plant and associated facilities when the power plant starts operation, no child will be allowed to work in order to prevent their drop-out from school and child labor. Periodic and regular patrols will be made to make sure there are no child laborers. **d. Education (LARAP)** - School facilities at power plant will be shared with the local residents. **e. Electrification (LARAP)** - Electrification of surrounding area will be examined. **f. Water and sanitation** - Water quality of tube wells and others will be checked periodically for the safety of local residents.
Salt laborers	a. Their ages ranged from 13 to 50 years old. Eleven were married and eight were unmarried. b. Six of them were literate, only eleven only wrote their names; the literacy of the others was unknown. c. Seven of them saw unskilled doctors when they got ill. The rest went to private doctors in Chakaria Upazila. Some of them got hepatitis. d. Six of their fathers were salt cultivators. e. Secondary work included: daily labor, shrimp labor, fish cultivator, construction labor, agriculture, and crab cultivator. f. Their income ranged from Tk.4,000 to 20,000.	**c. Health (LARAP)** - Health facilities at power plant will be shared with the local residents. **e. Education (LARAP)** - School facilities at power plant will be shared with the local residents. **f. Employment (LARAP)** - When employing local residents at the construction site as well as power plant and associated facilities after the power plant starts operation, local residents will be given first priority when they have the required skills. **f. Compensation (LARAP)**

Target	Comment	Reflected in Environment Management Plan
	g. Five of them had solar panels at home provided by Rahimafrooz Ltd. Others have no lights at home. h. All of them had water from tube wells. i. All of them lived in houses with clay wall. No matter which materials they used for their houses, conditions were unsanitary. j. They spend education for their children ranging from Tk 500 to 10,000 per month. k. They stated that their children were involved in family income generation activities from the salt field and their discontinuation and drop-out were on increase.	- Establish of "Livelihood Restoration and Improvement Plan" for continued economic activities - One-time assistance for lost income based on three months' income at minimum wage rates - Enrollment in vocational training courses based on assessment of skills **g. Electrification (LARAP)** - Electrification of surrounding area will be examined. **h. Water and sanitation** - Water quality of tube wells and others will be checked periodically for the safety of local residents.
Shrimp laborers	a. Their ages ranged from 18 to 70 years old. Thirteen were married and eight were unmarried. b. Thirteen of them were literate, seven only wrote their names, and one was unknown. c. Two of them directly saw private doctors. 19 of them first saw unskilled doctors when they got ill, and then went to private doctors in Chakaria Upazila. d. Their fathers were involved in salt cultivation, shrimp cultivation, salt mazi, shrimp business, salt business, grocery, and agriculture. e. Thirteen of them had salt labor as secondary work. Five were boat laborers. Others included one shrimp businessman, one boat mazi, and one boat carpenter. f. Their income ranged from Tk.4,000 to 30,000. g. Six of them had solar panels at home provided by Rahimafrooz Ltd. Others have no lights at home. h. All of them used water from tube wells. i. All of them lived in houses with clay walls. No matter which materials they used for their houses, conditions were unsanitary. . j. They spend on their children's education (from Tk 500 to 7,000 per month).	**c. Health (LARAP)** - Health facilities at the power plant will be shared with the local residents. **d. Employment (LARAP)** - When employing local residents at the construction site as well as power plant and associated facilities when the power plant starts operation, priority will be given to local residents when they have the required skills. **e. & f. Compensation (LARAP)** - Establish of "Livelihood Restoration and Improvement Plan" for continued economic activities - One-time assistance for lost income based on three months' income at minimum wage rates - Enrollment in vocational training courses based on assessment of skills **g. Electrification (LARAP)** - Electrification of surrounding area will be examined. **h. Water and sanitation** - Water quality of tube wells and others will be checked periodically for the safety of local residents. **i. Education (LARAP)** - School facilities at the power plant will be shared with the local residents.
Fsherman	a. Fisherman said that if the power plant is established in identified area, their	**a. & c. Movement of big ships** - Setting water routes by consultation with

Target	Comment	Reflected in Environment Management Plan
	occupation will be hampered due to movement of big ships in the sea. Sea water will be contaminated by coal dust and fly ash. On the other hand, mass people said that their area will be developed. b. One respondent ask where and how the waste of power plant will be dumped or minimized. If the big ship runs in the sea, their nets will be damaged / torn by the ship. c. When the big ship will move up-down in the sea, their nets will be damaged and their fishing catches will be reduced. As a result, their monthly income will be reduced.. d. Some people who used to catch both crab and shrimp have no objection to a coal fired power plant. But they demanded to be compensated for their lands at actual local market prices and resettled properly. A fisherman said that if the power plant is established in the identified areas, their occupation will be hampered due to the operation of big ships in the sea. Coal dust and fly ash will contaminate the sea water. The most of people said that their area will be developed.	concerned authorities. **b. Water pollution** - Cover installation on conveyor for coal transportation to coal yard. - Unloading of coal will be minimized (e.g., reduce the frequency of activity, etc.) during times of high speed winds. - Watering coal yard to keep the surface wet and prevent wind blowing the coal and dust. - Installation of a dust control fence - Re-greening especially along boundary of project, surrounding coal yard with domestic plants **b. Waste** - Waste management program consisting of reduction, reuse, and recycling of materials. - Systematic collection and protected storage - Waste disposal at appropriate location. - Hazardous waste should be treated under the related regulations - Prohibition of dumping any contaminating materials **d. Compensation (LARAP)** - Provision of alternative sites for continued economic activities - One-time assistance for lost income based on three months' income at minimum wage rates - Enrollment in vocational training courses based on assessment of skills

(Source: JICA Study Team)

b) Draft final Stage

Table 15.5-5 Main Comments and Reflected in Environment Management Plan (from 18 to 20 April of 2013)

Target	Comment	Reflected in Environment Management Plan
Salt Worker	Handout of presentation materials were shown to the participants. The participants could not understand the economic growth in the area surrounding the power plant site. A majority of participants said the future appeared promising. They asked about land acquisition. We informed them that the office of the D.C, Cox's Bazar will advise the affected people on how they will be compensated.	**Livelihood restoration (LARAP)** - Developing "livelihood restoration program", including job training programs to persons who want the training.
Shrimp Worker	Most of the participants said that they will	**Livelihood restoration (LARAP)**

Target	Comment	Reflected in Environment Management Plan
	lose their jobs because they sell their labors in the shrimp culture field. They expressed their concern that 455 hector lands are going to be acquired by the government for establishment of power plant. So, there will be no place for shrimp cultivation in that area. As a result, they will be unemployed.	- The same as those addressed in "Salt Worker"
Fisherman	24 fishermen were interviewed. All the fisherman were afraid that they are going to lose their fishing areas and that the sea water will be polluted by ash and waste water. They said big ships will move in the sea. Due to this, fisherman cannot catch fish from the sea easily and also said that their fishing nets will be damaged. The participants asked how much land would be acquired. We replied that 455 hectors of land will be acquired by the government. We discussed with them about the formation of a Grievances Redress Committee. This committee consists of CPGCBL, project staff, local representatives of affected people, Chairman of the respective union, local elites and law advisor. This committee will minimize any sort of grievances.	**Water quality** - Installation of wastewater treatment system by neutralization, settling and oil separation so any wastewater produced complies with wastewater standards and IFC guideline - Storage of oil and chemical materials in an appropriate tank with a retaining wall and method to prevent permeation into the ground **Marine traffic** - Consulting with related authorities on vessel schedules - Determining water routes after consultation with related authorities - Setting course buoys around navigation channel areas for marine safety - Informing local fishermen of the operation schedule, etc.
Women	24 women were interviewed. Every participant is pleased because a power plant is going to be established. They want to get proper treatment facilities of power plant site. They also said literacy rate is very poor in the area. They want to get schooling facilities so that their children can go the school for their education. We discussed with them about development in this area.	**Education** - New service facilities, such as schools and medical center, are made available to local residents, as required

(Source: JICA Study Team)

15.5.2 Transmission line

(1) Natural Environment

1) Terrestrial Wildlife

a). Location of Proposed 400kV Transmission Line

In order to transfer power from the proposed 2 x 600MW coal-fired power plant at Matarbari, Cox's Bazar, a 400kV Transmission line will be drawn from Matarbari to Anowara (Figure 15.1-2). The 400kV transmission line will pass through Matarbari Union of Maheshkhali upazila and Pekua upazila, Cox's Bazar district, and Banshkhali and Anowara upazila, Chittagong district.

b). Location of Survey

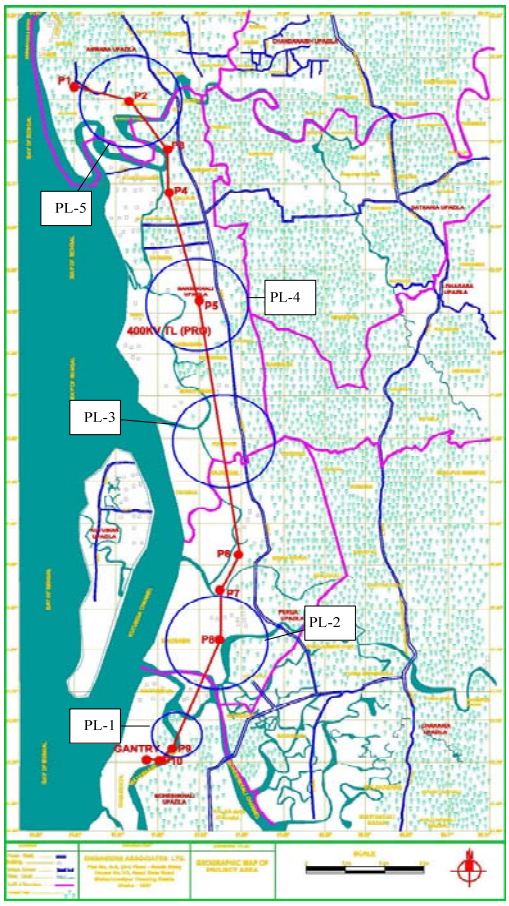
Five survey points on the proposed 400kV Transmission line have been identified by the JICA Study Team to survey flora and fauna. A short description of the survey points is given in Table 15.5-6.

Table 15.5-6 List of Survey Points

Sl. No.	Survey Point	Area Covered
1.	PL1	Village Rajghat, P.O. Matarbari, UZMaheshkhali, Cox's Bazar
2.	PL2	Village Bodhomajhirguna, P.O.-Pekua, Union-Bara Bakia, UZ-Pekua, Cox's Bazar
3.	PL3	Village Shekher Khil, P.O.Chamble, UZ-Banshkhali, Chittagong
4.	PL4	Village - East Kataria, P.OKataria, UZBanshkhali, Chittagong
5.	PL5	Village Barum Chhara, P.OBarum Chhara, UZAnowara, Chittagong

(Source: JICA Study team)

A geographic map showing the location of the survey points is given in Figure 15.5-15.



(Source: JICA Study Team)

Figure 15.5-15 Locations of Terrestrial Wildlife Survey

A list of flora and fauna identified at the five survey points is provided in Appendix C-15.5-4.

The listed species of flora and fauna which were identified by the survey in the rainy season include many areas to be critically reviewed in terms of biological aspects as a whole, so for these reasons, these species have been reviewed by other scientists in order to have correct data for compiling the interim report.

c). Results

a. Flora

Almost all areas for the construction of the Transmission Line are largely comprised of man-made fields of rice fields, shrimp farming ponds, and salt pans except for some scrubs with scattered trees of cash crop and non-timber trees nearby local residents' houses.

In all, 45 species in the rainy season and 44 species in the dry season were recorded in the Transmission Line sites. No threatened species, as designated by the IUCN status

declaration of 2012, were recorded. Three species (*Calamus guruba* Buch-Ham, *Trihosanthes cordata* Roxb, and *Lepisanthes rubiginosa*) which are considered as threatened species under local status by scientist groups in Bangladesh were recorded, but these species have wide distributions and are common in the region (Biologist-group's views of Chittagong University).

b. Fauna

<Insects>

A total of 18 species of 16 families under 10 orders in the rainy season and 21 species of 17 families under 10 orders in the dry season were recorded in the Transmission Line area. All of them have Not Threatened (NO) status per the IUCN status declaration of 2012.

<Amphibians>

A total of 10 species of 5 families under 1 order in the rainy season and 6 species of 3 families under 1 order in the dry season were recorded in the Transmission Line area, all of which are Not Threatened (NO) status by IUCN.

<Reptiles>

A total of 14 species of 8 families under 2 orders in the rainy season and 8 species of 5 families under 1 order in the dry season were recorded in the Transmission Line area, all of which are Not Threatened (NO) status by IUCN.

Four species (*Calotes versicolor*, *Mabuya mabuya*, *Gekko gecko*, *Naja naja*) which are considered as threatened species under local status by scientist groups in Bangladesh were recorded, but these species have wide distributions and are common in the region (Biologist-group's views of Chittagong University).

<Birds>

A total of 78 species of birds in the rainy season and 124 species of birds in the dry season were recorded in the Transmission Line area. No threatened species, as designated by the IUCN status declaration of 2012, were recorded. Two species (*Garrulax galbanus*, *Ketupa zeylonensis*) which are considered as threatened species under local status by scientist groups in Bangladesh were recorded, but these species have wide distributions and are common in the region.

<Mammals>

A total of 15 species of 8 families under 4 orders in the rainy season and 13 species of 8 families under 4 orders in the dry season were recorded in the Transmission Line area. All

of these species have Not Threatened (NO) status as per the IUCN status declaration of 2012.

c. Threatened Species in Project Areas (Power Plant and Transmission Line)

<Threatened Species listed on the IUCN List in the project areas and effective measures to mitigate any impacts on them>

From the results of the survey on flora and fauna which was carried out during the rainy and dry seasons in the project areas of the Power Plant and Transmission Line, a total of 6 species of 1 bird and 5 reptiles were identified as designated threatened species as CR, EN and VU on the IUCN Red List of 2012.
Except for these 6 species of reptiles, there were no other threatened species of flora and fauna observed in both project sites.

Spoon-billed Sandpiper (*Eurynorhynchus pygmeus*)

Based on the results of this survey, conducted from December 7th to March 30th 2013, migration behavior indicates that the study area cannot be classified as a wintering ground. That is, during winter while the Spoon-billed Sandpiper comes ashore to the sandy beach in front of the project site, the number of birds observed in the area is extremely small compared to the nearby coastal offshores of Sonadia Island. This is supported by findings by other researchers.
During the weekly survey in the month of December 7 to March 30, 2013, the Spoon billed Sandpiper was observed on only 3 days in the project site and 11 days in the southern front of Sonadia, and at most 2 individuals in one day were identified in the project site, which is about 15% whereas 13 individuals were identified in the southern front of Sonadia in one day.
This means the frequency with which the Spoon billed Sandpiper uses the Matarbari Island as a wintering ground is comparatively very low in comparison with that of the nearby offshore island of Sonadia. This is consistent with previous survey results indicating that Matarbari Island beach is not a main migratory habitat for migratory birds, particularly the Spoon billed Sandpiper in Bangladesh. This small numbers and short time wading of the Spoon billed Sandpiper which wading Matarbari Island mean that this area is not only underfed for feeding but also far from good natural conditions of mudflats for wintering or rest during migration.
These sets of survey results firmly believing that Matarbari Island beach is not a main migratory habitat for migratory birds, particularly the Spoon billed Sandpiper in Bangladesh (ornithology- group's views of Chittagong University) (Appendix C-15.5-6).

Inevitably, as has been noted, the project site and its surrounding areas are not categorized as the critical natural habitats for Spoon billed Sandpiper which is defined as per "JICA guidelines for environmental and social considerations (April 2010)".

Spotted Pond Turtle (*Geoclemys hamiltonii*)

This species was observed at the salt pans in the project site, although it did not appear to use these salt pans for its displacement and access to feeding, breeding and reproduction in view of its ecological features, so that there is no need to take special countermeasures to protect it besides capturing and replacing it into its original environment.

Sea-Turtle

The survey aims confirm the number of sea turtles landing to law eggs on the sandy beaches of Matarbari Island and its adjacent beach, and at the beach nearby on the offshore island. The following items will be examined and confirmed in the survey:

- The numbers of landing sea turtles.
- The name of species of landing sea turtles.
- The nesting behaviors of landing sea turtles.
- The record of hearing results on landing sea turtles from concerned people or authorities
-* The ecological document data on landing sea turtles from scientists

The survey results for 40 days (March 5th to 24th and April 1st to 20th 2013) have been tabulated and turtle landings confirmed by the survey for the duration aforesaid in the total study area were 34 individuals of 4 species of Olive ridley turtle (*Lepidochelys olivacea*), Loggerhead turtle (*Caretta caretta*), Green turtle (*Chelonia mydas*), and Hawksbill turtle (*Eretmochelys imbricate*).

The survey confirmed that tidal behavior somehow controls the spawning of both species. That is, the number of turtles that come ashore to spawn on the sandy beach during neap tide is extremely small compared to spring tide. This is supported by other findings at different sites.

Landing frequency decreased at almost all sites from March to April. These results were consistent with findings in different papers published in MTN (Marine Turtles Network) by Marine Life Alliance survey for Saint Martin’s island and Sonadia Island, which is on the same coast.

In 2011, a study of 2009-2010, 192 turtles per year were confirmed landing on Sonadia island. Furthermore, 19 turtle landings were confirmed in one day and night in the same investigation (Islam et al 2011) conducted by the MarineLife Alliance survey.

Meanwhile, only 34 turtles in 40 days observation were confirmed landing on Matarbari

Peninsula in the detailed-survey conducted by JICA Study team. Furthermore, only at most 1 turtle landing was confirmed in one day and night in the same survey. This means the frequency with which the sea turtle uses the Matarbari Peninsula as a nesting for laying eggs sandy beach is comparatively very low in comparison with that of the nearby offshore island of Sonadia.

These sets of survey results firmly believing that Matarbari Peninsula beach is not a main habitat for spawning sea turtles in Bangladesh (ornithology- group's views of Chittagong University, and, view of Dr. Prial Modsuddi who used to work as a member of IUCN in Bangladesh).

Inevitably, as has been noted, the project site and its surrounding areas are not categorized as the critical natural habitats for sea turtle which is defined as per "JICA guidelines for environmental and social considerations (April 2010)".

This is supported by other reports finding that nesting frequency is also very low in comparison with the nearby offshore island of Sonadia (eminent-reptile-group's views of Bangladesh) (Appendix C-15.5-7).

For the sea turtles, available mitigation measures such as controlling levels of lighting, noise and vibrations caused by construction work may be needed as the sandy coast adjacent to the project site appears to be their nesting and egg-laying sites.

Table 15.5-7 Threatened Species Observed in Project Areas (Power Plant and Transmission Line)

Taxa	No.	Scientific Name	Season		Conservation Status	Remarks
			Rainy	Dry	IUCN (2012)	
Bird	1	*Eurynorhynchus pygmeus* (Spoon-billed sandpiper)		O	CR	During the weekly survey in the month of December 7 to March 30, 2013, only 3 days in project site and at most 2 individuals in one day were identified in project site.
Reptile	1	*Geoclemys hamiltonii* (Spotted Pond Turtle)	**O**		VU	One individual found. It may have strayed into the salt pan as its main habitat is in fresh water ponds, rivers, and marshlands beside salt pans.
	2	*Lepidochelys olivacea* , (Olive Ridley Turtle)	-	**O**	VU	One strayed individual (*Lepidochelys olivacea*) found at a salt pan far from the sea coast. All other 3 species were observed at the adjoining sandy coast of the power plant project site. The numbers of these turtles landing at this coast for laying eggs was 15 individuals over 18 days, approximately one turtle landing per night. A more detailed survey to understand these turtles' nesting distributions has been carried out beginning March, 2013.
	3	*Caretta caretta* (Logger head turtle)	-	**O**	EN	
	4	*Chelonia mydas* (Green turtle)	-	**O**	EN	
	5	*Eretmochelys Imbricate* (Hawksbill turtle)	-	**O**	CR	

Taxa	No.	Scientific Name	Season		Conservation Status	Remarks
			Rainy	Dry	IUCN (2012)	
Total	5		(1)	(5)		

Notes: CR - Critically Endangered, EN - Endangered, VU - Vulnerable

(Source: JICA Study Team)

<Threatened Species that may be treated as rare species by Bangladesh scientist groups in the project areas and effective measures to mitigate the impacts on them>

During the site survey on fauna and flora in both project sites of the Power Plant and transmission line, 11 rare species which are not yet listed in the IUCN Red List of 2012 as threatened species, but are being evaluated as threatened species by Bangladesh scientist groups have been recorded (Table 15.5-8)

Table 15.5-8 Threatened Species Proposed by Bangladesh Scientist Groups

Taxga	No.	Scientific name	English name
Flora	1	*Calamus guruba Buch.-Ham.*	Cane
	2	*Trichosanthes cordata Roxb.*	Snake guard
	3	*Lepisanthes rubiginosa*	Rusty sapindus
	3		
Reptile	1	*Calotes versicolor*	Garden lizard
	2	*Mabuya mabuya*	Skink
	3	*Gekko gecko*	Tokay Gecko
	4	*Pangshura tentoria*	Median Roofed Turtle
	5	*Naja naja*	Bicled Cobra
	5		
Bird	1	*Arachnothera magna*	Streaked Spiderhunter
	2	*Ketupa zeylonensis*	Broun Fish Owl
	3	*Vanellus duvaucelii*	River Lapwing
	3		
Total	**11**		

(Source: JICA Study Team)

<Other>

According to “Data collection survey on coal power master plan follow-up in the People's Republic of Bangladesh: final report”, there are some endangered species in and around Sonadia Island. Therefore, an investigation of endangered species was conducted.

- Spotted green shanks (*Tringa guttifer*) (EN the IUCN Red List of 2012)

From the results of the survey on birds which was carried out during the rainy and dry seasons in the Power plant site and the Transmission line, none of this species was recorded.

- Great knotd (*Calidris tenuirostris*) (VU the IUCN Red List of 2012)

From the results of the survey on birds which was carried out during the rainy and dry seasons in the Power plant site and the Transmission line, none of this species was recorded.

- Indo-Pacific Finless Porpoised (*Neophocaena phocaenoides*) (VU the IUCN Red List of 2012)

From the results of the survey on dolphin which was carried out during the rainy and dry seasons in the canals, shores and offshore areas of the Power plant site and Sonadia Island, none of this species was recorded.

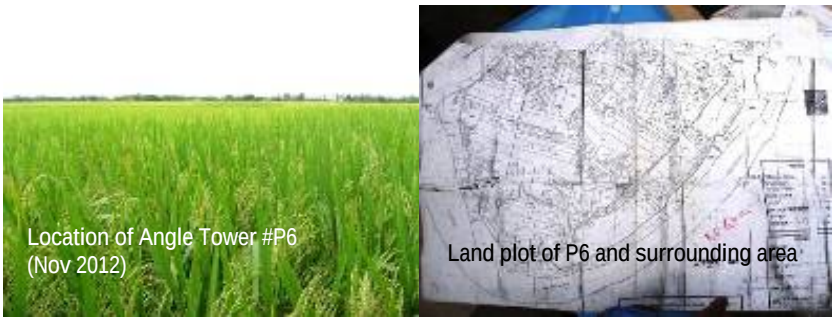
- Irrawaddy Dolphins (*Orcaella brevirostris*) (VU the IUCN Red List of 2012)

From the results of the survey on dolphins which was carried out during the rainy and dry seasons in the canals, shores and offshore areas of the Power plant site and Sonadia Island, none of this species was recorded.

(2) Social Environment

Route selection of transmission line was considered among two alternatives: one along with Chittagong Hill Tracts and the other (present one). The present route was selected to avoid possible adverse impact to forest area and indigenous population affined to neighboring Myanmar at CHT route. PGCB deliberately selected a route that avoids or minimizes involuntary resettlement, and the locations of angle towers have been placed in paddy fields and the transmission line will mostly pass above paddy fields throughout the route from Anowara Upazila to Matarbari Upazila.

Among four Upazilas where the transmission line will pass through, the angle tower No.1 (P1) and No.2 (P2) will be located in Anowara Upazila, No. 3 (P3) to No. 5 (P5) in Banshkhali, No.6 (P6) to No.8 (P8) in Pekua, and No.9 (P9) and No.10 (P10) in Maheshkhali. The rest towers, extension towers, will be allocated in these Upazilas.



Source: Taken by JICA Study Team

Figure 15.5-16 Angle Tower Sites on Transmission Line Route (Tower-1)

A household survey targeting the landowners of angle tower locations as well as focus group discussions targeting women, children, and farmers around the angle tower locations was conducted in December 2012.

The length of time of households residing at the angle tower locations varied from 20 to 100 years from one generation to the next. The average household size is 10.2 people. The literacy rate among the target nine families was relatively high: 67.4% for adults and 65.3% for children. Gender gap in literacy (male: 72.9%, female: 59.1%) was caused by the low literacy of female adult. Locations of angle towers from P8 to P10 were used for shrimp cultivation and salt cultivation. The rest were for paddy cultivation. Most of the population in the surrounding villages depended on agriculture as farmers and agricultural laborers. The interviewed households involved in agriculture earned 20,000 to 60,000 taka per month. And the household expenditure ranged from 12,000 to 60,000 taka (average: 32,000 taka). Based on the CBN method to assess the incidence of poverty, the landowners of the angle tower locations from P1 to P9[8] and their family members were not categorized as poor.

They use tube wells for drinking and cooking purposes. They have however no habit of boiling water before drinking. Electricity is not rare on the route, but not all of them had access to electricity at home. All of them used firewood for cooking. They collect information from their neighbors, from TV, mosque imam, community leader and friends.

The survey details and results are found in the Land Acquisition and Resettlement Action Plan as attached in the Appendix C-15.9-1.

(3) Stakeholder Meeting

1) 1st Stakeholder Meeting

[8] The area of P10 belonged to the government.

a) Objective

The 1st Stakeholder Meeting is aimed at hearing the opinions and/or comments of individuals and organizations regarding the project, and understanding the needs of local residents, as well as appropriately reflecting those needs into the relevant survey.

b) Implementation Methodology

In accordance with JICA Guidelines for Environmental and Social Consideration, the first stakeholder meetings for both the power plant and transmission line were held at the scoping stage of the Feasibility Study of the Coal-fired Power Plant Development Project (2 x 600MW) at Matarbari, Cox's Bazar. The project owners, the Power Grid Company of Bangladesh (PGCB) for the transmission line, hosted the meetings assisted by the JICA Study Team.

c) Notification

A notification letter was distributed to all key stakeholders prior to the meeting.

d) Results

Date: November 19, 2012
Time: 10am to 2pm
Venue: Upazila Parishad Auditorium, Chokoria Upazila in Cox's Bazar District
Host and Chair: Mayor, Chokoria Municipality, Manager, PGCB
Participants: Local government officers, Community leaders, Local NGOs, Local elite people, Local affected residents, etc., a total of 65.

Agenda:
- Registration
- Recitation of Quran
- Welcome Speech by Mayor of Chokoria & PGCB
- Background of the project by EAL
- Presentation on Environmental and Social aspects of the project by EAL
- Question & Answer Session
- Closing Speech by Mayor of Chokoria & PGCB
- Lunch

At the meeting, a power-point presentation was given to the local participants in their local language (Bengali) (Appendix C-15.5-8), with a full explanation of the project and

environmental impacts in addition to the mitigation measures to be taken, to allow the audience to fully understand the project and contribute valuable comments. The main comments raised by the participants and the responses made by PGCB are as follows, as per the meeting minutes and list of participants attached in the Appendix C-15.5-9.

Table 15.5-9 Main Comments, Responses, and Reflected in Environment Management Plan (Scoping Stage)

Comments	Responses	Reflected in Environment Management Plan
One of the participants wanted to know whether the owners of the land to be used for tower structures can continue to use them or not.	The project owner replied that as per the present rules of the Bangladesh Government, no land will be acquired for tower structures. Therefore, the owners of the land will have the right to cultivate crops on their land. However no big trees will be allowed to grow on the land in order to maintain minimum clearance levels with the transmission line.	**Compensation** - Compensation will be made for the standing crops during the construction period while they are unable to cultivate. - For the base area of each tower location, replacement cost will be applied for involuntary acquisition.
One of the participants from Bashkhali, wanted to know whether land will be acquired for the erection of towers and the value of the land to be paid	The project owner replied that there are no government rules to acquire the land for towers at this moment. Therefore, there is no question of payment of any value for the land. However, compensation will be provided for any crops or trees damaged during construction. The compensation price for damaged crops or trees is normally 1.5 times the rate fixed by the department of agriculture or forest.	**Compensation** - Compensation under the Law (CUL) for all the private land as stipulated by the Ordinance 1982: average of last 12 months' sales values of same kind of land X 1.5 (50% premium) - Cash grant that covers the difference between CUL and the replacement value (RV) - Provision of stamp duty, land registration fee, capital gains tax and value added tax incurred for replacement land
One of the participnats from Marayati Union, asked how much land was required for each tower.	The project owner replied that each tower has four legs 10m apart (i.e., 100m^2). The land will be occupied during the construction period of about 5-6 months to erect the towers. After the erection of the towers, the land can be used again for cultivation	(N/A)

(Source: JICA Study Team)

2) 2nd Stakeholder Meeting

a) Objective

The 2nd stakeholder meeting is aimed at disclosing the survey and evaluation results of environmental and social consideration to the participants (stakeholders) and receiving the comments on the results from the participants, in order to reflect them into the final report.

b) Implementation Methodology

In accordance with JICA Guidelines for Environmental and Social Consideration, the second stakeholder meetings for both the power plant and transmission line were held at the finishing of the draft final report of the Feasibility Study. PGCB hosted the meetings assisted by the JICA Study Team.

c) Notification

A notification letter was distributed to all key stakeholders prior to the meeting.

d) Results

Date: April 15, 2013
Time: 11am to 02pm
Venue: Upazila Parishad Auditorium, Chokoria Upazila in Cox's Bazar District
Host and Chair: General Manager of, PGCB
Participants: Local government officers, Community leaders, Local NGOs, Local elite people, Local affected residents, etc., a total of 80.

Agenda:
- Registration
- Recitation of Quran
- Welcome Speech by General Manager of PGCB
- Presentation on Environmental and Social aspects of the project by EAL
- Question & Answer Session
- Closing Speech by GM of PGCB
- Lunch

At the meeting, a power-point presentation was given to the local participants in their local language (Bengali) (Appendix C-15.5-8), with a full explanation of the project and environmental impacts in addition to the mitigation measures to be taken, to allow the audience to fully understand the project and contribute valuable comments. The main comments raised by the participants and the responses made by PGCB are as follows, as

per the meeting minutes and list of participants attached in Appendix C-15.5-9.

Table 15.5-10 Main Comments, Responses, and Reflected in Environment Management Plan (Draft Final)

Comments	Response	Reflected in Environment Management Plan
1. Is there is any provision for compensation of the land where transmission towers will be erected? 2. At present, there is 4 to 5 hours load shedding occurs in a day, whether the present electricity problem will be solved or not if this project is implemented.	1. According to the present govt. law, there is no provision for acquisition of land to construct transmission line. In this connection PGCB avoid to take transmission line over household, mosque, school etc. and PGCB try to construct it across the open land. However, during the construction time if any trees or crops are lost due to construction of transmission line, then compensation for this loss are made. Terms and conditions for compensation are prepared with the local Chairman and Members and payment is to be made accordingly. They try to pay more than the actual price. Again the told that payment will made according to govt. rules and regulations. If the govt. change the present law of compensation for transmission line and tell them to acquire the land for transmission line tower, then they will acquire the land accordingly. In fact, it is controlled by the govt. and they follow the govt. instructions. 2. You have to co-operate for the greater interest. Electricity is very essential for us and it is needed for all works including agriculture, industries and household. It is very difficult to move without electricity.	**1. Compensation** - Developing an appropriate "compensation plan" - Towers are constructed in non-residential areas to the maximum extent possible - Land acquisition should be conducted in compliance with relevant laws and regulations - After construction towers, land owner can cultivate under it. - Compensation should be conducted in compliance with relevant laws and regulations **2. Electrification** - Electrification of surrounding area will be examined.
Assistant Agriculture Extension Officer, Chokoria 1. How much amount of money will be paid per sq. meter during land acquisition. 2. Name of the Unions, over which the transmission line will be constructed?	1. Price of acquired land depends on govt. rules. Normally 1.5 times of actual price of land is paid against acquired land. 2. The proposed transmission line will be constructed from Matarbari to Anwara via Pekua and Banshkhali upazilas. The name of the unions over which	**1. Compensation** - The same as those addressed in "Above"

Comments	Response	Reflected in Environment Management Plan
	the transmission line will be taken is not in our hand at this moment.	
Land of their village which is selected for erection of proposed tower is meant for construction of house hold. They have no other alternative land for this household construction. In this situation what they will do?	The construction work will start after 1 to 2 years. If the land owner will construct the house before this period of time, then they will think the alternative way and if he does not construct the house before this period, then the plan will remain as it is. They will not resist him to work in this land. However, at the time of work, they will conduct survey and physically verify the situation and do the work accordingly.	**Route selection** - Towers are constructed in non-residential areas to the maximum extent possible - Transmission line route was selected avoiding any steep sloped areas
One of the stakeholders raised the following questions: 1. What benefits they will get from this project 2. Do they get electricity connection to every household, if the project is implemented 3. Since this is a long term project, what is the planning for employment of labor in this project? Whether the priority for employment of local people will be given and is there any specific percentage for employment of local people for this project? 4. The land adjacent to Nabogram under Barbakia union of Pekua Upazila, that will be used for the transmission line whether any compensation will be given for the use of this land. 5. Whether any problems will be created for this transmission line?	The transmission line is 62 Km. long from Matarbari to Anwara. There will be a sub-zone office at Anwara. PCGB will try to give priority to the affected people. There is no such allocated percentage of employment from the local people, but priority will be given. There will be no office establish in the middle of transmission line. Offices will be established at Matarbari and Anwara. But priority will be given to the local people	**2. Electrification** - Electrification of surrounding area will be examined. **4. Compensation** - Developing an appropriate "compensation plan" - Land acquisition should be conducted in compliance with relevant laws and regulations - After construction towers, land owner can cultivate under it. - Compensation should be conducted in compliance with relevant laws and regulations
One of the participants from Barunchara Union from the stakeholders raised the following questions: 1. There will be any effect on environment for the construction of towers? 2. About 2000 peoples of Barunchara Union are not getting electricity facility, whether those people will get electricity, if this line is constructed?	1. Dust may fly in the air due to moving vehicle and people at the time of erection of transmission tower, otherwise there will be no effect on environment. 2. After completion of this project electricity will be given to the people who are not getting electricity now.	**2. Electrification** - The same as those addressed in "Md. Abdul Mobin"
One of the stakeholders wanted to know whether the local people will get the electricity or not	The demand of electricity will be met, if the proposed power plant will be constructed here. As mentioned earlier there is shortage	**Electrification** - The same as those addressed in "Md. Abdul Mobin"

Comments	Response	Reflected in Environment Management Plan
	of power, but most of the people will get electricity, who are not getting it now.	
Land owner, No.5 Barunchara Union made the following questions: 1. The compensation will be given for the land inside the footings of towers as per present govt. rules. But the land could not be sold or transferred to anybody after erection of tower on it. Although the land owners will use it but cannot construct house on that land and they will face various problems. PGCB have made the master plan for it. If PGCB make the law and arrange to make payment at least the actual price of the land to the land owner, then the land owner will be benefited. He wanted to know whether they will recommend the above issue or not. 2. PGCB has the big program to construct the tower line, whether any activities to be done at the end of land owners for this work?	The payment can be made for the land. For this, PGCB shall recommend to the ministry. PGCB shall try our utmost to make payment even by modifying the present rules. The priority will be given to the land looser for employment, but cannot be sure at this moment.	**1. Compensation** - Developing an appropriate "compensation plan" - Land acquisition should be conducted in compliance with relevant laws and regulations - After construction towers, land owner can cultivate under it. - Compensation should be conducted in compliance with relevant laws and regulations

(Source: JICA Study Team)

3) Focus Group Discussion

Table 15.5-11 Main Comments and Reflected in Environment Management Plan (from 18, 19 and 21 December of 2012)

Target	Comment	Reflected in Environment Management Plan
Female group of five members (Jaliakata Village, Barabakia Union, Pekua Upazila, Cox's Bazar District)	a. All of five members were illiterate. b. Four of them had suffered from malaria. Respiratory problems, general fevers were commonly seen. They went to Upazila Health Complex for medical treatment. c. None of them had jobs. d. Two of their husbands were salt laborers. Two were daily laborers, and the rest one was agriculture laborer. e. Their husbands' income varied from Tk 4,500 to 6,000 per month. f. They collect information through NGO workers and neighbors. Not from TV or radio. g. Their houses were made of clay and thesis. h. They took water from tube wells for	**Electrification** - Electrification of surrounding area will be examined.

Target	Comment	Reflected in Environment Management Plan
	cooking and drinking purposes. They had ring-slab latrine (hygienic latrine). i. Three had no electricity yet. Two had lighting only by solar panels.	
Children group of five members (Chutachuda Village, Uzantia Union, Pekua Upazila, Cox's Bazar District)	a. All of them could read and write, ranging from Class ii (seven years old) to Class vi (ten years old). b. Respiratory problems and general fevers were commonly admitted among all children. Diarrhea and stomachache were admitted among three of them. They went to Upazila Health Complex for medical treatment. c. None of them had jobs. d. They collect information through TV, neighbors and their teachers. e. Two of their fathers were involved in fishing. Two were daily laborers, and the rest one was rickshaw puller Their fathers' income varied from Tk 5,000 to 20,000 per month. f. Their houses were made of clay. Two had tin as their roof material, and three had thesis. g. They took water from tube wells. They had ring-slab latrines. h. Three had no electricity yet. Two had lighting only by solar panels.	**Electrification** - Electrification of surrounding area will be examined.
Farmers Group of eight members (Baroum Chara Village, Baroum Chara Union, Anowara Upazila, Chittagong District)	a. Their ages ranged from 28 to 65 years old. All of them were married. b. All of them could read and write. The lowest education level among them was Class v, and the highest was H.S.C. c. All of them saw quack doctors for general diseases. They went to private doctors in Bottoli and Chittagong for more complex diseases. Six of them suffered from general fevers, diarrhea/stomachache, and respiratory diseases d. All of them were involved in agriculture. Most of the villagers depend on agriculture. Their secondary livelihood means vary from Imam, UP member, travel agent, and construction worker. e. Their income ranged from Tk.4,000 to 20,000. f. One of them had solar panels at home. Others had no lights at home. g. All of them had water from tube wells for cooking and drinking purposes. h. Two lived in bamboo-made houses. Three lived in permanent houses. Two	**Electrification** - Electrification of surrounding area will be examined.

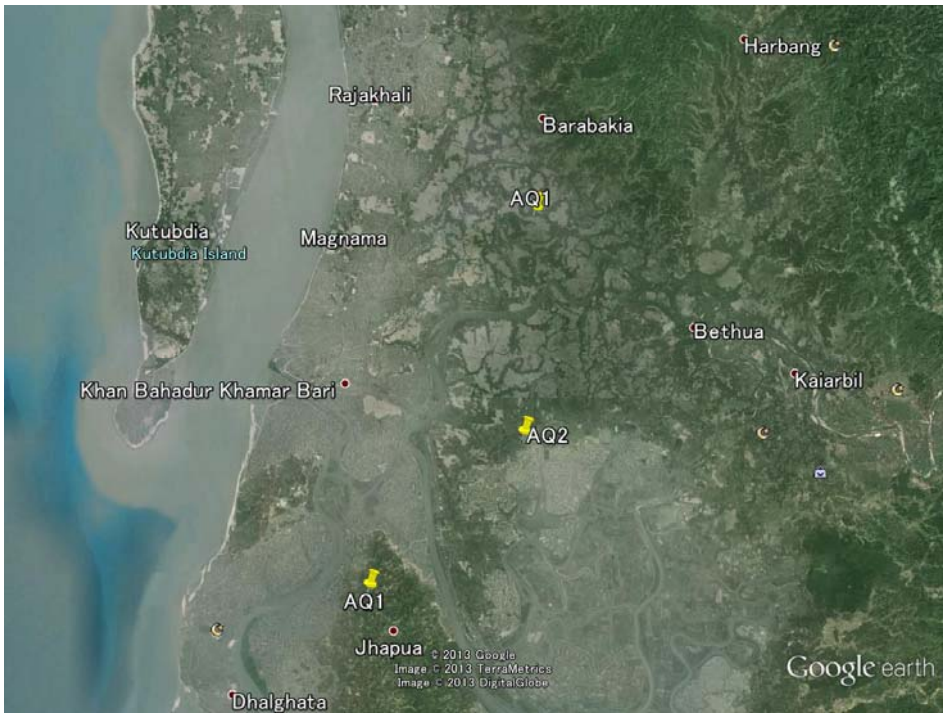
Target	Comment	Reflected in Environment Management Plan
	lived in clay-walled house. One lived in a house made of thesis and tin. Four of them had ring-slab toilets, the rest had pucca toilets..	

(Source: JICA Study Team)

15.5.3 Access road

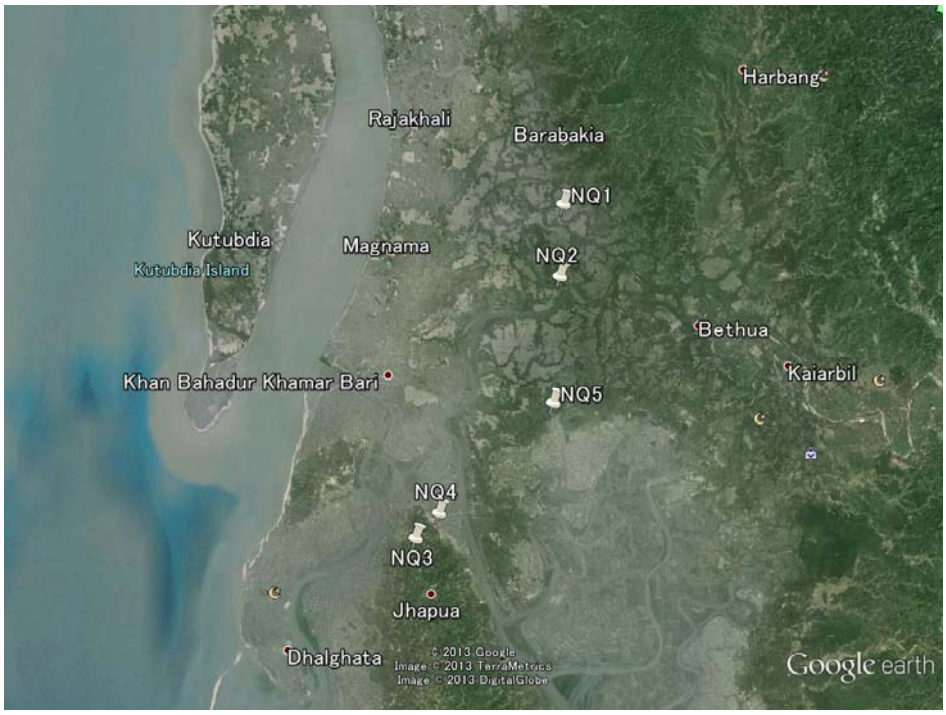
(1) Pollution Control

Locations of conducted environmental baseline surveys on the pollution control items are shown from Figure 15.5-17 to Figure 15.5-22. (Source: JICA Study Team)



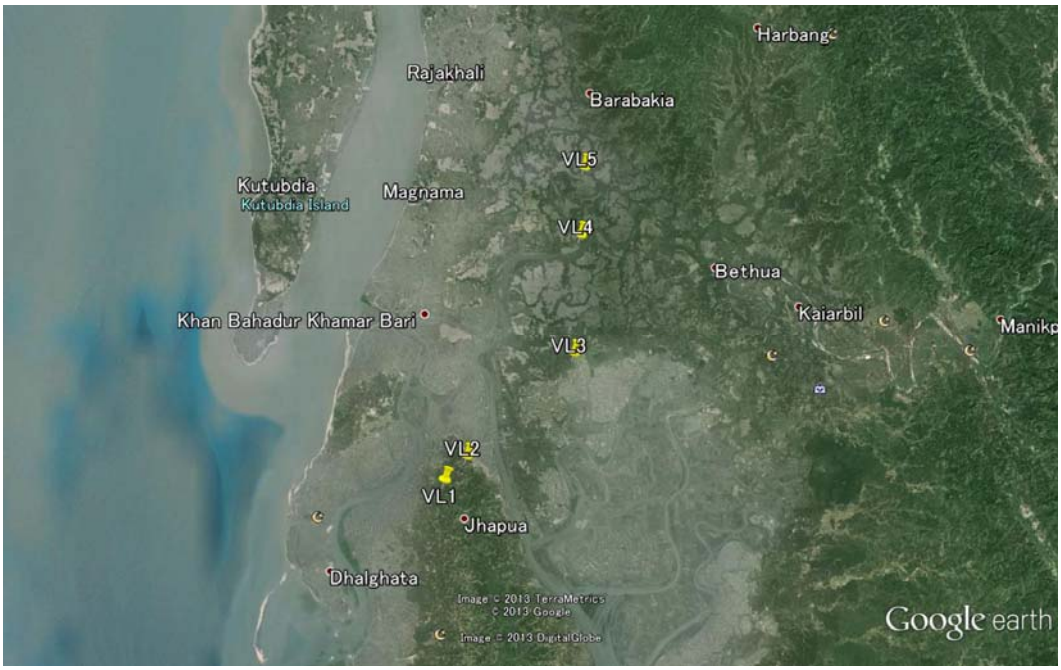
(Source: JICA Study Team)

Figure 15.5-17 Locations of Air Quality Survey



(Sorce: JICA Study Team)

Figure 15.5-18 Locations of Noise Survey



(Source: JICA Study Team)

Figure 15.5-19 Locations of Vibration Survey

(Source: JICA Study Team)

Figure 15.5-20 Locations of Surface Water Quality Survey

(Source: JICA Study Team)

Figure 15.5-21 Locations of Ground Water Survey

(Source: JICA Study Team)

Figure 15.5-22 Locations of Sediment Quality Survey

1) Air Quality

The existing ambient air quality of the study area was monitored at three (3) locations during the dry and rainy season monitoring period. The monitoring parameters included Particulate Matter (PM_{10}), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO) and Ozone (O_3).

a) PM_{10}

During monitoring periods of dry and rainy seasons, 24 hourly average PM_{10} concentration in ambient air in the study area was recorded in the range of 31.43 - 64.72 μg/m^3 and 24.51-40.65 μg/m^3. The maximum PM_{10} concentration was reported from Illisha bazar as 64.72 μg/m^3 and 40.65 μg/m^3 respectively. 24 hourly National Ambient Air Quality Standard (NAAQS) for PM_{10} in Bangladesh is 150 μg/m^3.

b) SO_2

The 24-hourly SO_2 concentration was recorded in the range of 4.71 - 6.72 μg/m^3 and 2.45 - 4.34 μg/m^3 respectively during the dry and rainy season monitoring period. During the monitoring period, the maximum SO_2 concentration is reported at Ilisha bazar as 6.72 and 4.34 μg/m^3. SO_2 concentrations at all the monitoring locations were reported well below

365 μg/m^3, which is a 24 hourly National Ambient Air Quality Standard (NAAQS) for SO_2 in Bangladesh.

c) NOx

During monitoring period of dry and rainy season the 24 hourly NOx average concentration in ambient air in the study area was recorded in the range of 13.65 - 21.35 μg/m^3 and 9.52-15.46 μg/m^3 respectively.
During the monitoring period, the maximum NOx concentration is reported at Ilisha bazar as 21.35 and 15.46 μg/m^3. There are no stipulated standards for 24 hourly NOx concentration in Bangladesh The annual Bangladesh standard guideline value for NOx are 100 μg/m^3 and present concentrations at all the locations are well below these values.

d) CO

The 8 hourly average CO concentration was recorded below 2 ppm. CO was reported low at all the monitoring locations while comparing with the Bangladesh Standards (9 ppm).

e) O_3

The 8 hourly O_3 concentration was recorded in the range of 22.4 - 35.7 μg/m^3 and 16.86 - 27.97 μg/m^3 respectively during the dry and wet season monitoring period. During the monitoring period, the maximum O_3 concentration is reported at Ilisha bazar as 35.7 and 27.97 μg/m^3. O_3 concentrations at all the monitoring locations were reported well below 157 μg/m^3, which is a 8-hourly National Ambient Air Quality Standard (NAAQS) for O_3 in Bangladesh.

2) Noise

Noise level was measured during 6th - 14th May 2013 in dry season and during 7th - 10th June, 2013 in rainy season.
At every location and phase, average noise level satisfied the Bangladesh Standard.

3) Vibration

Vibration level was measured on 5th May 2013 in dry season and 14th June, 2013 in rainy season.
The frequency was in a range of 4 - 40 Hz.
There is no vibration standard in Bangladesh, but the frequency value is popular in normal

environment, and there were no significant sources of vibration.

4) Surface Water Quality

Sampling Date is 29th March, 2013 in dry season and 4th June, 2013 in rainy season at three locations in Kuhelia River.

The surface water Quality was compared with the Bangladesh ECR standard for best practice based classification criteria. As per the best practice based classification standards of the Bangladesh ECR, the quality of most of the surface water samples from the river is of a level that can be utilized for fisheries, industrial process and for irrigation. Some of the water analysis parameters are discussed below in detail:

a) pH

All results for pH in surface water fell within the permissible limits of 6.5 to 8.5.

b) Dissolved Oxygen (DO)

The DO of the river water samples ranges between 7.1 to 7.5 mg/l for dry season and 7.3 - 7.4 mg/l for rainy season and thus meets the surface water classification for different usages.

c) BOD

The BOD levels range between 3.2 to 4.0 mg/l and 2.7 to 2.9 mg/l for dry and rainy season respectively. The values were below the permissible limits.

5) Soil (Groundwater Quality)

Four groundwater samples were collected from the borewells in close to the proposed bridge and Younuskhali village on 29th March, 2013 in dry season and 4th June, 2013 in rainy season.

The key parameters in groundwater are discussed below, compared with the Bangladesh ECR Standards for drinking water.

a) pH

The pH of the samples varies in the range of 6.5 to 6.8 and 6.5 to 6.6 for dry and wet season respectively which are well within the standard range of 6.5 to 8.5.

b) COD

The COD of both two ground water sample varies 5.2- 5.9 and 4.6 – 5.5 mg/l for dry and wet season which are exceed the permissible standard of 4 mg/l.

c) BOD_5

The BOD_5 content in the samples varied in the range of 0.55 to 0.63 mg/l and exceeds the permissible standards of 0.2 mg/l.

d) Arsenic

Arsenic content of both the samples are <0.005 mg/l which indicated the samples are free from arsenic.

6) Sediment Quality

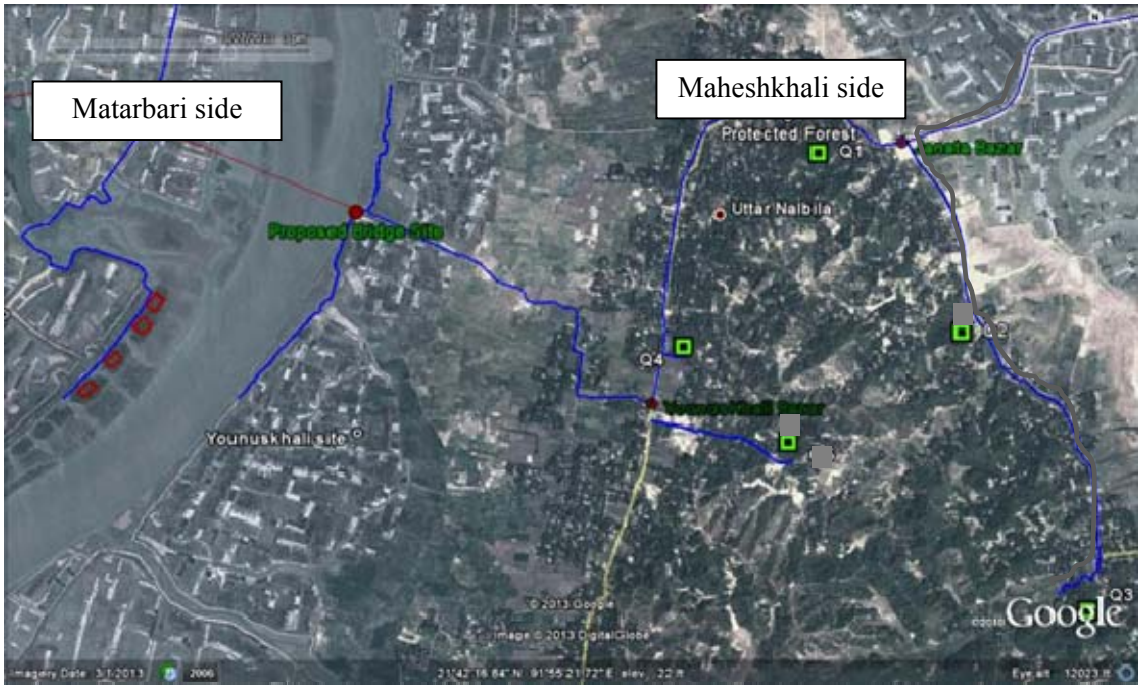
Three sediment samples were collected in Kohelia River on 29 March, 2013 in dry season and 4th June, 2013 in rainy season.
All samples have characteristics of sandy sediment, and there are no significant pollution.

(1) Natural Environment

1) Flora

a) Locations of Survey

Based on satellite image and field visit, various vegetation types in hill side forest area and few vegetation cover in the mangrove cluster near the proposed bridge area were studied. In important ecosystems, standardized transects will be established in order to assess species composition and vegetation structure.
Quadrate survey was conducted in the hill side forest and mangrove forest area to determine the biodiversity indices of the surroundings of the project area.
Location of quadrate survey and census route are shown in (Source: JICA Study Team)
Figure 15.5-23.



Legend: Census route, Quadrate, Mangrove

(Source: JICA Study Team)

Figure 15.5-23 Location of Quadrate Survey and Census Route

b) Terrestrial Vegetation

This hill side forest area has natural growing tree, herb and shrub. Also there are some homestead plants. Now this forest area is used for beneficial plantation. Planted dominant tree species are Akasmoni (*Acacia auriculiformis),* Eucaliptus *(Eucalyptus citriodora) etc.*
Janata bazar to proposed bridge site is approximately 5 km. There are planted tree along the road side from Janata bazar to Yununkhali bazar. The abundant species in this area is Akasmoni (*Acacia auriculiformis)*. Some natural growing herb and shrub (*Hyptis suaveolens, Clerodendrum viscosum)* also present in this area. Homestead like plant is present along the road side of Yunuskhali bazar to proposed bridge site e.g. Akasmoni (*Acacia auriculiformis),* Am (*Mangifera indica),* Kathal *(Artocarpus heterophyllus)* etc . Last 0.75 km approximately road side has no plantation and here some shrub and herb (*Clerodendrum viscosum, Leucas aspera, Rumex dentatus*) like species are present.
River bank side of the proposed bridge area is almost free from tree species. There are large number of salt cultivation land are present both side. In the Matarbari side there are totally 15-20 tree species of 5 family e.g. Coconut (*Cocos nucifera),* Koroi *(Albizia procera),* Eucalyptus *(Eucalyptus citriodora),* Paniala *(Flacourtia jangomas),* Khejur *(Phoenix sylvestris)* etc. But Yunuskhali side there is no plant species.

c) Mangrove forest

In the Matarbari bank there is a mangrove cluster and it approximately 0.60 km far from the proposed bridge site. The mangrove forest comprises only three types of plant species e.g. *Acanthus illicifolia, Ficus sp. and Sonneratia apetala.* Hargoja *(Acanthus illicifolia)* is the most abundant species in the mangrove forest.

2) Fauna

a) Mammals

a. Methodology

The survey was conducted to follow "Observational methods" including imaging by digital camera, identification of dung, tracks and others signs, night walks. Sometimes indigenous knowledge (especially from hunters) is shared to prepare preliminary list of species and/or help with identification of signs.

b. Result

Among the mammals, 11 species were recorded under 09 families. Almost all large mammals are facing habitat predicament due to human pressure. Common mammals that were found in the hill side forest area are *Herpestes javanicus, Macaca mulatta, Vulpes bengalensis, Cynopterus sphinx* etc.
Along the mangrove forest no mammals were seen during field survey. The mangrove forest totally inundates at high tide and there are no safe locations for wild animal to move.
Along the road side *Herpestes javanicus* was seen and local people stated that there are some *Vulpes bengalensis* species near the jungle of road.

b) Amphibians and Reptiles

The study area was divided into few categories according to the habitat that were required by these species and surveyed by transecting line methods, opportunistic searching method, sampling at breeding sites, nocturnal searches etc.
In the hill side forest, no amphibian and reptile were seen.

c) Birds

The field survey was conducted by setting up a single line at each site called a transect. Birds can be identified either visually, by their calls or digitally recorded. This method

involves identifying all the birds seen or heard while standing at a series of points along a transect (a straight line through the site). Bird counts were conducted at the start of first light which is before sunrise when birds vocalize most, and is known as the 'Dawn Chorus'. It is also a time of maximum bird movement as birds move through the bush to begin feeding.

The hill side forest area and mangrove forest were good condition for resident birds; local people told that some migratory birds come in this area at winter season. But during the field survey there were no densely bird species in the hill side forest along or nearby the road.

A total of about 13 bird species were observed within the hillside forest, along the road and bank side.

The mangrove forest seems to be safe and densely habitat for bird species. *Phalacrocorax fuscicollis, Ardeola grayii, Ardea alba modesta* are the most common species in the bank side. At high tide most of the aquatic birds stay at mangrove forest. During the low tide they come from the forest for catch fish, insect or others.

d) Benthos

Sediment sample was collected at sampling station in Kohelia Riveshown in (Source: JICA Study Team)
Figure 15.5-25 on 28 March, 2013 in dry season and 4 June 2013 in rainy season.

At every location Polychaetae or Oligochaeta was dominant.

(Source: JICA Study Team)

Figure 15.5-24 Locations of Aaquatic Benthic Animals Survey

3) IUCN Red List

Every species of fauna and flora were referred to IUCN Red List and confirmed that there are no species listed as threatened.

(3) Socio-economic environment

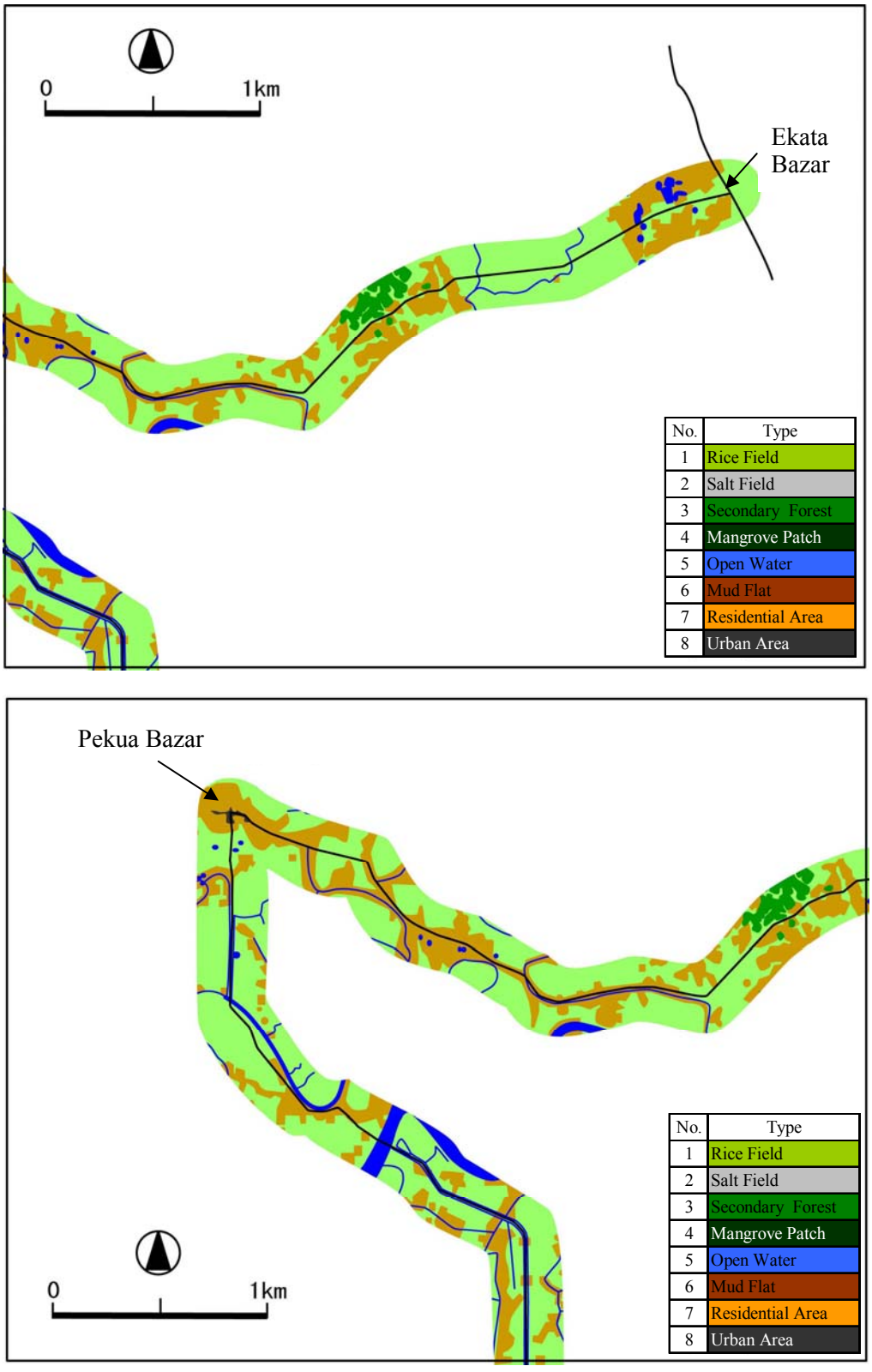
1) Land Use

The surrounding areas along all the candidates of access road have been mostly cultivated into rice fields, salt fields, residential areas, urban areas, ponds or channels with low biodiversity. Some crop fields of vegetables and mustards were also seen among rice fields. Planted palm trees and fruit trees such as mango and banana, stand tall around houses in the residential areas. Eucalyptus tree are also planted in the residential areas and along the existing road for shoulder protection. Forest area or secondary forest distributes in the limited area on hilly area. There is no natural forest along the candidates. In the urban areas both sides of the road are lined with stores and shops with few or no vegetation.
The following vegetation and land use types were identified along the candidates of access road.

