Chapter 10 Financing for Materialization of the Master Plan APPENDEX

10.1 Appendix-1 FINANCIAL MODEL FOR THE MASTER PLAN

AP Table 10-1 ECONOMIC ASSUMPTIONS

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Fiscal Year ending at June of	**Unit**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Inflation																								
Local Inflation (end of June)	% p.a.	0.10	0.02	0.09	0.06																			
Local inflation (average for fiscal year)	% p.a.	0.10	0.07	0.07	0.06																			
US inflation (average, calendar yr)	% p.a.	0.04	0.00	0.02	0.03																			
Inflation in Japan (average, calendar yr)	% p.a.	0.01	-0.01	-0.01	0.01																			
Price index																								
Local prices (average: 1995-96=100)		193.5	206.4	221.5	234.2																			
Local prices (end of June: 1996=100)		203.4	208.0	226.1	239.0																			
US prices (average: 1982-84=100)		215.3	214.5	218.6	224.0																			
Japanese prices (average: 2005=100)		101.7	100.3	99.3	100.3																			
Exchange rate																								
Taka/US$ (average)	Taka	68.60	68.80	69.59	68.08																			
Change from previous year	% p.a.	-0.01	0.00	0.01	-0.02																			
Taka/JPY (average)	Taka	0.62	0.70	0.82	0.81																			
Change from previous year	% p.a.	0.07	0.13	0.17	-0.01																			
Electricity Tariff																								
Average Billing Rate of BPDB	Tk/kWh	2.36	2.56	2.75	2.90																			
Ave Bulk Wholesale Tariff	Tk/kWh	2.37	2.37	2.37																				
Fuel price (constant price in US $)																								
Domestic Coal	US Cents/MM kcal	1,399.64	1,399.64	1,467.41	1,530.46	1,595.08	1,654.98	1,714.87	1,773.19	1,829.93	1,885.10	1,940.26	1,992.28	2,044.29	2,096.30	2,146.74	2,195.60	2,244.46	2,293.33	2,339.03	2,386.32	2,432.03	2,477.74	
Imported Coal	US Cents/MM kcal	1,454.02	1,454.02	1,538.73	1,617.54	1,698.32	1,773.19	1,848.06	1,920.96	1,991.88	2,060.84	2,129.80	2,194.82	2,259.83	2,324.85	2,387.90	2,448.97	2,510.05	2,571.13	2,628.26	2,687.37	2,744.50	2,801.64	
Heavy Fuel Oil (Furnace Oil)	US Cents/MM kcal	3,657.02	4,760.69	4,842.66	4,924.63	5,006.60	5,088.57	5,170.54	5,329.59	5,488.64	5,647.68	5,806.73	5,965.78	6,055.27	6,144.75	6,234.24	6,323.73	6,413.21	6,502.70	6,592.19	6,681.67	6,771.16	6,860.65	
High Speed Diesel Oil	US Cents/MM kcal	5,607.43	7,299.73	7,425.41	7,551.10	7,676.79	7,802.47	7,928.16	8,172.03	8,415.91	8,659.78	8,903.65	9,147.53	9,284.74	9,421.95	9,559.17	9,696.38	9,833.59	9,970.80	10,108.02	10,245.23	10,382.44	10,519.66	
Natural Gas (Domestic)																								
Natural Gas (Import)	US Cents/MM kcal	2,743.00	3,570.52	3,632.00	3,693.47	3,754.95	3,816.43	3,877.91	3,997.19	4,116.48	4,235.76	4,355.05	4,474.33	4,541.45	4,608.56	4,675.68	4,742.79	4,809.91	4,877.02	4,944.14	5,011.25	5,078.37	5,145.48	
Fuel price (constant price in BD Taka)																								
Domestic Coal	Tk/MM kcal	974.01	974.01	1,021.17	1,065.05	1,110.02	1,151.70	1,193.38	1,233.96	1,273.45	1,311.84	1,350.23	1,386.43	1,422.62	1,458.82	1,493.92	1,527.92	1,561.92	1,595.93	1,627.73	1,660.64	1,692.45	1,724.26	
	Taka/Ton	5,941.46	5,941.46	6,229.14	6,496.79	6,771.10	7,025.37	7,279.61	7,527.17	7,768.03	8,002.23	8,236.38	8,457.21	8,677.99	8,898.77	9,112.89	9,320.30	9,527.71	9,735.16	9,929.16	10,129.90	10,323.94	10,517.98	
Imported Coal	Tk/MM kcal	1,011.85	1,011.85	1,070.80	1,125.65	1,181.86	1,233.96	1,286.06	1,336.80	1,386.15	1,434.14	1,482.13	1,527.38	1,572.62	1,617.86	1,661.74	1,704.24	1,746.74	1,789.25	1,829.01	1,870.14	1,909.90	1,949.66	
	Taka/Ton	5,160.45	5,160.45	5,461.09	5,740.80	6,027.49	6,293.21	6,558.93	6,817.66	7,069.36	7,314.11	7,558.85	7,789.61	8,020.34	8,251.10	8,474.87	8,691.61	8,908.39	9,125.17	9,327.93	9,537.72	9,740.48	9,943.27	
Heavy Fuel Oil (Furnace Oil)	Tk/MM kcal	2,544.92	3,312.96	3,370.01	3,427.05	3,484.09	3,541.14	3,598.18	3,708.86	3,819.54	3,930.22	4,040.90	4,151.59	4,213.86	4,276.13	4,338.41	4,400.68	4,462.95	4,525.23	4,587.51	4,649.77	4,712.05	4,774.33	
	Taka/Litre	24.29	31.63	32.17	32.71	33.26	33.80	34.35	35.40	36.46	37.52	38.57	39.63	40.23	40.82	41.41	42.01	42.60	43.20	43.79	44.39	44.98	45.58	
High Speed Diesel Oil	Tk/MM kcal	3,902.21	5,079.88	5,167.34	5,254.81	5,342.28	5,429.74	5,517.21	5,686.92	5,856.63	6,026.34	6,196.05	6,365.77	6,461.25	6,556.74	6,652.23	6,747.71	6,843.20	6,938.68	7,034.17	7,129.66	7,225.14	7,320.63	
	Taka/Litre	34.95	45.50	46.28	47.06	47.85	48.63	49.41	50.93	52.45	53.97	55.49	57.01	57.87	58.72	59.58	60.43	61.29	62.14	63.00	63.85	64.71	65.56	
Natural Gas (Domestic)	Tk/MM kcal	308.73	333.42																					
	Taka/10^3 cft	73.91	79.82																					
Natural Gas (Import)	Tk/MM kcal	1,908.85	2,484.72	2,527.51	2,570.29	2,613.07	2,655.85	2,698.64	2,781.64	2,864.66	2,947.67	3,030.68	3,113.69	3,160.40	3,207.10	3,253.81	3,300.51	3,347.22	3,393.92	3,440.63	3,487.33	3,534.04	3,580.74	
	Taka/10^3 cft	456.98	594.84	605.09	615.33	625.57	635.81	646.05	665.93	685.80	705.67	725.54	745.42	756.60	767.78	778.96	790.14	801.32	812.50	823.69	834.87	846.05	857.23	

Source: PSMP Study Team

Conversion Factor			
Coal (Domestic)	1 kg=	6100	kcal
Coal (Imported)	1 kg=	5100	kcal
Furnace Oil	1 litre=	9546	kcal
High Speed Diesel Oil	1 litre=	8956	kcal

Natural gas (MM kcal/GJ)	1MMkcal=	4.1868	GJ
	1 M cal=	8.454*10^6	cubic meter
Natural gas (GJ/MM BTU)	1MMBTU=	1.0551	GJ
Natural gas (BTU per cubic feet)	1SCF=	1029	1,000 BTU
	1 cubic	10.33994	mmcfd
BPDB	1 cubic	239.4	Kcal
BPDB	1 cubic	950	BTU

AP Table 10-2 COST for GENERATION SUMMARY (Tk million) (1/6)

Total Generation Capacoty (MW)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New-PUBLIC	0	0	0	0	460	1,132	2,092	3,527	4,187	4,637	5,687	5,687	5,687	5,687	5,787	5,787	5,787	5,787	5,787	5,787	5,787	5,787	5,787	5,787
New-PUBLIC excl. Hydro/RE	0	0	0	0	460	1,132	2,092	3,527	4,187	4,637	5,687	5,687	5,687	5,687	5,687	5,687	5,687	5,687	5,687	5,687	5,687	5,687	5,687	5,687
New-IPP	0	0	0	0	0	400	565	1,215	3,015	4,215	6,165	6,915	6,915	7,665	7,665	7,665	7,665	7,665	7,665	7,665	7,665	7,665	6,900	6,900
New-RENTAL	0	0	0	194	1,771	1,771	1,771	1,628	1,058	1,058	51	51	51	51	51	51	51	51	51	0	0	0	0	0
New- PUBL/PRIV undeternied	0	0	0	0	0	0	0	0	0	0	0	600	2,000	2,200	2,900	3,600	4,900	6,100	6,200	8,200	10,500	12,600	16,000	17,600
New-Nuclear	0	0	0	0	0	0	0	0	0	0	0	1,000	1,000	2,000	2,000	2,000	2,000	3,000	4,000	4,000	4,000	4,000	4,000	4,000
New-Renewable	0	0	0	0	0	0	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
New-Intl Conn	0	0	0	0	0	0	500	500	500	500	500	1,000	1,000	1,000	1,500	2,250	3,250	3,250	3,500	3,500	3,500	3,500	3,500	3,500
Sub-Total for New Plants	0	0	0	194	2,231	3,303	5,039	6,981	8,871	10,521	12,514	15,364	16,764	18,714	20,014	21,464	23,764	25,964	27,314	29,263	31,563	33,663	36,298	37,898
Exist-PUBLIC	0	0	3,108	3,108	3,108	3,108	3,108	3,104	2,725	2,725	2,474	2,474	2,474	2,384	2,384	2,086	1,779	1,591	1,413	1,135	960	960	785	607
Exist-PUBLIC excl. Hydro/RE	0	0	2,878	2,878	2,878	2,878	2,878	2,874	2,495	2,495	2,244	2,244	2,244	2,154	2,154	1,856	1,549	1,361	1,183	905	730	730	555	377
Exist-IPP			0	1,271	1,271	1,271	1,271	1,271	1,271	1,271	985	985	985	985	985	985	985	985	985	985	985	625	175	175
Exist-RENTAL			0	559	559	421	421	421	421	421	421	421	421	421	421	421	421	421	0	0	0	0	0	0
Sub-Total for Existing Plants	0	0	3,108	4,938	4,938	4,800	4,800	4,796	4,417	4,417	3,880	3,880	3,880	3,790	3,790	3,492	3,185	2,997	2,398	2,120	1,945	1,585	960	782
Grand Total	0	0	3,108	5,132	7,169	8,103	9,839	11,777	13,288	14,938	16,394	19,244	20,644	22,504	23,804	24,956	26,949	28,961	29,712	31,383	33,508	35,248	37,258	38,680

2. CAPITAL COST excl. IDC (NEW plants: PUBLIC)

Capital Cost excl. IDC (Taka Million)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New-GEN PUBLIC	0	1,677	8,050	32,112	104,545	126,013	99,115	85,185	66,730	46,584	25,143	27,091	30,411	28,066	30,988	33,954	25,146	25,143	25,143	25,143	25,143	25,143	25,143	25,143
New-GEN PUBLIC excl. Hydro/RE	0	1,677	8,050	32,112	79,402	95,025	73,972	60,042	41,587	21,441	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New-Related Facilities	0	0	0	0	25,929	63,306	106,897	124,928	140,509	133,870	124,921	77,134	60,049	68,275	106,528	83,390	41,197	51,789	83,821	70,035	23,654	22,993	20,536	19,325
New-Related Facilities excl. Fuel Devt	0	0	0	0	11,322	12,011	12,157	12,756	26,869	17,961	5,574	8,629	8,490	17,418	57,614	57,300	16,869	27,968	62,742	49,910	3,820	3,375	3,208	2,874
New-Private (IPP + RENTAL)	0	4,199	46,812	95,800	40,514	83,458	141,403	125,847	77,141	61,170	24,113	10,334	24,113	0	0	0	0	0	0	0	0	0	0	0
New-Others (PUBL/PRIV Unclassified +	0	0	0	0	0	0	0	6,681	39,249	70,147	61,921	72,095	70,154	103,480	109,326	88,595	128,665	178,909	228,193	254,421	208,554	123,536	32,151	0
Grand Total for Master Plan	0	5,877	54,862	127,913	170,988	272,777	347,416	342,640	323,628	311,770	236,098	186,654	184,727	199,821	246,843	205,938	195,009	255,841	337,157	349,599	257,351	171,672	77,829	44,468

3. O&M COST (NEW plants: PUBLIC)

O&M Cost (Taka Million)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Generation																								
O&M Fixed	0	0	0	0	411	1,922	3,468	6,216	7,279	7,640	10,500	10,598	10,696	10,794	11,110	11,279	11,310	11,475	11,502	11,600	11,698	11,796	11,895	11,993
O&M Variable	0	0	0	0	83	569	1,050	1,752	2,184	2,525	3,345	3,541	3,737	3,933	4,130	4,411	4,558	4,803	4,915	5,111	5,307	5,503	5,700	5,949
O&M Total	0	0	0	0	495	2,491	4,601	8,051	9,546	10,248	13,928	14,223	14,517	14,811	15,323	15,856	16,160	16,571	16,710	17,004	17,277	17,593	17,887	18,235
ADMIN	0	0	0	0	49	249	452	797	946	1,016	1,384	1,414	1,443	1,473	1,524	1,569	1,587	1,628	1,642	1,671	1,701	1,730	1,759	1,794
Generation excl. Hydro																								
O&M Fixed	0	0	5,554	6,884	7,073	8,475	9,922	12,572	12,971	13,234	15,590	17,814	22,412	24,726	25,152	26,875	30,844	34,755	34,508	40,862	48,272	54,745	65,497	70,466
O&M Variable	0	0	1,368	1,354	1,856	2,142	2,427	2,932	3,001	3,146	3,635	3,635	4,619	5,111	5,155	5,133	5,889	6,288	6,157	7,507	9,093	10,484	12,787	13,932
O&M Total	0	0	6,921	7,022	8,928	10,617	12,487	15,642	16,110	16,518	19,362	21,595	27,178	29,983	30,569	32,394	37,410	41,721	41,345	49,050	58,045	65,910	78,964	85,079
ADMIN	0	0	692	702	752	920	1,108	1,564	1,611	1,652	1,936	2,160	2,718	2,998	3,057	3,239	3,727	4,158	4,120	4,891	5,790	6,577	7,882	8,494
Related Facilities																								
O&M Fixed	0	0	0	0	130	281	457	1,364	1,563	2,187	2,746	3,575	4,403	5,222	6,084	6,947	10,691	11,974	13,364	14,915	19,028	19,253	18,764	18,068
O&M Variable	0	0	0	0	260	561	914	1,775	2,174	3,422	4,540	6,196	7,852	9,490	11,216	12,941	16,532	17,254	20,033	23,136	26,080	25,758	24,779	23,387
O&M Total	0	0	0	0	390	842	1,371	3,139	3,737	5,609	7,286	9,770	12,255	14,711	17,300	19,889	27,224	29,228	33,396	38,052	45,108	45,011	43,542	41,455
ADMIN	0	0	0	0	39	84	137	314	374	561	729	977	1,225	1,471	1,730	1,989	2,722	2,923	3,340	3,805	4,511	4,501	4,354	4,145
Related Facilities excl. Fuel Devt																								
O&M Fixed	0	0	0	0	23	53	81	837	872	1,318	1,670	1,710	1,749	1,786	1,823	1,858	4,957	5,602	5,676	6,261	9,759	10,216	10,128	10,000
O&M Variable	0	0	0	0	46	107	162	721	791	1,682	2,387	2,466	2,545	2,619	2,693	2,763	5,064	4,509	4,658	5,827	7,541	7,683	7,506	7,251
O&M Total	0	0	0	0	70	160	244	1,559	1,663	2,999	4,057	4,175	4,294	4,405	4,516	4,621	10,021	10,111	10,334	12,088	17,300	17,899	17,634	17,251
ADMIN	0	0	0	0	7	16	24	156	166	300	406	418	429	441	452	462	1,002	1,011	1,033	1,209	1,730	1,790	1,763	1,725
PUBL/PRIV Unclassified																								
O&M Fixed	0	0	0	0	0	0	0	0	0	0	0	2,225	6,823	9,331	9,541	11,840	16,363	20,542	20,752	27,710	35,500	41,973	53,104	58,461
O&M Variable	0	0	0	0	0	0	0	0	0	0	0	0	985	1,521	1,565	1,609	2,579	3,028	3,072	4,564	6,238	7,630	10,021	11,203
O&M Total	0	0	0	0	0	0	138	138	138	138	138	2,371	7,953	10,998	11,367	13,835	19,620	24,247	24,504	32,954	42,419	50,283	63,806	70,344
ADMIN	0	0	0	0	0	0	14	14	14	14	14	237	795	1,100	1,137	1,383	1,948	2,411	2,436	3,281	4,228	5,014	6,367	7,020
Existing Plant (Hypothetically Constructed)																								
O&M Fixed			5,554	6,884	6,662	6,651	6,651	6,651	6,085	6,085	5,678	5,678	5,678	5,483	5,483	4,836	4,348	4,014	3,627	3,024	2,644	2,644	2,264	1,877
O&M Variable			1,368	1,354	1,772	1,770	1,770	1,770	1,602	1,602	1,468	1,468	1,468	1,423	1,423	1,272	1,107	1,009	918	776	687	687	598	508
O&M Total			6,921	8,238	8,434	8,420	8,420	8,420	7,687	7,687	7,146	7,146	7,146	6,906	6,906	6,108	5,456	5,023	4,546	3,800	3,331	3,331	2,862	2,386
ADMIN			692	702	702	701	701	842	769	769	715	715	715	691	691	611	546	502	455	380	333	333	286	239

4. FUEL COST (PUBLIC Undertakings)
4-1. Fuel Cost (Coal)
A. New Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	0	0	0	0	250	250	250	850	850	850	850	850	850	850	850	850	850	850	850	850	850
Net Annual Energy Output (GWh)			0	0	0	0	0	1,647	1,647	1,632	5,360	4,699	4,610	4,560	4,658	4,788	4,341	4,239	4,404	4,352	4,354	4,204	3,989	4,041
Fuel Cost			0	0	0	0	0	4,518	4,682	4,797	15,315	13,877	14,058	14,320	15,048	15,898	14,798	14,813	15,758	15,941	16,291	16,077	15,572	16,092

Source: PSMP Study Team

AP Table 10-3 COST for GENERATION SUMMARY (Tk million) (2/6)

A-1. New Plants (PUBL/PRIV Unclassified)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	0	0	0	0	0	0	0	0	600	1,800	1,800	2,400	3,000	4,200	5,400	5,400	7,200	9,400	11,400	14,600	16,200
Net Annual Energy Output (GWh)			0	0	0	0	0	0	0	0	0	0	7,822	7,746	11,706	11,628	18,468	21,324	21,833	31,416	44,259	55,521	72,438	81,348
Fuel Cost			0	0	0	0	0	0	0	0	0	0	21,250	21,607	33,506	34,130	56,530	66,589	69,744	104,368	151,006	191,545	254,926	292,151

B. Existing Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Net Annual Energy Output (GWh)			1,318	1,318	1,318	1,318	1,318	1,318	1,318	1,294	1,139	956	940	949	995	1,036	888	954	975	969	933	939	895	905
Fuel Cost			3,306	3,306	3,466	3,615	3,767	3,909	4,050	4,112	3,735	3,229	3,268	3,388	3,645	3,892	3,416	3,753	3,921	3,982	3,911	4,015	3,900	4,018

C. New and Existing Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			200	200	200	200	200	450	450	450	1,050	1,650	2,850	2,850	3,450	4,050	5,250	6,450	6,450	8,250	10,450	12,450	15,650	17,250
Net Annual Energy Output (GWh)			1,318	1,318	1,318	1,318	1,318	2,965	2,965	2,926	6,499	5,655	13,372	13,255	17,359	17,452	23,697	26,517	27,212	36,737	49,546	60,664	77,322	86,294
Fuel Cost			3,306	3,306	3,466	3,615	3,767	8,427	8,732	8,909	19,050	17,107	38,576	39,316	52,199	53,919	74,744	85,156	89,423	124,292	171,208	211,638	274,399	312,261

4-2. Fuel Cost (Gas)

A. New Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	0	460	512	1,402	2,437	3,097	3,547	3,998	3,997	3,997	3,997	3,997	3,997	3,997	3,997	3,997	3,997	3,997	3,997	3,997	3,997
Net Annual Energy Output (GWh)			0	0	3,429	3,832	9,438	15,277	15,838	16,712	14,499	12,770	12,977	13,010	13,377	14,313	13,076	13,556	14,019	14,171	13,839	14,149	12,923	13,764
Fuel Cost			0	0	21,966	24,385	53,268	83,608	84,707	89,536	78,822	71,859	75,050	77,317	80,632	87,269	81,274	85,305	89,297	91,501	90,701	94,009	87,368	94,131

B. Existing Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			2,468	2,468	2,468	2,468	2,468	2,468	2,140	2,140	1,990	1,990	1,990	1,954	1,954	1,656	1,349	1,161	983	705	530	530	355	177
Net Annual Energy Output (GWh)			13,656	13,656	13,656	14,495	11,262	9,415	6,887	6,469	6,361	6,353	6,354	6,242	5,262	4,684	3,842	3,248	2,645	1,813	1,814	1,227	607	616
Fuel Cost			71,957	93,665	95,278	102,643	81,146	69,348	50,136	48,476	48,982	50,345	51,769	52,111	44,498	40,224	34,065	29,127	24,122	16,933	16,685	11,439	5,712	5,847

C. New and Existing Plants

Fuel Cost	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			2,468	2,468	2,928	2,980	3,870	4,905	5,237	5,687	5,988	5,987	5,987	5,951	5,951	5,653	5,346	5,158	4,980	4,702	4,527	4,527	4,352	4,174
Net Annual Energy Output (GWh)			13,656	13,656	17,085	18,327	20,700	24,692	22,725	23,181	20,860	19,123	19,331	19,252	18,639	18,997	16,918	16,804	16,664	15,984	15,653	15,376	13,530	14,380
Fuel Cost			71,957	93,665	117,244	127,027	134,415	152,956	134,843	138,013	127,805	122,204	126,818	129,428	125,131	127,493	115,339	114,432	113,419	108,433	107,386	105,448	93,080	99,978

4-3. Fuel Cost (Oil-HFO)

A. New Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	0	0	620	690	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840
Net Annual Energy Output (GWh)			0	0	0	1,686	1,271	1,339	1,238	1,231	1,231	1,231	1,231	1,231	1,231	1,248	1,231	1,260	1,289	1,295	1,295	1,181	1,397	1,345
Fuel Cost			0	0	0	11,896	9,119	9,769	9,177	9,406	9,687	9,967	10,248	10,529	10,687	10,994	11,003	11,423	11,852	12,073	12,239	11,311	13,558	13,229

A-1. New Plants (PUBL/PRIV Unclassified)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	0	0	0	0	0	0	0	0	0	200	400	500	600	700	700	800	1,000	1,100	1,200	1,400	1,400
Net Annual Energy Output (GWh)			0	0	0	0	0	0	0	0	0	0	294	587	734	894	1,029	1,050	1,232	1,542	1,696	1,884	2,646	2,242
Fuel Cost			0	0	0	0	0	0	0	0	0	0	2,452	5,030	6,384	7,890	9,214	9,537	11,349	14,402	16,059	18,081	25,734	22,093

B. Existing Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			87	87	87	87	87	87	87	87	54	54	54	0	0	0	0	0	0	0	0	0	0	0
Net Annual Energy Output (GWh)			321	321	321	297	294	291	291	291	178	178	178	0	0	0	0	0	0	0	0	0	0	0
Fuel Cost			2,452	3,192	3,247	3,055	3,075	3,093	3,143	3,240	2,014	2,072	2,131	0	0	0	0	0	0	0	0	0	0	0

C. New and Existing Plants

Fuel Cost	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			87	87	87	707	777	927	927	927	894	894	1,094	1,240	1,340	1,440	1,540	1,540	1,640	1,840	1,940	2,040	2,240	2,240
Net Annual Energy Output (GWh)			321	321	321	1,983	1,565	1,630	1,529	1,522	1,409	1,409	1,703	1,818	1,965	2,142	2,260	2,310	2,521	2,837	2,991	3,065	4,043	3,587
Fuel Cost			2,452	3,192	3,247	14,951	12,193	12,862	12,320	12,646	11,700	12,040	14,831	15,559	17,071	18,885	20,217	20,961	23,200	26,475	28,298	29,392	39,292	35,323

4-4. Fuel Cost (Oil-HSD)

A. New Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Annual Energy Output (GWh)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Cost			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

B. Existing Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			123	123	123	123	123	119	68	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Annual Energy Output (GWh)			275	275	275	279	264	152	150	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Cost			4,188	5,452	5,546	5,556	5,503	3,220	3,310	3,412	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: PSMP Study Team

AP Table 10-4 COST for GENERATION SUMMARY (Tk million) (3/6)

C. New and Existing Plants

Fuel Cost	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			123	123	123	123	123	119	68	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Annual Energy Output (GWh)			275	275	275	279	264	152	150	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Cost			4,188	5,452	5,546	5,556	5,503	3,220	3,310	3,412	0	0	0	0	0	0	0	0	0	0	0	0	0	0

4-5. Hydro/RE & Intl Conn Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)																								
New Plants			0	0	0	0	0	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	100
New Plants (PUBL/PRIV Unclassified)			0	0	0	0	500	500	500	500	500	1,000	1,000	1,000	1,500	2,250	3,250	3,250	3,500	3,500	3,500	3,500	3,500	3,500
Existing Plants			230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230
Total			230	230	230	230	730	730	730	730	730	1,230	1,230	1,230	1,830	2,580	3,580	3,580	3,830	3,830	3,830	3,830	3,830	3,830
Net Annual Energy Output (GWh)																								
New Plants			0	0	0	0	0	0	0	0	0	0	0	0	333	333	333	333	333	333	333	333	333	333
New Plants (PUBL/PRIV Unclassified)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing Plants			414	806	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766
Total			414	806	766	766	766	766	766	766	766	766	766	766	1,099	1,099	1,099	1,099	1,099	1,099	1,099	1,099	1,099	1,099

4-6. Fuel Cost (Total)
A. New Plants incl. Unclassified and Hydro

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	0	460	1,132	2,092	3,527	4,187	4,637	5,688	6,287	7,687	7,887	8,687	9,387	10,687	11,887	11,987	13,987	16,287	18,387	21,787	23,387
Net Annual Energy Output (GWh)			0	0	3,429	5,518	10,709	18,263	18,723	19,575	21,090	18,700	26,934	27,134	32,039	33,204	38,478	41,762	43,110	53,109	65,776	77,272	93,726	103,073
Fuel Cost			0	0	21,966	36,281	62,387	97,895	98,566	103,739	103,823	95,704	123,058	128,804	146,257	156,181	172,818	187,668	197,999	238,286	286,297	331,023	397,159	437,696

B. Existing Plants incl. Hydro

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			3,108	3,108	3,108	3,108	3,108	3,104	2,725	2,725	2,474	2,474	2,474	2,384	2,384	2,086	1,779	1,591	1,413	1,135	960	960	785	607
Net Annual Energy Output (GWh)			15,984	16,376	16,336	17,155	13,904	11,942	9,412	8,970	8,444	8,253	8,238	7,957	7,023	6,486	5,496	4,968	4,386	3,548	3,513	2,932	2,268	2,287
Fuel Cost			81,903	105,615	107,537	114,868	93,491	79,570	60,639	59,240	54,731	55,646	57,167	55,499	48,143	44,116	37,481	32,880	28,043	20,915	20,595	15,454	9,612	9,866

C. New and Existing Plants incl. Hydro

Fuel Cost	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)	0	0	3,108	3,108	3,568	4,240	5,200	6,631	6,912	7,362	8,162	8,761	10,161	10,271	11,071	11,473	12,466	13,478	13,400	15,122	17,247	19,347	22,572	23,994
Net Annual Energy Output (GWh)	0	0	15,984	16,376	19,765	22,673	24,613	30,205	28,135	28,545	29,534	26,953	35,172	35,091	39,062	39,690	43,974	46,730	47,496	56,657	69,289	80,204	95,994	105,360
Fuel Cost			81,903	105,615	129,502	151,149	155,878	177,465	159,205	162,979	158,555	151,350	180,225	184,302	194,400	200,297	210,300	220,549	226,043	259,201	306,892	346,477	406,771	447,562

5. ELECTRICITY PURCHASE (Tk million)
A. New Private Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	194	1,771	2,171	2,947	3,454	4,684	5,884	6,827	9,077	9,077	10,827	11,327	12,077	13,077	14,077	15,327	15,276	15,276	15,276	14,511	14,511
Net Annual Energy Output (GWh)			0	1,168	5,284	6,303	8,722	11,805	20,028	26,589	32,398	40,994	40,996	50,114	54,004	60,348	63,135	69,807	79,232	79,099	78,882	78,741	75,162	76,395
Non-Fuel Cost			0	4,908	46,638	52,784	56,469	60,877	62,465	87,531	94,006	117,806	117,767	141,582	140,556	138,623	135,148	149,987	165,805	161,843	158,928	155,444	144,646	141,632
Fuel Cost			0	5,875	36,750	44,485	53,115	66,935	95,429	112,713	123,871	145,939	149,389	170,533	191,468	225,132	242,744	252,397	272,731	274,855	274,862	277,247	257,057	265,907
Total Cost			0	10,783	83,388	97,270	109,584	127,812	157,894	198,069	217,877	263,745	267,156	312,116	332,024	363,755	377,893	402,384	438,536	436,698	433,790	432,691	401,702	407,539

B. Existing Private Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	1,830	1,830	1,692	1,692	1,692	1,692	1,692	1,406	1,406	1,406	1,406	1,406	1,406	1,406	1,406	985	985	985	625	175	175
Net Annual Energy Output (GWh)			0	10,794	10,794	10,799	9,833	7,945	5,091	4,602	3,655	3,524	3,550	3,556	3,602	3,725	3,612	3,633	3,048	3,059	3,057	1,871	522	534
Non-Fuel Cost			0	16,498	17,773	15,573	15,370	15,136	14,851	14,734	10,545	10,532	10,534	10,535	10,542	10,556	10,544	10,546	8,455	8,455	8,455	6,525	2,611	2,612
Fuel Cost			0	54,833	55,777	56,609	51,502	41,916	27,857	25,869	20,416	20,325	21,047	21,660	22,267	23,309	23,013	23,461	18,511	18,838	19,085	12,331	3,579	3,710
Total Cost			0	71,331	73,550	72,182	66,873	57,052	42,708	40,603	30,961	30,858	31,581	32,195	32,809	33,864	33,557	34,007	26,965	27,294	27,540	18,856	6,190	6,322

C. New + Existing Private Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity (MW)			0	2,024	3,601	3,863	4,639	5,146	6,376	7,576	8,233	10,483	10,483	12,233	12,733	13,483	14,483	15,483	16,312	16,261	16,261	15,901	14,686	14,686
Net Annual Energy Output (GWh)			0	11,962	16,078	17,102	18,555	19,750	25,119	31,191	36,053	44,518	44,546	53,670	57,606	64,073	66,747	73,440	82,280	82,158	81,939	80,612	75,684	76,929
Non-Fuel Cost			0	21,405	64,411	68,358	71,840	76,012	77,316	102,266	104,551	128,338	128,302	152,118	151,097	149,179	145,692	160,533	174,259	170,299	167,384	161,969	147,257	144,245
Fuel Cost			0	60,708	92,527	101,094	104,617	108,852	123,286	138,582	144,287	166,265	170,435	192,193	213,735	248,440	265,757	275,859	291,242	293,693	293,946	289,578	260,636	269,616
Total Cost			0	82,114	156,938	169,452	176,456	184,864	200,602	238,672	248,838	294,603	298,737	344,311	364,833	397,619	411,449	436,392	465,501	463,992	461,330	451,547	407,893	413,861

6. EQUITY & LOAN
6-1 EQUITY & LOAN (GEN)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cap Cost before IDC	0	1,677	8,050	32,112	104,545	126,013	99,115	85,185	66,730	46,584	25,143	27,091	30,411	28,066	30,988	33,954	25,146	25,143	25,143	25,143	25,143	25,143	25,143	25,143
Cumulative Cap Cost	0	1,677	9,727	41,840	146,385	272,398	371,513	456,698	523,428	570,012	595,155	622,246	652,657	680,722	711,711	745,665	770,811	795,954	821,097	846,239	871,382	896,525	921,668	946,811
Equity	0	302	1,449	5,780	18,818	22,682	17,841	15,333	12,011	8,385	4,526	4,876	5,474	5,052	5,578	6,112	4,526	4,526	4,526	4,526	4,526	4,526	4,526	4,526
Equity (cumulative)	0	302	1,751	7,531	26,349	49,032	66,872	82,206	94,217	102,602	107,128	112,004	117,478	122,530	128,108	134,220	138,746	143,272	147,797	152,323	156,849	161,375	165,900	170,426
Dividend	0	0	0	0	229	1,067	2,055	3,517	4,310	4,872	6,156	6,428	6,699	6,975	7,352	7,686	8,053	8,325	8,596	8,868	8,698	8,969	9,113	9,385
Loan (Balance) incl. IDC	0	1,428	8,363	36,829	127,943	235,963	322,062	393,155	450,924	491,080	502,310	512,361	517,459	516,574	514,677	508,610	493,594	477,313	459,610	439,944	422,900	404,430	385,556	365,281
Donor Loan	0	1,221	7,152	30,915	107,455	199,819	273,475	334,183	383,608	417,989	427,691	436,585	441,076	440,459	438,960	433,898	421,185	407,397	392,392	375,711	361,077	345,225	329,027	311,633
Local Loan	0	207	1,211	5,914	20,488	36,143	48,587	58,972	67,316	73,092	74,619	75,776	76,382	76,115	75,717	74,712	72,409	69,917	67,217	64,232	61,823	59,206	56,529	53,649

Source: PSMP Study Team

AP Table 10-5 COST for GENERATION SUMMARY (Tk million) (4/6)

6-2 EQUITY & LOAN (GEN) excl. Hydro & Transmission

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cap Cost before IDC	0	1,677	8,050	32,112	79,402	95,025	73,972	60,042	41,587	21,441	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumulative Cap Cost	0	1,677	9,727	41,840	121,242	216,267	290,239	350,281	391,868	413,309	413,309	413,309	413,309	413,309	413,309	413,309	413,309	413,309	413,309	413,309	413,309	413,309	413,309	413,309
Equity	0	302	1,449	5,780	14,292	17,104	13,315	10,808	7,486	3,859	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equity (cumulative)	0	302	1,751	7,531	21,824	38,928	52,243	63,051	70,536	74,396	74,396	74,396	74,396	74,396	74,396	74,396	74,396	74,396	74,396	74,396	74,396	74,396	74,396	74,396
Dividend	0	0	0	0	229	795	1,449	2,640	3,161	3,451	4,464	4,464	4,464	4,464	4,464	4,464	4,464	4,464	4,464	4,464	4,464	4,022	4,022	3,895	3,895
Loan (Balance) incl. IDC	0	1,428	8,363	36,829	106,531	188,559	253,736	303,814	340,569	359,711	351,327	341,832	325,865	307,120	286,824	261,062	235,301	209,539	183,777	158,016	136,604	115,656	95,706	75,756
Donor Loan	0	1,221	7,152	30,915	89,151	159,308	215,093	257,849	289,322	305,751	298,698	290,893	277,384	261,499	244,287	222,399	200,511	178,623	156,735	134,848	116,482	98,514	81,397	64,281
Local Loan	0	207	1,211	5,914	17,380	29,251	38,643	45,965	51,247	53,960	52,629	50,939	48,481	45,621	42,537	38,663	34,789	30,916	27,042	23,168	20,122	17,143	14,309	11,475

6-3 EQUITY & LOAN (RF)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cap Cost before IDC	0	0	0	0	25,929	63,306	106,897	124,928	140,509	133,870	124,921	77,134	60,049	68,275	106,528	83,390	41,197	51,789	83,821	70,035	23,654	22,993	20,536	19,325
Cumulative Cap Cost	0	0	0	0	25,929	89,235	196,132	321,060	461,570	595,440	720,361	797,494	857,544	925,818	1,032,347	1,115,736	1,156,934	1,208,723	1,292,544	1,362,579	1,386,233	1,409,225	1,429,761	1,449,086
Equity	0	0	0	0	4,667	11,395	19,241	22,487	25,292	24,097	22,486	13,884	10,809	12,289	19,175	15,010	7,416	9,322	15,088	12,606	4,258	4,139	3,696	3,479
Equity (cumulative)	0	0	0	0	4,667	16,062	35,304	57,791	83,083	107,179	129,665	143,549	154,358	166,647	185,822	200,833	208,248	217,570	232,658	245,264	249,522	253,661	257,357	260,836
Dividend	0	0	0	0	0	192	413	936	1,207	1,762	2,287	5,806	7,076	7,441	7,794	10,381	11,858	12,171	12,502	13,148	14,716	14,971	15,220	15,441
Loan (Balance) incl. IDC	0	0	0	0	21,672	74,841	165,798	273,672	397,724	519,043	634,582	702,696	752,861	809,133	895,462	955,525	959,033	964,872	996,256	1,015,057	977,611	931,799	814,433	841,323
Donor Loan	0	0	0	0	18,513	63,943	141,696	233,960	340,144	444,083	543,171	601,543	644,402	692,505	766,456	817,835	820,800	825,759	852,561	868,638	836,533	797,275	696,793	710,164
Local Loan	0	0	0	0	3,158	10,898	24,102	39,712	57,580	74,959	91,411	101,154	108,459	116,628	129,006	137,690	138,232	139,113	143,695	146,419	141,078	134,524	117,640	131,159

6-4 EQUITY & LOAN (RF) excl. Fuel Development

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cap Cost before IDC	0	0	0	0	11,322	12,011	12,157	12,756	26,869	17,961	5,574	8,629	8,490	17,418	57,614	57,300	16,869	27,968	62,742	49,910	3,820	3,375	3,208	2,874
Cumulative Cap Cost	0	0	0	0	11,322	23,334	35,491	48,247	75,115	93,077	98,651	107,280	115,770	133,188	190,802	248,102	264,971	292,939	355,681	405,591	409,412	412,787	415,995	418,869
Equity	0	0	0	0	2,038	2,162	2,188	2,296	4,836	3,233	1,003	1,553	1,528	3,135	10,370	10,314	3,036	5,034	11,294	8,984	688	608	577	517
Equity (cumulative)	0	0	0	0	2,038	4,200	6,388	8,684	13,521	16,754	17,757	19,310	20,839	23,974	34,344	44,658	47,695	52,729	64,023	73,006	73,694	74,302	74,879	75,396
Dividend	0	0	0	0	0	35	77	383	430	745	1,005	1,065	1,125	1,183	1,237	1,292	2,487	2,537	2,612	3,030	4,380	4,422	4,458	4,493
Loan (Balance) incl. IDC	0	0	0	0	9,463	19,760	30,434	41,095	63,818	79,025	83,504	90,320	95,645	108,288	153,119	197,990	207,072	225,510	273,378	311,001	307,445	297,157	218,584	276,785
Donor Loan	0	0	0	0	8,084	16,889	26,024	35,131	54,551	67,548	71,375	77,197	81,611	92,280	130,594	168,995	176,769	192,548	233,489	265,701	262,661	253,864	186,635	235,019
Local Loan	0	0	0	0	1,379	2,871	4,410	5,964	9,267	11,477	12,130	13,123	14,034	16,008	22,525	28,995	30,303	32,963	39,890	45,299	44,784	43,293	31,949	41,766

6-5 EQUITY & LOAN (RF) for Renewable and International Connection

6-6 EQUITY & LOAN Hypothetically Constructed for Existing Plants

Equity & Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cap Cost before IDC																								
Cumulative Cap Cost	0	107,024	100,521	94,018	87,543	81,068	74,593	68,118	62,259	56,399	51,094	45,788	40,483	35,518	30,553	26,124	22,191	18,583	15,334	12,579	10,176	7,773	5,723	4,031
Equity																								
Equity (cumulative)	0	27,845	30,639	30,611	30,611	30,611	30,611	30,611	27,735	27,735	25,514	25,514	25,514	24,291	24,291	21,700	19,307	17,769	15,975	13,509	11,746	11,746	9,982	8,188
Dividend	0	0	1,671	1,838	1,837	1,837	1,837	1,831	1,664	1,664	1,531	1,531	1,531	1,457	1,457	1,302	1,158	1,066	959	811	705	705	599	491
Loan (Balance) incl. IDC	0	79,179	75,451	70,675	65,900	61,125	56,349	50,735	45,229	39,797	34,669	29,541	24,557	19,683	14,402	9,630	5,179	3,306	2,479	2,479	2,479	2,479	2,479	0
Donor Loan	0	67,592	64,408	60,331	56,254	52,176	48,099	43,316	38,617	33,980	29,604	25,227	20,974	16,814	12,306	8,234	4,421	2,822	2,116	2,116	2,116	2,116	2,116	0
Local Loan	0	11,587	11,042	10,344	9,646	8,948	8,250	7,419	6,612	5,816	5,065	4,314	3,583	2,869	2,095	1,396	758	484	363	363	363	363	363	0

6-7 EQUITY & LOAN for UNDECIDED Undertakings

Equity & Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cap Cost before IDC	0	0	0	0	0	0	0	6,681	39,249	70,147	61,921	72,095	70,154	103,480	109,326	88,595	128,665	178,909	228,193	254,421	208,554	123,536	32,151	0
Cumulative Cap Cost	0	0	0	0	0	0	0	6,681	45,929	116,076	177,997	250,093	320,246	423,727	533,052	621,647	750,312	929,221	1,157,414	1,411,835	1,620,389	1,743,925	1,776,076	1,776,076
Equity	0	0	0	0	0	0	0	1,203	7,065	12,626	11,146	12,977	12,628	18,626	19,679	15,947	23,160	32,204	41,075	45,796	37,540	22,237	5,787	0
Equity (cumulative)	0	0	0	0	0	0	0	1,203	8,267	20,894	32,040	45,017	57,644	76,271	95,949	111,897	135,056	167,260	208,335	254,130	291,670	313,907	319,694	319,694
Dividend	0	0	0	0	0	0	0	0	0	0	0	722	2,244	2,414	3,175	3,937	5,420	6,772	6,857	9,147	11,689	13,803	17,445	19,182
Loan (Balance) incl. IDC	0	0	0	0	0	0	0	5,689	39,243	106,128	179,934	239,554	292,303	369,491	467,711	548,160	654,116	795,501	983,922	1,188,426	1,351,560	1,436,515	1,423,730	1,378,270
Donor Loan	0	0	0	0	0	0	0	4,864	33,530	90,735	153,987	205,075	250,096	316,042	400,147	469,095	559,617	680,482	841,885	1,016,814	1,155,525	1,226,339	1,212,985	1,175,720
Local Loan	0	0	0	0	0	0	0	826	5,713	15,393	25,947	34,479	42,207	53,449	67,565	79,065	94,499	115,019	142,037	171,612	196,035	210,177	210,744	202,550

9. DONOR LOAN

9-1 DONOR LOAN (GEN)

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	1,221	7,152	30,915	107,455	199,819	273,475	334,183	383,608	417,989	427,691	436,585	441,076	440,459	438,960	433,898	421,185	407,397	392,392	375,711	361,077	345,225	329,027	311,633
Interest Payment	0	0	0	0	619	2,851	5,502	9,472	11,616	13,130	16,612	17,094	17,393	17,427	17,595	17,541	17,337	16,833	16,282	15,682	15,014	14,429	13,795	13,147
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	1,032	5,926	10,477	17,377	20,951	23,475	29,347	30,544	31,741	32,956	34,633	32,586	33,805	34,150	35,346
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	1,032	6,958	17,435	34,812	55,762	79,237	108,584	139,128	170,868	203,824	238,457	271,044	304,848	338,998	374,344

9-2 DONOR LOAN (GEN) excl. Hydro

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	1,221	7,152	30,915	89,151	159,308	215,093	257,849	289,322	305,751	298,698	290,893	277,384	261,499	244,287	222,399	200,511	178,623	156,735	134,848	116,482	98,514	81,397	64,281
Interest Payment	0	0	0	0	619	2,133	3,899	7,151	8,577	9,373	12,137	11,948	11,636	11,095	10,460	9,771	8,896	8,020	7,145	6,269	5,394	4,659	3,941	3,256
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	1,032	4,729	7,805	13,509	15,885	17,212	21,888	21,888	21,888	21,888	21,888	18,366	17,968	17,116	17,116
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	1,032	5,761	13,566	27,075	42,960	60,172	82,060	103,948	125,836	147,723	169,611	187,977	205,945	223,061	240,177

Source: PSMP Study Team

AP Table 10-6 COST for GENERATION SUMMARY (Tk million) (5/6)

9-3 DONOR LOAN (RF)

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	0	0	0	18,513	63,943	141,696	233,960	340,144	444,083	543,171	601,543	644,402	692,505	766,456	817,835	820,800	825,759	852,561	868,638	836,533	797,275	696,793	710,164
Interest Payment	0	0	0	0	0	509	1,092	2,502	3,219	4,696	6,092	16,135	19,609	20,413	21,131	28,595	32,197	31,947	31,511	31,918	34,746	33,461	29,567	30,195
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	0	848	1,820	4,170	5,365	7,827	10,153	26,948	32,859	34,477	36,032	48,994	55,675	57,054	58,518
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	0	848	2,668	6,838	12,203	20,030	30,183	57,131	89,990	124,467	160,500	209,493	265,168	322,221	380,739

9-4 DONOR LOAN (RF) excl. Fuel Development

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	0	0	0	8,084	16,889	26,024	35,131	54,551	67,548	71,375	77,197	81,611	92,280	130,594	168,995	176,769	192,548	233,489	265,701	262,661	253,864	186,635	235,019
Interest Payment	0	0	0	0	0	92	203	1,041	1,165	2,006	2,702	2,855	2,999	3,084	3,149	3,160	6,244	6,186	6,183	7,155	10,628	10,506	7,831	9,789
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	0	153	339	1,735	1,941	3,344	4,503	4,769	5,032	5,288	5,526	5,768	11,207	11,428	11,759
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	0	153	492	2,227	4,168	7,512	12,015	16,784	21,815	27,103	32,629	38,398	49,605	61,033	72,792

9-5 DONOR LOAN (Pub/PRIV Unclassified)

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	0	0	0	0	0	0	4,864	33,530	90,735	153,987	205,075	250,096	316,042	400,147	469,095	559,617	680,482	841,885	1,016,814	1,155,525	1,226,339	1,212,985	1,175,720
Interest Payment	0	0	0	0	0	0	0	0	0	0	0	2,009	6,230	8,568	8,795	10,906	15,026	18,659	18,455	24,210	30,656	35,761	44,829	48,357
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	0	0	1,218	1,218	1,218	1,218	1,218	4,567	11,981	16,256	16,824	20,531	27,587	33,865	33,215
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	0	0	1,218	2,436	3,655	4,873	6,091	10,658	22,639	38,895	55,719	76,250	103,837	137,702	33,215

9-6 DONOR LOAN Hypothetically Constructed for Existing Plants

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	67,592	64,408	60,331	56,254	52,176	48,099	43,316	38,617	33,980	29,604	25,227	20,974	16,814	12,306	8,234	4,421	2,822	2,116	2,116	2,116	2,116	2,116	0
Interest Payment	0	0	2,704	2,576	2,413	2,250	2,087	1,924	1,730	1,545	1,359	1,184	1,009	793	638	469	318	177	113	85	85	85	85	85
Loan Repayment (Instalment)	0	0	3,184	4,077	4,077	4,077	4,077	4,783	4,636	4,636	4,377	4,377	4,207	4,160	4,160	3,901	3,627	1,599	705	0	0	0	0	0
Repayment (Cumulative)	0	0	3,184	7,261	11,338	15,416	19,493	24,276	28,912	33,548	37,925	42,301	46,555	50,715	55,222	59,123	62,750	64,349	65,054	65,054	65,054	65,054	65,054	65,054

10. LOCAL LOAN

10-1 LOCAL LOAN (GEN)

Local Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	207	1,211	5,914	20,488	36,143	48,587	58,972	67,316	73,092	74,619	75,776	76,382	76,115	75,717	74,712	72,409	69,917	67,217	64,232	61,823	59,206	56,529	53,649
Interest Payment	0	0	0	0	79	460	798	1,303	1,575	1,768	2,210	2,262	2,287	2,284	2,298	2,284	2,251	2,179	2,102	2,018	1,926	1,855	1,775	1,695
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	175	1,236	2,146	3,118	3,724	4,153	5,146	5,350	5,554	5,762	6,047	5,472	5,680	5,739	5,943
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	175	1,411	3,558	6,675	10,399	14,552	19,698	25,048	30,603	36,365	42,412	47,883	53,563	59,302	65,245

10-2 LOCAL LOAN (GEN) excl. Hydro & Transmission

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	207	1,211	5,914	17,380	29,251	38,643	45,965	51,247	53,960	52,629	50,939	48,481	45,621	42,537	38,663	34,789	30,916	27,042	23,168	20,122	17,143	14,309	11,475
Interest Payment	0	0	0	0	79	368	593	1,006	1,186	1,287	1,637	1,604	1,550	1,474	1,385	1,290	1,171	1,052	933	814	695	605	514	429
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	175	1,032	1,691	2,458	2,860	3,084	3,874	3,874	3,874	3,874	3,874	3,047	2,979	2,834	2,834
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	175	1,207	2,898	5,356	8,215	11,300	15,173	19,047	22,921	26,794	30,668	33,715	36,694	39,528	42,362

10-3 LOCAL LOAN (RF)

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	0	0	0	3,158	10,898	24,102	39,712	57,580	74,959	91,411	101,154	108,459	116,628	129,006	137,690	138,232	139,113	143,695	146,419	141,078	134,524	117,640	131,159
Interest Payment	0	0	0	0	0	65	140	319	411	600	778	2,039	2,477	2,585	2,682	3,607	4,065	4,035	3,981	4,033	4,393	4,232	3,742	3,823
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	0	145	310	550	754	1,333	1,729	4,540	5,535	5,811	6,076	8,222	9,355	9,590	9,839
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	0	145	455	1,005	1,758	3,091	4,820	9,360	14,895	20,706	26,783	35,005	44,359	53,949	63,788

10-4 LOCAL LOAN (RF) excl. Fuel Development

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	0	0	0	1,379	2,871	4,410	5,964	9,267	11,477	12,130	13,123	14,034	16,008	22,525	28,995	30,303	32,963	39,890	45,299	44,784	43,293	31,949	41,766
Interest Payment	0	0	0	0	0	12	26	132	148	256	344	364	382	398	411	413	804	797	796	918	1,359	1,344	1,005	1,252
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	0	26	58	134	170	568	765	810	855	899	940	981	1,902	1,939	1,996
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	0	26	84	218	388	956	1,721	2,531	3,386	4,285	5,225	6,206	8,107	10,047	12,042

10-5 LOCAL LOAN (PUB/PRIV Unclassified)

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	0	0	0	0	0	0	826	5,713	15,393	25,947	34,479	42,207	53,449	67,565	79,065	94,499	115,019	142,037	171,612	196,035	210,177	210,744	202,550
Interest Payment	0	0	0	0	0	0	0	0	0	0	0	254	789	1,085	1,114	1,381	1,903	2,363	2,337	3,066	3,881	4,528	5,675	6,245
Loan Repayment (Instalment)	0	0	0	0	0	0	0	0	0	0	0	202	202	202	202	202	767	2,020	2,742	2,839	3,465	4,656	5,716	5,812
Repayment (Cumulative)	0	0	0	0	0	0	0	0	0	0	0	202	404	607	809	1,011	1,778	3,798	6,540	9,379	12,845	17,501	23,217	29,029

10-6 LOCAL LOAN Hypothetically Constructed for Existing Plants

Donor Loan	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Balance incl.IDC	0	11,587	11,042	10,344	9,646	8,948	8,250	7,419	6,612	5,816	5,065	4,314	3,583	2,869	2,095	1,396	758	484	363	363	363	363	363	0
Interest Payment	0	0	355	339	317	296	274	253	227	202	178	155	132	102	82	60	41	23	15	11	11	11	15	15
Loan Repayment (Instalment)	0	0	545	698	698	698	698	819	796	796	751	751	722	714	714	670	622	274	121	0	0	0	0	0
Repayment (Cumulative)	0	0	545	1,243	1,941	2,639	3,337	4,168	4,964	5,760	6,511	7,263	7,993	8,707	9,481	10,151	10,773	11,047	11,168	11,168	11,168	11,168	11,168	11,168

Source: PSMP Study Team

AP Table 10-7 COST for GENERATION SUMMARY (Tk million) (6/6)

11. DEPRECIATION & RESIDUAL VALUE

11-1 DEPRECIATION & SALVAGE VALUE (GEN)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Depreciation			0	0	790	4,382	7,336	12,038	14,311	15,783	19,377	19,837	20,296	20,763	21,452	22,018	22,639	23,099	23,559	24,019	21,479	21,600	21,334	21,794
Salvage Value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,999	564	1,209	0	0
Total			0	0	790	4,382	7,336	12,038	14,311	15,783	19,377	19,837	20,296	20,763	21,452	22,018	22,639	23,099	23,559	29,017	22,043	22,809	21,334	21,794
Cum Depreciation			0	0	790	5,172	12,508	24,546	38,857	54,640	74,017	93,853	114,150	134,913	156,365	178,383	201,023	224,122	247,680	276,698	298,741	321,551	342,885	364,679

11-2 DEPRECIATION & SALVAGE VALUE (GEN) excl. Hydro & Transmission

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Depreciation			0	0	790	3,923	6,310	10,552	12,365	13,377	16,512	16,512	16,512	16,512	16,512	16,512	16,512	16,512	16,512	16,512	13,512	13,174	12,448	12,448
Salvage Value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,999	564	1,209	0	0
Total			0	0	790	3,923	6,310	10,552	12,365	13,377	16,512	16,512	16,512	16,512	16,512	16,512	16,512	16,512	16,512	21,510	14,077	14,383	12,448	12,448
Cum Depreciation			0	0	790	4,712	11,022	21,574	33,939	47,317	63,828	80,340	96,851	113,363	129,875	146,386	162,898	179,409	195,921	217,431	231,508	245,891	258,339	270,788

11-3 DEPRECIATION & SALVAGE VALUE (RF)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Depreciation			0	0	0	543	1,165	2,664	3,429	5,003	6,491	17,072	20,816	21,844	22,840	30,920	35,175	36,058	36,995	38,883	43,411	44,132	44,833	45,458
Salvage Value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			0	0	0	543	1,165	2,664	3,429	5,003	6,491	17,072	20,816	21,844	22,840	30,920	35,175	36,058	36,995	38,883	43,411	44,132	44,833	45,458
Cum Depreciation			0	0	0	543	1,708	4,372	7,800	12,803	19,294	36,366	57,181	79,026	101,865	132,786	167,961	204,019	241,014	279,897	323,308	367,440	412,272	457,730

11-4 DEPRECIATION & SALVAGE VALUE (RF) excl. Fuel Development

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Depreciation			0	0	0	98	217	1,105	1,237	2,132	2,873	3,043	3,212	3,376	3,528	3,683	7,143	7,284	7,495	8,741	12,656	12,772	12,875	12,973
Salvage Value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			0	0	0	98	217	1,105	1,237	2,132	2,873	3,043	3,212	3,376	3,528	3,683	7,143	7,284	7,495	8,741	12,656	12,772	12,875	12,973
Cum Depreciation			0	0	0	98	315	1,420	2,656	4,789	7,662	10,705	13,917	17,292	20,821	24,504	31,647	38,931	46,426	55,167	67,823	80,595	93,470	106,443

11-5 DEPRECIATION & SALVAGE VALUE (PUB/PRIV Unclassified)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Depreciation			0	0	0	0	0	0	0	0	0	0	0	2,122	7,067	8,035	10,508	12,981	17,575	21,553	22,037	29,237	36,948	43,399
Salvage Value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			0	0	0	0	0	0	0	0	0	0	0	2,122	7,067	8,035	10,508	12,981	17,575	21,553	22,037	29,237	36,948	43,399
Cum Depreciation			0	0	0	0	0	0	0	0	0	0	0	2,122	9,189	17,224	27,732	40,713	58,288	79,841	101,878	131,116	168,064	211,463

11-6 DEPRECIATION & SALVAGE VALUE Hypothetically Constructed for Existing Plants

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Depreciation			6,206	6,206	6,178	6,178	6,178	6,178	5,562	5,562	5,008	5,008	5,008	4,668	4,668	4,132	3,636	3,310	2,952	2,458	2,106	2,106	1,753	1,394
Salvage Value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			6,206	6,206	6,178	6,178	6,178	6,178	5,562	5,562	5,008	5,008	5,008	4,668	4,668	4,132	3,636	3,310	2,952	2,458	2,106	2,106	1,753	1,394
Cum Depreciation			6,206	12,411	18,589	24,767	30,945	37,122	42,684	48,247	53,255	58,263	63,271	67,939	72,607	76,739	80,374	83,685	86,636	89,094	91,200	93,306	95,058	96,453

12. Unit Generation Cost (Tk/kWh)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New Generation Plants					7.17	8.45	7.52	7.03	7.25	7.44	7.39	8.32	7.33	7.89	7.51	7.80	7.66	7.78	7.94	7.64	7.24	7.06	6.91	6.88
Existing Plants				7.66	7.80	7.84	8.13	8.29	8.32	8.55	8.37	8.65	8.83	8.81	8.91	8.76	8.85	8.65	8.46	8.02	7.73	7.51	6.71	6.33
Electricity Purchased				6.86	9.76	9.91	9.51	9.36	7.99	7.72	6.90	6.62	6.71	6.42	6.33	6.21	6.16	5.94	5.66	5.65				
Unit Cost for Total Supply				7.30	8.59	8.84	8.63	8.42	7.97	7.96	7.53	7.55	7.36	7.27	7.08	7.04	7.06	6.91	6.70	6.67	6.63	6.57	6.44	6.44

Source: PSMP Study Team

AP Table 10-8 Unit Generation Cost for New Gen Plants (Public & Pub/Priv Unclassified) incl. Hydro & Transmission

(Taka Million)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Fiscal Year Ending at Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Generation Capacity (MW)				0	460	1,132	2,092	3,527	4,187	4,637	5,688	6,287	7,687	7,887	8,687	9,387	10,687	11,887	11,987	13,987	16,287	18,387	21,787	23,387
Net Generation (GWh)				0	3,429	5,518	10,709	18,263	18,723	19,575	21,090	18,700	26,934	27,134	32,039	33,204	38,478	41,762	43,110	53,109	65,776	77,272	93,726	103,073
Less Transmission Loss at end of 132kV @2.5%				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Energy at end of 132kV (GWh)				0	3,429	5,518	10,709	18,263	18,723	19,575	21,090	18,700	26,934	27,134	32,039	33,204	38,478	41,762	43,110	53,109	65,776	77,272	93,726	103,073
Less Transmission Loss at end of 33kV @1.0%				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Energy at end of 33kV (GWh)				0	3,429	5,518	10,709	18,263	18,723	19,575	21,090	18,700	26,934	27,134	32,039	33,204	38,478	41,762	43,110	53,109	65,776	77,272	93,726	103,073
Fixed Cost																								
Depreciation				0	790	4,382	7,336	12,038	14,311	15,783	19,377	19,837	20,296	22,885	28,519	30,053	33,147	36,080	41,134	45,572	43,516	50,837	58,282	65,193
O & M				0	130	281	457	1,364	1,563	2,187	2,746	5,799	11,225	14,553	15,625	18,787	27,055	32,516	34,115	42,625	54,528	61,226	71,868	76,528
Administrative Overhead				0	702	752	920	1,121	1,578	1,625	1,666	1,950	2,397	3,513	4,098	4,194	4,623	5,675	6,569	6,557	8,172	10,018	11,591	14,249
Loan Interest (Donor)				0	619	2,851	5,502	9,472	11,616	13,130	16,612	19,103	23,623	25,995	26,390	28,447	32,363	35,492	34,737	39,891	45,670	50,190	58,624	61,504
Loan Interest (Local)				0	79	460	798	1,303	1,575	1,768	2,210	2,516	3,076	3,369	3,412	3,665	4,154	4,542	4,439	5,084	5,807	6,382	7,450	7,939
Dividend				0	229	1,067	2,055	3,517	4,310	4,872	6,156	7,149	8,943	9,389	10,527	11,623	13,473	15,097	15,454	18,014	20,387	22,773	26,559	28,567
Land Cost																								
Sub-Total				0	2,550	9,792	17,068	28,815	34,953	39,366	48,768	56,354	69,560	79,704	88,572	96,770	114,814	129,402	136,448	157,743	178,081	201,427	234,375	253,981
Variable Cost (Local)																								
Fuel Cost				0	21,966	36,281	62,387	97,895	98,566	103,739	103,823	95,704	123,058	128,804	146,257	156,181	172,818	187,668	197,999	238,286	286,297	331,023	397,159	437,696
Electricity Purchase																								
O & M				0	83	569	1,050	1,752	2,184	2,525	3,345	3,541	4,722	5,454	5,695	6,020	7,137	7,831	7,986	9,675	11,545	13,133	15,721	17,152
Sub-Total				0	22,049	36,850	63,437	99,647	100,750	106,264	107,168	99,245	127,779	134,258	151,952	162,201	179,955	195,499	205,985	247,961	297,842	344,156	412,880	454,848
Salvage Value																								
Land																								
Plant				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,999	564	1,209	0	0
Annual Costs				0	24,598	46,642	80,505	128,462	135,704	145,630	155,936	155,599	197,340	213,962	240,524	258,971	294,769	324,901	342,433	405,704	475,923	545,583	647,254	708,829
Total Fixed Costs				0	2,550	9,792	17,068	28,815	34,953	39,366	48,768	56,354	69,560	79,704	88,572	96,770	114,814	129,402	136,448	157,743	178,081	201,427	234,375	253,981
Total Variable Costs				0	22,049	36,850	63,437	99,647	100,750	106,264	107,168	99,245	127,779	134,258	151,952	162,201	179,955	195,499	205,985	247,961	297,842	344,156	412,880	454,848
Generation Cost																								
Fixed Cost (Tk./kW/month)				0	462	721	680	681	696	707	714	747	754	842	850	859	895	907	949	940	911	913	896	905
Fixed Cost Averaged (Tk/kW/month)	801																							
Variable Cost (Tk./kWh)				0.00	6.43	6.68	5.92	5.46	5.38	5.43	5.08	5.31	4.74	4.95	4.74	4.89	4.68	4.68	4.78	4.67	4.53	4.45	4.41	4.41
Variable Cost Averaged	5.08																							
Generation Cost per Unit																								
Fixed Cost in kWh basis				0.00	0.74	1.77	1.59	1.58	1.87	2.01	2.31	2.73	2.37	2.63	2.51	2.52	2.63	2.61	2.69	2.55	2.37	2.32	2.27	2.26
Average Fixed Cost in kWh Basis	2.43																							
Variable Cost (Tk./kWh)				0.00	6.43	6.68	5.92	5.46	5.38	5.43	5.08	5.31	4.74	4.95	4.74	4.89	4.68	4.68	4.78	4.67	4.53	4.45	4.41	4.41
Fixed & Variable Composite (Tk./kWh)				0.00	7.17	8.45	7.52	7.03	7.25	7.44	7.39	8.32	7.33	7.89	7.51	7.80	7.66	7.78	7.94	7.64	7.24	7.06	6.91	6.88
Average Fixed & Variable Composite (Tk./kWh)	7.51																							
Levelized Fixed & Variable Comp @12% (Tk./kWh)	6.91																							

Source: PSMP Study Team

note:
Capacity includes the capacity of new plants by public and unclassified undertaking including Hydro.
Net generation represents the net generated outputs by new public and unclassified undertaking plants including Hydro.
The decrease of annual output in 2018 from 2017 owes to the decrease of outputs at Chittagong South 600 MW #1, Khulna 600MWs, Chittagong 600 MWs and many other gas fired stations.
Capital cost, investment and loan are the ones for development of new generation plants and related facilities.
The surge in depreciation in 2011is due to commissioning of new gas plants of Sikalbaha, Siddrganj and Fenchganj Power Stations.
Generation cost does not take into consideration of the salvage values.
The cost at the end of transmission with exception of the wheeling charge can be obtained by deducting the transmission loss by 2.5% from the net energy generation for the end of 132kV and the by additional 1% for the end of 33kV.