Table 15.5-12 Types of Vegetation and Land Use along Access Road

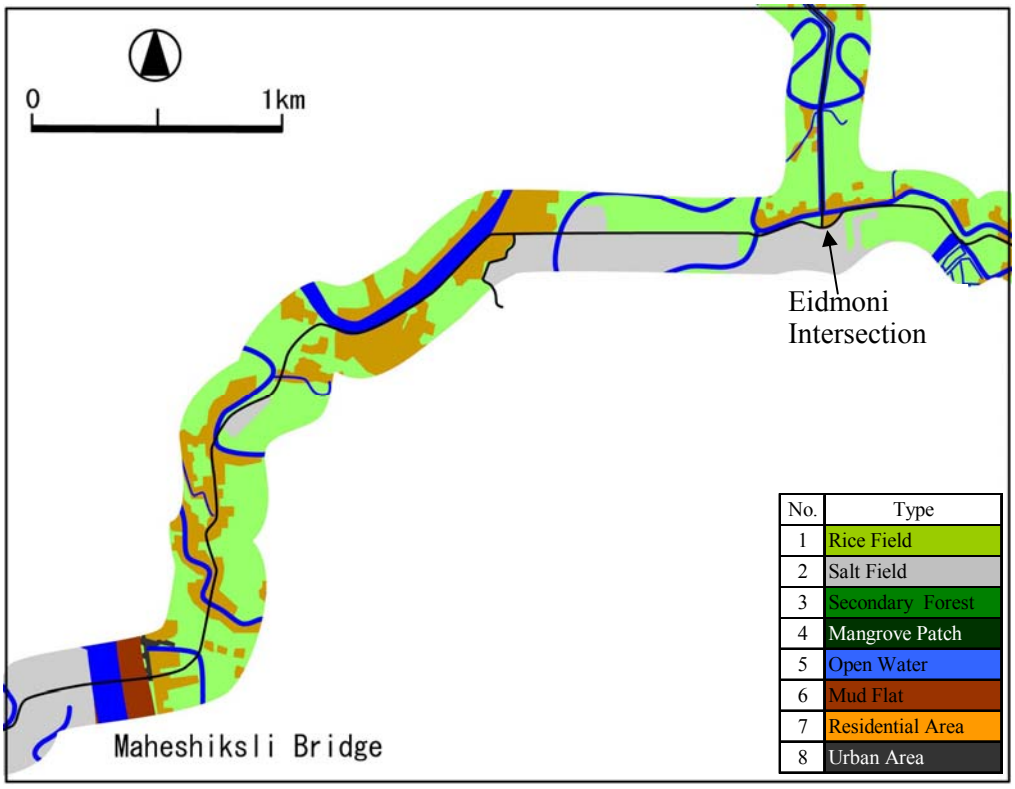
No.	Type	Notes
1	Rice Field	Rice fields, some other crop fields.
2	Salt Field	Salt field.
3	Secondary Forest	Tall tree forest on low hills
4	Mangrove Patch	Patches of mangrove trees on the bank along Kuhelia River
5	Open Water	Rivers, channels and large ponds
6	Mud Flat	Mostly seen along Kuhelia River.
7	Residential Area	Houses and gardens with planted tall fruit trees
8	Urban Area	Market Areas, paved roads

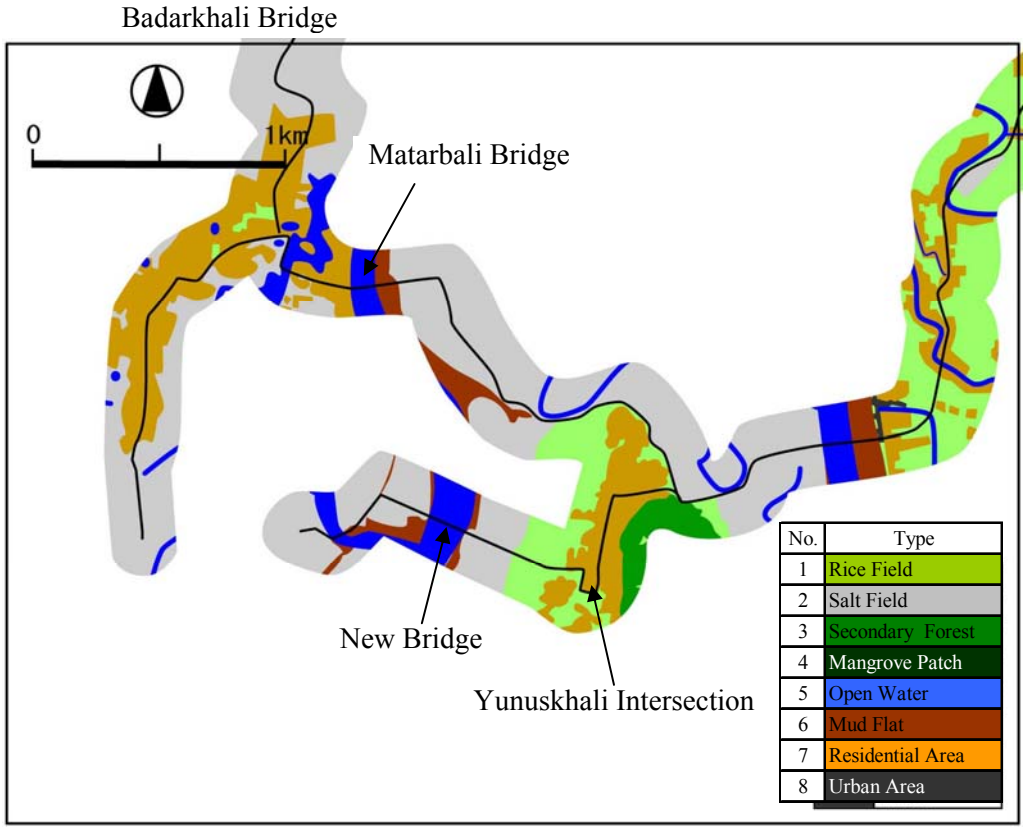
(Source: JICA Study Team)



(Source: JICA Study Team)

Figure 15.5-25 Types of Vegetation and Land Use along Access Road (1)





(Source: JICA Study Team)

Figure 15.5-26 Types of Vegetation and Land Use along Access Road (2)

2) Socio-economic Condition along Access Road

Density of population in the locality is not very high compare to other densely populated parts of Bangladesh. Local people are both from educated and non-educated. The area has many primary and secondary schools and set up of a college is under process. Huge number of Madrasha (religious schools) is there along with mosques where religious educations are offered. Many primary schools are there in the multipurpose shelter houses constructed in the area to address the emergency needs of cyclones and tidal bores. The area is a disaster prone area as many cyclones and tidal bores affected the area in the past. People in the area seem to be more orthodox compare to other parts of Bangladesh. Child girl students also wear scarf while going to school or Madrasha. Some little boys who have not even crossed their childhood also wear cap for full time which is an indication of bigotry. People are more orthodox in terms of rituals but less religious in terms of maintaining social solidarity or peace in the locality. Peace is less and thereby investment in the area is also less.

These days farmers who have no family labour do not go for land cultivation as that is not profitable to them. As a result, leasing out of land on annual rent basis is a common practice in the area. For salt cultivation each Kani (40 decimals) is leased out at BDT 12,000 to 18,000 where for shrimp cultivation at BDT 2,000-3,000. Shrimp is less profitable than salt cultivation due to modern technique used for salt production at less cost. With the modern technique salt production per hectare has gone very high and thereby profit also increased, in return, land lease value has also increased. Per decimal arable land price is BDT 7,000-8,000 or per hectare BDT 250,000-300,000. Land price along the road varies widely depending on the location where in some places per decimal is BDT 15,000-20,000. In the case of homestead land it is about BDT 30,000-35,000.

Some 20% households have migrant members outside the country, who are dependent on remittances. They are mainly working in Saudi, Dubai, Malaysia, Oman, etc. These people have less dependency on farming; as a result, affect to the family income would be less due to land acquisition or other interventions from the project side.

Women do not work in the field very often. Sometimes poor women, widows, divorcees work as day labourer in the field as well as road maintenance workers. Frequently they do not go for shopping or marketing in the local bazar. Women headed households also share with the neighbors to fulfill their shopping or marketing needs as maximum as possible to avoid teasing or harassment from the male members of the society. Women hawkers also sell some commodities in the village visiting door to door.

Presence of NGOs is there in the locality including all national level NGOs. The area is also known for operation of Muslim NGOs who were rendering services specifically to Rohinga refugees and other local Muslim people. All kinds of welfare activities are done

by those NGOs. People in the area are also positive to the NGO activities. Other local level institutions are also there about which more detail to be investigated.

3) Socio-economic Condition of Bridge Construction Area

Matarbari Island is situated in the north west of Maheshkhali Island. Many parts of this island are at stake because of unplanned shrimp farming and natural disasters. This island is rich in shrimp farming and solar salt pans. There are also many fish farms (local name: ghona) scattered on this island. The island lies between 21º41´ N to 21º44´ N latitude and 91º46´ E to 91º52´ E longitude.

The power plant site is located in Matarbari Union and Dhalghata Union of Maheshkhali Upazilla. As of 2011, when the official census was conducted for the first time in ten years[9], there were 8,168 households (44,937 people: 5.5 persons per household) in Matarbari Union. The population density was 1,661 per square kilometer. In Dhalghata Union, there were 2,250 households comprised of 12,877 people (5.7 persons per household), and the population density was 644 per square kilometer.

Although the working population was involved in either agriculture or the service industry in Sairer Dail (51.4% and 48.6%, respectively), almost all people of Nasir Mohammaddhil were involved in agriculture industry (94.9%) comprised mainly of fishing, salt and shrimp cultivation. Inhabitants did not have necessary facilities for basic living conditions, in other words, they had one of the most deteriorated living conditions in both villages: 99.9% of the Sairer Dail population had drinking water from tube wells, only 11.5% were connected to electricity, 70.2% lived in kutcha houses, and 72.6% had non-sanitary toilet facilities. 100% of the population in Nasir Mahammaddhil depends on either tube wells or other sources such as pond water. 91.9% of them use non-sanitary latrine or no toilet facilities. 88.0% of them lived in kutcha houses or jhupri.

(4) Stakeholder Meeting and Focus Group Discussion

1) 1st Stakeholder Meeting

a) Objective

The 1st Stakeholder Meeting (SHM) was aimed at hearing the opinions and/or comments of individuals and organizations regarding the project, and understanding the needs of local residents, as well as appropriately reflecting those needs into the relevant survey. The followings are the main objectives of the SHM:

[9] The result of the Population Census 2011 is still provisional (as of March 2013).

- To disseminate the project outline and related activities to the project stakeholders
- To know the views of the stakeholders' about the project
- To identify the issues and remedies, if any, related to the proposed project during and after the implementation
- To know the project impacts (positive and negative) on the community
- To exchange views about the proposed project

b) Implementation Methodology

In accordance with JICA Guidelines for Environmental and Social Consideration, stakeholder meeting for the access road was held at the scoping stage of the feasibility study on the access road. The meeting was chaired by Upazilla Nirbahi Officer (UNO) and assisted by the JICA Study Team. The methodology of the meeting is shown in Table 15.5-13.

Table 15.5-13 Methodology of 1st Stakeholder Meeting

Item	Description
Date	21st March, Thursday 2013
Time	11:00am – 1:30pm
Venue	Upazilla Parishad Conference Room
Targeted Stakeholders	Local Government Officers Community leaders Local NGOs Local Elite People Local affected residents
Notification Method	Notification over phone call was done to all key stakeholders prior to the meeting
Number of Paricipants	58 parsons
Chairperson	Upazilla Nirbahi Officer (UNO)
Facilitator	Resettlement Specialist of JICA Study Team
Agenda	Registration Recitation of Quran Keep One Minute Silent for Respecting the Departed Soul of Honorable President of Bangladesh Welcome Speech by XEN, PDB, Cox's Bazar Speech of Special Guests (4 persons) Presentation of the Project by JICA Study Team Question & Answer Session Closing Speech and Thanks to all by the Chairman of the Meeting* Lunch

* (SHM program was shorten because of official leave declaration from 2.00pm local time for the three day mourning to the departed soul of Honorable President of Bangladesh)

(Source: JICA Syudy Team)

c) Results

At the meeting, a power-point presentation was given to the participants in their local language (Bengali), with a full explanation of the project work, to allow the audience to fully understand the project and contribute valuable comments. The main comments raised by the participants are as follows in the Table 15.5-14

Table 15.5-14 Results of 1st Stakeholder Meeting

Participants	Comments	Response
	Shared the nationwide necessity of electricity	(N/A)
	Road is indispensible for a nations development This access road will help the Moheshkhali people to reach Chittagong by 2 hour journey which may upgrade the economy of the Project area	(N/A)
	Electricity is our crying need at this moment in Moheshkhali as because the Moheshkhali people get only 2 hours electricity services in a day JICA expert must look into the anticipated problems that may arise during and after the construction of the access road project	- Environmental Management Plan and Environmental Monitoring Plan will be built, and implemented during and after construction.
	Thanks to JICA for taking initiatives of Road construction in the remote village areas like Matarbari, Moheshkhali. The specific proposals are; - Road from Rangakhali to Mohori Gona Ghat, Dhalghata through existing embankment - Connecting road from Rangakhali to west Matarbari existing embankment	- Proposed road is not scope of the access road, but it will be considered in future. - The access road will be connected to the circuit road of the power plant, and these roads will connect the east and west side of Matarbari Island completely.
	Local development depends on the good communication systems Specific proposals and info: - Most of the settlements are in and around the existing big Pond - Existing road widening will encroach many houses - Jetty at Bahonaghata (Nayaghata) which is maintained by local people shall be taken into consideration during and after the road construction of the project - Proposed road can be straight if it starts before the Yunuskhali Bazar point of Kalarmarchara Road i.e. at the causeway	- Proper measurement, for example guide walls will be considered. - Widening will be conducted carefully. - The function of Jetty will be carefully considered through public consultations. - The proposed road route will cause resettlement for several households.

Participants	Comments	Response
	point	
	Many private land owner will be affected by the Power Plant project The proposed road will not be helpful for the Matarbari people Road construction at the proposed location for the Matarbari is immaterial and for no use	- Power plant issue - The access road will connect the east and west side of Matarbari Island, and benefit Matarbari people.
	Road crossing through hilly areas should consider Mitigation Measures like retaining wall etc. Matarbari is a siltation prone area. Study on siltation of the Kohelia River should be taken into consideration so that bridge construction over the Kohelia River does not create any damage to the Bridge adjacent areas Mangrove forest should be considered carefully so that no damage is done during and after the development A full scale EIA shall be prepared for this project and with that the Environmental Clearance have to be collected from DOE before construction of this project	- Drainage measurement will be considered. - Topographical and morphological study will be conducted. - The bridge alignment has been considered about the mangrove forest and sifted to north to avoid impact on it. - EIA study is conducted as 'Red Category' in Bangladeshi regulation.
	I received mixed reactions from my local people on the issue of Access Road Construction I'm one of the affected persons who will lose around 30-40 Kani of land for the Power Plant construction If environmental deterioration does not prevail due to road construction then I have no objection as I'm not a scientist to assess the affects This road construction is only for the Power Plants use not for the local development The bridge construction is no more useful for the local people as because an existing bridge is now workable and still doing well for us A leaflet was distributed among you for sharing the bad effects of the power plant at Matarbari and my people like to know from this meeting about the environmental effect of the construction of the Power Plant and Its access road. If the power plant is not environmentally viable then the access road may not be acceptable to us.	- It will be considered on environmental and social impact on road construction and operation. - This access road including road and bridge will benefit people not only Matarbari but also Dhalghata and Kalarmachara. - As the leaflet was not specified on the Matarbari site and included some misunderstanding, proper explanation will be done. **The explanation was done in the second SHM for the power plant.*
	For this access road development work; Initial Environmental Examination (IEE) will be done. Environmental Impact Assessment (EIA) will be done following the IEE. Advantages, disadvantages of local people	

Participants	Comments	Response
	during construction and maintenance of roads shall be noted in EIA study and for that the Environmental Management Plan (EMP) will be prepared. At the end, the environmental clearance of DOE will be taken, complying with the DOE procedures for starting the construction work in the project site.	
	More fruitful discussion was possible to do as maximum participants from different corners of the project assembled here to place their views. But sorry for wrapping this program before our schedule due to the declaration of three days national mourning for the death of Honorable President, GOB. Electricity is essential and we feel the electricity when it is absent. Government is trying to generate electricity all over the country to minimize the demand of electricity. Matarbari and Dhalghata is indivisible, neglected island and with the installation of power plant, deep sea port and other associated infrastructural development i.e. road construction, embankment etc. of the area will increase. Power plant project at the Dhalghata will be well protected by the CPGC The Dhalghata, Matarbari area will be safe from natural calamity JICA will ensure the top up compensation for the project affected peoples (PAPs) and the transportation cost, rehabilitation cost will be orderly done to ensure the PAPs compensation.	
	SHM was concluded by Chairperson.	

(Source:JICA Study Team)

2) 1st Focus Group Discussion (FGD) in Scoping Stage

The access road project will directly involve Kalarmachara Union and Matarbari Union, and indirectly but closely involved Dhalghata Union, and Matarbari Union and Dhalghata Union requested strongly to hold consultation meeting at each union to be enable to gather many local people. Therefore Focus Group Discussion (FGD) at each Union was planned and held instead of public consultation meeting.

Outline of FGD is shown in Table 15.5-15

Table 15.5-15 Outline of 1st FGD in Scoping Stage

Item	Kalarmachara Union	Matarbari Union	Dhalghata Union
Date	16 April 2013	26 April 2013	25 April 2013
Time	4:20 pm – 5:00pm	12:10 am – 3:40 pm	10:45 am – 1:00 pm
Venue	Union Parishad Auditorium, Moheshkali Upazilla office	Magdil Bazar in Matarbari Union	Muhuri Guna Govt. Primary School in Dhalghata Union
Focused person	Representative of the union, Woman, Intelligent people		
Participants	Local people: 7 persons including the Chairman	Statement opinion: 6 persons Total participants	Statement opinion: 6 persons Total participants: 42 persons
	Facilitator, Government and Local government officer, JICA Study Team	Facilitator, Government and Local government officer, JICA Study Team	Facilitator, Government and Local government officer, JICA Study Team

(Source: JICA Study Team)

a) Kalarmachara Union

The results of FGD in Kalarnmachara Union is shown in Table 15.5-16.

Table 15.5-16 Results of 1st FGD in Kalarmachara Union

No	Comments by participant	Comments by facilitator	Response
1	For any work, people participation, awareness and motivation should be required. So the client should do work with very close contact with local representative (i.e. Chairman, member and other elite persons).	Implementing agencies will work accordingly to local representative.	Coordination will be continuously made with local authorities to improve the local infrastructure.
2	At the intersection of the proposed access road at Yusushkhali bazar, there is a grave yard. They request not to touch that point, as this is very sensitive point. Other than in the Access road no historical/ archaeological site/other important places are there and also there is no potential risk and sensitive issues at and around the access road.	Detailed alignment should be made as not to touch this sensitive area.	Road alignment will be fixed upon sensitive area's consideration.
3	For the access road expansion land need to be acquired, for that reasons many complexities about owners' information will arise. For this reason joint verification team for original land owner identification is required for proper compensation.	Original land owners list will be identified through local land office and then DC office.	Developing an appropriate "land acquisition and resettlement action plan", including "livelihood restoration program".
4	For the land acquire for road development, take minimum land so that the affect will be less to the land owner.	JICA have policy to make minimum affected people of acquired land.	Developing an appropriate "land acquisition and resettlement action plan", including "livelihood restoration program".
5	Proper compensation should be provided to the land owner. Government compensation is not sufficient.	The compensation will made through Bangladesh and JICA guidelines.	Land acquisition and resettlement action plan will be developed through Bangladesh and JICA guidelines.
6	The soil condition is not good at that area. That's	Road design Engineer	For Road design, the guidelines are

No	Comments by participant	Comments by facilitator	Response
	why proper design for the road and proper protection need for the road. They also suggested for Guide wall for the road construction.	will consider this issues and design in proper way to protect the road.	as follows: BRRL manual (Bangladesh) , Japanese Guidelines, AASHTO (USA), etc.
7	In every rainy reason, flash water come down from the hills and washed the road and also enters the water in closed residences. As there is no drainage system around the road. So proper drainage network should be construction along the access road.	Drainage system network will be developed, in according with the road design.	Adequate drainage system will be developed so that it can be used even in the rainy season.
8	Along the access road proper road protection design and construction and also box culvert construction (if any).	It will be consider in road design, if needed.	For Road design, the guidelines are as follows: BRRL manual (Bangladesh) , Japanese Guidelines, AASHTO (USA), etc.
9	Along the road there are two or three ponds, which is very old. At the ponds side proper protection work need to be design.	It will be consider in road design.	For Road design, the guidelines are as follows: BRRL manual (Bangladesh) , Japanese Guidelines, AASHTO (USA), etc.
10	Take proper action at the intersection and turning of the road.	It will be consider in road design.	For Road design, the guidelines are as follows: BRRL manual (Bangladesh) , Japanese Guidelines, AASHTO (USA), etc.
11	The Bohonaghata jetty was made by the local participation. If the bridge constructed at the point, the people depends or live there life with the income on the jetty will be deprived. For them, there should be some compensation to that people.	If required, the compensation will be provided according to the Bangladesh and JICA guidelines.	Developing an appropriate “land acquisition and resettlement action plan”, including “livelihood restoration program”.
12	At the time of construction of access road, there will be some disturbance and the air pollution will happen. So proper methodology of work should be engaged.	It will be consider in a social and environmental management plan.	Pre and Post construction and operation methodology will be develop.
13	The people of this union are very much concern about the health and education. They request us to provide medical facilities at a routine basis during the road construction.	Health facilities will be improved through proper management plan.	Pre and Post construction and operation methodology will be develop.
14	At the time of construction, the local people should get preference from any other for any work.	The project owner gave assurances that priority will be given to local people for employment in the project.	Employ local residents as much as possible.
15	At the end of the meeting, the participants told that they are very much happy for that access road. For any cooperation need, they will give all support at any time. They also said that for the development of this area, the road network should be developed. For the social, environmental and economic perspective, if proper management plan prepared and proper communication with the Chairman, local elite and local representative has done, then no negative impact will impact in this project. The people are waiting for the road development.	JICA will introduce proper Social and Environmental Management plan.	

(Source: JICA Study Team)

b) Matarbari Union

In the FGD for Matarbari Union, there was no specific comment on the access road, but many comments on the power plant.

c) Dhalghata Union

The results of FGD in Kalarnmachara Union is shown in Table 15.5-17.

Table 15.5-17 Results of 1st FGD in Dhalghata Union

No	Comments by participant	Comments by facilitator	Response
1	- This is very good approach and this project is approved by the Govt. of Bangladesh. - Good communication network will be developed by this Access road. - Dredging is required at the Rangakhali Khal. - Total embankment development in this area is necessary for disaster problern. - Green environment and environmental safeguard policy should be taken.	JICA Study Team will consider all sort of design for embankment protect, dredging of river and khal and also the environmental safe guard policy. JICA will assist to introduce proper Social, Resettlement and Environmental Management plan.	For Road design, the guidelines are as follows: BRRL manual (Bangladesh), Japanese Guidelines, AASHTO (USA), etc. BWDB's dredging guidelines will applicable. DoE, JICA and IFC guidelines will apply for Environmental and Social consideration. Pre and Post construction and operation methodology will be developed.
2	- Dhalghata road network should be developed. - Save Dhalghata people through proper protect. - Road up to the Shammardhil ghat under this project is needed. - Local people will get preference as employment at the time of construction.	The extension of road will be considered in future. The project owner gave assurances that priority will be given to local people for employment in the project.	Employ local residents as much as possible.
3	- After this project, the total area infrastructure and peoples life style will be changed. - At 1991 cyclone, 25ft water surge hit this area, so the embankment needs to be above the 25ft from ground level. - People are scared about this power plant project activity, so proper and appropriate consultation is required. - Drainage system should be improved due to water scoring. - Local land price will increase. - Employment will increase during and after	Road design Engineer will consider this issue and design in proper way to protect the road. Drainage system network will be developed, in according with	For Road design, the guidelines are as follows: BRRL manual (Bangladesh), Japanese Guidelines, AASHTO (USA), etc. Adequate drainage system will be developed so that it can be used even in the

No	Comments by participant	Comments by facilitator	Response
	this project. - For the development of the nature, impact on environment is less significant. - Employment of fisher man and salt/shrimp production people, should be considered at the before and after construction. - Ecological critical area need to be considered. - Total cooperation will be gotten from Dhalghata's people.	the road design. JICA will introduce proper Social, Resettlement and Environmental Management plan.	rainy season. Pre and Post construction and operation methodology will be develop.
4	- The economic and living standard of this area is not good condition. - Embankment development throughout the area is to be the main objective, under this project, as in 1991 cyclone lot of people died as there is area in un-protected. - Dhalghat's people are watching over this project and JICA, for the development. - Education will be developed if road communication is developed. - Power plant name need to change, both union names should be incorporated.	Road design Engineer will consider this issues and design in proper way to protect the road.	For Road design, the guidelines are as follows: BRRL manual (Bangladesh), Japanese Guidelines, AASHTO (USA), etc.
5	- Road design height should be considered according to the last flood water level. - Without road development, no development will arise. - The access road should be extended up to the Shammardhil ghat. - People are scared when rainy season come in every year. - Tree plantation for green environment along the access road.	Road design Engineer will consider this issues and design in proper way to protect the road. This issue will be considered in future. Proper Environmental Management plan will be built.	For Road design, the guidelines are as follows: BRRL manual (Bangladesh), Japanese Guidelines, AASHTO (USA), etc. Pre and Post construction and operation methodology will be develop.
6	- For the access road development, embankment needs to be developed. - Medical facilities need to be improved.	Road design Engineer will consider this issues and design in proper way to protect the road. Health facilities will be improved through proper management plan.	For Road design, the guidelines are as follows: BRRL manual (Bangladesh), Japanese Guidelines, AASHTO (USA), etc. Pre and Post construction and operation methodology will be develop.
7	- Dredging is required at the Rangkhali khal. At summer season the salt carrying boat cannot move due to low depth. - Dhalghata to Matarbari road need to develop. - Total surrounding area embankment need to be developed.	All sort of design for embankment protect, dredging of river and khal and also the environmental safe guard policy will be considered.	BWDB's dredging guidelines will be applicable.

No	Comments by participant	Comments by facilitator	Response
8	Chairman: - For the access road and power plant, Dhalghata people will give land. - This project is the dream of this area. - All kind of support and cooperation will get from the people of Dhalghata. - The access road should be extended up to the Shammardhil ghat.	The extension of road will be considred.	

(Source: JICA Study Team)

3) 2nd Stakeholder Meeting

a) Objective

The second stakeholder meeting was aimed at hearing the opinions and/or comments of individuals and organizations regarding the environmental impact and environmental management plan at finalizing stage of EIA report. The followings are the main objectives of the SHM:

- To know the project impacts (positive and negative) on the community
- To know the Environmental Management Plan and the Environmental Monitoring Plan
- To exchange views about the proposed project

b) Implementation Methodology

In accordance with JICA Guidelines for Environmental and Social Consideration, stakeholder meeting for the access road was held at the scoping stage of the feasibility study on the access road. The meeting was chaired by Upazilla Nirbahi Officer (UNO) and assisted by the JICA Study Team. The methodology of the meeting is shown in Table 15.5-18.

Table 15.5-18 Methodology of 2nd Stakeholder Meeting

Item	Description
Date	1st August, Thursday 2013
Time	11:30am – 2:00pm
Venue	Upazilla Parishad Conference Room
Targeted Stakeholders	Local Government Officers Community leaders

Item	Description
	Local NGOs Local Elite People Local affected residents
Notification Method	Notification over phone call was done to all key stakeholders prior to the meeting
Number of Participants	71 persons
Chairperson	Upazilla Nirbahi Officer (UNO)
Facilitator	Resettlement Specialist of JICA Study Team
Agenda	1) Registration 2) Recitation from the Holy Quran 3) Welcome Speech by Manager, CPGCBL 4) Presentation of the Project by JICA Study Team 5) Participants' Opinion and Sharing about Project, Facilitated by Resettlement Specialist of JICA Study Team 6) Speech of Special Guests 7) Speech of Chief Guest 8) Speech of Host 9) Closing Speech and thanks to all by the Chairman of the Meeting

(Source: JICA Study Team)

c) Results

At the meeting, a power-point presentation was present before the local participants in their local language (Bengali), with a full explanation of the project work, to allow the audience to fully understand the project and contribute valuable comments. The main comments raised by the participants and then responded/shared by JICA Study team are listed in Table 15.5-19.

Table 15.5-19 Results of 2nd Stakeholder Meeting

Participants	Comments	Responses/Sharing
		Shared the nationwide necessity of electricity Invited all participants for the constructive discussion on the project work
Environmental Expert, JICA Study Team Present the Presentation of the SHM-2		
Resettlement Specialist, JICA Study Team Facilitate the SHM-2		
	Is there any measures taken to keep the existing Graveyard & Canal undisturbed at the Yunuskhali Bazar? Make sure that some small ponds and a big pond along the existing roadside will not be affected by the Access road. Existing drain which is now used for the irrigation purpose shall be avoided or not?	The access road is designed in a way that the existing Graveyard and Canal will remain untouched. The access road is especially designed to save the possible small ponds and the big pond along the route with retention wall and there the top width of the road will be properly maintained. The existing drain is fully avoided. The road is designed with required box culvert, regulator, sluice gate etc. to

Participants	Comments	Responses/Sharing
	Existing salt field/shrimp field will be affected for the project or not? What measures are to be taken for the possible marginal land owners of the project? Is there any special measure for the embankment protection?	produce the minimum intervention of the existing setup. And possibly the salt field/shrimp field will not be affected due to this access road project. The project will follow the minimum land use policy and in the unavoidable circumstances the possible marginal land owners will get the top up compensation (i.e. land price with financial aid), even for the construction material deposition temporary land shall be requisitioned With proper Hydrological study the embankment shall be designed to protect the embankment from erosion, surge effect etc.
	Fish hatchery/Shrimp Cultivation/Salt cultivation/4Production Tube-well might be in the project area What compensatory measures shall be taken for?	JICA principally avoid the private land use and resettlement for any project The possibility of the affect are underway to evaluate through socioeconomic and resettlement field survey The minimum private land is accepted for this project and the top up compensation shall be made for that
	Experience of past project compensation for the PAPs are not so good in Bangladesh What is the fate of the PAPs compensation in this project?	Nowadays the Project compensation is made before the start of any project work JICA has special care for the compensation of PAPs
	Land for the best quality road is not a problem for the local people	JICA is doing this project with best quality design and minimum land acquisition as because JICA don't encourage any resettlement
	Khash land (Government Land) shall be used than of Private land	JICA always encourage to use the Government owned land
	Road width shall be maintained in a way that the heavy vehicle can easily travel Local people shall get first priority to get the job opportunity of the project work during construction	Two lane 7.3m crest width road is designed for this project Local people will have the utmost priority to get the project job opportunity
	Crash Program for compensation should be taken for this project	Crash program shall be taken for compensation
	Jetty construction at the Bridge site shall be constructed so that existing waterway can be used Beautification of the Bridge site shall be made to encourage the tourism	Jetty at the Bridge side is approved by the RHD and beautification of the bridge site
	Women labor shall have the opportunity to get Job in this project	Women labor will get the priority to be employed during the construction of the project work
	RHD should design a sustainable road	Design of sustainable road is underway

(Source: JICA Study Team)

4) 2nd Focus Group Discussion (Finalizing stage)

The 2nd Focus Group Discussion (FGD) at each Union was planned and held instead of public consultation meeting.
Outline of FGD is shown in Table 15.5-20.

Table 15.5-20 Outline of 2nd FGD in Finalizing Stage

Item	Kalarmachara Union	Matarbari Union	Dhalghata Union
Date	25 July 2013	27 July 2013	26 July 2013
Time	10:45am –12:45am	10:15am –12:15am	11:40am –1:00pm
Venue	Kalarmarchara Union Parishad Office	Rajghat Government Primary School	Muhuri Guna Govt. Primary School in Dhalghata Union
Focused person	Ward Member (Male & Female), School Teacher, Religious Leader, Political Leader, Social Worker		
Participants	Local people: 25 persons	Local people: 31 persons	Local people: 22 persons
	Facilitator, Government and Local government officer, JICA Study Team	Facilitator, Government and Local government officer, JICA Study Team	Facilitator, Government and Local government officer, JICA Study Team

(Source: JICA Study Team)

a) Kalarmachara Union

The results of FGD in Kalarnmachara Union is shown in Table 15.5-21.

Table 15.5-21 Results of 2nd FGD in Kalarmachara

Item	Topics	Response
1.	Damages of House Structures	If there are, they will be compensated
2.	Compensation of the Damages	It will be Covered by RHD
3.	Top up compensation should be made before the start of the Project Work	It will be Covered by RHD
4.	No objection for this project would come from the local people if everything goes well as per suggestion above	N/A
The pros of the project were deliberately shared by the participants with the following points:		
5.	Communication between Dhalghata and Matarbari will be developed i.e. most of the Dhalghata people and 2/3rd of the Matarbari people will use the new proposed bridge & road as because the existing bridge is not much functional to them at present.	N/A
6.	Fish/salt transportation of Dhalghata, Matarbari and Kalarmarchara will be easier and ultimately this road will promote the business of these areas.	N/A

Item	Topics	Response
7.	Dropout of school going children will decrease.	N/A
8.	Female education will increase which will help to increase the total education rate of the project areas (female >male).	N/A
9.	Transport cost will be reduced remarkably	N/A
10.	Business centre will develop along the new road and Bridge ends	It will be considered by RHD and CPGCBL
11.	Migration of people (climate refugee) from Matarbari and Dhalghata will decrease	N/A
12.	Tourism will get a new shape for the construction of a new Bridge over Kohelia River and connectivity between Matarbari Sub-Island and Maheshkhali Island	N/A
13.	Health facilities will increase access of Ambulance to the remote areas and easy-quick transport facilities	N/A
14.	Pregnant women can avail easy-quick transport facilities if critical situation arises	N/A
15.	Security of the areas will be strengthened	N/A
16.	Social crime will decrease	N/A
17.	Land price will goes up i.e. demand of land will increase	N/A
Special suggestions were made by the participants relating to the project components		
18.	Toilet facilities should have some points along the roads	It will be considered by RHD
19.	Ensure the Road Safety (especially for the child)	It will be considered by RHD
20.	Final road design should be shared with the Project Affected Persons (PAPs) in the project areas	It will be considered by RHD
21.	Security of the Construction materials should be taken care of by the Contractors	It will be considered by RHD
22.	Uninterrupted Material Transportation to the construction site will be ensured by the local people	It will be considered by RHD
23.	Improvement of the existing Jetty (good landing facilities of children/female; heavy loading and unloading facilities etc.) is a request	It will be considered by RHD
24.	Improved Jetty will help to keep the waterway communication of Dhalghata-Kalarmarchara-Matarbari route	N/A
Facilities to the Implementing Authorities and PAPs		
25.	Security of the Constructions Materials is first and foremost important thing.	It will be considered by RHD
26.	Temporary land acquisition (if possible) will do instead of unnecessary permanent acquisition of land especially for storage of construction materials.	It will be considered by RHD
27.	Project Work Should be started after land acquisition with top up compensation	It will be considered by RHD
28.	A well defined work plan shall be shared with local people before the commencement of the project	It will be considered by RHD
In reply of the use of the land of Yunuskhali to Power Plant Site via Nayaghata Jetty, if Road & Bridge is not built, one answer was pronounced by the participants.		
29.	Fate of the local people will remain unchanged	N/A

Item	Topics	Response
The FGD was concluded with thanking each other and assuring necessary cooperation in future.		

(Source: JICA Study Team)

b) Matarbari Union

The results of FGD in Matarbari Union is shown in Table 15.5-22.

Table 15.5-22 Results of 2nd FGD in Matarbari

Item	Topics	Response
1.	Land loss for the Power Plant Project shall be maximum	It will be compensated by CPGCBL
2.	Assuming significant environmental deterioration due to Power Plant	Environment friendly Technology shall be Installed by the CPGCBL
3.	Top up compensation should be made before the start of the Project Work	It will be Covered by RHD
4.	No objection for this project would come from the local people if everything goes well as per suggestion above	N/A
The pros of the project were deliberately shared by the participants with the following points:		
5.	Communication between Matarbari and Maheshkhali Upazilla will be shortened and 2/3rd people will use the new proposed bridge & road as because the existing bridge is not much functional to them at present.	N/A
6.	Fish/salt transportation will be easier	N/A
7.	Female education will increase which will help to increase the total education rate of the project areas (female >male).	N/A
8.	Transport cost will be reduced remarkably	N/A
9.	Health facilities will increase due to access of Ambulance to the remote areas and easy-quick transport facilities as well	N/A
10.	Pregnant women can avail easy-quick transport facilities if critical situation arises	N/A
11.	Security of the area will be strengthened	N/A
12.	Social crime will decrease	N/A
13.	Land price will goes up i.e. demand of land will increase	N/A
14.	Factory i.e. Ice, Hatchery, Salt Processing, Fish Processing etc. will establish	N/A
15.	Job opportunity and Job Migration will create	N/A
16.	Day labourer, Rickshaw Puller will earn better	N/A
17.	Overall local economy will boost up	N/A
Special suggestions were made by the participants relating to the project components		
18.	Rangakhali to Billpara Road is highly important in addition to the access road which will shorten the road distance with Yunuskhali and Maheshkhali Upazilla	N/A

Item	Topics	Response
19.	For the protection/sustainability of the Power Plant as well as the protection of Matarbari Union, a well designed Ring Road is highly required	N/A
20.	Security of the Construction materials should be taken care of by the Contractors	It will be considered by RHD
21.	Uninterrupted Material Transportation to the construction site will be ensured by the local people	It will be considered by RHD
Facilities to the Implementing Authorities and PAPs		
22.	Security of the Constructions Materials is first and foremost important thing	It will be considered by RHD
23.	Temporary land acquisition (if possible) will do instead of unnecessary permanent acquisition of land especially for storage of construction materials.	It will be considered by RHD
24.	Project Work Should be started after land acquisition with top up compensation	It will be considered by RHD
25.	A well defined work plan shall be shared with local people before the commencement of the project	It will be considered by RHD
In reply of the land use of Rangakhali for the Power Plant access road, if Road & Bridge is not built, one answer was pronounced by the participants.		
26.	Fate of the local people will remain unchanged even the existence of Matarbari might be questionable	N/A
The FGD was concluded with thanking each other and assuring necessary cooperation in future.		

(Source: JICA Study Team)

c) Dhalghata Union

The results of FGD in Dhalghata Union is shown in Table 15.5-23.

Table 15.5-23 Results of 2nd FGD in Dhalghata

Item	Topics	Response
1.	Land loss for the Power Plant Project shall be maximum	It will be compensated by CPGCBL
2.	Assuming significant environmental deterioration due to Power Plant	Environment friendly Technology shall be Installed by the CPGCBL
3.	Top up compensation should be made before the start of the Project Work	It will be Covered by CPGCBL
4.	No objection for this project would come from the local people if everything goes well as per suggestion above	N/A
The pros of the project were deliberately shared by the participants with the following points:		
5.	Communication between Dhalghata and Maheshkhali Upazilla will be easier i.e. most of the Dhalghata people will use the new proposed bridge & road as because the existing bridge is not much functional to them at present.	N/A
6.	Fish/salt transportation will be easier	N/A
7.	Female education will increase which will help to increase the total education rate of the project areas (female >male).	N/A
8.	Transport cost will be reduced remarkably	N/A

Item	Topics	Response
9.	Migration of people (climate refugee) will remarkably decrease and the migrated people will return to their homestead	N/A
10.	Health facilities will increase the access of Ambulance to the remote areas and easy-quick transport facilities as well	N/A
11.	Pregnant women can avail easy-quick transport facilities if critical situation arises	N/A
12.	Security of the areas will be strengthened and ultimately the pirates attack and torture to the female/child will be bunged up	N/A
13.	Social crime will decrease	N/A
14.	Land price will goes up i.e. demand of land will increase	N/A
15.	Factory i.e. Ice, Hatchery, Salt Processing, Fish Processing etc. will establish	N/A
16.	Job opportunity and Job Migration will create	N/A
Special suggestions were made by the participants relating to the project components		
17.	Rangakhali to Muhurighona via Bangabandhu Road is highly important to be connected shortly with Yunuskhali and Maheshkhali Upazilla by road	N/A
18.	For the protection/sustainability of the Power Plant as well as the protection of Dhalghat Union, a well designed Ring Road is highly required	N/A
19.	Security of the Construction materials should be taken care of by the Contractors	It will be considered by RHD
20	Uninterrupted Material Transportation to the construction site will be ensured by the local people	It will be considered by RHD
Facilities to the Implementing Authorities and PAPs		
21.	Security of the Constructions Materials is first and foremost important thing.	It will be considered by RHD
In reply of the land use for the Power Plant Project if Road & Bridge is not built, one answer was pronounced by the participants.		
22.	Fate of the local people will remain unchanged even the existence of Dhalghata might be questionable.	N/A
The FGD was concluded with thanking each other and assuring necessary cooperation in future.		

(Source: JICA Study Team)

15.6 Environmental and Social Impact Evaluation

This chapter describes the results of predictions and impact evaluations of the main environmental impact items for the proposed power plant, port facility and transmission line.

These predictions and impact evaluations have been made using some simulation models as well as studying mitigation measures for avoiding or mitigating impacts with respect to various forms of environmental items.

The lists of all the mitigation measures are shown in the environment management plan of Chapter 15.7.

15.6.1 Power plant and port facility

(1) Power Plant

a) Pre-construction Phase and Construction Phase

a. Pollution Control

i. Air Quality

Generation of dust is expected by land preparation, and generation of air pollutants (SOx and NOx, etc.) is predicted from the operation of heavy machinery and trucks, but the impact will be limited only to the surrounding area.

According to the Beaufort scale, when wind speed exceeds about 6m/s, dust on the ground may be lifted up. However, the occurrence ratio of wind speed exceeding about 6m/s around the project site is very low, approximately 1%.

Watering the access road and construction site, especially in the dry season, and using cover sheets on trucks for the transportation of soil will be undertaken to reduce dust generation.

Periodic maintenance and management of all the construction machinery and vehicles will be conducted to reduce exhaust gas discharged from construction machinery and vehicles.

ii. Water Quality

There is water turbidity anticipated by excavation work, but the impact will be temporary. The impact of domestic wastewater and oil-containing wastewater is also expected.

Channels, ditches and a temporary settling pond will be dug and excavated around the construction area.

A wastewater treatment facility for workers, such as a septic tank and an oil separator for oily run-off water, will be installed in the worker’s camp and construction area. Oil and

chemical materials will be stored in an appropriate storage site to prevent permeation into the ground.

These measures will minimize the impact of contamination of sea water, river water and underground water.

iii. Waste

Waste generated from the construction work will include metal chips, waste plastic, wood shavings, waste glass and waste oil. Furthermore, household waste discarded from the camping ground of the workers will include cans, bottles and garbage. If such waste is inadequately handled, sea water, river water and underground water may be contaminated, and sanitation problems may arise.

Segregating waste at collection, recycling and reusing waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to related regulations. Hazardous waste will be treated under the related regulations. To reduce the amount of solid waste discharged from the workers during the construction work, efforts will be taken to employ local workers wherever possible, so that the amount of household waste at the plant will be minimized. These measures will be taken to ensure that water pollution or sanitary problems resulting from waste will not arise.

iv. Noise and Vibration

<Noise>

The impact of noise caused by the operation of heavy machinery and trucks is predicted, but will be limited to the surrounding area. However, there is a residential area located near the project site, and sufficient consideration must be given to minimizing any noise impact.

The level of noise resulting from the operation of the construction machinery was simulated using the following estimation model.

Noise level estimation model

Noise level estimation was made according to the following theoretical formula where each construction machine was assumed as a noise source:

$$LPA = LWA - 20\log_{10}r - 8 - A\gamma - AE$$

[Symbols]

LPA: Noise level at the estimated site (dB)
LWA: A-characteristic correction power level (dB) of noise source
r: Distance from noise source to estimation site
Aγ: Amount of attenuation by partition wall (dB)
AE: Amount of attenuation by air suction (dB)

Noise level data of noise source

The major construction machinery used in the construction work will include dump trucks, bulldozers and back hoes for excavation, truck cranes for transportation of the equipment and material, and mixers for producing concrete.

Table 15.6-1 shows the noise level of the construction machinery and the number of machines.

Table 15.6-1 Noise Level of Major Construction Machinery

Position (Next Figure)	Machine	Capacity	Noise Power level (dB)	Number of machines	Position (Next Figure)	Machine	Capacity	Noise Power level (dB)	Number of machines
1	Truck crane	11t	107	4	4	Generator	250kVA	99	10
	Truck	11t	109	1		Engine Compressor	75m^3/min	99	2
2	Crawler crane	50t	107	3	5	Truck crane	11t	107	6
	Truck crane	11t	107	11		Concrete Mixer	4.5m^3	110	18
	Truck	11t	109	9		Backhoe	1.4m^3	114	10
	Forklift	-	96	2		Concrete pump	70m^3/min	114	6
	Vehicle for height work	-	109	2		Generator	250kVA	99	10
3	Crawler crane	50t	107	3		Engine Compressor	75m^3/min	99	2
	Truck crane	11t	107	11	6	Crawler crane	50t	107	5
	Truck	11t	109	9		Concrete Mixer	4.5m^3	110	4
	Forklift	-	96	2		Small Truck crane	4t	80	3
	Vehicle for height work	-	109	2		Vehicle for height work	-	80	2
4	Truck crane	11t	107	6	7	Backhoe	1.4m^3	114	1
	Concrete Mixer	4.5m^3	110	18		Concrete Mixer	4.5m^3	110	1
	Backhoe	1.4m^3	114	10	8	Backhoe	1.4m^3	114	1
	Concrete pump	70m^3/min	114	6		Concrete Mixer	4.5m^3	110	1

Note: Noise source levels have been calculated from the A-characteristic correction value at a distance of 7 m from the construction machinery.

(Source; JICA Study Team)

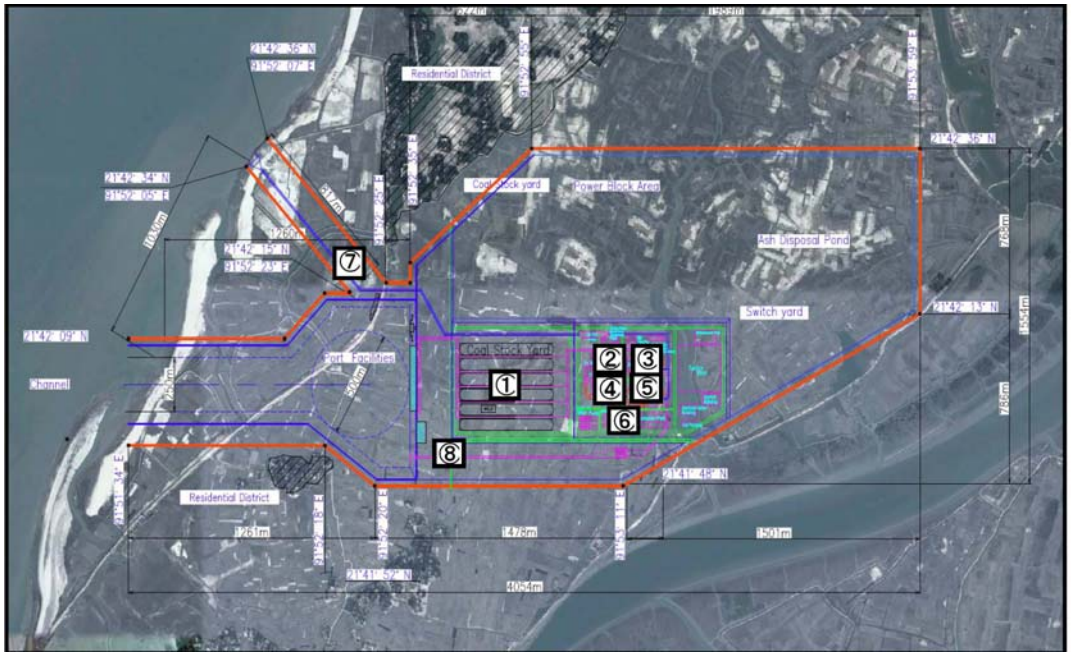
Calculation conditions

The calculation was conducted in respect to the construction of the power generation plant. The construction of the port facility and backfilling activity thereof was carried out in a different period and the calculation was conducted separately in "(2) Port Facility". All the aforementioned machines were assumed to be operating simultaneously. The operation

positions of the construction machinery are shown in Figure 15.6-1.

Construction activities will be actually conducted, leveling out the construction amount and scale, based on the construction schedule; therefore, all the machinery will not be operated simultaneously. The totals of 16 points used for simulation were selected at the boundary of power plant site and discharge facilities, and another 3 points at the nearest residence were also selected for simulation.

Prior to power plant construction, the dyke with the height of 5 meters and 16 meters (for the purpose of ash disposal site) will be constructed at inside the boundary of the power plant site; therefore, the dispersion model of the noise level will be simulated, taking into account the dyke construction being completed and playing as a sound insulating wall.



(Source: JICA Study Team)

Figure 15.6-1 Operation Positions of the Construction Machines

Results of simulation

Noise level generated by construction activities is 23.0 to 70.3dB(A) at the boundary of the power plant site and discharge facility and 36.4 to 55.4dB(A) at the nearest residence (1 point at north of the site and 2 points at south of the site.)

The noise levels at all points in residential areas exceed the day-time noise level standard of Bangladesh, but satisfy IFC/WB guideline.

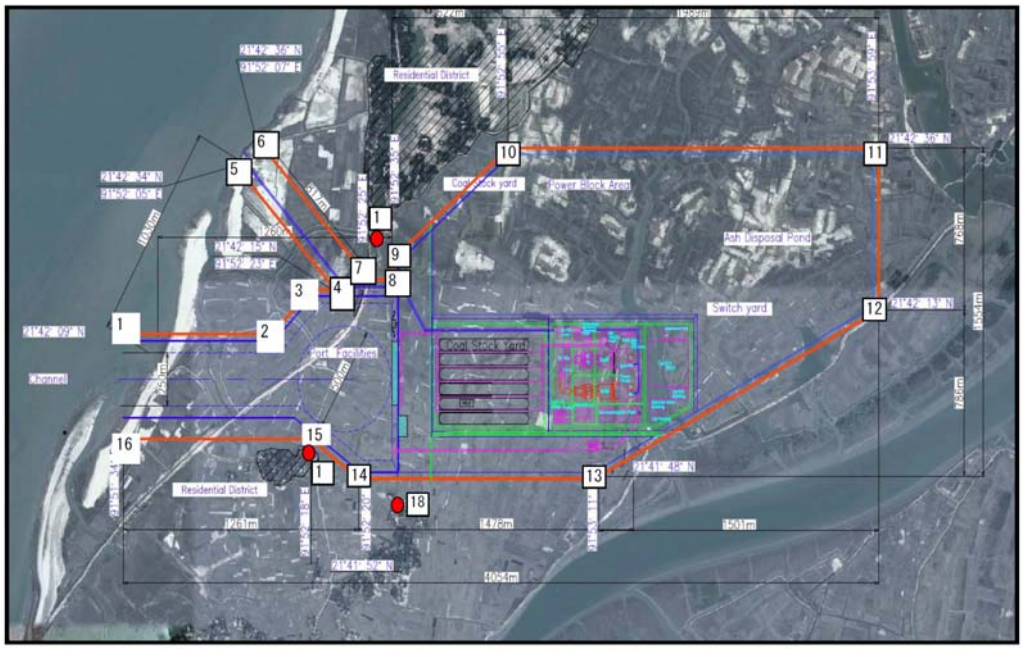
Noise impact caused by construction activities will be mitigated by managing the construction schedule in order to level out the construction amount and scale as well as introducing up-to-date low-noise equipment's. Monitoring on noise levels will also be

necessary.

Table 15.6-2 Results of Simulating Noise Levels From the Machines Used in Construction Work

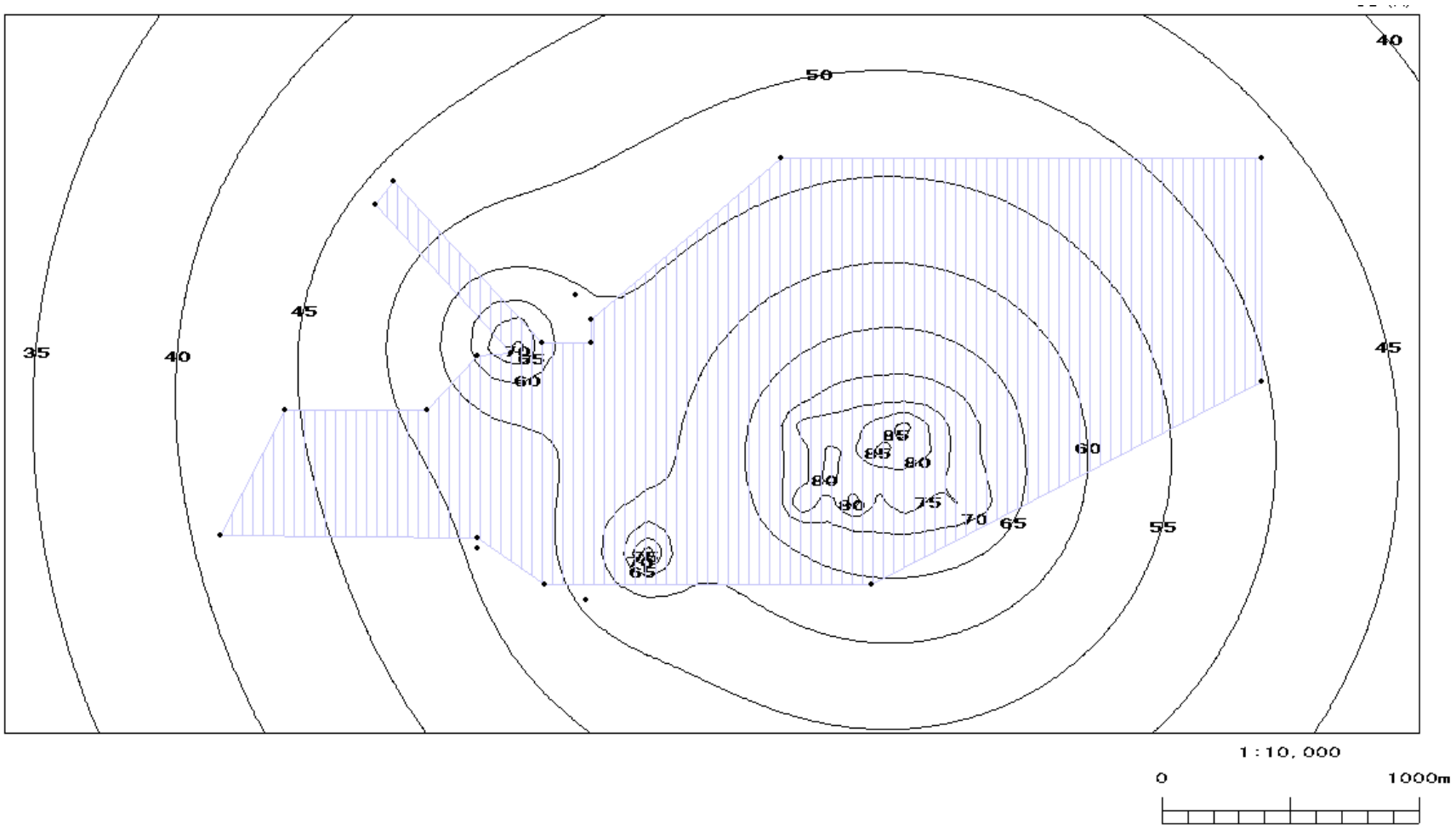
Simulation Points	Noise Levels (dBA)	DOE Limit Standard	IFC/WB EHS Guidelines: General
No. 1	40.8	Industrial Zone; Day 75 Night 70	Industrial Zone; Day 70 Night 70
No. 2	23.0		
No. 3	60.6		
No. 4	70.3		
No. 5	45.6		
No. 6	45.8		
No. 7	62.2		
No. 8	24.7		
No. 9	55.8		
No.10	53.3		
No.11	46.2		
No.12	50.3		
No.13	62.4		
No.14	35.0		
No.15	28.0		
No.16	27.1		
No.17	55.4	Residential Zone: Day 55 Night 45	Residential Zone: Day 55 Night 45
No.18	44.3		
No.19	36.0		

(Source: The Environmental Conservation Rules, 1997, IFC/WB Environmental Health and Safety Guidelines, General 2007)



(Source: JICA Study Team)

Figure 15.6-2 Locations of Simulation Points



(Source: JICA Study Team)

Figure 15.6-3 Results of Simulating the Diffusion of Noise Generated from Machines Used in Construction Work (Unit: dBA)

<Vibration>

The operation of heavy machinery and trucks is predicted to create vibration, but this will be limited to the surrounding area. In the actual construction work, schedule management will be performed to maintain constant amounts of construction work and to ensure that low vibration equipment will be used as much as possible. Construction work will be performed during daytime, especially piling work.

Material and equipment transportation will be mainly conducted by shipping, and schedule management will maintain level amounts of the construction work. Measures for reducing generation of vibration, such as speed reduction of vehicles in residential areas, will be taken, whereby vehicle vibration impact will be minimized. Thus, all efforts will be made to minimize the vibration impact.

v. Odor

In case domestic waste from the workers' camp is not appropriately treated, the rotting waste may produce a foul odor. Before starting the construction work, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced. These measures will be taken to minimize the generation of odor.

vi. Soil

Soil pollution will possibly be caused by leakages of oil and chemical materials at the construction site. Oil and chemical materials will be stored at an appropriate storage site to prevent any permeation into the ground. These measures will minimize the impact of any soil contamination.

vii. Sediment

Sediment pollution may occur in the case construction wastewater flows into the sea and surrounding rivers. Channels, ditches and temporary settling ponds will be dug and constructed around the construction area. Wastewater treatment facilities for workers, such as septic tanks and oil separators for oily run-off water, will be installed in the workers' camp and the construction area.

Oil and chemical materials will be stored in an appropriate storage site to prevent any permeation into the ground. These measures will minimize the impact of sediment contamination by sea water and river water.

b. Natural Environment

i. Protected Areas

Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, and it is located 15km south of the proposed project site. Environmental impact of air pollution, water turbidity, noise and other environmental impact during construction will be mitigated through appropriate countermeasures and the extent of any impact will be limited. Consequently, the impact to Sonadia ECA will be insignificant.

ii. Ecosystem

The project site consists of land used for salt farms and other purposes, and not primeval forests or tropical rain forests. A sandy beach is located in front of the proposed project site, however there are no mangrove forests or tidal flats.

The area is the presumed habitat of birds, dolphins, and sea turtles on the IUCN Red list (endangered species, etc.), and construction work may have a possible impact on the rare species and ecosystem.

Very few trees will be cut down due to the construction work, and the environmental impact of air pollution, water turbidity, noise and other environmental impact during construction will be minimized through appropriate countermeasures.

Within the project area, there is no habitat of precious species of flora designated by IUCN. Three species (*Calamus guruba* Buch-Ham, *Trihosanthes cordata* Roxb, *Lepisanthes rubiginosa*) which are considered by Bangladesh biologist as threatened species were observed in the project area, but they are commonly seen over broad areas and the impact of the project on these species will be insignificant.

As for precious species of animals designated by IUCN, the Spoon-billed Sandpiper (*Eurynorhynchus pygmeus*) and Hawksbill turtle (*Eretmochelys imbricate*) classified as CR (Critically Endangered), three turtles species (*Geoclemys hamiltonii*, *Chelonia mydas*, *Caretta caretta*) classified as EN (Endangered) and one turtle species (*Lepidochelys olivacea*) classified as VU (Vulnerable) were observed within the project site and the front beach. There were no other precious species of insects, amphibians, reptiles, mammals or birds that were designated by IUCN.

Five species of reptiles (*Calotes versicolor*, *Mabuya mabuya*, *Gekko gecko*, *Panghura tentoria*, *Naja naja*) which are considered by Bangladesh researchers as threatened species, and 2 species of birds (*Arachnothera magna*, *Ketupa zeylonensis*) considered as threatened species were observed at the project site, however they are commonly seen over broad areas and the impact of the project on these species is expected to be insignificant.

Regarding the Spoon billed Sandpiper, the frequency with which Spoon billed Sandpiper uses

the Matarbari Island as a wintering ground is relatively very low in comparison with the nearby offshore island of Sonadia. Many previous survey results point out that Matarbari Island beach is not a main migratory habitat for migratory birds, especially the Spoon billed Sandpiper in Bangladesh; this is also supported by other experts and reports. However, for the purpose of protecting the species, construction workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law.

Spawning takes place at nighttime when human activity is low, however the light and noise of any nighttime construction may have adverse effects on these species. Consequently, night construction activity in the spawning season should be avoided as much as possible, and should be conducted under minimum light. Lighting colors that do not affect the spawning (e.g., red or yellow) should be selected. The careful monitoring of spawning status is necessary.

As metioned in "Chapter 15.5.2, (1), 1), c), c., Threatened Species in project areas", the project site and its surrounding areas are not categorized as the critical natural

habitats for Spoon billed Sandpiper and sea turtles which is defined as per "JICA guidelines for environmental and social considerations (April, 2010)".

c. Social Environment

i. Land Acquisition

It is anticipated that 16 households currently living on the site without permission and 4 households who purchased the land will have to vacate their domiciles due to the land acquisition for the construction of the power plant. Apart from resettlement, land owners of the project site area will lose their land. Employers/ employees of salt farms and shrimp farms will lose their livelihood. Those people who run business, employers or employees at salt farms and shrimp farms in the site will lose their livelihood. Note that the site selection was reconsidered to the present site from the previous one (2 km south), where large settlements were found on private land, in order to avoid a large-scale resettlement.

As shown in Table 15.6-3, 343 households and 2,031 people will be affected by the construction of the power plant and the port facility. They had complex land use pattern: some of them had lands of their own, rented additional private land and government land; Some others had no land but rented private land and had domicile without permission. Characteristics of the affected people by category are shown in the following table.

Table 15.6-3 Characteristics of Affected People

Category		Impact	No. of HH	No. of HH Members
Owners of private land				
	Own & live	Lose land ownership Lose shelters and be physically displaced	4	25
	Own but do not live	Lose land ownership	237	1,429
Users of private land (lease)		Lose tenant rights	77	460
Users of government land with official agreement		Lose tenant rights	10	70
Users of government land without official agreement		Lose occupancy of land	140	844
Squatters living on government land		Lose occupancy of land for living place Lose shelters and be physically displaced	16	86

Note: HH means household.

(Source: JICA Study Team)

ii. Disturbance to Poor People

There are poor households among those to be resettled and/or lose their livelihood means. However, their living conditions will not deteriorate compared to their current conditions, and they will have job opportunities at the construction site.

The household monthly income of 343 households (2,031 people) directly and indirectly affected by this project is from zero taka to 842,000 taka, and the income of nearly 60% of the households is within the range of 10,000 taka to 30,000 taka. For individual monthly incomes, 44% of the all family members fall into the range of 2,000 taka to 4,000 taka.

According to the national household revenue and expenditure survey conducted in 2010, the poverty line of agricultural area of Bangladesh is 1,211.57 taka per person/ month, and Chittagong District is 1,304.64 taka per person/ month. Setting the poverty line at 1,500 taka per person/ month for the proposed power plant site at the end of 2012, lee than 10% of the local population falls below the poverty line on an income basis. This rate is far better than the poverty rate of rural areas for the whole of Bangladesh, which is 35.2%, and of the Chittagong District, which is 31.0%.

The employment of local people should be promoted for increased employment opportunities for various subcontract work resulting from the power plant construction activity. However, approximately 70% of heads of household are illiterate or can only write their signatures, so these people can only be engaged in very simple tasks due to their lack of skills. Livelihood restoration measures will be established, including job training for those who want it.

iii. Deterioration of Local Economy such as Losses of Employment and Livelihood Means/ Land Use and Utilization of Local Resources

It is expected that employers and employees of salt farms, shrimp farms, and fishermen will lose their means of livelihood. Fishing activities around the site will also be affected due to a rise of water temperature and restriction of fishing. The implementation of this project will change the traditional land use patterns and utilization of local resources, which may have a large impact on the existing local economy.

About 70% of the heads of 343 households are working in salt or shrimp farms as laborers, mazi, businessmen, or cultivators. Although the number of salt and shrimp farms will decrease due to the construction of the power plant, employment opportunities will increase for various subcontract work associated with construction. Local people will be given priority in employment. However, approximately 70% of heads of household are illiterate or can only write their signatures, so they can only be engaged in very simple tasks due to their lack of skills. Livelihood restoration measures will be established, including job training for those who want it.

The sandy beach is 7km long at the west coast of Matarbari Island, according to the Maheshkhali Upazila Officer. The width of the navigation channel to be altered is 400m and the length of discharge outlet is 100m, resulting in less than 10% of the sandy beach becoming disappeared. Then fishing ground for push net will be loss.

Fishermen around the project site fish offshore (3-50km from the coast), and as all dredged material will be land filled into land sites, not disposed into the ocean, therefore, there is no expected impact on fishery by the power plant construction.

The catches of shrimp fly in the coastal area may be affected by the change of the sand beach due to the construction of the navigation channel and water outlet. Decreased income from shrimp-fly fishing of the fishermen may be easily supplemented by increased job opportunities and job switching. Job training shall be provided for those who want it in order to assist in livelihood restoration.

iv. Disturbance to Water Usage, Water Rights, etc.

All water to be used for the construction work will be transported by vessels and stored in a tank. Ground water and river water will not be used.

The local economy may be affected by turbid water discharged from the construction site. Outflows of street dust and oil during rainy periods may also have certain effects. The turbid water discharged from the construction site and any oil spills may affect the water quality of the marine area, rivers and ground water, and adequate mitigation measures shall be taken. Water quality of well water, which is the main supply of drinking water, shall be monitored in order to monitor any adverse effects on ground water.

v. Disturbance to Existing Social Infrastructure and Services

As material and equipment transportation will be mainly conducted by vessels, increased marine traffic may disturb existing marine traffic including fishing boats. Additionally, vehicles transporting commuting workers may cause increased traffic and traffic jams around the project area.

In regard to vessels, water routes shall be determined after consultation with the related authorities. And in regard to vehicles, bus use will be promoted to reduce increasing the number of vehicles on the roads. The bus schedules shall be managed in consultation with related organizations.

vi. Social Institutions such as Social Infrastructure and Local Decision-making Institutions

The Deputy Commissioner's Office of Cox's Bazar District will officially take responsibility for initiatives to conduct local consultations concerning compensation. In consideration of changing emotions of local residents over the course of negotiations with office staff, LARAP (land acquisition and resettlement action plan) should be carried out in consultation with the local people.

A number of consultations with local residents have been conducted in preparing the draft LARAP in this feasibility study. Regulations in Bangladesh stipulate the need to conduct public consultations in land acquisition processes. In the resettlement process, personnel responsible for responding to complaints or suggestions from local residents will work at the power plant office.

vii. Misdistribution of Benefits and Compensation -

Equality of compensation shall be assured as there is a possibility of unequal compensation among local residents. Equality of compensation shall be assured in preparing the LARAP.

viii. Local Conflicts of Interest

Local conflicts may occur between local residents who may feel that they have received unfair compensation and other local residents or conflict with staff of the Deputy Commissioner's Office. Conflict may occur between local residents and external workers because of any changes to local customs if external workers cannot understand local customs.

A number of consultations with local residents have been conducted in preparing the draft LARAP in this feasibility study. Regulations in Bangladesh stipulate the need to conduct public consultations in land acquisition processes. In the resettlement process, personnel responsible for responding to complaints or suggestions from local residents will work at the power plant office.

Local people should be employed at the power plant to the maximum extent possible, and any

workers from other countries should be taught to respect local customs in order to facilitate good relationships with local people. The lodgings of the project workers should be equipped with sufficient living facilities to keep workers at the project site as much as possible.

ix. Gender

There are women among those to be resettled and/or lose their livelihood means. They currently have low living standards, living without proper facilities, will have better access to social services throughout the year. However, wives of those men who lose their land or jobs may suffer from adverse effects on their household economy. The employment of local women should be promoted at the power plant and associated facilities. However, they are not well literate, not skilled yet, not well-experienced. Livelihood restoration measures will be established, including job training for those who want it. And job opportunities will be open to them according to their qualification.

x. Children's Rights

Children are often forced to work and cannot attend school, and this may occur in the case of the construction of the power plant as well. There will be children among those to be resettled and/or lose their livelihood means. Children from those households losing their land or jobs may suffer from adverse impact on their household economy such as drop-out of school. Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers shall be conducted.

xi. Infectious Diseases such as HIV/AIDS

A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc. Local people should be recruited for simple work as much as possible so to minimize the risk of infectious diseases being transmitted from external workers. Pre-employment and periodic medical check-ups should be conducted for external workers (technical workers, etc).

xii. Work Environment (Including Work Safety)

A high risk rate of accidents is predicted for the construction work. Construction companies should establish work safety plans and submit them to CPGCBL to obtain approval. Work safety plans should stipulate mitigation measures on soft aspects (safety training, etc.) and hard aspects (provide workers with appropriate protective equipment, etc.).

d. Others

i. Accidents

Land traffic and marine traffic accidents during construction work may occur. As prevention measures for land traffic accidents, observation of traffic regulations, and training and education on safe driving will be implemented. People in the surrounding villages shall be informed of the bus schedules. For vessel operation, marking buoys will be set around the construction area for marine safety. Vessel schedules shall be announced to fishermen, etc.

ii. Cross-boundary Impact and Climate Change

CO_2 will be produced by the construction work. Periodic maintenance and management of all construction machinery and vehicles will be conducted.

b) Operation Phase

a. Pollution Control

i. Air Quality

<Emission gas>

SOx, NOx and Particulate Matter (PM) will be generated by the operation of the power plant. A flue gas desulphurization (FGD) system using marine water, an electrostatic precipitator (EP), and low-NOx burning method (multi phase burning) will be adopted in this project, and exhaust concentrations will be kept below the Bangladesh emission standards and the guideline values of the IFC/WB EHS guidelines.

Table 15.6-4 Emission Concentration and Emission Standards

Item	Unit	Proposed Concentration	Emission Standards of Bangladesh	IFC/WB EHS guidelines (Thermal power plants; 2008)
SOx	mg/Nm^3	820	- [1]	850
NOx	mg/Nm^3	460	600	510
PM	mg/Nm^3	50	500	50

Note: 1. In Bangladesh, SOx concentration in gas emissions is not regulated by law, except regulations concerning stack heights. The stack height is regulated to 275m or higher in this project.
2. O_2＝6% equivalent

(Source: JICA Study Team)

Prediction method

Whether or not simulating exhaust gas dispersion models under special metrological conditions, such as inversion layers and downdrafts, was considered, in addition to the dispersion model under normal metrological condition.

Inversion Layers

In case that an inversion layer of the temperature occurred temporarily above the stack of the power plant, exhaust gas would stay under the inversion layer, possibly causing the concentration of pollutants becoming high. Since there is no valid metrological data of the upper layer, the dispersion model was simulated with the worst case estimated.

Consideration according to the occurrence of downwash and down draft

Based on the Briggs model, when gas emissions speed is lower than 1.5 times of the wind speed of stack height, downwash may occur. In this project, the gas emission speed is 15.4m/s, so that downwash will occur when wind speed at the stack outlet level is more than 23m/s.

In order for the wind speed at the stack outlet level to become more than 23m/s, wind speed at ground level needs to be greater than 10m/s. The frequency of wind speed being greater than 10m/s at ground level around the power plant was only observed 14 times in the previous 12 years, according to the meteorological data measured at the observatories closest to the project; therefore, downwash was not considered to have occurred, and a dispersion model under downwash conditions was not simulated.

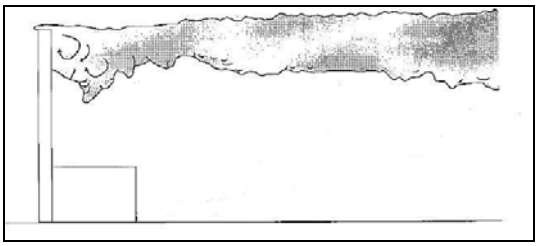


Figure 15.6-4 Outlook of the Downwash

Based on the Huber model, when stack height is lower than2.5 times of building height, downdraft may occur. In this project, stack height is 275 m. The building height in the vicinity of the stack for downdraft to occur would have to be more than 110 m. Since the height of all the proposed buildings will be under 65m, downdraft will not occur.

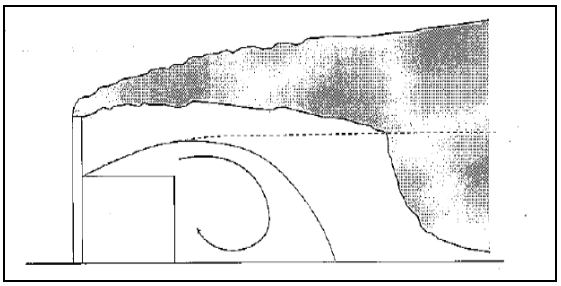


Figure 15.6-5 Outlook of the Down Draft

Dispersion Model of Exhaust Gas

Using the following Gaussian diffusion model, prediction of annual averages, a 24-hour and 1-hour value were calculated according to the time scale in conformity with the environmental standards of Bangladesh and the IFC/EHS guidelines (General ,2008)..

Normal Meteorological Condition

$$C = \frac{Q_p}{2\pi\ \sigma_y \sigma_z u} \cdot \exp(-2\frac{y_2}{2\sigma_y{}^2}) \exp\left\{-\frac{(z-He)^2}{2\sigma_z{}^2}\right\} + \exp\left\{-\frac{(z+He)^2}{2\sigma_z{}^2}\right\}$$

where

C:	Above-ground concentration at a leeward distance R (m)
Q_p:	Emission volume
σ_y:	Parameter in the horizontal direction (m)
σ_z:	Parameter in the vertical direction (m)
u:	Wind speed (m/s)
R:	Horizontal distance between smoke source and calculated point (m)
z:	Above-ground height
He:	Effective stack height (m)

$$He = H + \Delta H$$

H:	Stack height (m)
ΔH:	Elevation height (m)

Occurrence of Inversion Layer

The occurrence of an inversion layer as a temporary metrological phenomenon, the dispersion model on a 1-hour value was simulated, using the Gaussian Model shown below.

$$C(x) = \frac{Q_p}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot u} \cdot \sum_{n=-3}^{3}\left[\exp\left\{-\frac{(He+2n \cdot L)^2}{2\sigma_z{}^2}\right\} + \exp\left\{-\frac{(-He+2n \cdot L)^2}{2\sigma_z{}^2}\right\}\right]$$

Where;

Qp : Emission amount (g/s)
σy : Parameter of horizontal direction (m)
σz : Parameter of vertical direction (m)
u : Wind speed (m/s)
He : Effective stack height (m)
L : Height of mixing layer (m) (set as L=He, which is the worst case)
n : Reflection times (set as ±3)

Conditions for Simulation

- Emission specifications

Table 15.6-5 shows the exhaust volume, temperature, speed, and emissions of the NOx, SOx,

and soot & dust. All the sulfur oxide, nitrogen oxide and dust emitted from the stack are assumed to become SO_2, NO_2 and $PM_{10,}$ respectively.

Table 15.6-5 Emission Specifications

Item	Unit	2×600 MW
Emission volume (wet)	Nm^3/h	$1,819.5\times10^3$
Exhaust temperature	ºC	75
Exhaust speed	m/s	15.4
Actual stack height	m	275
SOx	kg/h	1,554
NOx	kg/h	872
PM	kg/h	95

Notes: 1. The values indicate the values under the maximum continuous load.
2. Sulfur content in coal is set to 1.0%.
3. The values take into consideration the following: SOx removal efficiency of FGD is 70%, and PM removal efficiency of EP is 99.8%.

(Source: JICA Study Team)

- Meteorological Conditions

Atmospheric stabilities at the stack outlet level tend toward neutral compared to the stabilities at ground level, according to the Pasquill stability categories shown below and wind speed. In simulating a dispersion model, atmospheric stabilities at the stack outlet level was set on rather the neutral side than the stabilities at ground level; for example, stability “A” was replaced with stability “B”, stability “B” was replaced with “C” and “C” was replaced with “D”.

Table 15.6-6 Pasquill Stability Categories

Wind speed at Ground Level U (ms^{-1})	Daytime				Nighttime (Rate of Solar Radiation = 0)
	Rate of Solar Radiation Q (unit 0.01 kWm^{-2})				
	Over 60	30 - 59	15 - 29	1 - 14	
U – 2.0	A	A-B	B	D	F
2.0 - 2.9	A-B	B	C	D	E
3.0 - 3.9	B	B-C	C	D	D
4.0 - 5.9	C	C-D	D	D	D
6.0 – U	C	D	D	D	D

Note: This category shows the stability of the atmosphere proposed by Pasquill. Category A indicates very unstable atmospheric condition; category B unstable atmospheric condition; category C less unstable; category D neutral; category E less stable; and category F stable.

(Source: http://www.env.go.jp/recycle/misc/facility_assess/mat02.pdf)

Meteorological data from the Kutubdia Meteorological Observatory located 10 km north of the project site was used when conducting an exhaust gas dispersion model on annual average and 24–hour values. Meteorological data for 10 years was analyzed and the data of the year 2009, which had 365 days of wind speed and wind direction data, was used in the simulation.

The Kutubdia Meteorological Observatory does not measure solar radiation data, therefore it was calculated based on the solar radiation data and cloud amount data of Dhaka, Bangladesh.
As for a 1-hour value, a dispersion model was simulated on the conditions of the stabilities and wind speed as shown in the table below.
Table 15.6-7 and from Figure 15.6-6 to Figure 15.6-14 show the prediction concentrations in ambient air quality, considering background concentration and the contributed concentration (annual average value, daily average value and 1-hour value) for this project based on the simulation. The outlines of the contributed concentration based on the simulation are described below.
The background concentration used in this study was from the short-term survey results of the existing conditions in the rainy and dry seasons; therefore, these survey results are not suitable to be directly compared with the standard values of the annual average values. For reference purposes, the dispersion model using these survey results was simulated.

- **Annual average value**

- Sulfur dioxides (SO_2)

The contributed concentration from the power plant is 6.2μg/m^3, which is less than one tenth of the Bangladesh ambient air quality standard values, 80μg/m^3.
Predicted concentration, taking into account the background concentration, is 9.2 to 10.3μg/m^3 and satisfies the ambient air quality standards of Bangladesh as well as environmental standards of the EU.
As for air pollutant impact on flora, the predicted concentration satisfies the Air Quality Guidelines for Europe 2nd edition (2001) by the WHO European office, of which the guideline value is 10 30μg/m^3.

- Nitrogen dioxide (NO_2)

The contributed concentration from the power plant is 3.5μg/m^3, which is less than one twentieth of the Bangladesh ambient air quality standard values, 100μg/m^3.
Predicted concentration, taking into account the background concentration, is 8.5 to 11.1μg/m^3 and satisfies the ambient air quality standards of Bangladesh as well as IFC/WB guideline values and environmental standard values of the EU.
As for air pollutant impact on flora, the predicted concentration satisfies the Air Quality Guidelines for Europe 2nd edition (2001) by the WHO European office, of which the guideline value is 30μg/m^3.

- Suspended Particulate Matter (SPM/PM_{10})

The contributed concentration from the power plant is 0.4μg/m^3, which is less than one hundredth of the Bangladesh ambient air quality standard values, 50μg/m^3.

Predicted concentration, taking into account the background concentration, is 42.4 to 62.4μg/m^3 and only the background concentration exceeds the ambient air quality standards of Bangladesh. It can be verified that the contributed concentration is very low and does not affect the background concentration.

The predicted concentration, however, satisfies the guideline values of IFC/WB as well as environmental standards of EU.

- **24 hour value**

- Sulfur dioxides (SO_2)

The contributed concentration from the power plant is 37.6μg/m^3 at a maximum, which is about one tenth of the Bangladesh ambient air quality standard values, 365μg/m^3.

Predicted concentration, taking into account the background concentration, is 40.6 to 41.7μg/m^3 and satisfies the ambient air quality standards of Bangladesh as well as the guideline values of IFC/WB and environmental standards of the EU.

- Nitrogen dioxide (NO_2)

The contributed concentration from the power plant is 21.1μg/m^3 at a maximum. Bangladesh does not regulate a 24 hour value (daily average value) of NO_2. Comparing to the Japanese standard, the contributed concentration of 21.1μg/m^3 is less than one third of the Japanese ambient air quality standard values which is 75 to 110 μg/m^3.

Predicted concentration, taking into account the background concentration, is 25.1 to 28.7μg/m^3 and satisfies the ambient air quality standard of Japan.

- Suspended Particulate Matter (SPM/PM_{10})

The contributed concentration from the power plant is 2.3μg/m^3, which is less than one seventieth of the Bangladesh ambient air quality standard values, 150μg/m^3.

Predicted concentration, taking into account the background concentration, is 44.3 to 64.3μg/m^3 and satisfies the ambient air quality standards of Bangladesh as well as the guideline values of IFC/WB and environmental standards of the EU.

- **1 hour value**

- Sulfur dioxides (SO_2)

The contributed concentration from the power plant under normal meteorological condition is

87.2μg/m^3 at a maximum. Bangladesh does not regulate a 1 hour value of SO_2. Comparing to the EU standard, the contributed concentration of 87.2μg/m^3 is less than one third of the EU ambient air quality standard value which is 350μg/m^3.

Predicted concentration, taking into account the background concentration, is 90.3 to 91.3μg/m^3 and satisfies the ambient air quality standards of the EU.

The contributed concentration from the power plant under the meteorological conditions of an invasion layer is 175.0 μg/m^3 at a maximum, which is less than one second of the EU ambient air quality standard values, 350μg/m^3.

Predicted concentration, taking into account the background concentration, is 178.0 to 179.1 μg/m^3 and satisfies the ambient air quality standards of the EU.

- Nitrogen dioxide (NO_2)

The contributed concentration from the power plant under normal meteorological conditions is 48.9μg/m^3 at a maximum. Bangladesh does not regulate a 1 hour value of NO_2. Comparing to the IFC/WB guideline and EU standards, the contributed concentration of 48.9μg/m^3 is less than one quarter of the IFC/WB guideline value and EU ambient air quality standard value which is 200μg/m^3.

Predicted concentration, taking into account the background concentration, is 53.9 to 56.5 μg/m^3 and satisfies the IFC/WB guideline value and EU ambient air quality standard value.

The contributed concentration from the power plant under the meteorological conditions of an invasion layer is 97.9μg/m^3 at a maximum, which is less than one second of the EU ambient air quality standard values, 200μg/m^3.

Predicted concentration, taking into account the background concentration, is 102.9 to 105.2 μg/m^3 and satisfies the ambient air quality standards of the EU.

- Suspended Particulate Matter (SPM/PM_{10})

The contributed concentration from the power plant under normal meteorological conditions is 5.3 μg/m^3 at a maximum, which is less than one fortieth of the Bangladesh ambient air quality standard values, 200μg/m^3.

Predicted concentration, taking into account the background concentration, is 47.3 to 67.3μg/m^3 and satisfies the ambient air quality standards of Bangladesh.

The contributed concentration from the power plant under the meteorological conditions of an invasion layer is 10.7μg/m^3 at a maximum, which is less than one twentieth of the Bangladesh ambient air quality standard values, 200μg/m^3.

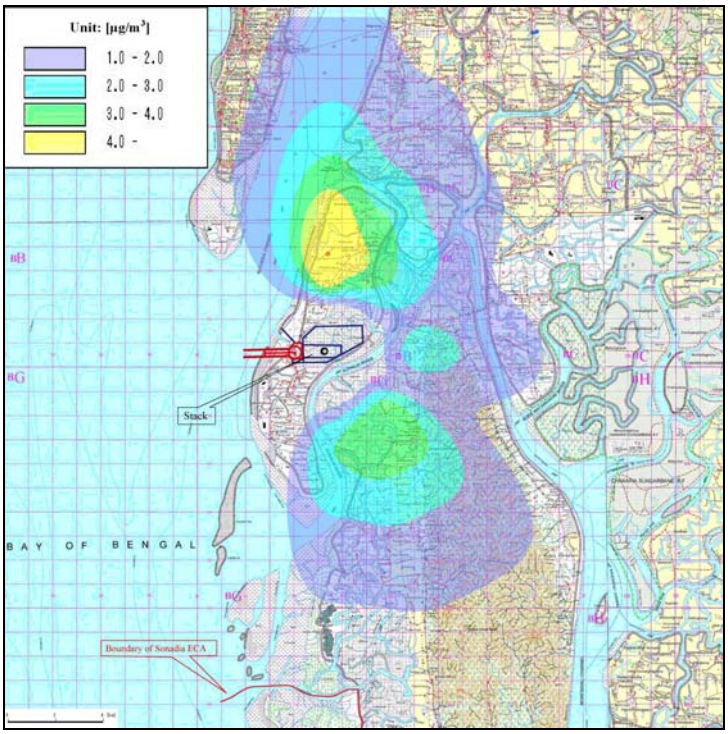
Predicted concentration, taking into account the background concentration, is 52.7 to 72.7 μg/m^3 and satisfies the ambient air quality standards of Bangladesh.

Table 15.6-7 Dispersion Concentration of Air Pollutants

Time scale	Item	Background concentration ($\mu g/m^3$) (1)	The highest concentration ($\mu g/m^3$) (2)	The appearance distance from stack (km)	Prediction concentration in ambient air quality ($\mu g/m^3$) (1)+(2)	Air quality standards ($\mu g/m^3$)	IFC guideline value (General 2007) ($\mu g/m^3$)	EU Standards (Japanese Standards) ($\mu g/m^3$)
Yearly Average	SO_2	(3.0－4.1)	6.2	4.1	(9.2－10.3)	80	-	20
	NO_2	(5.0－7.6)	3.5	4.1	(8.5－11.1)	100	40	40
	SPM/PM_{10}	(42－62)	0.4	4.1	(42.4－62.4)	50	70	70
24 hour Maximum	SO_2	3.0－4.1	37.6	3.8	40.6－41.7	365	125	125 (100)
	NO_2	5.0－7.6	21.1	3.8	25.1－28.7	-	-	- (75 - 110)
	SPM/PM_{10}	42－62	2.3	3.8	44.3－64.3	150	150	150 (100)
1 hour：normal condition (Maximum B,1m/s)	SO_2	3.0－4.1	87.2	3.7	90.3－91.3	-	500(10min)	350 (260)
	NO_2	5.0－7.6	48.9	3.7	53.9－56.5	-	200	200
	SPM/PM_{10}	42－62	5.3	3.7	47.3－67.3	SPM:200 (8hr)	-	- (200)
1 hour：Occurrence of Invasion layer (Maximum B,1m/s)	SO_2	3.0－4.1	175.0	3.7	178.0－179.1	-	500(10min)	350 (260)
	NO_2	5.0－7.6	97.9	3.7	102.9－105.2	-	200	200
	SPM/PM_{10}	42－62	10.7	3.7	52.7－72.7	SPM:200 (8hr)	-	- (200)

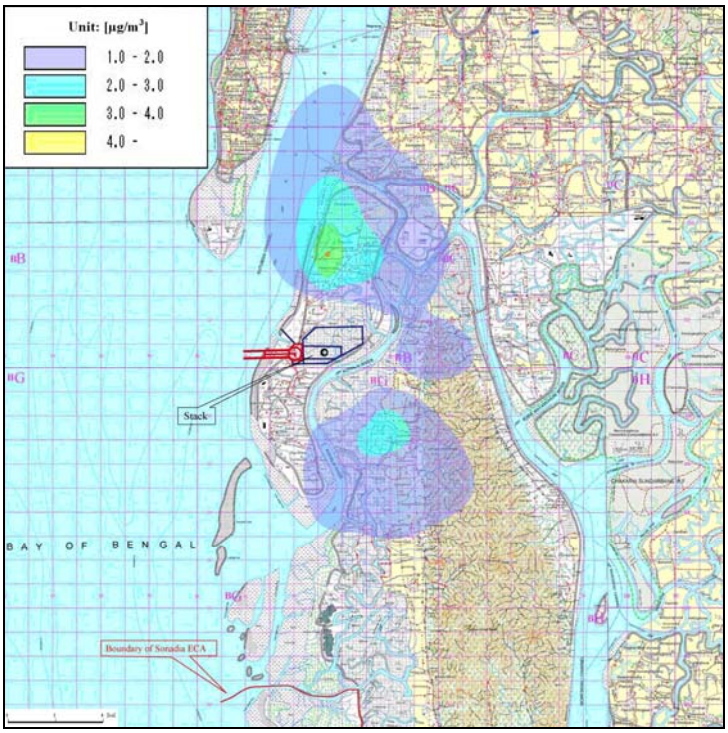
Note: This survey result indicates only short-term result in rainy and dry season and is not suitable to be directly compared with the standard value of the annual average value.

(Source: JICA Study Team)



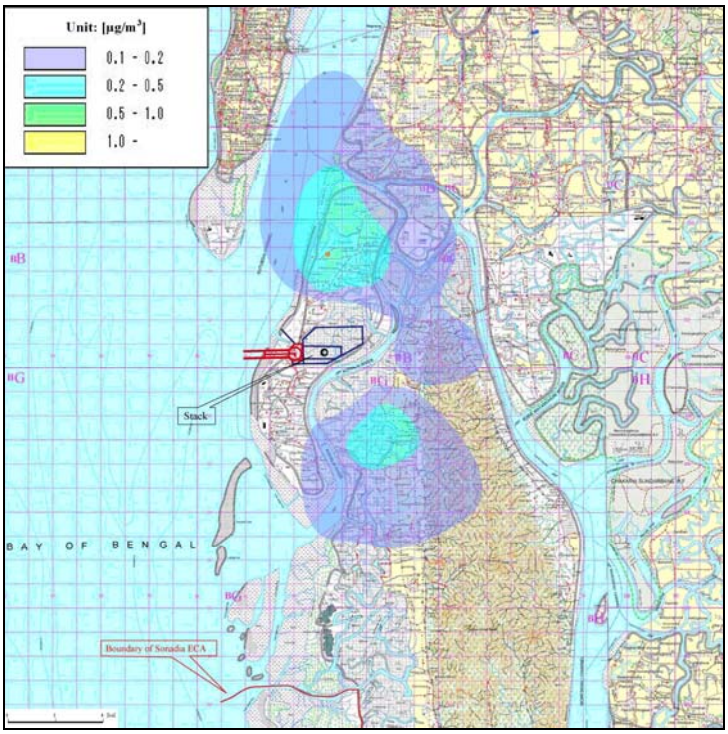
(Source: JICA Study Team)

Figure 15.6-6 Dispersion Concentration of Air Pollutants (Annual Average) (SO_2)



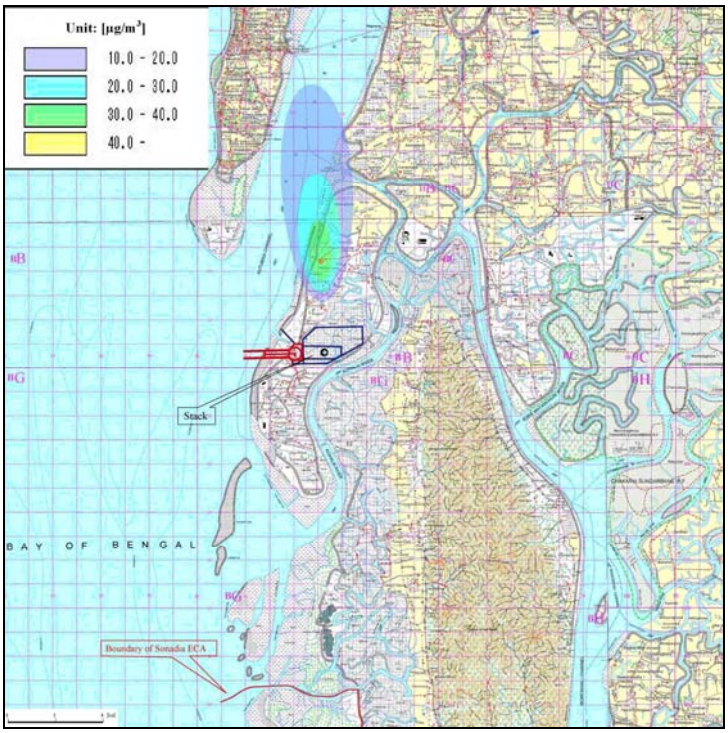
(Source: JICA Study Team)

Figure 15.6-7 Dispersion Concentration of Air Pollutants (Annual Average) (NO_2)



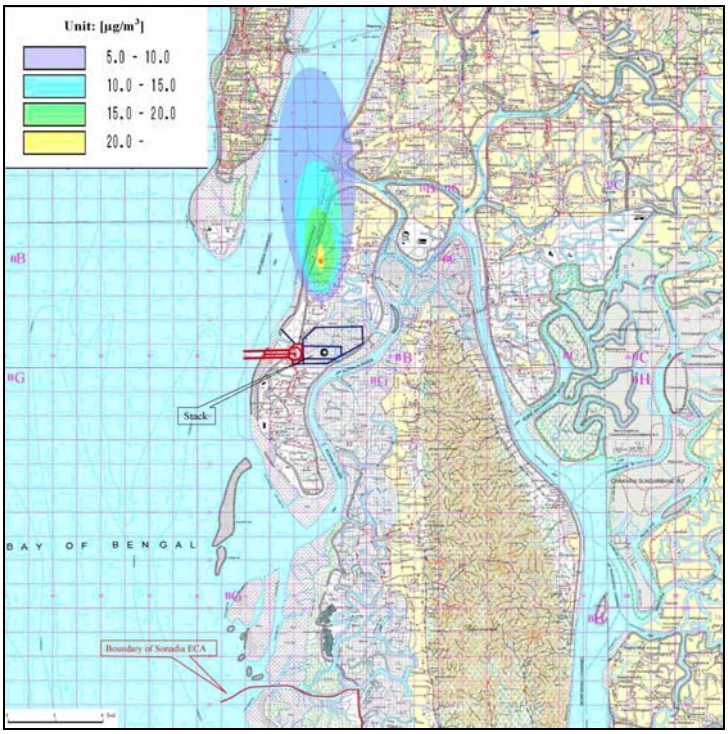
(Source: JICA Study Team)

Figure 15.6-8 Dispersion Concentration of Air Pollutants (Annual Average) (PM_{10})



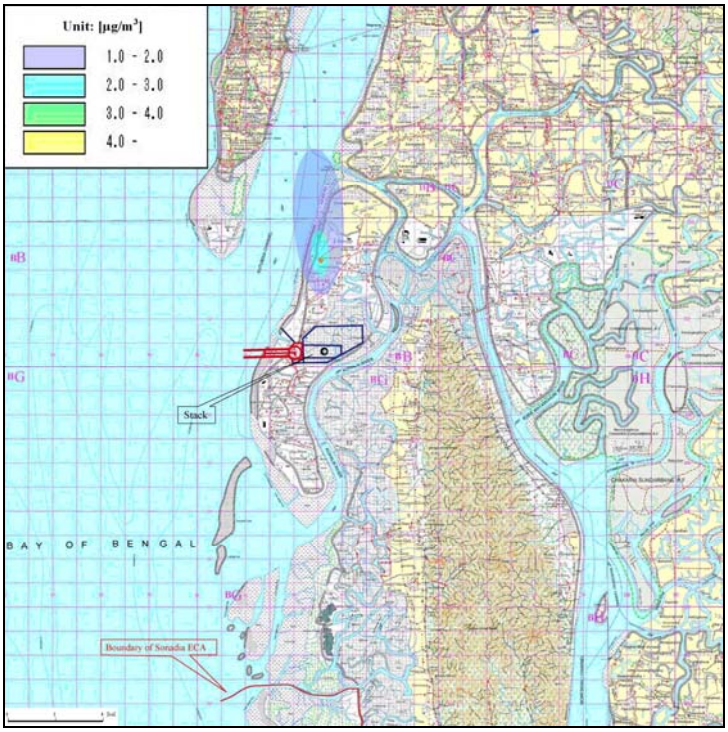
(Source: JICA Study Team)

Figure 15.6-9 Dispersion Concentration of Air Pollutant (24 hour Maximum) (SO_2)



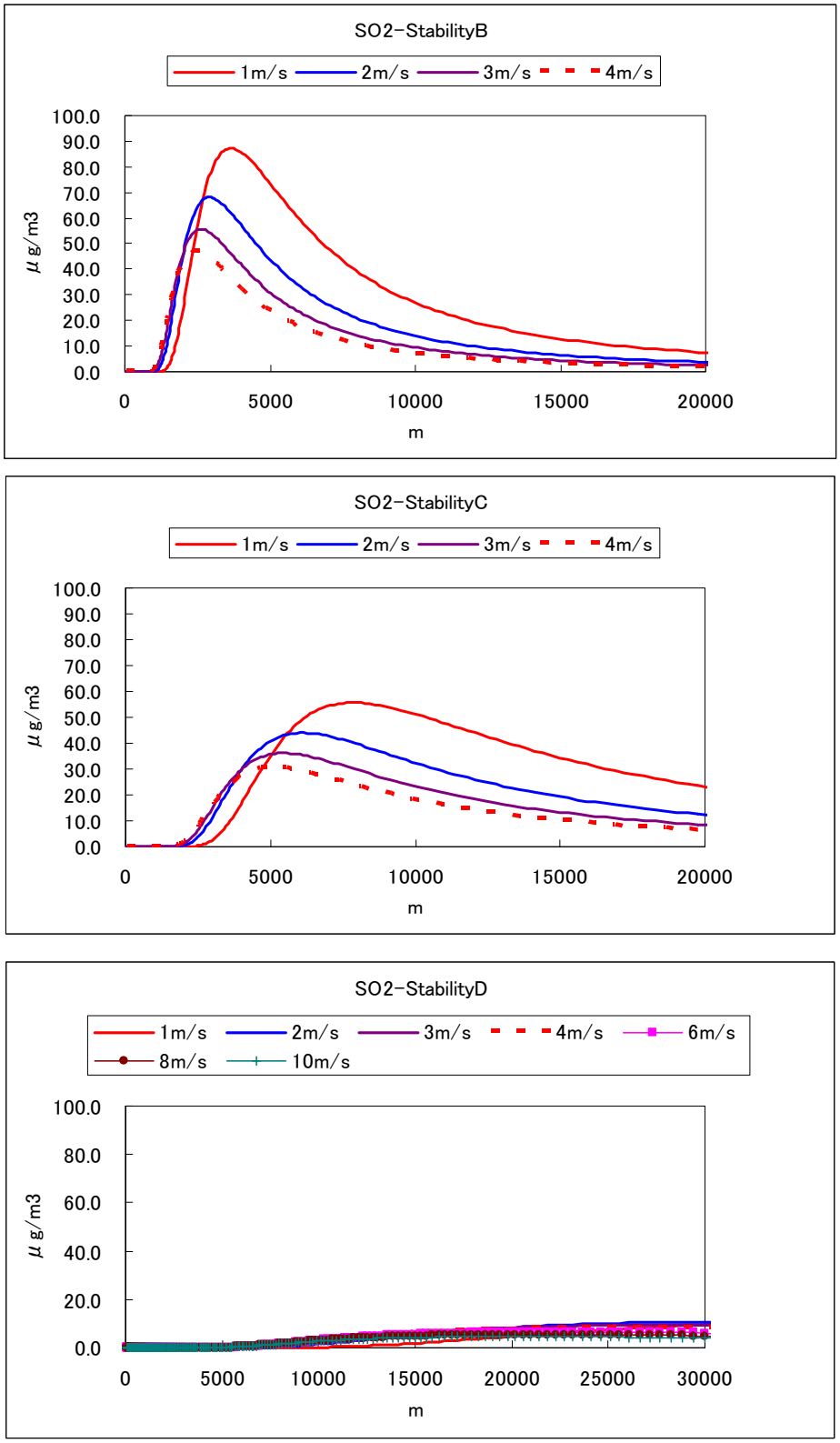
(Source: JICA Study Team)

Figure 15.6-10 Dispersion Concentration of Air Pollutants (24 hour Maximum) (NO_2)



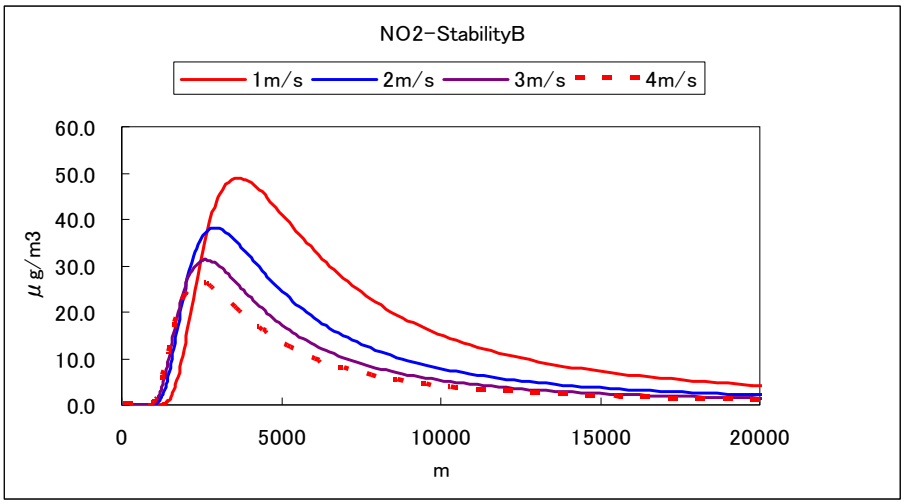
(Source: JICA Study Team)

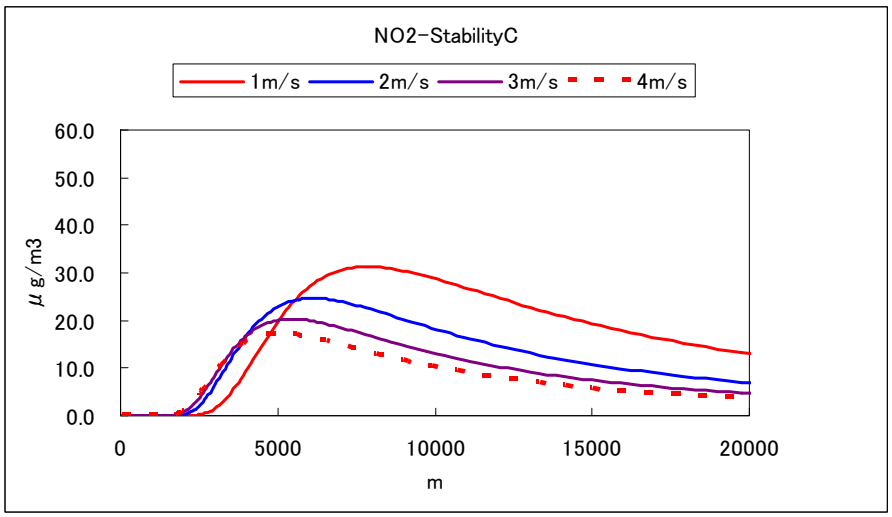
Figure 15.6-11 Dispersion Concentration of Air Pollutants (24 hour Maximum) (PM_{10})

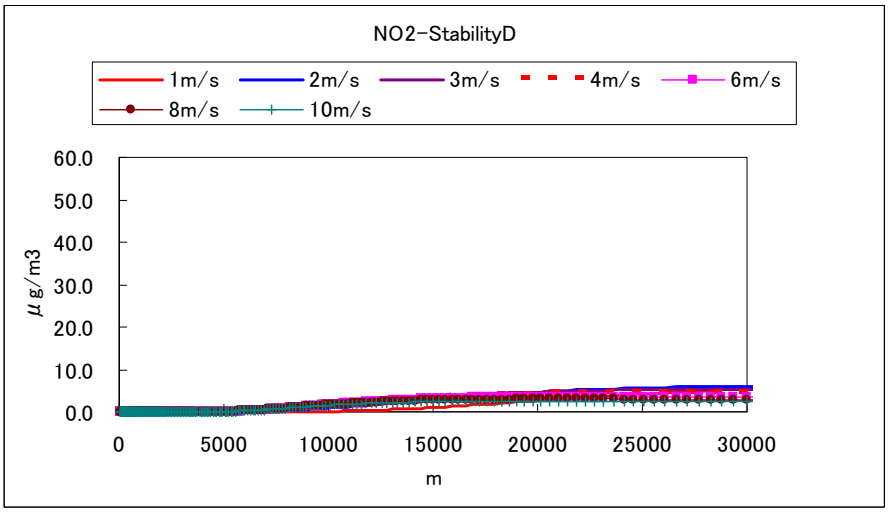


(Source: JICA Study Team)

Figure 15.6-12 Dispersion Concentration of Air Pollutants (1 hour Maximum) (SO_2)

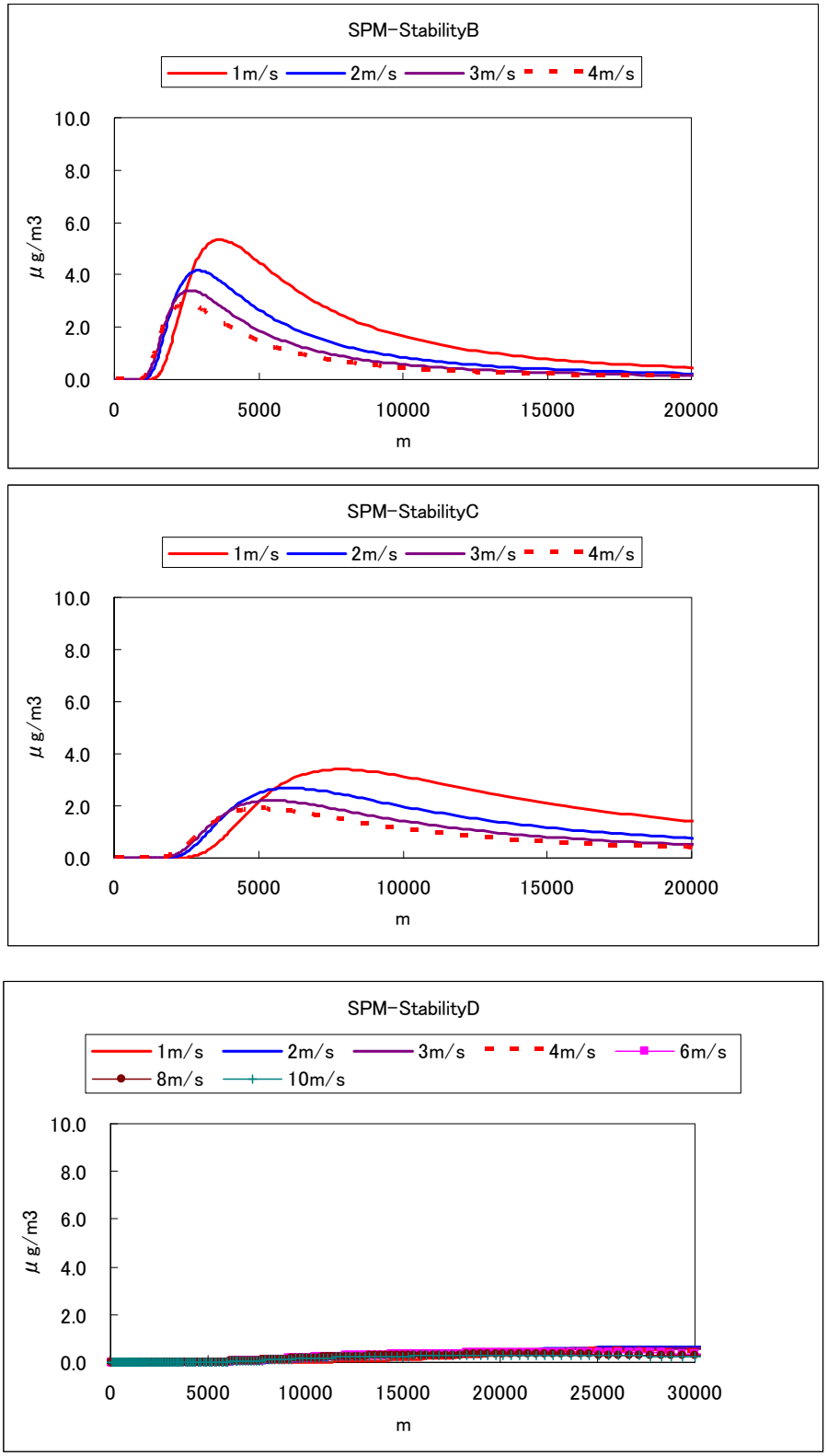






(Source: JICA Study Team)

Figure 15.6-13 Dispersion Concentration of Air Pollutants (1 hour Maximum) (NO_2)



(Source: JICA Study Team)

Figure 15.6-14 Dispersion Concentration of Air Pollutants (1 hour Maximum) (PM_{10})

The Department of Environment, Bangladesh limits the lowest stack height of coal-fired power plants to 275 meters to control of sulfur oxide (SO_2) levels emitted out from the stack, in accordance with the Environmental Conservation Rules of 1997. The coal-fired power plant with ultra super critical technology, which this project will adopt, is designed to be environmentally friendly and to reduce the concentration level of pollutants emitted from the power plant; therefore, SO_2 concentration will meet Bangladesh and international standards even with the lower stack height (200 meters) (Appendix C-15.6).

<Coal handling>

Coal handling and storage activities and ash handling disposal activities will result in the dispersion of dust particulates due to wind gusts. According to the Beaufort scale, when wind speed exceeds about 6m/s, dust on the ground may be lifted up. However the occurrence ratio of wind speed exceeding about 6m/s around the project site, is very low at about 1%. A cover will be installed on the conveyor for coal and ash transportation, and watering coal storage and the ash pond will be conducted to keep the surface wet.

ii. Water Quality

The impact of power plant wastewater, oil-containing wastewater, domestic wastewater and thermal effluents are expected from the plant operation.

<Thermal effluents>

Water used in the power plant will have intake at low speed (0.2m/s) from low-temperature seawater in the deep layer at the water inlet located in the port using the curtain wall method. Thermal effluent will be discharged from the water discharge outlet located 1km north of the port in order to prevent recirculation. The temperature of thermal effluent will be discharged within ΔT 7^{o}C compared to the water temperature of the intake water and will be less than 40^{o}C. Therefore the temperature of the thermal effluent is within the discharge water regulation (40^{o}C).

A diffusion estimation model of thermal effluents from the power plant is calculated based on the following formula.

Diffusion estimation model

$$\frac{\partial u}{\partial t}+\frac{\partial u^2}{\partial x}+\frac{\partial uv}{\partial y}+\frac{\partial uw}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial x}+\mu\nabla^2 u+\gamma\frac{\partial^2 u}{\partial z^2}$$

$$\frac{\partial v}{\partial t}+\frac{\partial uv}{\partial x}+\frac{\partial v^2}{\partial y}+\frac{\partial vw}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial y}+\mu\nabla^2 v+\gamma\frac{\partial^2 v}{\partial z^2}$$

$$\frac{\partial w}{\partial t}+\frac{\partial uw}{\partial x}+\frac{\partial vw}{\partial y}+\frac{\partial w^2}{\partial z}=g-\frac{1}{\rho}\frac{\partial p}{\partial z}+\mu\nabla^2 w+\gamma\frac{\partial^2 w}{\partial z^2}$$

(Continuity equation)

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0$$

In which:

u,v,w: Current velocity in x, y, z

t : Time

P: Pressure

ρ_w : Water density

μ and v: Coefficient of the horizontal and vertical eddy viscosity

Calculation conditions

The simulation condition of the discharge rate of thermal effluent from the power plant is described in the table below. Based on the field survey, NNE current as the predominant current (permanent current) was selected. The parameters used for simulation are the seabed topography data taken from sea charts and air temperature, wind speed and water temperature data taken from the results of the field survey (Table 15.6-8).

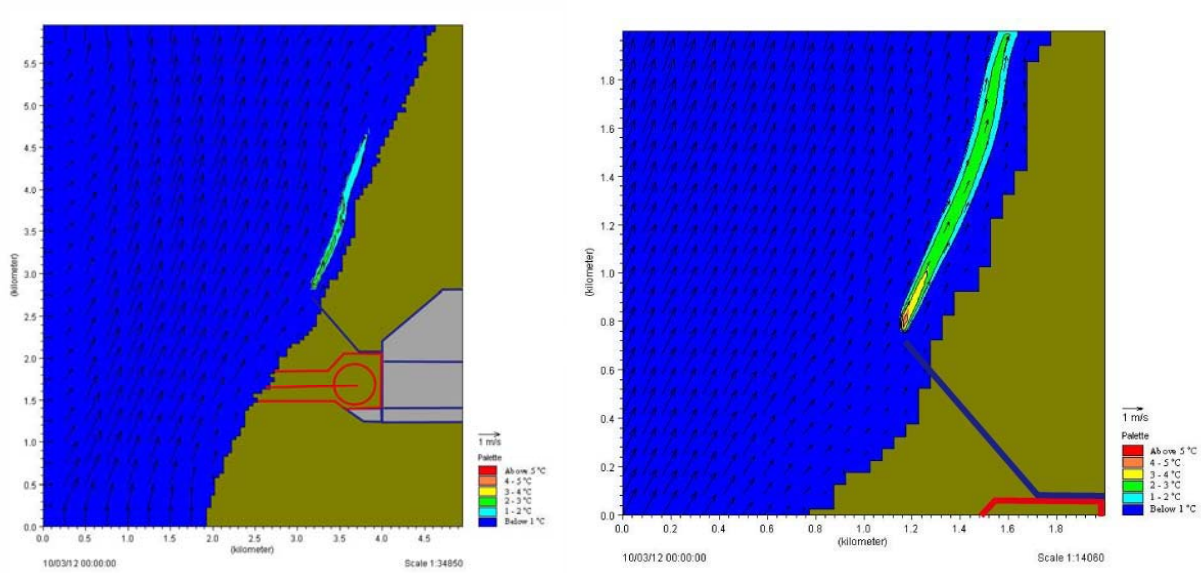
Table 15.6-8 Discharge Specifications

Item	Unit	2×600MW
Discharge volume	m^3/ s	50
Discharge speeds	m/s	0.5
Discharge water temperature	ºC	38
Surrounding water temperature	ºC	30
Air temperature	ºC	28.8
Wind speed	m/ s	1.0

(Source: JICA Study Team)

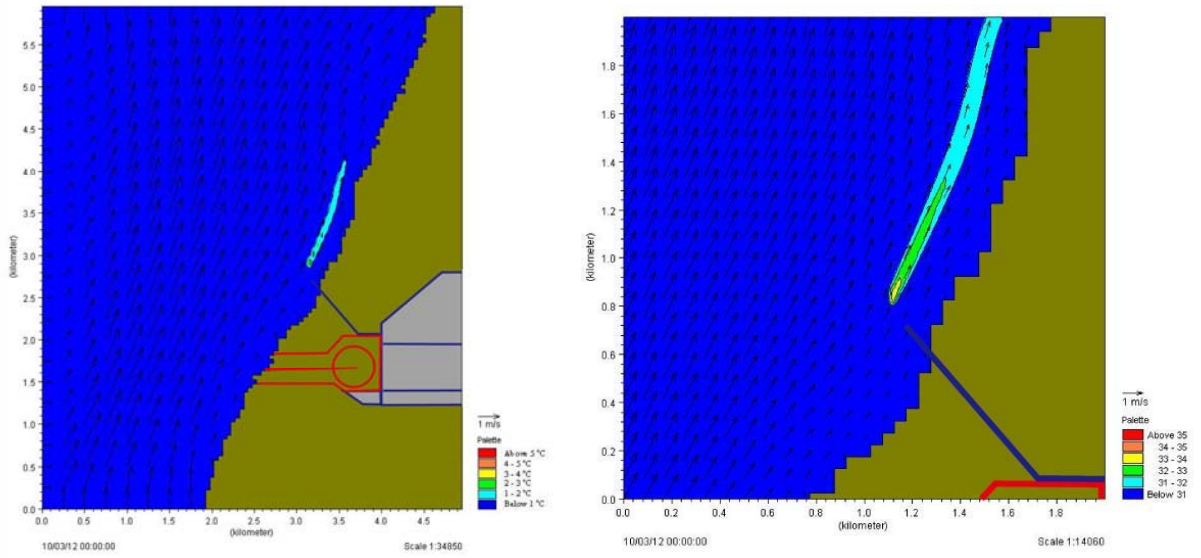
Results of simulation

Figure 15.6-15 and Figure 15.6-16 show the results of the simulation of thermal effluent diffusion.



(Source: JICA Study Team)

Figure 15.6-15 Dispersion of Thermal Effluent (NNE Current: Speed 0.5m/s)
(Location of the Discharge Point: 140m offshore)



(Source: JICA Study Team)

Figure 15.6-16 Dispersion of Thermal Effluent (NNE Current: Speed 0.5m/s)
(Location of the Discharge Point: 280m offshore)

Scenario 1: Discharge point is 140m offshore:

The sea area where the water temperature increases more than 4°C is up to 70m away from the discharge point; more than 3°C increase is up to 240m away; more than 2°C increase is up to

1,300m away, and more than 1°C increase is up to 1,800m away from the discharge point.

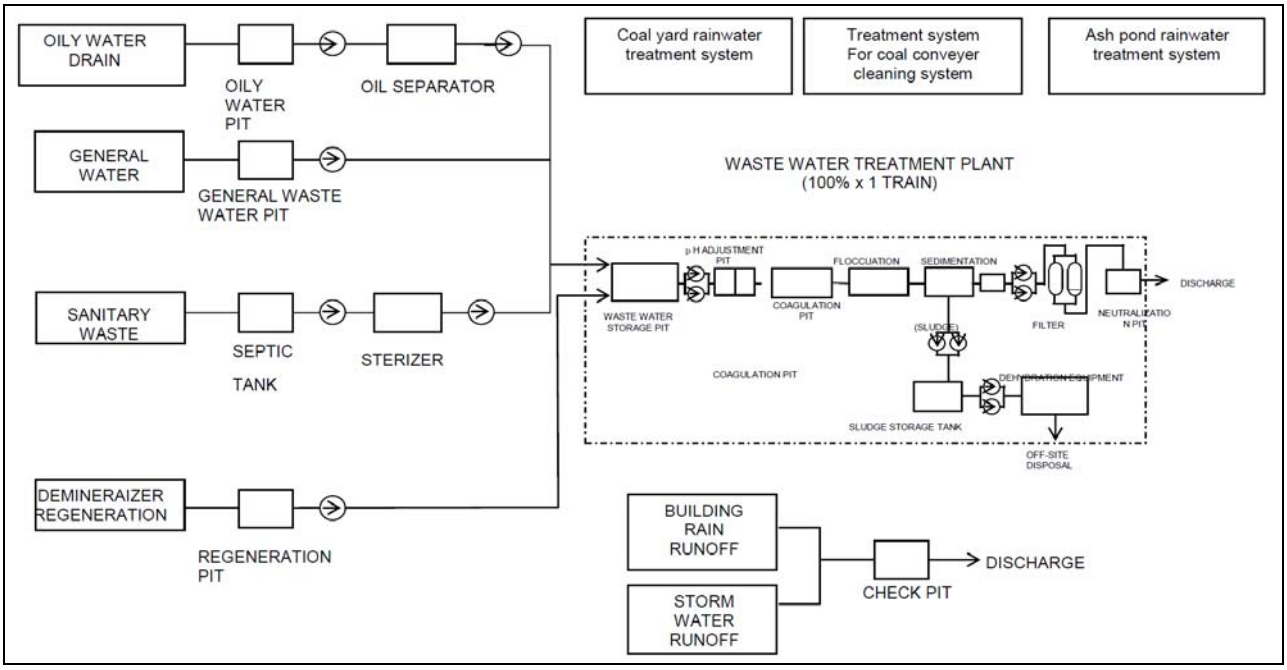
Scenario 2: Discharge point is 280m offshore:

No sea area experiences a water temperature increase of more than 4°C; sea area experiencing more than 3°C increase is up to 90m away; more than 2°C increase is up to 530m away; and more than 1°C increase is up to 1,400m away from the discharge point.

Sea area in front of the power plant is open water, and thermal effluent is diffused at the surface layer. Fish avoid the sea area if it exceeds a suitable water temperature, therefore living fish are likely to be impacted even though the thermal effluent is diffused. Furthermore, thermal effluent will be diffused into the bottom layer in the region close to the discharge point, which is likely to impact the benthos. Flora such as seaweed do not exist in the sea area in front of the power plant, and only fauna such as Polychaeta and Bivalvia are impacted by thermal effluent, though the impact range is limited to the area close to the discharge point.

<Plant wastewater, oil-containing wastewater, and domestic wastewater>

The operation of the power plant will produce wastewater from its facilities. Wastewater from each facility will collect in the central wastewater treatment system. The wastewater treatment system will consist of neutralization, coagulating sedimentation, and a filtration and oil separator. Wastewater will be managed and treated appropriately to comply with water quality of Bangladesh regulations and IFC/EHS Guideline values for thermal power plants. Treated wastewater will be mixed and diluted with a large volume of thermal effluents (Figure 15.6-17). The impact on water quality by the power plant operation is considered to be insignificant, because the impact intensity, duration and coverage area will be low, long term and limited, respectively.



(Source: JICA Study Team)

Figure 15.6-17 Discharge Flow

<Ash disposal pond and coal storage>

Rain water and wastewater from the ash pond and coal storage will leak directly into outside areas. Leakage from the bottom of the ash pond will be prevented by using an impermeable layer, such as high density polyethylene (HDPE) sheet or silt layer.

Wastewater will be managed and treated appropriately by neutralization and sedimentation to comply with water quality of Bangladesh regulations and IFC/WB EHS Guideline values for thermal power plants.

Coal ash is generally alkaline, and heavy metals are not eluted into the wastewater and rainwater drainage in most cases of Japanese power plants. However, the ingredients of heavy metals contained in the coal ash and wastewater from the ash disposal site will be monitored and analyzed by way of caution.

The above measures will be taken to ensure that the impact on the water quality will be insignificant.

<Seawater Desulphurization Method>

Sulfur dioxide in the exhaust gas is dissolved in seawater and becomes sulfate ion (SO_4^{2-}) with the seawater desulphurization method. Seawater contains 2,700 mg/L of sulfate ion, and the increase in the amount of sulfate ion by the seawater desulphurization method is 93 mg/L, which is about 3%. Seawater acts as a strong buffer, so that pH is not expected change greatly with the 3% increase of sulfate ion.

iii. Waste

General waste and hazardous waste will be generated. Workers in the power plant will produce sewerage and garbage. Waste oil will be generated from the operation and maintenance of the facilities. Sludge will be generated through precipitation treatment at the supply water treatment facility and the wastewater treatment facility.

Segregating waste at collection, recycling and reusing waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to the related regulations. Hazardous waste will be treated under the related regulations.

Fly ash and bottom ash will be generated in the process of coal combustion. Fly ash and bottom ash are not categorized as hazardous materials by Bangladesh regulations. An ash disposal pond (200 ha) will be built at the project site. The nominal capacity of the ash disposal pond is calculated based on the total volume of the ash to be accumulated for the duration of 25 years operation with 80% load factor. The total capacity is estimated to be 20,250,000 ton.

Reuse of coal-ash is not planned at present as there are no facilities to reuse coal-ash, such as a cement factory near the project site. Reuse of coal-ash already occurs in many countries, including in Europe, the United States, and Japan, and the feasibility is an issue to be discussed in the future.

The above measures will be taken to ensure that water pollution or sanitary problems resulting from waste do not arise.

iv. Noise and Vibration

<Noise>

Noise impact from the plant operation is predicted. There are residences near the project site, and sufficient consideration must be given to minimizing noise impact. The level of noise resulting from the operation of the major equipment was simulated using the following estimation model.

Noise level estimation model

An estimation of the noise level was made according to Chapter 15.6 1) Power plant a) Pre-construction Phase and Construction Phase.

Noise level data of noise source

The major equipment used in the power plant operation include boiler, coal mill, forced draft fan, gas duct etc for power plant facility and demineralization plant, water treatment equipment, wastewater treatment equipment, ash conveyer, etc for utility facility.

Table 15.6-9 shows the noise level of the major equipment and the number of equipment.

Table 15.6-9 Noise Level of Major Equipments

Item	Equipment Type	Noise Power Level (dB)	Number of Equipment
Power plant facility ・Unit 1 ・Unit 2	Boiler	70	2
	Coal mill	90	2
	Forced draft fan	105	2
	Air pre-heater	72	2
	EP	80	2
	FGD	70	2
	Induced draft fan	105	2
	Gas Duct	108	2
	Pump for FGD	101	2
	Circulation Pump	101	2
	Turbine building	70	2
	main transformer	90	2
Utility facility	Coal un-loader	84	2
	Coal conveyor from un-loader	87	3
	Stacker / reclaimer	84	10
	Coal conveyor to plant	87	3
	Demineralization plant	101	1
	Water treatment equipment	101	1
	Waste water treatment equipment	101	1
	Ash conveyor	101	1
	Waste water equipment for coal yard	101	1
	Switch yard	90	1

(Source: JICA Study Team)

Calculation conditions

Noise calculation was conducted for the power plant, taking into consideration the coal unloaders at the port. All the aforementioned machines are assumed to be operating simultaneously.

The totals of 16 points used for simulation were selected at the boundary of power plant site and discharge facilities, and another 3 points at the nearest residence were also selected for simulation.

Prior to power plant construction, the dyke with the height of 5 meters and 16 meters (for the purpose of ash disposal site) will be constructed at inside the boundary of the power plant site; therefore, the dispersion model of the noise level will be simulated, taking into account the dyke construction being completed and playing as a sound insulating wall.

Result of simulation

Table 15.6-10 shows the result of simulating the noise level for each sampling point during the operation of the plant equipment. Figure 15.6-19 shows the distribution of noise levels.

Noise level generated by power plant operation is 10.6 to 43.3dB (A) at the boundary of the

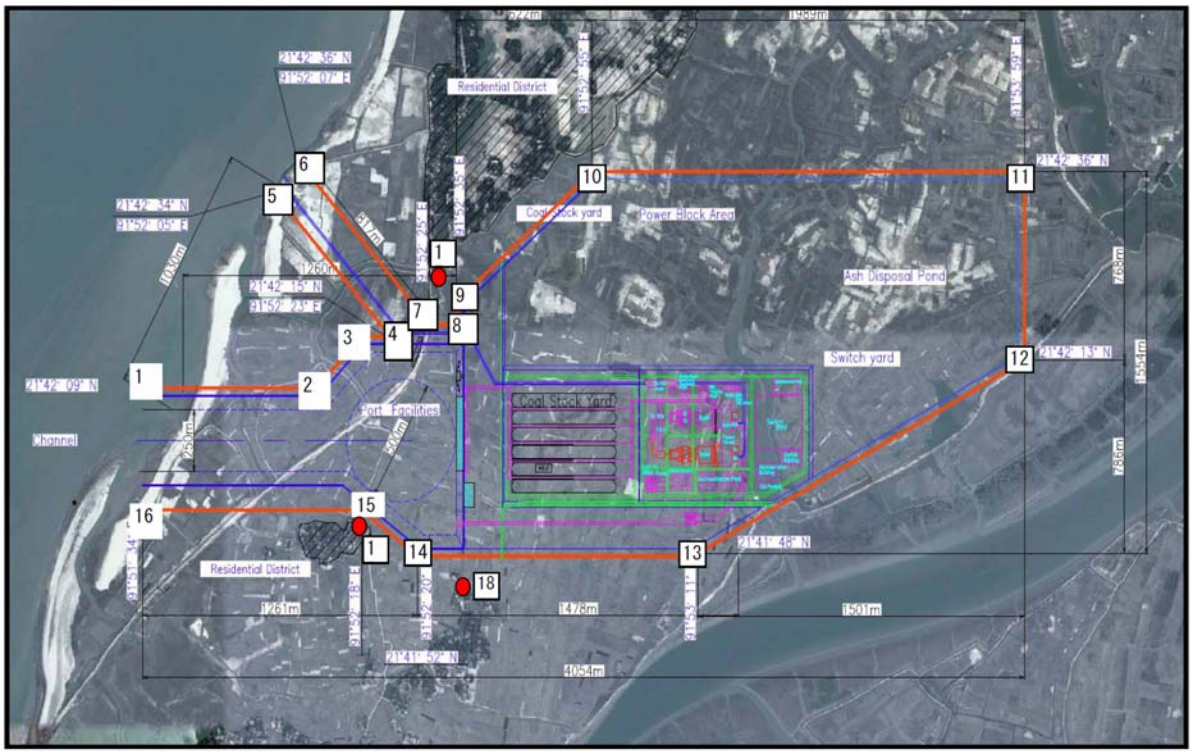
power plant site and discharge facility and 30.2 to 41.2 dB (A) at the nearest residence (1 point at north of the site and 2 points at south of the site).

The noise levels at all the points in residential areas satisfy the day-time noise level standard of Bangladesh. The noise level at 1 point in the residential areas exceeds the night-time noise level standard of Bangladesh; however, the range of the noise levels don't exceed the standard to the surrounding area of the power plant, and the noise level at the whole village satisfies the night-time standard. IFC/WB guideline is satisfied at all the points.