AP Table 10-9 Unit Generation Cost from Existing Plants (Public) incl. Hydro & Transmission

(Taka Million)

Fiscal Year Ending at	Unit	0 2007	1 2008	2 2009	3 2010	4 2011	5 2012	6 2013	7 2014	8 2015	9 2016	10 2017	11 2018	12 2019	13 2020	14 2021	15 2022	16 2023	17 2024	18 2025	19 2026	20 2027	21 2028	22 2029	23 2030
Generation Capacity (MW)					3,108	3,108	3,108	3,108	3,104	2,725	2,725	2,474	2,474	2,474	2,384	2,384	2,086	1,779	1,591	1,413	1,135	960	960	785	607
Net Generation (GWh)					16,376	16,336	17,155	13,904	11,942	9,412	8,970	8,444	8,253	8,238	7,957	7,023	6,486	5,496	4,968	4,386	3,548	3,513	2,932	2,268	2,287
Less Transmission Loss at end of 132kV @2.5%					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Energy at end of 132kV (GWh)					16,376	16,336	17,155	13,904	11,942	9,412	8,970	8,444	8,253	8,238	7,957	7,023	6,486	5,496	4,968	4,386	3,548	3,513	2,932	2,268	2,287
Less Transmission Loss at end of 33kV @1.0%					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Energy at end of 33kV (GWh)					16,376	16,336	17,155	13,904	11,942	9,412	8,970	8,444	8,253	8,238	7,957	7,023	6,486	5,496	4,968	4,386	3,548	3,513	2,932	2,268	2,287
Fixed Cost																									
Depreciation					6,206	6,178	6,178	6,178	6,178	5,562	5,562	5,008	5,008	5,008	4,668	4,668	4,132	3,636	3,310	2,952	2,458	2,106	2,106	1,753	1,394
O & M					6,884	6,662	6,651	6,651	6,651	6,085	6,085	5,678	5,678	5,678	5,483	5,483	4,836	4,348	4,014	3,627	3,024	2,644	2,644	2,264	1,877
Administrative Overhead					702	702	701	701	842	769	769	715	715	715	691	691	611	546	502	455	380	333	333	286	239
Loan Interest (Donor)					2,576	2,413	2,250	2,087	1,924	1,730	1,545	1,359	1,184	1,009	793	638	469	318	177	113	85	85	85	85	85
Loan Interest (Local)					339	317	296	274	253	227	202	178	155	132	102	82	60	41	23	15	11	11	11	15	15
Dividend					1,838	1,837	1,837	1,837	1,831	1,664	1,664	1,531	1,531	1,531	1,457	1,457	1,302	1,158	1,066	959	811	705	705	599	491
Land Cost																									
Sub-Total					18,545	18,109	17,912	17,727	17,678	16,037	15,827	14,469	14,271	14,073	13,193	13,019	11,410	10,046	9,092	8,119	6,768	5,883	5,883	5,001	4,101
Variable Cost (Local)																									
Fuel Cost					105,615	107,537	114,868	93,491	79,570	60,639	59,240	54,731	55,646	57,167	55,499	48,143	44,116	37,481	32,880	28,043	20,915	20,595	15,454	9,612	9,866
Electricity Purchase																									
O & M					1,354	1,772	1,770	1,770	1,770	1,602	1,602	1,468	1,468	1,468	1,423	1,423	1,272	1,107	1,009	918	776	687	687	598	508
Sub-Total					106,969	109,309	116,638	95,260	81,339	62,241	60,842	56,199	57,114	58,635	56,922	49,566	45,388	38,589	33,889	28,962	21,691	21,282	16,141	10,210	10,374
Salvage Value																									
Land																									
Plant					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Costs					125,514	127,418	134,550	112,988	99,017	78,278	76,669	70,668	71,385	72,708	70,115	62,585	56,798	48,635	42,981	37,081	28,459	27,165	22,024	15,212	14,474
Total Fixed Costs					18,545	18,109	17,912	17,727	17,678	16,037	15,827	14,469	14,271	14,073	13,193	13,019	11,410	10,046	9,092	8,119	6,768	5,883	5,883	5,001	4,101
Total Variable Costs					106,969	109,309	116,638	95,260	81,339	62,241	60,842	56,199	57,114	58,635	56,922	49,566	45,388	38,589	33,889	28,962	21,691	21,282	16,141	10,210	10,374
Generation Cost																									
Fixed Cost (Tk./kW/month)					497	486	480	475	475	490	484	487	481	474	461	455	456	471	476	479	497	511	511	531	563
Fixed Cost Averaged (Tk/kW/month)	488																								
Variable Cost (Tk./kWh)					6.53	6.69	6.80	6.85	6.81	6.61	6.78	6.66	6.92	7.12	7.15	7.06	7.00	7.02	6.82	6.60	6.11	6.06	5.51	4.50	4.54
Variable Cost Averaged	6.48																								
Generation Cost per Unit																									
Fixed Cost in kWh basis					1.13	1.11	1.04	1.27	1.48	1.70	1.76	1.71	1.73	1.71	1.66	1.85	1.76	1.83	1.83	1.85	1.91	1.67	2.01	2.21	1.79
Average Fixed Cost in kWh Basis	1.67																								
Variable Cost (Tk./kWh)					6.53	6.69	6.80	6.85	6.81	6.61	6.78	6.66	6.92	7.12	7.15	7.06	7.00	7.02	6.82	6.60	6.11	6.06	5.51	4.50	4.54
Fixed & Variable Composite (Tk./kWh)	7.66				7.80	7.84	8.13	8.29	8.32	8.55	8.37	8.65	8.83	8.81	8.91	8.76	8.85	8.65	8.46	8.02	7.73	7.51	6.71	6.33	6.33
Average Fixed & Variable Composite (Tk./kWh)	8.15																								
Levelized Fixed & Variable Comp @12% (Tk./kWh)	8.17																								

Source: PSMP Study Team

note:
Capacity includes the capacity of existing plants by public undertaking including Hydro.
Net generation represents the net generated outputs by existing public undertaking plants including Hydro.
Generation cost does not take into consideration of the salvage values.
The cost at the end of transmission with exception of the wheeling charge can be obtained by deducting the transmission loss by 2.5% from the net energy generation for the end of 132kV and the by additional 1% for the end of 33kV.

AP Table 10-10 Unit Purchase Cost of Electricity from New & Existing Private Plants

(Taka Million)

Fiscal Year	Unit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Generation					2,024	3,601	3,863	4,639	5,146	6,376	7,576	8,233	10,483	10,483	12,233	12,733	13,483	14,483	15,483	16,312	16,261	16,261	15,901	14,686	14,686
Net Generation					11,962	16,078	17,102	18,555	19,750	25,119	31,191	36,053	44,518	44,546	53,670	57,606	64,073	66,747	73,440	82,280	82,158	81,939	80,612	75,684	76,929
Less					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Energy at					11,962	16,078	17,102	18,555	19,750	25,119	31,191	36,053	44,518	44,546	53,670	57,606	64,073	66,747	73,440	82,280	82,158	81,939	80,612	75,684	76,929
Less					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Energy at					11,962	16,078	17,102	18,555	19,750	25,119	31,191	36,053	44,518	44,546	53,670	57,606	64,073	66,747	73,440	82,280	82,158	81,939	80,612	75,684	76,929
Fixed Cost																									
O & M																									
Loan																									
Loan																									
Dividend																									
Land Cost					19,832	62,366	66,304	70,103	74,245	75,264	98,740	99,740	123,953	123,960	147,687	146,608	144,482	141,451	156,327	170,194	166,273	163,387	158,179	143,927	140,814
Sub-Total					19,832	62,366	66,304	70,103	74,245	75,264	98,740	99,740	123,953	123,960	147,687	146,608	144,482	141,451	156,327	170,194	166,273	163,387	158,179	143,927	140,814
Variable Cost																									
Fuel Cost																									
Electricity					62,281	94,572	103,148	106,354	110,620	125,338	142,108	149,098	170,650	174,776	196,624	218,225	253,137	269,998	280,064	295,307	297,719	297,943	293,368	263,966	273,047
O & M																									
Sub-Total					62,281	94,572	103,148	106,354	110,620	125,338	142,108	149,098	170,650	174,776	196,624	218,225	253,137	269,998	280,064	295,307	297,719	297,943	293,368	263,966	273,047
Salvage Value																									
Land																									
Plant					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Costs					82,114	156,938	169,452	176,456	184,864	200,602	240,848	248,838	294,603	298,737	344,311	364,833	397,619	411,449	436,392	465,501	463,992	461,330	451,547	407,893	413,861
Total Fixed					19,832	62,366	66,304	70,103	74,245	75,264	98,740	99,740	123,953	123,960	147,687	146,608	144,482	141,451	156,327	170,194	166,273	163,387	158,179	143,927	140,814
Total					62,281	94,572	103,148	106,354	110,620	125,338	142,108	149,098	170,650	174,776	196,624	218,225	253,137	269,998	280,064	295,307	297,719	297,943	293,368	263,966	273,047
Generation Cost																									
Fixed Cost					817	1,443	1,430	1,259	1,202	984	1,086	1,010	985	985	1,006	960	893	814	841	869	852	837	829	817	799
Fixed Cost		987																							
Variable					5.21	5.88	6.03	5.73	5.60	4.99	4.56	4.14	3.83	3.92	3.66	3.79	3.95	4.05	3.81	3.59	3.62	3.64	3.64	3.49	3.55
Variable		4.32																							
Generation Cost																									
Fixed Cost					1.66	3.88	3.88	3.78	3.76	3.00	3.17	2.77	2.78	2.78	2.75	2.55	2.25	2.12	2.13	2.07	2.02	1.99	1.96	1.90	1.83
Average		2.62																							
Variable					5.21	5.88	6.03	5.73	5.60	4.99	4.56	4.14	3.83	3.92	3.66	3.79	3.95	4.05	3.81	3.59	3.62	3.64	3.64	3.49	3.55
Fixed &					6.86	9.76	9.91	9.51	9.36	7.99	7.72	6.90	6.62	6.71	6.42	6.33	6.21	6.16	5.94	5.66	5.65	5.63	5.60	5.39	5.38
Average		6.94																							
Levelized		7.84																							

Source: PSMP Study Team

note:
Capacity includes the new and existing capacity of private undertaking including IPP and Rentals
Net generation represents the net generated outputs by new and existing private undertaking plants including IPP and Rentals
The cost at the end of transmission with exception of the wheeling charge can be obtained by deducting the transmission loss by 2.5% from the net energy generation for the end of 132kV and the by additional 1% for the end of 33kV.
Generation cost does not take into consideration of the salvage values.
The cost at the end of transmission with exception of the wheeling charge can be obtained by deducting the transmission loss by 2.5% from the net energy generation for the end of 132kV and the by additional 1% for the end of 33kV.

AP Table 10-11 Overall Unit Cost of Electricity incl. New (public & pub/priv unclassified), Related Facilities, Existing Gen Plants and Purchased Electricity (new & existing)

(Taka Million)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Fiscal Year Ending at Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Generation Capacity (MW)				5,132	7,169	8,103	9,839	11,777	13,288	14,938	16,395	19,244	20,644	22,504	23,804	24,956	26,949	28,961	29,712	31,383	33,508	35,248	37,258	38,680
Net Generation (GWh)				28,338	35,843	39,775	43,168	49,955	53,254	59,736	65,587	71,471	79,718	88,761	96,668	103,763	110,721	120,170	129,776	138,815	151,228	160,816	171,678	182,289
Less Transmission Loss at end of 132kV @2.5%				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Energy at end of 132kV (GWh)				28,338	35,843	39,775	43,168	49,955	53,254	59,736	65,587	71,471	79,718	88,761	96,668	103,763	110,721	120,170	129,776	138,815	151,228	160,816	171,678	182,289
Less Transmission Loss at end of 33kV @1.0%				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Energy at end of 33kV (GWh)				28,338	35,843	39,775	43,168	49,955	53,254	59,736	65,587	71,471	79,718	88,761	96,668	103,763	110,721	120,170	129,776	138,815	151,228	160,816	171,678	182,289
Fixed Cost																								
Depreciation				6,206	6,995	10,658	13,731	19,320	21,725	23,478	27,812	27,888	28,516	31,269	36,715	38,404	44,422	46,999	51,940	57,265	58,630	65,715	73,263	79,919
O & M				6,884	7,096	8,626	10,200	13,704	14,236	15,042	17,849	20,211	24,946	27,395	27,957	29,813	36,978	41,633	41,557	48,594	59,601	66,629	77,391	82,331
Administrative Overhead				0	56	265	490	966	1,126	1,330	1,804	2,069	2,668	3,013	3,112	3,415	4,537	5,050	5,111	6,161	7,658	8,534	9,889	10,540
Loan Interest (Donor)				2,576	3,033	5,193	7,792	12,437	14,511	16,681	20,674	23,142	27,631	29,872	30,178	32,077	38,924	41,855	41,033	47,131	56,383	60,781	66,540	71,378
Loan Interest (Local)				339	396	767	1,098	1,687	1,950	2,226	2,732	3,035	3,590	3,869	3,905	4,138	4,998	5,361	5,250	6,013	7,177	7,737	8,470	9,206
Dividend				1,838	2,066	2,938	3,969	5,731	6,404	7,281	8,692	9,745	11,599	12,030	13,222	14,217	17,119	18,701	19,024	21,855	25,472	27,899	31,616	33,551
Land Cost				19,832	62,366	66,304	70,103	74,245	75,264	98,740	99,740	123,953	123,960	147,687	146,608	144,482	141,451	156,327	170,194	166,273	163,387	158,179	143,927	140,814
Sub-Total				37,675	82,009	94,752	107,382	128,091	135,216	164,779	179,303	210,042	222,911	255,134	261,697	266,545	288,429	315,926	334,110	353,292	378,309	395,474	411,095	427,739
Variable Cost (Local)																								
Fuel Cost				105,615	129,502	151,149	155,878	177,465	159,205	162,979	158,555	151,350	180,225	184,302	194,400	200,297	210,300	220,549	226,043	259,201	306,892	346,477	406,771	447,562
Electricity Purchase				62,281	94,572	103,148	106,354	110,620	125,338	142,108	149,098	170,650	174,776	196,624	218,225	253,137	269,998	280,064	295,307	297,719	297,943	293,368	263,966	273,047
O & M				1,354	1,902	2,445	2,982	4,243	4,577	5,809	7,199	7,474	8,734	9,496	9,811	10,054	13,308	13,349	13,563	16,278	19,774	21,503	23,826	24,911
Sub-Total				169,250	225,976	256,742	265,213	292,327	289,120	310,895	314,852	329,475	363,736	390,422	422,436	463,489	493,606	513,962	534,912	573,197	624,609	661,348	694,562	745,520
Salvage Value																								
Land																								
Plant				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,999	564	1,209	0	0
Annual Costs				206,925	307,985	351,493	372,596	420,418	424,336	475,674	494,155	539,517	586,647	645,556	684,133	730,034	782,035	829,888	869,021	926,489	1,002,917	1,056,822	1,105,657	1,173,258
Total Fixed Costs				37,675	82,009	94,752	107,382	128,091	135,216	164,779	179,303	210,042	222,911	255,134	261,697	266,545	288,429	315,926	334,110	353,292	378,309	395,474	411,095	427,739
Total Variable Costs				169,250	225,976	256,742	265,213	292,327	289,120	310,895	314,852	329,475	363,736	390,422	422,436	463,489	493,606	513,962	534,912	573,197	624,609	661,348	694,562	745,520
Generation Cost																								
Fixed Cost (Tk./kW/month)				612	953	974	909	906	848	919	911	910	900	945	916	890	892	909	937	938	941	935	919	922
Fixed Cost Averaged (Tk/kW/month)	904																							
Variable Cost (Tk./kWh)				5.97	6.30	6.45	6.14	5.85	5.43	5.20	4.80	4.61	4.56	4.40	4.37	4.47	4.46	4.28	4.12	4.13	4.13	4.11	4.05	4.09
Variable Cost Averaged	4.85																							
Generation Cost per Unit																								
Fixed Cost in kWh basis				1.33	2.29	2.38	2.49	2.56	2.54	2.76	2.73	2.94	2.80	2.87	2.71	2.57	2.61	2.63	2.57	2.55	2.50	2.46	2.39	2.35
Average Fixed Cost in kWh Basis	2.52																							
Variable Cost (Tk./kWh)				5.97	6.30	6.45	6.14	5.85	5.43	5.20	4.80	4.61	4.56	4.40	4.37	4.47	4.46	4.28	4.12	4.13	4.13	4.11	4.05	4.09
Fixed & Variable Composite (Tk./kWh)				7.30	8.59	8.84	8.63	8.42	7.97	7.96	7.53	7.55	7.36	7.27	7.08	7.04	7.06	6.91	6.70	6.67	6.63	6.57	6.44	6.44
Average Fixed & Variable Composite (Tk./kWh)	7.38																							
Levelized Fixed & Variable Comp @12% (Tk./kWh)	7.83																							

Source: PSMP Study Team

note:

Capacity includes the existing and new capacity of public, private and unclassified undertaking including IPP and Rentals

Net generation represents the net generated outputs of existing and new generation plants by public, private and public undertaking including IPP and Rentals

The decrease of annual output in 2018 from 2017 owes to the decrease of outputs at Chittagong South 600 MW #1, Khulna 600MWs, Chittagong 600 MWs and many other gas fired stat

Capital cost, investment and loan includes the ones for new plants, related facilities and hypothetically constructed for the existing plants.

Generation cost does not take into consideration of the salvage values.

The cost at the end of transmission with exception of the wheeling charge can be obtained by deducting the transmission loss by 2.5% from the net energy generation for the end of 132kV and the by additional 1% for the end of 33kV.

Chapter 12 Selection of Most-prioritized Projects APPENDIX

12.1 APPENDIX –Weighing of Evaluation Items by the AHP Method

(1) Weighting for detail items

The following table shows the result of weighting for detail item by using AHP method.

APTable 12-1 Result of Evaluation by AHP Method for detail items

	Items	1	2	3	4	5	6	7	8	9	10	11	12	13	Geometric Average	Level of Importance	Point Allocation
A Fuel Security																	
1	Fuel Transportation	1	2	-	-	-	-	-	-	-	-	-	-	-	1.4142	0.6667	12.10
2	Port Facilities	1/2	1	-	-	-	-	-	-	-	-	-	-	-	0.7071	0.3333	6.05
B Feasibility Factor for Construction																	
1	Securing the Necessary Amount of Ground Space	1	2	2	1	-	-	-	-	-	-	-	-	-	1.4142	0.3333	3.03
2	Transportation of Facilities	1/2	1	1	1/2	-	-	-	-	-	-	-	-	-	0.7071	0.1667	1.52
3	History of Flood	1/2	1	1	1/2	-	-	-	-	-	-	-	-	-	0.7071	0.1667	1.52
4	Topography / Geology	1	2	2	1	-	-	-	-	-	-	-	-	-	1.4142	0.3333	3.03
C Operational Conditions																	
1	Securement of Cooling Water	1	3	-	-	-	-	-	-	-	-	-	-	-	1.7321	0.75	6.80
2	Ash Treatment	1/3	1	-	-	-	-	-	-	-	-	-	-	-	0.5774	0.25	2.30
D Economic Conditions																	
1	Distance with Existing Power System	1	2	-	-	-	-	-	-	-	-	-	-	-	1.4142	0.6667	6.07
2	Project Cost	1/2	1	-	-	-	-	-	-	-	-	-	-	-	0.7071	0.3333	3.03
E Local Demand − Supply																	
1	Advantage on Power System Viewpoint	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	9.10
F Needs of Bangladesh																	
1	Needs level of Bangladesh	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	18.15
G Donor																	
1	Plan and Priority of WB,ADB Finance	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	9.10
H Environment Influence																	
1	Air Pollution	1	1	2	2	2	2	2	1	1	1	1	2	1	1.3770	0.0998	0.91
2	Water Contamination	1	1	2	2	2	2	2	1	1	1	1	2	1	1.3770	0.0998	0.91
3	Soil Pollution	1/2	1/2	1	1	1	1	1	1/2	1/2	1/2	1/2	1	1/2	0.6885	0.0499	0.45
4	Bottom Sediment	1/2	1/2	1	1	1	1	1	1/2	1/2	1/2	1/2	1	1/2	0.6885	0.0499	0.45
5	Noise and vibration	1/2	1/2	1	1	1	2	1	1/2	1/2	1/2	1/2	1	1/2	0.7262	0.0526	0.48
6	Offensive Odor	1/2	1/2	1	1	1/2	1	1/2	1/2	1/2	1/2	1/2	1	1/2	0.6189	0.0448	0.41
7	Waste	1/2	1/2	1	1	1	2	1	1/2	1/2	1/2	1/2	1	1/2	0.7262	0.0526	0.48
8	Ground subsidence	1	1	2	2	2	2	2	1	2	1	1	2	1	1.4524	0.1053	0.96
9	Geographical feature	1	1	2	2	2	2	2	1/2	1	1/2	1/2	2	1	1.1735	0.0850	0.77
10	Biota and Ecosystem	1	1	2	2	2	2	2	1	2	1	1	2	1	1.4524	0.1053	0.96

	Items	1	2	3	4	5	6	7	8	9	10	11	12	13	Geometric Average	Level of Importance	Point Allocation
11	Water usage	1	1	2	2	2	2	2	1	2	1	1	2	1	1.4524	0.1053	0.96
12	Accidents	1/2	1/2	1	1	1	1	1	1/2	1/2	1/2	1/2	1	1/2	0.6885	0.0499	0.45
13	Global warming	1	1	2	2	2	2	2	1	1	1	1	2	1	1.3770	0.0998	0.91
I Social Issues																	
1	Involuntary resettlement	1	2	1	2	1	2	2	1	2	1	1	1	-	1.3348	0.1081	0.98
2	Local Economy such as employment and livelihood etc.	1/2	1	1	2	2	2	2	1/2	1	1	1/2	1	-	1.0595	0.0858	0.78
3	The poor, indigenous and ethnic people	1	1	1	2	2	2	2	1	1	2	2	1	-	1.4142	0.1146	1.04
4	Misdistribution of benefit and loss	1/2	1/2	0.5	1	1	2	2	1/2	1	1/2	1/2	1	-	0.7937	0.0643	0.59
5	Local conflict of interests	1	1/2	0.5	1	1	1	1	1	1	1/2	1/2	1	-	0.7937	0.0643	0.59
6	Gender	1/2	1/2	1/2	1/2	1	1	1	1	1	1/2	1/2	1	-	0.7071	0.0573	0.52
7	Children's right	1/2	1/2	1/2	1/2	1	1	1	1	1	1/2	1/2	1	-	0.7071	0.0573	0.52
8	Land use and utilization of local resources	1	2	1	2	1	1	1	1	2	1/2	1	1	-	1.1225	0.0909	0.83
9	Social institutions such as social infrastructure and local decision making institutions	1/2	1	1	1	1	1	1	1/2	1	1	1	1	-	0.8909	0.0722	0.65
10	Existing social infrastructures	1	1	1/2	2	2	2	2	2	1	1	1	1	-	1.2599	0.1021	0.93
11	Cultural heritage	1	2	1/2	2	2	2	2	1	1	1	1	1	-	1.2599	0.1021	0.93
12	Infectious diseases such as HIV/AIDS etc	1	1	1	1	1	1	1	1	1	1	1	1	-	1.0000	0.0810	0.74
Total																	100.00

Source: PSMP Study Team

(2) Summary Table of Weighting

The following table shows the weighting that is the point allocation, for major and detail item.

APTable 12-2 Summary Table of Weighting

Evaluation Item		Point Allocation for Screening	
Major Items	Detail Items	1st	2nd
Fuel Security	Fuel Transportation	18.15	12.10
	Port Facilities		6.05
Feasibility Factor for Construction	Securing the Necessary Amount of Ground Space	9.10	3.03
	Transportation of Facilities		1.52
	History of Flood		1.52
	Topography / Geology		3.03
Operational Conditions	Securement of Cooling Water	9.10	6.80
	Ash Treatment		2.30
Economic Conditions	Distance with Existing Power System	9.10	6.07
	Project Cost		3.03
Local Demand-Supply	Advantage on Power System Viewpoint	9.10	9.1
Needs of Bangladesh	Needs Level of Bangladesh	18.15	18.15
Donor	Plan and Priority of WB,ADB Finance	9.10	9.10
Environment Influence	Air Pollution	9.10	0.91
	Water Contamination		0.91
	Soil Pollution		0.45
	Bottom Sediment		0.45
	Noise and Vibration		0.48
	Offensive Odor		0.41
	Waste		0.48
	Ground Subsidence		0.96
	Geographical Feature		0.77
	Biota and Ecosystem		0.96
	Water Usage		0.96
	Accidents		0.45
	Global Warming		0.91
Social Issues	Involuntary resettlement	9.10	0.98
	Local Economy such as employment and livelihood etc.		0.78
	The poor, indigenous and ethnic people		1.04
	Misdistribution of benefit and loss		0.59
	Local conflict of interests		0.59
	Gender		0.52
	Children's right		0.52
	Land use and utilization of local resources		0.83
	Social institutions such as social infrastructure and local decision making institutions		0.65
	Existing social infrastructures		0.93
	Cultural heritage		0.93
	Infectious diseases such as HIV/AIDS etc		0.74
Total		100.00	100.00

Source: PSMP Study Team

(3) Evaluation method of each evaluation item

The evaluation method of each evaluation item is shown on the following table.

APTable 12-3 Concept of Evaluation

Items				View of Evaluation
	Major Items		Minor Items	
A	Fuel Security	1	Fuel Transportation	In general, a coal-fired power station using domestic coal should be located near coal mines in light of fuel transportation costs. In case it is difficult to select a place and a selected location ends up being far in distance from the coal mine, the problem regarding secure stable fuel supply transportation with reduced cost potentially utilizing existing infrastructure and the ingenious application of the new infrastructure should be the focal points to be studied
		2	Port Facility	In the most cases, coal will be imported by coal ships, so the development of coal-fired power plants should include the development of port facilities. In light of this, it is preferable for power stations to be located seaside. Given that coal transportation via big ships does reduce transportation costs, their utilization and related factors such as depth, sea conditions etcetera should be taken into consideration.
B	Feasibility Factor for Construction	1	Securing the Necessary Amount of Ground Space	The ground space for power plant construction should have an enough area for the installed facilities to function normally. For example, in installing two 600MW coal-fired power plant facilities, 140,000 m2 are needed for generation facilities, 15,000 m2 for water treatment facilities, and 100,000 m2 for a coal storage yard should be acquired. Therefore, the securement of such ground space is an absolute candidate site prerequisite.
		2	Transportation of Facilities	In the construction of a power plant, a variety of mechanical facilities will need to be transported to the site. In the majority of cases, large-size facilities will be dismantled into smaller parts prior for transport. However some facilities will contain big parts that will not be able to be broken down any further. For example, in the case of 600MW facilities, the size of a main-transformer is 14m x 13m x 10m and the weight is 320 t; and, the stator of generator is 15m x 7m x 5m and the weight is 400 t. Most of these facilities are imported by ship. So if the site is not at a seaside location (domestic coal power plant), the transportation from the point of unloading to the site should be needed and whether such a route can be secured or not is an essential point that needs to be evaluated.

Items				View of Evaluation
	Major Items		Minor Items	
		3	History of Flood	Bangladesh has many experiences of flood disaster because almost part of the country is morass. The site selected for the power station should not be an area vulnerable to floods. Hence, after investigating the record of past flood disasters, the selection of a site possessing a low probability of flood disaster are imperative.
		4	Topography / Geology	Flat ground should be considered ideal for power plant construction, Even if there are some instances of power plants being constructed on cliffs in Japan, at the least, flat ground should be required for the main facilities. In addition, stable ground is necessary for stable power plant operations. These points are absolute prerequisites in selecting a site.
C	Operational Conditions	1	Securement of Cooling Water	Water is also necessary for the operation of thermal power plants. Water includes plant usage water which is used and consumed by the power generation facility, and cooling water for the condenser and cooler. The flow rate of cooling water is about 30 t/s for 1 x 600MW facility. In case of adoption of the closed cycle type, there is no need for such a large amount of water but 1-2 t/s will be needed for make up and other use. Therefore, the possibility in being able to secure such an amount of water should be one of the conditions.
		2	Ash Treatment	Coal ash is generated by burning coal with the amount of ash generally total 10 to 20% of the coal amount. This amount changes according to the type of coal. The amount of ash generation by a 1 x 600MW coal fired power plant is about 150,000 to 200,000 t/year. The possibility in being able to treat such an amount of ash over a long period of time should be a point of consideration in site selection.
D	Economic Conditions	1	Distance with Existing Power System	In selecting an appropriate site, another important point from an economic point of view is the distance between the power station and the existing grid because there is a direct correlation between this distance and the interconnection cost.
		2	Project Cost	The project cost levels substantially impact the economical analysis.
E	Local Demand-Supply	1	Advantage on Power System Viewpoint	After evaluating not only to shorten the distance of power emission line but also the necessity to reinforce emission line in order to stabilize grid, to evaluate whether there is advantage on power system viewpoint.
F	Needs of Bangladesh	1	Needs Level of Bangladesh	It is important to correspond to the status of the study and pick up on actual needs according to its national plan or policy.

Items				View of Evaluation
	Major Items		Minor Items	
G	Donor	1	Plan and Priority of WB,ADB Finance	At the time of building generation and power system facility in Bangladesh, it is necessary to cooperate with donor such as ADB or WB. So to evaluate the matching with their advantage of development or plan etc.
H	Environment Influence	1	Air Pollution	Evaluation for i) the amount of exhaust gas originating from the use of heavy equipment such as bulldozers, cranes, pile drivers and dump trucks; ii) the amount of dust from land reclamation, development, and road construction etc, and; iii) actual air emissions such as SOx, NOx, and PM by operating existing thermal plants.
		2	Water Contamination	Evaluation for water contamination caused by oil leakage from heavy equipment, dumping of construction wastes and sewages from camp into river/groundwater during construction of power plant / coal-mine / substation, etc.
		3	Soil Pollution	Evaluation for soil pollution caused by oil leakage during construction period and fuel oil leakage during operations, effluence of wastewater including untreated toxic heavy metal.
		4	Bottom Sediment	Evaluation for bottom sediment caused by precipitation of pollutant in wastewater during construction and operation.
		5	Noise and vibration	Evaluation for noise and vibration caused by the operation of construction equipment (especially pile drivers) during construction, and that observed in the boundary area of the power plant site during operation.
		6	Offensive Odor	Evaluation for offensive odor corresponding to the degree of air pollution.
		7	Waste	Evaluation for construction wastes such as coal ash created during operation.
		8	Ground subsidence	Evaluation for distribution pattern of soft clay layer that may cause sink age due to its heavy weight. Draw up recommendations on proper fundamental structure design.
		9	Geographical feature	Evaluation for topographical and/or geological losses of academic and social values.
		10	Biota and Ecosystem	Evaluation for biota and the ecosystem caused by land reclamation and building transmission lines.
		11	Water usage	Evaluation for water usage around the project site and downstream.
		12	Accidents	Evaluation from a safety perspective.
		13	Global warming	Evaluation for greenhouse gas emission.
I	Social Issues	1	Involuntary resettlement	Check if there is any large-scale land acquisition and thus involuntary resettlement anticipated in the proposed site (both permanently and temporarily). Basic principle is to avoid or minimize such adverse impacts. When

Items				View of Evaluation
	Major Items		Minor Items	
				unavoidable, appropriate measures such as compensation should be considered which is deemed appropriate from international and national perspective.
		2	Local Economy such as employment and livelihood etc.	Identify potential loss of agricultural land and that of job opportunities for local people (both permanently and temporarily) caused by the future projects. Identify critical gaps between relevant laws and regulations of Bangladesh and JICA Guidelines for Environmental and Social Considerations to examine suitable livelihood restoration and improvement plan for them including compensation.
		3	The poor, indigenous and ethnic people	Identify appropriate livelihood restoration and improvement plans for vulnerable people such as the destitute, poor, and indigenous people, landless farmers, etc.
		4	Misdistribution of benefit and loss	Identify potential and appropriate ways of equal distribution of project benefits, mitigation measures for damages and losses caused to local people.
		5	Local conflict of interests	Identify appropriate ways of engaging in dialogs and cooperation between relocated communities and host communities when involuntary resettlement is unavoidable.
		6	Gender	Identify women's life styles that are socially vulnerable. Examine possible ways of securing their rights and plans to enhance the quality of life.
		7	Children's right	Minimize adverse impacts on children caused by possible socio-economic changes into their society due to the project implementation, and secure their rights.
		8	Land use and utilization of local resources	Identify relevant laws and regulations in Bangladesh regarding land use and local resources utilization to compare with requirements of JICA Guidelines to examine compensation and other appropriate measures.
		9	Social institutions such as social infrastructure and local decision making institutions	Involve all local stakeholders not only Project Affected People (PAPs), but local governments, universities, NGOs and religious organizations who can influence decision-makings.
		10	Existing social infrastructures	Identify possible losses from present land /infrastructure system (both temporarily and permanently) and examine alternatives.
		11	Cultural heritage	Identify potential effects on and losses of heritages and/or tradition, or landscape blockades at the proposed sites to examine alternatives. Examine potential alternate transmission routes when present ones become

Items				View of Evaluation
	Major Items		Minor Items	
				an obstacle for worshipers and tourists to appreciate the country's cultural heritage.
		12	Infectious diseases such as HIV/AIDS etc	Identify possibility of HIV/AIDS infection among people related to project implementation (such as construction workers). And look into prevention measures.

Source: PSMP Study Team

12.2 APPENDIX – 2 1st Screening

12.2.1 Fuel Security

For Barapukuria, as there is an existing coal mine and power station in operation, it could be a candidate site. Current situation of coal production and usage and the forecast of future development would be the key point for new site.

The other 3 sites (Khalaspir, Dighipara, and Phulbari) hopeful to produce coal in the near future, so the judgment for possibility would be done after investigation about current progress of development.

On the other hand, mining deep mines such as Jamalgonj, Kuchima posed serious technical difficulties resulting in zero developmental progress and a low evaluation result.

About the candidate site of import coal power plant, it is needed for Bheramara site to transport fuel as it located inner area. All of the other sites locate sea side. Chittagong, Mongla, and Matarbari as candidates for Deep Sea Ports are easy to secure imported coal from via the maintenance of port facilities. Meghnaghat, Zajira, Maowa located near the river side so that the establishment of coal transportation routes by internal ships is possible.