Table 15.6-10 Results of Simulating Noise Levels from Major Equipments

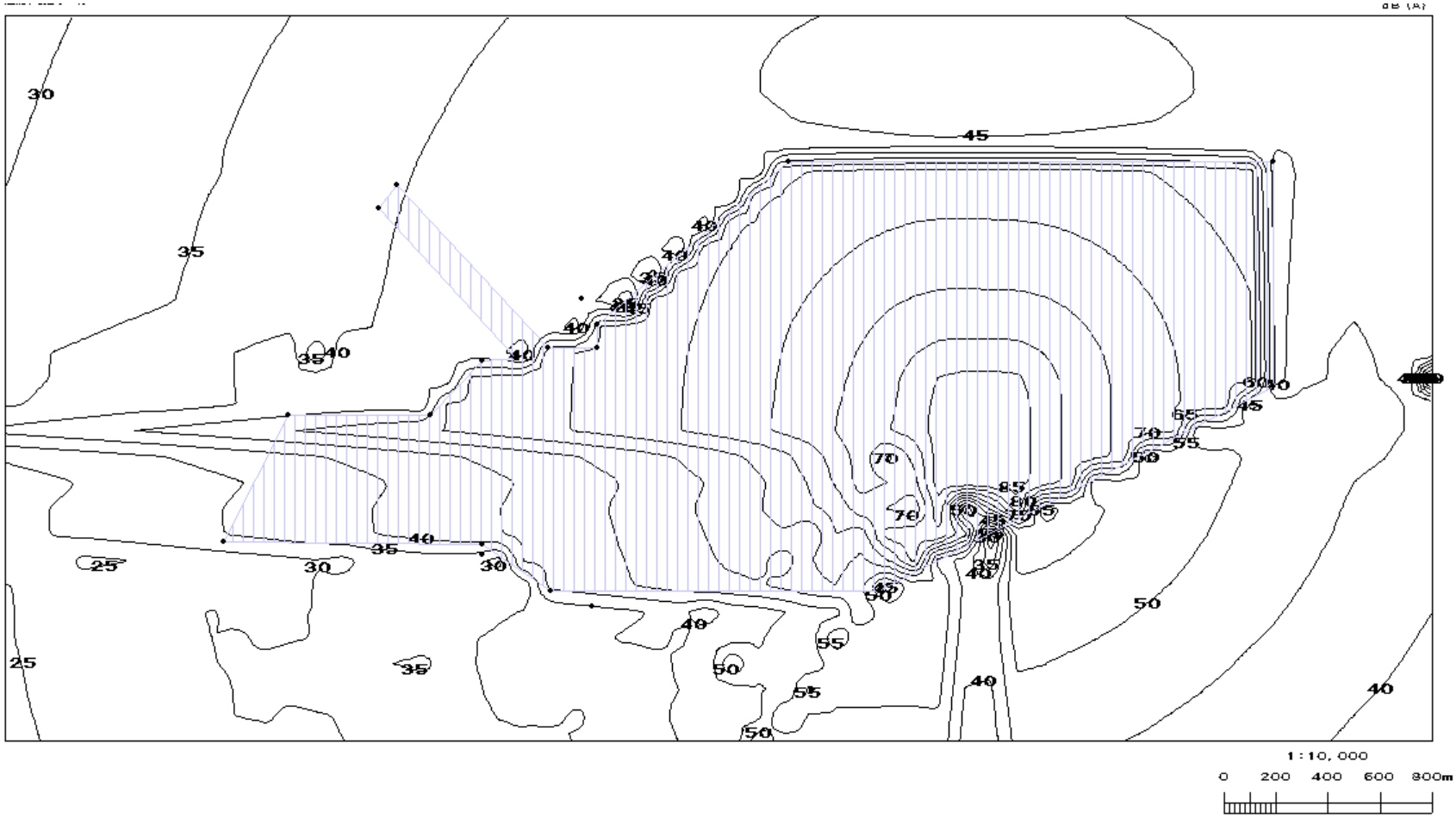
Simulation Points	Noise Levels (dBA)	DOE Limit Standard	IFC/WB EHS Guidelines: General
No. 1	41.0	Industrial Zone; Day 75 Night 70	Industrial Zone; Day 70 Night 70
No. 2	31.7		
No. 3	41.8		
No. 4	33.9		
No. 5	39.4		
No. 6	39.6		
No. 7	37.1		
No. 8	30.4		
No. 9	31.1		
No.10	35.2		
No.11	10.6		
No.12	39.0		
No.13	44.5		
No.14	28.7		
No.15	23.0		
No.16	22.6		
No.17	41.2	Residential Zone: Day 55 Night 45	Residential Zone: Day 55 Night 45
No.18	37.1		
No.19	30.2		

(Source: The Environmental Conservation Rules, 1997, IFC/WB Environmental Health and Safety Guidelines, General 2007)



(Source: JICA Study Team)

Figure 15.6-18 Locations of Simulation Points



(Source: JICA Study Team)

Figure 15.6-19 Results of Simulating the Diffusion of Noise Genarated from Plant Equipment (Unit: dBA)

Maintenance of equipment will be conducted, and low noise type equipment and adequate enclosures will be installed.

<Vibration>

The impact of vibration is predicted to be caused by plant operation. Maintenance of equipment will be conducted, and low vibration type equipment and adequate enclosures will be installed.

v. Odor

In case domestic waste from the workers' camp is not appropriately treated, bad odors from rotten waste may occur. Before starting plant operation, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produces. These measures will be taken to minimize the generation of odor.

vi. Soil

Soil pollution will possibly be caused by seepages from the ash disposal site and leakages of oil and chemical materials. The bottom of the ash pond should have an impermeable layer (less than 10-6cm/sec), such as impermeable geo-membrane, sheet and clay. Oil and chemical materials will be stored at an appropriate storage site to prevent any permeation into ground. These measures will minimize the impact of any contamination of the soil.

vii. Sediment

Sediment pollution may occur in the case power plant wastewater and domestic wastewater flow into the sea and the surrounding rivers. Rain water and wastewater from the ash pond and coal storage will not be leaked directly into outside areas. Leakages from the bottom of the ash pond will be prevented by using an impermeable layer, such as a high density polyethylene (HDPE) sheet.

Wastewater will be collected in a central wastewater treatment system. It will be managed and treated appropriately to comply with water quality regulations. The negative impacts on water quality due to rain water and wastewater from the ash pond and coal storage are considered to be significant, however, the intensity, duration and coverage area will be limited.

b. Natural Environment

i. Protected Areas

Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, and it is located 15km south of the proposed project site.

<Direct Impact>

Table 15.6-11 Evaluation of Environmental Impact on Sonadia ECA

Items	Results of Evaluation
Air Quality	Simulation of exhaust gas diffusion indicated that no area inside Sonadia ECA will exceed the ambient air quality standard. Therefore, no impact of air pollution on Sonadia ECA is anticipated.
Water Quality	Simulation of thermal effluent diffusion indicated that the diffusion range of thermal effluents will be limited to the sea front area of the power plant, and will not reach Sonadia ECA located about 15km away from the power plant. Other types of wastewater from the power plant will be discharged after appropriate treatment, therefore, no impact of water quality on Sonadia ECA is expected.
Noise	Noise levels attenuated with distance, so that no noise impact on Sonadia ECA, which is located 15km away from the power plant site, is expected.
Current Flow	Simulation of flow conditions indicated that the change of the flow conditions caused by dredging of the navigation channel will be limited to the sea front area of the power plant, with no impact expected to reach Sonadia ECA.
Drift Sand	Simulation of drift sand indicated that the change of the drift sand caused by dredging of the navigation channel will be limited to the sea front area of the power plant, with no impact expected to reach Sonadia ECA.

(Source: JICA Study Team)

<Indirect Impact>

(Movement of marine organisms between the sea front area of the power plant and the sea area of Sonadia Island)

The conclusion of the fish and nekton survey conducted in Kutubdia, Matarbari, Dhalghata, and Sonadia Island is as follows.

Number of species collected

Table 15.6-12 and Figure 15.6-20 shows the number of species collected at each sampling site. At Dhalghata, Matarbari and Kutubdia, a higher number of species was seen in the dry season than in the rainy season. In contrast, a lower number of species was seen in the dry season than in the rainy season at Sonadia Island.

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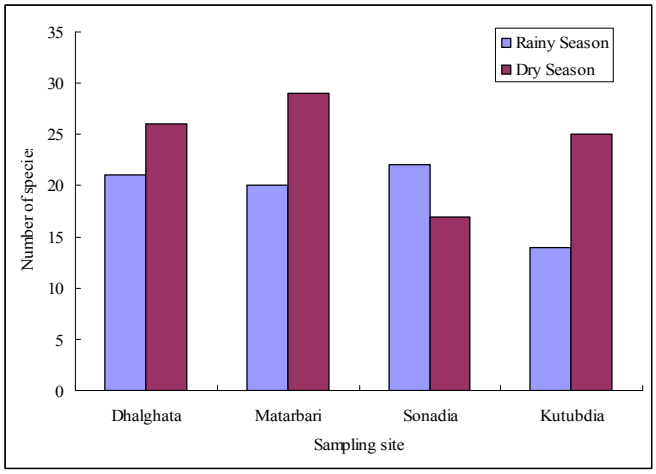
Table 15.6-12 Number of Species Collected in Each Sampling Site

Survey Period	Dhalghata	Matarbari	Sonadia	Kutubdia
Rainy Season	21	20	22	14
Dry Season	26	29	17	25

(Source: JICA Study Team)



(Source: JICA Study Team)

Figure 15.6-20 Number of Species at Each Sampling Site in Rainy and Dry Seasons

Mass of the catch at each sampling site

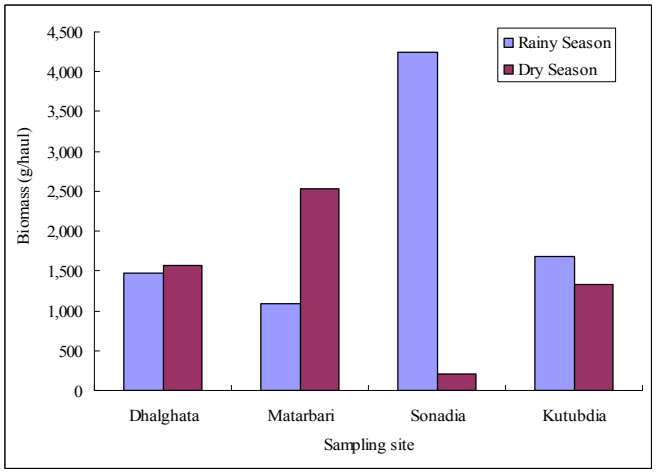
Table 15.6-13 and Figure 15.6-21 shows the biomass of the catch at each sampling site. At Dhalghata and Kutubdia, the biomass was more or less similar between the dry and rainy seasons, while the mass in the dry season was about double that in the rainy season in Matarbari. In contrast, biomass in the rainy season was more than 20 times larger than in the dry season at Sonadia.

Table 15.6-13 Biomass of the Catch in a Haul of the Net at Each Sampling Site

(unit : g)

Survey Period	Dhalghata	Matarbari	Sonadia	Kutubdia
Rainy Season	1,480	1,082	4,250	1,674
Dry Season	1,569	2,530	211	1,336

(Source: JICA Study Team)



(Source: JICA Study Team)

Figure 15.6-21 Biomass at Each Sampling Site in Rainy and Dry Seasons

Species composition at each sampling site

In the rainy season, 2 species of Cephalopoda (squids and octopus), 12 species of Malacostraca (shrimps and crabs), and 30 species of Actinopterygii (ray-finned fishes) were collected. Species composition in each sampling site is shown in Table 15.6-14.

In the dry season (January/2013), 4 species of Cephalopoda (squids and octopus), 18 species of Malacostraca (shrimps and crabs), and 30 species of Actinopterygii (ray-finned fishes) were collected. Species composition in each sampling site is shown in Table 15.6-15.

Table 15.6-14 List of Species (Rainy Season)

CLASS/Order/Species	Dhalghata	Matarbari	Sonadia	Kutubdia
CEPHALOPODA				
Sepiida (cuttlefish)				
Sepia sp.	1	0	1	0
Teuthida (squids)				
Loligo sp.	1	1	1	1
MALACOSTRACA				
Stomatopoda (mantis shrimps)				
Squilla sp.	1	0	1	1
Decapoda (shrimps and crabs)				
Acanthopotamon martensi	1	1	0	0
Charybdis natator	0	0	1	1
Acetes sp.	0	0	1	1
Exopalaemon peliferus	0	0	0	1
Exopalaemon styliferus	1	1	1	0
Matuta planipes	0	0	1	0
Metapenaeus lysianassa	0	1	1	1
Metapenaeus monoceros	1	1	0	0
Parapenaeopsis sculptilis	0	0	0	1
Scylla sp.	0	1	0	0
Solenocera sp.	0	0	1	0
ACTINOPTERYGII (ray-finned fish)				
Anguilliformes (eels)				
Coilia dussumieri	0	0	1	0
Coilia peliferus	0	0	0	1
Pisodonophis boro	1	1	1	0
Setipinna phasa	0	0	0	1
Stolephorus tri	1	1	1	0
Siluriformes (catfish)				
Arius sp.	0	0	1	1
Aulopiformes				
Harpadon nehereus	0	0	1	1
Syngnathiformes (sea horses)				
Syngnathoides sp.	1	0	0	0
Mugiliformes (mullets)				
Liza sp.	1	1	0	0
Valamugil speigleri	1	1	0	0
Perciformes (perches)				
Ambassis sp.	0	1	0	0
Boleophthalmus viridis	1	0	0	0

CLASS/Order/Species	Dhalghata	Matarbari	Sonadia	Kutubdia
Eleutheronema tetradactylum	1	0	0	0
Glossogobius giuris	1	1	0	0
Lates calcarifer	0	1	0	0
Lepturacanthus savala	0	0	1	1
Lutjanus johnii	1	1	1	0
Odontamblyopus rubicundus	1	1	1	0
Pampus argenteus	0	0	1	0
Polynemus paradiseus	0	0	0	1
Pseudapocryptes elongates	1	1	0	0
Scatophagus argus	0	1	0	0
Sillago domina	0	0	0	1
Strongylura strongylura	0	1	0	0
Terapon jarbua	1	1	0	0
Trypauchen vagina	1	1	1	0
Pleuronectiformes (flatfish)				
Cynoglossus cynoglossus	1	0	0	0
Cynoglossus lingua	0	0	1	0
Paraplagusia bilineata	1	0	1	0
Tetraodontiformes (puffers)				
Chelonodon patoca	0	0	1	0
Number of species	21	20	22	14

Notes: 1= collected, 0 = not collected

(Source: JICA Study Team)

Table 15.6-15 List of Species (Dry Season; January/2013)

CLASS/Order/Species	Dhalghata	Matarbari	Sonadia	Kutubdia
CEPHALOPODA				
Sepiida (cutlet fish)				
Sepia sp.	1	1	0	1
Teuthida (squids)				
Histioteuthis celelaria pacifica	0	0	1	0
Loligo sp.	1	1	1	0
Octoopda (octopuses)	0	0	0	0
Octopus sp.	1	0	0	0
MALACOSTRACA				
Stomatopoda (mantis shrimps)				
Orantoskuilla inornata	1	1	0	0
Squilla sp.	0	0	0	1
Decapoda (shrimps and crabs)				
Solenocera melantho	0	1	0	0
Solenocera sp.	0	0	1	0
Penaeus affinis	1	1	0	0
Penaeus merguiensis	1	0	0	0
Penaeus semisulcatus	0	1	0	0
Penulirus sp.	0	0	0	1
Metapenaeus brevicornis	0	0	1	1
Metapenaeus lysianassa	0	0	1	1
Metapenaeus monoceros	1	0	0	1
Metapenaeus tenuipes	1	1	0	0
Trachypenaeus sp.	0	0	1	0

CLASS/Order/Species	Dhalghata	Matarbari	Sonadia	Kutubdia
Acetes sp.	1	1	1	1
Panulirus ornatus	1	1	0	0
Matuta planipes	0	1	1	1
Scylla olivacea	0	1	0	1
Portunus sanguinolentus	1	0	0	0
ACTINOPTERYGII (ray-finned fish)				
Anguilliformes (eels)				
Gymnothorax punctatus	0	0	0	1
Congresox talabonoides	0	0	0	1
Muraenesox bagio	0	0	0	1
Thyrsoidea macruna	0	1	0	0
Aulopiformes				
Harpadon nehereus	1	1	0	1
Clupeiformes (sardines and anchovies)				
Pellona dichella	1	0	0	0
Sardinella fimbriata	0	0	0	1
Sardinella melanura	0	1	0	1
Tenualosa megaloptera	0	1	1	0
Coilia dussumieri	1	1	0	1
Ilisha filigera	0	0	1	0
Setipinna taty	1	0	0	1
Tenualosa ilisha	0	0	0	1
Thryssa purava	0	1	0	1
Mugiliformes (mullets)				
Mugil cephalus	1	0	0	0
Perciformes (perch)				
Johnius argentatus	1	1	0	1
Butis butis	0	1	1	0
Drepane punctata	1	1	0	0
Lates calcarifer	0	1	1	0
Odontamblyopus rubicundus	1	1	0	1
Apocryptes dantatus	0	1	0	0
Otolithoides pama	1	1	0	0
Pampus argenteus	1	0	1	1
Pampus chinensis	0	1	0	0
Secutor ruconius	1	1	1	0
Sillago domina	1	1	0	0
Lepturacanthus savala	0	1	1	1
Trichiurus haumela	1	0	0	0
Pleuronectiformes (flatfish)				
Cynoglossus cynoglossus	1	1	1	1
Tetraodontiformes (puffers)				
Torquigener oblongus	1	0	1	1
Number of species	26	29	17	25

Notes: 1= collected, 0 = not collected

(Source: JICA Study Team)

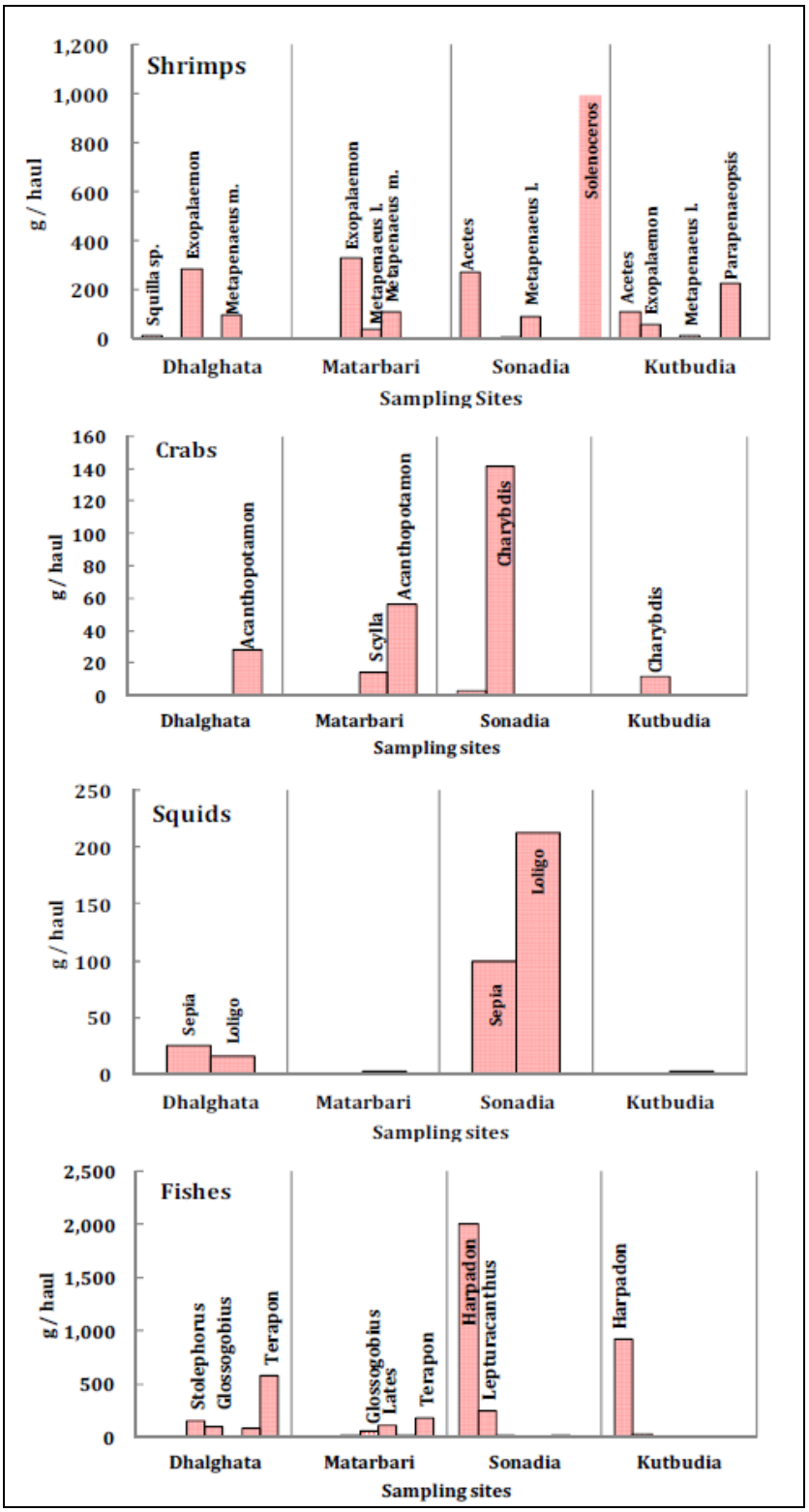
Species Composition and CPUE

Rainy season

Variable shrimps were evenly distributed in all the sampling sites except *Solenocera* that was conspicuous in Sonadia. Other predatory crabs, squids and fish were also distributed at moderate or low levels except in Sonadia where a predatory crab *Charybdis*, squids and cuttlefishes such as *Loligo* and *Sepia* were conspicuous. In case of finfish, a shrimp eater *Harpadon* was prominent in Sonadia and Kutubdia where the fish was not seen in the dry season (Figure 15.6-22).

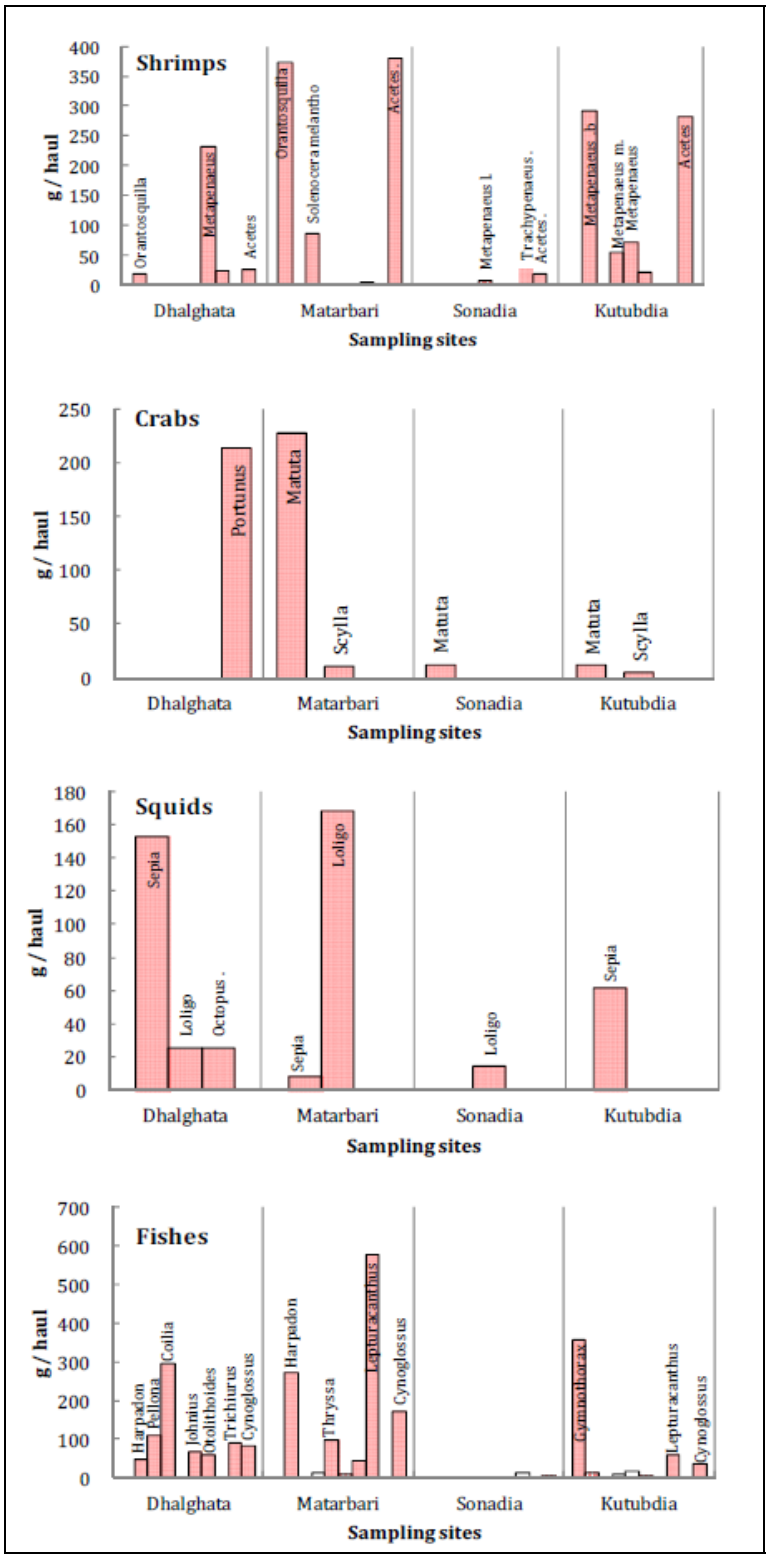
Dry season

Small shrimps represented by *Acetes* sp. and *Metapenaeus* spp. were prominent in Dhalghata, Matarbari and Kutubdia. Those small shrimps are important food for other predators, therefore predatory mantis shrimp *Orantosquilla*, squids, cuttlefish, octopus, and crabs were also prominent in the same 3 sampling sites. Similarly, fish feed on small shrimps such as *Harpadon*, *Coillia*, *Lepturacanrthus* and *Gymnothorax,* which were conspicuous in the same sites. In contrast, very few nektons were collected at Sonadia (Figure 15.6-23).



(Source: JICA Study Team)

Figure 15.6-22 Species Composition and CPUE (g/haul) at Each Sampling Site (Rainy Season)



(Source: JICA Study Team)

Figure 15.6-23 Species Composition and CPUE (g/haul) at Each Sampling Site (Dry Season; January/2013)

Discussion

Migration of Nektons

Predatory species such as Squid (*Loligo*), Cuttlefish (*Sepia*), Octopus, Swimming crabs, Anchovies (*Thryssa* and *Coillia*), Bombay duck (*Harpadon*), Cutlass fish (*Lepturacanthus*), Morey eel (*Gymnothorax*) were observed at places where there were many small shrimp species. Therefore, migration of those predatory species can be judged as a feeding migration. All of those species are obviously migrating for small shrimps without any particular course. Usually they inhabit offshore but they start migrating inshore during the monsoon. This onshore-offshore migration happens in a quite extensive range. Up until now, nothing has been reported about courses of such foraging migration, and no proof has been found even in the present sampling study. We cannot deny that some foraging fish may migrate from protected areas to the construction site of the power plant. Nevertheless, there will be no necessity to give that a lot of consideration because even if they came from a protected area, they will be merely visitors to the protected areas for foraging.

In conclusion, the authors of the present report judge that the power plant construction at the restricted area of Matarbari Island does have quite a minor impact on huge populations of the foraging species around the area.

Other information

Information on marine organisms moving for spawning between Matarbari and Sonadia Islands is not well identified. Hilsa (*Tenualosa ilisha*) move for spawning at the estuary of Ganges River[10]; however, thermal effluents and other wastewater from the power plant operation are not expected to impact the spawning of Hilsa, since the Ganges River is 100km away from the power plant site.

ii. Ecosystem

The project site consists of land used for salt farms and other purposes, with no primeval forests or tropical rain forests. A sandy beach is located in front of the proposed project site, but there are no mangrove forests or tidal flats.

The area is the presumed habitat of birds, dolphins, and sea turtles of the IUCN Red list (endangered species, etc.), and operation of the power plant may impact the rare species and ecosystem.

Environmental impact of air pollution, water turbidity, and noise, etc., during the operation phase will be mitigated through appropriate countermeasures, as described above, and results of simulations also indicate that environmental standards will be met. The water intake and discharge of cooling water used in the power plant will be carried out at a flow rate much lower than the current in the surrounding ocean, and the water flow in the surrounding sea will not be affected.

[10] Personal note from Mr. Muhammad Zaher (Fisheries Research Institude in Cox's Bazar)

In addition, smaller fish in the sea area have sufficient swimming ability in comparison to the flow rate of water intake, and it is considered they will not be affected as a consequence. The diffusion area of thermal effluents with increased temperature of 2 ºC or higher is limited to a certain surface layer and fish can easily bypass this area.

As mentioned above, the frequency with which Spoon billed Sandpiper uses the Matarbari Island as a wintering ground is relatively very low in comparison with the nearby offshore island of Sonadia. Many previous survey results point out that Matarbari Island beach is not a main migratory habitat for migratory birds, especially the Spoon billed Sandpiper in Bangladesh; this is also supported by other experts and reports. However, for the purpose of protecting the species, construction workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law.

For four IUCN precious species of sea turtles, it is highly likely that the spawning of these species take place on the sea coast, and a detailed survey should be conducted. Light and noise of nighttime construction may have adverse effects on the sea turtles. Consequently, night construction activity in the spawning season should be avoided as much as possible, and should be conducted under minimum light. Lighting color that does not affect spawning (e.g., red or yellow) will be selected. Low-noise equipment shall also be installed. The careful monitoring of spawning status is necessary.

As metioned in "Chapter 15.5.2, (1), 1), c), c., Threatened Species in project areas", the project site and its surrounding areas are not categorized as the critical natural
habitats for Spoon billed Sandpiper and sea turtles which is defined as per "JICA guidelines for environmental and social considerations (April, 2010)".

c. Social Environment

i. Disturbance to Poor People

Resettled people may experience a deterioration of their household economies and livelihood losses due to their relocation if appropriate measures are not taken. Poor people who currently have low living standards, living without proper facilities, will have better access to social services throughout the year if roads are improved along with the construction of the power plant, especially improved access during the rainy season.

Living standards of poor people will not be improved only with the provision of compensation and livelihood restoration measures, if appropriate social infrastructure is not established. The road around the project site is especially in a bad condition (not possible to travel in the rainy season), preventing local access to social services. Additionally, the existing road will be cut-off by the construction of the power plant. An access road, a community road that will replace the existing road and a road around the power plant boundary shall be built. These roads will be built with sufficient height so that they can be used even in the rainy season.

Local people should be employed to work at the power plant and related facilities to the maximum extent possible according to their skills.

ii. Deterioration of Local Economy such as Losses of Employment and Livelihood Means/ Land Use and Utilization of Local Resources

There will be permanent losses or reduction of livelihood means in salt farming, shrimp farming and fishing activities. Employment opportunities will be offered at the power plant for local people.

The implementation of this project will change the traditional land use patterns and utilization of local resources, which may have a large impact on the existing local economy. Local people should be employed to work at the power plant and related facilities to the maximum extent possible according to their skills. Livelihood restoration means shall be conducted including job training for those who want it. Services (e.g., laundry, catering services, etc.) and products offered by the local community should be used by the power plant as much as possible.

Both fishermen around the project site who operate in the marine area (3 - 50km from the coast) outside of the adverse effects of thermal effluents and other wastewater discharge of the power plant, and fish catches will not be affected.

Efforts for regional development will be promoted, including the establishment of a local development plan in cooperation with the local government.

iii. Disturbance to Water Usage, Water Rights, etc.

In the operation phase, all water used for the project will be supplied not from ground water or river water, but from sea water desalinated by reverse osmosis. The local economy may be affected by discharged water from the power plant into the sea. Wastewater generated from the power plant will be appropriately treated before discharge. Waste will also be appropriately treated and disposed of, with necessary countermeasures to prevent any seepages of oil and chemicals.

iv. Disturbance to the Existing Social Infrastructure and Service

Traffic volume and traffic jams will increase in the surrounding roads during the operation phase. Mitigation measures to decrease traffic volume shall be conducted, such as the promotion of bus use. Additionally, an access road, community road and road around the power plant boundary shall be built. These roads will be built with sufficient height so that they can be used even in the rainy season, in order to enable public access to markets and social services.

In addition, a school and medical facility constructed within the power plant site shall be open to all local people for the improvement of their lives.

v. Misdistribution of Benefits and Compensation

People who live in other areas may have limited access or be prevented from accessing the school and medical facility within the power plant site and the access road, which may cause grievances. The access road, school and medical facility constructed within the power plant site shall be open to all local people to the maximum extent possible in order to improve peoples' lives.

vi. Local Conflicts of Interest

Local conflicts of interest may occur between employers and employees of salt farms, shrimp farms and the fishing industry, and between local administration bodies and local political leaders. There may be feelings of resentment and reconciliation, as people living around the project site will benefit through improvement of social infrastructure and services. Local people should be employed at the power plant to the maximum extent possible, and workers from other countries should be taught to respect local customs in order to facilitate good relationships with the local people. However, conflicts among local residents may occur if such benefits were misdistributed. The lodgings of project workers should be equipped with sufficient living facilities in order to keep workers at the project site as much as possible.

The access road, school and medical facility constructed within the power plant site shall be open to all local people to the maximum extent possible for the improvement of peoples' lives.

vii. Gender

Residents will have better access to social services throughout the year if roads are improved along with the construction of the power plant, especially access during the rainy season.

viii. Children's Rights

There is a possibility that children may be forced to work and not attend school. Labor contracts between the subcontractors and children shall be prohibited. Regular patrols to check for child workers shall be conducted.

Further, children's rights to go to school may further deteriorate if the access way to their school is physically blocked by the construction site. The access road, community road and road around the power plant boundary shall be built with sufficient height so that it can be used even in the rainy season, so that access to markets and social services shall be improved, including access by children.

ix. Work Environment (Including Work Safety)

Work accidents involving workers may occur at the power plant site. CPGCBL shall establish a work safety plan. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and on hard aspects (provide workers with appropriate protective equipment, etc.).

d. Others

i. Accidents

Marine traffic and land traffic accidents may occur during plant operation. Fires caused by spontaneous ignition of stored coal may also occur.

Observation of traffic regulations, installation of traffic signs, and training and education on safe driving shall be conducted for land traffic vehicles. For ocean navigation, determining water

routes after consultation with related authorities, and setting course buoys around navigation channel for marine safety will be undertaken as prevention measures for accidents.
Fire prevention measures shall be conducted including regular watering of the coal storage site, installation of fire protection equipment in the power plant and organization of fire-fighting team and fire-fighting training.

ii. Cross-boundary Impact and Climate Change
CO_2 will be produced by the operation of the power plant. Ultra supercritical (USC) technology will be adopted at the power plant, producing less CO_2 of approximately 566 thousand tons/year compared to a sub-critical coal-fired power plant.

(2) Port Facility

a) Pre-construction Phase and Construction Phase

a. Pollution Control

i. Air Quality
The operation of heavy machinery and trucks is expected to produce dust and air pollutants (SOx and NOx, etc.), but the impact will be limited to the surrounding area.
According to the Beaufort scale, when wind the speed exceeds approximately 6m/s, dust on the ground may be swept up. However, wind speed is not expected to exceed approximately 6m/s around the project site.
Watering the access road and construction site, especially in the dry season, and using cover sheets on trucks for the transportation of soil will be undertaken in order to reduce dust. There will be periodic maintenance and management of all the construction machinery and vehicles to reduce exhaust being discharged from such machines and vehicles.

ii. Water Quality
Turbid water is expected to be produced from dredging activity. In addition, concrete wastewater and oil-containing wastewater are expected to have an effect, albeit only temporary.
In conducting dredging work of the marine area, pump dredgers will be used and anti-diffusion membranes will be installed around the construction site to prevent diffusion of turbidity. For dredging work on the land site, steel sheet piles will be installed for enclosure on the marine side before excavation work starts. Pump dredgers will be used after marine water penetrates into the area. Turbid water from the land (including rain water) will be treated with a precipitation system and supernatant will be discharged into the excavated part of the port.

iii. Waste
Sand and silt will be generated from dredging work of the canal and the port. Sand will be, after being dehydrated at the effluent outlet, entirely reused for land preparation of the plant, and silt

will be entirely disposed of in the ash pond adequately managed and treated as dust and waste water .

General waste and hazardous waste will be appropriately treated and disposed of as in the case of the power plant construction. These measures will be taken to ensure that no water pollution or sanitary problems result from waste.

iv. Noise

There will be noise and vibration impacts from construction activity in the sea area, dredging and land preparation, but it is predicted to be temporary. However, there are residences near the port construction area and sufficient consideration must be given to minimizing noise impact. The level of noise resulting from the plant operation of the construction machinery was simulated using the following estimation model.

Noise level estimation model

Noise level estimation was made according to Chapter 15.6 (1), 1), ,a), a. Pollution control, iv. Noise.

Noise level data of noise source

The major construction machinery used in the construction work includes dump trucks, bulldozers and back hoes for excavation, and pump dredgers. Table 15.6-16 shows the noise levels of the construction machinery and the number of machines.

Table 15.6-16 Noise Level of Major Construction Machines

Position (Next Figure)	Machine	Capacity	Noise Power level (dB)	Number of machines	Position (Next Figure)	Machine	Capacity	Noise Power level (dB)	Number of machines
1	Grab dredger	23m^3	100	4	4	Motor grader	4.5m	113	1
	Sand carrier	500m^3	111	4		Motor sprinkler	5.5-6.kL	102	1
2	Pump dredger	D ,000PS	119	2	5	Backhoe	3.0m^3	103	15
	Sand carrier	500m^3	111	4		Dump truck	11-40t	109	100
3	Backhoe	3.0m^3	103	15		Bulldozer	15-32t	118	7
	Dump truck	11-40 t	109	100		Truck crane	11t	107	6
	Vibratory hammer	60kW	116	8		Vibratory hammer	60kW	116	8
	Motor grader	4.5m	113	1		Motor grader	4.5m	113	1
	Motor sprinkler	5.5-6.5kL	102	1		Motor sprinkler	5.5-6.5kL	102	1
4	Backhoe	3.0m^3	103	15	6	Backhoe	3.0m^3	103	15
	Dump truck	11-40t	109	100		Dump truck	11-40t	109	100
	Bulldozer	15-32t	118	7		Bulldozer	15-32t	118	7
	Vibratory hammer	60kW	116	8		Motor sprinkler	5.5-6.5kL	102	1

Note: Noise source level has been calculated from the A-characteristic correction value at a distance of 7m from the construction machinery.

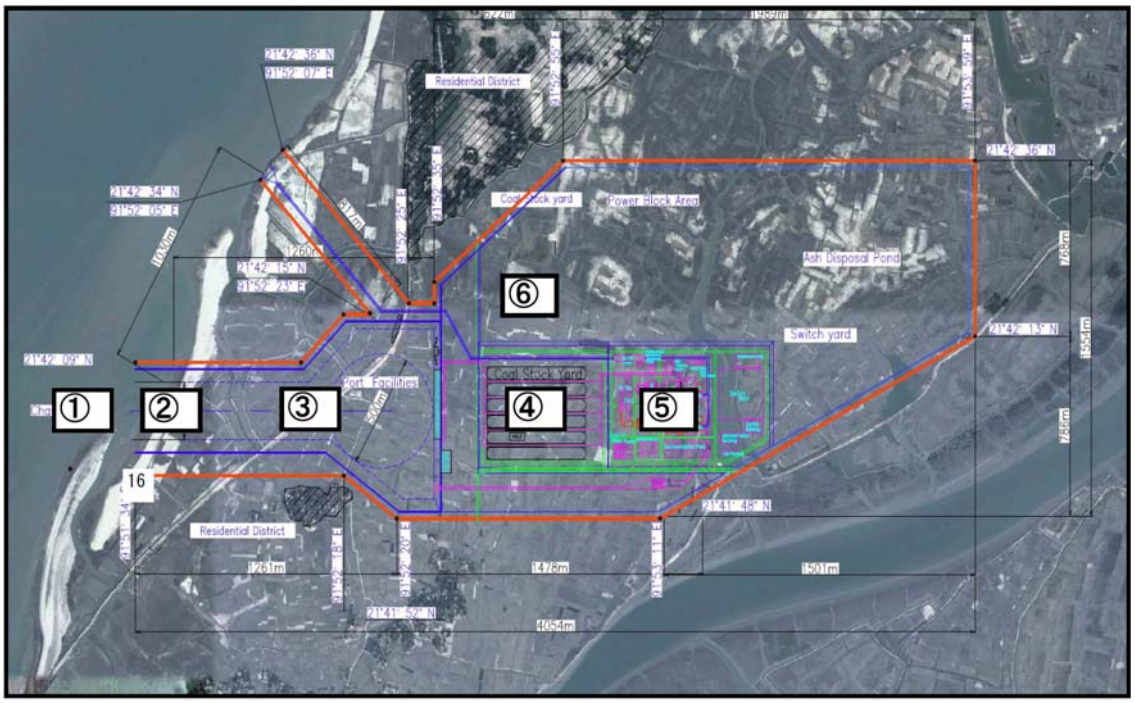
(Source: JICA Study Team)

Calculation conditions

Calculation of noise levels was conducted for the construction of the port and backfilling of sand, etc. All the aforementioned machines are assumed to be operating simultaneously. The operation position of the construction machinery is shown in Figure 15.6-24.

Construction activities will be actually conducted, leveling out the construction amount and scale, based on the construction schedule; therefore, all the machinery will not be operated simultaneously. The totals of 16 points used for simulation were selected at the boundary of power plant site and discharge facilities, and another 3 points at the nearest residence were also selected for simulation.

Prior to power plant construction, the dyke with the height of 5 meters and 16 meters (for the purpose of ash disposal site) will be constructed at inside the boundary of the power plant site; therefore, the dispersion model of the noise level will be simulated, taking into account the dyke construction being completed and playing as a sound insulating wall.



(Source: JICA Study Team)

Figure 15.6-24 Operation Positions of Construction Machines

Results of simulation

Table 15.6-17 shows the results of simulating the noise levels for each sampling point during the operation of the construction machinery. Figure 15.6-26 shows the distribution of noise levels.

Noise level generated by the construction activities is 35.7 to 73.2dB(A) at the boundary of the

power plant site and discharge facility, and 51.5 to 57.5dB(A) at the nearest residence (1 point at north of the site and 2 points at south of the site).

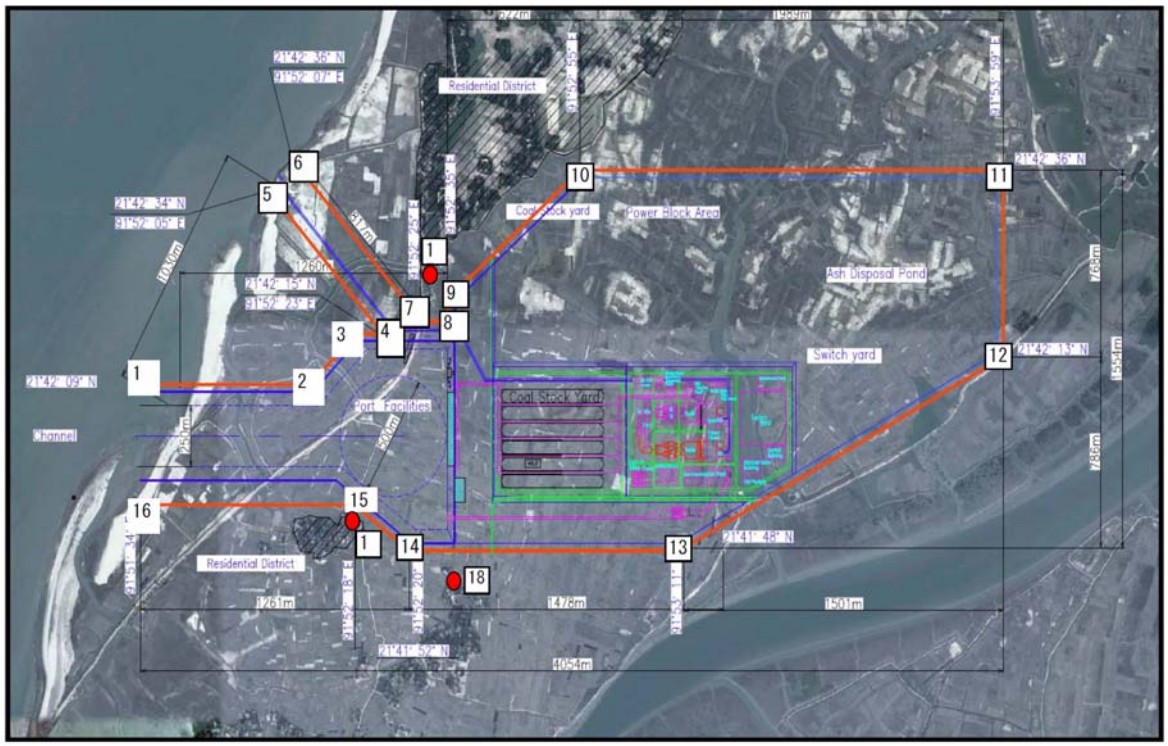
The noise levels at all the points in residential areas exceed the day-time noise level standard of Bangladesh and exceed the IFC/WB guideline values at 2 points.

Table 15.6-17 Results of Simulating Noise Levels from machines Used in Construction Work

(Unit: dBA)

Simulation Points	Noise Levels (dBA)	DOE Limit Standard	IFC/WB EHS Guidelines: General
No. 1	71.8	Industrial Zone; Day 75 Night 70	Industrial Zone; Day 70 Night 70
No. 2	73.2		
No. 3	61.0		
No. 4	46.3		
No. 5	59.8		
No. 6	58.4		
No. 7	43.8		
No. 8	35.7		
No. 9	44.1		
No.10	57.6		
No.11	53.1		
No.12	56.0		
No.13	66.0		
No.14	52.3		
No.15	51.5		
No.16	55.3		
No.17	51.5	Residential Zone: Day 55 Night 45	Residential Zone: Day 55 Night 45
No.18	53.5		
No.19	57.5		

(Source: The Environmental Conservation Rules, 1997, IFC/WB Environmental Health and Safety Guidelines, General 2007)

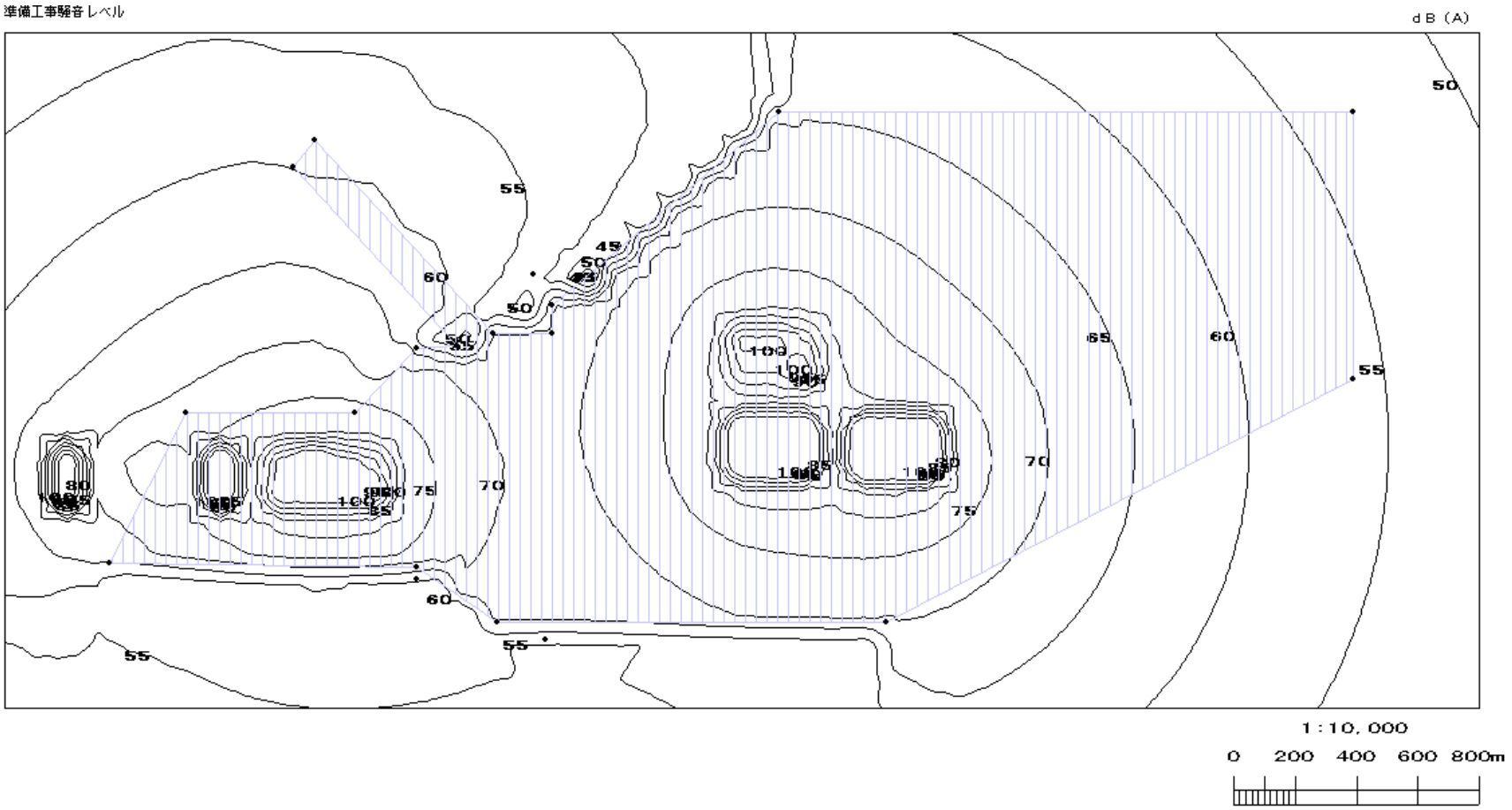


(Source: JICA Study Team)

Figure 15.6-25 Locations of Simulation Points

In the actual construction work, schedule management will be performed to maintain constant amounts of construction work and to ensure that low-noise/ low vibration equipment will be used as much as possible. Construction work will be performed during daytime, especially piling work. Thus, all efforts will be made to minimize the noise impact.

Material and equipment transportation will be mainly conducted by shipping, and schedule management will maintain constant amounts of the construction work. Measures for reducing the generation of noise, such as speed reduction of vehicles in residential areas, will be taken, whereby vehicle noise impact will be minimized.



(Source: JICA Study Team)

Figure 15.6-26 Results of Simulating the Diffusion of Noise Generated from Machines Used in Construction Work (Unit: dBA)

v. Subsidence

Groundwater will not be used during the construction phase of the port facility, therefore subsidence will not occur.

b. Natural Environment

i. Protected Areas

Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, and it is located 15km south of the proposed project site. Environmental impact of air pollution, water turbidity and noise, etc., during construction will be mitigated through appropriate countermeasures and the extent of any impact will be limited. Consequently, the impact on Sonadia ECA will be insignificant.

ii. Ecosystem

The sandy beach is 7km long at the west coast of Matarbari Island, according to the Maheshkhali Upazila Officer. The width of the navigation channel to be altered is 400m and the length of discharge outlet is 100m, resulting in less than 10% of the sandy beach which may disappear.

The area to be altered by port construction work consists of land used for salt farms and other purposes, and not primeval forests or tropical rain forests. A sandy beach is located in front of the proposed project site, but there are no mangrove forests and tidal flats. The area is the presumed habitat of birds, dolphins, and sea turtles of the IUCN Red list (endangered species, etc.), and there is the possibility that construction will have an impact on the rare species and ecosystem.

Very few trees will be cut down in the construction activity and the environmental impact of air pollution, water turbidity and noise, etc, during construction will be minimized through appropriate countermeasures.

As mentioned above, the frequency with which Spoon billed Sandpiper uses the Matarbari Island as a wintering ground is relatively very low in comparison with the nearby offshore island of Sonadia. Many previous survey results point out that Matarbari Island beach is not a main migratory habitat for migratory birds, especially the Spoon billed Sandpiper in Bangladesh; this is also supported by other experts and reports. However, for the purpose of protecting the species, construction workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law.

For four IUCN precious species of sea turtles, it is highly likely that the spawning of these species take place on the sea coast, and a detailed survey should be conducted. Light and noise of nighttime construction may have adverse effects on the sea turtles. Consequently, night

construction activity in the spawning season should be avoided as much as possible, and should be conducted under minimum light. Lighting color that does not affect spawning (e.g., red or yellow) will be selected. Low-noise equipment shall also be installed. The careful monitoring of spawning status is necessary.
As metioned in "Chapter 15.5.2, (1), 1), c), c., Threatened Species in project areas", the project site and its surrounding areas are not categorized as the critical natural
habitats for Spoon billed Sandpiper and sea turtles which is defined as per "JICA guidelines for environmental and social considerations (April, 2010)".

iii. Hydrology
The environmental impact on hydrology is more serious after the completion of the plant construction compared to during the construction period, and there was a review of the expected changes in ocean currents during the operation phase.

iv Topography and Geology
For topography and geology of the area, the environmental impact is more serious after the completion of the construction of the plant compared to during the construction period, and there was a review of expected sand sedimentation changes that may occur during the operation phase.

c. Social Environment

i. Disturbance to Existing Social Infrastructure and Social Services
Pump dredgers will be used in dredging work in the marine area, and increased marine traffic may slightly disturb the existing marine traffic including fishing boats. As mitigation measures, the water cource shall be determined after consultation with related authorities.

ii. Work Environment (Including Work Safety)
A high risk rate of accidents is predicted during the construction work. Construction companies shall establish work safety plans and submit them to CPGCBL to obtain approval. Work safety plans shall stipulate mitigation measures on soft aspects (safety training, etc) and on hard aspects (provide workers with appropriate protective equipment, etc).

d. Accidents

Marine traffic accidents may occur during the construction work. As prevention measures, the navigation route of vessels shall be determined after consultation with related authorities. Marking buoys will be set around the construction area for marine safety.

b) Operation Phase

a. Pollution Control

i. Air Quality

It is expected that air pollution will be caused from the exhaust gas generated from vessels using the port. There will also be dust, produced from the loading-unloading of coal. Hired vessels will be compliant to MARPOL 73/78 treaty.

Coal handling and storage activities will result in the dispersion of dust particulates due to wind. According to the Beaufort scale, when wind speed exceeds approximately 6m/s, dust may be swept up from the ground. There is a low occurrence ratio of wind speed exceeding approximately 6m/s around the project site (about 1%).

In addition, a cover will be installed on the conveyor for coal transportation and watering coal storage and handling area will be conducted to keep the surfaces wet.

ii. Water Quality

Turbid water is expected to be produced from the maintenance dredging of the navigation channel. Water pollution is also expected from the wastewater discharged from vessels using the port. However, the dredging method and equipment will be chosen to minimize turbidity, and the number of days that coal vessels enter and leave the port is approximately 50 days per year, which is relatively few.

iii. Waste

Dredging will be periodically conducted for maintenance of the water way. Waste will be generated from the vessels using the port. Dredged material from the maintenance of the port shall be reused around the project to the maximum extent possible, and residual sand will be disposed of within the project site.

iv. Noise and Vibration

Noise and vibration impacts from unloading the coal are predicted. The results of noise simulation concerning coal unloading activity is included in the noise simulation during the operation phase, and the noise levels at the nearest residential area satisfy the environmental standards.

Maintenance of equipment and installation of low noise type equipment will be conducted.

v. Subsidence

Groundwater will not be used during the operation phase of the port facility, therefore subsidence will not occur.

b. National Environment

i. Protected Areas

Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, and it is located 15km south of the proposed site. As described above, during the operation phase it is predicted that there will be no significant change of the ocean current by the port, or any significant changes to ocean topography by sand deposits. Environmental impact of air pollution, water pollution and noise, etc, during operation will be mitigated through appropriate countermeasures, and the extent of any impact will be limited. Consequently, the impact on Sonadia ECA will be insignificant.

ii. Ecosystem

The project site consists of land used for salt farms and other purposes, and there are no primeval forests or tropical rain forests. A sandy beach is located in front of the proposed project site, with no mangrove forests or tidal flats.

The area is the presumed habitat of birds, dolphins, and sea turtles of the IUCN Red list (endangered species, etc.), and there is the possibility that operation will have an impact on the rare species and ecosystem.

As described above, no significant change of ocean currents and ocean topography is predicted during the operation phase. Environmental impact of air pollution, water turbidity and noise, etc. during operation will be mitigated through appropriate countermeasures, and the simulation results indicate that the environmental standards will be satisfied.

As mentioned above, the frequency with which Spoon billed Sandpiper uses the Matarbari Island as a wintering ground is relatively very low in comparison with the nearby offshore island of Sonadia. Many previous survey results point out that Matarbari Island beach is not a main migratory habitat for migratory birds, especially the Spoon billed Sandpiper in Bangladesh; this is also supported by other experts and reports. However, for the purpose of protecting the species, construction workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law.

For four IUCN precious species of sea turtles, it is highly likely that the spawning of these species take place on the sea coast, and a detailed survey should be conducted. Light and noise of nighttime construction may have adverse effects on the sea turtles. Consequently, night construction activity in the spawning season should be avoided as much as possible, and should be conducted under minimum light. Lighting color that does not affect spawning (e.g., red or yellow) will be selected. Low-noise equipment shall also be installed. The careful monitoring of spawning status is necessary

As metioned in "Chapter 15.5.2, (1), 1), c), c., Threatened Species in project areas", the project

site and its surrounding areas are not categorized as the critical natural
habitats for Spoon billed Sandpiper and sea turtles which is defined as per "JICA guidelines for environmental and social considerations (April, 2010)".

iii. Hydrology

The construction of the port facility may alter the hydrology of the surrounding area. At the time of the site selection, predictions were made regarding any changes to the ocean currents of the area. Using the same simulation methodology, any changes of the ocean currents were predicted based on the results of a field survey. As shown in Chapter 4, it was confirmed that the impact of the port facility on any changes in ocean currents was limited and not considered significant, largely because the proposed port facility will be an excavated type.

iv. Topography and Geology

The construction of the port facility may alter the geography and geology of the area around the proposed site, and cause the natural seashore to disappear. Predictions regarding sand sedimentation and changes in ocean topography of the area were made during the time of the site selection. Simulations of sand sedimentation and changes in ocean topography were conducted by a similar method based on the field survey results.
As shown in Chapter 4.5, sand sedimentation and topography change will be very limited as this will be an artificially excavated port.

c. Social Environment

i. Disturbance to the Existing Social Infrastructure and Services

Navigation of large coal transport vessels and tankers will cause increased marine traffic, and may disturb the existing marine traffic including fishing boats. As mitigation measures, navigation routes shall be determined after consultation with related authorities.

ii. Work Environment (Including Work Safety)

Accidents may be caused by the entry and departure of vessels and the loading-unloading of coal. Work safety plans shall be established that stipulate mitigation measures on soft aspects (safety training, etc) and on hard aspects (provide workers with appropriate protective equipment, etc).

d. Accidents

Marine traffic accidents may occur. As mitigation measures, navigation routes shall be determined after consultation with related authorities. Course buoys will also be set around

navigation channel for marine safety.

15.6.2 Transmission line

1) Pre-construction Phase and Construction Phase

a) Pollution Control

a. Air Quality

Dust is expected from land preparation and other construction work, but the impact will be temporary. Generation of air pollutants (SOx, NOx, etc.) from the operation of heavy machinery and trucks is predicted, but the impact will be limited to within the surrounding area. Watering the construction site, especially in the dry season, and using cover sheets on trucks for the transportation of soil will be undertaken in order to reduce dust.
There will be periodic maintenance and management of all construction machinery and vehicles to reduce exhaust discharged from such machinery and vehicles.

b. Water Quality

There may be soil runoff from the exposed soil of the embankments and cut slopes, and water pollution of the downstream area of the surrounding river is predicted. The transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation.

c. Noise and Vibration

Noise and vibration are expected to be caused by the operation of heavy machinery and trucks, but will be limited to the surrounding area. In the actual construction work, schedule management will be performed to maintain constant amounts of construction work and low noise/ low vibration equipment will be used as much as possible. Construction work will be performed during daytime, especially piling work.
Measures for reducing the generation of noise, such as speed reduction of vehicles in residential areas will be taken, whereby minimizing vehicle noise and vibration impact. Thus, all efforts will be made to minimize the noise and vibration impact.

b) Natural Environment

a. Ecosystem

The transmission line route is the presumed habitat of birds of the IUCN Red list (endangered

species, etc.), and the construction work is predicted to have an impact on the rare species and the surrounding ecosystem. The impact of air pollution, noise and vibration due to construction work is expected on the terrestrial ecosystem.

The transmission line route bypasses the protected areas, and will use land used for rice fields and other agricultural activity, and not any primeval forests or tropical rain forests. Very few trees will be cut down from the construction activity and the environmental impact of air pollution, water turbidity and noise, etc, during construction will be minimized through appropriate countermeasures.

There is no habitat of precious species of flora designated by the IUCN within the transmission line route.

Three species (Calms grub Bunch-Ham, Trihosanthes cordata Roxb, Lepisanthes rubiginosa) which are considered by Bangladesh researchers as threatened species have been observed within the transmission line route, but they are commonly seen over broad areas and the impact of the project on these species is expected to be insignificant.

There are no precious species of insects, amphibians, reptiles, mammals and birds designated by the IUCN observed through the surveys of rainy and dry seasons within the route.

Four species of reptiles (Calotes versicolor, Mabuya mabuya, Gekko gecko, Naja naja) which are considered by Bangladesh researchers as threatened species, and 2 species of birds (Garrulax galbanus, Ketupa zeylonensis) considered as threatened species have been observed within the transmission line route, but they are commonly seen over broad areas and the impact of the project on these species is expected to be insignificant.

b. Topography and Geology

There may be soil runoff from the exposed soil of the embankments and cut slopes. The transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff generation.

c) Social Environment

a. Land Acquisition and Compensation

The construction of one tower base requires $2m^2$ x 4 = $8m^2$ of land. The construction of 157 transmission towers, including angle towers and suspension towers, is planned requiring a total amount of $1,256m^2$ of land acquisition. Voluntary offers of land do not require compensation, but it is assumed here that all land necessary for tower construction will be acquired.

The table below shows the details of the assumed affected people. Land acquisition will be conducted on the basis of compensation at replacement cost. As the land to be acquired for each

transmission tower is small, it is not expected that there will be any semi-permanent loss of livelihood means. However, there is a possibility of temporary impact on livelihood means during the construction period.

Table 15.6-18 Affected People and Land Owners at Angle Tower Points

Category	Impact	No. of HH	No. of HH Members
Owners of private land	- Temporarily affected during construction period	8	83
Users of government land with official agreement	- Temporarily affected during construction period	1	9
Total		10	92

(Source: JICA Study Team)

In the case of acquisition of farm land, entry into such land will be temporarily halted during the construction period and hence farming will be impossible. Also, all trees within clearance distance from cables will be removed. All standing crops and trees lost by the land owners will be compensated with a market price.

b. Deterioration of Local Economy such as Losses of Employment and Livelihood Means/ Land Use and Utilization of Local Resources

Farm land located at the base of the towers will be lost, although the total area will be small. Land owners and users of tower locations will be tentatively affected during construction period resulting in a loss of means of livelihood. In addition, land located under the transmission line will decline in value. Tall trees will be cut down. However local people will be employed for construction work.

In the case of acquisition of farm land, entry into such land will be prohibited temporarily during the construction period and hence farming will be impossible. The construction work aims to employ as many local residents as possible, and to use the services and products of the local community as much as possible.

The transmission line construction areas can be reused for farming after the completion of each transmission tower construction, except for the $2m^2$ x 4 = $8m^2$ of land used for tower bases. Therefore, adverse effects on income will be very limited.

c. Disturbance to Water Usage, Water Rights, etc.

There may be soil runoff from the exposed soil of the embankments and cut slopes, resulting in water pollution of the downstream area of the surrounding rivers and consequently alteration of

water use. The transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation.

d. Social Institutions such as Social Infrastructure and Local Decision-making Institutions

The Deputy Commissioner's Office of Cox's Bazar District will be responsible for taking the initiative to conduct local consultations concerning compensation. In consideration of the possible changing emotions of local residents over the course of negotiations with office staff, compensation should be carried out in consultation with the local people.

e. Cultural Heritage

There is a possibility that some historical, cultural and/or archaeological property and heritage may be found in the course of the construction work. In this case, construction work will be interrupted and experts will be consulted.

f. Infectious Diseases such as HIV/AIDS

A temporary influx of migrant labor during the construction period may increase the risk of transmitted diseases. Local people will be recruited for simple work as much as possible and there is low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups shall be carried out for external workers (technical workers, etc).

g. Work Conditions (Including Work safety)

A high risk rate of accidents is predicted during the construction work. The construction company shall establish a work safety plan and submit it to PGCB to obtain approval. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc) and on hard aspects (provide workers with appropriate protective equipment, etc).

d) Accidents

There may be land traffic accidents during the construction work. Also, other accidents may occur, including soil runoffs and tower breakages caused by cyclones, etc. As prevention measures for land traffic accidents, observation of traffic regulations, installation of traffic signs and training and education on safe driving will be implemented.
In addition, the transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff generation.

2) Operation Phase

a) Water Quality

There may be soil runoff from the exposed soil of the embankments and cut slopes, and water pollution of the downstream area of the surrounding river is predicted. The transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation.

b) Natural Environment

a. Ecosystem

Birds striking the transmission lines and other impacts are expected. Bird species inhabiting areas along the proposed transmission line route are mainly sandpipers and plovers, and their flight altitude is relative low; therefore, the bird strikes is expected to be insignificant. However, installing lights or signs to prevent birds striking to the transmission lines is considered necessary if the bird strikes become significant.

b. Topography and Geology

There may be soil runoff from the exposed soil of the embankments and cut slopes. The transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff generation.

c) Social Environment

a. Deterioration of Local Economy such as Losses of Employment and Livelihood Means

Farm land located at the base of towers will be lost, although the total area will be small. The transmission line construction area can be reused for farming after the completion of the construction, except for the $2m^2$ x 4 = $8m^2$ of land for tower bases, and any adverse effects on income will be very limited.

b. Disturbance to Water Usage, Water Rights, etc.

Soil runoff may occur from the exposed soil of the embankments and cut slopes, resulting in water pollution of the downstream area of the surrounding rivers and possible alteration of water use. The transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation.

c. Work Conditions (Including Work Safety)

There is a risk that accidents, such as electrification and workers falling, may occur during maintenance work. A work safety plan shall be established including mitigation measures on soft aspects (safety training, etc) and on hard aspects (provide workers with appropriate protective equipment, etc).

d) Accidents

Accidents may occur from such factors as soil runoffs and tower breakages caused by cyclones, etc. The transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff generation.

15.6.3 Access road

(1) Pre-construction and Construction Phase

1) Pollution Control

a) Air Quality

Generation of dust is expected by land preparation, and generation of air pollutants (SOx and NOx, etc.) is anticipated from the operation of heavy machinery and trucks, but the impact will be limited only to the bridge construction and road construction area.
According to the Beaufort scale, when wind speed exceeds about 6m/s, dust on the ground may be lifted up. However, the occurrence ratio of wind speed exceeding about 6m/s around the project site is very low, approximately 1%.
Watering the access road, especially in the dry season, and using cover sheets on trucks for the transportation of soil will be undertaken to reduce dust generation. Periodic maintenance and management of all the construction machinery and vehicles will be conducted to reduce exhaust gas discharged from construction machinery and vehicles.

b) Water Quality

a. Road Construction

There may be soil runoff from the exposed soil of the embankments and cut slopes, and water pollution of the downstream area of the surrounding river is predicted. Since the road construction area is mainly salt field or paddy field, soil runoff and turbid water generation will not be significant.

b. Bridge Construction

Turbid water is expected to be produced from dredging activity in the river. In addition, concrete wastewater and oil-containing wastewater are expected to have an effect, but only temporary. In conducting dredging work in the river, grab or pump dredgers will be used and anti-diffusion membranes will be installed around the construction site to prevent diffusion of turbidity, especially toward the mangrove forest.
These measures will minimize the impact of contamination of sea water, river water and underground water.

c) Waste

Waste generated from the construction work will include waste plastic, waste glass and waste oil. Furthermore, household waste discarded from the camping ground of the workers will include cans, bottles and garbage. If such waste is inadequately handled, sea water, river water and underground water may be contaminated, and sanitation problems may arise.
Segregating waste at collection, recycling and reusing waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to related regulations. Hazardous waste will be treated under the related regulations. To reduce the amount of solid waste discharged from the workers during the construction work, efforts will be taken to employ local workers wherever possible, so that the amount of household waste at the workers camp will be minimized. These measures will be taken to ensure that water pollution or sanitary problems resulting from waste will not arise.
Sand and silt will be generated from dredging work in the river. Sand will be, after being dehydrated at the effluent outlet, entirely reused for making mound, and silt will be entirely disposed of in the sedimentation pond adequately managed and treated as dust and waste water.

d) Noise and Vibration

a. Noise

The impact of noise caused by the operation of heavy machinery and trucks is predicted, but will be limited to the surrounding area. However, there is a residential area located near the road construction area and sufficient consideration must be given to minimizing any noise impact.

b. Vibration

The operation of heavy machinery and trucks is predicted to create vibration, but this will be limited to the surrounding area. In the actual construction work, schedule management will be performed to maintain constant amounts of construction work and to ensure that low vibration equipment will be used as much as possible. Construction work will be performed during daytime, especially piling work.
Measures for reducing generation of noise, such as speed reduction of vehicles in residential areas, will be taken, whereby vehicle noise impact will be minimized. Thus, all efforts will be made to minimize the noise impact.

e) Odor

In case domestic waste from the workers' camp is not appropriately treated, the rotting waste may produce a foul odor. Before starting the construction work, workers will be instructed to classify and collect garbage and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to ensure that odor by putrefaction is not produced. These measures will be taken to minimize the generation of odor.

f) Soil

Soil pollution will possibly be caused by leakages of oil and chemical materials at the construction site. Oil and chemical materials will be stored at an appropriate storage site to prevent any permeation into the ground. These measures will minimize the impact of any soil contamination.

g) Sediment

Sediment pollution may occur in the case construction wastewater flows into the river. Channels, ditches and temporary settling ponds will be dug and constructed around the construction area. Wastewater treatment facilities for workers, such as septic tanks and oil separators for oily run-off water, will be installed in the workers' camp and the construction area.
Oil and chemical materials will be stored in an appropriate storage site to prevent any permeation into the ground. These measures will minimize the impact of sediment contamination by river water.

h) Subsidence

Groundwater will not be used during the construction phase of the port facility, therefore subsidence will not occur.

2) Natural Environment

a) Protected Areas

Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, and it is located about 20 km south of the road and bridge construction area. Environmental impact of air pollution, water turbidity, noise and other environmental impact during construction will be not significant and the extent of any impact will be limited. Consequently, the impact to Sonadia ECA will be insignificant.

b) Ecosystem

The road construction areas are farms and other purposes, and there is wide forest in hill side area.
A part of trees in the residential area will be cut down due to the road widening work, but it can be minimized and mitigated. And the impact of the traffic related to construction works on the hill side forest area will be very limited in period and magnitude, so the impact on flora and fauna will not be significant.
Although mangrove forest is located along the west bank of Kohelia River, the bridge point was sifted to north to avoid the direct impact on the mangrove forest. And bridge construction works will be conducted under the consideration mentioned above.
Regarding fauna, habitat fragmentation is considered. However most part of road construction area is utilizing existing road facility and newly constructed area is existing embankment and salt filed. Therefore the impact on fauna will not be significant.

c) Topography and Geology

The construction of the access road may affect the topography and geology of the area around the proposed site. Cutting and filling will cause erosion of the slope, but the affect will not be significant because the most part of the road are used exiting road and embankment, and the entire topography of project site is very flat. Some protect measures against slope sliding or erosion especially in rainy season will be considered.

3) Social Environment

a) Land Acquisition

RHD will acquire approximately 11.85ha of land for bridge and road construction as shown in Table 15.6-19.

Table 15.6-19 Anticipated Land Acquisition

Sl. No	Mouza Details	Plot Nos	Area (m^2)
1	Thana: Maeshkhali, Union:Kalarmachara , Mouza:Yunuskhali	42	32,566.87
2	Thana: Maeshkhali, Union: Matarbari, Mouza: Matarbari	26	85,844.29
3	Thana: Maeshkhali, Union: Yunuskhali, Mouza: Uttarnalbila	1	123.6,467
	Total	**69**	**118,534.8**
Total land acquisition in hectar			**11.85 ha**

(Source: JICA Study Team)

Use of land also varies which include residential purpose (7.14%), commercial purpose (1.79%), agricultural (75.0%) and pond (14.29%) and some others as shown in Table 15.6-20.

At the proposed site where the access road will be constructed, 56 landowners/users will be directly affected by the project implementation who own, rent or use private land within the proposed alignment site. All 56 landowners will be directly affected who are farming in salt or shrimp farms. here will be no resettlement.

Table 15.6-20 Use of Land to be Affected

Land use	Number of landowner/users	%	Remarks
Use as homestead	4	7.14	
Use for commercial purpose	1	1.79	
Agricultural	42	75.00	
Unused	1	1.79	
Other (specify)	8	14.29	Pond to be affected
Total:	56	100	

(Source: JICA Study Team)

Table 15.6-21 Primary Occupation of the Families of the Affected Landowners/Users

Occupation	Male	%	Female	%	Total	%
Farming	48	34.29	0	0.00	48	20.17
Housemakers	4	2.86	46	46.94	50	21.01
Day labour	43	30.71	0	0.00	43	18.07
Teacher	2	1.43	1	1.02	3	1.26
Doctor	1	0.71	0	0.00	1	0.42
Business	2	1.43	0	0.00	2	0.84
Working abroad	2	1.43	0	0.00	2	0.84
Student	37	26.43	45	45.92	82	34.45
Unemployed	1	0.71	0	0.00	1	0.42

Disabled	0	0.00	2	2.04	2	0.84
Others	0	0.00	4	4.08	4	1.68
Total	**140**	**100**	**98**	**100**	**238**	**100**

(Source: JICA Study Team)

b) Disturbance to Water Usage, Water Rights, etc.

All water to be used for the construction work will be transported by vehicles and stored in a tank. Ground water and river water will not be used.

The local economy may be affected by turbid water discharged from the construction site. Outflows of street dust and oil during rainy periods may also have certain effects. The turbid water discharged from the construction site and any oil spills may affect the water quality of the river and ground water, and adequate mitigation measures shall be taken. Water quality of well water, which is the main supply of drinking water, shall be monitored in order to monitor any adverse effects on ground water.

c) Social Institutions Such as Social Infrastructure and Local Decision-Making Institutions

The Deputy Commissioner's Office of Cox's Bazar District will be responsible for taking the initiative to conduct local consultations concerning compensation. In consideration of the possible changing emotions of local residents over the course of negotiations with office staff, compensation should be carried out in consultation with the local people.

d) Disturbance to Existing Social Infrastructure and Services

As material, equipment and worker transportation may disturb existing road and water traffic including fishing boats. Additionally, dredging work may also disturb the water traffic. Especilly the existing jetty will not available during construction.

In regard to vessels, water routes shall be determined after consultation with the related authorities. And in regard to vehicles, bus use will be promoted to reduce increasing the number of vehicles on the roads. The bus schedules shall be managed in consultation with related organizations.

e) Local Conflicts of Interest

Local conflicts may occur between local residents who may feel that they have received unfair compensation and other local residents or conflict with staff of the Deputy Commissioner's Office. Conflict may occur between local residents and external workers because of any changes to local customs if external workers cannot understand local customs.

A number of consultations with local residents have been conducted in preparing the draft LARAP in this feasibility study. Regulations in Bangladesh stipulate the need to conduct public

consultations in land acquisition processes.
Local people should be employed for the construction works to the maximum extent possible, and any workers from other countries should be taught to respect local customs in order to facilitate good relationships with local people. The lodgings of the project workers should be equipped with sufficient living facilities to keep workers at the project site as much as possible.

f) Children's Rights

Children are often forced to work and cannot attend school, and this may occur in the case of the construction of the road and bridge as well. There will be children among those to be lose their livelihood means. Children from those households losing their land or jobs may suffer from adverse impact on their household economy such as drop-out of school. Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers shall be conducted.

g) Infectious Diseases such as HIV/AIDS

A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc. Local people should be recruited for simple work as much as possible so to minimize the risk of infectious diseases being transmitted from external workers. Pre-employment and periodic medical check-ups should be conducted for external workers (technical workers, etc.).

h) Work Environment (Including Work Safety)

A high risk rate of accidents is predicted for the construction work. Construction companies should establish work safety plans and submit them to CPGCBL to obtain approval. Work safety plans should stipulate mitigation measures on soft aspects (safety training, etc.) and hard aspects (provide workers with appropriate protective equipment, etc.).

4) Others

a) Accidents

Land traffic and water traffic accidents during construction work may occur. As prevention measures for land traffic accidents, observation of traffic regulations, and training and education on safe driving will be implemented. People in the surrounding villages shall be informed of the bus schedules. For vessel operation, marking buoys will be set around the construction area for water safety. Vessel schedules shall be announced to fishermen, etc.

b) Cross-Boundary Impact and Climate Change

CO_2 will be produced by the construction work. Periodic maintenance and management of all construction machinery and vehicles will be conducted.

(2) Operation Phase

1) Pollution Control

a) Air Quality

It is expected that air pollution will be caused from the exhaust gas generated from vehicles related to the power plant.

b) Water Quality

There may be soil runoff from the exposed soil of the embankments and cut slopes, and water pollution of the downstream area of the surrounding river is predicted. The access road route is mainly located flat area, and in the hill area and slopes adequate measures to prevent erosion will be treated.

c) Noise and Vibration

The major noise and vibration source will be vehicles, but the increase of traffic amount will not be significant.

2) Natural Environment

a) Protected Areas

Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, and it is located about 20km south of the access road. There will be no significant impact caused by the traffic.

b) Ecosystem

The mangrove forest is located along the west bank of Kohelia River. The hydrological and morphological change is not significant. And the accessibility to the mangrove forest will be restricted. Therefore the impact on the mangrove forest will not be significant.

c) Topography and Geology

Although erosion of slope is expected, the affects will be minimized by some protection works.

3) Social Environment

a) Deterioration of Local Economy such as Losses of Employment and Livelihood Means

Farm land located at the base of towers will be lost, although the total area will be small. The road construction area can be reused for farming after the completion of the construction.

b) Disturbance to Water Usage, Water Rights, etc.

Soil runoff may occur from the exposed soil of the embankments and cut slopes, resulting in water pollution of the downstream area of the surrounding rivers and possible alteration of water use. The access road route is mainly located in flat area, so the soil runoff and turbid water generation will not be significant except the hill area.
In the hill area drainage system will be improved and slope protection works will be done.

c) Disturbance to the Existing Social Infrastructure and Service

Traffic volume and traffic jams will increase in the access road, community road and road around the power plant boundary. Mitigation measures to decrease traffic volume shall be conducted, such as the promotion of bus use.

d) Misdistribution of Benefits and Compensation

People who live in other areas may have limited access or be prevented from accessing the school and medical facility along the access road, which may cause grievances. The access road shall be open to all local people to the maximum extent possible in order to improve peoples' lives.

e) Local Conflicts of Interest

Local conflicts of interest may occur between employers and employees of salt farms, shrimp farms and the fishing industry, and between local administration bodies and local political leaders. There may be feelings of resentment and reconciliation, as people living around the access road will benefit. However, conflicts among local residents may occur if such benefits were mis-distributed.
The access road shall be open to all local people to the maximum extent possible for the

improvement of peoples' lives.

f) Gender

Residents will have better access to social services throughout the year if access road is constructed along with the construction of the power plant, especially access during the rainy season.

g) Children's Rights

There is a possibility that children may be forced to work and not attend school. Labor contracts between the subcontractors and children shall be prohibited. Regular patrols to check for child workers shall be conducted.
The access road shall be built with sufficient height so that it can be used even in the rainy season, so that access to markets and social services shall be improved, including access by children.

4) Others

a) Accidents

The risk of traffic accident may be increased. Observation of traffic regulations, installation of traffic signs, and training and education on safe driving shall be conducted for land traffic vehicles.

b) Cross-Boundary Impact and Climate Change

CO_2 will be emitted from the vehicles. The safety drive instruction will also contribute to reduce CO_2 emission.

15.6.4 Summary of environmental and social impact assessment

The results of environmental impact assessment are summarized through Table 15.6-22 to Table 15.6-25.

Table 15.6-22 Results of Environmental Impact Assessment for the Power Plant

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	A-	B-	B-	**Construction phase:** - Prevention measures for dust dispersion will be taken by spraying water. - Maintenance of machinery will be conducted regularly, resulting in reducing exhaust gas emissions. **Operation phase:** - Concentration of pollutants in emission gas will meet emission gas standards by adopting low-NOx combustion methods, electrostatic precipitators (around 99.8% efficiency: 7,707 mg/m^3 -> 50 mg/m^3) and flue gas desulphurization equipment (around 70% efficiency: 2,526 mg/m^3 -> 820 mg/m^3). - Ground concentration of pollutants caused by emission gas will meet ambient air quality standards. - Prevention measures for dust dispersion will be taken at coal storage and ash disposal sites.
	2	Water Quality	A-	A-	B-	B-	**Construction phase:** - Turbid water, such as rainwater run off, will be treated with precipitation processes. - Wastewater containing oil will be treated with oil-water separator. **Operation phase:** - Plant wastewater will be treated at a wastewater treatment facility in order for pollutants in the water to meet wastewater quality standards. - The outlet for intake of cooling water and the outlet for discharge of thermal effluent are designed to be located far away from each other. The diffusion of the increase of water temperature will occur only in the surface layer. - Wastewater discharged from coal storage and ash disposal sites will be treated at the wastewater treatment facility.
	3	Waste	B-	B-	B-	B-	**Construction phase:** - Construction waste and general waste will be re-used, recycled or disposed following relevant laws and regulations. **Operation phase:** - Sludge from the wastewater treatment facility, waste oil from machine inspections and general waste will be

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							re-used, recycled or disposed following relevant laws and regulations. - All fly ash and bottom ash will be disposed of inside the power plant site.
	4	Noise and Vibration	B-	A-	B-	B-	**Construction phase:** - Construction machinery and vehicles will be regularly maintained. - Low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area (Max 114dB -> 70.3dB). **Operation phase:** - Construction machinery and vehicles will be regularly maintained. - Low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area (Max 108dB -> 43.3dB).
	5	Subsidence	C-	C-	D	D	**Construction and Operation phases:** - Ground water will not be used during construction and operation phases.
	6	Odor	B-	B-	B-	B-	**Construction and Operation phases:** - General waste will be re-used, recycled or disposed following relevant laws and regulations.
	7	Soil	B-	B-	B-	B-	**Construction phase:** - Wastewater containing oil will be treated with oil-water separator. - Oil and chemical substances will be appropriately stored. **Operation phase:** - Ash disposal site will be designed to prevent seepage. - Storage for oil and chemical substances will be designed to prevent seepage.
	8	Sediment	B-	B-	B-	B-	**Construction and Operation phases:** - Wastewater and waste will be appropriately treated and disposed.
Natural Environ -ment	9	Protected Areas	C-	C-	D	D	**Construction and Operation phases:** - Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, located 15km south of the proposed project site. - Air quality, water quality and noise levels during both construction and operation phases will meet environmental standards, and the impacts will not reach Sonadia ECA.
	10	Ecosystem	A-	A-	A-	B-	**Construction phase:** - Impact of air pollution, water turbidity and noise, etc., during the operation phase will be mitigated through appropriate countermeasures, as described above. - The Spoon billed Sandpiper, listed in the IUCN Red list,

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							was observed at the beach in front of the power plant. However, Matarbari Peninsula beach is not the main migratory habitat for migratory birds, particularly the Spoon billed Sandpiper in Bangladesh. For the purpose of protecting the species, construction workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law. - Four species of sea turtle species listed in the IUCN Red list, spawn at the sea front area of the power plant. Mitigation measures will be taken, especially night-time lighting and lowering noise levels. Monitoring will also be conducted. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but these species are generally observed widely around the area. **Operation phase:** - Impact of air pollution, water turbidity and noise, etc., during the operation phase will be mitigated through appropriate countermeasures, as described above, and the results of simulation also indicate that environmental standards are met. - The frequency with which this species uses the Matarbari Peninsula as a wintering ground is relatively very low in comparison with the nearby offshore island of Sonadia. Many previous survey results point out that Matarbari Peninsula beach is not a main migratory habitat for migratory birds, especially the Spoon billed Sandpiper in Bangladesh; this is also supported by other experts and reports. However, for the purpose of protecting the species, construction workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law. - Four kinds of sea turtle species listed in the IUCN Red list spawn at the sea front area of the power plant. Mitigation measures will be taken, especially night-time lighting and lowering noise levels. Monitoring will also be conducted. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but these species are generally observed widely around the area.
Social Environ-Ment	11	Land Resettlement	A-	D	A-	D	**Pre-construction phase:** - 343 households and 2,031 people will be affected by the construction of the power plant and the port facility. LARAP (Land Acquisition and Resettlement Action Plan), that includes not only a compensation plan but also a livelihood restoration program for affected people, shall be established.
	12	Disturbance to Poor People	A-/B+	A-/B+	A-/B+	A-/B+	**Pre-construction and Construction phases:** - The employment of local people will be promoted for

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							increased employment opportunities for various subcontract work resulting from the power plant construction activity. - Livelihood restoration measures will be established including job training for those who want it. **Operation phase:** - Poor people who currently have deteriorated living standards without proper facilities will have better access to social services throughout the year if roads are improved along with the construction of the power plant, especially access during the rainy season.
	13	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	D	D	- There were no ethnic and indigenous people found on or around the project site.
	14	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	A-	A-/B+	A-	A-/B+	**Pre-construction and Construction phases:** - The employment of local people will be promoted for increased employment opportunities for various subcontract work resulting from the power plant construction activity. - Livelihood restoration measures will be established including job training for those who want it. **Operation phase:** - The employment of local people will be promoted for increased employment opportunities for various subcontract work resulting from the power plant construction activity. - Livelihood restoration measures will be established including job training for those who want it. - Services, such as laundry and catering services, and products provided by the local community will be preferentially used to the extent possible.
	15	Land Use and Utilization of Local Resources	A-	A-	A-	A-	**Pre-construction, Construction, and Operation phases:** - The employment of local people will be promoted for increased employment opportunities for various subcontract work resulting from the power plant construction activity. - Livelihood restoration measures will be established including job training for those who want it.
	16	Disturbance to Water Usage, Water Rights, etc.	A-	B-	B-	B-	**Construction phase:** - Wastewater will be treated, and monitoring of groundwater will be conducted. **Operation phase:** - Plant water used during the operation phase will be taken from sea water through a desalinating process, so that no impact to river and ground water is anticipated.
	17	Disturbance to	B-	B-/B+	B-	B-/B+	**Construction phase:**

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
		the Existing Social Infrastructure and Services					- For vessels, a water route will be determined after consultation with related authorities. - For vehicles, bus use will be promoted to reduce increasing the number of vehicles used. - Bus schedules will be managed in consultation with related organizations. **Operation phase:** - Bus use will be promoted - An access road, community road and road around the power plant boundary will be built. - A school and medical facility constructed within the power plant site will be open to all local people for the improvement of their lives.
	18	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	B-	D	B-	D	**Pre-construction phase:** - Regulations of Bangladesh stipulate that public consultation must be held in the land acquisition process. In the resettlement process, personnel responsible for responding to complaints or suggestions from local residents will work at the power plant office.
	19	Misdistribution of Benefits and Compensation	B-	B+	B-	B-/B+	**Pre-construction phase:** - Equality of compensation shall be assured as there is a possibility of unequal compensation between local residents. **Operation phase:** - The access road, school and medical facility constructed within the power plant site will be open to all local people.
	20	Local Conflicts of Interest	B-	B-/B+	B-	B-/B+	**Preconstruction phase:** - Regulations of Bangladesh stipulate that public consultation must be held in the land acquisition process. In the resettlement process, personnel responsible for responding to complaints or suggestions from local residents will work at the power plant office. **Construction phase:** - Local people will be employed to the maximum extent possible, and foreign workers will be taught to respect local customs in order to facilitate good relationships with local people. Lodgings of project workers will be equipped with sufficient living facilities keeping order that workers remain at the project site as much as possible. **Operation phase:** - Lodgings of project workers will be equipped with sufficient living facilities keeping order that workers remain at the project site as much as possible. - The access road, school and medical facility constructed within the power plant site will be open to all local people.
	21	Cultural Heritage	D	D	D	D	- There are no historical, cultural and archaeological

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							properties or heritage sites in or around the site.
	22	Landscape	D	D	D	D	- There is no picturesque scenery in or around the site.
	23	Gender	B-/B+	B+	B-/B+	B+	**Pre-construction and Construction phases:** - There are women among those to be resettled and/or lose their livelihood means. They currently have low living standards and lack proper facilities; they will have better access to social services throughout the year. However, wives of those men who lose their land or jobs may suffer from adverse effects on their household economy. - Livelihood restoration measures will be established for improving life quality. **Operation phase:** - The access road, school and medical facility constructed within the power plant site shall be open to all local people to the maximum extent possible for the improvement of their lives. - Job opportunities will be open to them according to their qualification.
	24	Children's Rights	B-	B-/B+	B-	B-/B+	**Pre-construction and Construction phases:** - Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers will be conducted. **Operation phase:** - Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers will be conducted. - The access road, school and medical facility constructed within the power plant site shall be open to all local people to the maximum extent possible for the improvement of their lives.
	25	Infectious Diseases such as HIV/AIDS	B-	D	B-	D	**Construction phase:** - Local people will be recruited for simple work as much as possible and there is a low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc).
	26	Work Environment (Including Work Safety)	B-	B-	B-	B-	**Construction and Operation phases:** - The construction company shall establish a work safety plan and submit it to CPGCBL to obtain approval. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and on hard aspects (provide workers with appropriate protective equipment, etc).
Other	27	Accidents	B-	B-	B-	B-	**Construction phase:** - For land traffic, observation of traffic regulations, installation of traffic signs and training and education on safe driving will be conducted.

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							- For marine traffic, marking buoys will be set up around the construction area for marine safety. - Schedule of vessels will be announced to fishermen, etc. **Operation phase:** - Observation of traffic regulations, installation of traffic signs, and training will be conducted. - Education on driving safety shall be carried out for land traffic vehicles. - For ocean navigation, water routes will be determined after consultation with related authorities, and course buoys shall be set on navigation channel for marine safety. - For fire prevention, regular watering of the coal storage site, installation of fire protection equipment in the power plant, and organization of fire-fighting teams and fire-fighting training shall be carried out.
	28	Cross-boundary Impact and Climate Change	B-	B-	B-	B-	**Construction phase:** - Periodic maintenance and management of all construction machinery and vehicles will be conducted. **Operation phase:** - CO_2 will be produced by plant operation. Ultra supercritical (USC) technology will be adopted at the power plant, which compared to a sub critical coal-fired power plant will produce less CO_2 of approximately 555,400 tons /year.

Notes: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.

(Source: JICA Study Team)

Table 15.6-23 Results of Environmental Impact Assessment for the Port Facility

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	B-	B-	B-	**Construction phase:** - Prevention measures for dust dispersion will be taken by spraying water. - Maintenance of machinery will be conducted regularly, resulting in reducing exhaust gas emissions. **Operation phase:**

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							- Air pollution caused by exhaust gas generated from the vessels using the port is predicted. - Dust dispersion, generated from loading-unloading of coal, is also predicted.
	2	Water Quality	A-	A-	B-	B-	**Construction phase:** - Pump dredgers will be used and anti-diffusion membrane will be installed to prevent diffusion of turbidity. - When excavating the land area, steel sheet piles will be installed for enclosure on the marine side before any excavation work. - Turbid water from the land will be treated with a precipitation system. **Operation phase:** - Dredging method and equipment will be selected to minimize turbidity. - The number of days that coal vessels enter and leave the port is about 50 days per year, which is relatively few.
	3	Waste	A-	A-	B-	B-	**Construction phase:** - Sand and silt from dredging work of the navigation channel and the port will be re-used for land preparation of the plant and disposed of into the ash pond. **Operation phase:** - Dredged materials generated by maintenance of the port will be reused to the maximum extent around the project and residual material will be disposed of within the project site.
	4	Noise and Vibration	B-	B-	B-	B-	**Construction phase:** - Construction machinery and vehicles will be maintained regularly. - Low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area (Max 119dB -> 73.2dB). **Operation phase:** - Construction machinery and vehicles will be maintained regularly. - Low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area (101dB -> 43.3dB).
	5	Subsidence	C-	C-	D	D	**Construction and Operation phases:** - Ground water will not be used during construction and operation phases.
	6	Odor	D	D	D	D	**Construction and Operation phases:** - No expected use of substances that may be a potential source of bad odors.

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
	7	Sediment	D	D	D	D	**Construction and Operation phases:** - No hazardous waste will pollute the sediment.
Natural Environ-Ment	8	Protected Areas	C-	C-	D	D	**Construction and Operation phases:** - Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, located 15km south of the proposed project site. - Air quality, water quality and noise levels during both the construction and operation phases will meet environmental standards, and the impacts will not reach Sonadia ECA.
	9	Ecosystem	A-	A-	A-	B-	**Construction phase:** - Impact of air pollution, water turbidity and noise, etc., during the operation phase will be mitigated through appropriate countermeasures, as described above. - The frequency with which this species uses the Matarbari Peninsula as a wintering ground is relatively very low in comparison with the nearby offshore island of Sonadia. Many previous survey results point out that Matarbari Peninsula beach is not a main migratory habitat for migratory birds, especially the Spoon billed Sandpiper in Bangladesh; this is also supported by other experts and reports. However, for the purpose of protecting the species, construction workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law. - Four species of sea turtle species listed in the IUCN Red list spawn at the sea front area of the power plant. Mitigation measures will be taken, especially night-time lighting and minimizing noise levels. Monitoring will also be conducted. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but these species are generally observed widely around the area. **Operation phase:** - Impact of air pollution, water turbidity and noise, etc. during the operation phase will be mitigated through appropriate countermeasures, as described above, and the results of simulations also indicate that environmental standards will be satisfied. - The frequency with which this species uses the Matarbari Peninsula as a wintering ground is relatively very low in comparison with the nearby offshore island of Sonadia. Many previous survey results point out that Matarbari Peninsula beach is not a main migratory habitat for migratory birds, especially the Spoon billed Sandpiper in Bangladesh; this is also supported by other experts and reports. However, for the purpose of protecting the species, construction workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law.

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							- Four species of sea turtle species listed in the IUCN Red list spawn at the sea front area of the power plant. Mitigation measures will be taken, especially night-time lighting and minimizing noise levels. Monitoring will also be conducted. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but these species are generally observed widely around the area.
	10	Hydrology	B-	B-	B-	B-	**Construction and Operation phases:** - The impact of the port facility on changes in ocean currents will be limited and not considered significant, because the proposed port facility is an excavated type port.
	11	Topography and Geology	B-	B-	B-	B-	**Construction and Operation phases:** - The impact of the port facility and sedimentation on changes in topography will be limited and not considered significant, because the proposed port facility is an excavated type port.
Social Environ-ment	12	Disturbance to the Existing Social Infrastructure and Social Services	B-	B-	B-	B-	**Construction and Operation phases:** - For vessels, a water route will be determined after consultation with the related authorities.
	13	Work Environment (Including Work Safety)	B-	B-	B-	B-	**Construction and Operation phases:** - The construction company shall establish a work safety plan and submit it to CPGCBL to obtain approval. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and hard aspects (provide workers with appropriate protective equipment, etc).
Other	14	Accidents	B-	B-	B-	B-	**Construction phase:** - Marking buoys will be set around the construction area for marine safety. - Schedules of vessels will be announced to fishermen, etc. **Operation phase:** - The water route of large coal transport vessels will be determined after consultation with related authorities. - Course buoys will be set on navigation channel for marine safety.
	15	Cross-boundary Impact and Climate Change	D	D	D	D	**Construction phase:** - CO_2 will be produced from construction work, but no impact on climate change is expected. **Operation phase:** - CO_2 will be produced by entry and departure of vessels, but no impact on climate change is expected.

Note: A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the

study progresses.)
D: No impact is expected.

(Source: JICA Study Team)

Table 15.6-24 Results of Environmental Impact Assessment for the Transmission Line

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	D	B-	D	**Construction phase:** - Prevention measures for dust dispersion will be taken by spraying water. - Maintenance of machinery will be conducted regularly, resulting in reducing exhaust gas emissions. **Operation phase:** - No specific air pollution is expected.
	2	Water Quality	B-	B-	B-	B-	**Construction and Operation phase:** - The transmission line route was selected avoiding any steep sloping land. - Any slopes shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation.
	3	Noise and Vibration	B-	D	B-	D	**Construction phase:** - Construction machinery and vehicles will be maintained regularly. - Low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area. **Operation phase:** - No specific noise and vibration is expected.
Natural Environ-Ment	4	Protected Areas	A-	D	D	D	**Construction phase:** - Transmission line route was selected avoiding any protected areas. **Operation phase:** - No specific impact on protected areas is predicted.
	5	Ecosystem	A-	B-	A-	B-	**Construction phase:** - Transmission line route was selected avoiding any protected areas. - There are no flora species listed in the IUCN Red list along the transmission line route. - Precious species of insects, amphibians, reptiles, mammals and birds designated by IUCN are not observed along the transmission line route. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but those species are generally observed widely around the area. **Operation phase:** - Birds striking the lines and other impacts are expected to be insignificant.

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
	6	Topography and Geology	C-	C-	B-	B-	**Construction and Operation phases:** - Transmission line route was selected avoiding any steep sloping land. - Any slopes shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation.
Social Enviro-Nment	7	Land Acquisition and Compensation	B-/C	D	B-	D	**Pre-construction phase:** - Construction of one tower base requires 2m x 4m = 8m^2 of land. The construction of 157 transmission towers, including angle towers and suspension towers, is planned and this requires 1,256m^2 of land acquisition in total. - Land acquisition will be conducted on the basis of compensation at replacement cost. - Trees within clearance distance from cables will be removed. - Standing crops and trees will be compensated at market price.
	8	Disturbance to Poor People	B-/C	A-/C	D	D	**Pre-construction and Operation phases:** - No poor people were identified among the affected people.
	9	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	D	D	**Pre-construction and Operation phases:** - No ethnic minority groups or indigenous people were identified along the transmission line route.
	10	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	B-/B+	B-	B-/B+	B-	**Pre-construction and Construction phases:** - Land owners and users of tower locations will be tentatively affected during the construction period resulting in a temporary loss of means of livelihood. - As mitigation measures, employing as many local residents as possible, and using the services and products offered by the local community. **Operation phase:** - The transmission line construction area can be reused for farming after the completion of the transmission tower construction, except for 2m^2 x 4 of land for tower bases, therefore adverse effects on income will be very limited.
	11	Land Use and Utilization of Local Resources	B-	D	B-	D	**Pre-construction phase:** - The transmission line construction area can be reused for farming after the completion of the transmission tower construction, except for the 8m x 2m of land for tower bases, therefore adverse effects on income will be very limited.
	12	Disturbance to Water Usage, Water Rights, etc.	B-	C-	B-	B-	**Construction and Operation phases:** - Transmission line route was selected avoiding any steep sloping land. - Any slopes shall be reinforced with concrete, plantation or

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							other means to minimize soil runoff and turbid water generation.
	13	Disturbance to Existing Social Infrastructure and Services	D	D	D	D	**Construction phase:** - Since the volume of increased traffic will be small, no significant impact is anticipated. **Operation phase:** - No specific adverse effects is predicted for existing social infrastructure.
	14	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	B-	D	B-	D	**Pre-construction phase:** - The Deputy Commissioner's Office of Cox's Bazar District will take responsibility for initiatives to conduct local consultations concerning compensation. In consideration of possible changes in the emotions of local residents in the course of negotiations with the office staff, LARAP preparation will be carried out in consultation with the local people. **Operation phase:** - No specific impact is predicted concerning social infrastructure and local decision-making institutions.
	15	Misdistribution of Benefits and Compensation	D	D	D	D	- No specific impact is predicted concerning the misdistribution of benefits and compensation.
	16	Local Conflicts of Interest	D	D	D	D	- No specific impact is predicted concerning local conflicts of interest.
	17	Cultural Heritage	C-	D	C-	D	**Construction phase:** - There is a possibility that some historical, cultural and/or archaeological property or heritage sites may be found over the course of the construction work. In this case, construction work will be interrupted and experts will be consulted. **Operation phase:** - No specific impact is predicted concerning cultural heritage.
	18	Landscape	B-	B-	D	D	**Construction and Operation phases:** - Transmission line route was selected avoiding any protected and scenic areas to the maximum extent.
	19	Gender	D	D	D	D	- No specific negative impact expected.
	20	Children's Rights	D	D	D	D	- No specific negative impact expected.
	21	Infectious Diseases such as HIV/AIDS	B-	D	B-	D	**Construction phase:** - Local people will be recruited for simple work as much as possible and there is a low risk of infectious diseases being transmitted by external workers. Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc). **Operation phase:** - No specific negative impacts are expected.

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
	22	Work Conditions (Including Work Safety)	B-	B-	B-	B-	**Construction phase:** - The construction company shall establish a work safety plan and submit it to PGCB to obtain approval. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc) and hard aspects (provide workers with appropriate protective equipment, etc). **Operation phase:** - The work safety plan shall be established including mitigation measures on soft aspects (safety training, etc) and hard aspects (provide workers with appropriate protective equipment, etc).
	23	Electro-magnetic Fields	D	B-	D	D	**Construction and Operation phases:** - Transmission line route was selected avoiding any residential areas to the maximum extent.
Others	24	Accidents	B-	B-	B-	B-	**Construction and Operation phases:** - Transmission line routes were selected as to avoid any steep sloping land. - Any slopes shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation.
	25	Cross-boundary Impact and Climate Change	D	D	D	D	- Cross boundary and CO_2 emissions are not anticipated in relation to the transmission line.

Notes: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.

(Source: JICA Study Team)

Table 15.6-25 Results of Environmental Impact Assessment for the Access Road

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	B-	B-	B-	**Construction phase:** - Prevention measures for dust dispersion will be taken by spraying water. - Maintenance of the machinery will be conducted regularly, resulting in reducing exhaust gas emissions. **Operation phase:** - Traffic regulations and rules shall be complied with.

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
	2	Water Quality	B-	B-	B-	B-	**Construction phase:** - Increased turbidity will be settled within a short period **Operation phase:** - The effect of the bridge structure on hydrology distribution will not be significant.
	3	Sediment	B-	B-	B-	B-	**Construction and Operation phases:** - The change of hydrology and sedimentation will not be significant.
	4	Soil	B-	B-	B-	B-	**Construction phase:** - Oil and chemical substances will be appropriately stored. **Operation phase:** - Soil quality of waterway will be affected by traffic.
	5	Noise and Vibration	B-	B-	B-	B-	**Construction phase:** - Construction machinery and vehicles will be maintained regularly. - Low-noise/ low-vibration machinery will be introduced. - Noise level generated from construction machinery will meet the noise level standards at the nearest residential area. **Operation phase:** - Traffic regulations and rules shall be complied with.
	6	Odor	B-	B-	B-	D	**Construction phase:** - General waste will be re-used, recycled or disposed following with the relevant laws and regulations **Operation phase:** - None
	7	Wastes	B-	D	B-	D	**Construction phase:** - Construction waste and general waste will be re-used, recycled or disposed following with the relevant laws and regulations. **Operation phase:** - None
Natural Environment	8	Hill side forest	B-	D	B-	D	**Construction phase:** - Some trees along the village road shall be cut. **Operation phase:** - None
	9	Ecosystem	B-	B-	B-	B-	**Construction and Operation phase:** - Impact of hydrological change and water turbidity during construction phase on mangrove forests and tidal flats will be avoided/minimized by design of road and bridge alignment. The birds on mud flats, are common species, will not be significant.
	10	Topography and Geology	B-	B-	B-	B-	**Construction and Operation phases:** - The impact of the access road construction on changes in

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
							topography will be limited and not considered significant, because the most part of the road are used exiting road and embankment, and the entire topography of project site is very flat.
Social Environment	11	Resettlement (Land acquisition)	D (B-)	D (D)	D (B-)	D (D)	**Pre-construction phase:** - At least 37 households will be affected by the construction of the access road, but there is no resettlement. LARAP that includes not only a compensation plan but also a livelihood restoration program for affected people shall be established.
	12	Disturbance to Poor People	B-/B+	B-/B+	B-/B+	B-/B+	**Pre-construction and Construction phases:** - The employment of local people will be promoted for the increased employment opportunity for subcontract work resulting from the access road construction activity. **Operation phase:** - Construction of the access road will be built with sufficient height so that it can be used even in the rainy season.
	13	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	D	D	- There are no ethnic and indigenous people found on or around the access road.
	14	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	B-/B+	B-/B+	B-/B+	B-/B+	**Pre-construction and Construction phases:** - The employment of local people will be promoted for the increased employment opportunity for subcontract work resulting from the access road construction activity. **Operation phase:** - Transportation of products in this area and materials from urban area will benefit local people.
	15	Land Use and Utilization of Local Resources	B-	B-/B+	B-	B-/B+	**Pre-construction and Construction phases:** - Construction work will affect land use and utilization of local people, but is limited. **Operation phase:** - Land use and utilization will be changed, but many benefits from the access road.
	16	Disturbance to Water Usage, Water Rights, etc.	B-	D	B-	D	**Construction phase:** - Draine system will be monitered. **Operation phase:** - None
	17	Disturbance to the Existing Social Infrastructure	B-	B-/B+	B-	B-/B+	**Construction phase:** - Mitigation measures will be taken. **Operation phase:** - Mitigation measures for traffic amount increase will

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
		and Services					be taken. - Access road will benefit existing social infrastructure and services.
	18	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	B-	B-	B-	B-	**Pre-construction phase:** - Laws of Bangladesh stipulate to conduct public consultation in land acquisition process.
	19	Misdistribution of Benefits and Compensation	B-	B-	B-	B-	**Pre-construction and Operation phase:** - There is a possibility of unequal compensation between the local residents. Equality of compensation shall be assured in preparing the LARAP.
	20	Local Conflicts of Interest	B-	B-	B-	B-	**Pre-construction, Conmstruction and Operation phase:** - Laws of Bangladesh stipulate to conduct public consultation in land acquisition process.
	21	Cultural Heritage	D	D	D	D	- There is no historical, cultural and archaeological property and heritage existing on or around the access road.
	22	Landscape	D	D	D	D	- There is no picturesque scenery existing on or around the access road.
	23	Gender	D	B+	D	B+	**Pre-construction and Construction phases:** - There is no specific negative impact anticipated. **Operation phase:** - The access road shall be open to all local people to the maximum possible extent for the improvement of their lives.
	24	Children's Rights	D	B+	D	B+	**Pre-construction and Construction phases**: - There is no specific negative impact anticipated.. **Operation phase**: - Children will have better access to social services, but child workers must be checked.
	25	Infectious Diseases such as HIV/AIDS	B-	D	B-	D	**Construction phase:** - Local people will be recruited for simple work as much as possible and there is a low risk of infectious diseases transmitted from outside. Pre-employment and periodic medical check-ups will be carried out for external workers (technical workers, etc.).
	26	Work Conditions (Including Work Safety)	B-	D	B-	D	**Construction and Operation phases:** - The construction company shall establish a work safety plan and submit it to the client to get approval. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and hard aspects (provide workers with appropriate protective equipment, etc.).

Item	No.	Impact	Assessment based Scoping		Assessment based Survey Results		Results
			Pre/ construction Phase	Operation Phase	Pre/ construction Phase	Operation Phase	
Others	27	Accidents	B-	B-	B-	B-	**Construction phase:** - Regarding land traffic, observation of traffic regulations, installation of traffic signs and training and education on safety driving will be implemented. - Regarding river traffic, necessary measures will be set up around construction area for navigation and other activity safety. - Schedules of vessels will be announced to the relevant persons/organizations, etc. **Operation phase:** - Signs for both road and navigation safety will be set up at proper positions.
	28	Cross-boundary Impact and Climate Change	B-	B-	B-	B-	**Construction phase:** - Periodic maintenance and management of all the construction machinery and vehicles will be conducted **Operation phase:** - Proper maintenance of road and bridge for sustainable use will be conducted.

Notes: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)
D: No impact is expected.

(Source: JICA Study Team)

15.7 Environmental and Social Management Plan

15.7.1 Power plant and port facility

(1) Power Plant

1) Implementation System

a) Construction Phase

At the construction phase, the Project Implementation Unit (PIU) of CPGCBL shall carefully consider all construction activities with the supervision consultant, and encourage the contractor to fully understand the necessary mitigation measures and to implement them.

For this purpose, an environmental management unit (EMU) shall be organized prior to construction activity and an expert environmental management administrator in the EMU shall be employed. The unit will discuss and prepare mitigation measures with the supervision consultant and the contractor prior to the start of construction.

We anticipate a large inflow of workers and vehicles once construction begins. The EMU shall also function as a grievance organization to understand and address any grievances from local people during the construction phase, and conduct appropriate mitigation measures.

The EMU shall improve the understanding of the surrounding community regarding construction details, the schedule and mitigation measures, and shall obtain local input from people and change the mitigation measures as appropriate.

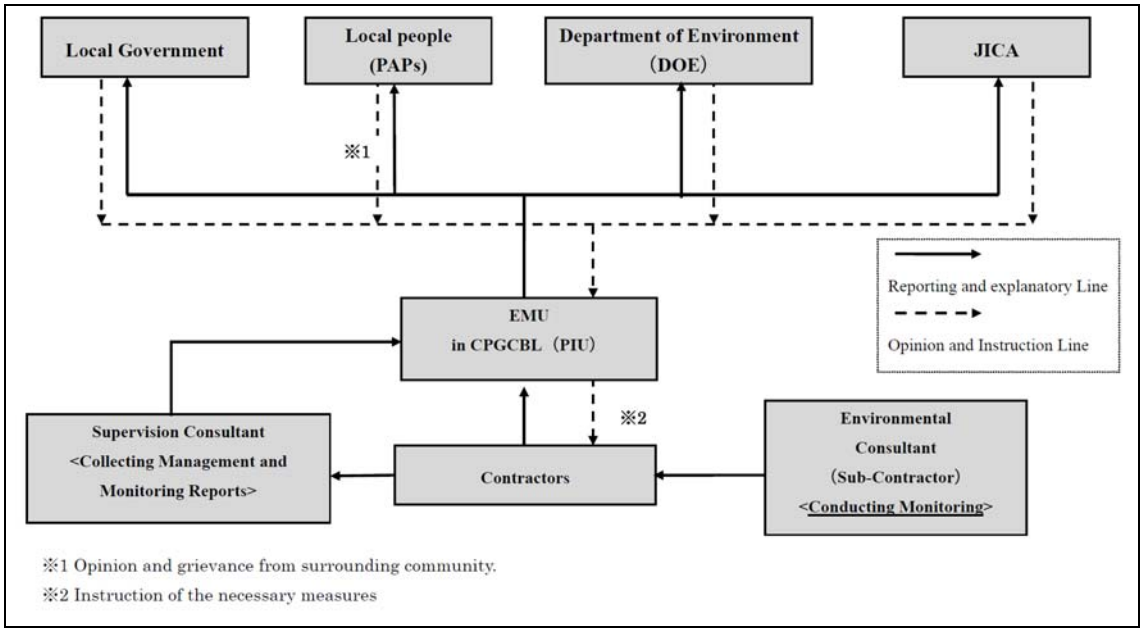
In order to confirm the implementation of environmental management and to consider further mitigation measures, the contractor should submit regular reports to the supervisory consultant and the EMU on the implementation status of the management plan.

The administrator of the EMU shall regularly hold explanation sessions with the local community, continuously listen to their grievances, submit reports to the Department of Environment, JICA and other relevant organizations regarding those grievances, as well as the implementation status of environmental management and environmental monitoring (described hereinafter).

If environmental problems occur due to construction work, the EMU shall confirm the cause with the contractor as soon as possible.

In order to resolve these problems, the administrator of the EMU shall instruct the contractor and consultant regarding necessary measures. If the problem is serious, the PIU may order the contractor to halt construction work until the problem is resolved.

Figure 15.7-1 outlines the environmental management and monitoring implementation structure in accordance with the reporting flow during the construction phase.



(Source: JICA Study Team)

Figure 15.7-1 Environmental Management and Monitoring Implementation Structure in the Construction Phase for the Power Plant and Port Facility

b) Operation Phase

The power plant is responsible for organizing the EMU in a manner that allows it to develop and implement an environmental management plan that includes mitigation measures. An expert environmental management administrator at the EMU shall be employed to ensure the environmental management plan is appropriately implemented. The administrator shall encourage the project staff to familiarize themselves with the environmental management plan prior to the start of plant operation, and shall regular educate those regarding ongoing matters during the operation phase.

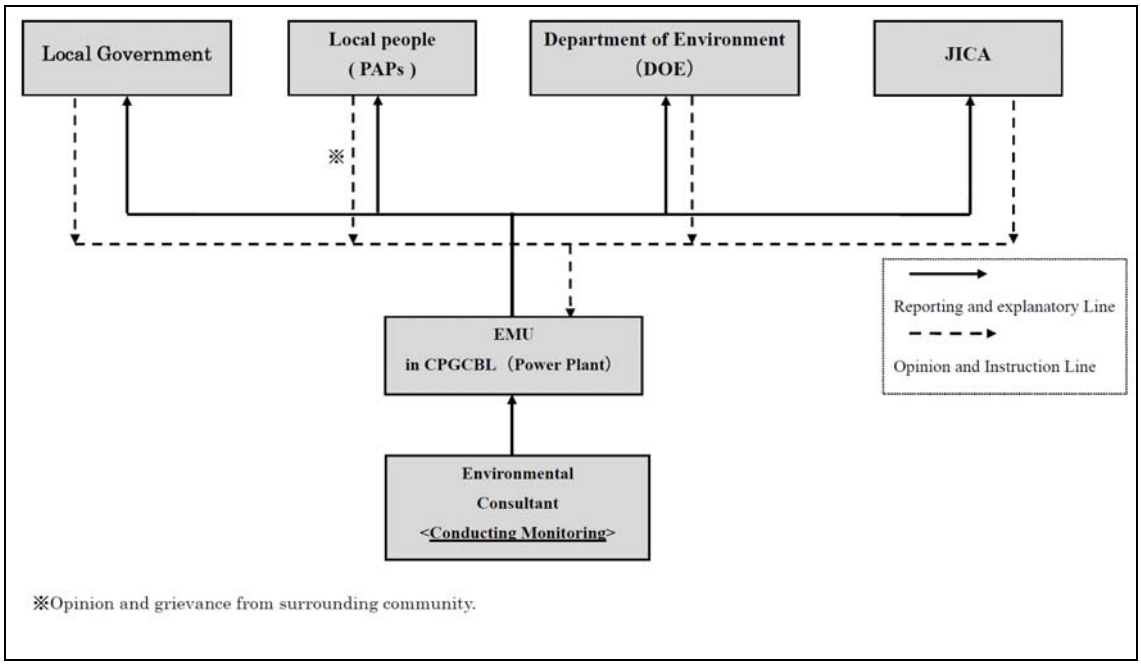
The EMU shall also function as a grievance organization and will strive to understand and address any grievances from the local people during the operation phase, and undertake appropriate mitigation measures.

The basic function of the environmental management plan is to lease with the local community, and to provide them with sufficient explanations based on positive mitigation measures, which is very important.

The administrator shall report on the contents and implementation status of the environmental management plan and environmental monitoring plan described below to the director of the plant, with the director taking final responsibility.

The administrator of the EMU shall shall regularly hold explanation sessions with the local community, continuously listen to their grievances, submit reports to the Department of Environment, JICA and other relevant organizations regarding those grievances, as well as on the implementation status of environmental management and environmental monitoring activities (described hereinafter).

Figure 15.7-2 describes the environmental management and monitoring implementation structure with the reporting flow during the operation phase.



(Source: JICA Study Team)

Figure 15.7-2 Environmental Management and Monitoring Implementation Structure in Operation Phase for the Power Plant and Port Facility

2) Mitigation Measures

The major environmental impact, mitigation measures, responsible organization, and expenses for each environmental item during the construction and operation phases for the power plant and port facility are listed in Table 15.7-1 and Table 15.7-2.

Table 15.7-1 Environmental Management Plan (Power Plant)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Pre-construction Phase									
1	Land acquisition	1) Loss of private land 2) Loss of salt fields, shrimp farms and fishing ground for push net 3) Loss of residential/ commercial structures 4) Loss of trees, home gardens, fish ponds and fruit	1) - 4) - The acquisition and requisition of immovable property ordinance of 1982 - JICA guideline (2010)	1) Consideration for land owners 2) Consideration for persons losing their homes 3), 4) Consideration for persons losing their property	1) - 4) - Developing an appropriate "Land acquisition and resettlement action plan" - Land acquisition should be conducted in compliance with the relevant laws and regulations - The cost related to relocation will be given to relocated residents - Employ local residents, especially loss of salt fields, shrimp farms, and fishing ground for push net as much as possible	1) - 4) - At the site	1) - 4) - During land acquisition process	- Office of the Deputy Commissioner - CPGCBL	Expenses to be paid by CPGCBL - Total cost relating to land acquisition: 3,864,045,082 Tk.
2	Disturbance to poor people	- Poor households among those who are to be resettled.	- JICA guideline (2010)	- Consideration for poor people	- Developing "Livelihood restoration program", including job training programs to persons who want the training.	- At the site	- Prior to start construction	- Office of the Deputy Commissioner - CPGCBL	Expenses to be paid by CPGCBL - Job training programs: 120,000 Tk./ 20person・20day
3	Social Institutions such as Social	- Changing peoples' thinking through	- Affected peoples' emotions	- Consideration to affected peoples'	- Developing an appropriate "Land acquisition and resettlement action plan"	- At the site	- Prior to start construction	- Office of the Deputy Commissioner - CPGCBL	Expenses to be paid by CPGCBL

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
	Infrastructure and Local Decision-making Institutions	interacting with local government officers, local residents and others in the land acquisition procedure		emotions					
4	Misdistribution of Benefits and Compensation	- It can occur among residents, workers, government officers and local politicians	- Affected peoples' emotions	- Consideration for uneven distribution of benefits and losses	- Implement the same mitigation measures as those outlined in "Social infrastructure"	- At the site	- Prior to start construction	- Office of the Deputy Commissioner - CPGCBL	Expenses to be paid by CPGCBL
5	Local Conflicts of Interest	- It can occur among residents, workers, government officers and local politicians	- Affected peoples' emotions	- Consideration to affected peoples' emotions	- Implement the same mitigation measures as those outlined in "Social infrastructure"	- At the site	- Prior to start construction	- Office of the Deputy Commissioner - CPGCBL	Expenses to be paid by CPGCBL
Construction Phase									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization	1) - 3) - Ambient air quality standard - IFC guideline value for ambient air quality (General/ 2007)	1) - 3) - Prevention of air pollution in the surrounding area	1) Dust prevention - Watering access road and construction site, especially in the dry season - Using cover sheets on trucks for the transportation of soil 2) Prevention of exhaust gas emission - Periodic maintenance and	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		of equipment 3) Air pollution arising from incineration of construction materials and waste			management of all the construction machinery and vehicles 3) Waste management - Prohibit open burning				
2	Water Quality	1) Wastewater from construction area 2) Domestic wastewater of workers 3) Inappropriate disposal of waste 4) Leakage oil and chemical materials from construction activity	1), 2) - Wastewater standards 3), 4) - Waste management rule	1) - 4) - Prevention of water pollution in the surrounding area	1) Wastewater - Excavate channels, ditches and temporary settling pond around construction area - Install oil separator for treatment of oily wastewater - Construct silt basin 2) Domestic wastewater - Install wastewater treatment facility for workers such as septic tanks 3) Waste management - Prohibit illegal dumping 4) Oil and chemical materials leakage - Storage of oil and chemical materials in an appropriate storage site and appropriate method to prevent permeation into ground	1) - 4) - Construction area	1) - 4) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
3	Waste	1) Construction	1) - 3)	1) - 3)	1), 2) Construction and	1) - 3)	1) - 3)	- Implementation:	Expenses

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		waste from construction work 2) Domestic waste from workers 3) Hazardous waste such as dry batteries, etc.	- Waste management rule	- Prevention of inappropriate waste disposal	domestic waste - Conduct separate waste collection and promote recycling and reuse - Appropriate disposal of non-recyclable waste according to rules 3) Hazardous waste - Hazardous waste should be treated under the related regulations	- Construction area - Villages near the site	- During construction phase	Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	included in contract cost by Contractor
4	Noise and Vibration	1) Noise and vibration caused by construction machinery 2) Noise caused by vehicles used for mobilization of equipment and workers	1), 2) - Noise level standards - IFC guideline values for noise (General/ 2007)	1), 2) - Reduction of noise levels from construction activities	1) Construction machinery - Optimizing construction schedule - Performing construction work during daytime, especially piling work - Using low-noise/ low vibration equipment 2) Mobilization - Transportation of material and equipment for construction by shipping - Determine a traffic control plan including route-setting - Limit truck speed especially around residential areas	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
5	Odor	- Domestic waste from workers	- Waste management rule	- Prevention of generating odor	- Taking appropriate measures for handling general waste	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental	Expenses included in contract cost by

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					- Prohibit illegal waste disposal			Consultant - Supervisor: CPGCBL/ Supervision Consultant	Contractor.
6	Soil	1) Leakages of oil and chemical materials from construction activity 2) Inappropriate disposal of waste	1), 2) - Waste management rule	1), 2) - Prevention of soil pollution in the surrounding area	1) Leakages of oil and chemical materials - Storage of oil and chemical materials in an appropriate storage site and method to prevent permeation into the ground 2) Waste management - Prohibit illegal dumping	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
7	Sediment	1) Run off water from construction area 2) Domestic wastewater of workers 3) Leakages of oil and chemical materials from construction activity	1) - 3) - Wastewater standards - Waste management rule	1) - 3) - Prevention of water pollution in the surrounding area	1) - 3) - Implement the same mitigation measures as those addressed in “Water quality” and “Waste”	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
8	Ecosystem	1) Existence of endangered species 2) Spawning of sea turtles	1), 2) - Bangladesh wild life act,1974 (Preservation) (Amendment) - JICA guideline	1), 2) - Protection of endangered species	1) Existence of endangered species - Prohibit disturbance, harassment, and hunting, especially of the Spoon billed Sandpiper, by	1) Construction area 2) Construction site adjoining sand beach	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			(2010)		workers - Replace to nearby site, if needed 2) Spawning of sea turtles - Turning off unnecessary lights during the nesting season - Using a smaller number or lower wattage of lights - Using red, yellow lights (as sea turtles are less affected by these colors) - Using low noise machinery - Planning construction activities to minimize adverse effects during the nesting season			Consultant	
		- Potential impact due to water pollution caused by construction activities	- Wastewater standards	- Prevention of water pollution in order to reduce negative impact on marine organisms	- Implement the same mitigation measures as those addressed in "Water quality"	- Construction area			
9	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Increase in employment and business opportunities	- Number of employment opportunities for local residents and number of businesses around the	- Improvement of the local economy - Improvement of living standards of local residents - Consideration to	- Employ local residents as much as possible - Use the services (i.e., laundry and catering services, etc.) and products offered by the local community.	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expense is included in contract cost by Contractor - Hire local residence:

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			construction area	local residents' feelings	- Developing "Livelihood restoration program", including job training programs to persons who want the training.				1,000Tk./person -day
10	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Local residents' feelings	- Consideration to local residents' feelings	- Implement the same mitigation measures as those addressed in the "Local economy"	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
11	Disturbance to Water Usage, Water Rights, etc.	1) Adverse impact due to water pollution 2) Usage of underground water	1) Water pollution - Same as those addressed in "Water quality" 2) Ground water - Drinking water quality standards	1) Water pollution - Same as those addressed in "Water quality" 2) Ground water - Consideration to local residents' living	1) Water pollution - Implement the same mitigation measures as those addressed in "Water quality" 2) Ground water - Monitoring of water levels and water quality at wells in residential areas	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
12	Disturbance to Existing Social Infrastructure and Services	1) Increased marine traffic may disturb the existing marine traffic including fishing boats 2) Traffic jams caused by increased number of	1) - 3) -Increasing traffic volume around the construction site	1) - 3) - Mitigation of traffic jams	1) Marine traffic - Consulting with related authorities on the schedules of vessels - Determining water routes after consultation with related authorities 2), 3) Land traffic - Making appropriate vehicle schedules	1) Sea area near the site 2), 3) Roads near the construction area	1) - 3) During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		vehicles during construction 3) Closure of the existing road along the shoreline			- Reducing the number of vehicles used by using buses - Consulting with related authorities on bus schedules				
13	Local Conflicts of Interest	- Conflicts between local residents and external workers	- Change in local customs	- Consideration of the attitudes of local residents to the project	- Employ local residents as much as possible - Promote communication between external workers and local people (e.g., join in local events)	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
14	Gender	1) Gender among those who are to be resettled 2) Loss of salt fiels, shrimp farms and fishing site for oush net	1), 2) - Living standars of gender	1), 2) - Consideration of living standards of gender	1), 2) - Developing "Livelihood restoration program", including job training programs to persons who want the training.	1), 2) - Villages near the site	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses to be paid by CPGCBL - Job training programs: 120,000 Tk./ 20person・20day
15	Children's Rights	- Child labor	- Child labor	- Banning child labor	- Prohibit labor contracts between subcontractor and children - Patrolling periodically to check for any child labor	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
16	Infectious	- Temporary influx	- Sanitation for	- Consideration	- Implementation of periodic	- Construction	- During	- Implementation:	Expenses

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
	Diseases such as HIV/AIDS	of migrant labor during construction may increase risk of infection	local residents	for sanitation for local residents	medical check-ups by temporary medical team - Education and training on health care of workers	area	construction phase	Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	included in contract cost by Contractor - Medical checkups: 22,500Tk./ person (Full Medical Checkup) - Safety education and training: 75,000Tk./ 20 person
17	Work environment (including work safety)	1) Labor accidents 2) Diseases caused by air pollutants, water pollutants, and noise by construction work	1) Labor accidents - Handling heavy loads - Working at heights - Electric shocks 2) Environment pollution - Ambient air quality standards - Noise level standards - Waste management rule - IFC guideline	1), 2) - Prevention of labor accidents and health problems	1) Labor accidents - Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment, such as helmets - Install fire extinguishers in fire handling places - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor - Protective equipment: 5,000Tk./ person

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			values for ambient air quality and noise (General/ 2007)		maintenance checks as appropriate during the construction period - Use equipment that protects against electric shocks 2) Environment pollution - Observe related standards and provide workers with appropriate equipment, such as masks, ear plugs, etc.				
18	Accidents	- Traffic accidents	1) Marine traffic 2) Land traffic	1), 2) - Traffic accidents	1) Marine traffic - Marking buoys around the construction area for marine safety - Informing vessel schedules to local fishermen, etc. 2) Land traffic - Informing bus schedules to the surrounding villages - Determining a traffic control plan - Training safe operation of vehicles	1) Sea area near the site 2) Roads near the construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor - Making buoys: 5,000Tk./ unit
19	Cross-boundary impact and climate change	- CO_2 will be produced by construction work	- Amount of CO_2 emissions	- Reduce CO_2 emissions as much as possible	- Periodic maintenance and management of all construction machinery and vehicles	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
								Consultant	
Operational Phase									
1	Air Quality	1) Exhaust gas from the stacks 2) Dust from ash disposal activity 3) Exhaust gas from vehicles used for mobilization of equipment and workers 4) Dust from coal handling activities at jetty and coal yard	1) - 4) - Emission gas standards - Ambient air quality standards - IFC guideline values for ambient air quality (General/ 2007) and gas emission (Thermal power plant/ 2008)	1), 3) - Prevention of air pollution in the surrounding area 2) Appropriate handling of ash 4) Appropriate coal handling during stock and unloading activities	1) Power plant operational activities: - To reduce PM emissions, Electrostatic Precipitator (EP; around 99.8% efficiency) will be installed - To reduce NO_2 emissions, firing system will use low combust technology - To reduce SO_2 emissions, sea water FGD equipment (FGD; around 70% efficiency) will be installed - For stack design, the height is 275m - Duct will be provided with CEMS (Continuous Emission Monitoring System) with the supported infrastructure as required under the gas emission standards and IFC guideline 2) Ash handling - Shifting the fly ash and the bottom ash to the ash pond using air sealed conveyer - Watering in ash pond as required for the dry season	1) Stack 2) Ash pond 3) Villages near the site 4) Coal stock yard	1) - 4) - During operation of power plant	- CPGCBL/ Environmental Consultant	- Flue gas treatment facilities: 319 million US$ - Flue gas duct and stack: 114 million US$ - Coal handling and transportion facilities: 182 million US$ - Re-greening: 100Tk./ m^2 (50ha) (Expenses included in contract cost by Contractor)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					- Re-greening especially along the boundary of the plant site, surrounding ash pond with domestic plants 3) Gas emissions from vehicles - Periodic maintenance and management of vehicles 4) Coal handling - A cover will be installed for the conveyor for coal transportation to coal yard - Unloading of coal will be minimized (e.g., reduce the frequency of activity, etc.) during times of high speed winds - Spraying water in coal yard to keep the surface wet and prevent wind from blowing coal and dust - Installation of a dust control fence - Re-greening especially along boundary of plant site, surrounding coal yard with domestic plants				
2	Water Quality	1) Thermal effluents from cooling system 2) Wastewater from	1) - 3) - Wastewater standards - IFC guideline	1) - 4) - Prevention of sea water pollution	1) Thermal effluents - Thermal effluents are discharged to north side far from the intake point of	1) - 4) - Power plant, especially at discharge of	1) - 4) During the operation of power plant	- CPGCBL/ Environmental Consultant	- Wastewater treatment system: (Expenses