Bheramara and Chandpur have been deemed as difficulty to secure coal because the plan for the construction of gas-fired power plant is proceeding.

Based on the above point of view, the result of the evaluation via the AHP method is as follows,

APTable 12-4 Evaluation for Fuel Security (AHP Method)

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1	1/2	1	5	5	5	1/2	1	1/2	1/2	1/2	1/2	1/2	2	1/2	0.9985	0.0516
2	Phulbari	1	1	1/2	1	5	5	5	1/2	1	1/2	1/2	1/2	1/2	1/2	2	1/2	0.9985	0.0516
3	Khalaspir	2	2	1	2	5	5	5	1	2	1	1	1	1	1	3	1	1.7224	0.0890
4	Dighipara	1	1	1/2	1	5	5	5	1/2	1	1/2	1/2	1/2	1/2	1/2	2	1/2	0.9985	0.0516
5	Jamalgonj	1/5	1/5	1/5	1/5	1	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/3	1/5	0.2792	0.0144
6	Kuchima	1/5	1/5	1/5	1/5	1	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/3	1/5	0.2792	0.0144
7	Bheramara	1/5	1/5	1/5	1/5	1	1	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/3	1/5	0.2792	0.0144
8	Chittagong	2	2	1	2	5	5	5	1	2	1	1	1	1	1	4	1	1.7537	0.0906
9	Cox's Bazar	1	1	1/2	1	5	5	5	1/2	1	1/2	1/2	1/2	1/2	1/2	3	1/2	1.0241	0.0529
10	Mongla	2	2	1	2	5	5	5	1	2	1	1	1	1	1	4	1	1.7537	0.0906
11	Khulna	2	2	1	2	5	5	5	1	2	1	1	1	1	1	4	1	1.7537	0.0906
12	Meghnaghat	2	2	1	2	5	5	5	1	2	1	1	1	1	1	4	1	1.7537	0.0906
13	Zajira	2	2	1	2	5	5	5	1	2	1	1	1	1	1	4	1	1.7537	0.0906
14	Maowa	2	2	1	2	5	5	5	1	2	1	1	1	1	1	4	1	1.7537	0.0906
15	Chandpur	1/2	1/2	1/3	1/2	3	3	3	1/4	1/3	1/4	1/4	1/4	1/4	1/4	1	1/3	0.5221	0.0270
16	Matarbari	2	2	1	2	5	5	5	1	2	1	1	1	1	1	3	1	1.7224	0.0890

Source: PSMP Study Team

12.2.2 Feasibility Factor for Construction

In case of Bheramara and Chandpur, new gas fired power plant is planning to be constructed, so the feasibility for coal fired plant is not so high...

For Barapukuria, Khalaspir, Dighipara, Phulbari at inner area, the study regarding the transportation of equipment is needed.

Based on the above point of view, the results of the evaluation via the AHP method is as follows,

APTable 12-5 Evaluation for Feasibility Factor for Construction (AHP Method)

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1	1	1	1	1	5	2	2	2	2	2	2	2	5	2	1.7294	0.0939
2	Phulbari	1	1	1	1	1	1	5	2	2	2	2	2	2	2	5	2	1.7294	0.0939
3	Khalaspir	1	1	1	1	1	1	5	2	2	2	2	2	2	2	5	2	1.7294	0.0939
4	Dighipara	1	1	1	1	1	1	5	2	2	2	2	2	2	2	5	2	1.7294	0.0939
5	Jamalgonj	1	1	1	1	1	1	5	2	2	2	2	2	2	2	5	2	1.7294	0.0939
6	Kuchima	1	1	1	1	1	1	5	2	2	2	2	2	2	2	5	2	1.7294	0.0939
7	Bheramara	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	0.2212	0.0120
8	Chittagong	1/2	1/2	1/2	1/2	1/2	1/2	5	1	1	1	1	1	1	1	5	1	0.9429	0.0512
9	Cox's Bazar	1/2	1/2	1/2	1/2	1/2	1/2	5	1	1	1	1	1	1	1	5	1	0.9429	0.0512
10	Mongla	1/2	1/2	1/2	1/2	1/2	1/2	5	1	1	1	1	1	1	1	5	1	0.9429	0.0512
11	Khulna	1/2	1/2	1/2	1/2	1/2	1/2	5	1	1	1	1	1	1	1	5	1	0.9429	0.0512
12	Meghnaghat	1/2	1/2	1/2	1/2	1/2	1/2	5	1	1	1	1	1	1	1	5	1	0.9429	0.0512
13	Zajira	1/2	1/2	1/2	1/2	1/2	1/2	5	1	1	1	1	1	1	1	5	1	0.9429	0.0512
14	Maowa	1/2	1/2	1/2	1/2	1/2	1/2	5	1	1	1	1	1	1	1	5	1	0.9429	0.0512
15	Chandpur	1/5	1/5	1/5	1/5	1/5	1/5	5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1	1/5	0.2704	0.0147
16	Matarbari	1/2	1/2	1/2	1/2	1/2	1/2	5	1	1	1	1	1	1	1	5	1	0.9429	0.0512

Source: PSMP Study Team

12.2.3 Operating Conditions

In general, it is difficult to secure water at the inner area and the usage of well water is needed in case there is no river around the site. On the contrary, water inlet from river or sea can be acceptable for secure water.

Regarding ash treatment, all of candidate site has enough area; major problem would not be arising for the time being.

Based on the above point of view, the results of the evaluation via the AHP method is as follows,

APTable 12-6 Evaluation for Operating Conditions (AHP Method)

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1/2	1/2	1/2	1/2	1/2	1	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	0.4341	0.0250
2	Phulbari	2	1	1	1	1	1	2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	0.7384	0.0425
3	Khalaspir	2	1	1	1	1	1	2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	0.7384	0.0425
4	Dighipara	2	1	1	1	1	1	2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	0.7384	0.0425
5	Jamalgonj	2	1	1	1	1	1	2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	0.7384	0.0425
6	Kuchima	2	1	1	1	1	1	2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	0.7384	0.0425
7	Bheramara	1	1/2	1/2	1/2	1/2	1/2	1	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	0.4341	0.0250
8	Chittagong	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820
9	Cox's Bazar	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820
10	Mongla	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820
11	Khulna	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820
12	Meghnaghat	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820
13	Zajira	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820
14	Maowa	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820
15	Chandpur	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820
16	Matarbari	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1.4247	0.0820

Source: PSMP Study Team

12.2.4 Economic Conditions

Basically all of candidate sites could connect to existing power grid easily. For other points, no material differences have been discerned at the 1st screening. So the result of the AHP method is as follows.

APTable 12-7 Evaluation for Economic Conditions

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
2	Phulbari	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
3	Khalaspir	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
4	Dighipara	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
5	Jamalgonj	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
6	Kuchima	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
7	Bheramara	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
8	Chittagong	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
9	Cox's Bazar	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
10	Mongla	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
11	Khulna	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
12	Meghnaghat	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
13	Zajira	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
14	Maowa	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
15	Chandpur	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625
16	Matarbari	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0000	0.0625

Source: PSMP Study Team

12.2.5 Local Demand and Supply

In terms of ideal power plant characteristics, it is best for a plant to be located near the point of demand as much as possible. This is because the length of the transmission line from the power plant can be shortened but also the transmission line expansion necessary for stabilizing the power system can be minimized in case of utilization of a long-distance transmission line. It is necessary to study the aforementioned ideal power supply arrangement maintaining the regional imbalances between power supply as much as possible utilizing not only the overall power demand but also regional power demand.

At the first screening, an evaluation was carried out to narrow down the sixteen (16) potential sites nominated from a long list to the mid list as follows, based on the evaluation criteria shown in APTable 12-8. The results of the evaluation are shown as follows.

APTable 12-8 Evaluation Criteria

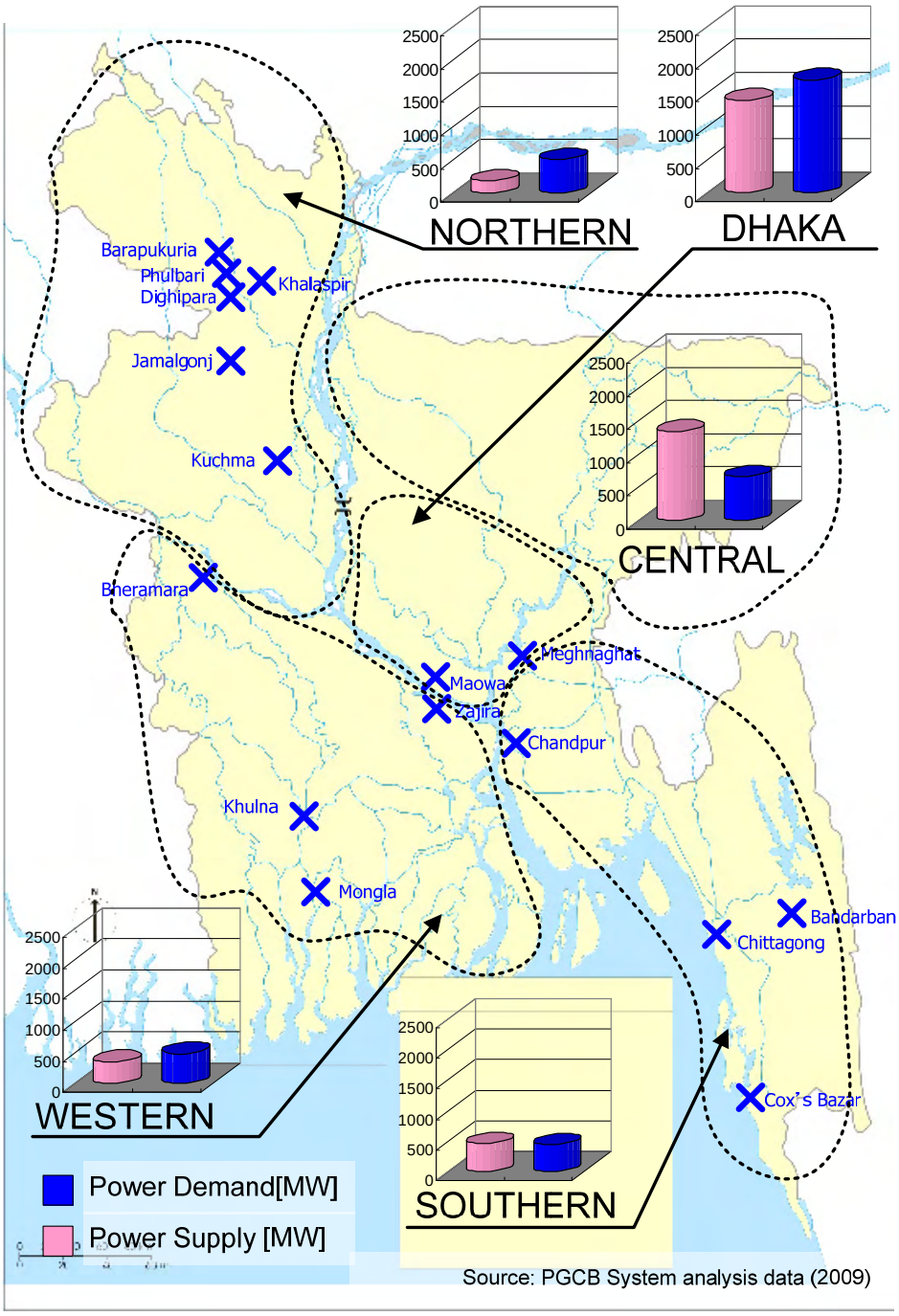
Score	Demand / Supply
5	≥1.5
4	1.2 – 1.49
3	0.75 – 1.19
2	0.5 – 0.74
1	<0.5

APTable 12-9 Result of 1st Screening (Local Demand and Supply) [1]

Region	Power supply (MW)	Power demand (MW)	Power demand supply	Score	Potential site for coal power development
Southern	463	440	0.95	3	Chittagong, Cox's Bazar, Chandpur, Bandarban
Dhaka	1393	1700	1.22	4	Meghnaghat, Maowa
Central	1342	659	0.49	1	
Western	353	484	1.37	4	Khulna, Zajira, Bheramara, Mongla
Northern	189	505	2.68	5	Barapukuria, Phulbari, Khalaspir, Dighipara, Jamalgonji, Kuchma

Source: PGCB CENTRAL LOAD DESPATCH CENTER "Daily Report"

[1] The Figs of power supply and power demand including the load shedding are those based on 21:00 data at the end of FY 2009



Source: PGCB CENTRAL LOAD DESPATCH CENTER "Daily Report"

APFig. 12-1 Regional imbalances between power supply & demand and Potential site for coal power development（long list）[1]

[1] The Figs of power supply and power demand including the load shedding are those based on 21:00 data at the end of FY 2009.

For this item, a quantitative evaluation was already conducted. However, AHP method has been used for total evaluation. The results via AHP method was conducted as a matter of convenience as follows,

APTable 12-10 Evaluation for Local Demand and Supply

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1	1	1	1	1	2	3	3	2	2	2	2	2	3	3	1.7067	0.0960
2	Phulbari	1	1	1	1	1	1	2	3	3	2	2	2	2	2	3	3	1.7067	0.0960
3	Khalaspir	1	1	1	1	1	1	2	3	3	2	2	2	2	2	3	3	1.7067	0.0960
4	Dighipara	1	1	1	1	1	1	2	3	3	2	2	2	2	2	3	3	1.7067	0.0960
5	Jamalgonj	1	1	1	1	1	1	2	3	3	2	2	2	2	2	3	3	1.7067	0.0960
6	Kuchima	1	1	1	1	1	1	2	3	3	2	2	2	2	2	3	3	1.7067	0.0960
7	Bheramara	1/2	1/2	1/2	1/2	1/2	1/2	1	2	2	1	1	1	1	1	2	2	0.9170	0.0516
8	Chittagong	1/3	1/3	1/3	1/3	1/3	1/3	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1	1	0.5107	0.0287
9	Cox's Bazar	1/3	1/3	1/3	1/3	1/3	1/3	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1	1	0.5107	0.0287
10	Mongla	1/2	1/2	1/2	1/2	1/2	1/2	1	2	2	1	1	1	1	1	2	2	0.9170	0.0516
11	Khulna	1/2	1/2	1/2	1/2	1/2	1/2	1	2	2	1	1	1	1	1	2	2	0.9170	0.0516
12	Meghnaghat	1/2	1/2	1/2	1/2	1/2	1/2	1	2	2	1	1	1	1	1	2	2	0.9170	0.0516
13	Zajira	1/2	1/2	1/2	1/2	1/2	1/2	1	2	2	1	1	1	1	1	2	2	0.9170	0.0516
14	Maowa	1/2	1/2	1/2	1/2	1/2	1/2	1	2	2	1	1	1	1	1	2	2	0.9170	0.0516
15	Chandpur	1/3	1/3	1/3	1/3	1/3	1/3	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1	1	0.5107	0.0287
16	Matarbari	1/3	1/3	1/3	1/3	1/3	1/3	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1	1	0.5107	0.0287

Source: PSMP Study Team

12.2.6 Needs of Bangladesh

Through discussion with CP until the 1st screening, the priority of coal imports at port such as Chittagong, the possibility of the development of domestic coal and the development of river side sites such as Meghnaghat, Zajira, Maowa are high. Based on this information, the result of the AHP method is as follows,

APTable 12-11 Evaluation for Needs of Bangladesh

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1	1	1	5	5	3	1/2	3	1	1/2	1/2	1	1	5	1	1.3622	0.0696
2	Phulbari	1	1	1	1	5	5	3	1/2	3	1	1/2	1/2	1	1	5	1	1.3622	0.0696
3	Khalaspir	1	1	1	1	5	5	3	1/2	3	1	1/2	1/2	1	1	5	1	1.3622	0.0696
4	Dighipara	1	1	1	1	5	5	3	1/2	3	1	1/2	1/2	1	1	5	1	1.3622	0.0696
5	Jamalgonj	1/5	1/5	1/5	1/5	1	1	1	1/5	1	1/4	1/5	1/5	1/3	1/3	1	1/3	0.3691	0.0188
6	Kuchima	1/5	1/5	1/5	1/5	1	1	1	1/5	1	1/4	1/5	1/5	1/3	1/3	1	1/3	0.3691	0.0188
7	Bheramara	1/3	1/3	1/3	1/3	1	1	1	1/5	1	1/4	1/5	1/5	1/3	1/3	1	1/3	0.4193	0.0214
8	Chittagong	2	2	2	2	5	5	5	1	3	3	1	1	2	2	5	3	2.3828	0.1217
9	Cox's Bazar	1/3	1/3	1/3	1/3	1	1	1	1/3	1	1/3	1/5	1/5	1/3	1/3	2	1/3	0.4603	0.0235
10	Mongla	1	1	1	1	4	4	4	1/3	3	1	1/2	1/2	1	1	3	1	1.2737	0.0650
11	Khulna	2	2	2	2	5	5	5	1	5	2	1	1	2	2	5	4	2.4421	0.1247
12	Meghnaghat	2	2	2	2	5	5	5	1	5	2	1	1	3	3	5	3	2.5232	0.1288
13	Zajira	1	1	1	1	3	3	3	1/2	3	1	1/2	1/3	1	1	3	2	1.2603	0.0643
14	Maowa	1	1	1	1	3	3	3	1/2	3	1	1/2	1/3	1	1	3	2	1.2603	0.0643
15	Chandpur	1/5	1/5	1/5	1/5	1	1	1	1/5	1/2	1/3	1/5	1/5	1/3	1/3	1	1/2	0.3691	0.0188
16	Matarbari	1	1	1	1	3	3	3	1/3	3	1	1/4	1/3	1/2	1/2	2	1	1.0074	0.0514

Source: PSMP Study Team

12.2.7 Donor

According to the presentation held on Sep. 2009 by ADB, Chittagong、Khulna、Meghnaghat and Zajira were mentioned as candidate sites. That means at least ADB, one of the donors, has determined them as prioritized sites. Based on it, the results of the AHP method is as follows,

APTable 12-12 Evaluation for Donor

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
2	Phulbari	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
3	Khalaspir	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
4	Dighipara	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
5	Jamalgonj	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
6	Kuchima	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
7	Bheramara	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
8	Chittagong	3	3	3	3	3	3	3	1	3	3	1	1	1	3	3	3	2.2795	0.1250
9	Cox's Bazar	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
10	Mongla	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
11	Khulna	3	3	3	3	3	3	3	1	3	3	1	1	1	3	3	3	2.2795	0.1250
12	Meghnaghat	3	3	3	3	3	3	3	1	3	3	1	1	1	3	3	3	2.2795	0.1250
13	Zajira	3	3	3	3	3	3	3	1	3	3	1	1	1	3	3	3	2.2795	0.1250
14	Maowa	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
15	Chandpur	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417
16	Matarbari	1	1	1	1	1	1	1	1/3	1	1	1/3	1/3	1/3	1	1	1	0.7598	0.0417

Source: PSMP Study Team

12.2.8 Environment Influence

As for the environment influence side, the potential impact to the neighboring area has been considered. On the stage of the 1st screening, Chittagong is a priority because of existing international ports. Mongla is also an existing international port but there is an environmental protected area so that the point is low. Cox's Bazar is also not good for development because it is a resort area with a long beach.

Based on it, the results of the AHP method is as follows,

APTable 12-13 Evaluation for Environment Influence

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
2	Phulbari	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
3	Khalaspir	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
4	Dighipara	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
5	Jamalgonj	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
6	Kuchima	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
7	Bheramara	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
8	Chittagong	2	2	2	2	2	2	2	1	3	3	2	2	2	2	2	2	2.0148	0.1210
9	Cox's Bazar	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/3	1	1	1/2	1/2	1/2	1/2	1/2	1/2	0.5316	0.0319
10	Mongla	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/3	1	1	1/2	1/2	1/2	1/2	1/2	1/2	0.5316	0.0319
11	Khulna	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
12	Meghnaghat	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
13	Zajira	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
14	Maowa	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
15	Chandpur	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627
16	Matarbari	1	1	1	1	1	1	1	1/2	2	2	1	1	1	1	1	1	1.0443	0.0627

Source: PSMP Study Team

12.2.9 Social Issues

As for the social issues side, the influence of the neighboring society via power plant construction is being considered. On the stage of the 1st screening, Phulbari has a low estimation because the neighborhood is already moving against coal mine development. Jamalgonj and Kuchima also have a low estimation because they have almost no possibility to develop coal mines. Further, the influence for the local industry is a little stronger in the case of Maowa than the other sites.

Based on it, the results of the AHP method are as follows,

APTable 12-14 Evaluation for Social Issues

No.	Site Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Geometric Average	Level of Importance
1	Barapukuria	1	1	1/2	1/2	1	1	1/2	1/5	1/3	1/2	1/3	1/2	1/2	1	1/2	1/2	0.5574	0.0306
2	Phulbari	1	1	1/2	1/2	1	1	1/2	1/5	1/3	1/2	1/3	1/2	1/2	1	1/2	1/2	0.5574	0.0306
3	Khalaspir	2	2	1	1	2	2	1	1/3	1/2	1	1/2	1	1	2	1	1	1.0632	0.0583
4	Dighipara	2	2	1	1	2	2	1	1/3	1/2	1	1/2	1	1	2	1	1	1.0632	0.0583
5	Jamalgonj	1	1	1/2	1/2	1	1	1/2	1/5	1/3	1/2	1/3	1/2	1/2	1	1/2	1/2	0.5574	0.0306
6	Kuchima	1	1	1/2	1/2	1	1	1/2	1/5	1/3	1/2	1/3	1/2	1/2	1	1/2	1/2	0.5574	0.0306
7	Bheramara	2	2	1	1	2	2	1	1/3	1/2	1	1/2	1	1	2	1	1	1.0632	0.0583
8	Chittagong	5	5	3	3	5	5	3	1	2	3	2	3	3	5	3	3	3.1233	0.1713
9	Cox's Bazar	3	3	2	2	3	3	2	1/2	1	2	1	2	2	3	2	2	1.9090	0.1047
10	Mongla	2	2	1	1	2	2	1	1/3	1/2	1	1/2	1	1	2	1	1	1.0632	0.0583
11	Khulna	3	3	2	2	3	3	2	1/2	1	2	1	2	2	3	2	2	1.9090	0.1047
12	Meghnaghat	2	2	1	1	2	2	1	1/3	1/2	1	1/2	1	1	2	1	1	1.0632	0.0583
13	Zajira	2	2	1	1	2	2	1	1/3	1/2	1	1/2	1	1	2	1	1	1.0632	0.0583
14	Maowa	1	1	1/2	1/2	1	1	1/2	1/5	1/3	1/2	1/3	1/2	1/2	1	1/2	1/2	0.5574	0.0306
15	Chandpur	2	2	1	1	2	2	1	1/3	1/2	1	1/2	1	1	2	1	1	1.0632	0.0583
16	Matarbari	2	2	1	1	2	2	1	1/3	1/2	1	1/2	1	1	2	1	1	1.0632	0.0583

Source: PSMP Study Team

12.3 APPENDIX – 3 2nd Screening

12.3.1 Fuel Security

(1) Fuel Transportation

As for domestic coal, Khalaspir, Phulbari and Dighipara are adjacent each other. There is difference to the extent of development, however, it would be reasonable that one single power station is accommodated with then available coal flexibly from fuel security reason. The detail site selection would be proceeded later, for the fuel transportation point of view, because there are no long distance, it has good condition.

With respect to imported coal, Chittagong, Mongla and Khulna are regarded as high priority sites since there already exist port facility currently functioning. Since the depth of the sea is shallow, it will be difficult for large vessel to access to Meghnaghat、Zajira and Maowa, however, it would be relatively easy to build port facility for smaller coastal vessel. Cox's Bazar site is facing shallow beach for a good distance from the shore so that it would be difficult to build port facility. The evaluation was conducted from above mentioned points and the result is shown as follows.

APTable 12-15 Evaluation for Fuel Transportation

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	3	1	1	1	1	1	1	1.1298	0.1200
2	Chittagong	1	1	3	1	1	1	1	1	1	1.1298	0.1200
3	Cox's Bazar	1/3	1/3	1	1/3	1/3	1/3	1/3	1/3	1/3	0.3766	0.0400
4	Mongla	1	1	3	1	1	1	1	1	1	1.1298	0.1200
5	Khulna	1	1	3	1	1	1	1	1	1	1.1298	0.1200
6	Meghnaghat	1	1	3	1	1	1	1	1	1	1.1298	0.1200
7	Zajira	1	1	3	1	1	1	1	1	1	1.1298	0.1200
8	Maowa	1	1	3	1	1	1	1	1	1	1.1298	0.1200
9	Matarbari	1	1	3	1	1	1	1	1	1	1.1298	0.1200

Source: PSMP Study Team

(2) Port Facilities

The site for domestic coal at inner area has no capability to build port facility (the transportation would be done on land), and the concept for import coal site is same as (1).

Based on this concept, the result is shown as follows,

APTable 12-16 Evaluation for Port Facilities

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/5	1/3	1/5	1/5	1/3	1/3	1/3	1/5	0.3001	0.0276
2	Chittagong	5	1	3	1	1	3	3	3	1	1.9486	0.1793
3	Cox's Bazar	3	1/3	1	1/3	1/3	1	1	1	1/3	0.6934	0.0638
4	Mongla	5	1	3	1	1	3	3	3	1	1.9486	0.1793
5	Khulna	5	1	3	1	1	3	3	3	1	1.9486	0.1793
6	Meghnaghat	3	1/3	1	1/3	1/3	1	1	1	1/3	0.6934	0.0638
7	Zajira	3	1/3	1	1/3	1/3	1	1	1	1/3	0.6934	0.0638
8	Maowa	3	1/3	1	1/3	1/3	1	1	1	1/3	0.6934	0.0638
9	Matarbari	5	1	3	1	1	3	3	3	1	1.9486	0.1793

Source: PSMP Study Team

12.3.2 Feasibility Factor for Construction

(1) Securing the Necessary Amount of Ground Space

As for land acquisition, the PSMP Study Team views that Cox's Bazar is located in wide open area, however, it is not suitable to build power station adjacent to long beach. The concrete location of B-K-D-P area is not fixed yet, however, there is plenty of appropriate land which is wide open enough to build power station. With respect to other sites, it seems not so much trouble to acquire the land as some sites already acquire the wide open area by Government or already selected the land for acquisition. Especially, in case of Meghnaghat, not only the land is secured but also some preparation has done, so it is more prioritized than other sites.

Based on above point, the result is shown as follows,

APTable 12-17 Evaluation for Securing the Necessary Amount of Ground Space

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	2	1	1	1/2	1	1	1	1.0000	0.1065
2	Chittagong	1	1	2	1	1	1	1	1	1	1.0801	0.1150
3	Cox's Bazar	1/2	1/2	1	1/2	1/2	1/3	1/2	1/2	1/2	0.5162	0.0550
4	Mongla	1	1	2	1	1	1/2	1	1	1	1.0000	0.1065
5	Khulna	1	1	2	1	1	1/2	1	1	1	1.0000	0.1065
6	Meghnaghat	2	1	3	2	2	1	2	2	2	1.7935	0.1910
7	Zajira	1	1	2	1	1	1/2	1	1	1	1.0000	0.1065
8	Maowa	1	1	2	1	1	1/2	1	1	1	1.0000	0.1065
9	Matarbari	1	1	2	1	1	1/2	1	1	1	1.0000	0.1065

Source: PSMP Study Team

(2) Transportation of Facilities

B-K-D-P area has some disadvantage since it is located far inland so that it is required further investigation as regard to concrete transportation route for heavy and/or bulky facilities. For Cox's Bazar, it faces long beach so that it is not suitable for unloading of large equipment. Other sites

would not have significant problem for unloading large equipment since they are located on the coast.

Based on above point, the result is shown as follows,

APTable 12-18 Evaluation for Transportation of Facilities

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/2	1	1/2	1/2	1/2	1/2	1/2	1/2	0.5833	0.0625
2	Chittagong	2	1	2	1	1	1	1	1	1	1.1665	0.1250
3	Cox's Bazar	1	1/2	1	1/2	1/2	1/2	1/2	1/2	1/2	0.5833	0.0625
4	Mongla	2	1	2	1	1	1	1	1	1	1.1665	0.1250
5	Khulna	2	1	2	1	1	1	1	1	1	1.1665	0.1250
6	Meghnaghat	2	1	2	1	1	1	1	1	1	1.1665	0.1250
7	Zajira	2	1	2	1	1	1	1	1	1	1.1665	0.1250
8	Maowa	2	1	2	1	1	1	1	1	1	1.1665	0.1250
9	Matarbari	2	1	2	1	1	1	1	1	1	1.1665	0.1250

Source: PSMP Study Team

(3) History of Flood

Any sites have certain risk to the extent somehow. Especially, Chittagong, Cox's Bazar, Mongla, Khulna and others, there are relatively higher risk caused by cyclone in southern part of Bangladesh.

Based on above point, the result is shown as follows,

APTable 12-19 Evaluation for History of Flood

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	2	2	2	2	1	1	1	2	1.4697	0.1538
2	Chittagong	1/2	1	1	1	1	1/2	1/2	1/2	1	0.7349	0.0769
3	Cox's Bazar	1/2	1	1	1	1	1/2	1/2	1/2	1	0.7349	0.0769
4	Mongla	1/2	1	1	1	1	1/2	1/2	1/2	1	0.7349	0.0769
5	Khulna	1/2	1	1	1	1	1/2	1/2	1/2	1	0.7349	0.0769
6	Meghnaghat	1	2	2	2	2	1	1	1	2	1.4697	0.1538
7	Zajira	1	2	2	2	2	1	1	1	2	1.4697	0.1538
8	Maowa	1	2	2	2	2	1	1	1	2	1.4697	0.1538
9	Matarbari	0.5	1	1	1	1	1/2	1/2	1/2	1	0.7349	0.0769

Source: PSMP Study Team

(4) Topography / Geology

Flooding may impact to ground condition. Most of the sites face such ground risk to some extent, except for Meghnaghat as the land is next to existing IPP power station which has reliable track records as for ground condition.

Based on above point, the result is shown as follows,

APTable 12-20 Evaluation for Topography / Geology

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1/2	1	1	1	0.9259	0.1043
2	Chittagong	1	1	1	1	1	1/2	1	1	1	0.9259	0.1043
3	Cox's Bazar	1	1	1	1	1	1/2	1	1	1	0.9259	0.1043
4	Mongla	1	1	1	1	1	1/2	1	1	1	0.9259	0.1043
5	Khulna	1	1	1	1	1	1/2	1	1	1	0.9259	0.1043
6	Meghnaghat	2	2	2	2	2	1	1	1	1	1.4697	0.1656
7	Zajira	1	1	1	1	1	1/2	1	1	1	0.9259	0.1043
8	Maowa	1	1	1	1	1	1/2	1	1	1	0.9259	0.1043
9	Matarbari	1	1	1	1	1	1/2	1	1	1	0.9259	0.1043

Source: PSMP Study Team

12.3.3 Operational Conditions

(1) Securing of cooling water

For B-K-D-P are, like Barapukuria power station, ground water can be used for cooling, however, it should be considered the impact of land subsidence at the same time. PSMP Study Team will conduct the further investigation for water taking from adjacent rivers.

For sites next to coast such as Cox's Bazar, Zajira and Maowa, there are some possibilities to impact for sea water taking due to shallow water.

Based on above point, the result is shown as follows,

APTable 12-21 Evaluation for Securing of Cooling water

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	0.5400	0.0588
2	Chittagong	2	1	1	1	1	1	1	1	1	1.0801	0.1176
3	Cox's Bazar	2	1	1	1	1	1	1	1	1	1.0801	0.1176
4	Mongla	2	1	1	1	1	1	1	1	1	1.0801	0.1176
5	Khulna	2	1	1	1	1	1	1	1	1	1.0801	0.1176
6	Meghnaghat	2	1	1	1	1	1	1	1	1	1.0801	0.1176
7	Zajira	2	1	1	1	1	1	1	1	1	1.0801	0.1176
8	Maowa	2	1	1	1	1	1	1	1	1	1.0801	0.1176
9	Matarbari	2	1	1	1	1	1	1	1	1	1.0801	0.1176

Source: PSMP Study Team

(2) Ash Treatment

For Mongla, it would be required that coal ash is to be used as recycle material but not for landfill since there is mangrove forest nearby designated as national heritage. It is needed to further study for concrete treatment hereinafter.

As for Khulna, Zajira, Maowa, Meghnaghat and others, there are wide areas, however, not enough land for reclamation by ash.

Based on above point, the result is shown as follows,

APTable 12-22 Evaluation for Ash Treatment

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	2	4	2	3	1	1	1	1.5375	0.1561
2	Chittagong	1	1	2	4	2	3	1	1	1	1.5375	0.1561
3	Cox's Bazar	1/2	1/2	1	2	1/2	1	1/2	1/2	1/2	0.6804	0.0691
4	Mongla	1/4	1/4	1/2	1	1/3	1/2	1/3	1/3	1/3	0.3866	0.0393
5	Khulna	1/2	1/2	2	3	1	2	1	1	1	1.1298	0.1147
6	Meghnaghat	1/3	1/3	1	2	1/2	1	1/2	1/2	1/2	0.6218	0.0631
7	Zajira	1	1	2	3	1	2	1	1	1	1.3180	0.1338
8	Maowa	1	1	2	3	1	2	1	1	1	1.3180	0.1338
9	Matarbari	1	1	2	3	1	2	1	1	1	1.3180	0.1338

Source: PSMP Study Team

12.3.4 Economic Conditions

(1) Distance with Existing Power System

Except for Cox's Bazar and Maowa, there is an existing transmission line near the site.

Based on above point, the result is shown as follows,

APTable 12-23 Evaluation for Distance with Existing Power System

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	2	1	1	1	1	3	2	1.3180	0.1361
2	Chittagong	1	1	2	1	1	1	1	3	2	1.3180	0.1361
3	Cox's Bazar	1/2	1/2	1	1/2	1/2	1/2	1/2	2	1	0.6804	0.0703
4	Mongla	1	1	2	1	1	1	1	3	2	1.3180	0.1361
5	Khulna	1	1	2	1	1	1	1	3	2	1.3180	0.1361
6	Meghnaghat	1	1	2	1	1	1	1	3	2	1.3180	0.1361
7	Zajira	1	1	2	1	1	1	1	3	2	1.3180	0.1361
8	Maowa	1/3	1/3	1/2	1/3	1/3	1/3	1/3	1	1/2	0.4121	0.0426
9	Matarbari	0.5	1/2	1	1/2	1/2	1/2	1/2	2	1	0.6804	0.0703

Source: PSMP Study Team

(2) Project Cost

The project cost of the coal-fired power plant changes according to the type of coal handling facility which depends on how to secure coal.

These candidate sites are categorized into three types according to how to secure coal, utilizing domestic coal on the mine mouth (B-K-D-P), receiving directly imported coal (Chittagong, Cox's Bazar, Mongla, Khulna, Matarbari), internal transportation of imported coal (Meghnaghat, Zajira, Maowa), and the required equipment cost is estimated to substantially increase in this turn.

Based on above point, the result is shown as follows,

APTable 12-24 Evaluation for Project Cost

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	2	2	2	2	3	3	3	2	2.1197	0.2172
2	Chittagong	1/2	1	1	1	1	2	2	2	1	1.1665	0.1195
3	Cox's Bazar	1/2	1	1	1	1	2	2	2	1	1.1665	0.1195
4	Mongla	1/2	1	1	1	1	2	2	2	1	1.1665	0.1195
5	Khulna	1/2	1	1	1	1	2	2	2	1	1.1665	0.1195
6	Meghnaghat	1/3	1/2	1/2	1/2	1/2	1	1	1	1/2	0.6022	0.0617
7	Zajira	1/3	1/2	1/2	1/2	1/2	1	1	1	1/2	0.6022	0.0617
8	Maowa	1/3	1/2	1/2	1/2	1/2	1	1	1	1/2	0.6022	0.0617
9	Matarbari	0.5	1	1	1	1	2	2	2	1	1.1665	0.1195

Source: PSMP Study Team

12.3.5 Local Demand-Supply

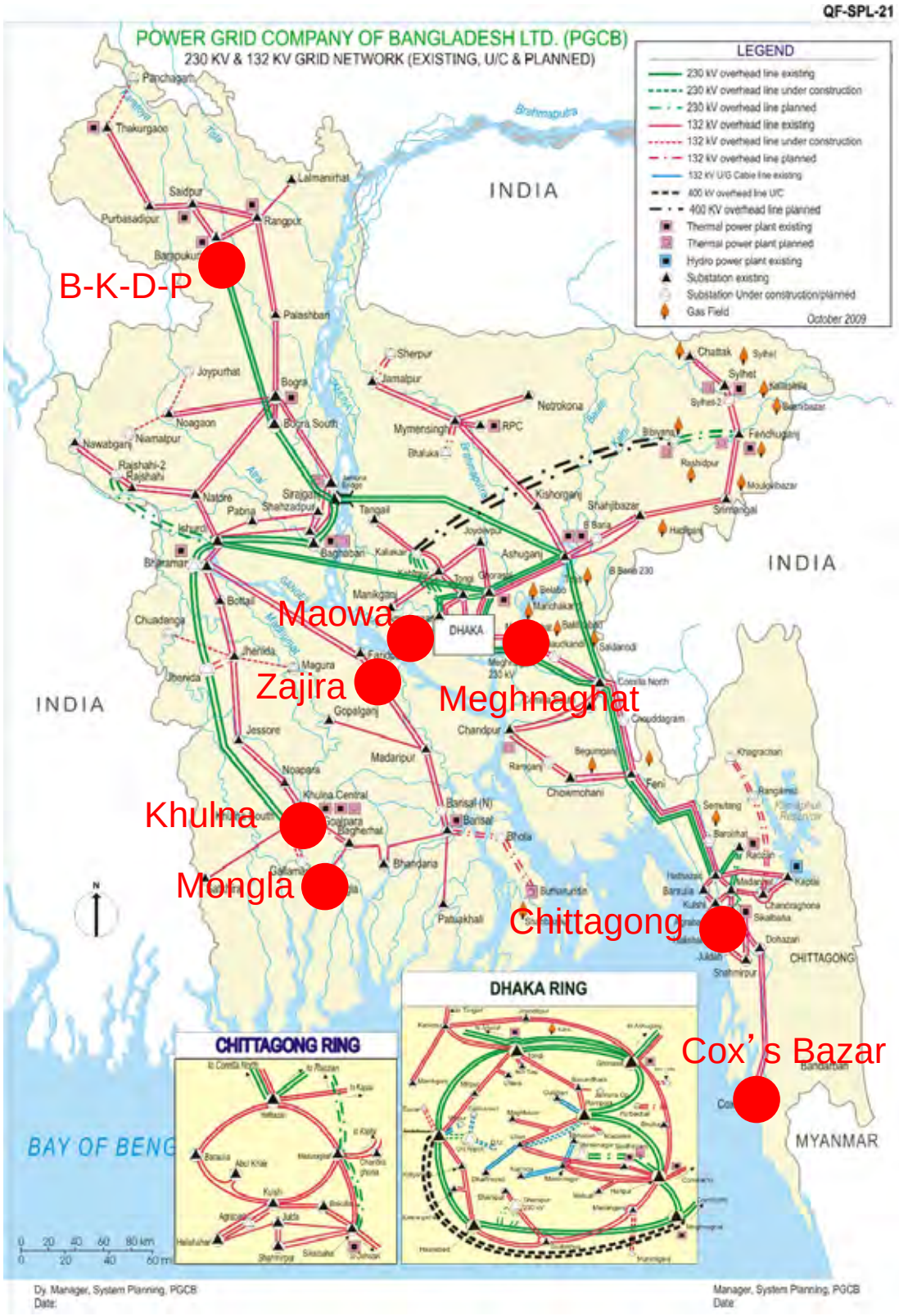
(1) Advantageous sites in the point of network view

At the second screening, an evaluation has been carried out to narrow down the eight (8) potential sites nominated from a mid list to a short list, based on the site reconnaissance from the viewpoint of access to the existing power system. However, as for the potential site where the site reconnaissance has not been carried out, an evaluation has been carried out based on the power system diagram. The results of the evaluation are shown as follows,

APTable 12-25 Result of 2nd screening (Local Demand-Supply)

Potential site for coal power development	Ease of access to the existing power system	Score (on a scale of 1 to 5)
K-P-D	Situated close to the route of 230kV Barapukuria - Bogla South transmission line	4
Chittagong	Situated in the load center of the southern region with developed existing 230kV and 132kV power systems in the surrounding areas	4
Cox's Bazar	Situated approximately 150km south of Chittagong with only a 132kV double circuit transmission line in the surrounding areas	2
Mongla	Situated approximately 40km south of Khulna with only a 132kV single circuit transmission line existing in the surrounding areas	2
Khulna	Situated in the load center of the western region with a developed existing 230kV and 132kV power systems in the surrounding areas	4
Meghnaghat	An already-planned 400kV Meghnaghat – Aminbazar transmission line, and an already-procured 400kV substation site	5
Zajira	Situated approximately 40km northeast of Khulna with only a 132kV single circuit transmission line existing in the surrounding areas, and the possibility of easy access after the completion of Padma Bridge (planned)	3
Maowa	Situated close to the Dhaka region with developed existing 230kV and 132kV power systems in the surrounding areas	4

Source: PSMP Study Team



APFig. 12-2　Existing Power System and Coal Power Development Sites（mid list）

Based on above point, the result is shown as follows,

APTable 12-26 Evaluation for local demand-supply (AHP method)

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	3	3	1	1/2	2	1	1	1.2765	0.1251
2	Chittagong	1	1	3	3	1	1/2	2	1	1	1.2765	0.1251
3	Cox's Bazar	1/3	1/3	1	1	1/3	1/4	1/2	1/3	1/3	0.4311	0.0422
4	Mongla	1/3	1/3	1	1	1/3	1/4	1/2	1/3	1/3	0.4311	0.0422
5	Khulna	1	1	3	3	1	1/2	2	1	1	1.2765	0.1251
6	Meghnaghat	2	2	4	4	2	1	3	2	2	2.2597	0.2214
7	Zajira	1/2	1/2	2	2	1/2	1/3	1	1/2	1/2	0.7025	0.0688
8	Maowa	1	1	3	3	1	1/2	2	1	1	1.2765	0.1251
9	Matarbari	1	1	3	3	1	1/2	2	1	1	1.2765	0.1251

Source: PSMP Study Team

12.3.6 Needs of Bangladesh

(1) Needs level of Bangladesh

In Bangladesh, the original study for coal power development is also proceeding at a very quick pace so that F/S will be able to commence soon. It is important to correspond to the status of the study and pick up on actual needs.

After discussion, the PSMP Study Team has achieved a tentative consensus that the first priority site will be Chittagong, the second Meghnaghat. Further, obtaining consensus for the development of a B-K-D-P site in utilizing domestic coal while developing the basic usage of import coal is a first priority.

Based on above point, the result is shown as follows,

APTable 12-27 Evaluation for Needs level of Bangladesh

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	4	4	1	2	3	3	2	2.0263	0.1898
2	Chittagong	1	1	4	4	1	2	3	3	2	2.0263	0.1898
3	Cox's Bazar	1/4	1/4	1	1	1/4	1/3	1/2	1/2	1/3	0.4230	0.0396
4	Mongla	1/4	1/4	1	1	1/4	1/3	1/2	1/2	1/3	0.4230	0.0396
5	Khulna	1	1	4	4	1	2	3	3	2	2.0263	0.1898
6	Meghnaghat	1/2	1/2	3	3	1/2	1	2	2	1	1.1819	0.1107
7	Zajira	1/3	1/3	2	2	1/3	1/2	1	1	1/2	0.6934	0.0649
8	Maowa	1/3	1/3	2	2	1/3	1/2	1	1	1/2	0.6934	0.0649
9	Matarbari	0.5	1/2	3	3	1/2	1	2	2	1	1.1819	0.1107

Source: PSMP Study Team

12.3.7 Donor

(1) Development priority and plan of Multilateral Development Banks

According to the presentation held on Sep. 2009 by ADB, Chittagong、Khulna、Meghnaghat and Zajira were mentioned as candidate sites.

Based on above point, the result is shown as follows,

APTable 12-28 Evaluation for Development priority and plan of Multilateral Development Banks

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/3	1	1	1/3	1/3	1/3	1	1	0.6137	0.0588
2	Chittagong	3	1	3	3	1	1	1	3	3	1.8411	0.1765
3	Cox's Bazar	1	1/3	1	1	1/3	1/3	1/3	1	1	0.6137	0.0588
4	Mongla	1	1/3	1	1	1/3	1/3	1/3	1	1	0.6137	0.0588
5	Khulna	3	1	3	3	1	1	1	3	3	1.8411	0.1765
6	Meghnaghat	3	1	3	3	1	1	1	3	3	1.8411	0.1765
7	Zajira	3	1	3	3	1	1	1	3	3	1.8411	0.1765
8	Maowa	1	1/3	1	1	1/3	1/3	1/3	1	1	0.6137	0.0588
9	Matarbari	1	1/3	1	1	1/3	1/3	1/3	1	1	0.6137	0.0588

Source: PSMP Study Team

12.3.8 Environment Influence

(1) Air Pollution

Regarding air pollution, sulfur oxide, nitrogen oxide and particle matter will be exhaust from construction machinery or transportation vehicles during construction. During operation, sulfur oxide, nitrogen oxide and particle matter will be exhaust from coal fired power plant. There is coal dust generation in the case of domestic coal mine development. Therefore, environmental impacts due to air pollution are supposed in all sites, no material difference between sites is supposed.

Based on above point, the result is shown as follows,

APTable 12-29 Evaluation for Air Pollution

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(2) Waste Contamination

Regarding water contamination, drainage due to wash the equipment and sewages are drained during construction phase. In operation phase, drainage water from FGD, ash treatment and power generation unit are drained. Therefore, environmental impacts due to water contamination are supposed in all sites, no material difference between sites is supposed.

Based on above point, the result is shown as follows,

APTable 12-30 Evaluation for Waste Contamination

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(3) Soil Pollution

Regarding soil pollution, there is possibility of pollution due to oil leakage during both construction phase and operation phase. So, environmental impacts due to soil pollution are supposed in all sites, no material difference between sites is supposed.

Based on above point, the result is shown as follows,

APTable 12-31 Evaluation for Soil Pollution

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(4) Bottom Sediment

Regarding bottom sediment, there is possibility of pollution due to dredge work during construction phase. Environmental impacts to bottom sediment are supposed in sites where use imported coal power plant with dredge work. Based on above point, the result is shown as follows,

APTable 12-32 Evaluation for Bottom Sediment

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	3	3	3	3	3	3	3	3	2.6553	0.2727
2	Chittagong	1/3	1	1	1	1	1	1	1	1	0.8851	0.0909
3	Cox's Bazar	1/3	1	1	1	1	1	1	1	1	0.8851	0.0909
4	Mongla	1/3	1	1	1	1	1	1	1	1	0.8851	0.0909
5	Khulna	1/3	1	1	1	1	1	1	1	1	0.8851	0.0909
6	Meghnaghat	1/3	1	1	1	1	1	1	1	1	0.8851	0.0909
7	Zajira	1/3	1	1	1	1	1	1	1	1	0.8851	0.0909
8	Maowa	1/3	1	1	1	1	1	1	1	1	0.8851	0.0909
9	Matarbari	1/3	1	1	1	1	1	1	1	1	0.8851	0.0909

Source: PSMP Study Team

(5) Noise and Vibration

Regarding noise and vibration, noise and vibration due to pilling and excavation are supposed during construction phase. In operation phase, noise and vibration caused from operation of each machinery such as fan and pump in power plant, and drilling in coal mine are supposed. In addition that, because there are impacts of the noise and vibration caused by transportation of equipment and material, environmental impacts due to noise and vibration are supposed in all sites, no material difference between sites is supposed.

Based on above point, the result is shown as follows,

APTable 12-33 Evaluation for Noise and Vibration

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(6) Offensive Odor

Regarding offensive odor, though the ammonia which is used for the SCR can become source of odor, it is supposed that there is little impact because the discharge quantity is small.

Based on above point, the result is shown as follows,

APTable 12-34 Evaluation for Offensive Odor

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(7) Waste

Regarding waste, because occurrence of industrial waste is supposed both during construction and operation phase, environmental impacts due to waste are supposed in all sites, no material difference between sites is supposed.

Based on above point, the result is shown as follows,

APTable 12-35 Evaluation for Waste

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(8) Ground subsidence

Regarding ground subsidence, since underground water is pumped with the coal mine and used as power plant service water, environmental impacts due to ground subsidence are supposed in domestic coal fired power plant site. It is supposed that there is little environmental impact due to ground subsidence in imported coal fired power plant which uses river water or sea water as cooling water.

Based on above point, the result is shown as follows,

APTable 12-36 Evaluation for Ground Subsidence

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	0.2392	0.0244
2	Chittagong	5	1	1	1	1	1	1	1	1	1.1958	0.1220
3	Cox's Bazar	5	1	1	1	1	1	1	1	1	1.1958	0.1220
4	Mongla	5	1	1	1	1	1	1	1	1	1.1958	0.1220
5	Khulna	5	1	1	1	1	1	1	1	1	1.1958	0.1220
6	Meghnaghat	5	1	1	1	1	1	1	1	1	1.1958	0.1220
7	Zajira	5	1	1	1	1	1	1	1	1	1.1958	0.1220
8	Maowa	5	1	1	1	1	1	1	1	1	1.1958	0.1220
9	Matarbari	5	1	1	1	1	1	1	1	1	1.1958	0.1220

Source: PSMP Study Team

(9) Geographical feature

Regarding geographical feature, no impact is supposed in all sites because all sites are plain.

Based on above point, the result is shown as follows,

APTable 12-37 Evaluation for Geographical Feature

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(10) Biota and Ecosystem

Regarding biota and ecosystem, it is supposed that there are influence of lumbering trees and shrubs and land alteration by land formation work. So, environmental impacts to biota and ecosystem are supposed in all sites other than Meghnaghat site.

Based on above point, the result is shown as follows,

APTable 12-38 Evaluation for Biota and Ecosystem

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	3	3	1	1	1	1	1	1.2765	0.1304
2	Chittagong	1	1	3	3	1	1	1	1	1	1.2765	0.1304
3	Cox's Bazar	1/3	1/3	1	1	1/3	1/3	1/3	1/3	1/3	0.4255	0.0435
4	Mongla	1/3	1/3	1	1	1/3	1/3	1/3	1/3	1/3	0.4255	0.0435
5	Khulna	1	1	3	3	1	1	1	1	1	1.2765	0.1304
6	Meghnaghat	1	1	3	3	1	1	1	1	1	1.2765	0.1304
7	Zajira	1	1	3	3	1	1	1	1	1	1.2765	0.1304
8	Maowa	1	1	3	3	1	1	1	1	1	1.2765	0.1304
9	Matarbari	1	1	3	3	1	1	1	1	1	1.2765	0.1304

Source: PSMP Study Team

(11) Water usage

Regarding for water usage, there is a possibility of exerting influence on life water for peripheral people.

Based on above point, the result is shown as follows,

APTable 12-39 Evaluation for Water Usage

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/5	1/5	1/5	1/5	1/5	1/5	1/5	1/5	0.2392	0.0244
2	Chittagong	5	1	1	1	1	1	1	1	1	1.1958	0.1220
3	Cox's Bazar	5	1	1	1	1	1	1	1	1	1.1958	0.1220
4	Mongla	5	1	1	1	1	1	1	1	1	1.1958	0.1220
5	Khulna	5	1	1	1	1	1	1	1	1	1.1958	0.1220
6	Meghnaghat	5	1	1	1	1	1	1	1	1	1.1958	0.1220
7	Zajira	5	1	1	1	1	1	1	1	1	1.1958	0.1220
8	Maowa	5	1	1	1	1	1	1	1	1	1.1958	0.1220
9	Matarbari	5	1	1	1	1	1	1	1	1	1.1958	0.1220

Source: PSMP Study Team

(12) Accidents

Regarding accidents, it is supposed that there is no impact because prevention is possible by the introduction of the high quality facility and execution of appropriate health and safety activity.

Based on above point, the result is shown as follows,

APTable 12-40 Evaluation for Accidents

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(13) Global warming

Regarding global warming, since there is carbon dioxide emission during power plant operation, environmental impacts of global warming are supposed in all sites, no material difference between sites is supposed.

Based on above point, the result is shown as follows,

APTable 12-41 Evaluation for Global Warming

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

12.3.9 Social Issues

Based on available secondary data and literature, the present condition of 16 potential sites, future project viability, social change and the social impact potentially caused by such project implementation were examined by checking social scoping items in order to compare and prioritize them.

APTable 12-42 Result of Site Survey (Social Issues)

	Site Name	Impacts predicted at construction stage	Impacts predicted at operation stage
1	B-K-D-P	Information sharing on the development of power plants and local consultation with inhabitants should be thoroughly conducted to obtain a solid understanding and local consensus. Dialog with inhabitants and an active learning process with NGOs such as the GrameenBank, BRAC, and ASA which are already involved in community development in Phulbari are highly recommended.	Land acquisition and resettlement could cause severer social unrest and protests from the local community Environmental protection measures should be thoroughly executed in order to not cause pollution or health hazards; hence, local resistance can be averted.
2	Chittagong	Construction site is already prepared, where inflow of inhabitants without legal status should be avoided Information sharing on development of power plant and local consultation with inhabitants should be thoroughly conducted in order to obtain solid understanding and local consensus. Careful coordination is expected so as not to raise ethnic disputes. Dialogs with inhabitants and active learning processes with NGOs such as BRAC, ASA and PROSHIKA which are already involved in community development in Chittagong are highly recommended	Local consultation and environmental protection measures should be executed so as not to cause pollution or health hazards, so that local resistance can be avoided. Ethnic minorities' rights should be respected and proper management is highly expected not to raise local conflict among them.
3	Cox's Bazar	Mitigation measures against anticipated impact on forests or the beach should be taken. Information sharing on development of power plant and local consultation with inhabitants should be thoroughly conducted in order to obtain a solid understanding and local consensus. Careful coordination is expected so as to not raise ethnic disputes. Dialogs with inhabitants and active learning process with NGOs such as BRAC, ASA and PROSHIKA which are already involved in community development in Cox's Bazar are highly recommended	Local consultation and environmental protection measures should be executed so as not to cause pollutions or health hazard, so that local resistance can be avoided. Ethnic minorities' rights should be respected and proper management is highly expected so as to not raise local conflict among them.

	Site Name	Impacts predicted at construction stage	Impacts predicted at operation stage
4	Mongla	Mitigation measures for the aquaculture industry, tourism and service industries will be required. Information sharing on development of power plant and local consultation with inhabitants should be thoroughly conducted in order to obtain a solid understanding and local consensus. Dialogs with inhabitants and active learning processes with NGOs such as BRAC and ASA which are already involved in community development in Mongla are highly recommended	Local consultation and environmental protection measures should be executed so as not to cause pollution or health hazards, so that local resistance can be avoided.
5	Khulna	Mitigation measures for aquaculture industry, tourism and service industries will be required. Information sharing on development of power plant and local consultation with inhabitants should be thoroughly conducted in order to obtain a solid understanding and local consensus. Dialogs with inhabitants and active learning processes with NGOs such as BRAC and ASA which are already involved in community development in Khulna are highly recommended	Local consultation and environmental protection measures should be executed so as not to cause pollution or health hazards, so that local resistance can be averted.
6	Meghnaghat	Information sharing on development of power plant and local consultation with inhabitants should be thoroughly conducted in order to obtain a solid understanding and local consensus. Dialogs with inhabitants and active learning processes with NGOs such as BRAC, ASA and PROSHIKA which are already involved in community development in Sonargaon are highly recommended	Local consultation and environmental protection measures should be executed so as not to cause pollution or health hazards, so that local resistance can be averted.
7	Zajira	Information sharing on development of power plant and local consultation with inhabitants should be thoroughly conducted in order to obtain a solid understanding and local consensus. Dialogs with inhabitants and active learning processes with NGOs such as BRAC, ASA and PROSHIKA which are already involved in community development in Shariatpurare highly recommended	Local consultation and environmental protection measures should be executed so as not to cause pollution or health hazards, so that local resistance can be averted.

	Site Name	Impacts predicted at construction stage	Impacts predicted at operation stage
8	Maowa	Impact on local industries can happen because commercial and service industries are popular. Information sharing on development of power plant and local consultation with inhabitants should be thoroughly conducted in order to obtain a solid understanding and local consensus. Dialogs with inhabitants and active learning processes with NGOs such as BRAC, ASA and PROSHIKA which are already involved in community development in Lohajang are highly recommended	Local consultation and environmental protection measures should be executed so as not to cause pollution or health hazards, so that local resistance can be averted.
13	Matarbari	Information sharing on development of power plant and local consultation with inhabitants should be thoroughly conducted in order to obtain a solid understanding and local consensus. Dialogs with inhabitants and active learning processes with NGOs such as BRAC, ASA and PROSHIKA which are already involved in community development in Shariatpurare highly recommended	Local consultation and environmental protection measures should be executed so as not to cause pollution or health hazards, so that local resistance can be averted.

Source: PSMP Study Team

(1) Involuntary resettlement

There is no material difference on necessity between the sites. The result is as follows,

APTable 12-43 Evaluation for Involuntary Resettlement

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(2) Local Economy such as employment and livelihood etc.

Local economics in Chittagong, Cox's Bazar, Mongla, and Khulna are flourishing more than the other sites. The results are as follows,

APTable 12-44 Evaluation for Local Economy such as Employment and Livelihood etc.

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769
2	Chittagong	2	1	1	1	1	2	2	2	2	1.4697	0.1538
3	Cox's Bazar	2	1	1	1	1	2	2	2	2	1.4697	0.1538
4	Mongla	2	1	1	1	1	2	2	2	2	1.4697	0.1538
5	Khulna	2	1	1	1	1	2	2	2	2	1.4697	0.1538
6	Meghnaghat	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769
7	Zajira	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769
8	Maowa	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769
9	Matarbari	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769

Source: PSMP Study Team

(3) The poor, indigenous and ethnic people

The estimation for Chittagong, Cox's Bazar, Mongla, and Khulna are high because of its local economics. The result is as follows,

APTable 12-45 Evaluation for the Poor, Indigenous and Ethnic People

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769
2	Chittagong	2	1	1	1	1	2	2	2	2	1.4697	0.1538
3	Cox's Bazar	2	1	1	1	1	2	2	2	2	1.4697	0.1538
4	Mongla	2	1	1	1	1	2	2	2	2	1.4697	0.1538
5	Khulna	2	1	1	1	1	2	2	2	2	1.4697	0.1538
6	Meghnaghat	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769
7	Zajira	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769
8	Maowa	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769
9	Matarbari	1	1/2	1/2	1/2	1/2	1	1	1	1	0.7349	0.0769

Source: PSMP Study Team

(4) Misdistribution of benefit and loss

There is no difference between the sites. The results are as follows,

APTable 12-46 Evaluation for Misdistribution of Benefit and Loss

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(5) Local conflict of interests

There is also no difference between the sites. The results are as follows,

APTable 12-47 Evaluation for Local Conflict to Interests

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(6) Gender

There is also no difference between the sites. The results are also as follows,

APTable 12-48 Evaluation for Gender

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(7) Children's right

The estimation for B-K-D-P is lower than the other sites. The results are as follows,

APTable 12-49 Evaluation for Children's Right

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	0.3766	0.0400
2	Chittagong	3	1	1	1	1	1	1	1	1	1.1298	0.1200
3	Cox's Bazar	3	1	1	1	1	1	1	1	1	1.1298	0.1200
4	Mongla	3	1	1	1	1	1	1	1	1	1.1298	0.1200
5	Khulna	3	1	1	1	1	1	1	1	1	1.1298	0.1200
6	Meghnaghat	3	1	1	1	1	1	1	1	1	1.1298	0.1200
7	Zajira	3	1	1	1	1	1	1	1	1	1.1298	0.1200
8	Maowa	3	1	1	1	1	1	1	1	1	1.1298	0.1200
9	Matarbari	3	1	1	1	1	1	1	1	1	1.1298	0.1200

Source: PSMP Study Team

(8) Land use and utilization of local resources

The estimation for B-K-D-P is a little higher than the other sites. The results are as follows,

APTable 12-50 Evaluation for Land Use and Utilization of Local Resources

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	2	2	2	2	2	2	2	2	1.8517	0.2000
2	Chittagong	1/2	1	1	1	1	1	1	1	1	0.9259	0.1000
3	Cox's Bazar	1/2	1	1	1	1	1	1	1	1	0.9259	0.1000
4	Mongla	1/2	1	1	1	1	1	1	1	1	0.9259	0.1000
5	Khulna	1/2	1	1	1	1	1	1	1	1	0.9259	0.1000
6	Meghnaghat	1/2	1	1	1	1	1	1	1	1	0.9259	0.1000
7	Zajira	1/2	1	1	1	1	1	1	1	1	0.9259	0.1000
8	Maowa	1/2	1	1	1	1	1	1	1	1	0.9259	0.1000
9	Matarbari	1/2	1	1	1	1	1	1	1	1	0.9259	0.1000

Source: PSMP Study Team

(9) Social institutions such as social infrastructure and local decision making institutions

There are no differences between the sites. The results are as follows,

APTable 12-51 Evaluation for Social institutions such as Social Infrastructure and Local Decision Making Institutions

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(10) Existing social infrastructures

There is no difference between the sites. The results are as follows,

APTable 12-52 Evaluation for Existing Social Infrastructure

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

(11) Cultural heritage

B-K-D-P site has no problem, Mongla has a site of world heritage so that the estimation is low, Khulna has no big problem. Based on this information, the result is as follows,

APTable 12-53 Evaluation for Cultural Heritage

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	3	3	4	2	3	3	3	3	2.6207	0.2603
2	Chittagong	1/3	1	1	2	1/2	1	1	1	1	0.8851	0.0879
3	Cox's Bazar	1/3	1	1	2	1/2	1	1	1	1	0.8851	0.0879
4	Mongla	1/4	1/2	1/2	1	1/3	1/2	1/2	1/2	1/2	0.4780	0.0475
5	Khulna	1/2	2	2	3	1	2	2	2	2	1.6606	0.1649
6	Meghnaghat	1/3	1	1	2	1/2	1	1	1	1	0.8851	0.0879
7	Zajira	1/3	1	1	2	1/2	1	1	1	1	0.8851	0.0879
8	Maowa	1/3	1	1	2	1/2	1	1	1	1	0.8851	0.0879
9	Matarbari	1/3	1	1	2	1/2	1	1	1	1	0.8851	0.0879

Source: PSMP Study Team

(12) Infectious diseases such as HIV/AIDS etc

There is no difference between the sites. The results are as follows,

APTable 12-54 Evaluation for Infectious Diseases such as HIV/AIDS etc

No.	Site Name	1	2	3	4	5	6	7	8	9	Geometric Average	Level of Importance
1	B-K-D-P	1	1	1	1	1	1	1	1	1	1.0000	0.1111
2	Chittagong	1	1	1	1	1	1	1	1	1	1.0000	0.1111
3	Cox's Bazar	1	1	1	1	1	1	1	1	1	1.0000	0.1111
4	Mongla	1	1	1	1	1	1	1	1	1	1.0000	0.1111
5	Khulna	1	1	1	1	1	1	1	1	1	1.0000	0.1111
6	Meghnaghat	1	1	1	1	1	1	1	1	1	1.0000	0.1111
7	Zajira	1	1	1	1	1	1	1	1	1	1.0000	0.1111
8	Maowa	1	1	1	1	1	1	1	1	1	1.0000	0.1111
9	Matarbari	1	1	1	1	1	1	1	1	1	1.0000	0.1111

Source: PSMP Study Team

Chapter 16 Economic and Financial Analysis of the Most Prioritized Projects APPENDEX