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		plant process 3) Rainwater drainage from ash pond and coal yard 4) Leakages of oil and chemical materials	values for wastewater (Thermal power plant/ 2008) 4) Waste management rule		cooling water to reduce the impact on surrounding area 2) Wastewater from plant process - Installation of wastewater treatment system by neutralization, settling and oil separation so any wastewater produced complies with wastewater standards and IFC guideline 3) Run off water - Run off water is collected in the pond and discharged after appropriate treatment - The bottom of the ash pond shall have an impermeable layer (less than 10^{-6}cm/sec) such as impermeable geo-membrane, sheet and clay 4) Oil and chemical materials leakage - Storage of oil and chemical materials in an appropriate tank with retaining wall and method to prevent permeation into ground	thermal effluents and wastewater treatment system			included in contract cost by Contractor)
3	Waste	1) Fly ash and bottom ash	1) - 3) - Waste	1) Appropriate handling of coal	1) Ash pond is designed with capacity of 25 years	1) Ash pond 2), 3)	- During the operation of	- CPGCBL/ Environmental	- Ash handling facilities: 114

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		2) Sludge from wastewater treatment and waste oil from equipment, etc. 3) Sewage and garbage from workers	management rule	ash 2), 3) - Management of waste, especially hazardous waste - Prevention of inappropriate waste disposal	operation 2), 3) Waste management - Developing a waste management program consisting of reduction, reuse, and recycling of materials - Systematic collection and protected storage - Waste disposal at appropriate location - Hazardous waste shall be treated under the related regulations - Prohibition of dumping any contaminating materials	- Power plant	power plant	Consultant	million US$ (Expenses included in contract cost by Contractor)
4	Noise and vibration	1) Noise and vibration from steam turbines, generators, and pumps, etc. 2) Noise by ash disposal activity 3) Noise caused by vehicles used for mobilization of equipment and workers 4) Noise from coal handling activity	1) - 4) - Noise level standards - IFC guideline values for noise (General/ 2007)	1) - 4) - Mitigation of noise generated by the power plant	1) - 4) - Maintenance of equipment - Installation of low noise/ low vibration type equipment - Adequate basis of equipment to reduce vibration - Adequate enclosure of equipment to reduce noise	1) - 4) - Power plant	1) - 4) - During the operation of power plant	- CPGCBL/ Environmental Consultant	- Buildings housing boiler and turbine generator (Expenses included in contract cost by Contractor)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		at jetty and coal yard							
5	Odor	- Domestic waste from workers	- Waste management rule	- Prevention of generating odors	- Taking appropriate measures for handling domestic waste - Prohibit illegal waste disposal	- Power plant	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
6	Soil	1) Seepage from ash pond 2) Leakages of oil and chemical materials	1), 2) - Ground water (Drinking water quality standards) - Waste management rule	1), 2) - Prevention of soil and water pollution in the surrounding area	1) Seepage from ash pond - The bottom of the ash pond should have an impermeable layer (less than 10^{-6}cm/sec) such as impermeable geo-membrane, sheet and clay 2) Oil and chemical materials leakage - Storage of oil and chemical materials in an appropriate tank with retaining wall and method to prevent permeation into ground	1) Ash pond 2) Power plant	1), 2) - During coal unloading activity	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
7	Sediment	1) Wastewater from plant process 2) Run off water from ash disposal site and coal yard 3) Leakages of oil and chemical materials	1), 2) - Wastewater standards - IFC guideline values for wastewater (Thermal power plant/ 2008) 3) Waste	1) - 3) - Prevention of sea water pollution	1) Wastewater from plant process - Installation of wastewater treatment system by neutralization, settling and oil separation so any wastewater produced complies with wastewater standards and IFC	1), 2) - Wastewater treatment system 3) Power plant	1) - 3) - During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			management rule		guideline 2) Run off water - Run off water is collected in the pond and discharged after appropriate treatment 3) Oil and chemical materials leakage - Storage of oil and chemical materials in an appropriate tank with retaining wall and method to prevent permeation into ground				
8	Ecosystem	1) Existence of endangered species 2) Spawning of sea turtles	1), 2) - Bangladesh wild life act, 1974 (Preservation) (Amendment) - JICA guideline (2010)	1), 2) - Protection of endangered species	1) Existence of endangered species - Prohibit disturbance, harassment, and hunting, especially of the Spoon billed Sandpiper, by workers 2) Spawning of sea turtles - Turning off unnecessary lights during the nesting season - Using a smaller number or lower wattage of lights - Using red and yellow lights (as sea turtles are less affected by these colors) - Using low noise machinery	1) Power plant 2) Power plant adjoining sand beach	1), 2) - During the operation of the power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
		- Negative impact due to air	- Emission gas standards	- Prevention of air pollution, water	- Implement the same mitigation measures as	- Power plant			

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		pollutants, noise, and waste management	- Ambient air quality standards - Wastewater standards - Noise level standards - Waste management rule - IFC guideline values for ambient air quality (General/ 2007) and gas emissions (Thermal power plant/ 2008)	pollution, noise, and inappropriate waste treatment	those addressed in "Air quality", "Water quality", "Noise", and "Waste"				
9	Disturbance to Poor People	- Improved road along with the power plant	- Living standards of poor people	- Access to social services	- Construction of the access road, community road, and road around the power plant boundary - These roads will be built with sufficient height that they can be used even in the rainy season	- Villages near the site	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
10	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Increase in employment and business opportunities	- Number of employment opportunities for local residents and number of businesses around the	- Improvement of the local economy - Improvement of living standards of local residents - Consideration of	- Employment of local residents as much as possible - Use of services (i.e., laundry and catering services, etc.) and products offered by the local	- Villages near the site	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			power plant	local residents' feelings	community				
11	Land Use and Utilization of Local Resources	- Changing traditional land use patterns and utilization of local resources	- Local residents' feelings	- Consideration of local residents' feelings	- Implement the same mitigation measures as those addressed in "Local economy"	- Villages near the site	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
12	Disturbance to Water Usage, Water Rights, etc.	- Adverse impact due to water pollution	- Same as those addressed in "Water quality"	- Same as those addressed in "Water quality"	- Implement the same mitigation measures as those addressed in "Water quality"	- Power plant	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
13	Disturbance to the Existing Social Infrastructure and Services	1) Traffic jams caused by increased vehicles 2) Improved roads along with the power plant 3) Improved social infrastructure along with the power plant	- Impact to social infrastructure and services	1) Minimization of increasing traffic volume 2) Access to social services 3) Improvement of living standards of local residents	1) Traffic volume - Minimizing traffic volume by using buses for employees 2) Access to social services - Construction of the access road, community road, and road around the power plant boundary - These roads can be used even in the rainy season. 3) Improvement of living - New service facilities, such as school and medical center, are made available to local residents, as required - Electrification of surrounding area will be examined	1), 2) - Villages near the site 3) Power plant	1) - 3) - During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
14	Misdistribution of Benefits and Compensation	- It can occur among residents, workers, government officers and local politicians	- Affected peoples' emotions	- Consideration to affected peoples' emotions	- Developing an employment plan that is fair to every affected person	- Villages near the site	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
15	Local Conflicts of Interest	- Conflict between local residents and workers	- Change in local customs	- Consideration of the attitudes of local residents to the project	- Employ local residents as much as possible - Promote communication between workers and local people (e.g., join in local events)	- Villages near the site	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Hire local residence: 1,000Tk./person -day
16	Gender	- Improved road along with the power plant	- Living standards of gender	- Access to social services and markets	- Implement the same mitigation measures as those outlined in "Poor people"	- Villages near the site	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
17	Children's Rights	- Child labor	- Children's rights	- Banning child labor	- Prohibit labor contracts between subcontractor and children - Patrolling periodically to check for any child labor	1), 2) - Power plant	1), 2) - During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
18	Work environment (including work safety)	1) Labor accidents 2) Diseases caused by air pollutants, water pollutants, and noise from the operation of the power plant	1) Labor accidents - Handling heavy loads - Working at heights - Electric shocks 2) Environment	1), 2) - Prevention measures against labor accidents and health problems	1) Labor accidents - Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment such as helmet	1), 2) - Power plant	1), 2) - During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Safety education and training: 75,000Tk./ 20person

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			pollution - Ambient air quality standards - Noise level standards - Waste management rule - IFC guideline values for ambient air quality and noise (General/ 2007)		- Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Use equipment that protects against electric shock 3) Environment pollution - Observe related standards and provide workers with appropriate facilities				- Protective equipment: 5,000Tk./ person
19	Accidents	1) Traffic accidents 2) Fire 3) Cyclones and tidal surge	1) Traffic accidents - Marine traffic - Land traffic 2) Fire 3) Cyclones and tidal surge	1) Prevention of traffic accidents 2) Prevention of fire 3) Prevent floods caused by cyclones	1) Traffic accidents - Determining water routes and setting course buoys on navigation channel for safety - Informing vessel schedules to local fishermen, etc. - Observation of traffic regulations, installation of traffic signs, and education on safe driving - Informing vicles schedules , such as bus, to the surrounding villages 2) Fire - Installing fire extinguishers in fire handling places - Installing fire fighting system	1), 3) - Villages near the site 2) Power plant	1) - 3) - During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Course buoys: 5,000Tk./ unit - Fire extinguisher: 60,000Tk./ set (Consist of 6 pcs)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					- Spraying water in coal yard - Developing fire fighting organization and implementing fire drills 3) Cyclones and tidal surges - Construction of embankment along navigation channels and revetment in the port to prevent floods caused by cyclones.				
20	Cross-boundary impact and climate change	- CO_2 emission	- Amount of CO_2 emission	- Reduce CO_2 emissions per electric generate (kW)	- Use of USC of high efficiency for power generation	- Power plant	- During the operation of power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Boiler and auxiliaries: 433million US$

(Source: JICA Study Team)

Table 15.7-2 Environmental Management Plan (Port Facility)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Construction Phase									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment 3) Air pollution arising from incineration of construction materials and waste	1) - 3) - Ambient air quality standard - IFC guideline values for ambient air quality (General/ 2007)	1) - 3) - Prevention of air pollution in the surrounding area	1) Dust prevention - Watering access road and construction site, especially in the dry season - Using cover sheets on trucks for the transportation of soil 2) Prevention of exhaust gas emission - Periodic maintenance and management of all the construction machinery and vehicles 3) Waste management - Prohibit open burning	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
2	Water Quality	1) Dredging 2) Landfill for land preparation	1) Dredging - Regulations relating to dredging - Water quality Standards - Ambient water quality standards (Sea water) 2) Wastewater	1), 2) - Prevention of water pollution in the surrounding coastal area	1) Dredging - Conducting dredging at sea area with pump dredger and setting film preventing the diffusion of contamination - When dredging terrestrial area, firstly driving steel sheet pile at the sea side and dredging with pump or	1) Dredging area 2) Power plant site	1) During the dredging activities 2) During landfill activities	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			standards for industrial activity		grab after sea water penetrates the land 2) Landfill - Treating turbid water from land, such as rainwater, with precipitation process and discharging the remaining water into the excavated part of the port				
3	Waste	- Dredging material for the channel	- Regulations relating to dredging	- Prevention of inappropriate waste disposal	- Disposal of dredging material * Sand: Use for leveling the site * Silt: Dispose in the ash pond (7,500,000m^3)	- Dredging area and power plant site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
4	Noise and Vibration	- Noise and vibration caused by construction machinery	- Noise level standards - IFC guideline values for noise (General/ 2007)	- Reduction of noise levels from construction activities	- Optimizing construction schedule - Perform construction work during daytime, especially piling work - Using low-noise/ low vibration equipment	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
5	Ecosystem	1) Existence of endangered species 2) Spawning of sea turtles	1), 2) - Bangladesh wild life act, 1974 (Preservation) (Amendment) - JICA guideline (2010)	1), 2) - Protection of endangered species	1) Existence of endangered species - Prohibit disturbance, harassment, and hunting, especially the Spoon billed Sandpiper, by workers - Replace to nearby sites if needed. 2) Spawning of sea turtles	1) Construction area 2) Construction site adjoining sand beach	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					- Turning off unnecessary lights during the nesting season - Using a smaller number or lower wattage of lights - Using red and yellow lights (as sea turtles are less affected by these colors) - Using low noise machinery - Planning construction activities to minimize adverse effects during the nesting season				
6	Disturbance to the Existing Social Infrastructure and Social Services	- Increase the number of construction vessels	- Increasing traffic volume around the construction site	- Interference to other tankers, barges, and fishing boats	- Consulting with related authorities on vessel schedules - Determining water routes after consultation with related authorities	- Sea area around the site	-During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
7	Work environment (including work safety)	1) Labor accidents 2) Diseases caused by air pollutants, water pollutants, and noise by construction work	1) Labor accidents - Handling heavy loads - Working at heights - Electric shocks 2) Environment pollution - Ambient air quality standards - Noise level	1), 2) - Prevention of labor accidents, traffic accidents, and health problems	1) Labor accidents - Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment, such as a helmet - Inspect and ensure that any lifting devices, such as cranes, are appropriate for	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor - Protective equipment: 5,000Tk./ person

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			standards - Waste management rule - IFC guideline values for ambient air quality and noise (General/ 2007)		expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate during the period of construction - Use equipment that protects against electric shock 2) Environment pollution - Observe related standards and provide workers with appropriate facilities				
8	Accidents	- Traffic accidents	- Marine traffic accidents	- Prevention of traffic accidents	- Setting marking buoys around the construction area for marine safety - Informing vessel schedules to local fishermen, etc.	- Sea area around the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
Operational Phase									
1	Air Quality	1) Dust from coal handling activity at port 2) Exhaust gas from vessels	1) Coal handling - Ambient air quality standards - IFC guideline for ambient air quality (General/ 2007) 2) MALPOL 73/78 treaty (Annex VI)	1) Appropriate coal handling during coal unloading activity 2) Prevention of air pollution caused by vessels	1) Coal handling - A cover will be installed on the conveyor for coal transportation to coal yard - Unloading of coal will be minimized (e.g., reduce the frequency of activity, etc.) during times of high speed winds - Spraying water in coal handling area to keep the	1), 2) - Port facility	1), 2) - During coal unloading activity	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL/ Vessel owners

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					surface wet and prevent wind from blowing coal and dust 2) Prevention of exhaust gas emission - Hire vessels compliant to MARPOL 73/78 treaty - Stop engines in the port				
2	Water Quality	- Dredging material for the maintenance of the navigation channel	- Regulations relating to dredging - Water quality standards - Ambient water quality standards (Sea water)	- Minimization of water pollution by dredging	- To choose dredging method and equipment that will minimize turbidity	- Dredging area	- During the dredging activities	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
		1) Operation of the port may cause a coal spillage, and as a result, water pollution will occur 2) Leakages of oil from oil tankers 3) Wastewater from vessels will cause water pollution	1) Water pollution - Wastewater standards - Ambient water quality standards (Sea water) 2), 3) - MALPOL 73/78 treaty (Annex I-V) 3) Wastewater from vessels - International Convention for the control and	1) Appropriate coal handling during coal unloading activity 2), 3) Prevention of water pollution caused by vessels	1) Operation of the port - Cover installation on conveyor for coal transportation to coal yard 2) Leakages of oil from oil tankers - Installation of oil fence 3) Wastewater from vessels - Prohibition of dumping any contaminated materials - Hire vessels compliant to MARPOL 73/78 treaty and BWM - Any wastewater from vessels will be treated by	1) - 3) - Port facility	1) - 3) - During coal unloading activity - During oil storage activity		Expenses by CPGCBL/ Vessel owners

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			management of Ships' Ballast Water and Sediments (BWM), 2004		the port facility				
3	Waste	- Dredging material for the maintenance of the channel	- Waste management rule	- Prevention of inappropriate waste disposal	- Disposal of dredging material * Sand: Use for leveling the site * Silt: Dispose in the ash pond (365,000m^3/year)	- Dredging area	- During the dredging activities.	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
		- Waste from vessels	- Waste management rule - MALPOL 73/78 treaty (Annex I-V)	- Appropriate waste management	- Prohibition of dumping any contaminated materials - Hire vessels compliant to MARPOL 73/78 treaty - Any waste from vessles will be treated by the port facility	- Port facility	- During coal unloading activity		Expenses by CPGCBL / Vessel owners
4	Noise and Vibration	- Noise from coal handling activity at the port	- Noise level standards - IFC guideline values for noise (General/2007)	- Mitigation of noise generated by the unloading activity	- Maintenance of equipment. - Installation of low noise type equipment - Optimizing coal unloading schedule	- Port facility	- During coal unloading activity	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
5	Ecosystem	1) Existence of endangered species 2) Spawning of sea turtles	1), 2) - Bangladesh wild life act, 1974 (Preservation) (Amendment) - JICA guideline (2010)	1), 2) - Protection of endangered species	1) Existence of endangered species - Prohibit disturbance, harassment, and hunting, especially of the Spoon billed Sandpiper, by workers	- Around the port facility	- During the operation of the power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					2) Spawning of sea turtles - Turning off unnecessary lights during the nesting season - Using a smaller number or lower wattage of lights - Using red and yellow lights (as sea turtles are less affected by these colors) - Using low noise machinery				
		1) Operation of the port may cause a coal spillage, and as a result, water pollution will occur 2) Leakage oil from oil tanker 3) Wastewater from vessels will cause water pollution	1) Water quality standards (Sea water) 2), 3) - MALPOL 73/78 treaty (Annex I-V) 3) Wastewater from vessels - International Convention for the control and management of Ships' Ballast Water and Sediments (BWM), 2004	1) Appropriate coal handling during coal unloading activity 2). 3) Prevention of water pollution caused by vessels	1) Operation of the port - Cover installation on conveyor for coal transportation to coal yard. 2) Leakages of oil from oil tankers - Installation of oil fence 3) Wastewater from vessels - Prohibition of dumping any contaminated materials - Hire vessels compliant to MARPOL 73/78 treaty and BWM - Any wastewater and waste from vessels will be treated by the port facility	1) - 3) - Port facility	1) - 3) - During coal unloading activity - During oil storage activity		Expenses by CPGCBL/ Vessel owners
6	Hydrology	- Potential impact to tidal currents caused by construction of	- Tidal currents	- Minimization of change of tidal currents	- Conducting tidal current simulation and design of port facility that minimizes the change of tidal currents	- Port facility	- During design of the port facility	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		the port facility							
7	Topography and Geology	- Potential impact on coastal line caused by changing tidal currents	- Coastal line	- Minimization of change of coastal line	- Conducting tidal current simulation and design of port facility that minimizes the change of drift sand movement	- Port facility	- During design of the port facility	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
8	Disturbance to the Existing Social Infrastructure and Social Services	- Increase in the number of vessels	- Increasing traffic volume around the power plant	- Interference to other tankers or barges	- Setting water routes after consultation with related authorities	- Sea area around port facility	- During coal transport	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
9	Work Environment (Including Work Safety)	1) Labor accidents 2) Diseases caused by air pollutants and noise by coal unloading activity	1) Labor accidents - Handling heavy loads - Working at heights 2) Environmental pollution - Ambient air quality standards - Noise level standards - Waste management rule - IFC guideline values for ambient air quality and noise (General/ 2007)	1), 2) Prevention of labor accidents and health problems	1) Labor accidents - Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment such as a helmet - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate 2) Environment pollution - Observe related standards and provide workers with	1), 2) Port facility	1), 2) - During coal unloading activity	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					appropriate equipment				
10	Accidents	- Traffic accidents	- Marine traffic	- Prevention of traffic accidents	- Consulting with related authorities on vessel schedules - Determining water routes after consultation with related authorities - Setting course buoys around navigation channel area for marine safety - Informing operation schedule to local fishermen etc.	- Sea area around port facility	- During coal transport	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

(Source: JICA Study Team)

15.7.2 Transmission line

(1) Implementation System

a) Construction Phase

At the construction phase, the PIU of PGCB shall carefully consider all construction activities with the supervision consultant, and encourage the contractor to fully understand the necessary mitigation measures and implement them.

In this regard, an environmental management unit (EMU) shall be organized prior to the start of construction and an expert environmental management administrator in the EMU shall be employed. The unit will discuss and prepare mitigation measures with the supervision consultant and the contractor prior to the start of construction.

A large inflow of workers and vehicles is expected once construction begins.

The EMU shall also function as a grievance organization will seek to understand and address any grievances from local people during the construction phase, and conduct appropriate mitigation measures.

The EMU shall improve the understanding of the surrounding community regarding construction details, schedule and mitigation measures, and shall obtain local people's opinions and change the mitigation measures as appropriate.

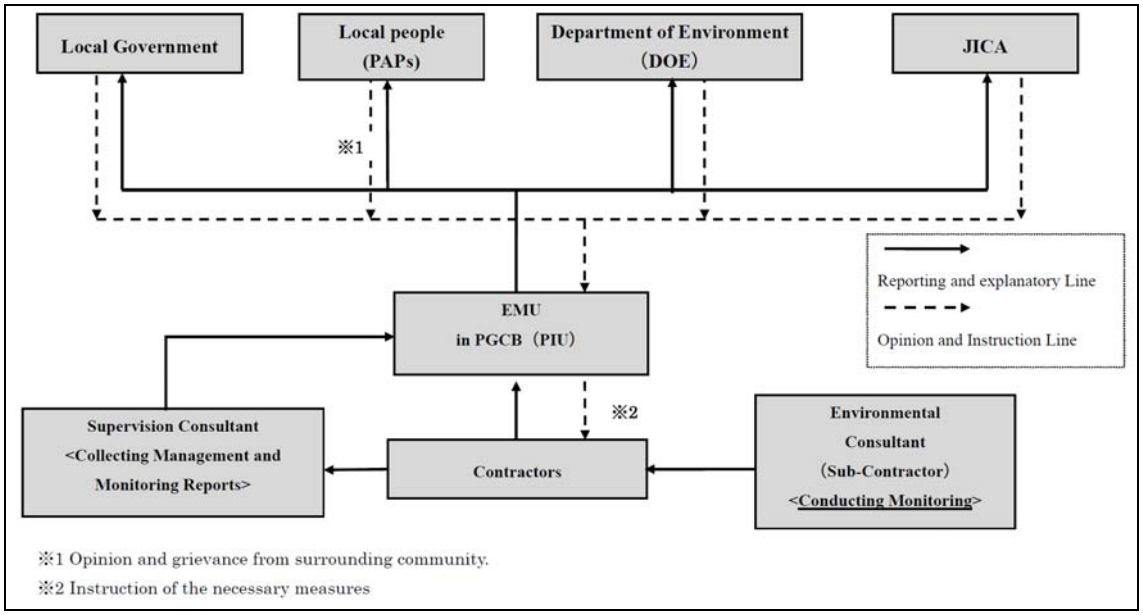
In order to confirm the implementation of environmental management and to consider further mitigation measures, the contractor should submit regular reports to the supervisory consultant and the EMU on the implementation status of the management plan.

The administrator of the EMU shall regularly hold explanation sessions with the local community, continuously listen to their grievances, submit reports to the Department of Environment, JICA and other relevant organizations regarding those grievances, as well as the implementation status of environmental management and environmental monitoring (described hereinafter).

If environmental problems occur due to construction work, the EMU shall confirm the cause with the contractor as soon as possible.

In order to resolve these problems, the administrator of the EMU shall instruct the contractor and consultant regarding necessary measures. If the problem is serious, the PIU may order the contractor to halt construction work until the problem is resolved.

Figure 15.7-3 outlines the environmental management and monitoring implementation structure in accordance with the reporting flow during the construction phase.



(Source: JICA Study Team)

Figure 15.7-3 Environmental Management and Monitoring Implementation Structure in Construction Phase for Transmission Line

b) Operation Phase

The power plant is responsible for organizing the EMU in a manner that allows it to develop and implement an environmental management plan that includes mitigation measures. An expert environmental management administrator in the EMU shall be employed to ensure the environmental management plan is appropriately implemented. The administrator shall encourage the project staff to familiarize themselves with the environmental management plan prior to the start of plant operation, and shall regular educate them regarding ongoing matters during the operation phase.

The EMU shall also function as a grievance organization and will strive to understand and address any grievances from the local people during the operation phase, and conduct appropriate mitigation measures.

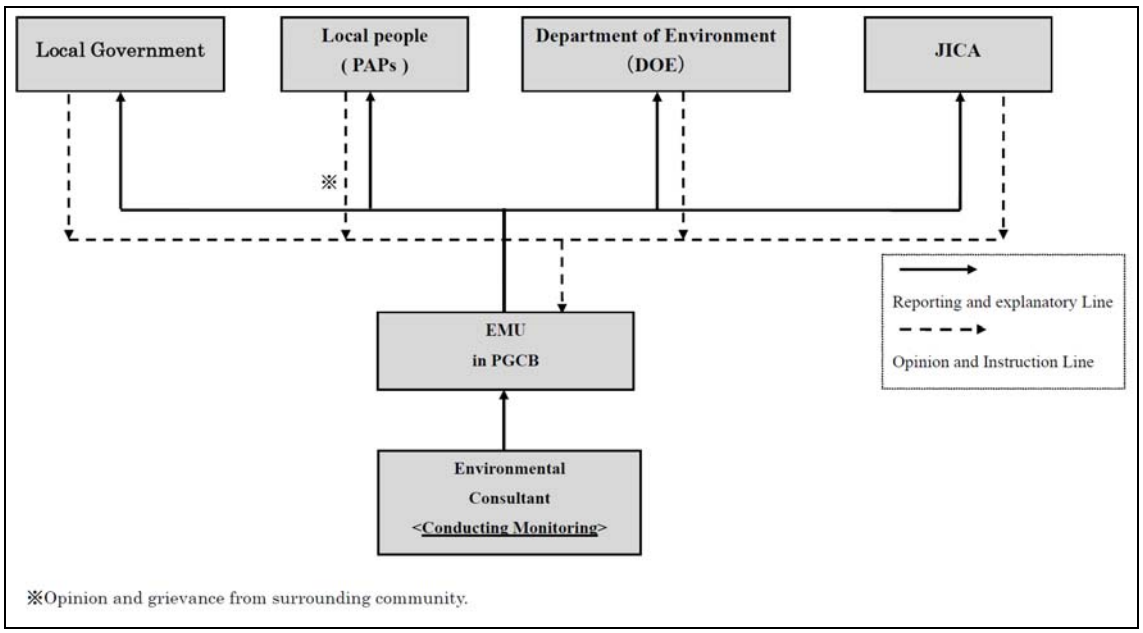
The basic function of the environmental management plan is to liase with the local community, and to provide them with sufficient explanations based on positive mitigation measures, which is very important.

The administrator shall report the contents and implementation status of the environmental management plan and environmental monitoring plan described below to the director of the plant, with the director taking final responsibility.

The administrator of the EMU shall regularly provide explanations to the local community,

continuously listen to their grievances, submit reports to the Department of Environment, JICA and other relevant organizations regarding those grievances, as well as on the implementation status of environmental management and environmental monitoring activities (described hereinafter).

Figure 15.7-4 describes the environmental management and monitoring implementation structure with the reporting flow during the operation phase.



(Source: JICA Study Team)

Figure 15.7-4 Environmental Management and Monitoring Implementation Structure in Operation Phase for the Transmission Line

(2) Mitigation Measures

The major environmental impacts, mitigation measures, responsible organizations, and expenses for each environmental item in the construction and operation phases for the power plant and port facility are listed in Table 15.7-3.

Table 15.7-3 Environmental Management plan (Transmission Line)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Pre-construction Phase									
1	Land acquisition and Compensation	1) Loss of land at tower bases 2) Kept out of the construction zone 3)Trees and buildings will be removed if they are within clearance distance	1) - 3) - Electricity act, 1910 - JICA guideline (2010)	1) - 3) - Consideration for owners	1) - 3) - Developing an appropriate "compensation plan" - Towers are constructed in non-residential areas to the maximum extent possible - Land acquisition should be conducted in compliance with relevant laws and regulations - After construction towers, land owner can cultivate under it. - Compensation should be conducted in compliance with relevant laws and regulations	1), 2) Tower bases 3) ROW of transmission line route	1) During land acquisition process 2) During Constrution phase 3) Prior to the start construction	- Office of the Deputy Commissioner - PGCB	Expenses to be paid by PGCB - Total cost relating to the land acquisition: 3,119,219 Tk.
2	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- Change of people's thinking through interacting with local government officers, local residents and others in the land acquisition procedure	- Affected peoples' emotions	- Consideration to affected peoples' emotions	- Compensation should be conducted in compliance with relevant laws and regulations	- Tower bases	- Prior to the start construction	- Office of the Deputy Commissioner - PGCB	Expenses to be paid by PGCB
Construction Stage									

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment 3) Air pollution arising from incineration of construction materials and waste	1) - 3) - Ambient air quality atandard - IFC guideline values for ambient air quality (General/ 2007)	1) - 3) - Prevention of air pollution in the surrounding construction area	1) Dust prevention - Watering access roads and construction site, especially in the dry season - Using cover sheet on trucks for the transportation of soil 2) Prevention of exhaust gas emission - Periodic maintenance and management of all construction machinery and vehicles 3) Waste management - Prohibit open burning and illegal dumping	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor
2	Water Quality	1) Run off water from construction area 2) Domestic wastewater of workers 3) Inappropriate disposal of waste	1), 2) - Wastewater standards 3) Waste management rule	1) - 3) - Prevention of water pollution in the surrounding construction area	1) Run off water - Transmission line route was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of the construction area with concrete, as necessary based on geological survey 2) Domestic wastewater - Install wastewater treatment facility for workers, such as septic tanks	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					3) Waste management - Prohibit illegal waste disposal				
3	Noise and Vibration	1) Noise and vibration caused by construction machinery 2) Noise caused by vehicles used for mobilization of equipment and workers	1), 2) - Noise level standards - IFC guideline values for noise (General/ 2007)	1), 2) - Reduction of noise level from construction activities	1) Construction machinery - Optimizing construction schedule - Perform construction work during daytime, especially piling work - Using low-noise/ low vibration equipment 2) Mobilization - Limit truck speed, especially around residential areas	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor
4	Ecosystem	1) Removal of vegetation 2) Loss of protected species	1) Cover of vegetation and trees 2) Existence of protected species	1), 2) - Mitigation of environmental impact on the loss of vegetation and protected species	1) Vegetation - Tower construction area should be re-vegetated with native plants 2) Protected species - Consult with specialists about moving individual animals if any protected species are discovered	1), 2) - Tower bases	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor - Re- vegetation: 100Tk./ m^2 (15,700m^2; 10mx10mx157)
5	Topography and Geology	- Soil runoff	- Soil runoff	- Prevention of soil runoff	- Transmission line route was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of construction areas with	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					concrete, as necessary based on geological survey			Consultant	
6	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Loss of farmlands, being kept out of construction zones	- Local residents' feelings	- Consideration of local residents' feelings	- Employ as many local residents as possible - Use the services (i.e., laundry and catering services, etc.) and products offered by the local community	- Villages along the transmission line route	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor
7	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Local residents' feelings	- Same as those addressed in "Local Economy"	- Same as those addressed in "Rocal Economy"	- Villages along the transmission line route	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor
8	Disturbance to Water Usage, Water Rights, etc.	- Water pollution caused by soil runoff	- Water quality standards (Inland surface water)	- Prevention of water pollution in downstream areas	- Transmission line route was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of construction areas with concrete, as necessary based on geological survey - Re-greening in construction areas	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor
9	Cultural Heritage	- Further destruction of buried cultural heritage due to	- Loss of cultural heritage	- Protect cultural heritage	- Stop construction work if any cultural heritage area is discovered and immediately consult with specialists	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		engineering work						- Supervisor: PGCB/ Supervision Consultant	
10	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	- Sanitation of local residents	- Consideration of sanitation of local residents	- Implementation of periodic medical check-ups - Education and training on workers' health care	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor - Medical checkup: 22,500Tk./ person (Full medical checkup) - Safety education and training: 75,000Tk./ 20 person
11	Work Conditions (including work safety)	- Labor accidents	- Handling heavy loads - Working at heights - Electric shocks	- Prevention measures against labor accidents, accidents and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment such as a helmet - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor - Protective equipment: 5,000Tk./ person

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					appropriate during the construction period - Use facilities and equipment that protects against electric shocks				
12	Accidents	- Soil runoff and tower breakages	- Soil runoff	- Prevention of soil runoff	- Transmission line route was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of the construction area with concrete, as necessary based on geological survey	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor
Operational Stage									
1	Water Quality	- Run off water from tower bases	- Water quality standards (Inland surface water)	- Prevention of water pollution in the lower reach	- Preventing soil loss by stabilizing any slopes of construction area with concrete, as necessary based on geological survey	- Tower bases	- During operation phase	- PGCB/ Environmental Consultant	Expenses by PGCB
2	Ecosystem	- Birds striking the lines	- Birds striking	- Prevention of birds striking	- Installation of lights and signs, etc, if needed	- Along the transmission line route	- During operation phase	- PGCB/ Environmental Consultant	Expenses by PGCB
3	Topography and Geology	- Soil runoff	- Soil runoff	- Prevention of soil runoff	- Same as those addressed in "Water Quality"	- Along the transmission line route	- During the operation phase	- PGCB/ Environmental Consultant	Expenses by PGCB
4	Deterioration of the local economy, such as lossed employment	- Loss of farmlands	- Same as those outlined in "Local Economy in the Construction	- Same as those outlined in "Local Economy in the Construction	- Implement the same mitigation measures as those ouitlined in "Local Economy in the Construction phase"	- Tower bases	- During the operation phase	- PGCB/ Environmental Consultant	Expenses by PGCB

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
	and livelihood		phase"	phase"					
5	Disturbance to Water Usage, Water Rights, etc.	- Water pollution caused by soil runoff	- Same as those outlined in "Water Usage in the Construction phase"	- Same as those outlined in "Water Usage in the Construction phase"	- Implement the same mitigation measures as those outlined in "Water Usage in the Construction phase"	- Tower bases	- During the operation phase	- PGCB/ Environmental Consultant	Expenses by PGCB
6	Work Conditions (including work safety)	- Labor accidents	- Handling heavy loads - Working at heights - Electric shocks	- Prevention measures against labor accidents, accidents, and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment such as a helmet - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate - Use facilities and equipment that protects against electric shocks	- Along the transmission line route	- During the inspection work	- PGCB/ Environmental Consultant	Expenses by PGCB - Safety education and training: 75,000Tk./20person - Protective equipment: 5,000Tk./person
7	Accidents	- Soil runoff and tower breakages	- Soil runoff	- Prevention of soil runoff	- Same as those addressed in "Water Quality"	- Along the transmission line route	- During the inspection work	- PGCB/ Environmental Consultant	Expenses by PGCB

(Source: JICA Study Team)

(3) Proposed Mitigation or Management Measures for threatened species

Biological repercussions to nesting turtles do not always occur.

Any impact is dependent upon the level of physical disturbance caused by noise and lighting adjacent to the sand beach coast.

When the levels of physical disturbance appears to be high, effective mitigation measures described in the table below should be discussed.

Table 15.7-4 Proposed Mitigation or Management Measures on Threatened Species

	Scientific (English)	IUCN	Proposed Mitigation or Management Measures
1	*Eurynorhynchus pygmeus* (Spoon-billed Sandpiper)	CR	For the purpose of protecting the species, workers will be instructed to strictly comply with hunting and capturing restrictions prescribed by law.
2	*Geoclemys hamiltonii* (Spotted Pond Turtle)	VU	Feed on fish, invertebrates, and floating aquatic plants. There are no ponds or waterways which provide them with such foods in the project site. Prohibit disturbance, harassment, and hunting by project workers or contractors while working, traveling by vehicles or residing in the project field accommodation and encourage workers to quickly place them into nearby fresh ponds or rivers if they encounter the creatures.
3	*Lepidochelys olivacea* , (Olive Ridley Turtle)	VU	Sensitive to light and noise, so noise and use of flashlights on the coast at night can cause nesting females to halt their nesting. Measures available to mitigate these impacts should be taken: ➢ Turning off unnecessary lights during the nesting season ➢ Using a smaller number or lower wattage of lights ➢ Shielding, redirecting and repositioning lights ➢ Using red, yellow, and low-pressure sodium-vapor lights (as sea turtles are less affected by these colors) ➢ Using low-level noise heavy machinery (concrete mixing, excavation machinery, etc.) ➢ Planning construction activities to minimize adverse effects during the nesting season ➢ Avoiding tall structures creating shade on the coast to maintain nest temperatures ➢ Control the introduction of non-native plants which may lead to impenetrable root mats (The optimal use of any one of these measures depends upon the results of the current sea turtle survey)
4	*Caretta caretta* (Logger head turtle)	EN	
5	*Chelonia mydas* (Green turtle)	EN	
6	*Eretmochelys Imbricate* (Hawksbill turtle)	CR	

(Source: JICA Study Team)

The protection measures outlined in Table 15.7-5 shall be considered when dealing with the 11 species indicated by the Bangleshi scientist groups.

Table 15.7-5 Threatened Species Proposed by Bangladesh Scientist Groups

Taxa	No.	Scientific Name	English Name	Available Mitigation Measures
Flora	1	*Calamus guruba Buch.-Ham.*	Cane	➢ Transfer to similar sites to the project area And if impossible to transfer: ➢ Collection of seeds or adoption of cuttings
	2	*Trichosanthes cordata Roxb.*	Snake guard	
	3	*Lepisanthes rubiginosa*	Rusty sapindus	
	3			
Reptile	1	*Calotes versicolor*	Garden lizard	➢ Prohibit disturbance, harassment, killing or possession of these species by project workers or contractors while working.
	2	*Mabuya mabuya*	Skink	
	3	*Gekko gecko*	Tokay Gecko	
	4	*Pangshura tentoria*	Median Roofed Turtle	
	5	*Naja naja*	Bicled Cobra	
	5			
Bird	1	*Arachnothera magna*	Streaked Spiderhunter	(These species can easily fly away from the disturbed habitat and find other suitable habitats) ➢ Prohibit illegal hunting by project workers or contractors while working.
	2	*Ketupa zeylonensis*	Broun Fish Owl	
	3	*Vanellus duvaucelii*	River Lapwing	
	3			
Total	**11**			

(Source: JICA Study Team)

15.7.3 Access road

(1) Implementation System

1) Construction Phase

At the construction phase, the PIU of the executing agency shall carefully consider the construction activity with Supervision Consultant and encourage the contractor to well understand the necessary mitigation measures and to implement them.

In this regard, the Environmental Management Unit (EMU) in Executiing Agency (PIU) shall be organized prior to the construction activity and an expert environmental management administrator shall be placed. The unit will discuss and prepare the mitigation measures with Supervision Consultant and the contractor prior to the construction activity.

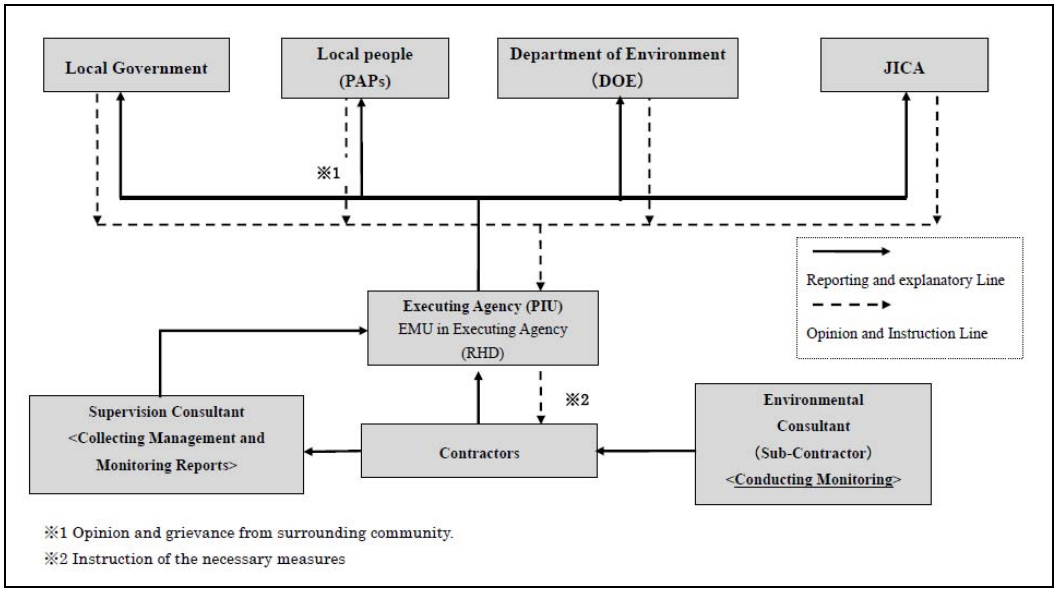
During construction activity in which large inflow of workers and vehicles is predicted, the environmental management unit shall promote the understanding of the surrounding community about the contents and schedule of the construction activity and mitigation measures and collect the local people's opinion and correcting the mitigation measures as appropriate.

In order to confirm the implementation of the environmental management and to consider further mitigation measures, the contractor should submit a regular report to the Supervision Consultant and environmental management unit on the implementation status of the

management plan.

The environmental management administrator shall regularly conduct explanation to the local people and submit a report to Department of Environment (DOE), JICA and other relevant organizations about the implementation status of the environmental management, in addition to the environmental monitoring described hereinafter.

Figure 15.7-5 describes the environmental management and monitoring implementation structure with the reporting flow in construction phase.



(Source: JICA Study Team)

Figure 15.7-5 Environmental Management and Monitoring Implementation Structure in Construction Phase for Access Road

2) Operation Phase

EMU is responsible for organizing an environmental management unit to develop and implement the environmental management plan as a mitigation measures.

An expert environmental management administrator shall be placed so that the environmental management plan is appropriately implemented.

The environmental management administrator shall enhance the understanding of the environmental management plan to the project staff prior to the operation, and continue regular education of the staff during operation phase.

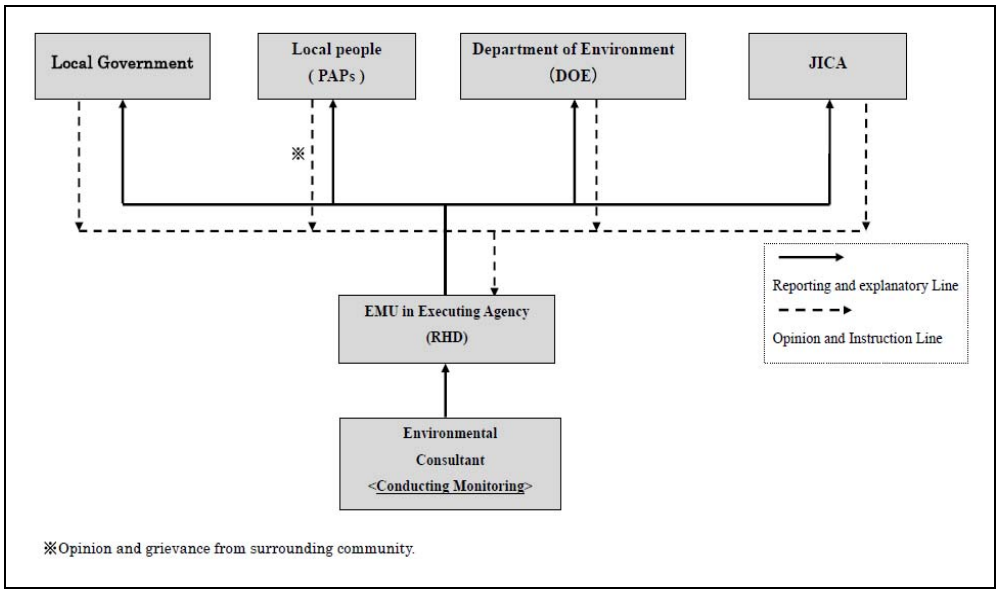
The environmental management unit shall also function as a grievance organization to understand and address the grievance from the local people during operation phase, and conduct appropriate mitigation measures.

Basic policy of the environmental management plan is to coordinate with the local community, and sufficient explanation of the positive mitigation measures for the local people is very important.

The administrator shall report the contents and implementation status of the environmental management plan and the environmental monitoring plan described below to the director of the plant, with the director taking final responsibility.

The environmental management administrator shall regularly conduct explanation to the local people and submit a report to Department of Environment, JICA and other relevant organizations about the implementation status of the environmental management, in addition to the environmental monitoring described hereinafter.

Figure 15.7-6 describes the environmental management and monitoring implementation structure with the reporting flow in operation phase.



(Source: JICA Study Team)

Figure 15.7-6 Environmental Management and Monitoring Implementation Structure in Operation Phase for Access Road

(2) Mitigation Measures

The major environmental impact, mitigation measures, responsible organization, and expense for each environmental item in construction and operation phase for access road is listed in Table 15.7-6

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Table 15.7-6 Environmental Management Plan (Access Road)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Pre-construction phase									
1	Land acquisition	1) Loss of private land 2) Loss of paddy fields, salt fields and shrimp farms 3) Loss of trees, home gardens, drainage ponds, and fruit	1) - 3) - Law of land - JICA guideline (2010)	1),2) - Consideration for land owners 3) Consideration for persons losing their property	1) - 3) - Land acquisition should be conducted in compliance with the relevant laws and regulations - The cost related to relocation will be given to relocated residents - Existing roads should be given maximum utilization - Repair and improvement of roads should be proposed at the minimum scale feasible	1) - 3) - At the site	1) - 3) - During land acquisition process	- Office of the Deputy Commissioner - RHD	RHD
2	Disturbance to Poor People	- Poor households among those who are to be resettled.	- JICA guideline (2010)	- Consideration for burden on vulnerable groups	- Developing “livelihood restoration program” including; * provide small scale trade facilities at new bridge sites, * provide employment opportunity during construction period and operation & maintenance period - Developed access road will function as a vital access/supply route in time of disaster for communities along the road and bridges	- At the site	- Prior to start of construction	- Office of the Deputy Commissioner - RHD	RHD

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
3	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- Changing peoples` thinking through interacting with local government officers, local residents and others in the land acquisition procedure	- Affected peoplees' emotions	- Consideration to affected peoples' emotions	- Developing an appropriate "land acquisition plan"	- At the site	- Prior to start of construction	- Office of the Deputy Commissioner - RHD	RHD
4	Misdistribution of Benefits and Compensation	- It can occur among residents, workers, government officers, and local politicians	- Affected peoplees' emotions	- Consideration for uneven distribution of benefits and losses	- Developing an appropriate "land acquisition plan"	- At the site	- Prior to start of construction	- Office of the Deputy Commissioner - RHD	RHD
5	Local Conflicts of Interest	- It can occur among residents, workers, government officers, and local politicians	- Affected peoplees' emotions	Consideration to affected peoples' feelings	- Developing an appropriate "land acquisition and resettlement action plan", including "livelihood restoration program". The program will cover; * provide small scale trade facilities at new bridge sites, * provide employment opportunity during construction period and operation & maintenance period - Developed access road will function as a vital access/supply route in time of disaster for communities	- At the site	- Prior to start of construction	- Office of the Deputy Commissioner - RHD	RHD

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					along the road and bridges				
Construction phase									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment	1) , 2) - Ambient air quality standards - IFC guideline values for ambient air quality (General/ 2007)	1) , 2) - Prevention of air pollution in the surrounding area	1) Dust prevention - Watering access road, especially in the dry season - Using cover sheets on trucks for the transportation of soil 2) Gas emission prevention - Periodic maintenance and management of all the construction machinery and vehicles	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
2	Water Quality	1) River water from construction area 2) Waterway in salt/paddy field	1) , 2) - Waste water standards	1), 2) - Prevention of water pollution in the surrounding area	1) River water - Install silt protection curtain 2) Waterway in salt/paddy fields - Cover the slope	1) River 2) Waterway in salt/paddy fields	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
3	Waste	1) Construction waste from construction work 2) Domestic waste from workers 3) Hazardous waste	1) - 3) - Waste management rule	1) - 3) - Prevention of inappropriate waste disposal	1), 2) Construction and Domestic waste - Conduct separate waste collection and promote recycling and reuse. - Appropriate disposal of non-recyclable waste according to rules 3) Hazardous waste - Hazardous waste should be treated under the related regulation	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
4	Noise and Vibration	1) Noise and vibration caused	1), 2) - Noise level	1), 2) - Reduction of	1) Construction machinery - Optimizing construction	1), 2) - Construction area	1), 2) - During	- Implementation: Contractor/	Expense is included in

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		by construction machinery 2) Noise caused by vehicles used for mobilization of equipment and workers	standards - IFC guideline values for noise (General/ 2007)	noise levels from construction activities	schedule - Performing construction work during daytime, especially piling work. - Using low-noise/ low vibration equipment, as much as possible 2) Mobilization - Transportation of material and equipment for construction by shipping - Determine a traffic control plan including route-setting - Limit truck speed, especially around residential areas		construction phase	Environmental Consultant - Supervisor: RHD/ Supervision Consultant	contract cost by Contractor.
5	Odor	- Domestic waste from workers	- Waste management rule	- Prevention of generating odors	- Taking appropriate measures for handling general waste. - Prohibit illegal waste disposal	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
6	Soil	1) Leakages of oil and chemical materials from construction activity 2) Inappropriate disposal of waste 3) Exaust gas and dust from vehicles	1), 2) - Waste management rule 3) Ground water (Drinking water quality standards)	1), 2) - Prevention of water and soil pollution in the surrounding area	1) Leakages of oil and chemical materials - Storage of oil and chemical materials in an appropriate storage site and method to prevent permeation into the ground. 2) Waste management - Prohibit illegal dumping 3) Ground water - Groundwater monitoring	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
7	Sediment	- Waste water or waste by the construction activities may contaminate river bottom sediment	- Wastewater standards - Waste management rule	- Prevention of water pollution in the surrounding area	- Excavate channels, ditches and temporary settling pond around bridge construction area	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
8	Hill side forests	- Cutting trees	- Forest law	- Protection of forest	- Transplant trees, etc.	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
9	Ecosystem	1) Mangrove forest 2) Tidal flats	1), 2) - Bangladesh wild life act, 1974 (Preservation) (Amendment) - JICA guideline (2010) - World bank OP4.04	1), 2) - Protection of mangrove	1), 2) - Silt protect curtain will be installed if necessary. - Prohibit disturbance,	1), 2) - Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
10	Topography and Geology	- Soil runoff	- Soil runoff	- Minimization of erosion	- Covering the surface of slope	- Access road	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
11	Deterioration of Local Economy such as Losses of	- Increase in employment and business opportunities	- Number of employment opportunities for local	- Improvement of the local economy - Improvement of	- Employment of local residents as much as possible.	- Villages near the road	- During construction phase	- Implementation: Contractor/ Environmental Consultant	Expense is included in contract cost by Contractor.

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
	Employment and Means of Livelihood		residents	living standards of local residents - Consideration to local residents' feeling				- Supervisor: RHD/ Supervision Consultant	
12	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Local residents' feeling	- Consideration to local residents' feelings	- Employ local residents as much as possible.	- Villages near the road	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	
13	Disturbance to Water Usage, Water Rights, etc.	- Adverse impact due to water pollution - Usage of underground water	- Same as those addressed in "water quality"	-Same as those addressed in "water quality"	- Implement the same mitigation measures as those addressed in "water quality"	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
14	Disturbance to Existing Social Infrastructure and Services	- Increased vihicles and vessels to carry construction materials may disturb the existing traffic including - Traffic jams caused by increased vehicles during construction	- Road and vessel traffic volume around the construction site	- Mitigation of road traffic jams and safety	- Consulting with related authorities on schedule of vessels - Determining a water route after consultation with related authorities - Proper signage around construction area for navigation safety - Informing vessel schedule to local fishermen, etc. - Optimization of vehicle schedule.	- Roads near the construction area - River	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					-Reducing the number of vehicles by using buses - Consulting with related authorities on schedules - Informing vehicle schedules to the surrounding villages - Determining a traffic control plan - Training safe operation of vehicles				
15	Local Conflicts of Interest	- Conflict between local residents and workers	- Change in local customs	- Consideration to the attitudes of local residents to the project	- Employ local residents as much as possible - Promote communication between external workers and local people (e.g., join in local events)	- Villages near the road	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
16	Children's Right	- Child labor	- Child labor	- Banning child labor	- Prohibit labor contracts between subcontractor and children - Patrolling periodically to check for any child labor	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
17	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	- Sanitation for local residents	- Consideration for sanitation for local residents	- Implementation of periodic medical check-ups by temporary medical team - Education and training for health care of workers	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor. - Medical checkups: 22,500Tk./ person (Full

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
									Medical Checkup) - Safty ecucation and training: 75.000Tk./ 20 person
18	Work Conditions (Including Work Safety)	1) Labor accidents 2) Diseases caused by air pollutants, water pollutants, and noise by construction work	1) Labor accidents - Handling heavy loads - Working at heights - Electric shocks 2) Environment pollution - Ambient air quality standards - Noise level standards - Waste management rule - IFC guideline value for ambient air quality (General/ 2007) - IFC guideline value for noise (General/ 2007)	1) 2) - Prevention of labor accidents and health problems	1) Labor accidents - Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment such as helmets - Install fire extinguishers in fire handling places - Inspect and ensure that any lifting devices such as cranes are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate during the period of construction. - Use equipment that protects against electric shocks. 2) Environment pollution - Observe related standards and provide workers with appropriate equipments such as masks, ear plugs, etc.	1) 2) - Construction area	1) 2) During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor. - Protective equipment: 5,000 Tk./ person

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
19	Accidents	- Traffic accidents	- Land traffic - River traffic	- Traffic accidents	- Observation of traffic regulations, installation of traffic signs, and education on safe driving - Training safe operation of vehicles. - Optimization of vehicle schedule. - Reducing the number of vehicles by using buses - Consulting with related authorities on schedules - Informing vehicle schedules to the surrounding villages - Consulting with related -authorities on schedules of vessels - Determining a water route after consultation with related authority. - Setting proper signs around construction area for navigation safety - Informing vessel operation schedule to local fishermen etc.	- Roads near the construction area - River	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
20	Cross-boundary impact and climate change	- CO_2 will be produced by construction work	- Amount of CO_2 emission	- Reduce CO_2 emission as much as possible	- Periodic maintenance and management of all the construction machinery and vehicles	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Operational Phase									
1	Air Quality	1) Exhaust gas from vehicles used for mobilization of equipment and workers 2) Dust from road	1), 2) - Ambient air quality standards - IFC guideline values for ambient air quality (General/ 2007)	1), 2) - Prevention of air pollution	1), 2) Gas emissions from vehicles - Periodic maintenance and management of vehicles - Transplanting trees - Promotion of bus use fro commute	1), 2) - Along the road - Power plant	1), 2) - During the operation of the power plant	- RHD/ Environmental Consultant	RHD
2	Water Quality	- Waterway in salt/ paddy fields	- Ambient water standards (Inland surface water)	- Prevention of water pollution	- Cover the slope	- Waterway in salt/ paddy fields	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
3	Noise and Vibration	- Noise caused by vehicles used for mobilization of equipment and workers	- Noise level standards - IFC guideline values for noise (General/2007)	- Prevention of noise and vibration impact	- Determine a traffic control plan including route-setting - Limit truck speed, especially around residential areas	- Along the road	- During the operation of power plant	- RHD/ Environmental Consultant	RHD
6	Soil	-Surface water	- Ambient water Standards (Inland surface water)	- Prevention of soil and water pollution in the surrounding area	- Same as “Water Quality”	- Salt/ paddy fields	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
7	Sediment	- Existence of bridge piers	- World bank OP4.04	- Prevention of deterioration of tidal flat	- Dredging or filling if necessary	- River around bridge	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
8	Ecosystem	1) Mangrove forest 2) Tidal flats	1), 2) - Bangladesh wild life act, 1974 (Preservation) (Amendment) - JICA guideline	1), 2) - Protection of endangered species - Protection critical natural	1), 2) - Developing “protective measures” - Prohibit disturbance	1), 2) - Around the new bridge	1), 2) - During the operation of the power plant	- RHD/ Environmental Consultant	RHD

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			(2010) - World bank OP4.04	habitat					
9	Topography and Geology	- Soil runoff	- Soil runoff	- Minimization of erosion	- Guide wall, covering the surface of slope	- Access road	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
10	Disturbance to Poor People	- Improved road connection	- Living standads of poor people	- Access to social services	- New access road will be built with heights so that it can be used even in the rainy season	- Villages near the site	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
11	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Improved transportation condition	- Economic situation of dealing products	- Improvement of the local economy - Improvement of living standards of local residents - Consideration to local residents' feelings	- Transportation of products in this area and materials from urban area will benefit people	- Villages near the site	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
12	Land Use and Utilization of Local Resources	- Changing traditional land use patterns and utilization of local resources	- Local residents' feelings	- Consideration to local residents' feelings	- Improved transportation will maintain land use and utilization	- Villages near the site	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
13	Disturbance to the Existing Social Infrastructure and Services	1) Traffic jams caused by increased vehicles 2) Improved roads	- Impact to social infrastructure and services	1) Traffic volume will increase 2) Access to social services	1) Traffic volume - Minimizing traffic volume by using buses for employees of power plant 2) Access to social services - The access road can be used even in the rainy season.	1), 2) - Villages near the site	1), 2) - During the operation of the power plant	- RHD/ Environmental Consultant	RHD

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
14	Misdistribution of Benefits and Compensation	Can occur among residents, workers, government officers, and local politicians	- Affected peoples' emotions	- Consideration to affected peoples' emotions	- Establish a consultation section for any grievances	- Villages near the site	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
15	Local Conflicts of Interest	- Conflict between local residents	- Change in local customs	- Consideration of the attitudes of local residents to the project	- Establish a consultation section for any grievances	- Villages along the road	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
16	Gender	Improved road	- Living standards of gender	- Access to social services and market	- The access road can be used even in the rainy season.	- Villages along the road	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD
17	Children's Rights	1) Child labor 2) Improved road	1) Child labor 2) Improvemant of access to social services	1) Banning child labor 2) Access to social services	1) Child labor - Prohibit labor contracts between subcontractor and children - Patrolling periodically to check for any child labor 2) Improved road - The access road can be used even in the rainy season.	1), 2) - Villages along the road	1), 2) - During the operation of the power plant	- RHD/ Environmental Consultant	RHD
19	Accidents	- Traffic accidents	- Land traffic	- Prevention of traffic accidents	- Observation of traffic regulations, installation of traffic signs, and education on safe driving - Reducing the number of vehicles by scheduling buses - Consulting with related authorities on schedules - Informing vehicle	- Villages along the road	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD - Safety education and training: 75,000Tk./ 20 person

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					schedules to the surrounding villages				
20	Cross-boundary Impact and Climate Change	- Efficient road maintenance - Idling stops, economic driving	- Amount of CO_2 emissions	- Reduce CO_2 emissions per road length	- Efficient maintenance - Promotion of efficient fuel driving	- Villages along the road	- During the operation of the power plant	- RHD/ Environmental Consultant	RHD

(Source: JICA Study Team)

15.8 Monitoring Plan

15.8.1 Power plant and port facility

An Environmental Monitoring Plan will be prepared to provide guidelines for environmental management plan during the construction and operation phases of the Coal-fired Power Plant. The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected, by construction activity. Environmental management is a sustainable way of planning, arranging, supervising, organizing, and developing the environment for the maintenance of the preservation of natural resources and the prevention or reduction of damage to the environment.

(1) Power Plant

The major environmental impact, monitoring method, responsible organization, and expense for each environmental item in the construction and operation phases for the power plant are listed in Table 15.8-1.

(2) Port Facility

The major environmental impacts, monitoring methods, responsible organizations, and expenses for each environmental item in the construction and operation phases for the power plant are listed in Table 15.8-2.

Table 15.8-1 Environmental Monitoring Plan (Power Plant)

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Pre-Construction									
1	Land acquisition	1) Loss of private land 2) Loss of salt fields, shrimp farms and fishing sites for push net 3) Loss of residential/ commercial structures 4) Loss of trees, home gardens, fish ponds and fruit plants	1) - 4) - The acquisition and requisition of immovable property ordinance of 1982 - JICA guideline (2010)	1) - 4) - Confirmation of compensation process	1) - 4) - Attendance at compensation payment - Record of compensation agreements	1) - 4) - Areas eligible for compensation - Record of compensation agreements	1) - 4) - During land acquisition process	- Office of the Deputy Commissioner - CPGCBL	Expenses by CPGCBL - Witness: 6,500Tk./ person･day
2	Disturbance to poor people	1) Poor households among those who are to be resettled 2) Loss of salt fields, shrimp farms and fishing sites	1), 2) - JICA guideline (2010)	1), 2) - Same as those addressed in “Land acquisition”	1), 2) - Interviewing affected people	1), 2) - Affected people	1), 2) - Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses by CPGCBL - Interviewer: 5,500Tk./ person･day
3	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- Changing peoples` thinking through interacting with local government officers, local residents and others in the land acquisition procedure	- Affected peoples’ feelings	- Confirmation of affected peoples’ feelings	- Interviewing affected people	- Affected people	- Once after compensation	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses by CPGCBL - Interviewer: 5,500Tk./ person･day
4	Misdistribution of Benefits and Compensation	- Misdistribution of benefits among residents, workers,	- Same as those addressed in “Social institutions”	- Same as those addressed in “Social institutions”	- Same as those addressed in “Social	- Same as those addressed in “Social	- Same as those addressed in “Social	- Implementation: Contractor/ Environmental	Expenses by CPGCBL

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		government officers and local politicians			institutions"	institutions"	institutions"	Consultant - Supervisor: CPGCBL/ Supervision Consultant	(Simultaneous collection with "Social institutions")
5	Local Conflicts of Interest	- Conflicts among residents, workers, government officers and local politicians	- Same as those addressed in "Social institutions"	- Same as those addressed in "Social institutions"	- Same as those addressed in "Social institutions"	- Same as those addressed in "Social institutions"	- Same as those addressed in "Social institutions"	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses by CPGCBL (Simultaneous collection with "Social institutions")
Construction Phase									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment 3) Air pollution arising from incineration of construction materials and waste	1) - 3) **PM_{10}** - Ambient air quality standards - IFC guideline values for ambient air quality (General/ 2007) **Meteorological Condition (Temperature, Moisture, Wind)**	1) - 3) - Evaluation of effect of the mitigation measures towards air pollution	1) - 3) - Collecting samples and analyzing at a lab - Measuring meteorological data	1) - 3) **- 3 points** Residential area around the power plant	1) - 3) - Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor - Sampling: 50,000Tk./ sample - Analyzing: 45,000Tk./ sample

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
2	Water Quality (Soil) (Sediment)	1) Run off water from construction area 2) Domestic wastewater of workers 3) Inappropriate disposal of waste 4) Leakages of oil and chemical materials from construction activity	1) - 4) **pH, BOD, TSS, Oil, Coliforms, etc.** - Wastewater standards - Ambient water quality standards (Inland surface water) - Ground water quality (Drinking water quality standards)	1) - 4) - Evaluation of effect of the mitigation measures towards water pollution	1) - 4) - Collecting samples and analyzing at a lab	1) - 4) - **1 point:** Foreside of the drain outlet - **1 point:** Surface water near the construction area - **1 point:** Ground water from existing wells - **5 points:** Sea water near the construction area	1) - 4) - Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor - Sampling: 50,000Tk./ sampling - Analyzing: 100,000Tk./ all sample
3	Wastes (Odor) (Sediment)	1) Construction waste from construction work 2) Domestic waste from workers 3) Hazardous waste such as dry batteries, etc.	1) - 3) **Kinds and quantity of waste, and the disposal method** - Waste management rule	1) - 3) - Evaluation of effect of the mitigation measures for waste	1) - 3) - Record of kinds and quantity of waste, and the disposal method	1) - 3) - Contractor's office	1) - 4) - Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
4	Noise and Vibration	1) Noise and vibration caused by construction machinery 2) Noise caused by vehicles used for mobilization of equipment and workers	1), 2) **Noise level** - Noise level standards - IFC guideline values for noise (General/ 2007)	1), 2) - Evaluation of effect of the mitigation measures towards noise levels	1), 2) - Measurement using noise level meter	1), 2) - **3 points:** On the border of the site near the residential areas	1), 2) - Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor - Measurement: 50,000Tk./ session
5	Ecosystem (Endangered	1) Existence of endangered species	1), 2) **Species, Number**	1) Evaluation of existence of	1), 2) - Observation	1) Endangered species	1) Endangered species	- Implementation: Contractor/	Expenses included in

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
	Species)	2) Spawning of sea turtles	- Bangladesh wild life act, 1974 (Preservation) (Amendment) - JICA guideline (2010)	endangered species 2) Evaluation of spawning of sea turtles		- **1 point:** Construction area 2) Sea turtle - **2 lines:** Beach in front of the site and the sandbar	- Migration bird: Once a week in migration season - Others: Twice a year in dry and rainy seasons 2) Every 3 days in spawning season	Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	contract cost by Contractor - Observation: 400,000Tk./ researcher・year
	Ecosystem (Marine Biota)	1) Potential impact due to the degradation of water quality caused by civil engineering work 2) Domestic wastewater of workers 3) Inappropriate disposal of solid waste	1) - 3) **Species, Number** - Phyto and Zoo Plankton - Benthos (Sea bottom)	1) - 3) - Evaluation of effect of the mitigation measures towards water pollution	1) - 3) - Collecting samples at the site, analyzing at a lab	1) - 3) - **5 points:** Sea area in front of construction area	1) - 3) - Twice a year in dry and rainy seasons		Expenses included in contract cost by Contractor - Sampling & analyzing: 200,000Tk./ season (Simultaneous collection with "water quality")
	Ecosystem (Mud Flat, Fish & Nekton)	1) - 3) - Same as those addressed in "Marine Biota"	1) - 3) **Species, Number, Weight** - Benthos (Mud flat) - Fish and Nekton	1) - 3) - Same as those addressed in "Marine Biota"	1) - 3) - Collecting samples at the site, analyzing at a lab	1) - 3) - **Benthos: 1 point** (Beach in front of the site) - **Fish and Necton: 1 point**	1) - 3) - Twice a year in dry and rainy seasons		Expense is included in contract cost by Contractor - Sampling &

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
						(Sea area in front of the site)			analyzing: 200,000Tk./ season
6	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Increase in employment and business opportunities	- Number of employment opportunities for local residents and number of businesses around the construction area	- Improvement of the local economy - Improvement of living standards of local residents - Consideration to local residents' feelings	- Information from related institutions - Interviewing residents	- Related institutions - Villages near the site	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor - Interviewer: 5,500Tk./ researcher
7	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Same as those addressed in "Local Economy"	- Same as those addressed in "Local Economy"	- Same as those addressed in "Local Economy"	- Same as those addressed in "Local Economy"	- Same as those addressed in "Local Economy"	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
8	Disturbance to Water Usage, Water Rights, etc.	- Usage of underground water	- Pollution and usage of underground water	- Evaluation of effect of the mitigation measures towards water pollution - Consideration to local residents' living on the usage of underground water	- Implement the same mitigation measures as those addressed in "Water quality" - Ground water level	- **1 point:** Existing well	- Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor (Simultaneous collection with "Water quality")
9	Disturbance to Existing Social Infrastructure and Services	1) Increase in the number of vessels 2) Increase in the number of cars	1), 2) - Traffic volume by construction	1), 2) - Evaluation of effect of construction schedule	1), 2) - Record of numbers of vessels and cars being used	1), 2) - Sea area and villages near the site	1), 2) - Once a year	- Implementation: Contractor/ Environmental Consultant	Expenses included in contract cost by Contractor

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
								- Supervisor: CPGCBL/ Supervision Consultant	
10	Local Conflicts of Interest	- Conflict between local residents and external workers	- Change in local customs	- Confirmation of the attitudes of local residents to the project	- Interviewing residents	- Villages near the site	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor (Simultaneous collection with "Local economy"
11	Gender	1) Gender among those who are to be resettled 2) Loss of salt fields, shrimp farms and fishing sites for push net	1), 2) - Living standards of gender	1), 2) - Confirmation of living standards of egnder	1), 2) - Interviewing gender	1), 2) - Villages near the site	1), 2) - Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor (Simultaneous collection with "Local economy"
12	Children's Right	- Child labor	- Existence of child labor	- Evaluation of effect of banning child labor	- Checking the labor contracts between subcontractor and workers - Patrolling construction area for child labor	- Contractor's office - Construction area	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
13	Infectious Diseases	- Temporary influx of	- Health of labors	- Evaluation of	- Labor health	- Related	- Once a year	- Implementation:	Expenses

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
	such as HIV/AIDS	migrant labor during construction may increase risk of infection		sanitation for labor	records	institutions		Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	included in contract cost by Contractor
14	Work Environment (Including Work Safety)	- Labor accidents	**Record of accidents** - Handling heavy loads - Working at heights - Electric shock	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
15	Accidents	- Traffic accidents	**Record of accidents** - Marine traffic - Land traffic	- Evaluation of effect of traffic schedules	- Record of accidents	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
16	Cross-boundary Impact and Climate Change	- CO_2 will be produced by construction work	- CO_2 emissions	- Efforts to reduce CO_2	- Record of machinery maintenance	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Operation Stage									
1	Air Quality	1) Exhaust gas from the stacks 2) Dust from ash disposal activity 3) Exhaust gas from vehicles used for mobilization of equipment and workers 4) Dust from coal handling activity at jetty and coal yard	1) - 4) **SO_2, NO_2, PM_{10}** - Emission gas standards - Ambient air quality standards - IFC guideline values for gas emission (Thermal power plant/ 2008) and ambient air quality (General/ 2007) 2) - 4) **Meteorological Condition (Temperature, Moisture, Wind)**	1) - 4) - Evaluation of effect of the mitigation measures towards air pollution	1) Exhaust gas - CEMS (Continuous Emission Monitoring System) 2) - 4) - Collecting samples at the site, analyzing at a lab - Measuring the meteorological data	1) Stack outlet 2) - 4) - **3 points:** Residential area around the power plant	1) Continuous measure-ment 2) - 4) - Once every 3 months	- CPGCBL/ Environmental Consultant	- CEMS (Expenses included in contract cost by Contractor) Expenses by CPGCBL - Sampling: 50,000Tk./ staff - Analyzing: 45,000Tk./ sample
2	Water Quality (Soil) (Sediment)	1) Thermal effluents from cooling system 2) Wastewater from plant process 3) Rainwater drainage from ash pond and coal yard 4) Leakages of oil and chemical materials	1) - 4) **Water temperature, pH, DO, SS, oil, BOD, COD, Heavy metals** - Wastewater standards - Ambient water quality standards (Sea water) - IFC guideline values for wastewater (Thermal power plant/ 2008) - Ground water (Drinking water	1) - 4) - Evaluation of effect of the mitigation measure towards water pollution	1) Thermal effluents - Measuring vertical sea water temperature profile with CTD meter 2) - 4) - Collecting samples at the site, analyzing at a lab - Continuous measurement using a sensor	1), 4) - **5 points:** Sea area around thermal water discharge point - **1 point:** Ground water from existing well 2), 3) - **2 points:** Drain outlet of the wastewater treatment facility	1), 4) - Once every 3 months 2), 3) - **SS, Oil, BOD, Heavy metal etc.**: Sampling and analyzing (as necessary, but at least once every 3 months)	- CPGCBL/ Environmental Consultant	- Continuous sensor (Expenses included in contract cost by Contractor) Expenses by CPGCBL - CTD: 20,000 US$ - Sampling:

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
			quality standards)				- **pH**: Continuous measure-Ment		50,000Tk./ staff - Analyzing: 100,000Tk./ sample
3	Waste (Odor) (Sediment)	1) Fly ash and bottom ash 2) Sludge from wastewater treatment and waste oil from equipment, etc. 3) Sewage and garbage from workers	1) **Amount of coal ash generation and disposal** 2), 3) **Kinds and quantity of waste, and the disposal method** - Waste management rule	1) - 3) - Evaluation of effect of the handling of coal ash, sludge, and garbage	1) Coal ash - Record of the amount of coal ash generation and disposal 2), 3) - Record of the amount of sludge and garbage	1) - 3) - Power plant office	1) - 3) - Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
4	Noise and Vibration	1) Noise and vibration from steam turbines, generators, and pumps, etc. 2) Noise from ash disposal activity 3) Noise caused by vehicles used for mobilization of equipment and workers 4) Noise from coal handling activity at jetty and coal yard	1) - 4) **Noise level** - Noise level standards - IFC guideline values for noise (Thermal power plant/ 2008) (General/2007))	1) - 4) - Evaluation of effect of the mitigation measures towards noise levels	1) - 4) - Measurement using noise level meter	1) - 4) - **3 points:** On the border of the site near the residential areas	1) - 4) - Once every 3 months	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Measurement: 100,000Tk./ session
5	Ecosystem (Endangered Species)	1) Existence of endangered species (migration bird) 2) Spawning of sea	1), 2) **Species, Number** - Bangladesh wild life act, 1974	1) Evaluation of existence of endangered species (migration bird)	1), 2) - Observation	1) Endangered species (migration bird)	1) Once a week in migration season 2) Every 3 days	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Observation:

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		turtles	(Preservation) (Amendment) - JICA guideline (2010)	2) Evaluation of spawning of sea turtles		- **1 point:** Ash pond 2) Sea turtles - **2 lines:** Beach in front of the site and the sandbar	in spawning season		200,000Tk/ researcher
	Ecosystem (Marine Biota)	1) Degradation of water quality caused by operation of power plant 2) Domestic wastewater of workers 3) Inappropriate disposal of solid waste	1) - 3) **Species, Number** - Phyto and Zoo plankton - Benthos (sea bottom)	1) - 3) - Evaluation of effect of the mitigation measure towards water pollution	1) - 3) - Collecting samples at the site, analyzing at a lab	1) - 3) - **5 points:** Sea area in front of the site	1) - 3) - Twice a year in dry and rainy seasons		Expenses by CPGCBL - Sampling & Analyzing: 300,000Tk./ all sample (Simultaneous collection with "water qulity")
	Ecosystem (Mud Flat, Fish & Nekton)	1) - 3) - Same as those addressed in "Marine Biota"	1) - 3) **Species, Number, Weight** - Benthos (mud flat) - Fish and nekton	1) - 3) - Same as those addressed in "Marine Biota"	1) - 3) - Collecting samples at the site, analyzing at a lab	1) - 3) - **Benthos: 1 point** (Beach in front of the site) - **Fish and Necton: 1 point** (Sea area in front of the site)	1) - 3) - Twice a year in dry and rainy seasons		Expenses by CPGCBL - Sampling & Analyzing: 300,000Tk./ all sample
6	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Increase in employment and business opportunities	- Number of employment opportunities for local residents and number of businesses around the construction area-	- Evaluation of increase in employment and business opportunities	- Information from related institutions - Interviewing residents	- Related institutions - Villages near the site	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Interviewer: 5,500Tk./ researcher

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
7	Land Use and Utilization of Local Resources	- Changing traditional land use patterns and utilization of local resources	- Local residents' feelings	- Confirmation of local residents' feelings	- Interviewing residents	- Villages near the site	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL (Simultaneous collection with "Local economy")
8	Disturbance to the Existing Social Infrastructure and Services	1) Increase in the number of vessels 2) Increase in the number of cars	1), 2) - Traffic volume	1), 2) - Evaluation of effect of traffic schedules	1), 2) - Record of numbers of vessels and cars being used	1), 2) - Power plant office	1), 2) Continuous records	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
9	Misdistribution of Benefits and Compensation	- It can occur among residents, workers, government officers, and local politicians	- Local residents' feelings	- Confirmation of local residents' feelings	- Interviewing residents	- Villages near the site	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL (Simultaneous collection with "Local economy"
10	Local Conflicts of Interest	- Conflict between local residents and workers	- Local residents' feelings	- Confirmation of local residents' feelings	- Interviewing residents	- Villages near the site	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL (Simultaneous collection with "Local economy"
11	Gender	1) Loss of salt fields, shrimp farms and fishing sites for push net 2) Improved road along with the power plant	1), 2) - Living standards of gender	1), 2) - Confirmation of living standards of gender	1), 2) - Interviwing gender	1), 2) - Villages near the site	1), 2) - Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL (Simultaneous collection with "Local econom

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
12	Children's Rights	1) Child labor 2) Improved road along with the power plant	1) Child labor 2) Enrollment rate	1) Evaluation of effect of banning child labor 2) Improvement of enrollment rate	1) Child labor - Checking labor contracts between subcontractor and workers - Patrolling working area for child labor 2) Enrollment rate - Information from related institutions	1) Working area 2) Related institutions	1), 2) - Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
13	Work Environment (Including Work Safety)	- Labor accidents	**Record of accidents** - Handling heavy loads - Working at heights - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- Power plant office	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
14	Accidents	1) Traffic accidents 2) Fire	1) Record of traffic accidents - Land traffic - Marine traffic 2) Fire - Record	1), 2) - Evaluation of effect of the work safety plan	1), 2) - Record of accidents and fire	1), 2) - Power plant office	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
15	Cross-boundary Impact and Climate Change	- CO_2 emissions	- Amount of CO_2 emissions	- Efforts to reduce CO_2	- Calculate the CO_2 emissions from fuel consumption	- Power plant office	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

(Source: JICA Study Team)

Table 15.8-2 Environmental Monitoring Plan (Port Facility)

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Initiator Supervisor	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Construction Phase									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment 3) Air pollution arising from incineration of construction materials and waste	1) - 3) - Same as those addressed in "Air quality" of the power plant	1) - 3) - Same as those addressed in "Air quality" of the power plant	1) - 3) - Same as those addressed in "Air quality" of the power plant	1) - 3) - Same as those addressed in "Air quality" of the power plant	1) - 3) - Same as those addressed in "Air quality" of the power plant	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
2	Water Quality (Waste)	1) Dredging 2) Landfill for land-reparation	1), 2) **pH, BOD, COD,TSS, Oil, Heavy metals** - Ambient water quality standards (Sea water)	1), 2) - Evaluation of effect of the mitigation measure towards water pollution	1), 2) - Collecting samples and analyzing at a lab	1), 2) - **2 points:** Sea water near the construction area	1), 2) - Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor - Sampling: 25,000Tk./ staff (Simultaneous collection with "water qulity" of the power plant)- Analyzing: 15,000Tk./ sample
3	Noise and Vibration	- Noise and vibration caused by construction machinery	- Same as those addressed in "Noise" of the power plant	- Same as those addressed in "Noise" of the power plant	- Same as those addressed in "Noise" of the	- Same as those addressed in "Noise" of the	- Same as those addressed in "Noise" of	- Implementation: Contractor/ Environmental	Expenses included in contract cost by

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Initiator Supervisor	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
					power plant	power plant	the power plant	Consultant - Supervisor: CPGCBL/ Supervision Consultant	Contractor (Simultaneous measure with "Noise" of the power plant)
4	Ecosystem (Endangered Species)	1) Existence of endangered species 2) Spawning of sea	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor (Simultaneous measure with "Ecosystem" of the power plant)
	Ecosystem (Marine Biota)	1) Potential impact due to the degradation of water quality caused by civil engineering works 2) Domestic wastewater of workers 3) Inappropriate disposal of solid waste	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant		
	Ecosystem (Mud Flat, Fish & Nekton)	1) - 3) - Same as those addressed in "Marine Biota"	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant		

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Initiator Supervisor	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
5	Disturbance to Existing Social Infrastructure and Services	- Increase in the number of vessels	- Traffic volume from construction	- Evaluation of effect of construction schedule	- Record of numbers of vessels	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
6	Work Environment (Including Work Safety)	- Labor accidents	- Same as those addressed in "Work environment" of the power plant	- Same as those addressed in "Work environment" of the power plant	- Same as those addressed in "Work environment" of the power plant	- Same as those addressed in "Work environment" of the power plant	- Same as those addressed in "Work environment" of the power plant	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
7	Accidents	- Traffic accidents	**Record of accidents** - Marine traffic	- Evaluation of operation schedule of vessels	- Record of accidents	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by contractor
Operation Stage									
1	Air Quality	1) Dust from coal handling activity at port 2) Exhaust gas from vessels	1) Coal handling **PM_{10}** - Ambient air quality standards - IFC guideline for ambient air quality	1), 2) - Evaluation of effect of the mitigation measure towards air pollution	1) Coal handling - Collecting samples at the site, analyzing at a lab 2) Exhaust gas from vessels	1) Coal handling - Same as those addressed in "Air quality of the power plant" 2) Exhaust gas	1) Coal handling - Same as those addressed in "Air quality of the power	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Sampling: 25,000Tk./ staff

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Initiator Supervisor	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
			(General/ 2007) 2) Exhaust gas from vessels- - MALPOL 73/78 treaty (Annex VI)		- Record of entrance into and leave from the port of vessels	from vessels - Port office	plant" 2) Exhaust gas from vessels Once a year		(Simultaneous collection with "Air qulity" of the power plant) - Analyzing: 20,000Tk./ sample
2	Water Quality	- Dredging material for the maintenance of the navigation channel	**pH, BOD, COD,TSS, Oil, Heavy metals** - Ambient water quality standards (Sea water)	- Evaluation of effect of the mitigation measures towards water pollution	- Collecting samples at the site, analyzing at a lab	- **2 points:** Around the dredging area	- Once during dredging activity	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL - Sampling: 25,000Tk./ staff (Simultaneous collection with "Water qulity" of the power plant) - Analyzing: 15,000Tk./ sample

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Initiator Supervisor	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		1) Operation of the port may cause a coal spillage and as a result, water pollution will occur 2) Leakages of oil 3) Wastewater from vessels will cause water pollution	1), 2) - **Record of accidents** 3) **Kinds of wastewater from vessels** - MALPOL 73/78 treaty (Annex I-V) - International convention for the control and management of Ships' Ballast Water and Sediments(BWM),2004	1) - 3) - Evaluation of effect of the mitigation measures towards water pollution	1), 2) - Record of coal spillages and oil leakages 3) - Record of kind, nature, amoungt, and discharge point of wastewater from vessels	1) - 3) - Port office	1) - 3) - Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
3	Waste	- Waste from vessels	**Kinds and quantity of waste from vessels** - Waste management rule - MALPOL 73/78 treaty (Annex I-V)	- Evaluation of effect of waste management	- Record of kinds and quantity of waste from vessels	- Port office	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
4	Noise and Vibration	- Noise from coal handling activity at the port	- Same as those addressed in "Noise" of the power plant	- Same as those addressed in "Noise" of the power plant	- Same as those addressed in "Noise" of the power plant	- Same as those addressed in "Noise" of the power plant	- Same as those addressed in "Noise" of the power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
5	Ecosystem (Endangered Species)	1) Existence of endangered species 2) Spawning of sea turtle	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	1), 2) - Same as those addressed in "Ecosystem (Endangered species)" of the power plant	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Initiator Supervisor	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
	Ecosystem (Marine Biota)	1) Operation of the port may cause a coal spillage, and as a result, water pollution will occur 2) Leakages of oil from oil tankers 3) Wastewater from vessels will cause water pollution	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Marine biota)" of the power plant		
	Ecosystem (Mud Flat, Fish & Nekton)	1) - 3) - Same as those addressed in "Marine Biota"	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant	1) - 3) - Same as those addressed in "Ecosystem (Mud Flat, Fish & Nekton)" of the power plant		
6	Disturbance to Existing Social Infrastructure and Social Services	- Increase in the number of vessels	- Traffic volume	- Evaluation of effect of traffic schedule	- Record of numbers of vessels being used	- Port office	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
7	Work Environment (Including Work Safety)	- Labor accidents	**Record of accidents** - Handling heavy loads - Working at heights - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- Port office	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL
8	Accidents	- Traffic accidents	**Record of accidents** - Marine traffic	- Evaluation of vessel schedules	- Record of accidents	- Port office	- Once a year	- CPGCBL/ Environmental Consultant	Expenses by CPGCBL

(Source: JICA Study Team)

15.8.2 Transmission line

An Environmental Monitoring Plan will be prepared to provide guidelines for environmental management plan during construction and operation of the Transmission Line. The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected, by the construction activities. Environmental management is a sustainable way of planning, arranging, supervising, organizing, and developing the environment for the maintenance of the preservation of natural resources and the prevention or reduction of damage to the environment.

The major environmental impact, monitoring method, responsible organizations, and expenses for each environmental item in the construction and operation phases for the transmission line are listed in Table 15.8-3.

Table 15.8-3 Environmental Monitoring Plan (Transmission Line)

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Pre-Construction									
1	Land acquisition and Compensation	1) Loss of land at tower bases 2) Kept out of the construction zone 3) Trees and buildings will be removed if they are within clearance distance	1) - 3) - Electricity act, 1910 - JICA guideline (2010)	1) - 3) - Confirmation of compensation process	1) - 3) - Attendance at compensation payment - Record of compensation agreements	1) - 3) - Areas eligible for compensation	1) - 3) During land acquisition process	- Office of the Deputy Commissioner - PGCB	Expenses by PGCB - Witness: 6,500/person
2	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- Changing peoples` thinking through interacting with local government officers, local residents and others in the compensation procedure	- Affected peoples' feelings	- Confirmation of affected peoples' feelings	- Interviewing affected people	- Affected people	- Once after compensation	- PGCB	Expenses by PGCB - Interviewer: 5,500Tk./ person
Construction Phase									
1	Ecosystem (Endangered Species)	- Existence of endangered species	**Species, Number** - Bangladesh wild life act, 1974 (Preservation) (Amendment) - JICA guideline (2010)	- Confirmation of endangered species existence	- Observation	- Migration birds **5 lines:** Near rivers - Others **5 points:** Construction area near rivers	- Migration birds Once a week in migration season - Others Twice a year in dry and rainy seasons	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by contractor - Observation : 870,000Tk./ year
2	Work Environment (Including Work Safety)	- Labor accidents	**Record of accidents** - Handling heavy loads - Working at heights - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant	Expenses included in contract cost by contractor

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
								- Supervisor: PGCB/ Supervision Consultant	
Operation Stage									
1	Ecosystem (Migratory Birds)	- Existence of the towers and cable	**Species, Number** - Struck birds	- Confirmation of bird strikes	- Observation	- **5 lines:** Near rivers	- Once a week in migration season	- PGCB/ Environmental Consultant	Expenses by PGCB - Observation (Birds): 3,150,000Tk./ year
2	Work Environment (Including Work Safety)	- Labor accidents	**Record of accidents** - Handling heavy loads - Working at heights - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- PGCB office	- Once a year	- PGCB/ Environmental Consultant	Expenses by PGCB
3	Accidents	- Soil runoff and tower breakages	- Condition of the soil on tower bases - Inclination of the towers	- Prevent of soil runoff and tower breakages	- Observation of the foundation on the tower bases - Measurement of inclination of the towers	- Towers	- Before and after the rainy season - After cyclone	- PGCB	Expenses by PGCB

(Source: JICA Study Team)

15.8.3 Access road

The major environmental impact, monitoring method, responsible organization, and expense for each environmental item in the construction and operation phases for the access road are listed in Table 15.8-4.

Table 15.8-4 Environmental Monitoring Plan (Access Road)

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
Pre-Construction									
1	Land Acquisition	1) Loss of private land 2) Loss of salt fields, shrimp farms, and fishing sites 3) Loss of residential/ commercial structures 4) Loss of trees, home gardens, ponds, and fruit	1) - 4) - Percentage of acquired land, structures and trees	1) - 4) - Confirmation of compensation process	1) - 4) - Attendance of compensation payment - Record of compensation agreements	1) - 4) - Areas for compensation	1) - 4) - During land acquisition process	- Office of the Deputy Commissioner - RHD	RHD - Witness: 6,500 Tk./ person.day
2	Disturbance to Poor People	- Poor households among those who lose jobs	- People's opinion	- Same as those addressed in "Loss of work"	- Interviewing affected people	- Affected people	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	RHD - Interviewer: 5,500Tk./ person /day
3	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- Changing peoples` thinking through interacting with local government officers, local residents and others in the land acquisition procedure	- People's opinion	- Confirmation of affected peoples' feelings	- Interviewing affected people	- Affected people	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	RHD (Simultaneous collection with "Loss of work")
4	Misdistribution of Benefits and Compensation	- It can occur among residents, workers, government officers, and local politicians	- People's opinion	- Same as those addressed in "Land acquisition"	- Same as those addressed in "Land acquisition"	- Same as those addressed in "Land acquisition"	- Same as those addressed in "Land acquisition"	- Implementation: Contractor/ Environmental Consultant - Supervisor:	RHD

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
								RHD/ Supervision Consultant	
5	Local Conflicts of Interest	- It can occur among residents, workers, government office, and local politicians	- People's opinion	- Same as those addressed in "Social institutions"	- Same as those addressed in "Social institutions"	- Same as those addressed in "Social institutions"	- Same as those addressed in "Social institutions"	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	RHD (Simultaneous collection with "Loss of work")
Construction phase									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment	1), 2) **PM_{10}** - Ambient air quality standards - IFC guideline value for ambient air quality (General/ 2007)	1), 2) - Evaluation of effect of the mitigation measure towards air pollution	1) , 2) - Collecting samples and analyzing at the lab.	1) ,2) 3 points -Along the road	1), 2) - Once every three month	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor. - Sampling: 50,000Tk./ sample - Analyzing: 45,000Tk./ sample
2	Water Quality	1) Run off water from construction area 2) River water	1) ,2) **pH, BOD, SS, Oil, Coliforms, etc.** - Waste water standards - Ambient water quality standards (inland surface water)	1) , 2) - Evaluation of effect of the mitigation measure towards water pollution	1) , 2) - Collecting samples and analyzing at the lab.	1) Run off water - Waterway in the salt/paddy field **2 point** - Ground water of existing wells: **1 point** 2) River water - Near the construction area: **5 point**	1) , 2) - Once every three month	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor. - Sampling: 50,000Tk./ sampling - Analyzing: 100,000Tk./ all sample
3	Wastes	1) Construction waste	1) - 3)	1) - 3)	1) - 3)	1) - 3)	1) 4)	- Implementation:	Expense is

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
		from construction work 2) Domestic waste from workers 3) Hazardous waste such as dry batteries, etc.	**Kind and quantity of waste, and the disposal method** - Waste management rule	- Evaluation of effect of the mitigation measure for waste	- Record of kinds and quantity of waste, and the disposal method	- Contractor's office	- Once a year	Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	included in contract cost by Contractor.
4	Noise and Vibration	1) Noise and vibration caused by construction machinery 2) Noise caused by vehicles used for mobilization of equipment and workers	1), 2) **Noise level** - Noise level standards - IFC guideline value for noise (General/ 2007)	1), 2) - Evaluation of effect of the mitigation measure towards noise level	1), 2) - Measurement using noise level meter	1), 2) **3 points** -Along the road	1), 2) - Once every three month	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor. - Measurement: 50,000Tk./ session
5	Ecosystem (Mangrove forest)	- Existence of mangrove forest	**Density** - JICA guideline (2010) - World bank OP 4.04	- Evaluation of existence of mangrove forest	- Observation	**2 line**	- Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor. - Observation: 400,000Tk./ researcher・year - Sampling & analyzing: 200,000Tk./ season
	Ecosystem (Tidal flat)	- Potential impact due to the degradation of sedimentation and erosion	1) Topographic future 2) Sediment quality 3) Benthic animals	1) - 3) - Evaluation of effect of the mitigation measure towards water pollution - Confirming the population and change in types of the marine organism	1) - 3) - Collecting samples at the site, analyzing at the lab	1) - 3) **5 points** - Sea area in front of construction area	1) - 3) - Twice a year at dry and rainy season		
6	Topography and geology	- Soil runoff	**SS** - Ambient water quality standards (Inland surface	- Evaluation of soil runoff	- Collecting samples at the site, analyzing at	**2 point** - Waterway in the salt/paddy field	- Once every three month	- Implementation: Contractor/	Expense is included in contract cost by

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
			water)		a lab			Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Contractor (Simultaneous collection Same aswith "Water quality").
7	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Increase in employment and business opportunities	- Number of employment opportunities for local residents	- Improvement of the local economy - Improvement of living standards of local residents - Consideration to local residents' emotions	- Hearings from the related institutions - Interviewing residents	- Related institutions - Villages near the site	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor. - Interviewer: 5,500Tk./ researcher
8	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Same as those addressed in "Local Economy"	- Same as those addressed in "Local Economy"	- Same as those addressed in "Local Economy"	- Same as those addressed in "Local Economy"	- Same as those addressed in "Local Economy"	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor. (Simultaneous collection Same aswith "Local Ecomony").
9	Disturbance to Existing Social Infrastructure and Services	1) Increase the number of vessels 2) Increase the number of cars	1), 2) - Traffic volume by construction	1), 2) - Evaluation of effect of construction schedule	1), 2) - Record of numbers of vessels and cars	1), 2) - Project site	1), 2) - Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
10	Local Conflicts of Interest	- Conflict between local residents and workers	- Change in local custom	- Confirmation of the attitude of local residents to the project	- Interviewing residents	- Villages near the site	- Once a year	- Implementation: Contractor/ Environmental Consultant	Expense is included in contract cost by Contractor.

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
								- Supervisor: RHD/ Supervision Consultant	(Simultaneous collection with "Local economy")
11	Children's Right	- Subcontractor's recruitment	- Number of working child	- Evaluation of effect of banning child labor	- Checking the labor contract between subcontractor and labors - Patrolling in construction area	- Contractor's office - Construction area	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
12	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	- Health of labors	- Evaluation of sanitation for labor	- Labor health records	- Related institutions	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
13	Work condition (including work safety)	- Labor accidents	**Record of accidents** - Handling heavy loads - Working at heights - Electric shock	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
14	Accidents	- Traffic accidents	**Record of accidents** - Land traffic - River traffic	- Evaluation of effect of traffic schedule	- Record of accidents	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor:	Expense is included in contract cost by Contractor.

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
								RHD/ Supervision Consultant	
15	Cross-boundary impact and climate change	- CO_2 will be produced by construction work	- Record of machine maintenance	- Efforts to reduce CO_2	- Record of machine maintenance	- Contractor's office	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
Operation Stage									
1	Air Quality	1) Exhaust gas from vehicles used for mobilization of equipment and workers for power plant 2) Dust from road surface	1), 2) **SO_2, NO_2, PM_{10}** - Ambient air quality standards - IFC guideline values for ambient air quality (General/ 2007)	1), 2) - Evaluation of effect of the mitigation measure towards air pollution	1), 2) - Collecting samples at the site, analyzing at the lab.	1), 2) **3 points** - Residential area around the road	1), 2) - Once every three month	- RHD/ Environmental Consultant	RHD - Sampling: 50,000Tk./ sample - Analyzing: 45,000Tk./ sample
2	Water Quality	- Surface runoff	**Water temperature, DO, SS, oil, BOD, COD, heavy metals** - Ambient water quality standards (Inland surface water)	- Evaluation of effect of the mitigation measure towards water pollution	- Collecting samples at the site, analyzing at the lab Continuous measurement using a sensor	**4 points** - Salt/paddy field	- Once every three month	- RHD/ Environmental Consultant	RHD - Sampling: 50,000Tk./ sampling - Analyzing: 100,000Tk./ all

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
									sample
4	Noise and vibration	- Noise caused by vehicles used for mobilization of equipment and workers	- Noise level standards - IFC guideline values for noise (General/2007)	- Evaluation of effect of the mitigation measure towards noise level	- Measurement using noise level meter	**3 points** - Along the road	- Once every three month	- RHD/ Environmental Consultant	RHD - Measurement: 50,000Tk./ session
5	Ecosystem (Mangrove forest) Ecosystem (Tidal flat)	- Existence of mangrove forest	**Density** - JICA guideline (2010) - World bank OP 4.04	- Evaluation of existence of mangrove forest	- Observation	**Density** - 2 line	- Once every three month	- RHD/ Environmental Consultant	RHD - Observation: 400,000Tk./ researcher・year
		- Potential impact due to the degradation of sedimentation and erosion	1) Topographic future 2) Sediment quality 3) Benthic animals	1) - 3) - Evaluation of effect of the mitigation measure towards water pollution - Confirming the population and change in types of the marine organism	1) - 3) - Collecting samples at the site, analyzing at the lab	1) – 3) **5 points** - Sea area in front of construction area	1) - 3) Twice a year at dry and rainy season		
6	Topography and geology	- Soil runoff	**SS** - Ambient water quality standards (Inland surface water)	- Evaluation of soil runoff	- Collecting samples at the site, analyzing at the lab Continuous measurement using a sensor	**4 points** - Salt/paddy field	- Once every three month	- RHD/ Environmental Consultant	RHD (Simultaneous collection Same aswith “Water quality”).
7	Disturbance to Poor People	- Improved road	- Living standards of poor people	- Evaluation of access to social services	- Hearings from the related institutions - Interviewing residents	- Related institutions - Villages near the site	- Once a year	- RHD/ Environmental Consultant	RHD - Interviewer: 5,500Tk./ researcher
8	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Improved transportation condition	- Number of employment	- Evaluation of increase in sales of products and income	- Same as those addressed in ”Poor people”	- Same as those addressed in ”Poor people”	- Same as those addressed in ”Poor people”	- RHD/ Environmental Consultant	RHD (Simultaneous collection Same aswith “Poor people”).
9	Land Use and	- Changing traditional	- Local residents’feeling	- Confirmation of	- Interviewing	- Villages near the	- Once a year	- RHD/	RHD

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
	Utilization of Local Resources	land use patterns and utilization of local resources		local residents'feeling	residents	site		Environmental Consultant	(Simultaneous collection Same aswith "Poor people").
10	Disturbance to the Existing Social Infrastructure and Services	1) Increase the number of vessels 2) Increase the number of cars	1), 2) - Traffic volume	1), 2) - Evaluation of effect of traffic schedule	1), 2) - Record of numbers of vessels and cars	1), 2) - Along the road	1), 2) - Once a year	- RHD/ Environmental Consultant	RHD
11	Misdistribution of Benefits and Compensation	- It can occur among residents, workers, government officers, and local politicians	- Local residents'feeling	- Confirmation of local residents'feeling	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Once a year	- RHD/ Environmental Consultant	RHD (Simultaneous collection Same aswith "Poor people").
12	Local Conflicts of Interest	- Conflict between local residents and workers	- Local residents'feeling	- Confirmation of local residents'feeling	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Once a year	- RHD/ Environmental Consultant	RHD (Simultaneous collection Same aswith "Poor people").
13	Gender	Improved road	- Living standards of gender	- Evaluation of access to social services	- Same as those addressed in "Poor people"	- Same as those addressed in "Poor people"	- Once a year	- RHD/ Environmental Consultant	RHD (Simultaneous collection Same aswith "Poor people").
14	Children's Rights	1) Child labor 2) Improved road along with the power plant	1) Child labor 2) Improvemant of access to social services	1) Evaluation of effect of banning child labor 2) Evaluation of access to social services	1) Child labor - Checking the labor contract between subcontractor and labors - Patrolling in construction area 2) Same as those	1) Working area 2) Same as those addressed in "Poor people"	1), 2) - Once a year	- RHD/ Environmental Consultant	RHD (Simultaneous collection Same aswith "Poor people").

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of collecting and Analyzing Data	Location	Duration and Frequency		
					addressed in "Poor people"				
15	Work condition (including work safety)	- Labor accidents	**Rercord of accidents** - Handling heavy loads - Working at heights - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- Related institutions	- Once a year	- RHD/ Environmental Consultant	RHD
16	Accidents	- Traffic accidents	**Rercord of accidents** - Land traffic - Marine traffic	- Evaluation of effect of the work safety plan	- Record of accidents	- Related institutions	- Once a year	- RHD/ Environmental Consultant	RHD
17	Cross-boundary impact and climate change	- CO_2 emission	- Amount of CO_2 emission	- Efforts to reduce CO_2	- Trffic amount	- Related institutions	- Once a year	- RHD/ Environmental Consultant	RHD

(Source: JICA Study Team)

15.9 Actions Taken for Land Acquisition and Resettlement

Further details are found in the Land Acquisition and Resettlement Action Plan (Appendix C-15.9-1).

15.9.1 Power plant and port facility

Major actions taken by CPGCBL are summarized down below:

(1) Finalization of Land acquisition and Resettlement Action Plan

CPGCBL will prepare and submit an application for land acquisition to MPEMR and make a request to the Deputy Commissioner of Cox's Bazar District. CPGCBL will also prepare and submit the Resettlement Action Plan (RAP) to MPEMR.
CPGCBL will allocate a sufficient budget for Additional Grants (AGs) on top of DC's payment for land and Resettlement Benefits (RBs), which are to be approved by the GOB.

(2) Data Collection and EP Identification

CPGCBL will deploy adequate human resources for supervision, consultation, and monitoring of land acquisition, resettlement and rehabilitation activities during project implementation. CPGCBL, in line with the DC, will design and conduct a socioeconomic survey and collect data. A supplemental survey can be conducted to obtain additional key information and update all the data, and the RAP should be revised if required. ID cards, EP files, and Entitlement Cards will be issued at this stage.

(3) Local Consultation and Information Management

CPGCBL will prepare an information brochure for information dissemination. Local consultations such as public consultation meetings and focus group discussions should be organized to ensure people affected by the project remain informed of the project implementation process, benefits and losses, environmental and social impact, etc. (Appendix C-15.9-3 and Appendix C-15.9-4)

(4) Finalization of Budget and Implementation of Land Acquisition and Resettlement

The DC will pay the cash Compensation under Law (CCL) for the affected lands, structures crops and trees to the EPs. CPGCBL will pay the AG on top of DC's payment for the lands and other RBs to the EPs. CPGCBL is responsible for asssiting EPs purchase land and relocate, rehabilitate their livelihood rehabilitation/improvement program. CPGCBL will formulate a

grievance redress committee (GRC) to receive grievances from stakeholders including the affected people.

(5) Monitoring

CPGCBL will formulate not only an internal monitoring mechanism, but an external monitoring mechanism with which the resettlement process and final outcome is assessed.

15.9.2 Transmission line

Major actions taken by PGCB are summarized down below:

(1) Finalization of Tower Locations

In addition to finalizing the locations of angle towers from P1 to P10, PGCB will find and fix the suspension towers that run from Anowara to Pekua. When conducting site surveys for identifying suspension tower locations, efforts shall be made to avoid houses and populated areas as prescribed by JICA guidelines and given PGCB's values.

(2) Negotiation with Landowners

As there will be few tower locations, landowners and leasees will not have to relocate to other areas and the degree of damage to their agricultural activities will be minimized and only occur during the construction period. In case they do not agree to voluntarily provide their land for laying the tower base, PGCB is responsible for acquiring the land based on Ordinance 1982 and JICA guidelines, and for paying the replacement cost for the acquired land.

15.9.3 Access road

Major actions taken by RHD are summarized down below:

(1) Finalization of Land Acquisition and Resettlement Action Plan

RHD will prepare and submit an application for land acquisition to MOC and make a request to the Deputy Commissioner of Cox's Bazar District. RHD will also prepare and submit the Resettlement Action Plan (RAP) to MOC.
RHD will allocate a sufficient budget for Additional Grants (AGs) on top of DC's payment for land and Resettlement Benefits (RBs), which are to be approved by the GOB.

(2) Data Collection and EP Identification

RHD will deploy adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities during project implementation. RHD, in line with the DC, will design and conduct a socioeconomic survey and collect data. A supplemental survey can be conducted to obtain additional key information and update all the data, and the RAP should be revised if required. ID cards, EP files, and Entitlement Cards will be issued at this stage.

(3) Local Consultation and Information Management

RHD will prepare an information brochure for information dissemination. Local consultations such as public consultation meetings and focus group discussions should be organized to ensure people affected by the project remain informed of the project implementation process, benefits and losses, environmental and social impact, etc.

(4) Finalization of Budget and Implementation of Land Acquisition and Resettlement

The DC will pay the cash Compensation under Law (CCL) for the affected lands, structures crops and trees to the EPs. RHD will pay the AG on top of DC's payment for the lands and other RBs to the EPs. RHD is responsible for asssiting EPs purchase land and relocate, rehabilitate their livelihood rehabilitation/improvement program. RHD will formulate a grievance redress committee (GRC) to receive grievances from stakeholders including the affected people.

(5) Monitoring

RHD will formulate not only an internal monitoring mechanism, but an external monitoring mechanism with which the resettlement process and final outcome is assessed.

15.10 Others

15.10.1 Environmental checklist

(1) Power Plant and Port Facility

1) Power Plant

JICA's Environmental Checklist for the power plant, which consist of the main check items, evaluation (Yes/No) and confirmation of environmental issues (reasons and mitigation measures) is described in Table 15.10-1.

2) Port Facility

JICA's Environmental Checklist for the port facility is described in Table 15.10-2.

(2) Transmission line

JICA's Environmental Checklist for the transmission line is described in Table 15.10-3.

(3) Access road

JICA's Environmental Checklists for the roads and Bridges, which consist of the main check items, evaluation (Yes/No) and confirmation of environmental issues (reasons and mitigation measures) are described in Table 15.10-4 and Table 15.10-5 respectively.

Table 15.10-1 Environmental Checklist (Thermal Power Plant)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports already been officially prepared? (b) Have EIA reports been approved by authorities of the host country's government? (c)-1 Have EIA reports been unconditionally approved? (c)-2 If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) N (c)-1 N (c)-2 - (d) N	(a) - Draft EIA reports have been prepared for CPGCBL by the JICA Study Team. (b)(c) - CPGCBL has not yet officially submitted the EIA report to the Department of Environment of Bangladesh, and the EIA report has not yet been approved by the Bangladesh DOE. (d) - Required environmental permits other than the EIA reports have not been obtained from the appropriate regulatory authorities of Bangladesh.
	(2) Explanation to the Local Stakeholders	(a)-1 Have contents of the project and the potential impacts been adequately explained to the local stakeholders based on appropriate procedures, including information disclosure? (a)-2 Has approval been obtained from the local stakeholders? (b) Have comments from the stakeholders (such as local residents) been reflected to the project design?	(a)-1 Y (a)-2 Y (b) Y	(a) - CPGCBL has so far conducted two stakeholder meetings (SM) with the support of the JICA Study Team and EAL. - The first SM was held at the scoping stage of the Feasibility Study of the Coal-fired Power Plant Development Project on November 12th, 2012 at Yunus Khali Government Primary School, Maheshkhali Upazila, Cox's Bazar District. There were 66 total attendees, including local government officers, community leaders, local affected residents, etc. CPGCBL hosted the meeting assisted by the JICA Study Team. Notification letters were distributed to all the key stakeholders prior to the meeting. At the meeting, a power-point presentation with a full explanation of the project was given to the participants in their local language, to allow the audience to fully understand the project and to contribute valuable comments. - The second SM was held at the Draft final on April 16th 2013 at Moheshkhali Upazila Parishad Auditorium, Cox’s Bazar. There were 133 total attendees, including local government officers, community leaders, local affected residents, etc. At the meeting, a power-point presentation with a full explanation of the project was given to the participants in their local language, to allow the audience to fully understand the project and to contribute valuable comments. (b) - The comments from the stakeholders have been reflected in the project design (refer to 15.5.1 (4)).
	(3) Examination of	(a) Have alternative plans of the project been examined with social and environmental	(a) Y	(a) - Alternative plans of the project were examined in regard to zero option and two

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Alternatives	considerations?		different locations for the power plant site. Environmental and social issues were adequately taken into account in considering the alternative plans of the project.
2 Pollution Control	(1) Air Quality	(a)-1 Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by the power plant operations comply with the country's emission standards? (a)-2 Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? (a)-3 Are any mitigating measures taken? (b)-1 In the case of coal-fired power plants, is there a possibility that fugitive dust from the coal piles, coal handling facilities, and dust from the coal ash disposal sites will cause air pollution? (b)-2 Are adequate measures taken to prevent air pollution?	(a)-1 Y (a)-2 N (a)-3 Y (b)-1 Y (b)-2 Y	(a) - SOx, NOx and Particle Matter will be generated by the operation of the power plant. - Using the following Gaussian diffusion model, prediction of annual averages, a 24-hour and 1-hour value was calculated according to the time scale in conformity with the environmental standards of Bangladesh and the IFC/EHS guidelines (refer to Chapter 15.6.1 (1), b), a., i.). - A flue gas desulphurization (FGD: around 70% efficiency) system using marine water, an electrostatic precipitator (EP: around 99.8% efficiency), and low-NOx burning method (multi phase burning) will be used during this project, and exhaust concentrations will be kept below Bangladesh's emission standards and the spirit of IFC/WB EHS guidelines. (b) - Coal handling and storage activities and ash handling disposal activities will result in the dispersion of dust particulates due to wind gusts. According to the Beaufort scale, when wind speed exceeds about 6m/s, dust on the ground may be lifted up. However, the occurrence ratio of wind speed exceeding 6m/s around the project site is very low at about 1%. A cover will be installed on the conveyor for coal and ash transportation, and watering coal storage and an ash pond will be built to keep the surface wet.
	(2) Water Quality	(a)-1 Do effluents including thermal effluents from the power plant comply with the country's effluent standards? (a)-2 Is there a possibility that effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause any significant temperature rise in the receiving waters? (b) In the case of coal-fired power plants, do leachates from the coal piles and coal ash disposal sites comply with the country's effluent standards? (c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?	(a)-1 Y (a)-2 N (b)Y (c) Y	(a)-1 - The temperature of thermal effluent will be discharged within ΔT 7°C compared to the water temperature of the intake water and will be less than 40°C. Therefore the temperature of the thermal effluent is within the discharge water regulation . - Simulation of thermal effluent diffusion was conducted under two conditions; one where the discharge point is 140 meters away from the costal line, and the other where it is 280 meters away from the costal line, in order to identify how far the discharge point should be to avoid the impact of thermal effluent to the coastal area.. **In the case that the discharge point is 140m offshore:** The sea area where the water temperature increases more than 4°C is up to 70m away from the discharge point; more than 3°C increase is up to 240m away, more than 2°C increase is up to 1,300m away, and more than 1°C increase is up to 1,800m away from the discharge point. **In the case that the discharge point is 280m offshore:** No sea area experiences a water temperature increase of more than 4°C; sea

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				area experiencing more than a 3°C increase is up to 90m away; more than 2°C increase is up to 530m away; and more than 1°C increase is up to 1,400m away from the discharge point. Sea area in front of the power plant is open water, and thermal effluent is diffused at the surface layer. Fish avoid the sea area if it exceeds a suitable water temperature, therefore living fish are likely to be impacted even though the thermal effluent is diffused. Furthermore, thermal effluent will be diffused into the bottom layer in the region close to the discharge point, which is likely to impact the benthos. Flora such as seaweed do not exist in the sea area in front of the power plant, and only fauna such as Polychaeta and Bivalvia are impacted by thermal effluent, though the impact range is limited to the area close to the discharge point. - Wastewater from each facility will be collected in the central wastewater treatment system. The wastewater treatment system, which will consist of neutralization, coagulating sedimentation, and a filtration and oil separator, will manage and treat wastewater appropriately to comply with water quality in accordance with Bangladesh regulations and IFC/EHS guidelines for thermal power plants. Treated wastewater will be mixed and diluted with a large volume of thermal effluents. The impact on water quality by the power plant operation is considered to be insignificant because the impact intensity is low, the duration is long term, and the coverage area is limited. (b), (c) - Leakage from the bottom of the ash pond will be prevented using an impermeable layer, such as high density polyethylene (HDPE) sheet or silt layer. - Wastewater will be managed and treated appropriately by neutralization and sedimentation to comply with water quality in accordance with Bangladesh regulations and IFC/WB EHS guidelines for thermal power plants. - Heavy metal ingredients contained in the coal ash and wastewater from the ash disposal site will be monitored and analyzed as a precaution.
	(3) Wastes	(a) Are wastes, (such as waste oils, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's regulations?	(a) Y	- To separate waste collection, recycling and reuse of waste will be promoted and non-recyclable waste will be disposed at appropriate sites, according to the related regulations. - Hazardous waste will be treated under the related regulations. - Fly ash and bottom ash are not categorized as hazardous materials by Bangladesh regulations. An ash disposal pond (200 ha) will be built at the project site. The nominal capacity of the ash disposal pond is calculated based on the total volume of the ash to be accumulated for the duration of 25 years operation with an 80% load factor. The total capacity is estimated to be 20,250,000 tons.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				- Reuse of coal-ash is not planned at present as there are no facilities to reuse coal-ash, such as a cement factory near the project site. Coal-ash reuse already occurs in Europe, United States, Japan and in many other countries, and the feasibility of coal-ash reuse in Bangladesh is an issue to be discussed in the future.
	(4) Noise and Vibration	(a) Do noise and vibrations comply with the country's standards?	(a) Y	<Noise> - The totals of 16 points used for simulation were selected at the boundary of power plant site and discharge facilities, and another 3 points at the nearest residence were also selected for simulation. - Prior to power plant construction, dykes 5 meters and 16 meters high (for the purpose of ash disposal site) will be constructed inside the boundary of the power plant site; this will simulate the dispersion model of the noise level, taking into the dyke playing as a sonic barrier. - According to the result of simulation, the noise level generated by power plant operation is 10.6 - 43.3dB (A) at the boundary of the power plant site and discharge facility and 30.2 - 41.2 dB (A) at the nearest residence (1 point at north of the site and 2 points at south of the site). - The noise levels at all the points in residential areas satisfy day-time noise level standards for Bangladesh. The noise level at 1 point in the residential areas exceeds night-time noise level standards for Bangladesh; however, the range of the noise levels don't exceed standards for the area surrounding the power plant, and the noise level in the whole village satisfies night-time standards. IFC/WB guidelines are satisfied at all the points. - As part of mitigation measures, equipment maintenance will be conducted and low noise equipment and adequate enclosures will be installed. <Vibration> - As part of mitigation measures, since vibration is expected to be caused by plant operation. Maintenance of equipment will be conducted, and low noise/vibration equipment and adequate enclosures will be installed.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) - Ground water will not be used during the operation phase.
	(6) Odor	(a)-1 Are there any odor sources? (a)-2 Are adequate odor control measures taken?	(a)-1 Y (a)-2 Y	(a) - In case domestic waste from the workers' camp is not appropriately treated, foul odors may start emanating from rotten waste. Before starting plant operation, workers will be instructed to separate and collect garbage, and illegal waste disposal will be prohibited. Garbage will be disposed on a periodic basis to prevent

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				odor by putrefaction.
3 Natural Environment	(1) Protected Areas	(a)-1 Is the project site located in protected areas designated by the country's laws or international treaties and conventions? (a)-2 Is there a possibility that the project will affect the protected areas?	(a)-1 N (a)-2 N	(a) - The project site is not located in any protected areas. - Sonadia ECA, which has been designated as Ecological Critical Area pursuant to the Environmental Protection Law of Bangladesh, is located 15km south of the proposed project site. - Air quality, water quality and noise levels during both construction and operation phases will meet environmental standards, and the impacts will not reach Sonadia ECA.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d)-1 Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? (d)-2 Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms? (e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas?	(a) N (b) Y (c) Y (d)-1 N (d)-2 Y (e) N	(a) - The project site consists of land used for salt farms and other purposes, with no primeval forests or tropical rain forests. A sandy beach is located in front of the proposed project site, but there are no mangrove forests or tidal flats. (b) - It is highly likely that four species of IUCN precious sea turtles spawn on the sea coast, and a detailed survey should be conducted. - For the purpose of protecting the Spoon billed Sandpiper, construction workers will be instructed to strictly comply with hunting and capturing restrictions as prescribed by law. Light and noise of nighttime construction may have adverse effects on the sea turtles. (c) - Night construction activity in the spawning season should be avoided as much as possible, and should be conducted under minimum light. - Lighting color that does not affect spawning (e.g., red or yellow) will be selected. - Low-noise equipment shall also be installed. - The careful monitoring of spawning status is necessary. (d) - This project does not intake surface water or ground water. (e) - The water intake and discharge of cooling water used in the power plant will be carried out at a flow rate much lower than the current in the surrounding ocean, and the water flow in the surrounding sea will not be affected. - In addition, smaller fish in the sea area have sufficient swimming ability in comparison to the flow rate of water intake, and they are not likely to be affected as a consequence. - The diffusion area of thermal effluents with increased temperature of 2 ºC or higher is limited to a certain surface layer and fish can easily bypass the area.
4 Social	(1)	(a)-1 Is involuntary resettlement caused by	(a)-1 Y	(a)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
Environment	Resettlement	project implementation? (a)-2 If involuntary resettlement occurs, will efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to the affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Will compensation be paid prior to the resettlement? (e) Are the compensation guidelines set forth in the document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h)-1 Is the organizational framework established to properly implement resettlement? (h)-2 Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Will a grievance redress mechanism be set up?	(a)-2 Y (b) Y (c) Y (d) Y (e) Y (f) Y (g) Y (h)-1 Y (h)-2 (i) Y (j) Y	- The site selection was reconsidered to the present site from the previous one (2 km south), where large settlements were found on private land, in order to avoid a large-scale resettlement. (b) - CPGCBL has so far conducted two public consultation meetings (PCM) with the support of the JICA Study Team and EAL. - The first PCM was held at the scoping stage of the Feasibility Study of the Coal-fired Power Plant Development Project on November 14th, 2012 at Puran Bazar Government Primary School, Maheshkhali Upazila, Cox's Bazar District with the attendance of 115 people including local government officers, community leaders, local affected residents, etc. CPGCBL hosted the meeting assisted by the JICA Study Team. Notification letters were distributed to all the key stakeholders prior to the meeting. At the meeting, a power-point presentation with a full explanation of the project was given to the participants in their local language, to allow the audience to fully understand the project and to contribute valuable comments. - The second PCM was presided over by Mr. ATM Zahirul Islam, Managing Director, CPGCBL, assisted by the JICA Study Team on February 13th, 2013 at Chokoria Upazila Parishad Auditorium with the attendance of 50 people total including local government officers, local affected residents, local NGOs, etc. Notification letters were distributed to the selected representatives of the affected people prior to the meeting. - Even after this feasibility study is over, the PAPs and their communities will be consulted about the project, the rights and options available to them, and the proposed mitigation measures for adverse effects, and to the extent possible will be involved in the decision-making process concerning their resettlement. (c) - LARAP (Land Acquisition and Resettlement Action Plan), that includes not only a compensation plan but also a livelihood restoration program for affected people, will be established. (d) - According to the Ordinance of 1982, serving the last notice (Section 7 the Ordinance of 1982), the DC shall pay the amount to the owners of the acquired property within another 60 days from the date of deposit by the project proponent. The DC will take possession of the property after completion of compensation payment to the PAPs and immediately declare this in the official gazette, and hand the property over to the project proponent. (e)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				- LARAP (Land Acquisition and Resettlement Action Plan) including a compensation plan for affected people, will be established. (f) - The employment of local people will be promoted to increase employment opportunities for various subcontract work resulting from the power plant's construction. - Measures to restore the livelihood of the local people will be undertaken, including job training for those who want it. - Children's ability to go to school may be negatively impacted if access routes to schools are physically blocked by the construction site. The access road, community road and road around the power plant boundary shall be built with sufficient height so that it can be used even in the rainy season, resulting in improved access (including for children) to markets and social services. (g) - Under Section 6 in the Ordinance of 1982, a second public notice will be served stating the GOB's decision on the land acquisition and possession. The DC Office will confirm the PAPs, exact land area and size for acquisition, number of relocated houses, agriculture land, forestry and fishing areas that will be lost. The persons to be displaced will be requested to submit their statements of property, amounts and particulars of the claims to compensation after 15 days of the second notice being served. The DC Office will respond to any grievances made by the PAPs in order to agree to the assistance package. (h) - The Deputy Commissioner's Office of Cox's Bazar District will officially take responsibility for initiatives to conduct local consultations concerning compensation. In consideration of changing emotions of local residents over the course of negotiations with office staff, LARAP preparations should be carried out in consultation with the local people. (i) - Appropriate reporting including auditing and redress functions, monitoring and evaluation mechanisms will be identified and set in place as part of the resettlement management system. In addition to internal monitoring conducted by CPGCBL, an external monitoring group should be hired and will evaluate the resettlement process and final outcome (j) - In the resettlement process, personnel responsible for responding to complaints or suggestions from local residents will work at the power plant office.
	(2) Living and	(a)-1 Is there a possibility that the project will	(a)-1 Y	(a)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Livelihood	adversely affect the living conditions of the inhabitants? (a)-2 Are adequate measures being considered to reduce the impacts, if necessary? (b)-1 Is sufficient infrastructure (e.g., hospitals, schools, and roads) available for the project`s implementation? (b)-2 If the existing infrastructure is insufficient, have any plans been developed to construct new infrastructure or improve the existing infrastructure? (c) Is there a possibility that large vehicle traffic for transportation of materials, such as raw materials and products, will impact traffic in the surrounding areas, impede the movement of inhabitants, and any cause risks to pedestrians? (d)-1 Is there a possibility that diseases, including infectious diseases, such as HIV, being transmitted due to the immigration of workers associated with the project? (d)-2 Are adequate considerations given to public health, if necessary? (e) Is there a possibility that the amount of water used (e.g., surface water, groundwater) and the discharge of thermal effluents by the project will adversely affect existing water uses and uses of water areas (especially fishery)?	(a)-2 Y (b)-1 N (b)-2 Y (c) Y (d)-1 Y (d)-2 Y (e) N	- 267 households and 1,588 people will be affected by the construction of the power plant and the port facility. In addition, there are 76 households living or making their living around the project area that will indirectly be affected by the project. - Local people should be employed to work at the power plant and related facilities to the maximum extent possible according to their skills. - Measures to restore the livelihood of the local people will be undertaken, including job training for those who want it. - Services (e.g., laundry, catering services, etc.) and products offered by the local community should be used by the power plant as much as possible. - Efforts for regional development will be promoted, including the establishment of a local development plan in cooperation with the local government. (b) - A school and medical facility constructed within the power plant site shall be open to all local people with the aim of improving their living standards. (c) - Mitigation measures to decrease traffic volume shall be conducted, such as the promotion of commuting by bus. - The management of schedules of vehicles used during the project will be conducted in cooperation with related organizations, and the schedules will be announced to local people living in surrounding villages. - An access road, community road and road around the power plant boundary shall be built. These roads will be built with sufficient height so that they can be used even in the rainy season, in order to enable public access to markets and social services. (d) - Local people will be recruited for simple work to the extent possible and there is a low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc). (e) - Plant water used during the operation phase will be taken from seawater utilizing a desalinating process and therefore no impact on river or ground water is anticipated.
	(3) Heritage	(a)-1 Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage of the area? (a)-2 Are adequate measures being considered to protect these sites in accordance with the	(a)-1 N (a)-2 Y	(a) - There are no historical, cultural and archaeological properties or heritage sites in or around the site.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		country's laws?		
	(4) Landscape	(a)-1 Is there a possibility that the project will adversely affect the local landscape? (a)-2 Are necessary measures taken?	(a)-1 N (a)-2 N	(a) - There is no picturesque scenery in or around the site.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) Y	(a) (b) - There were no ethnic and indigenous people found on or around the project site.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project do not violate the safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d)	(a) - The project proponent will not violate any laws and ordinances associated with the working conditions of Bangladesh. (b) (c) - The construction company shall establish a work safety plan and submit it to CPGCBL to obtain approval. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and on hard aspects (provide workers with appropriate protective equipment, etc). (d)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce adverse impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts?	(a) Y (b) Y (c) Y	(a) <Noise and Vibration> - Construction machinery and vehicles will be regularly maintained. - Low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area. <Water Quality> - Turbid water, such as rainwater run off, will be treated with precipitation

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?		processes. - Wastewater containing oil will be treated with oil-water separator. <Air Quality> - Prevention measures for dust dispersion will be taken by spraying water. - Maintenance of machinery will be conducted regularly, resulting in reducing exhaust gas emissions. <Waste> - Construction waste and general waste will be re-used, recycled or disposed following relevant laws and regulations. (b) - One flora species listed in IUCN is found at the project site, but the species is generally observed widely around the area. - Four kinds of sea turtle species listed in the IUCN Red list spawn at the sea front area of the power plant. Mitigation measures will be taken, especially regarding night-time lighting and lowering noise levels. Monitoring will also be conducted. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but these species are generally observed widely around the area. (c) - The employment of local people will be promoted for increased employment opportunities for various subcontract work resulting from the power plant construction activity. - Local people will be employed to the maximum extent possible, and foreign workers will be taught to respect local customs in order to facilitate good relationships with local people. Lodgings of project workers will be equipped with sufficient living facilities keeping order that workers remain at the project site as much as possible. - Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers will be conducted. - Local people will be recruited for simple work to the extent possible and there is a low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc). - In regard to vessels, water routes shall be determined after consultation with the related authorities. Marking buoys will be set around the construction area for marine safety. The schedule of vessels shall be announced to fishermen, etc. - And in regard to vehicles, bus use will be promoted to reduce increasing the number of vehicles on the roads. The bus schedules shall be managed in consultation with related organizations and shall be communicated to people in the

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				surrounding villages.
	(2) Accident Prevention Measures	(a) In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles (e.g., sprinkler systems)?	(a) Y	(a) - Fire prevention measures shall be conducted including regular watering of the coal storage site, installation of fire protection equipment in the power plant and organization of fire-fighting team and fire-fighting training.
	(3) Monitoring	(a) Will the proponent develop and implement a monitoring program for items that are considered to have potential environmental impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d)	(a) - An Environmental Monitoring Plan will be prepared to provide guidelines for an environmental management plan during the construction and operation phases of the Coal-fired Power Plant. - The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected, by the construction activities and power plant operation. (b) - Refer to Chapter 15.1.8 (1) (c) - An expert environmental management administrator in EMU of CPGCBL shall report on the details and implementation status of the environmental monitoring plan (d)
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities). (b) Where necessary, pertinent items described in the Ports and Harbor checklist should also be checked (e.g., projects including construction of port and harbor facilities).	(a) Y (b) Y	(a) Refer to the Checklist of "Transmission Line" (b) Refer to the Checklist of "Port and Harbor"
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).	(a) Y	(a) - Ultra supercritical (USC) technology will be adopted at the power plant, producing approximately 566 thousand tons/year less CO_2 than a sub-critical coal-fired power plant.