16.1 The Model for Economic Analysis of Prioritized Projects

APTable 16-1 ECONOMIC ASSUMPTIONS

Fiscal Year ending at June of	Unit	0 2008	1 2009	2 2010	3 2011	4 2012	5 2013	6 2014	7 2015	8 2016	9 2017	10 2018	11 2019	12 2020	13 2021	14 2022	15 2023	16 2024	17 2025	18 2026	19 2027
Inflation																					
Local Inflation (end of June)	% p.a.	10.0%	2.3%	8.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%
Local inflation (average for fiscal year)	% p.a.	9.9%	6.7%	7.3%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%
US inflation (average, calendar yr)	% p.a.	3.8%	-0.4%	1.9%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Inflation in Japan (average, calendar yr)	% p.a.	1.4%	-1.4%	-1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Price index																					
Local prices (average: 1995-96=100)		193.5	206.4	221.5	234.2	247.5	261.6	276.5	292.3	308.9	326.6	345.2	364.8	385.6	407.6	430.9	455.4	481.4	508.8	537.8	568.5
Local prices (end of June: 1996=100)		203.4	208.0	226.1	239.0	252.6	267.0	282.2	298.3	315.3	333.3	352.3	372.4	393.6	416.0	439.8	464.8	491.3	519.3	548.9	580.2
US prices (average: 1982-84=100)		215.3	214.5	218.6	224.0	229.6	235.4	241.3	247.3	253.5	259.8	266.3	273.0	279.8	286.8	294.0	301.3	308.8	316.6	324.5	332.6
Japanese prices (average: 2005=100)		101.7	100.3	99.3	100.3	101.3	102.3	103.3	104.4	105.4	106.5	107.5	108.6	109.7	110.8	111.9	113.0	114.1	115.3	116.4	117.6
Exchange rate																					
Taka/US$ (average)	Taka	68.60	68.80	69.59	68.08	77.14	79.00	80.85	82.71	84.56	86.41	88.27	90.12	91.98	93.83	95.69	97.54	99.40	101.25	103.11	104.96
Change from previous year	% p.a.	-0.62%	0.29%	1.15%	-2.17%	13.31%	2.40%	2.35%	2.29%	2.24%	2.19%	2.15%	2.10%	2.06%	2.02%	1.98%	1.94%	1.90%	1.87%	1.83%	1.80%
Taka/JPY (average)	Taka	0.62	0.70	0.82	0.81	0.84	0.87	0.90	0.94	0.97	1.00	1.04	1.07	1.10	1.14	1.17	1.20	1.24	1.27	1.30	1.34
Change from previous year	% p.a.	6.90%	12.90%	17.14%	-0.73%	2.64%	4.01%	3.86%	3.71%	3.58%	3.46%	3.34%	3.23%	3.13%	3.04%	2.95%	2.86%	2.78%	2.71%	2.64%	2.57%
Electricity Tariff																					
Average Billing Rate of BPDB	Tk/kWh	2.36	2.56	2.75	2.90	3.07	3.24	3.43	3.62	3.83	4.05	4.28	4.52	4.78	5.05	5.34	5.65	5.97	6.31	6.67	7.05
Ave Bulk Wholesale Tariff	Tk/kWh	2.37	2.37	2.37																	
Willingness-to-Pay (generation level)	Tk/kWh		7.32	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85
Fuel price (real)																					
Domestic Coal	US Cents/MM kcal		1,400	1,400	1,467	1,530	1,595	1,655	1,715	1,773	1,830	1,885	1,940	1,992	2,044	2,096	2,147	2,196	2,244	2,293	2,339
	US$/ton		85.38	85.38	89.51	93.36	97.30	100.95	104.61	108.16	111.63	114.99	118.36	121.53	124.70	127.87	130.95	133.93	136.91	139.89	142.68
Imprted Coal	US Cents/MM kcal		1,454	1,454	1,539	1,618	1,698	1,773	1,848	1,921	1,992	2,061	2,130	2,195	2,260	2,325	2,388	2,449	2,510	2,571	2,628
	US$/ton		73.80	73.80	78.10	82.10	86.20	90.00	93.80	97.50	101.10	104.60	108.10	111.40	114.70	118.00	121.20	124.30	127.40	130.50	133.40
Heavy Fuel Oil (Furnace Oil)	US Cents/MM kcal		3,657	4,761	4,843	4,925	5,007	5,089	5,171	5,330	5,489	5,648	5,807	5,966	6,055	6,145	6,234	6,324	6,413	6,503	6,592
High Speed Diesel Oil	US Cents/MM kcal		5,607	7,300	7,425	7,551	7,677	7,802	7,928	8,172	8,416	8,660	8,904	9,148	9,285	9,422	9,559	9,696	9,834	9,971	10,108
Natural Gas (Domestic)																					
Natural Gas (Import)	US Cents/MM kcal		2,428	3,571	3,632	3,693	3,755	3,816	3,878	3,997	4,116	4,236	4,355	4,474	4,541	4,609	4,676	4,743	4,810	4,877	4,944
Fuel price (real)																					
Domestic Coal	Tk/MM kcal		974	974	1,021	1,065	1,110	1,152	1,193	1,234	1,273	1,312	1,350	1,386	1,423	1,459	1,494	1,528	1,562	1,596	1,628
	Taka/Ton		5,941	5,941	6,229	6,497	6,771	7,025	7,280	7,527	7,768	8,002	8,236	8,457	8,678	8,899	9,113	9,320	9,528	9,735	9,929
Imprted Coal	Tk/MM kcal		1,012	1,012	1,071	1,126	1,182	1,234	1,286	1,337	1,386	1,434	1,482	1,527	1,573	1,618	1,662	1,704	1,747	1,789	1,829
	Taka/Ton		5,160	5,160	5,461	5,741	6,027	6,293	6,559	6,818	7,069	7,314	7,559	7,790	8,020	8,251	8,475	8,692	8,908	9,125	9,328
Heavy Fuel Oil (Furnace Oil)	Tk/MM kcal		2,545	3,313	3,370	3,427	3,484	3,541	3,598	3,709	3,820	3,930	4,041	4,152	4,214	4,276	4,338	4,401	4,463	4,525	4,588
	Taka/Litre		24.29	31.63	32.17	32.71	33.26	33.80	34.35	35.40	36.46	37.52	38.57	39.63	40.23	40.82	41.41	42.01	42.60	43.20	43.79
High Speed Diesel Oil	Tk/MM kcal		3,902	5,080	5,167	5,255	5,342	5,430	5,517	5,687	5,857	6,026	6,196	6,366	6,461	6,557	6,652	6,748	6,843	6,939	7,034
	Taka/Litre		34.95	45.50	46.28	47.06	47.85	48.63	49.41	50.93	52.45	53.97	55.49	57.01	57.87	58.72	59.58	60.43	61.29	62.14	63.00
Natural Gas (Domestic)	Tk/MM kcal		309	333																	
	Taka/10^3 cft		73.91	79.82																	
Natural Gas (Import)	Tk/MM kcal		1,689	2,485	2,528	2,570	2,613	2,656	2,699	2,782	2,865	2,948	3,031	3,114	3,160	3,207	3,254	3,301	3,347	3,394	3,441
	Taka/10^3 cft		404	595	605	615	626	636	646	666	686	706	726	745	757	768	779	790	801	813	824

Source: JICA study team

Legend:

	=Actuals and shall not be changed.
	=Exchange rate indicated by JICA in March 2010. Actual Record by BB is US$1=Tk 69.185 for FY 2010.
	=Estimate based on July-February Performance
	=Fields for input with assumptive data.

Conversion Factor				
Coal (Domestic)		1 kg=	6,100	kcal
Coal (Imported)		1 kg=	5,100	kcal
Furnace Oil		1 litre=	9,546	kcal
High Speed Diesel Oil		1 litre=	8,956	kcal
Natural gas (MM kcal/GJ)		1MMkcal=	4.1868	GJ
		1 M cal=	8.454*10^6	cubic meter
Natural gas (GJ/MM BTU)		1MMBTU=	1.0551	GJ
Natural gas (BTU per cubic feet)		1SCF=	1,029	1,000 BTU
		1 cubic feet=	10.3399	mmcfd
	BPDB	1 cubic feet=	239.4000	Kcal
	BPDB	1 cubic feet=	950.0000	BTU

Fiscal Year ending at June of	Unit	20 2028	21 2029	22 2030	23 2031	24 2032	25 2033	26 2034	27 2035	28 2046	29 2037	30 2038	31 2039	32 2040	33 2041	34 2042	35 2043	36 2044	37 2045	38 2046	39 2047	40 2048
Inflation																						
Local Inflation (end of June)	% p.a.	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%
Local inflation (average for fiscal year)	% p.a.	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%
US inflation (average, calendar yr)	% p.a.	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Inflation in Japan (average, calendar yr)	% p.a.	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Price index																						
Local prices (average: 1995-96=100)		600.9	635.1	308.9	326.6	345.2	364.8	385.6	407.6	430.9	455.4	481.4	508.8	537.8	568.5	600.9	635.1	430.9	455.4	481.4	508.8	537.8
Local prices (end of June: 1996=100)		613.3	648.3	315.3	333.3	352.3	372.4	393.6	416.0	439.8	464.8	491.3	519.3	548.9	580.2	613.3	648.3	439.8	464.8	491.3	519.3	548.9
US prices (average: 1982-84=100)		340.9	349.4	253.5	259.8	266.3	273.0	279.8	286.8	294.0	301.3	308.8	316.6	324.5	332.6	340.9	349.4	294.0	301.3	308.8	316.6	324.5
Japanese prices (average: 2005=100)		118.8	120.0	105.4	106.5	107.5	108.6	109.7	110.8	111.9	113.0	114.1	115.3	116.4	117.6	118.8	120.0	111.9	113.0	114.1	115.3	116.4
Exchange rate																						
Taka/US$ (average)	Taka	106.82	108.67	110.53	112.38	114.24	116.09	117.94	119.80	140.20	123.51	125.36	127.22	129.07	130.93	132.78	134.64	136.49	138.35	140.20	142.06	143.91
Change from previous year	% p.a.	1.77%	1.74%	33.64%	32.90%	32.19%	31.52%	30.87%	30.25%	49.41%	29.07%	28.52%	27.99%	27.48%	26.98%	26.51%	26.05%	45.46%	44.58%	43.73%	42.92%	42.13%
Taka/JPY (average)	Taka	1.37	1.41	1.44	1.47	1.51	1.54	1.57	1.61	1.97	1.67	1.71	1.74	1.77	1.81	1.84	1.87	1.91	1.94	1.97	2.01	2.04
Change from previous year	% p.a.	2.50%	2.44%	53.69%	51.83%	50.10%	48.48%	46.96%	45.54%	73.66%	42.93%	41.74%	40.61%	39.54%	38.52%	37.56%	36.64%	67.77%	65.83%	64.00%	62.26%	60.62%
Electricity Tariff																						
Average Billing Rate of BPDB	Tk/kWh	7.45	7.88	3.83	4.05	4.28	4.52	4.78	5.05	5.34	5.65	5.97	6.31	6.67	7.05	7.45	7.88	5.34	5.65	5.97	6.31	6.67
Ave Bulk Wholesale Tariff	Tk/kWh																					
Willingness-to-Pay (generation level)	Tk/kWh	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85
Fuel price (real)																						
Domestic Coal	US Cents/MM kcal	2,386	2,432	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478	2,478
	US$/ton	145.57	148.35	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14	151.14
Imprted Coal	US Cents/MM kcal	2,687	2,745	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802	2,802
	US$/ton	136.40	139.30	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20	142.20
Heavy Fuel Oil (Furnace Oil)	US Cents/MM kcal	6,682	6,771	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861	6,861
High Speed Diesel Oil	US Cents/MM kcal	10,245	10,382	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520	10,520
Natural Gas (Domestic)																						
Natural Gas (Import)	US Cents/MM kcal	5,011	5,078	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145	5,145
Fuel price (real)																						
Domestic Coal	Tk/MM kcal	1,661	1,692	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724
	Taka/Ton	10,130	10,324	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518	10,518
Imprted Coal	Tk/MM kcal	1,870	1,910	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950	1,950
	Taka/Ton	9,538	9,740	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943	9,943
Heavy Fuel Oil (Furnace Oil)	Tk/MM kcal	4,650	4,712	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774	4,774
	Taka/Litre	44.39	44.98	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58	45.58
High Speed Diesel Oil	Tk/MM kcal	7,130	7,225	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321	7,321
	Taka/Litre	63.85	64.71	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56	65.56
Natural Gas (Domestic)	Tk/MM kcal																					
	Taka/10^3 cft																					
Natural Gas (Import)	Tk/MM kcal	3,487	3,534	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581	3,581
	Taka/10^3 cft	835	846	857	857	857	857	857	857	857	857	857	857	857	857	857	857	857	857	857	857	857

Source: PSMP Study Team

Legend:

	=Actuals and shall not be changed.
	=Exchange rate indicated by JICA in March 2010. Actual Record by BB is US$1=Tk 69.185 for FY 2010.
	=Estimate based on July-February Performance
	=Fields for input with assumptive data.

Conversion Factor

Coal (Domestic)		1 kg=	6,100	kcal
Coal (Imported)		1 kg=	5,100	kcal
Furnace Oil		1 litre=	9,546	kcal
High Speed Diesel Oil		1 litre=	8,956	kcal
Natural gas (MM kcal/GJ)		1MMkcal=	4.1868	GJ
		1 M cal=	8.454*10^6	cubic meter
Natural gas (GJ/MM BTU)		1MMBTU=	1.0551	GJ
Natural gas (BTU per cubic feet)		1SCF=	1,029	1,000 BTU
		1 cubic feet=	10.3399	mmcfd
	BPDB	1 cubic feet=	239.4000	Kcal
	BPDB	1 cubic feet=	950.0000	BTU

APTable 16-2 PROJECT PARAMETERS <2010 Constant Price>

Item			Combined Cycle Gas Turbine	
Capital Investment				
	Capacity		1200.0	MW
	Plant Factor		85.0%	
	Annual Output		8,935.2	GWh
	Auxiliary Consumption		5.0%	
	Net Units at Busbar		8,488.4	GWh
	Net Heat Rate		1,911	kcal/kWh
	Project Life		30	years
	Construction to Start		July 1, 2014	
	Commercial Operation to Start		July 1, 2018	
	Land Cost			Tk/m²/yr
	Price of Fuel		Refer to Macro Assumption	
	Equipment and Infrastructure Cost		Refer to Project Capital Cost	
	Depreciation		30	years for total plant
	Salvage Value		10.0%	
	Physical Contingencies		5.0%	of total EPC Contract
	Price Contingencies (Foreign)		2.0%	p.a. of total EPC Contract per
	Price Contingency (Local)		5.0%	p.a. of total EPC Contract per
Finance				
	Equity	18%	18%	of total investment
	Debt	82%	82%	of total investment
		Donor Loan	70%	70% of total investment
		Domestic Loan	12%	12% of total investment
	Donor Loan			
		Grace Period	5	5 years
		Repayment Period	20	20 years
		Rate of Interest During Operation Period	4.00%	4.00% p.a.
		Rate of Interest During Construction	4.00%	4.00% p.a.
	Domestic Loan			
		Grace Period	5	5 years
		Repayment Period	20	20 years
		Rate of Interest During Operation Period	3.00%	3.00% p.a.
		Rate of Interest During Construction	3.00%	3.00% p.a.
Operation & Maintenance				
	Normal Maintenance			
		Fixed Cost	3,699	3,699 Taka/kW/year (US$53.30/kW)
		Variable Cost	208	208 Taka/MWh
Administration Cost				
		Overhead Cost	10.00%	10.00% of O&M cost

(source)

Target Financial Ratio

Debt/equity ratio		(Target set by FRRP=60%)
Return on equity (after tax)	6.0%	
Return on equity (before tax)		
Return on asset		

Source: PSMP Study Team

APTable 16-3 CAPITAL COST (Imported Coal) <2010 Constant Price>

A2. Fuel Gas Brunch Pipeline	Total Cost			Year 1 (Tk million)	Year 2 (Tk million)	Year 3 (Tk million)	Year 4 (Tk million)
	Foreign Cy (US$ million)	Local Cy (Tk.	Total Cost (Tk				
A. Construction Work							
A1.Power Plant Installation & Related Works							
FOB Price of Imported Equipment	1,308	4,410	95,455				
Construction, Erection, Commissioning &	90	14,632	20,895				
A2. Transmission Line							
Main Transmission Line	39	0	2,693				
A3. Total EPC Contract (Foreign)	1,437	0	100,001	15,000	30,000	35,000	20,000
A4. Total EPC Contract (Local)	0	19,042	19,042	2,856	5,713	6,665	3,808
B. Consulting Services							
Consulting Services (Foreign)	72	0	5,000	750	1,500	1,750	1,000
Consulting Services (Local)	0	952	952	143	286	333	190
C. Contingency							
C1. Physical Contingency (Foreign)	72	0	5,000	750	1,500	1,750	1,000
C2. Physical Contingency (Local)	0	952	952	143	286	333	190
C3. Price Contingency (Foreign)	29	0	1,997	300	599	699	399
C4. Price Contingency (Local)	0	952	952	143	286	333	190
E. Interest During Construction							
E1. Cumulative Total of A-C (Foreign) excl C-3				16,500	49,500	88,001	110,001
E2. Cumulative Total of A-C (Local) excl. C-4				3,142	9,426	16,757	20,946
E3. Interest During Construction (Foreign)				231	924	1,925	2,772
E4. Interest During Construction (Local)				6	23	47	68
Exchange Loss During Construction							
TOTAL PROJECT COST (excl Price Contingency)							
Total (Foreign)				16,731	33,924	40,425	24,772
Total (Local)				3,148	6,306	7,378	4,257
TOTAL				19,879	40,231	47,804	29,029
CUMULATIVE INVESTMENT (excl. Price Contingency)							
Total (Foreign)				16,731	50,655	91,081	115,853
Total (Local)				3,148	10,581	16,832	21,089
TOTAL				19,879	61,236	107,913	136,942
CUMULATIVE BALANCE OF LOAN (excl. Price Contingency)							
Total (Foreign)				13,915	42,865	75,539	95,860
Total (Local)				2,385	7,348	12,950	16,433
TOTAL				16,301	50,214	88,489	112,293
Equity (18%) in Taka million				3,578	11,023	19,424	24,650
Borrowing from GOB (12%) in Taka million				2,385	7,348	12,950	16,433
Borrowing of External Funds (70%) in Taka million				13,915	42,865	75,539	95,860

(Note) Constant price as of June, 2010

Source: PSMP Study Team

APTable 16-4 CAPITAL COST (Minemouth) <2010 Constant Price>

A2. Fuel Gas Brunch Pipeline	Total Cost			Year 1 (Tk million)	Year 2 (Tk million)	Year 3 (Tk million)	Year 4 (Tk million)
	Foreign Cy (US$ million)	Local Cy (Tk. million)	Total Cost (Tk million)				
A. Construction Work							
A1.Power Plant Installation & Related Works							
FOB Price of Imported Equipment	1,237	2,205	88,267				
Construction, Erection, Commissioning &	90	14,656	20,926				
A2. Transmission Line							
Main Transmission Line	35	0	2,443				
A3. Total EPC Contract (Foreign)	1,362	0	94,775	14,216	28,432	33,171	18,955
A4. Total EPC Contract (Local)	0	16,861	16,861	2,529	5,058	5,901	3,372
B. Consulting Services							
Consulting Services (Foreign)	68	0	4,739	711	1,422	1,659	948
Consulting Services (Local)	0	843	843	126	253	295	169
C. Contingency							
C1. Physical Contingency (Foreign)	68	0	4,739	711	1,422	1,659	948
C2. Physical Contingency (Local)	0	843	843	126	253	295	169
C3. Price Contingency (Foreign)	27	0	1,893	284	568	662	379
C4. Price Contingency (Local)	0	843	843	126	253	295	169
E. Interest During Construction							
E1. Cumulative Total of A-C (Foreign) excl C-3				15,638	46,913	83,402	104,252
E2. Cumulative Total of A-C (Local) excl. C-4				2,782	8,346	14,838	18,547
E3. Interest During Construction (Foreign)				219	876	1,824	2,627
E4. Interest During Construction (Local)				5	20	42	60
Exchange Loss During Construction							
TOTAL PROJECT COST (excl Price Contingency)							
Total (Foreign)				15,857	32,151	38,313	23,478
Total (Local)				2,787	5,584	6,533	3,770
TOTAL				18,644	37,736	44,846	27,247
CUMULATIVE INVESTMENT (excl. Price Contingency)							
Total (Foreign)				15,857	48,008	86,321	109,798
Total (Local)				2,787	8,371	14,904	18,674
TOTAL				18,644	56,379	101,225	128,472
CUMULATIVE BALANCE OF LOAN (excl. Price Contingency & IDC)							
Total (Foreign)				13,051	39,466	70,858	89,931
Total (Local)				2,237	6,766	12,147	15,417
TOTAL				15,288	46,231	83,005	105,347
Equity (18%) in Taka million				3,356	10,148	18,221	23,125
Borrowing from GOB (12%) in Taka million				2,237	6,766	12,147	15,417
Borrowing of External Funds (70%) in Taka million				13,051	39,466	70,858	89,931

(Note) Constant price as of June, 2010

Source: PSMP Study Team

APTable 16-5 CAPITAL & OPERATIONAL COST <EIRR> (Imported Coal)

(Taka Million)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Fiscal Year Ending at	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Gross Annual Energy Output (GWh)						8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935
Net Annual Energy Output (GWh)						8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488
Electricity Sales						66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634
Capital Expenditure (cumulative)		19,879	61,236	107,913	136,942																
Foreign Currency		16,731	50,655	91,081	115,853																
Local Currency		3,148	10,581	16,832	21,089																
Fund Raising (Balance at Year End)																					
Equity (Cumulative Investment)		3,578	11,023	19,424	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650
Loan Balance (foreign)		13,915	42,865	75,539	95,860	95,860	95,860	95,860	95,860	95,860	89,469	83,078	76,688	70,297	63,906	57,516	51,125	44,735	38,344	31,953	25,563
Loan Balance (local)		2,385	7,348	12,950	16,433	16,433	16,433	16,433	16,433	16,433	15,338	14,242	13,146	12,051	10,955	9,860	8,764	7,669	6,573	5,478	4,382
Repayment of Loans																					
Foreign Loan Repayment						0	0	0	0	0	6,391	6,391	6,391	6,391	6,391	6,391	6,391	6,391	6,391	6,391	6,391
Local Loan Repayment						0	0	0	0	0	1,096	1,096	1,096	1,096	1,096	1,096	1,096	1,096	1,096	1,096	1,096
Equity																					
Increase of Equity						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redemption of Equity						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed Cost																					
O & M (Fixed)						4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439
Admin Overhead Expense (Fixed)						444	444	444	444	444	444	444	444	444	444	444	444	444	444	444	444
Depreciation																					
Variable Cost																					
Fuel Cost						25,308	26,080	26,853	27,625	28,374	29,100	29,826	30,552	31,231	31,933	32,612	33,291	33,291	33,291	33,291	33,291
O & M (Variable)						1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859
Admin Overhead Expense (Variable)						186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186
Salvage Value																					
Land																					
Plant																					
Annual Costs						32,235	33,007	33,780	34,552	35,302	36,027	36,753	37,479	38,158	38,860	39,539	40,218	40,218	40,218	40,218	40,218
Total Fixed Costs						4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883
Total Variable Costs						27,352	28,125	28,897	29,670	30,419	31,145	31,870	32,596	33,275	33,977	34,656	35,335	35,335	35,335	35,335	35,335
EIRR under the Logical Willingness-to-Pay																					
Economic Benefit						66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634
Capital Cost		19,879	41,357	46,677	29,029																
Operation Cost						32,235	33,007	33,780	34,552	35,302	36,027	36,753	37,479	38,158	38,860	39,539	40,218	40,218	40,218	40,218	40,218
Economic Benefit - Economic Cost		-19,879	-41,357	-46,677	-29,029	34,400	33,627	32,855	32,082	31,333	30,607	29,881	29,155	28,477	27,774	27,095	26,416	26,416	26,416	26,416	26,416
EIRR		17.69%																			

Source: PSMP Study Team

		21	22	23	24	25	26	27	28	29	30	31	32	33	34
Fiscal Year Ending at	**Unit**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**
Gross Annual Energy Output (GWh)		8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935
Net Annual Energy Output (GWh)		8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488
Electricity Sales		66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634
Capital Expenditure (cumulative)															
Foreign Currency															
Local Currency															
Fund Raising (Balance at Year End)															
Equity (Cumulative Investment)		24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650	24,650
Loan Balance (foreign)		19,172	12,781	6,391	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Loan Balance (local)		3,287	2,191	1,096	0	0	0	0	0	0	0	0	0	0	0
Repayment of Loans															
Foreign Loan Repayment		6,391	6,391	6,391	6,391	0	0	0	0	0	0	0	0	0	0
Local Loan Repayment		1,096	1,096	1,096	1,096	0	0	0	0	0	0	0	0	0	0
Equity															
Increase of Equity		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redemption of Equity		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed Cost															
O & M (Fixed)		4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439
Admin Overhead Expense (Fixed)		444	444	444	444	444	444	444	444	444	444	444	444	444	444
Depreciation															
Variable Cost															
Fuel Cost		33,291	33,291	33,291	33,291	33,291	33,291	33,291	33,291	33,291	33,291	33,291	33,291	33,291	33,291
O & M (Variable)		1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859
Admin Overhead Expense (Variable)		186	186	186	186	186	186	186	186	186	186	186	186	186	186
Salvage Value															
Land															0
Plant															13,694
Annual Costs		40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218
Total Fixed Costs		4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883
Total Variable Costs		35,335	35,335	35,335	35,335	35,335	35,335	35,335	35,335	35,335	35,335	35,335	35,335	35,335	35,335
EIRR under the Logical Willingness-to-Pay															
Economic Benefit		66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	80,328
Capital Cost															
Operation Cost		40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218	40,218
Economic Benefit - Economic Cost		26,416	26,416	26,416	26,416	26,416	26,416	26,416	26,416	26,416	26,416	26,416	26,416	26,416	40,111
EIRR															

Source: PSMP Study Team

APTable 16-6 CAPITAL & OPERATIONAL COST <EIRR> (Minemouth)

(Taka Million)

Fiscal Year Ending at	Unit	1 2015	2 2016	3 2017	4 2018	5 2019	6 2020	7 2021	8 2022	9 2023	10 2024	11 2025	12 2026	13 2027	14 2028	15 2029	16 2030	17 2031	18 2032	19 2033	20 2034
Gross Annual Energy Output (GWh)						8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935
Net Annual Energy Output (GWh)						8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488
Electricity Sales						66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634
Capital Expenditure (cumulative)		18,644	53,592	92,854	113,568																
Foreign Currency		15,857	48,008	86,321	109,798																
Local Currency		2,787	5,584	6,533	3,770																
Fund Raising (Balance at Year End)																					
Equity (Cumulative Investment)		3,356	9,647	16,714	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442
Loan Balance (foreign)		13,051	37,515	64,998	79,497	79,497	79,497	79,497	79,497	79,497	74,198	68,898	63,598	58,298	52,998	47,698	42,399	37,099	31,799	26,499	21,199
Loan Balance (local)		2,237	6,431	11,142	13,628	13,628	13,628	13,628	13,628	13,628	12,720	11,811	10,903	9,994	9,085	8,177	7,268	6,360	5,451	4,543	3,634
Repayment of Loans																					
Foreign Loan Repayment						0	0	0	0	0	5,300	5,300	5,300	5,300	5,300	5,300	5,300	5,300	5,300	5,300	5,300
Local Loan Repayment						0	0	0	0	0	909	909	909	909	909	909	909	909	909	909	909
Equity																					
Increase of Equity						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redemption of Equity						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed Cost																					
O & M (Fixed)						4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439
Admin Overhead Expense (Fixed)						444	444	444	444	444	444	444	444	444	444	444	444	444	444	444	444
Depreciation																					
Variable Cost																					
Fuel Cost						23,055	23,673	24,291	24,910	25,509	26,089	26,670	27,251	27,794	28,356	28,899	29,442	29,442	29,442	29,442	29,442
O & M (Variable)						1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859
Admin Overhead Expense (Variable)						186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186
Salvage Value																					
Land																					
Plant																					
Annual Costs						29,982	30,601	31,219	31,837	32,436	33,017	33,597	34,178	34,721	35,283	35,826	36,369	36,369	36,369	36,369	36,369
Total Fixed Costs						4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883
Total Variable Costs						25,100	25,718	26,336	26,954	27,553	28,134	28,714	29,295	29,838	30,400	30,943	31,486	31,486	31,486	31,486	31,486
EIRR under the Logical Willingness-to-Pay																					
Economic Benefit						66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634
Capital Cost		18,644	34,948	39,262	20,714																
Operation Cost						29,982	30,601	31,219	31,837	32,436	33,017	33,597	34,178	34,721	35,283	35,826	36,369	36,369	36,369	36,369	36,369
Economic Benefit - Economic Cost		-18,644	-34,948	-39,262	-20,714	36,652	36,034	35,416	34,798	34,198	33,618	33,037	32,456	31,913	31,351	30,808	30,265	30,265	30,265	30,265	30,265
EIRR		22.10%																			

Source: PSMP Study Team

Fiscal Year Ending at	Unit	21 2035	22 2036	23 2037	24 2038	25 2039	26 2040	27 2041	28 2042	29 2043	30 2044	31 2045	32 2046	33 2047	34 2048
Gross Annual Energy Output (GWh)		8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935	8,935
Net Annual Energy Output (GWh)		8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488	8,488
Electricity Sales		66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634
Capital Expenditure (cumulative)															
Foreign Currency															
Local Currency															
Fund Raising (Balance at Year End)															
Equity (Cumulative Investment)		20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442	20,442
Loan Balance (foreign)		15,899	10,600	5,300	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Loan Balance (local)		2,726	1,817	909	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Repayment of Loans															
Foreign Loan Repayment		5,300	5,300	5,300	5,300	0	0	0	0	0	0	0	0	0	0
Local Loan Repayment		909	909	909	909	0	0	0	0	0	0	0	0	0	0
Equity															
Increase of Equity		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redemption of Equity		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed Cost															
O & M (Fixed)		4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439	4,439
Admin Overhead Expense (Fixed)		444	444	444	444	444	444	444	444	444	444	444	444	444	444
Depreciation															
Variable Cost															
Fuel Cost		29,442	29,442	29,442	29,442	29,442	29,442	29,442	29,442	29,442	29,442	29,442	29,442	29,442	29,442
O & M (Variable)		1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859	1,859
Admin Overhead Expense (Variable)		186	186	186	186	186	186	186	186	186	186	186	186	186	186
Salvage Value															
Land															0
Plant															11,357
Annual Costs		36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369
Total Fixed Costs		4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883
Total Variable Costs		31,486	31,486	31,486	31,486	31,486	31,486	31,486	31,486	31,486	31,486	31,486	31,486	31,486	31,486
EIRR under the Logical Willingness-to-Pay															
Economic Benefit		66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	66,634	77,991
Capital Cost															
Operation Cost		36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369	36,369
Economic Benefit - Economic Cost		30,265	30,265	30,265	30,265	30,265	30,265	30,265	30,265	30,265	30,265	30,265	30,265	30,265	41,622
EIRR															

Source: PSMP Study Team

APTable 16-7 ECONOMIC INTERNAL RATE OF RETURN (Imported Coal)

(Taka Million)

Fiscal Year	Economic Cost (A)			Economic Benefit (B)	(B) - (A)
	Capital	O&M	Total Cost		
2015	19,879		19,879		-19,879
2016	41,357		41,357		-41,357
2017	46,677		46,677		-46,677
2018	29,029		29,029		-29,029
2019		32,235	32,235	66,634	34,400
2020		33,007	33,007	66,634	33,627
2021		33,780	33,780	66,634	32,855
2022		34,552	34,552	66,634	32,082
2023		35,302	35,302	66,634	31,333
2024		36,027	36,027	66,634	30,607
2025		36,753	36,753	66,634	29,881
2026		37,479	37,479	66,634	29,155
2027		38,158	38,158	66,634	28,477
2028		38,860	38,860	66,634	27,774
2029		39,539	39,539	66,634	27,095
2030		40,218	40,218	66,634	26,416
2031		40,218	40,218	66,634	26,416
2032		40,218	40,218	66,634	26,416
2033		40,218	40,218	66,634	26,416
3034		40,218	40,218	66,634	26,416
3035		40,218	40,218	66,634	26,416
3036		40,218	40,218	66,634	26,416
3037		40,218	40,218	66,634	26,416
2038		40,218	40,218	66,634	26,416
2039		40,218	40,218	66,634	26,416
2040		40,218	40,218	66,634	26,416
2041		40,218	40,218	66,634	26,416
2042		40,218	40,218	66,634	26,416
2043		40,218	40,218	66,634	26,416
2044		40,218	40,218	66,634	26,416
2045		40,218	40,218	66,634	26,416
2046		40,218	40,218	66,634	26,416
2047		40,218	40,218	66,634	26,416
2048		40,218	40,218	80,328	40,111
EIRR	**17.69%**				

Source: PSMP Study Team

APTable 16-8 ECONOMIC INTERNAL RATE OF RETURN (Minemouth)

(Taka Million)

Fiscal Year	Economic Cost (A)			Economic Benefit (B)	(B) - (A)
	Capital	O&M	Total Cost		
2015	18,644		18,644		-18,644
2016	34,948		34,948		-34,948
2017	39,262		39,262		-39,262
2018	20,714		20,714		-20,714
2019		29,982	29,982	66,634	36,652
2020		30,601	30,601	66,634	36,034
2021		31,219	31,219	66,634	35,416
2022		31,837	31,837	66,634	34,798
2023		32,436	32,436	66,634	34,198
2024		33,017	33,017	66,634	33,618
2025		33,597	33,597	66,634	33,037
2026		34,178	34,178	66,634	32,456
2027		34,721	34,721	66,634	31,913
2028		35,283	35,283	66,634	31,351
2029		35,826	35,826	66,634	30,808
2030		36,369	36,369	66,634	30,265
2031		36,369	36,369	66,634	30,265
2032		36,369	36,369	66,634	30,265
2033		36,369	36,369	66,634	30,265
3034		36,369	36,369	66,634	30,265
3035		36,369	36,369	66,634	30,265
3036		36,369	36,369	66,634	30,265
3037		36,369	36,369	66,634	30,265
2038		36,369	36,369	66,634	30,265
2039		36,369	36,369	66,634	30,265
2040		36,369	36,369	66,634	30,265
2041		36,369	36,369	66,634	30,265
2042		36,369	36,369	66,634	30,265
2043		36,369	36,369	66,634	30,265
2044		36,369	36,369	66,634	30,265
2045		36,369	36,369	66,634	30,265
2046		36,369	36,369	66,634	30,265
2047		36,369	36,369	66,634	30,265
2048		36,369	36,369	80,328	43,959
EIRR	22.10%				

Source: PSMP Study Team

Chapter 18 Environmental and Social Examination on Most Prioritized Projects APPENDIX

18.1 Laws and regulation regarding environmental and social consideration

18.1.1 Environmental policy

Strategy, Policy, Law, Rule

Bangladesh has legislated an inclusive policy and law, which is related to all environmental controls after the United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, 3-14 June 1992. The main domestic strategies, policies, laws and rules adopted in Bangladesh related to the environment are shown below.