(Source: JICA Study Team)

Table 15.10-2 Environmental Checklist (Port and Harbor)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c)-1 Have EIA reports been unconditionally approved? (c)-2 If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?		- An EIA report for the port facility will be included in the one for the power plant.
	(2) Explanation to the Local Stakeholders	(a)-1 Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? (a)-2 Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?		- The SHMs for the power plant included the items of the port facility.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) - Alternative plans of the project were examined in regard to the zero option and two different types of port facilities; conventional type and excavated type. Environmental and social aspects were well taken into account in considering the alternative plans of the project.
2 Pollution Control	(1) Air Quality	(a)-1 Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted from ships, vehicles and project equipment's comply with the country's emission standards? (a)-2 Are any mitigating measures taken?	(a)-1 Y (a)-2 Y	(a) - It is expected that air pollution will be caused from the exhaust gas generated from vessels using the port. There will also be dust, produced from the loading-unloading of coal. Hired vessels will be compliant to MARPOL 73/78 treaty. - Coal handling and storage activities will result in the dispersion of dust particulates due to wind. According to the Beaufort scale, when wind speed exceeds approximately 6m/s, dust may be swept up from the ground. There is a low occurrence ratio of wind speed exceeding approximately 6m/s around the project site (about 1%). - In addition, a cover will be installed on the conveyor for coal transportation and a

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				watering coal storage and handling area will be set up to keep the surfaces wet.
	(2) Water Quality	(a) Do effluents from the project facilities comply with the country's effluent and environmental standards? (b) Do effluents from the ships and other project equipment's comply with the country's effluent and environmental standards? (c) Does the project prepare any measures to prevent leakages of oils and toxicants? (d) Does the project cause any alterations in coastal lines and disappearance/appearance of surface water to change water temperature or quality by decrease of water exchange or changes in flow regimes? (e) Does the project have any measures to prevent polluting the surface, sea or underground water by penetration from reclaimed land?	(a) Y (b) Y (c) Y (d) N (e) Y	(a), (c) - Wastewater from each facility will be collected in the central wastewater treatment system. The wastewater treatment system, which will consist of neutralization, coagulating sedimentation, and a filtration and oil separator, will manage and treat wastewater appropriately to comply with water quality stipulated in Bangladesh regulations and IFC/EHS guidelines for thermal power plants. Treated wastewater will be mixed and diluted with a large volume of thermal effluents. The impact on water quality by the power plant operation is considered to be insignificant, because the impact intensity, duration and coverage area will be low, long term and limited, respectively. (b) - Water pollution is also expected from the wastewater discharged from vessels using the port. However, the number of days that coal vessels enter and leave the port is approximately 50 days per year, which is relatively few. (d) - Type of the port facility will be excavated type and does not cause any alterations in coastal lines and disappearance/appearance of surface water to change water temperature or quality by decrease of water exchange or changes in flow regimes. (e) - Land filling will not be conducted.
	(3) Wastes	(a) Are wastes generated from the ships and other project facilities properly treated and disposed of in accordance with the country's regulations? (b) Is offshore dumping of dredged soil properly disposed in accordance with the country's regulations? (c) Does the project have any measures to avoid dumping or discharge toxicants?	(a) Y (b) Y (c) Y	(a) - To separate waste collection, recycling and reuse of waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to the related regulations. - Hazardous waste will be treated under the related regulations. (b) - Dredging will be periodically conducted for maintenance of the water way. Dredged material from the maintenance of the port shall be reused around the project to the maximum extent possible, and residual sand will be disposed of within the project site. (c) - Sand and silt will be generated from dredging work of the canal and the port. Sand will be, after being dehydrated at the effluent outlet, entirely reused for land preparation of the plant, and silt will be entirely disposed of in the ash pond, adequately managed and treated as dust and waste water. - General waste and hazardous waste will be appropriately treated and disposed of in a manner consistent with cases of the power plant construction.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(4) Noise and Vibration	(a) Do noise and vibrations comply with the country's standards?	(a) Y	(a) - Noise and vibration impacts from unloading the coal are predicted. The results of noise simulation concerning coal unloading activity is included in the noise simulation during the operation phase, and the noise levels at the nearest residential area satisfy environmental standards. - Maintenance of equipment and installation of low noise type equipment will be conducted.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) - Groundwater will not be used during the operation phase of the port facility, therefore subsidence will not occur.
	(6) Odor	(a)-1 Are there any odor sources? (a)-2 Are adequate odor control measures taken?	(a)-1 N (a)-2 N	(a) - No expected use of substances that may be a potential source of bad odors.
	(7) Sediment	(a) Are adequate measures taken to prevent contamination of sediments by discharges or dumping of hazardous materials from the ships and related facilities?	(a) Y	(a) - Hazardous waste will be managed properly so as not to pollute the sediment.
3 Natural Environment	(1) Protected Areas	(a)-1 Is the project site located in protected areas designated by the country's laws or international treaties and conventions? (a)-2 Is there a possibility that the project will affect the protected areas?	(a)-1 N (a)-2 N	(a) - Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, and it is located 15km south of the proposed site. As described below, during the operation phase it is predicted that there will be no significant change of the ocean current by the port, or any significant changes to ocean topography by sand deposits. - Environmental impact of air pollution, water turbidity and noise, etc., during operation will be mitigated through appropriate countermeasures and the extent of any impact will be limited.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d)-1 Is there a possibility that the project will adversely affect aquatic organisms?	(a) N (b) Y (c) Y (d)-1 Y (d)-2 Y (e)-1 Y (e)-2 Y	(a) - The project site consists of land used for salt farms and other purposes, and there are no primeval forests or tropical rain forests. A sandy beach is located in front of the proposed project site, with no mangrove forests or tidal flats. (b) - One flora species listed in the IUCN Red list is found at the project site, but the species is generally observed widely around the area. - Four kinds of sea turtle species listed in the IUCN Red list spawn at the sea front area of the power plant. Mitigation measures will be taken, especially with regard to night-time lighting and to minimize noise levels. Monitoring will also be conducted. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but these species are generally observed widely around the area. (c) (d) (e)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(d)-2 Are adequate measures taken to reduce negative impacts on aquatic organisms? (e)-1 Is there a possibility that the project will adversely affect vegetation or wildlife of coastal zones? (e)-2 If any negative impacts are anticipated, are adequate measures taken to reduce the impacts on vegetation and wildlife?		- Port operation shall be carried out using minimum light. - Lighting color that does not affect spawning (e.g., red or yellow) will be selected. - Low-noise equipment shall also be installed. - Careful monitoring of spawning habits is necessary.
	(3) Hydrology	(a) Do the project facilities affect adversely impact flow regimes, waves, tides, currents of rivers and etc if the project facilities are constructed on/by the seas?	(a) N	(a) - The construction of the port facility may alter the hydrology of the surrounding area. At the time of the site selection, predictions were made regarding any changes to the ocean currents of the area. Using the same simulation methodology, any changes of the ocean currents were predicted based on the results of a field survey. - It was confirmed that the impact of the port facility on any changes in ocean currents was limited and not considered significant, largely because the proposed port facility will be an excavated type.
	(4) Topography and Geology	(a) Does the project require any large scale changes of topographic/geographic features or cause disappearance of the natural seashore?	(a) N	(a) - The construction of the port facility may alter the geography and geology of the area around the proposed site, and cause the natural seashore to disappear. Predictions regarding sand sedimentation and changes in ocean topography of the area were made during the time of the site selection. - Simulations of sand sedimentation and changes in ocean topography were conducted by a similar method based on the field survey results. - Sand sedimentation and topography change will be very limited as this will be an artificially excavated port.
4 Social Environment	(1) Resettlement	(a)-1 Is involuntary resettlement caused by project implementation? (a)-2 If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?		- The LARAP (land acquisition and resettlement action plan) for the power plant is included the items for the port facility.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(d) Is compensation going to be paid prior to resettlement? (e) Are compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h)-1 Is the organizational framework established to properly implement resettlement? (h)-2 Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
	(2) Living and Livelihood	(a)-1 Is there a possibility that the project will adversely affect the living conditions of inhabitants? (a)-2 Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that changes in water uses (including fisheries and recreational uses) in the surrounding areas due to project will adversely affect the livelihoods of the inhabitants? (c) Is there a possibility that the port and harbor facilities will adversely affect the existing water traffic and road traffic in the surrounding areas? (d)-1 Is there a possibility that diseases, including infectious diseases, such as HIV will be transmitted due to the immigration of workers associated with the project? (d)-2 Are considerations given to public health, if necessary?		- Same as the power plant
	(3) Heritage	(a)-1 Is there a possibility the project will damage	(a)-1 N	(a)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		the local archeological, historical, cultural, and religious heritage of the area? (a)-2 Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)-2 N	- There are no historical, cultural and archaeological properties or heritage sites in or around the site.
	(4) Landscape	(a)-1 Is there a possibility the project will adversely affect the local landscape? (a)-2 Are necessary measures taken?	(a)-1 N (a)-2 N	(a) - There is no picturesque scenery in or around the site.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce the impact on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) Y	(a) (b) - There were no ethnic and indigenous people found on or around the project site.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment, which prevents industrial accidents, and the management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate the safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d)	(a) - The project proponent will not violate any laws and ordinances associated with the working conditions of Bangladesh. (b), (c) - Accidents may be caused by the entry and departure of vessels and the loading-unloading of coal. Work safety plans shall be established that stipulate mitigation measures on soft aspects (safety training, etc) and on hard aspects (provide workers with appropriate protective equipment, etc). (d)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the	(a) Y (b) Y (c) Y	(a) <Noise and Vibration> - Construction machinery and vehicles will be maintained regularly, and low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		natural environment (ecosystem), are adequate measures considered to reduce the impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?		the nearest residential area. <Water Quality> - Pump dredgers will be used and anti-diffusion membranes will be installed to prevent diffusion of turbidity. - When excavating the land area, steel sheet piles will be installed for enclosure on the marine side before any excavation work. - Turbid water from the land will be treated with a precipitation system. <Air Quality> - Prevention measures for dust dispersion will be taken by spraying water. - Maintenance of machinery will be conducted regularly, with the aim of reducing exhaust gas emissions. <Waste> - Sand and silt from dredging work of the navigation channel and the port will be re-used for land preparation of the plant and disposed of into the ash pond. (b) - Impact of air pollution, water turbidity and noise, etc., during the operation phase will be mitigated through appropriate countermeasures, as described above. - One flora species listed in the IUCN Red list is found at the project site, but the species is generally observed widely around the area. - Four kinds of sea turtle species listed in the IUCN Red list spawn at the sea front area of the power plant. Mitigation measures will be taken, especially with regard to night-time lighting and to minimize noise levels. Monitoring will also be conducted. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but these species are generally observed widely around the area. (c) - Pump dredgers will be used in dredging work in the marine area, and increased marine traffic may slightly disturb the existing marine traffic including fishing boats. As a mitigation measure, the construction area shall be determined after consultation with related authorities. Marking buoys will also be set around the construction area for marine safety. The schedule of vessels shall be announced to fishermen, etc.
	(2) Monitoring	(a) Will the proponent develop and implement a monitoring program for those items considered to have a potential environmental impact? (b) What are the items, methods and frequencies of the monitoring program? (c) Will the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the	(a) Y (b) Y (c) Y (d)	(a) - An Environmental Monitoring Plan will be prepared to provide guidelines for an environmental management plan during the construction and operation of the Coal-fired Power Plant. - The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected, by the power plant's construction and operation. (b)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?		- Refer to Chapter 15.8-1 (c) - Same as the power plant (d)
6 Note	Note on Using Environmental Checklist	(a) Where necessary, impacts on groundwater hydrology (groundwater level drawdown and salinization) that may be caused by alteration of topography, such as land reclamation and canal excavation should be considered, and impacts, such as land subsidence that may be caused by groundwater uses should be considered. If significant impacts are anticipated, adequate mitigation measures should be taken. (b) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N (b) Y	(a) (b) - CO_2 will be produced by entry and departure of vessels, but no impact on climate change is expected.

(Source: JICA Study Team)

Table 15.10-3 Environmental Checklist (Transmission Line)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c)-1 Have EIA reports been unconditionally approved? (c)-2 If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) N (c)-1 N (c)-2 - (d) N	(a) - Draft EIA report has been prepared for PGCB by the JICA Study Team. (b)(c) - PGCB has not yet officially submitted the EIA report to Department of Environment of Bangladesh, and EIA report has not been approved by DOE of Bangladesh yet. (d) - Required environmental permits other than EIA report have not been obtained from the appropriate regulatory authorities of Bangladesh.
	(2) Explanation to the Local Stakeholders	(a)-1 Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? (a)-2 Is an understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a)-1 Y (a)-2 Y (b) Y	(a) - PGCB has so far conducted one stakeholder meetings (SM) with the support of the JICA Study Team and EAL. - The first SM was held at the scoping stage of the Feasibility Study of the Coal-fired Power Plant Development Project on November 19th, 2012 at Upazila Parishad Auditorium, Chokoria Upazila, Cox's Bazar District with the attendance of 65 people total, including local government officers, community leaders, local affected residents, etc. PGCB hosted the meeting assisted by the JICA Study Team. Notification letters were distributed to all the key stakeholders prior to the meeting. At the meeting, a power-point presentation with a full explanation of the project was given to the participants in their local language, to allow the audience to fully understand the project and to contribute valuable comments. - The second SM was held at the Draft final on April 15th, 2013 at Upazila Parishad Auditorium with the attendance of 80 people total, including local government officers, community leaders, local affected residents, etc. At the meeting, a power-point presentation with a full explanation of the project was given to the participants in their local language, to allow the audience to fully understand the project and to contribute valuable comments. (b) - The comments from the stakeholders have been reflected in the project design (refer to 15.5.2).
	(3) Examination of	(a) Have alternative plans of the project been examined with social and environmental	(a) Y	(a) - Alternative plans of the project were examined in regard to two different

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Alternatives	considerations?		transmission line routes. Environmental and social aspects were well taken into account in considering the alternative plans of the project.
2 Pollution Control	(2) Water Quality	(a)-1 Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (a)-2 If the water quality degradation is anticipated, are adequate measures considered?	(a)-1 Y (a)-2 Y	(a) - The transmission line route was selected avoiding any steep sloping land. - Any slopes shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation.
3 Natural Environment	(1) Protected Areas	(a)-1 Is the project site located in protected areas designated by the country's laws or international treaties and conventions? (a)-2 Is there a possibility that the project will affect the protected areas?	(a)-1 N (a)-2 N	(a) - The transmission line route bypasses the protected areas.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (e)-1 Is there any possibility that the project will cause negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and the disturbance of the ecosystem due to introduction of exotic (non-native invasive) species and pests? (e)-2 Are adequate measures for preventing such impacts considered? (f) In cases where the project site is located in undeveloped areas, is there any possibility that	(a) N (b) Y (c) N (d) Y (e)-1 N (e)-2 N (f) N	(a) - The transmission line route will pass through the land used for rice fields and other agricultural activity, and not any primeval forests or tropical rain forests. (b) - There is no habitat of precious species of flora designated by the IUCN within the transmission line route. Three species (Calamus guruba Buch-Ham, Trihosanthes cordata Roxb, Lepisanthes rubiginosa) which are considered by Bangladesh researchers as threatened species have been observed within the transmission line route, but they are commonly seen over broad areas and the impact of the project on these species is expected to be insignificant. - There are no precious species of insects, amphibians, reptiles, mammals and birds designated by the IUCN observed through the surveys of rainy and dry seasons within the route. Four species of reptiles (Calotes versicolor, Mabuya mabuya, Gekko gecko, Naja naja) which are considered by Bangladesh researchers as threatened species, and 2 species of birds (Garrulax galbanus, Ketupa zeylonensis) considered as threatened species have been observed within the transmission line route, but they are commonly seen over broad areas and the impact of the project on these species is expected to be insignificant. (c) - No significant ecological impacts are expected. (d) - Birds striking the transmission lines and other impacts are expected. However, the bird species inhabiting areas along the proposed transmission line route are mainly sandpipers and plovers, and their flight altitude is relative low; therefore,

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		the new development will result in extensive loss of the natural environment?		the impact of bird strikes is expected to be insignificant. Still, it is considered necessary to install lights or signs to prevent birds from striking the transmission lines. (e) - There is no possibility that the project will cause the negative impacts such as the destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of the ecosystem (f) - There is no possibility that the new development will result in extensive loss of the natural environment.
	(3) Topography and Geology	(a)-1 Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or landslides? (a)-2 Were adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a)-1 N (a)-2 (b) N (c) N	(a) - There may be soil runoff from the exposed soil of the embankments and cut slopes. The transmission line route shall avoid using steep sloping land, and any slopes used shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation. (b) - Transmission line route was selected so as to avoid any steep sloped areas (c) - Transmission line route was selected so as to avoid any steep sloped areas
4 Social Environment	(1) Resettlement	(a)-1 Is involuntary resettlement caused by project implementation? (a)-2 If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Will an adequate explanation on compensation and resettlement assistance be given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is compensation going to be paid prior to the	(a)-1 Y (a)-2 Y (b) Y (c) Y (d) Y (e) Y (f) N	(a) - Transmission line route was selected so as to avoid any residential areas to the extent possible. - The construction of one tower base requires $2m^2$ x 4 = $8m^2$ of land. The construction of 157 transmission towers, including angle towers and suspension towers, is planned requiring a total amount of $1,256m^2$ of land acquisition. - As the land to be acquired for each transmission tower is small, there is not expected to be any semi-permanent loss of livelihood. (b) - A series of focus group discussions were conducted on the 18th to 21st of December, 2012, focusing on women, children and farmers, and a description of this project provided to those groups of affected people and their comments were received. (c)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		resettlement? (e) Are the compensation policies prepared in the document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h)-1 Is there an organizational framework in place to properly implement resettlement? (h)-2 Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(g) Y (h)-1 Y (h)-2 (i) Y (j) Y	- Land acquisition will be conducted providing compensation for replacement cost. - Standing crops and trees will be compensated at market price. (d) - According to the Ordinance of 1982, serving the last notice (Section 7 the Ordinance of 1982), the DC shall pay the amount to the owners of the acquired property within another 60 days from the date of deposit by the project proponent. The DC will take possession of the property after completion of the compensation payment to the PAPs, immediately declare this in the official gazette, and hand the property over to the project proponent. (e) - LARAP including a compensation plan for affected people, will be established. (f) - There are no vulnerable groups included among the people compensated relating to the transmission line. (g) - Under Section 6 in the Ordinance of 1982, a second public notice will be served stating the GOB's decision on the land acquisition and taking possession thereof. The DC Office will confirm the PAPs, exact land area and size for acquisition, number of relocated houses, agriculture land, forestry and fishing areas that will be lost. The persons to be displaced will be requested to submit their statements of property, amounts and particulars of any compensation claims after 15 days of the second notice being served. The DC Office will respond to any grievances made by the PAPs in order to agree to the assistance package. (h) - The Deputy Commissioner's Office of Cox's Bazar District will be responsible for taking the initiative to conduct local consultations concerning compensation. In consideration of the possible changing emotions of local residents over the course of negotiations with office staff, LARAP preparation should be carried out in consultation with the local people. (i) - Appropriate reporting including auditing and redress functions, monitoring and evaluation mechanisms will be identified and put in place as part of the resettlement management system. In addition to an internal monitoring conducted by PGCB, an external monitoring group should be hired and will evaluate the resettlement process and final outcome (j)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				- In the resettlement process, personnel responsible for responding to complaints or suggestions from local residents will work.
	(2) Living and Livelihood	(a)-1 Is there a possibility that the project will adversely affect the living conditions of inhabitants? (a)-2 Are adequate measures considered to reduce the impacts, if necessary? (b)-1 Is there a possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? (b)-2 Are adequate considerations given to public health, if necessary? (c)-1 Is there any possibility that installation of structures, such as power line towers will cause radio interference? (c)-2 If any significant radio interference is anticipated, are adequate measures considered? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a)-1 Y (a)-2 Y (b)-1 Y (b)-2 Y (c)-1 Y (c)-2 Y (d) N	(a) - Farm land located at the base of towers will be lost, although the total area will be small. The transmission line construction area can be reused for farming after the completion of construction, except for the $2m^2$ x 4 = $8m^2$ of land for the tower bases, and any adverse effects on income will be very limited. - Mitigation measures include employing as many local residents as possible, and using the services and products offered by the local community. (b) - A temporary influx of migrant labor during the construction period may increase the risk of transmitted diseases. Local people will be recruited for simple work as much as possible and there is low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups shall be carried out for external workers (technical workers, etc). (c) - Transmission line route was selected avoiding any residential areas to the extent possible, so that radio interference will not be caused. (d)
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) Y	(a) - There is a possibility that some historical, cultural and/or archaeological property and heritage may be found in the course of the construction work. In this case, construction work will be interrupted and experts will be consulted.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) - Transmission line route was selected so as to avoid any protected and scenic areas to the extent possible.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce the impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) Y	(a) (b) - No ethnic minority groups or indigenous people were identified along the transmission line route.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a) Y (b) Y	(a) - The project proponent will not violate any laws and ordinances associated with the working conditions of Bangladesh. (b) (c)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(c) Y (d) N	- There is a risk that accidents, such as electrification and workers falling, may occur during maintenance work. A work safety plan shall be established including mitigation measures on soft aspects (safety training, etc) and on hard aspects (provide workers with appropriate protective equipment, etc). (d) - It will not be necessary to provide security guards.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) Y (c) Y	(a) <Noise and Vibration> - Construction machinery and vehicles will undergo regularly maintenance, and low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area. <Water Quality> - The transmission line route was selected so as to avoid any steep sloping land. - Any slopes shall be reinforced with concrete, plantation or other means to minimize soil runoff and turbid water generation. <Air Quality> - Prevention measures for dust dispersion will be taken by spraying water. - Machinery will be undergo regularly maintenance, resulting in reduced exhaust gas emissions. (b) - Transmission line route was selected so as to avoid any protected areas. - There are no flora species listed in the IUCN Red list along the transmission line. - Precious species of insects, amphibians, reptiles, mammals and birds designated by IUCN are not observed along the transmission line route. - Other fauna species designated as valuable by biologists of Bangladesh have been observed, but those species are generally observed widely around the area. (c)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				- Land owners and users of tower locations will be tentatively affected during the construction period, resulting in a temporary loss of means of their livelihood. As part of mitigation measures, efforts will be made to employ as many local residents as possible, and to use the services and products offered by the local community. - There is a possibility that some historical, cultural and/or archaeological property or heritage sites may be found over the course of construction work. In this case, construction work will be interrupted and experts will be consulted.
	(2) Monitoring	(a) Will the proponent develop and implement a monitoring program for the items that are considered to have potential environmental impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Will the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d)	(a) - An Environmental Monitoring Plan will be prepared to provide guidelines for an environmental management plan during the construction and operation phases of the transmission Line. - The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected, by construction and operation activities. (b) - Refer to Chapter 15.8-2 (c) - An expert environmental management administrator in EMU of PGCB shall report the details and implementation status of the environmental monitoring plan (d)
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Road checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a) Y	(a) - Refer to the "Road" checklist.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) - Cross boundary and CO_2 emissions are not anticipated in relation to the transmission line.

(Source: JICA Study Team)

Table 15.10-4 Environmental Checklist (Roads)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a)Y (b)N (c) - (d) -	(a)Draft EIA reports have been prepared for RHD by JICA Study Team. (b)EIA report has been officially submitted to DOE by RHD, but not approved. (c)N/A (d)N/A
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a)Y (b)Y	(a)Stakeholder meeting and three times Focus Group Meetings (FGD) at related three Unions have been held in the scoping stage and finalizing stage. The access road project has been welcomed in every meeting. (b)All comments were carefully considered and the issues which were related to project directly have been reflected to design or Environmental Management Plan.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	(a)During route selection stage, 5 alternative plans have been examined with social and environmental considerations; especially, avoiding affects on mangrove forest and minimizing land acquisition and resettlement were carefully considered. In addition, during design stage, avoiding affects on the graveyard in Kalarmachara, several alternative plans were discussed within the team and with local residents.
2 Pollution Control	(1) Air Quality	(a) 1. Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? 2. Does ambient air quality comply with the country's air quality standards? 3. Are any mitigating measures taken? (b) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	(a) 1. Y 2. Y 3. Y	(a) 1. Vehicle traffic related construction works and operation will be increased and affect ambient air quality, but it will be not significant. 2. NOx, SO2, PM10, CO and O3 were observed in dry and rainy season, and all values comply with Bangladesh Standard (ECR 1997 and subsequent amendment in 2005) 3. Reducing traffic amount to use bus and education for drivers are considered. (b) There is no industrial area, and the emission of pollutant from vehicles will not be significant.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			(b) N	
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b) Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater? (c) Do effluents from various facilities, such as parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	(a) N (b) Y (c) Y	(a) There is little possibility because the roads will be constructed on the existing roads and embankment and in salt fields, and construction works will be conducted during dry season. (b) There is a possibility that some contamination of surface water introduced to paddy field and salt field will be occurred during road operation, the water quality monitoring will be conducted. (c) Although there is not any plan to build parking areas/service areas, if there is in the detailed design stage, proper measures will be considered.
	(3) Wastes	(a) Are wastes generated from the project facilities, such as parking areas/service areas, properly treated and disposed of in accordance with the country's regulations?	(a)N	(a)Wastes generated from the project facilities will be properly treated and disposed by contractor and instructed by the RHD.
	(4) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	(a)Y	(a) Noise values observed along road comply with the ECR 1997, subsequent amendment in 2005, but there is no standard on vibration.
3 Natural Environment	(1) Protected Areas	(a) 1. Is the project site located in protected areas designated by the country's laws or international treaties and conventions? 2. Is there a possibility that the project will affect the protected areas?	(a) 1. N 2. -	(a) 1. There is no protected area around the proposed new road. 2. N/A
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection	(a) Y (b) N (c) Y (d) - (e) N (f) N	(a) There is mangrove forest near the power plant site, so the alignment of the access road has been considered to avoid impact on it. (b) There is no sensitive habitat. (c)Although significant impacts on mangrove forest are not anticipated, proper measures will be taken during and after construction. (d) N/A (e)There is little possibility that installation of roads will cause impacts, because the most of the route is existing road, and others are salt/shrimp field and BWDB embankment. (f) Although there is a possibility that this access road will introduce new

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		measures taken to reduce the impacts on the ecosystem? (d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? (e) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? (f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?		development, there is no natural environment except the mangrove forest. The mangrove forest will be protected properly by DOF and RHD.
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	(a) N	(a) Although some parts of new roads will be constructed in salt field, box culverts will be installed properly.
	(4) Topography and Geology	(a) 1. Is there any soft ground on the route that may cause slope failures or landslides? 2. Are adequate measures considered to prevent slope failures or landslides, where needed? (b) 1. Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? 2. Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a) 1. N 2. - (b) 1. N 2. - (c) 1. N 2. -	(a) 1. The most of the route is existing road, and others are salt/shrimp field and BWDB embankment. 2. N/A (b) 1. There is no steep slope along he proposed road. 2. N/A (c) 1. There is no steep slope along he proposed road. 2. N/A
4 Social	(1)	(a) Is involuntary resettlement caused by	(a) 1.	(a) 1. There is no involuntary resettlement caused by the access road.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
Environment	Resettlement	project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) 1. Is the organizational framework established to properly implement resettlement? 2. Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	N 2. - (b) Y (c) Y (d) Y (e) Y (f) Y (g) Y (h) 1. Y 2. Y (i) Y (j) Y	2. N/A (b) Stakeholder meeting and three times Focus Group Meetings (FGD) at related three Unions have been held in the scoping stage and finalizing stage. (c) Census survey and socioeconomic survey were conducted to develop the land acquisition and resettlement plan. (d) The compensations will be paid before construction. (e) The compensation policies are prepared and described in LARAP. (f) A series of Focus Group Discussion were conducted focusing on women, children, elder people, and various workers. (g) Agreements with the affected people will be obtained after the detailed survey on the acquired land and the affected people are finished, and before the construction works is started. (h) 1. The Deputy Commissioner's Office of Cox's Bazar District will be responsible for taking the initiative to conduct local consultations concerning compensation. 2. The budget of Implementing LARAP will be provided to DC Office by RHD. (i) Appropriate reporting including auditing and redress functions, monitoring and evaluation mechanisms will be identified and put in place as part of LARAP. (j) During and after the land acquisition process, personal responsible for responding to complaints or suggestions from local residents will work.
	(2) Living and Livelihood	(a) 1. Where roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? 2. Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of	(a) 1. Y 2. N/Y 3. Y (b) N (c) Y (d) Y	(a) 1. According to increase of demand for the existing means of transportation, such as rickshaw, tempo and baby taxi, income of the associated workers will be increased, and benefit for local residents will be increased. 2. There is not significant impacts since the land acquisition will be small part of the current use. On the other hand, from a long term viewpoint, since there are possibilities that both positive and negative impacts will be occurred. 3. Basically, for long term impacts, local community and government should

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		livelihood, or unemployment? 3. Are adequate measures considered for preventing these impacts? (b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary? (c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)? (e) Is there any possibility that roads will impede the movement of inhabitants? (f) Is there any possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference?	(e) N (f) N	concern and build consensus of the region. (b) There will be no adverse affect but will be positive affect. (c) A temporary influx of migrant labor during the construction period may increase the risk of transmitted diseases. Local people will be recruited for simple work as much as possible and there is low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups shall be carried out for external workers (technical workers, etc). (d) All drivers of vehicles related to construction works of road and the power plant and operation of the power plant will be instructed to comply with the traffic rules, and respect local peoples during driving. (e) The road is designed on the existing road, embankment and salt field. (f) The proposed bridge will be built several kilometers north of the mangrove forest, and there is no residential area.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There is no local archeological, historical, cultural, and religious heritage around the road.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There is no scenery place around the roads.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and	(a) - (b) -	(a) N/A (There are no ethnic minorities and indigenous peoples.) (b) N/A (ditto)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		indigenous peoples in relation to land and resources to be respected?		
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures being taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) The project proponent will not violate any laws and ordinances associated with the working conditions of Bangladesh. (b) The construction company shall establish a work safety plan and submit it to RHD to obtain approval. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and on hard aspects (provide workers with appropriate protective equipment, etc). (c) (ditto) (d) Security guards will be taught to respect local customs in order to facilitate good relationships with local people.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) Y (c) Y	(a) <Noise and Vibration> - Construction machinery and vehicles will be regularly maintained. - Low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area. <Water Quality> - As measures for turbid water, such as rainwater runoff, settling pond will be build properly. <Air Quality> - Prevention measures for dust dispersion will be taken by spraying water. - Maintenance of machinery will be conducted regularly, resulting in reducing exhaust gas emissions. <Waste> - Construction waste and general waste will be re-used, recycled or disposed following relevant laws and regulations.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				(b) - The access road route has been determined to avoid affects on the mangrove forest, and the conditions during and after construction will be monitored. (c) - The employment of local people will be promoted for increased employment opportunities for the road construction activity. - Local people will be employed to the maximum extent possible, and foreign workers will be taught to respect local customs in order to facilitate good relationships with local people. Lodgings of project workers will be equipped with sufficient living facilities keeping order that workers remain at the project site as much as possible. - Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers will be conducted. - Local people will be recruited for simple work to the extent possible and there is a low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc). - And in regard to vehicles, bus use will be promoted to reduce increasing the number of vehicles on the roads. The bus schedules shall be managed in consultation with related organizations and shall be communicated to people in the surrounding villages.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d)Y/N	(a) An Environmental monitoring plan is prepared based on the scoping and impact assessment, and will be revised after the detailed design completion. (b) Refer to Table 15.8-3 in Chapter 15.8. (c) Refer to Figure 15.7-5 and Figure 15.7-6 in Chapter 15.7. (d) It will be confirmed after EIA approval.
6 Note	Reference to Checklist of	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also	(a) N (b) Y	(a) There is no item to be checked. (b) Refer to the Power Transmission and Distribution Lines checklist.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Other Sectors	be checked (e.g., projects including large areas of deforestation). (b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).		
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) Although CO_2 will be emitted from vehicles, the increase of traffic amount will be small, and several measures will be taken to reduce CO_2 emission.

(Source: JICA Study Team)

Table 15.10-5 Environmental Checklist (Bridge)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a)Y (b)N (c) - (d) -	(a)Draft EIA reports have been prepared for RHD by JICA Study Team. (b)EIA report has been officially submitted to DOE by RHD, but not approved. (c)N/A (d)N/A
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a)Y (b)Y	(a)Stakeholder meeting and three times Focus Group Meetings (FGD) at related three Unions have been held in the scoping stage and finalizing stage. The access road project has been welcomed in every meeting. (b)All comments were carefully considered and the issues which were related to project directly have been reflected to design or Environmental Management Plan.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	(a)During route selection stage, 3 alternative plans have been examined with social and environmental considerations; especially, avoiding affects on mangrove forest and minimizing land acquisition and construction cost have been carefully considered.
2 Pollution Control	(1) Air Quality	(a) 1. Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? 2. Does ambient air quality comply with the country's air quality standards? 3. Are any mitigating measures taken? (b) If air quality is already exceeded country's standards near the route, is there a possibility that the project will make air pollution worse?	(a) 1. Y 2. Y 3. Y	(a) 1. Vehicle traffic related construction works and operation will be increased and affect ambient air quality, but it will be not significant. 2. NOx, SO_2, PM_{10}, CO and O_3 were observed in dry and rainy season, and all values comply with Bangladesh Standard (ECR 1997 and subsequent amendment in 2005) 3. Reducing traffic amount to use bus and education for drivers are considered. (b) Current air quality comply with the standards.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			(b) N	
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b) Is there a possibility that the project will contaminate water sources, such as well water?	(a) N (b) Y	(a) There is little possibility because the roads will be constructed on the existing roads and embankment and in salt fields, and construction works will be conducted during dry season. (b) Although there is a possibility that turbidity is increased in river water during construction, the affect will be minimized by proper measures, such as silt protection curtain.
	(3) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards? (b) Do low frequency sound from the vehicle and train traffic comply with the country's standards?	(a)Y (b)	(a) Noise values observed along road comply with the ECR 1997, subsequent amendment in 2005, but there is no standard on vibration. (b) ***(To be confirmed)***
3 Natural Environment	(1) Protected Areas	(a) 1. Is the project site located in protected areas designated by the country's laws or international treaties and conventions? 2. Is there a possibility that the project will affect the protected areas?	(a) 1. N 2. -	(a) 1. There is no protected area around the proposed new road. 2. N/A
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? (e) Is there a possibility that installation of bridges and access roads will cause impacts, such as destruction of forest, poaching,	(a) Y (b) N (c) Y (d) - (e) N	(a) There is mangrove forest near the power plant site, so the alignment of the access road has been considered to avoid impact on it. (b) There is no sensitive habitat. (c)Although significant impacts on mangrove forest are not anticipated, proper measures will be taken during and after construction. (d) N/A (e)There is little possibility that installation of bridge and access roads will cause impacts, because the bridge alignment has been avoided the mangrove forest and located in salt field area, and the access road route is on existing road, salt/shrimp field and BWDB embankment.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?		
	(3) Hydrology	(a) Is there a possibility that hydrologic changes due to the installation of structures will adversely affect surface water and groundwater flows?	(a) Y	(a) Although hydrologic impacts are expected, the span of pier has been well considered to minimized impacts.
	(4) Topography and Geology	(a) 1. Is there any soft ground on the route that may cause slope failures or landslides? 2. Are adequate measures considered to prevent slope failures or landslides, where needed? (b) 1. Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? 2. Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a) 1. N 2. - (b) 1. N 2. - (c) 1. N 2. -	(a) 1. The most of the route is existing road, and others are salt/shrimp field and BWDB embankment. 2. N/A (b) 1. There is no steep slope along he proposed road. 2. N/A (c) 1. There is no steep slope along he proposed road. 2. N/A
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document?	(a) 1. N 2. - (b) Y (c) Y (d) Y (e) Y (f) Y (g) Y (h) 1. Y 2. Y (i) Y (j) Y	(a) 1. There is no involuntary resettlement caused by the proposed bridge. 2. N/A (b) Stakeholder meeting and three times Focus Group Meetings (FGD) at related three Unions have been held in the scoping stage and finalizing stage. (c) Census survey and socioeconomic survey were conducted to develop the land acquisition and resettlement plan. (d) The compensations will be paid before construction. (e) The compensation policies are prepared and described in LARAP. (f) A series of Focus Group Discussion were conducted focusing on women, children, elder people, and various workers. (g) Agreements with the affected people will be obtained after the detailed survey on the acquired land and the affected people are finished, and before the construction works is started. (h) 1. The Deputy Commissioner's Office of Cox's Bazar District will be responsible for taking the initiative to conduct local consultations concerning compensation. 2. The budget of Implementing LARAP will be provided to DC Office by RHD.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) 1. Is the organizational framework established to properly implement resettlement? 2. Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		(i) Appropriate reporting including auditing and redress functions, monitoring and evaluation mechanisms will be identified and put in place as part of LARAP. (j) During and after the land acquisition process, personal responsible for responding to complaints or suggestions from local residents will work.
	(2) Living and Livelihood	(a) 1. Where bridges and access roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? 2. Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? 3. Are adequate measures considered for preventing these impacts? (b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary? (c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (d) Is there any possibility that the project will adversely affect road traffic in the surrounding	(a) 1. Y 2. N/Y 3. Y (b) N (c) Y (d) Y (e) N (f) N	(a) 1. According to increase of demand for the existing means of transportation, such as rickshaw, tempo and baby taxi, income of the associated workers will be increased, and benefit for local residents will be increased. 2. There is not significant impacts since the land acquisition will be small part of the current use. On the other hand, from a long term viewpoint, since there are possibilities that both positive and negative impacts will be occurred. 3. Basically, for long term impacts, local community and government should concern and build consensus of the region. (b) There will be no adverse affect but will be positive affect. (c) A temporary influx of migrant labor during the construction period may increase the risk of transmitted diseases. Local people will be recruited for simple work as much as possible and there is low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups shall be carried out for external workers (technical workers, etc). (d) All drivers of vehicles related to construction works of bridge, access road and the power plant, and operation of the power plant will be instructed to comply with the traffic rules, and respect local peoples during driving. (e) The bridge is designed between salt fields and on the river. (f) The proposed bridge will be built several kilometers north of the mangrove forest, and there is no residential area.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		areas (e.g., increase of traffic congestion and traffic accidents)? (e) Is there any possibility that project will impede the movement of inhabitants? (f) Is there any possibility that bridges will cause a sun shading and radio interference?		
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There is no local archeological, historical, cultural, and religious heritage around the bridge.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There is no scenery place around the bridge.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?	(a) - (b) -	(a) N/A (There are no ethnic minorities and indigenous peoples.) (b) N/A (ditto)
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures being taken to ensure that security guards involved in the	(a) Y (b) Y (c) Y (d) Y	(a) The project proponent will not violate any laws and ordinances associated with the working conditions of Bangladesh. (b) The construction company shall establish a work safety plan and submit it to RHD to obtain approval. The work safety plan shall stipulate mitigation measures on soft aspects (safety training, etc.) and on hard aspects (provide workers with appropriate protective equipment, etc). (c) (ditto) (d) Security guards will be taught to respect local customs in order to facilitate good relationships with local people.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		project not to violate safety of other individuals involved, or local residents?		
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) Y (c) Y	(a) <Noise and Vibration> - Construction machinery and vehicles will be regularly maintained. - Low-noise/ low-vibration machinery will be used. - Noise levels generated from construction machinery will meet noise level standards at the nearest residential area. <Water Quality> - As measures for turbid water in river silt protection curtain will be installed properly. <Air Quality> - Maintenance of machinery will be conducted regularly, resulting in reducing exhaust gas emissions. <Waste> - Construction waste and general waste will be re-used, recycled or disposed following relevant laws and regulations. (b) - The bridge alignment has been determined to avoid affects on the mangrove forest, and the conditions during and after construction will be monitored. (c) - The employment of local people will be promoted for increased employment opportunities for the bridge and access road construction activity. - Local people will be employed to the maximum extent possible, and foreign workers will be taught to respect local customs in order to facilitate good relationships with local people. Lodgings of project workers will be equipped with sufficient living facilities keeping order that workers remain at the project site as much as possible. - Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers will be conducted. - Local people will be recruited for simple work to the extent possible and there is a low risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc). - And in regard to vehicles, bus use will be promoted to reduce increasing the number of vehicles on the roads. The bus schedules shall be managed in consultation with related organizations and shall be communicated to people in the surrounding villages.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d)Y/N	(a) An Environmental monitoring plan is prepared based on the scoping and impact assessment, and will be revised after the detailed design completion. (b) Refer to Table 15.8-3 in Chapter 15.8. (c) Refer to Figure 15.7-5 and Figure 15.7-6 in Chapter 15.7. (d) It will be confirmed after EIA approval.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Roads, Railways and Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation). (b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	(a) Y (b) Y	(a) Refer to the Roads checklist. (b) Refer to the Power Transmission and Distribution Lines checklist.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) Although CO_2 will be emitted from vessels and vehicles, the increase of traffic amount will be small, and several measures will be taken to reduce CO_2 emission.

(Source: JICA Study Team)

15.10.2 Monitoring form

(1) Power Plant and Port Facility

Items that require monitoring shall be decided on according to the sector and nature of the project, with reference to the following list of items (Table 15.10-6).

Table 15.10-6 Monitoring Form (Power Plant and Port Facility)

(1) Pre-construction Phase

1) Land Acquisition

- Including in LARAP

2) Others

- Interviewing affected people about their livelihood

(2) Construction Phase

1) Air Quality

Date: (Parameter: PM_{10}, Unit $\mu g/m^3$)

Location	Measured Value (24hr Average)	Ambient air quality standards	IFC/ EHC Guideline (General; 2007)	Remarks
St.1		150 (24hr)	50 (24hr)	
St.2				
St.3				

(Source: JICA Study Team)

Meteorological Condition

Location (Date)	Time		Temperature (°o.)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
St.1	AM	:					m/sec
	PM	:					m/sec
St.2	AM	:					m/sec
	PM	:					m/sec
St.3	AM	:					m/sec
	PM	:					m/sec

Source: JICA Study Team)

2) Water Quality

a. Drain Outlet

(Date:)

Parameter	Unit	Result	Wastewater discharge standards			Remarks (Measurements method)
			Inland surface water	Public sewer	Irrigated land	
Temperature	℃.		-	-	-	
pH	-		6-9	6-9	6-9	
BOD	mg/L		50	250	100	
COD	mg/L		200	400	400	
TSS	mg/L		150	500	200	
Oil & grease	mg/L		10	20	10	
As	mg/L		0.2	0.05	0.2	
Cd	mg/L		0.05	0.5	0.5	
T-Cr	mg/L		0.5	1.0	1.0	
Cu	mg/L		0.5	3.0	3.0	
Fe	mg/L		2	2	2	
Pad	mg/L		0.1	1.0	0.1	
Hg	mg/L		0.01	0.01	0.01	
Total fecal coliform	MPN/100mL		-	-	-	

(Source: JICA Study Team)

b. Surface Water

(Date:)

Parameter	Unit	Result	Ambient water quality standards					
			A	B	C	D	E	F
Temperature	℃.		-	-	-	-	-	-
pH	-		6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
BOD	mg/L		2 or less	3 or less	3 or less	6 or less	10 or less	10 or less
DO	mg/L		6 or above	5 or above	6 or above	5 or above	5 or above	5 or above
Total fecal coliform	MPN/100mL		50 or less	20 or less	5000 or less	5000 or less	-	1000 or less

Notes: Category of water body is as below.

A: Potable water source supply after bacteria freeing only
B: Water used for recreational purposes
C: Potable water source supply after conventional processing
D: Water used for pisci-culture
E: Industrial use water including chilling and other processes
F: Water used for irrigation

(Source: JICA Study Team)

c. Ground Water

(Date:)

Parameter	Unit	Result	Drinking water quality standards	WHO guideline (Drinking water)	Remarks (Measurements method)
Water level	m			-	From MWL
Temperature	°C		20 - 30	-	
pH	-		6.5 8.5	-	
Chloride	mg/L		150 - 600	-	
NH_3	mg/L		0.5	-	
Iron (Fe)	mg/L		0.3 1.0	-	
Hardness	mg/L		200 - 500	-	
Arsenic (As)	mg/L		0.05	0.01	
DO	mg/L		6.0	-	
BOD	mg/L		0.2	-	
COD	mg/L		4.0	-	
TSS	mg/L		10	-	
TDS	mg/L		1,000	1,000	
Coliform	N/100mL		0	-	
Salinity	-		-	-	

(Source: JICA Study Team)

d. Sea Water

(Dredging Activity)

(Dates;)

Parameter	Unit	Results		Remarks
		St.1	St.2	
Temperature	°C			
pH	-			
BOD	mg/L			
COD	mg/L			
TSS	mg/L			
Oil & grease	mg/L			
As	mg/L			
Cd	mg/L			
T-Cr	mg/L			
Cu	mg/L			
Fe	mg/L			
Pd	mg/L			
Hg	mg/L			

(Source: JICA Study Team)

(Water Quality)

(Date:)

Parameter	Unit	SP-1			SP-2			SP-3		
		Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
Depth	M									
Temperature	°C									
Salinity	-									
pH	-									
DO	mg/L									
BOD	mg/L									
COD	mg/L									
Oil & Grease	mg/L									
SS	mg/L									
T-Cr	mg/L									
Cu	mg/L									
Fe	mg/L									
Zn	mg/L									
Pb	mg/L									
Cd	mg/L									
Hg	mg/L									
As	mg/L									

Parameter	Unit	SP-4			SP-5			Average		
		Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
Depth	M									
Temperature	°C									
Salinity	-									
pH	-									
DO	mg/L									
BOD	mg/L									
COD	mg/L									
Oil & Grease	mg/L									
SS	mg/L									
T-Cr	mg/L									
Cu	mg/L									
Fe	mg/L									
Zn	mg/L									
Pb	mg/L									
Cd	mg/L									
Hg	mg/L									
As	mg/L									

(Source: JICA Study Team)

3) Noise

Date; (Unit: dBA)

Location	Result	Noise standards					Remarks
		A	B	C	D	E	
St.1		Day (6AM-9PM): 45 Night (9PM-6AM): 35	Day: 50 Night: 40	Day: 60 Night: 50	Day: 70 Night: 60	Day: 70 Night: 70	
St.2							
St.3							

Notes: Category of areas is as below.

A: Silent zone
B: Residential area
C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes)
D: Commercial area
E: Industrial area

(Source: JICA Study Team)

Reference: IFC/EHS guidelines

Receptor	Day 07:00-22:00	Night 22:00-07:00
Residential, institutional, educational area	55	45
Industrial, commercial area	70	70

(Source: IFC/EHS General Guidelines, 2007)

Meteorological Condition

Location (Date)	Time		Temperature (^{o}C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
St.1	AM	:					m/sec
	PM	:					m/sec
St.2	AM	:					m/sec
	PM	:					m/sec
St.3	AM	:					m/sec
	PM	:					m/sec

(Source: JICA Study Team)

4) Ecosystem

a. Endangered Species

(Migration Birds)

Date (Time)	Total No. of individuals	Species Name and No. of individuals

(Source: JICA Study Team)

(Others)

(Date:)

Scientific name	Local name	English name	Total No. of individuals	Conservation Status		Remarks
				IUCN	Local	

(Source: JICA Study Team)

b. Sea Turtle

Date (Time)	Total No. of individuals (Location)		Species Name and No. of individuals
	Line-1	Line-2	
	Long. N Lati. E	Long. N Lati. E	Length of the lines(Line-1; m,Line-2; m)
	Long. N Lati. E	Long. N Lati. E	Length of the lines(Line-1; m,Line-2; m)
	Long. N Lati. E	Long. N Lati. E	Length of the lines(Line-1; m,Line-2; m)

(Source: JICA Study Team)

c. Phyto-plankton

(Date;) (Unit: cells/L)

Species		SP.1			SP.2			SP.3		
		Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
Depth (m)		0.5			0.5			0.5		
1										
2										
・										
・										
No. of species										
Total										

Species		SP.4			SP.5			Average		
		Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
Depth (m)		0.5			0.5			-	-	-
1										
2										
・										
・										
No. of species										
Total										

(Source: JICA Study Team)

d. Zoo-plankton

(Date:) (Unit: Individual/m^3)

Species		SP.1		SP.2		SP.3	
		0 <- 5	5 <- B+1	0 <- 5	5 <- B+1	0 <- 5	5 <- B+1
1							
2							
・							
・							
No. of species							
Total							

Species		SP.4		SP.5		Average	
		0 <- 5	5 <- B+1	0 <- 5	5 <- B+1	0 <- 5	5 <- B+1
1							
2							
・							
・							
No. of species							
Total							

(Source: JICA Study Team)

e. Benthos (Sea Bottom)

(Date;) (Unit: Individuals/m^2)

Species		SP-1	SP-2	SP-3	SP-4	SP-5	Total
1							
2							
・							
・							
Total							

(Source: JICA Study Team)

f. Benthos (Mud Flat)

(Date;) (Unit: Individuals/m^2)

		Result
1		
2		
・		
・		
Number of species		
Total		

(Source: JICA Study Team)

g. Fish and Nekton

(Date;) (Unit: Individuals/haul, g/haul)

		Result	
		No. of individuals	weight
1			
2			
・			
・			
Number of species			
Total			

(Source: JICA Study Team)

5) Other

1) Waste
- Kinds and quantity of waste, and the disposal method

2) Social Environment
- Interviewing residents to assess their opinions
- Grievances
- Record of numbers of vessels and cars being used

3) Working Environment and Accidents
- Record of accidents

4) CO_2 Emission
- Record of machinery maintenance

(3) Operation Phase

1) Air Quality

a. CEMS (Continuous Emission Monitoring System)

(Date: from to)

Parameter	Unit	Period exceeding the standard	Emission gas standards	IFC/ EHC Guideline (Thermal Power Plant; 2008)	Remarks
SO_2	mg/Nm^3		-	850	
NO_X	mg/Nm^3		600	510	
PM_{10}	mg/Nm^3		500	50	

Notes: Dry Gas, Excess O_2 Content is 6%

(Source: JICA Study Team)

b. Ambient Air Quality

(Date: from to) (Unit: $\mu g/m^3$)

Parameter	Ave. time	Results			Ambient air quality standards	IFC/ EHC Guideline (General; 2007)	Remarks
		St.1	St.2	St.3			
SO_2	(1hr)				350 (1hr)	-	
	(24hr)				125 (24hr)	125 (24hr)	
NO_2	(1hr)				200 (1hr)	200 (1hr)-	
	(24hr)				100 (24hr)	-	
PM_{10}	(24hr)				150 (24hr)	150 (24hr)	

(Source: JICA Study Team)

Meteorological Condition

Location (Date)	Time		Temperature (^oC)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
St.1	AM	:					m/sec
	PM	:					m/sec
St.2	AM	:					m/sec
	PM	:					m/sec
St.3	AM	:					m/sec
	PM	:					m/sec

(Source: JICA Study Team)

2) Water Quality

a. Sea Water

(Date:)

Parameter	Unit	SP-1			SP-2			SP-3		
		Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
Depth	m									
Temperature	°C									
Salinity	-									
pH	-									
DO	m/L									
BOD	m/L									
COD	m/L									
Oil & Grease	m/L									
SS	m/L									
T-Cr	m/L									
Cu	m/L									
Fe	m/L									
Zn	m/L									
Pb	m/L									
Cd	m/L									
Hg	m/L									
As	m/L									

Parameter	Unit	SP-4			SP-5			Average		
		Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
Depth	M									
Temperature	°C									
Salinity	-									
pH	-									
DO	mg/L									
BOD	mg/L									
COD	mg/L									
Oil & Grease	mg/L									
SS	mg/L									
T-Cr	mg/L									
Cu	mg/L									
Fe	mg/L									
Zn	mg/L									
Pb	mg/L									
Cd	mg/L									
Hg	mg/L									
As	mg/L									

(Source: JICA Study Team)

b. Sea Water

(Dredging Activity)

(Dates;)

Parameter	Unit	Results		Remarks
		St.1	St.2	
Temperature	°C			
pH	-			
BOD	mg/L			
COD	mg/L			
TSS	mg/L			
Oil & grease	mg/L			
As	mg/L			
Cd	mg/L			
T-Cr	mg/L			
Cu	mg/L			
Fe	mg/L			
Pd	mg/L			
Hg	mg/L			

(Source: JICA Study Team)

c. Ground Water

(Date:)

Parameter	Unit	Result	Drinking water quality standards	WHO guideline (Drinking water)	Remarks (Measurements method)
Temperature	°C		20 - 30	-	
pH	-		6.5 8.5	-	
Chloride	mg/L		150 - 600	-	
NH_3	mg/L		0.5	-	
Iron (Fe)	mg/L		0.3 1.0	-	
Hardness	mg/L		200 - 500	-	
Arsenic (As)	mg/L		0.05	0.01	
DO	mg/L		6.0	-	
BOD	mg/L		0.2	-	
COD	mg/L		4.0	-	
TSS	mg/L		10	-	
TDS	mg/L		1,000	1,000	
Coliform	N/100mL		0	-	
Salinity	-		-	-	

(Source: JICA Study Team)

d. Drain Outlet

(Continuous measurement: pH)

(Date: from to)

Para -meter	Location	Period exceeding the standard	Wastewater discharge standards			IFC guideline (Thermal power: 2008)	Remarks
			Inland surface water	Public sewer	Irrigated land		
pH	St.1		6-9	6-9	6-9	6-9	
	St.2						

(Source: JICA Study Team)

(Sampling)

(Date:)

Parameter	Unit	Result		Wastewater discharge standards			IFC guideline (Thermal power: 2008)	Remarks
		St.1	St.2	Inland surface water	Public sewer	Irrigated land		
Temperature	ºC			40 (Summer) 45 (Winter)	40 (Summer) 45 (Winter)	40 (Summer) 45 (Winter)	-	
BOD	mg/L			50	250	100	-	
COD	mg/L			200	400	400	-	
TSS	mg/L			150	500	200	50	
Oil & grease	mg/L			10	20	10	10	
As	mg/L			0.2	0.05	0.2	0.5	
Cd	mg/L			0.05	0.5	0.5	0.1	
T-Cr	mg/L			0.5	1.0	1.0	0.5	
Cu	mg/L			0.5	3.0	3.0	0.5	
Fe	mg/L			2	2	2	1	
Pd	mg/L			0.1	1.0	0.1	0.5	
Hg	mg/L			0.01	0.01	0.01	0.005	
Total fecal coliform	MPN/100mL			-	-	-	-	

(Source: JICA Study Team)

e. Record of "Coal spillages& oil leakages" and "Kind, Nature, Amount, and Discharge point of wastewater from vessels" (Port facility)

3) Noise

(Date;) (Unit: dBA)

Location	Result	Noise standards					Remarks
		A	B	C	D	E	
St.1		Day (6AM-9PM): 45 Night (9PM-6AM): 35	Day: 50 Night: 40	Day: 60 Night: 50	Day: 70 Night: 60	Day: 70 Night: 70	
St.2							
St.3							

Notes: Category of areas is as below.

A: Silent zone, B: Residential area, C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes), D: Commercial area, E: Industrial area

Reference: IFC/EHS guidelines

Receptor	Day (07:00-22:00)	Night (22:00-07:00)
Residential, institutional, educational area	55	45
Industrial, commercial area	70	70

(Source: IFC/EHS General Guidelines, 2007)

Meteorological Condition

Location (Date)	Time		Temperature (ºC)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
St.1	AM	:					m/sec
	PM	:					m/sec
St.2	AM	:					m/sec
	PM	:					m/sec
St.3	AM	:					m/sec
	PM	:					m/sec

(Source: JICA Study Team)

4) Ecosystem

a. Endangered Species

(Migration birds)

Date (Time)	Total No. of individuals	Species Name and No. of individuals

(Source: JICA Study Team)

b. Sea Turtle

Date (Time)	Total No. of individuals (Location)		Species Name and No. of individuals
	Line-1	Line-2	
	Long. N Lati. E	Long. N Lati. E	Length of the lines(Line-1; m,Line-2; m)
	Long. N Lati. E	Long. N Lati. E	Length of the lines(Line-1; m,Line-2; m)
	Long. N Lati. E	Long. N Lati. E	Length of the lines(Line-1; m,Line-2; m)

(Source: JICA Study Team)

c. Phyto-plankton

(Date;) (Unit: cells/L)

Species	SP.1			SP.2			SP.3		
	Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
Depth (m)	0.5			0.5			0.5		
1									
2									
・									
・									
No. of species									
Total									

Species	SP.4			SP.5			Average		
	Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
Depth (m)	0.5			0.5			-	-	-
1									
2									
・									
・									
No. of species									
Total									

(Source: JICA Study Team)

d. Zoo-plankton

(Date:) (Unit: Individual/m^3)

Species		SP.1		SP.2		SP.3	
		0 <- 5	5 <- B+1	0 <- 5	5 <- B+1	0 <- 5	5 <- B+1
1							
2							
・							
・							
No. of species							
Total							

Species		SP.4		SP.5		Average	
		0 <- 5	5 <- B+1	0 <- 5	5 <- B+1	0 <- 5	5 <- B+1
1							
2							
・							
・							
No. of species							
Total							

(Source: JICA Study Team)

e. Benthos (Sea bottom)

(Date;) (Unit: Individuals/m^2)

Species		SP-1	SP-2	SP-3	SP-4	SP-5	Total
1							
2							
・							
・							
Total							

(Source: JICA Study Team)

f. Benthos (Mud Flat)

(Date;) (Unit: Individuals/m^2)

		Result
1		
2		
・		
・		
Number of species		
Total		

(Source: JICA Study Team)

g. Fish and Nekton

(Date;) (Unit: Individuals/haul, g/haul)

		Result	
		No. of individuals	weight
1			
2			
・			
・			
Number of species			
Total			

(Source: JICA Study Team)

5) Other

1) Waste

- Kinds and quantity of waste, and the disposal method

2) Social Environment

- Interviewing residents to assess their opinions
- Grievances
- Record of numbers of vessels and cars being used

3) Working Environment and Accidents

- Record of accidents

4) CO_2 Emission

- Estimate amount of CO_2 emission

(2) Transmission Line

Items that require monitoring shall be decided on according to the sector and nature of the project, with reference to the following list of items (Table 15.10-7).

Table 15.10-7 Monitoring Form (Transmission Line)

(1) Pre-construction Phase

1) Land Acquisition and Compensation

- Including a compensation plan

2) Others

- Interviewing to affected people about their livelihood

(2) Construction Phase

1) Ecosystem

(Migration Birds)

(Line;)

Date (Time)	Total No. of individuals	Species Name and No. of individual

(Source: JICA Study Team)

(Others)

(Date:)

Scientific name	Local name	English name	Total No. of individuals	Conservation Status		Remarks
				IUCN	Local	

(Source: JICA Study Team)

2) Working Environment and Accidents

- Record of accidents

(3) Operation Phase

1) Ecosystem

(Struck Birds)

(Line;)

Date	Total No. of individuals	Species Name and No. of individuals

(Source: JICA Study Team)

2) Working Environment and Accidents

- Record of accidents

3) Soil Runoff and Tower Breakages

(Condition of Tower Bases)

(Date;)

No. of Tower	Soil condition on the tower base	Inclination of the tower	Remarks

(Source: JICA Study Team)

(3) Access Road

Items that require monitoring shall be decided on according to the sector and nature of the project, with reference to the following list of items (Table 15.10-8).

Table 15.10-8 Monitoring Form (Access Road)

(1) Pre-construction phase

1) Land Aacquisition

- Including in LARAP

2) Others

- Interviewing affected people about their livelihood

(2) Construction Phase

1) Air Quality

Date: (Parameter: PM_{10}, Unit $\mu g/m^3$)

Location	Measured Value (24hr Average)	Ambient air quality standards	IFC/ EHC Guideline (General; 2007)	Remarks
St.1		150 (24hr)	50 (24hr)	
St.2				
St.3				

(Source: JICA Study Team)

2) Water Quality

a. Run Off Water from Construction Area

(Date:)

Parameter	Unit	Result
Temperature	°C.	
pH	-	
BOD	mg/L	
SS	mg/L	
DO	mg/L	
Total fecal coliform	MPN/100mL	

(Source: JICA Study Team)

b. Surface Water

(Date:)

Parameter	Unit	Result
Temperature	°C.	
pH	-	
BOD	mg/L	
SS	mg/L	
DO	mg/L	
Total fecal coliform	MPN/100mL	

(Source: JICA Study Team)

3) Waste

Place	Kinds of waste	Quantity	Disposal method
St.1 (Karamachara)			
St.2 (Matarbari)			

(Source: JICA Study Team)

4) Noise

Date; (Unit: dBA)

Location	Result	Noise standards					Remarks
		A	B	C	D	E	
St.1		Day (6AM-9PM): 45 Night (9PM-6AM): 35	Day: 50 Night: 40	Day: 60 Night: 50	Day: 70 Night: 60	Day: 70 Night: 70	
St.2							
St.3							

Notes: Category of areas is as below.
A: Silent zone
B: Residential area
C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes)
D: Commercial area
E: Industrial area

(Source: JICA Study Team)

Reference: IFC/EHS guidelines

Receptor	Day (07:00-22:00)	Night (22:00-07:00)
Residential, institutional, educational area	55	45
Industrial, commercial area	70	70

(Source: IFC/EHS General Guidelines, 2007)

5) Ecosystem

a. Mangrove Forest

Date (Time)	Location	Number of mangrove forest	Area	Density

(Source: JICA Study Team)

b. Benthos (Mud Flat)

(Date;) (Unit: Individuals/m^2)

Species		SP-1	SP-2	SP-3	SP-4	SP-5	Total
1							
2							
・							
・							
Total							

(Source: JICA Study Team)

c. Sediment quality

Parameters	SD1		SD2		SD3	
	Dry season (Date:)	Rainy season (Date:)	Dry season (Date:)	Rainy season (Date:)	Dry season (Date:)	Rainy season (Date:)
Location						
Appearances						
Odor						
Colour						
Grading Analysis (mm)						
Density (gm/cm^3)						
Water content (%)						
Ignition loss (gm/gm)						
COD (µg/g)						
Mercury (µg/g)						
Arsenic (µg/g)						
Lead (µg/g)						
Chromium (µg/g)						
Cadmium (µg/g)						
Copper (µg/g)						
Nickel (µg/g)						
Zinc (µg/g)						

(Source: JICA Study Team)

-Topographic feature

6) Other

1) Social Environment

- Interviewing residents to assess their opinions
- Grievances
- Record of numbers of vessels and cars being used
- Child labor

2) Working Environment and Accidents

- Record of accidents

3) CO_2 Emission

- Record of machinery maintenance

(3) Operation Phase

1) Air Quality

a. Ambient Air Quality

(Date: from to) (Unit: μg/m^3)

Parameter	Ave. time	Results			Ambient air quality standards	IFC/ EHC Guideline (General; 2007)	Remarks
		St.1	St.2	St.3			
SO_2	(1hr)				350 (1hr)	-	
	(24hr)				125 (24hr)	125 (24hr)	
NO_2	(1hr)				200 (1hr)	200 (1hr)-	
	(24hr)				100 (24hr)	-	
PM_{10}	(24hr)				150 (24hr)	150 (24hr)	

(Source: JICA Study Team)

2) Water Quality

a. Surface water

(Date:)

Parameter	Unit	Result
Temperature	°C.	
pH	-	
BOD	mg/L	
SS	mg/L	
DO	mg/L	
Total fecal coliform	MPN/100mL	

(Source: JICA Study Team)

3) Waste

	Kinds of waste	Quantity	Disposal method
St.1 (Karamachara)			
St.2 (Matarbari)			

(Source: JICA Study Team)

4) Noise

(Date;) (Unit: dBA)

Location	Result	Noise standards					Remarks
		A	B	C	D	E	
St.1		Day (6AM-9PM): 45 Night (9PM-6AM): 35	Day: 50 Night: 40	Day: 60 Night: 50	Day: 70 Night: 60	Day: 70 Night: 70	
St.2							
St.3							

Notes: Category of areas is as below.
A: Silent zone, B: Residential area, C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes), D: Commercial area, E: Industrial area

(Source: JICA Study Team)

Reference: IFC/EHS guidelines

Receptor	Day 07:00-22:00	Night 22:00-07:00
Residential, institutional, educational area	55	45
Industrial, commercial area	70	70

(Source: IFC/EHS General Guidelines, 2007)

5) Ecosystem

a. Mangrove Forest

Date (Time)	Location	Number of mangrove forest	Area	Density

(Source: JICA Study Team)

b. Benthos (Mud Flat)

(Date;) (Unit: Individuals/m^2)

Species		SP-1	SP-2	SP-3	SP-4	SP-5	Total
1							
2							
.							
.							
Total							

(Source: JICA Study Team)

c. Sediment Quality

Parameters	SD1		SD2		SD3	
	Dry season (Date:)	Rainy season (Date:)	Dry season (Date:)	Rainy season (Date:)	Dry season (Date:)	Rainy season (Date:)
Location						
Appearances						
Odor						
Colour						
Grading Analysis (mm)						
Density (gm/cm^3)						
Water content (%)						
Ignition loss (gm/gm)						
COD (µg/g)						
Mercury (µg/g)						
Arsenic (µg/g)						
Lead (µg/g)						
Chromium (µg/g)						
Cadmium (µg/g)						
Copper (µg/g)						
Nickel (µg/g)						
Zinc (µg/g)						

(Source: JICA Study Team)

6) Other

1) Social Environment
- Interviewing residents to assess their opinions
- Grievances
- Record of numbers of vessels and cars being used
- Child labor

2) Working Environment and Accidents
- Record of accidents

3) CO_2 Emission
- Traffic amounts