(1) The National Environmental Policy, 1992
(2) Environmental Action Plan, 1992
(3) The Bangladesh Environmental Conservation Act, 1995
(4) The Environmental Conservation Rules, 1997(ECR)
(5) National Conservation Strategy (NCS), 1992
(6) National Environmental Management Action Plan "NEMAP", 1995
(7) The Environmental Court Act, 2000

The Environmental Policy which was established in 1992 plays the overarching role of outlining the whole of the policy. The objectives of the Environmental Policy are:

- To maintain ecological balance and overall development through protection and improvement of the environment
- To protect the country against natural disasters
- To identify and regulate activities, which pollute and degrade the environment
- To ensure environmentally sound development in all sectors
- To ensure sustainable, long term and environmentally sound use of all national resources
- To actively remain adherent to all international environmental initiatives as much as possible

These objectives include 15 sectors. Environmental policy for industrial areas has been stipulated as follows:

- Adopt corrective measures for industries polluting the environment in phases.
- Undertake Environmental Impact Assessment (EIA) for all new industries both in the public and private sectors.
- Impose a ban on the establishment of industries producing goods which cause environmental pollution; close down such existing industries in phases and discourage the use of such polluting products through the development/introduction of the environmentally sound substitutes.
- Encourage development of environmentally sound and appropriate technology and initiatives with the best of labors and provision of proper wages.
- Prevent wastage of raw materials in industries and ensure their sustainable use.

It also stipulates policy implementation by the National Environment Committee and the legal status of the Department of the Environment (DOE) which implements EIA.

In addition, the Bangladesh State of Environment (SoE) Report, which was prepared in 2001 as a response to the recommendations provided in Agenda 21 at the Earth Summit in 1992, identifies five key environmental issues in Bangladesh (Land degradation, Water Pollution and Scarcity, Air

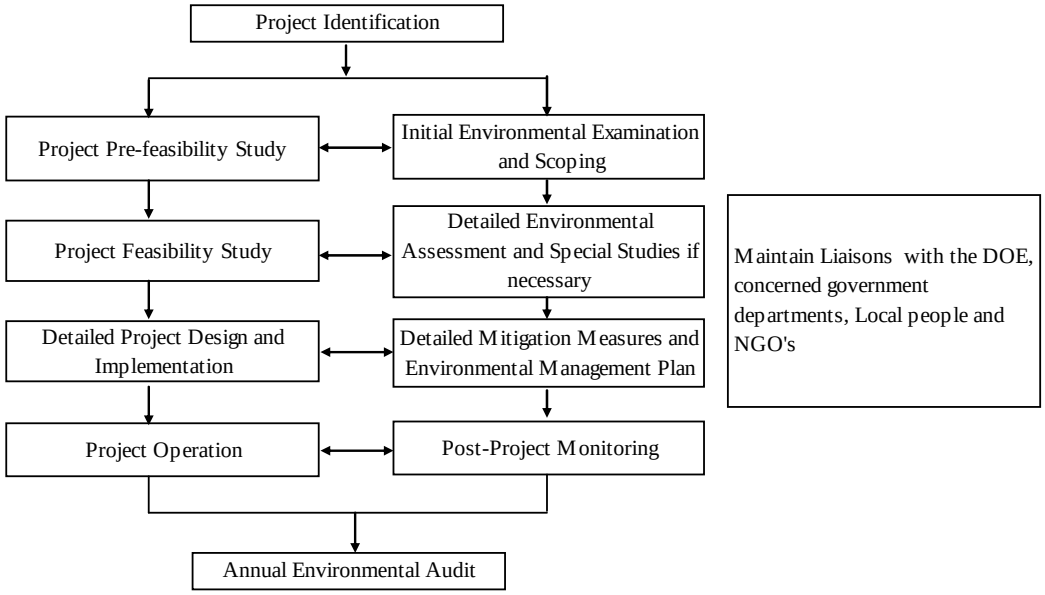
pollution, Biodiversity, Natural disaster), and Bangladesh intends to realize a sustainable environment and development through countermeasures for these five key issues.

18.1.2 Laws and regulations regarding environmental control

(1) Procedures of EIA

The procedures of EIA regarding industrial development in Bangladesh have been stipulated in the Environmental Conservation Rules based on the Environmental Conservation Act. As detailed EIA guidelines regarding procedures, investigation contents and assessment processes, an EIA guideline for Industries was issued by the DOE in 1997. Further, EIA Guidelines for coal mine development were issued in March 2009.

The Environmental Conservation Act has designated projects to be divided into four categories (Green, Amber-A, Amber-B, Red). In the event of a Red Category industrial unit or project, the Initial Environmental Examination (IEE) and a full EIA are required. Subject to a satisfactory review of the environmental assessment, the DOE issues an authorization for the project to proceed.



Source : "EIA Process" EIA Guidelines for Industries, Department of Environment, 1997

APFig. 18-1 Flow chart of EIA process

Coal mine development and Power development are allocated to the Red Category by ECR, and an Initial Environmental Examination (IEE) and a full EIA are required. The IEE procedures are as follows.

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

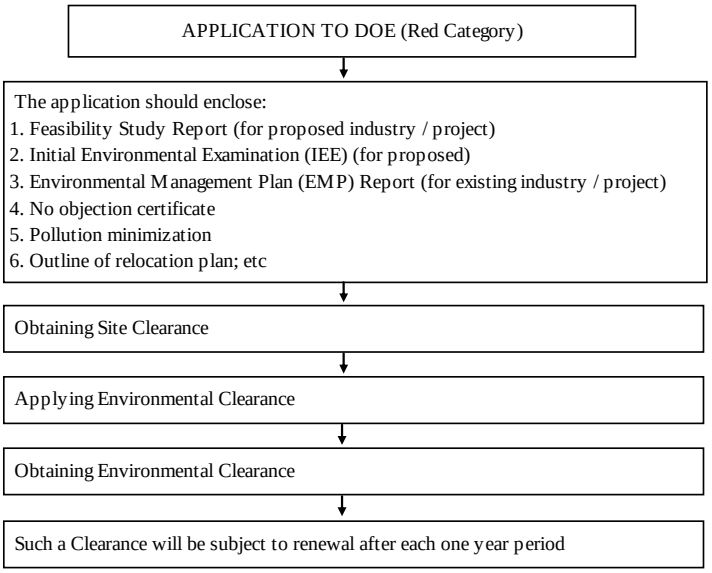
After the completion of an IEE report, the entrepreneur should apply to the DOE in the prescribed format for the application of a Location Clearance Certificate (LCC). The following documents shall be attached with an LCC application.

- Report on the feasibility of the industrial unit or project

- Report on the IEE relating to the industrial unit or project
- No Objection Certificate (NOC) of the local authority
- Emergency plan relating adverse environmental impacts and plans for the mitigation of the effect of pollutions
- Outline of relocation, rehabilitation plan (where applicable)
- Other necessary information (where applicable)

The LCC shall be issued along with DOE's comments on the TOR of the EIA within thirty days of the receipt of the LCC application. The entrepreneur shall submit the EIA report prepared on the basis of a program outlined in the TOR of the EIA to DOE for approval. The EIA report shall be approved within thirty working days. After obtaining approval for the EIA report, an Environmental Clearance Certificate (ECC) shall be granted to the concerned entrepreneur within fifteen working days. The entrepreneur can commence commercial operations after obtaining the ECC[1].
The validity period of Environmental Clearance Certificate shall be one year. At the same time the Environmental Clearance Certificate is validated, the DOE will verify that the environmental standards required by the DOE concerning certification and sound operating conditions are satisfied.
APFig. 18-2 shows the EIA flow chart for procedures in the RED category.

The Environmental Management Plan (EMP) is a key requirement of the EIA, for projects classified in the Red categories. The main objective of the EMP is to enable the entrepreneur to show the DOE how to achieve environmental performance during the construction and operational phases assessed in the EIA which is approved by the DOE. The EMP must describe in detail the organization and management responsibilities, provide details of the mitigation measures identified in the EIA implementation, and explain how the monitoring is implemented. The entrepreneur is also required to comply with environmental regulations.



Source : "EIA Flow Chart" EIA Guidelines for Industries, Department of Environment, 1997

APFig. 18-2 EIA flow chart for procedures on RED category

(2) Environmental regulation

Details of the environmental standards applicable in Bangladesh are described in the Environmental Conservation Rules (ECR). Regulated Areas spread to all industries and regulated

[1] DoE comment, Aug.2010

items are air quality, water quality (surface water, drink water), noise (boundary, source), emissions from motor vehicles or ships, odor, sewage discharge, waste from industrial units and industrial effluents or emissions. Items and standards, which are related to the construction and operation of coal-fired power plants, are listed below. Tables and annotations of environmental regulation are described as textual description of ECR.

(a) Air quality

APTable 18-1 shows the air quality standard in Bangladesh. Air quality standards adhere to WHO guidelines.

APTable 18-1 Standards for air quality in Bangladesh[1]

No.	Pollutant	Density (mg/m^3)		Exposure time
		ECR	WHO guide line	
a)	Carbon Mono-oxide	10	-	8 hours
		40	-	1 hour
b)	Lead (Pb)	0.5	-	Annual
c)	Nitrogen Oxide	0.1	0.04	Annual
d)	Suspended Particulate Matter (SPM)	0.2	-	8 hours
e)	Particulate Matter 10 (PM10)	0.05	0.02	Annual
		0.15	0.05	24 hours
f)	Particulate Matter 2.5 (PM2.5)	0.015	0.01	Annual
		0.065	0.025	24 hours
g)	Ozone	0.235	-	1 hour
		0.157	0.160	8 hours
h)	Sulfur dioxide	0.08	-	Annual
		0.365	0.02	24 hours

Source： Bangladesh Gazette, July 19, 2005 IFC Environmental Health and Safety Guidelines 2007

APTable 18-2 shows gas emission standards for industrial facilities in Bangladesh. APTable 18-3 shows gas emission standards for industrial boiler in Bangladesh.

APTable 18-2 Gas emission standard for industrial facilities[2]

No.	Parameter	Unit	Standard Limit
1	Particulates		
	a) Electric Power Station of 200 Megawatts and above	mg/Nm^3	150
	b) Electric Power Station less than 200 Megawatts	mg/Nm^3	350
2	Chlorine	mg/Nm^3	150
3	Hydrochloric Acid gas & mist	mg/Nm^3	350
4	Total Fluoride (F)	mg/Nm^3	25
5	Sulfuric Acid mist	mg/Nm^3	50
6	Lead particle	mg/Nm^3	10
7	Mercury particle	mg/Nm^3	0.2
8	Sulfur Dioxide		
	a) Sulfuric Acid manufacture (DCDA process)	kg/ton	4
	b) Sulfuric Acid manufacture (SCSA process) Minimum Stack height for Sulfuric Acid emission	kg/ton	10
	Lowest height of stack for dispersion of sulfuric acid a) Coal Fired Electric Power Station		
	i) 500 Megawatts & above	M	275
	ii) 200-500 Megawatts	M	220
	iii) Below 200 Megawatts	M	$14\ (Q)^{0.3(1)}$
	b) Boiler		
	i) For Steam up to 15 tons/hour	M	11

1 Not exceed one time in year

2 (1)Q=SO2 emission in kg/hour

No.	Parameter	Unit	Standard Limit
	ii) For steam above 15 tons/hour	M	14 $(Q)^{0.3(1)}$
9	Nitrogen Oxides		
	a) Nitric Acid manufacture	kg/ton	3
	b) Gas Fired Electric Power Station		
	i) 500 Megawatts & above	ppm	50
	ii) 200-500 Megawatts	ppm	40
	iii) Less than 200 Megawatts	ppm	30
	c) Metal Treatment Furnace	ppm	200
10	Soot & Dust Particles		
	a) Air Ventilated Furnace	mg/Nm^3	500
	b) Brick-field	mg/Nm^3	1000
	c) Cooking Furnace	mg/Nm^3	500
	d) Limestone Furnace	mg/Nm^3	250

Source： The Environmental Conservation Rules, 1997

APTable 18-3 Gas emission standard for industrial boiler

No.	Parameters	Standards for presence in a unit of mg/Nm3
1	Soot and particulate (fuel based)	
	a) Coal	500
	b) Gas	100
	c) Oil	300
2	Oxides of Nitrogen (fuel based)	
	a) Coal	600
	b) Gas	150
	c) Oil	300

Source： The Environmental Conservation Rules, 1997

A coal fired power plant utilizes coal (main fuel) and oil (auxiliary fuel for startup). Because the planned output of the power plant is 600MW, the emission standard limit of particulates is $150mg/Nm^3$. As for Sulfur Dioxide, if the stack of 275m height is mounted, there are no standard limit of emissions densities and amount limits. The Emission standard limit of Oxides of Nitrogen shown in APTable 18-3 is 600 mg/Nm^3 in the case of coal-firing and 300 mg/Nm^3 in the case of oil firing.

It is common in setting an emission standard to SO2 based on global standards. APTable 18-4 shows a comparison of the flue gas emission standards of Bangladesh with that of World Bank (IFC). A new coal-fired power plant should consider these world standards.

APTable 18-4 Comparison of flue gas emission standard between Bangladesh and IFC[1]

Parameters	ECR	IFC
SO_2	-(1)	$850mg/m^3$ (2)
NOx	600 mg/m^3	510 mg/m^3
Particulate Matter (PM)	500mg/m^3	50mg/m^3
Dry Gas , Excess O2 Content	-	6%

Source： The Environmental Conservation Rules, 1997 IFC Environmental Health and Safety Guidelines 2008

(b) Water quality

APTable 18-5 shows ambient water quality standard (inland surface water), APTable 18-6 shows environmental water quality standard (drinking water), and APTable 18-7 shows waste water

[1] (1) Lowest height of stack is defined
(2) As high limit in non-degraded airshed

standard parameters in Bangladesh. As for drinking water standard, waste water standard, it is put down in accordance with WHO guidelines.
And World Bank guideline stipulates monitoring of necessary heavy metals according to the character of each thermal power plant.

APTable 18-5 Ambient water quality standard (inland surface water)[1]

No.	Best Practice based classification	pH	BOD mg/1	Dissolved Oxygen (DO), mg/l	Total Coliform Bacteria quantity/ml
a)	Potable Water Source supply after bacteria freeing only	6.5-8.5	2 or less	6 or above	50 or less
b)	Water used for recreation purpose	6.5-8.5	3 or less	5 or above	200 or less
c)	Potable Water Source Supply after conventional processing	6.5-8.5	3 or less	6 or above	5000 or less
d)	Water used for pisciculture	6.5-8.5	6 or less	5 or above	5000 or less
e)	Industrial use water including chilling & other processes	6.5-8.5	10 or less	5 or above	
f)	Water used for irrigation	6.5-8.5	10 or less	5 or above	1000 or less

Source： The Environmental Conservation Rules, 1997

APTable 18-6 Environmental water quality standard (drinking water)

No.	Parameter	Unit	Standard limit	WHO guideline
1	Aluminum	mg/l	0.2	0.2
2	Ammonia (NH_3)	mg/l	0.5	-
3	Arsenic	mg/l	0.05	0.01
4	Barium	mg/l	0.01	0.7
5	Benzene	mg/l	0.01	0.01
6	BOD_5 20^{O}C	mg/l	0.2	-
7	Boron	mg/l	1.0	0.5
8	Cadmium	mg/l	0.005	0.003
9	Calcium	mg/l	75	-
10	Chloride	mg/l	150-600	-
11	Chlorinated Alkanes			-
	Carbon tetrachloride	mg/l	0.01	-
	1.1 Dichloroethylene	mg/l	0.001	-
	1.2 Dichloroethylene	mg/l	0.03	-
	Tetrachloroethylene	mg/l	0.03	-
	Trichloroethylene	mg/l	0.09	-
12	Chlorinated phenols			-
	Pentachlorophenol	mg/l	0.03	-
	2.4.6 Trichlorophenol	mg/l	0.03	-
13	Chlorine (residual)	mg/l	0.2	-
14	Chloroform	mg/l	0.09	0.3
15	Chromium (hexavalent)	mg/l	0.05	-
16	Chromium (total)	mg/l	0.05	0.05
17	COD	mg/l	4	-
18	Coliform (fecal)	n/100 ml	0	-
19	Coliform (total)	n/100 ml	0	-
20	Color	Huyghens unit	15	-
21	Copper	mg/l	1	-
22	Cyanide	mg/l	0.1	-
23	Detergents	mg/l	0.2	-
24	DO	mg/l	6	-
25	Fluoride	mg/l	1	1.5

[1]Textual annotations are as follows.
(1) Maximum amount of ammonia presence in water are 1.2 mg/l (as nitrogen molecule) which is used for pisciculture.
(2) For water used in irrigation Electrical Conductivity-2250 micro mho/cm (at 25oC). Sodium less than 26 mg/l, Boron less than 2 mg/l

No.	Parameter	Unit	Standard limit	WHO guideline
26	Hardness (as $CaCO_3$)	mg/l	200-500	-
27	Iron	mg/l	0.3	-
28	Nitrogen (Total)	mg/l	1	-
29	Lead	mg/l	0.05	0.01
30	Magnesium	mg/l	30-35	-
31	Manganese	mg/l	0.1	0.4
32	Mercury	mg/l	0.001	0.006
33	Nickel	mg/l	0.1	0.07
34	Nitrate	mg/l	10	3
35	Nitrite	mg/l	Less than 1	-
36	Odor		Odorless	-
37	Oil & Grease	mg/l	0.01	-
38	Ph		6.5-8.5	-
39	Phenolic compounds	mg/l	0.002	-
40	Phosphate	mg/l	6	-
41	Phosphorus	mg/l	0	-
42	Potassium	mg/l	12	-
43	Radioactive Materials (gross alpha activity)	Bq/l	0.01	-
44	Radioactive Materials (gross beta activity)	mg/l	0.1	-
45	Selenium	mg/l	0.01	-
46	Silver	mg/l	0.02	-
47	Sodium	mg/l	200	-
48	Suspended particulate matters	mg/l	10	-
49	Sulfide	mg/l	0	-
50	Sulfate	mg/l	400	-
51	Total dissolved solids	mg/l	1000	1000
52	Temperature	℃	20-30	-
53	Tin	mg/l	2	-
54	Turbidity	JTU	10	-
55	Zinc	mg/l	5	-

Source： The Environmental Conservation Rules, 1997 Guidelines for Drinking-water Quality WHO 2008

APTable 18-7 Wastewater discharge standards[1]

No.	Parameter	Unit	Inland Surface Water	Public Sewer at secondary treatment plant	Irrigated Land	IFC (World Bank guideline)
1	Ammoniacal Nitrogen (N molecule)	mg/l	50	75	75	-
2	Ammonia (free ammonia)	mg/l	5	5	15	-
3	Arsenic (As)	mg/l	0.2	0.05	0.2	0.5
4	BOD_5 20°C	mg/l	50	250	100	-
5	Boron	mg/l	2	2	2	-
6	Cadmium (Cd)	mg/l	0.05	0.5	0.5	0.1
7	Chloride	mg/l	600	600	600	-
8	Chromium (total Cr)	mg/l	0.5	1.0	1.0	0.5
9	COD	mg/l	200	400	400	-

[1]Textual annotations are as follows.
(1) These standards shall be applicable to industrial units or projects other than those given under Quality Standards for Classified Industries (Schedule 12).
(2) These quality standards must be ensured at the moment of going into trial production for industrial units and at the moment of going into trial production for industrial units and at the moment of going into operation for other projects.
(3) The value must not exceed the quality standard during spot check at any time ; if required, the quality standards may be more strict to meet the environment terms in certain areas.
(4) Inland Surface Water shall mean drain, pond, tank, water body or water hole, canal, river, spring and estuary.
(5) Public sewer shall mean sewer connected with fully combined processing plant including primary and secondary treatment.
(6) Irrigated land shall mean appropriately irrigated plantation area of specified crops based on quantity and quality of waste water.
(7) Inland Surface Quality Standards (Schedule 13) shall be applicable for any discharge taking place in public sewer or land not defined in Notes 5

No.	Parameter	Unit	Inland Surface Water	Public Sewer at secondary treatment plant	Irrigated Land	IFC (World Bank guideline)
10	Chromium (hexavalent Cr)	mg/l	0.1	1.0	1.0	-
11	Copper (Cu)	mg/l	0.5	3.0	3.0	0.5
12	Dissolved Oxygen (DO)	mg/l	4.5-8	4.5-8	4.5-8	-
13	Electrical Conductivity	micro mho/cm	1200	1200	1200	-
14	Total Dissolved Solids (TDS)	mg/l	2,100	2,100	2,100	-
15	Fluoride (F)	mg/l	7	15	10	-
16	Sulfide (S)	mg/l	1	2	2	-
17	Iron (Fe)	mg/l	2	2	2	1
18	Total Kjeldahl Nitrogen (N)	mg/l	100	100	100	-
19	Lead (Pb)	mg/l	0.1	1.0	0.1	0.5
20	Mangaense (Mn)	mg/l	5	5	5	-
21	Mercury (Hg)	mg/l	0.01	0.01	0.01	0.005
22	Nickel (Ni)	mg/l	1.0	2.0	1.0	-
23	Nitrate (N molecule)	mg/l	10.00	Undetermined	10	-
24	Oil & grease	mg/l	10	20	10	10
25	Phenol compounds(C_6H_5OH)	mg/l	1.0	5	1	-
26	Dissolved Phosphorus (P)	mg/l	8	8	10	-
27	Radioactive Materials.	As determined by Bangladesh Atomic Energy Commission				-
28	PH		6-9	6-9	6-9	6-9
29	Selenium	mg/l	0.05	0.05	0.05	-
30	Zn (Zn)	mg/l	5.0	10.0	10.0	1
31	Total Dissolved solid	mg/l	2,100	2,100	2,100	-
32	Temperature	Centigrade	40	40	40-Summer	-
			45	45	45-Winter	-
33	Total Suspended Solid (TSS)	mg/1	150	500	200	50
34	Cyanide (CN)	mg/1	0.1	2.0	0.2	-

Source： The Environmental Conservation Rules, 1997 IFC Environmental Health and Safety Guidelines 2008

(c) Others

As for noise, the standard limit is set for every category of zone class. APTable 18-8 shows the Noise standard in Bangladesh.

APTable 18-8 Standard for sound[1]

No	Zone Class	Limits in dBa (ECR)		Limits in dBa (IFC)	
		Day	Night	Day	Night
a)	Silent Zone	45	35	55	45
b)	Residential Zone	50	40		
c)	Mixed Zone (this area is used combinedly as residential, commercial and industrial purposes)	60	50	70	70
d)	Commercial Zone	70	60		
e)	Industrial Zone	70	70		

Source： The Environmental Conservation Rules, 1997 IFC Environmental Health and Safety Guidelines 2007

[1]Textual annotations are as follows.
(1) The day time is considered from 6 a.m. to 9 p.m. The night time is considered from 9 p.m. to 6 a.m
(2) From 9 at night to 6 morning is considered night time.
(3) Area within 100 meters of hospital or education institution or educational institution or government designated / to be designated / specific institution / establishment are considered Silent Zones. Use of motor vehicle horn or other signals and loudspeaker are forbidden in Silent Zone.

Ammonia is used in SCR, which is possible to be introduced for the purpose of nitrogen oxide reduction. Including ammonia, APTable 18-9 shows the odor emission standard in Bangladesh.

APTable 18-9 Odor emission standard[1]

Parameter	Unit	Standard Limit
Acetaldehyde	ppm	0.5 – 5
Ammonia	ppm	1 – 5
Hydrogen Sulfide	ppm	0.02 – 0.2
Methyl Disulfide	ppm	0.009 – 0.1
Methyl Sulfide	ppm	0.01 – 0.2
Styrene	ppm	0.4 – 2.0

Source The Environmental Conservation Rules, 1997

18.1.3 Protected area and environmentally controlled area

Classification of Protected areas and environmentally-controlled areas in Bangladesh are shown in APTable 18-10. Those areas are declared as National Park, Wildlife Sanctuary, Game Reserve, Botanical gardens, and Eco-parks under the Wildlife (Preservation) Order, Reserved Forests and Protected Forests under the Forest Act and Ecologically Critical Areas (ECA) notified under the Environmental Conservation Act.

APTable 18-10 Classification of Protected area, Environmentally controlled area

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

Source: PSMP Study Team

There are fifteen National parks, thirteen wildlife sanctuaries, five botanical gardens and eco-parks in Bangladesh declared under the Wildlife (Preservation) Order having total area of 2,702.2km^2. List of Protected areas and environmentally-controlled areas are shown as APTable 18-11. There are nine ECA and the total areas is 8063.2 km^2 excluding the Gulshan-Banani-Baridhara Lake.[2] Though industrial development is basically restricted in the ECA, if the project possesses a high development possibility and a high priority as a nation, IEE will be implemented as an exception and the DOE will render a judgment concerning project implementation[3]. APTable 18-12 shows a list of ECA notified under the Environmental Conservation Act. Site selection should be implemented under the condition of not causing environmental impact to protected areas and/or environmentally controlled areas.

[1]Textual annotations are as follows.
(1)Following regulatory limit shall be generally applicable to emission/exhaust outlet pipe of above 5 meter hight:
Q = 0.108 x He2Cm (Where Q = Gas Emission rate Nm3/hour)
He = Hight of exhaust outlet pipe (m)
Cm = Above mentioned limit (ppm)
(2)In cases where a special parameter has been mentioned, the lower limit shall be applicable for warning purpose, and the higher limit shall be applicable for prosecution purpose or punitive measure.

[2] A situation Analysis Report on Environment(MDG7) Bangladesh

[3] Interviewed with DoE

APTable 18-11 List of Protected area, environmentally controlled area

Classification	No.	Name	Place	Area (km^2)
A	1	Bhawal National Park	Gazipur	50.2
	2	Modhupur National Park	Tangail/ Mymensingh	84.4
	3	Ramsagar National Park	Dinajpur	0.3
	4	Himchari National Park	Cox's Bazar	17.3
	5	Lawachara National Park	Moulavibazar	12.5
	6	Kaptai National Park	Chittagong Hill Tracts	54.6
	7	Nijhum Dweep National Park	Noakhali	163.5
	8	Medha Kachhapia National Park	Cox's Bazar	4.0
	9	Satchari National Park	Habigonj	2.4
	10	Khadim Nagar National Park	Sylhet	6.8
	11	Baraiyadhala National Park	Chittagong	29.3
	12	Kuakata National Park	Patuakhali	16.1
	13	Nababgonj National Park	Dinajpur	5.2
	14	Shingra National Park	Dinajpur	3.1
	15	Kadigarh National Park	Mymensingh	3.4
B	1	Rema-Kalenga Wildlife Sanctuary	Hobigonj	18.0
	2	Char Kukri-Mukri Wildlife Sanctuary	Bhola	0.4
	3	Sundarban (East) Wildlife Sanctuary	Bagerhat	312.3
	4	Sundarban (West) Wildlife Sanctuary	Satkhira	715.0
	5	Sundarban (South) Wildlife Sanctuary	Khulna	369.7
	6	Pablakhali Wildlife Sanctuary	Chittagong Hill Tracts	420.9
	7	Chunati Wildlife Sanctuary	Chittagong	77.6
	8	Fashiakhali Wildlife Sanctuary	Cox's Bazar	32.2
	9	Dudh Pukuria-Dhopachari Wildlife Sanctuary	Chittagong	47.2
	10	Hazarikhil Wildlife Sanctuary	Chittagong	29.1
	11	Sangu Wildlife Sanctuary	Bandarban	57.6
	12	Teknaf Wildlife Sanctuary	Cox's Bazar	116.2
	13	Tengragiri Wildlife Sanctuary	Barguna	40.5
D	1	National Botanical Garden	Dhaka	0.8
	2	Baldha Garden	Dhaka	-
	3	Madhabkunda Eco-Park	Moulavibazar	2.7
	4	Sitakunda Botanical Garden and Eco-park	Chittagong	8.1
	5	Dulahazara Safari Parks	Cox’s Bazar	6.0

Source: UUhttp://www.bforest.gov.bd/conservation.php (accessed January 2011)

APTable 18-12 List of Environmental Critical Areas

Classification	No.	Name	Place	Area (km^2)
F	1	The Sundarbans	Bagerhat, Khulna, Satkhira	7,620.3
	2	Cox’s Bazar (Teknaf, Sea beach)	Cox’s Bazar	104.7
	3	St. Martin Island	Cox’s Bazar	5.9
	4	Sonadia Island	Cox’s Bazar	49.2
	5	Hakaluki Haor	Moulavi Bazar	183.8
	6	Tanguar Haor	Sumamganj	97.3
	7	Marjat Baor	Jhinaidha	2
	8	Gulshan-Banani-Baridhara Lake	Dhaka	-
	9	Rivers (Buriganga, Turag, Sitalakhya and Balu) around Dhaka city	Dhaka	-

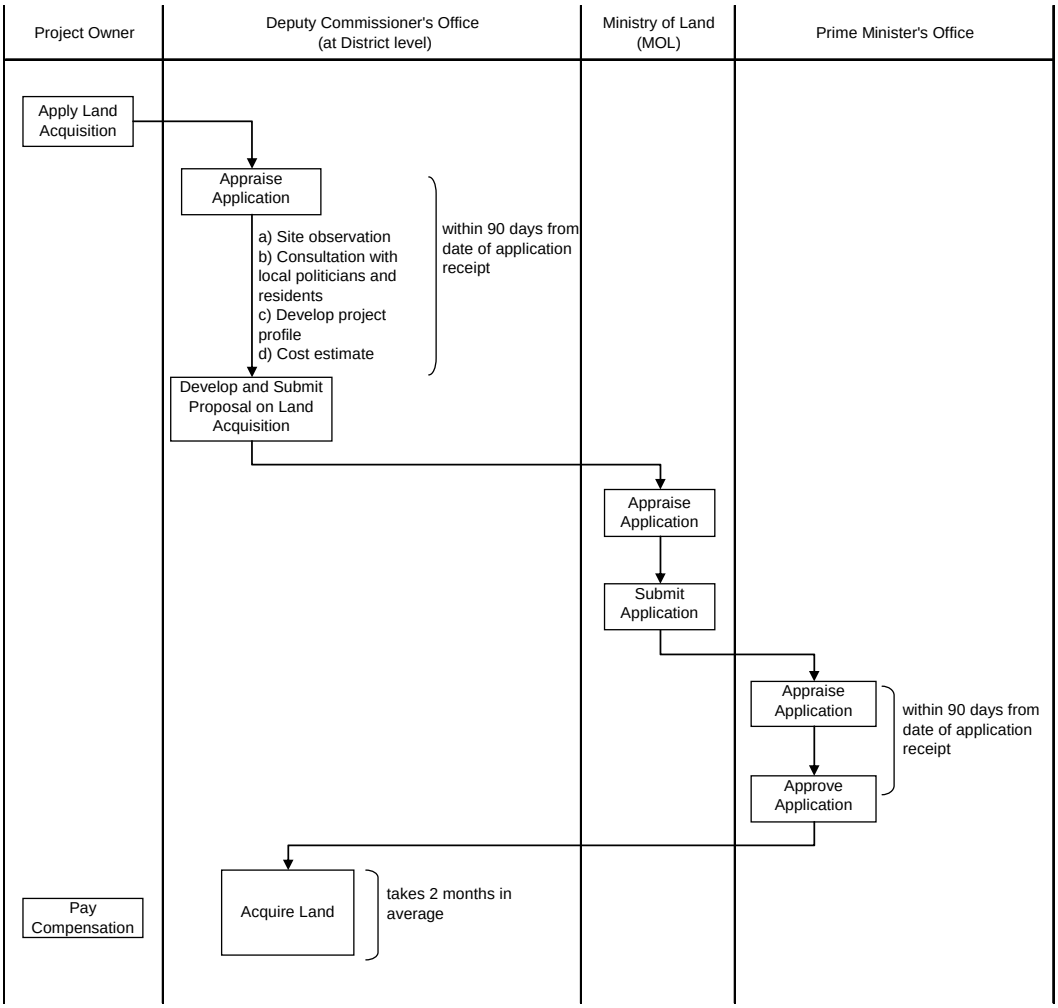
Source: Biodiversity National Assessment and Programme of Action 2020) ,DoE Bangladesh, 2010

18.1.4 Land Acquisition and Involuntary Resettlement

(1) Land Acquisition

Land acquisition is implemented in Bangladesh as stipulated in the Acquisition and Requisition of Immovable Property Ordinance of 1982, and land acquisition for power plant and transformer substation is not an exception. The Ordinance stipulates the procedure for land acquisition as the following.

(1) The Project Owner submits an application for land acquisition to the Deputy Commissioner's Office[1]. The Project Owner is responsible to describe the project details in the application.
(2) DC Office appraises the application within 90 days from the submission date. DC Office conducts site visits in which site observation and local consultation with politicians and residents are done, and develops a project profile and cost estimate.
(3) DC Office submits a proposal for land acquisition to the Ministry of Land (MOL).
(4) MOL appraises the proposal and forwards it to the Prime Minister. PM appraises the proposal within 3 months from the submission date.
(5) After getting PM's approval, DC Office takes a course of action for land acquisition. It takes 2 months in average. It is the Project Owner who should pay for compensation.



Source: PSMP Study Team

APFig. 18-3 Official Process for Land Acquisition

[1] Each District is headed by the Deputy Commissioner, and each Division is comprised of several Districts, and headed by the Commissioner.

As for government-funded projects, the project owner also has to submit a Development Project Proposal, DPP, to the Government of Bangladesh. These two applications: one for land acquisition and another for development project proposal, can go spontaneously for getting approval.

The Project Owner does not have to reach MOL for their intervention as long as the size of the acquired land is less than 16.5 acres. DC Office handles all the procedures on behalf. In Metropolitan Area[1], however, MOL is involved in the appraisal process of all applications of land acquisition no matter how big the land size is.
The Ordinance stipulates that land owners are compensated with 1.5 times of the present land price for acquisition of their private-owned lands. No other payment is made even for their resettlement cost including new land purchase and house construction.

As for the land acquisition for the right of way (ROW) of new transmission line extension, the Electricity Act 1910 stipulates that it is not required to acquire land, even the sites for transmission towers. No compensation for land is considered in the Act. Agricultural products, trees and other properties in the ROW are however compensated for their values for the adverse impact during construction period. The owners and users of land and property are entitled to continue their original activities in the operation stage.

(2) Involuntary Resettlement

There is no legislation in Bangladesh that stipulates involuntary resettlement and compensation, and it is left to each Project Owner can make a decision. The Project Owners therefore tend to follow established guidelines introduced by investors and donors.

18.2 B-K-D-P Site Information

18.2.1 Site Outlook

The proposed power plant site with domestic coal use is located at the center of Barapukuria, Khalaspir, Dighipara, and Phulbari (B-K-D-P site). The site is within Kushdaha and Binodpur Unions under Nawabganj Upazilla of Dinajpur District. Not far from Nawabganj Town, it is situated in the middle of three domestic coal mines: Barapukuria, Khalashpir, and Dighipara. A map depicting the B-K-D-P site is provided in APFig. 18-4.

[1] Dhaka Mega City, Chittagong City, Barisal City, Khulna City, Rajshahi City and Sylhet City.

Source: http://www.banglapedia.org/httpdocs/HT/H_0143.HTM (accessed May 2010)

APFig. 18-4 Proposed B-K-D-P Site

(1) Health and Sanitation Environment

Local respondents drink water from tube wells. There is no problem with groundwater level which varies from between 25 to 30 feet in the rainy season and from 60 to 80 feet in the dry season. Further, the tube well water is arsenic free.

Local people often suffer from respiratory diseases, diarrhea, fevers, headaches, colds, etc. They do not know the direct causes behind these diseases and simply believe it is normal day-to-day phenomenon. Simple and effective prevention measures have not been fully taken such as the washing of hands after returning home from their outside sojourns or after latrine usage, after caring for their livestock (such as cows and hens) at home, and especially before and after meals that are eaten by hand.

Latrines vary from the *pucca* (concrete) slab one, the *kutcha* (soil-made) one, sanitary (brick-built) one, or just through open spaces use.

The residents in the study area go to the village doctors (*quake*) for simple treatment, and visit the qualified doctors or the government hospital for critical treatment.

(2) Housing Conditions

The house floors are made of clay without any solid foundation. The ceiling is made of tin and the walls are often made out of clay. Some houses are made of bamboo, bricks and tin-shade. Some have a separate kitchen. Their houses are not quake or sound proof. Massive floods can wash them away if heavy rain strikes the area.

(3) Income and Expenditure, and Job Opportunities

According to the Household Income and Expenditure Survey 2005, the average household income in rural areas is Tk. 6,095, expenditures are Tk. 5,165 per month, and Engel's co-efficient applied to rural areas is 58.5 percent of their consumption expenditure.

Most women are housewives; men are businessmen, farmers, van pullers and school teachers, etc. They do not have a wide variety of job opportunities because they are not so well educated or well trained, and thus sources of income generation are also limited. A certain number of residents are associated with the Samity (Association) such as the BRAC and the TMSS, and have taken loans out for business.

(4) Climate condition

The seasons in Bangladesh are roughly divided into the rainy season from April to September, the dry season from October to March. APTable 18-13, APTable 18-14, APTable 18-15, APTable 18-16, APTable 18-17 and APTable 18-18 shows the monthly maximum and minimum air temperature, monthly precipitation, monthly maximum and minimum relative humidity, and monthly average wind speed and the prevailing wind direction at Dinajpur which is located 20 km north west from the proposed site. Colored cell in each table indicates maximum and minimum value.

As for the air temperature, the maximum temperature is over 25°C. The minimum air temperature is under 10 °C in the period from December to January, and the differences between maximum and minimum air temperatures are large, around 20 °C. The monthly maximum temperature is 41.0 °C in May 2007 and monthly minimum temperature is 5.0 °C in January 2003.

The annual precipitation reaches a level of 1,300mm to 3,000mm. The precipitation is primarily concentrated from May to September. Conversely, there is no rainfall in some of the months between November and March. As described above, there is a marked difference in the rainfall between the rainy season and dry season.

As for the humidity level, it is relatively high; the monthly minimum relative humidity exceeds 50% in the period from May to September.

As for the wind speed and wind direction, these elements are largely influenced from the monsoons. It is clear that the wind blows from the west from December to March, and the wind blows from east from April to November. The average wind speed is low, below 2m/s throughout the year.

APTable 18-13 Monthly maximum air temperature at Dinajpur

Unit: °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	26.5	27	35	37.2	37.5	36.8	35	35.5	35	35	31.8	27.5
2001	26.4	30.5	35.2	38.8	36.4	35.5	36.8	36.5	35.5	34	31.5	27.2
2002	26	31.5	35.4	35.3	36	34.4	35.8	35.5	36	34	32.8	30.5
2003	26.5	28.4	32.5	36.4	36.8	37	37.4	36	35	33	31	27.6
2004	25.6	31.6	37	33.8	40	36.2	34	35.4	34	33.2	31	28.8
2005	26.3	31.4	33.6	35.5	37	40	35	35.5	35.8	33.2	31	27.8
2006	28	33.5	35.8	38.5	36.8	37	36	36.7	35.4	34.2	31	28
2007	28.5	29	35.5	35.7	41	40.7	35	36.5	34.8	35	31.8	27.5
2008	27	29.6	35.2	37	36	35.6	35.2	35.7	35	33.6	32	28.8
2009	26.8	31.2	34.5	38	38	37.5						

Source : BMD, Dhaka

APTable 18-14 Monthly minimum air temperature at Dinajpur

Unit: °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	7.2	9.6	13.4	17	20.8	23.7	24.3	24.4	22	18	13.3	9
2001	5.7	7	12.4	19	20.8	21.5	25	24.8	24.4	20.4	13	8.5
2002	9	9.5	13.5	16.8	20.4	23	24	24	22.2	16.8	15.4	9
2003	5	11	10.5	18	20	22.4	23.3	25.2	23.3	20.2	11	9.5
2004	7.5	6.2	13.8	18.5	20	22	23.4	25.3	23	18.2	13.3	6.6
2005	7.5	8.4	16.4	17.5	19.5	20.3	23.8	24.8	24	19.5	13.2	9.2
2006	8	11.8	13.5	18.6	20.3	22.2	24.5	25	22.7	18.3	10.5	10.2
2007	6.4	11.5	13	19	19.6	21	24.5	25	23.3	19.7	14	9.5
2008	9.6	7.2	14.5	17.3	20.5	22.5	24.3	23.7	23.7	18.2	13.5	11.2
2009	7.8	9.5	12.8	18.8	20.6	21.8						

Source： BMD, Dhaka

APTable 18-15 Monthly precipitation at Dinajpur

Unit: (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
2000	0	30	1	147	325	399	197	195	196	25	0	0	1515
2001	0	0	0	5	222	573	158	318	462	382	53	0	2173
2002	8	18	13	168	104	658	795	246	481	56	6	0	2553
2003	11	34	53	105	147	337	532	197	230	380	0	31	2057
2004	7	0	12	163	278	517	602	128	253	330	0	3	2293
2005	9	15	37	89	255	474	507	597	222	770	0	0	2975
2006	0	0	1	67	259	222	218	126	340	21	23	8	1285
2007	0	30	2	33	121	474	401	233	234	51	0	0	1579
2008	33	1	19	27	220	363	437	385	242	45	0	0	1772
2009	0	0	10	41	369	457							

Source： BMD, Dhaka

APTable 18-16 Monthly maximum relative humidity at Dinajpur

Unit: %

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	100	100	100	100	100	100	98	98	100	98	100	100
2001	100	100	98	96	100	100	98	98	99	99	99	100
2002	100	100	98	98	98	100	100	100	100	100	98	100
2003	100	100	100	98	98	98	98	100	98	100	100	100
2004	100	100	100	98	98	100	100	98	98	98	98	100
2005	100	98	99	98	98	98	98	98	100	99	100	99
2006	100	99	96	98	98	97	97	98	99	98	99	98
2007	100	99	98	97	98	99	98	98	98	99	99	100
2008	100	100	98	96	97	98	98	98	98	99	98	100
2009	100	97	98	98	98	98	—	—	—	—	—	—

Source： BMD, Dhaka

APTable 18-17 Monthly minimum relative humidity at Dinajpur

Unit: %

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	39	14	19	15	54	58	58	58	57	39	45	35
2001	29	26	12	17	42	58	54	53	57	45	35	33
2002	30	26	21	32	49	55	59	59	54	36	33	38
2003	38	34	22	19	18	52	49	53	55	45	26	37
2004	43	31	17	43	26	59	62	58	57	41	24	33
2005	34	25	24	17	23	15	56	58	48	43	35	35
2006	32	20	15	14	39	49	56	55	56	37	23	37
2007	24	31	18	18	18	22	53	54	49	47	31	26
2008	19	26	22	30	43	57	52	51	54	44	39	43
2009	36	24	13	7	14	46	–	–	–	–	–	–

Source： BMD, Dhaka

APTable 18-18 Monthly average wind speed (m/s) and prevailing wind direction at Dinajpur

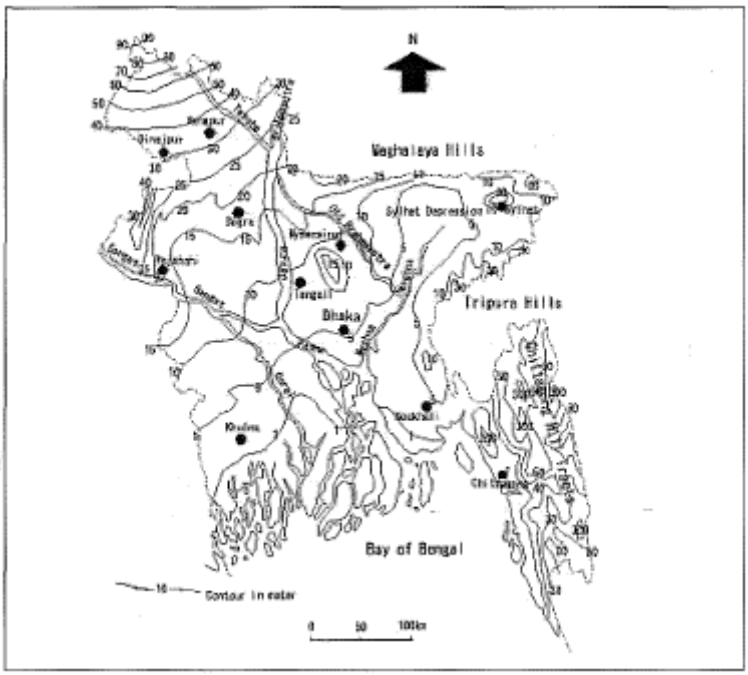
Year	Jan		Feb		Mar		Apr		May		Jun	
	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir
2000	1.2	W	1.3	W	1.2	W	1.2	E	1.1	E	1	E
2001	1.2	W	1.1	W	1.2	W	1.2	E	1.1	E	1.1	E
2002	1	W	1.1	W	1.4	W	1.1	E	1	E	1	E
2003	1.1	W	1.1	W	1.1	E	1.1	E	1	E	1	E
2004	1.1	W	1.1	W	1.3	W	1.1	E	1	E	1	E
2005	0.9	W	1	W	0.8	E	0.8	E	0.9	E	0.9	E
2006	0.7	W	0.7	E	0.8	W	0.8	E	0.8	E	0.8	E
2007	0.8	W	0.9	E	1.3	W	1.1	E	1.1	E	1.3	E
2008	0.9	W	0.9	W	1	E	1.1	E	1	E	1.1	E
2009	0.7	W	1	W	0.7	E	1	E	1.2	E	0.8	E
Year	Jul		Aug		Sep		Oct		Nov		Dec	
	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir
2000	1.2	E	1	SE	1.1	E	1.3	E	1	NE	0.8	N
2001	1.1	E	1	E	1	E	1	E	1	E	1.1	W
2002	1	E	1.1	E	1.1	E	1	E	1.3	E	1	W
2003	1.1	E	1	E	1	E	1.1	E	1	W	1	W
2004	1	E	1	E	1	E	1	E	0.9	E	1	E
2005	0.8	E	0.8	E	0.9	E	1	E	0.6	N	0.7	W
2006	0.8	E	1	E	1.6	E	0.9	E	0.9	W	0.8	W
2007	1.2	E	1	E	1	E	0.8	E	0.9	E	0.7	W
2008	0.8	E	0.8	E	1	E	0.8	E	0.8	E	0.7	W
2009	-	-	-	-		-	-	-	-	-		

Source： BMD, Dhaka

(5) Topography and Underground water

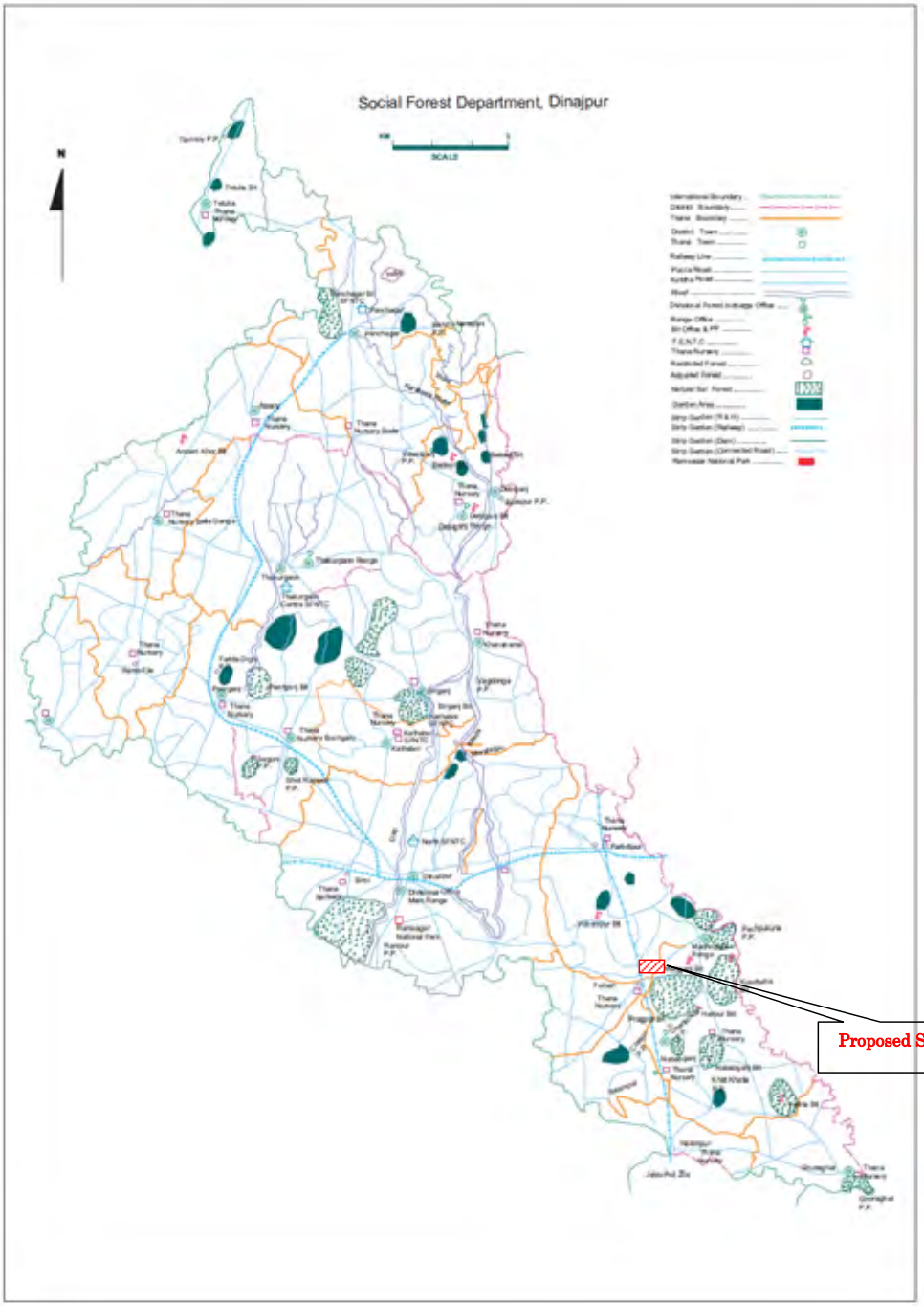
(a) Topography

APFig. 18-5 shows the topographical features of Bangladesh. The general topography of the B-K-D-P site area is mostly plain paddy fields with some residential houses, schools, shops etc.



Source: Taro OKA (2004): Floods and disaster in Bangladesh; Annual Report of Disaster Prevention Research Institute, Kyoto University

APFig. 18-5 Topographical features of Bangladesh



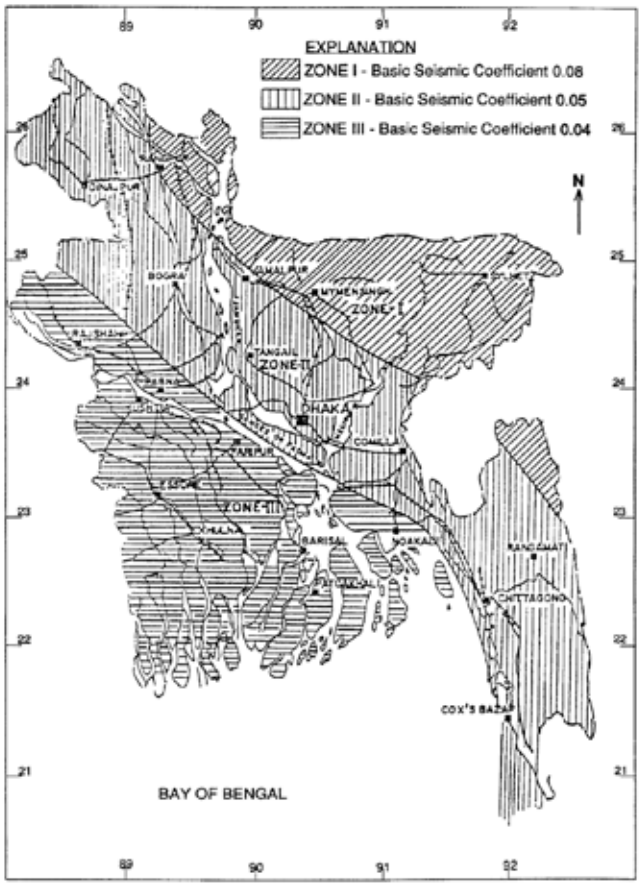
Source： DoF

APFig. 18-6 Distribution of reserved forest in Dinajpur district

(b) Earthquake occurrence situation

APFig. 18-7 shows seismic zoning map in Bangladesh. As shown in APFig. 18-7, the seismic zones in Bangladesh are classified into three zones and the earthquake vibration is estimated to be severe in Zone I, north east of Bangladesh. B-K-D-P site area is located in Zone II.

APTable 18-65 is an earthquake occurrence record in Bangladesh from 1918 to 2008. The maximum magnitude was 8.5, which was occurred in 1997 and 2007.



Source： Bangladesh Meteorological Dept(BMD), 1972

APFig. 18-7 Seismic zoning map in Bangladesh

(c) Soils, water quality and underground water

Geological data is obtained from boring survey results which is conducted at a nearby proposed site by DPHE Territorial Division. The boring survey is conducted in 2002 in the Daldalia village under the Bendighi Union of Phulbari Upazilla, which is very close to the proposed site. The drilling depth was 60.65m. (see APTable 18-19). There are two Aquifers between the depths of 60.65m. As for water quality, out of two measured items, the amount of iron concentration present is over Bangladesh Standard for drinking water, 1.0mg/l. APTable 18-20 shows the measured water quality in the boring survey and the deep well for the existing Barapukuria coal-fired power plant (125MW×2).

Because of underground water pumping in the existing Barapukuria coal mine and the power plant near the B-K-P-D site, Ground water level decreases significantly in B-K-D-P. APFig. 18-8 shows water level variation of deep wells, which is used for the makeup water of the Barapukuria power plant in the period from 2007 to 2009. And

APFig. 18-9 and APFig. 18-10 show yearly change of the deep well water level from 2007 to 2008 and from 2008 to 2009. There was a maximum 2m deep well water level drop at 4UXA from 2007 to 2008. And there was a maximum 1.5m deep well water level drop at 3UXA, it shows the water level lowered totally. On the other hand, there are no signs of decreasing surface level of the little Jamuna River from 2007 to 2008. So, this variation of groundwater level doesn't seem from river water.

APTable 18-19 Boring result in Phulbari in 2002

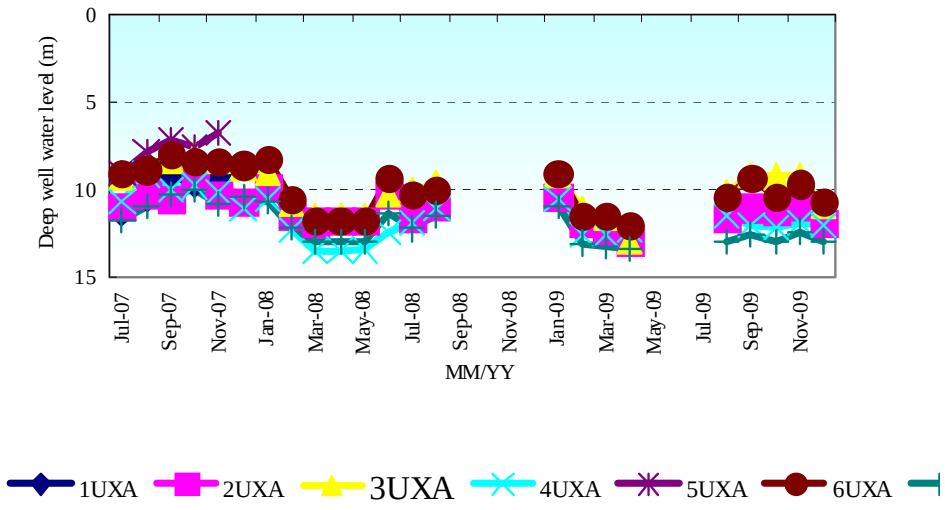
Depth to Top (m)	Depth to Base (m)	Lithologic Description	
0.00	12.00	Silty clay	Aquitard 1
12.00	24.00	Fine sand	Aquifer 1
24.00	42.00	Clay	Aquitard 2
42.00	48.00	Medium sand	Aquifer 2
48.00	60.65	Coarse sand	Aquitard 1

Source: DPHE

APTable 18-20 Water quality of deep well for Barapukuria coal-fired power plant[1]

No.	Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking water
1	Arsenic, As	ppb	0.05 (mg/l)	50
2	Bicarbonate (HCO_3)	mg/L	107 *	—
3	Calcium	mg/L	NA	75
4	Conductivity	µs/cm	187 *	—
5	Chloride	mg/L	3.5	150 – 600
7	Hardness (as Ca CO_3)	mg/L	58.4 *	200 – 500
8	Iron, Fe	mg/L	1.5	0.3 – 1.00
11	pH	—	6.25 *	6.5 – 8.5
12	Total Alkalinity as $CaCO_3$	mg/L	87 *	—
15	Silica (SiO_2)	mg/L	57.2 *	—

Source: Barapukuria coal-fired power plant

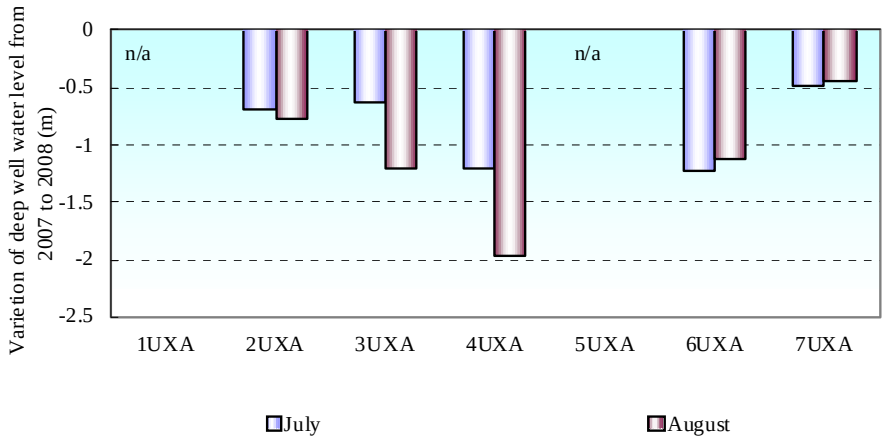


Source： Barapukuria coal-fired power plant

APFig. 18-8 Monthly deep well level variation, Barapukuria power plant[2]

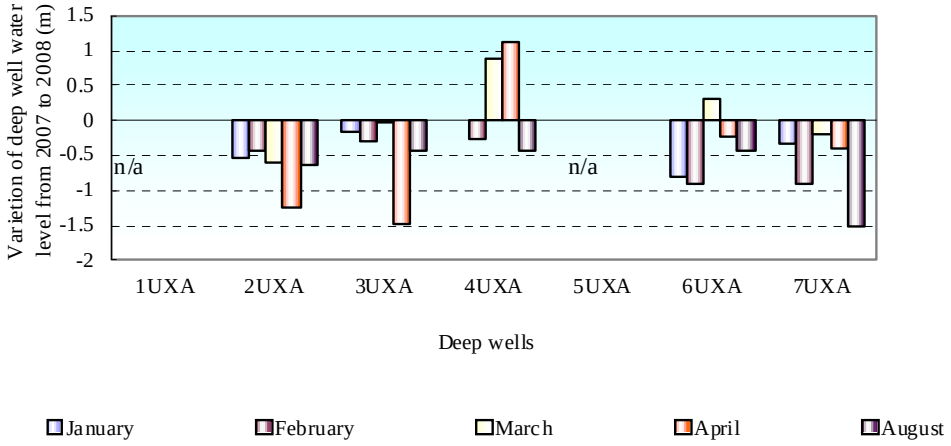
[1] *Data of deep well water(99m) for Barapukuria coal-fired power plant

[2] There are no data from Sep. to Dec. 2008 and May to Jul. 2009 due to defect of water level gauge.



Source: Barapukuria coal-fired power plant

APFig. 18-9 Yearly change of deep well water level from 2007 to 2008



Source： Barapukuria coal-fired power plant

APFig. 18-10 Yearly change of deep well water level from 2008 to 2009

(6) Air quality

Information regarding the air quality condition around the proposed site is not clear. APTable 18-21 shows the estimated maximum ground concentration due to exhaust gas from the Barapukuria power plant which was estimated in the EIA report for the Barapukuria power plant which is near the B-K-D-P. As for NOx, result of the estimation is not satisfying current Bangladesh air quality standard.

APTable 18-21 Estimated maximum ground concentration due to exhaust gas from Barapukuria power plant

(Unit: microgram/m3)

No.	Parameter	Maximum average concentrations	Current Environmental Standard (Bangladesh)
1	Sulfur-dioxide	230	365 (24 hour), 80 (1 year)
2	Oxides Nitrogen	134	100 (1 year)
3	Suspended Particulate Maters(SPM)	7.5	20 (8 hour)

Source : Environmental Impact Assessment (EIA) of Barapukuria Coal Fired Thermal Power Plant, BPDP, Dinajpur

(7) Ecological situation

The ecological situation data has been obtained from the Department of Botany and Zoology of Dhaka University, Respective Upazila offices and local consultant.

(a) Terrestrial Communities

1) Flora

The area is well vegetated with planted trees. The plants found around the site include a total of 74 different species. Out of those plants on the Red List of the International Union for Conservation of Nature (IUCN) there are two species. All of them fall under the category of LC[1]. A list of plants near the proposed site is shown in APTable 18-22.

APTable 18-22 List of plants near B-K-P-D site

No.	Local Name	English Name	Scientific Name	IUCN Global Status
1	Ada	Ginger	*Zingiber officinale*	--
2	Am	Mango	*Mangifera indica L. (Anacard)*	--
3	Arjun		*Terminalia arjuna*	--
4	Ashoke		*Saraca asoca*	--
5	Ashwagondha		*Withania somniferum*	--
6	Babla		*Acacia nilotica*	--
7	Basak		*Adhatoda zeylanica*	--
8	Bash	Bamboo	*Podocarpus neriifolius*	LC
9	Bel	Indian apple	*Aegle marmelos (L).*	--
10	Beli		*Jasmin sambac Ait (Olea)*	--
11	Bet	Cane Tree		--
12	Bokul	Mimusops Elengi	*Mimusops elengi L*	--
13	Boroi	Indian Jujube	*Zizyphus rugosa Lam*	--
14	Bot	Banayan tree	*Ficus benghalensis L. (Mora)*	--
15	Chameli		*Jasminum grandiflorum L. (Oleace)*	--
16	Dalim	Pomegranate	*Punica granatum L.*	--
17	Debdaru	Pine	*Polyalthia longifolia*	--
18	Dhol Kalmi		*Ipomoea fistolosa*	--
19	Dhutra		*Barringtonia acutangula*	--
20	Dumur		*Ficus hispida*	--
21	Gashpul		*Zephyranthes tubispatha Herb. (Amaryllidaceae)*	--
22	Golap	Rose	*Rosa centifolia L. (Rosaceae)*	--

[1] Least Concern

No.	Local Name	English Name	Scientific Name	IUCN Global Status
23	Halencha		*(Altermanthere philoxeroides)*	--
24	Hyacinth		*(Eichhomia crassipes)*	--
25	Ipil Ipil	Ipil Ipil	*Leucaena Latisiliqua*	--
26	Jaba		*Hibiscus rosa sinensis L. (Malvaceae)*	--
27	Jam	Black Berry	*Syzygium cumini skiel. (Myrtaceae)*	--
28	Jambura	Citron	*Citrus grandis*	--
29	Jamrul	Star apple	*Syzygium samraogense (Bl.)*	--
30	Jhau	Poplar	*Thysanolaena maxima*	--
31	Kachu		*Colocasia esculenta (L.)*	--
32	Kadbel	Wood apple	*Feronia limonia (L.)*	--
33	Kalmi		*(lpomoea aquatica)*	--
34	Kalo Dhutra		*Datura metel*	--
35	Kamranga	Carambola	*Averrhoa carambola*	--
36	Kathal	Jack fruts	*Artocarpus heterphyllus Lamk*	--
37	Khejur	Date Palm	*Phoenix sylvestris*	--
38	Kola	Banana	*Musa Paradisica*	--
39	Koroi		*Derris robusta Benth.*	--
40	Kowa nim		*Melia sempervirens*	--
41	Krishnachura	Delonix Regia	*Delonix regia (Boj.) Raf. (Leguminosae)*	--
42	Lebu	Lemon	*Citrus aurantifolia*	--
43	Madar		*Erythriana variegata L. var. orientalis Merr.*	--
44	Mahua		*Madhuca indica gmel*	--
45	Man Kochu		*Alocasia indica*	--
46	Mankata		*Xeromphis spinosa*	--
47	Mehedi		*Lawsonia inermis*	--
48	Mehogoni		*Swietenia mahagoni*	--
49	Methi		*Trigonella foenumgraecum*	--
50	Muktajhuri		*Abroma augusta*	--
51	Narikel	Coconut	*Cocos nucifers L. (Palmae)*	--
52	Nayantara		*Catharanthus roseus*	--
53	Neem		*Azadirachta indica*	--
54	Pakur		*Ficus infectoria*	--
55	Patabahar	Patabahar	*Cdiaeum variegatum*	--
56	Pepe	Papaya	*Carica papaya L (caricaceae)*	--
57	Peyara	Guava	*Psidium Guajava (L) Bat. (Myrtaceae)*	--
58	Pui Shak		*Basella alba L.*	--
59	Radhachura		*Caesalpinia pulcherrima Sw. (Leguminosae)*	--
60	Rain tree		*Samea Samon*	--
61	Rangan		*Ixorarosea will (Rubiceae)*	--
62	Rashun	Garlic	*Allium sativum*	--
63	Sajina		*Moringa Oleifera Lamk. (Moringa)*	--
64	Shal		*Shorea robusta*	LC
65	Shatamuli		*Asparagus racemosus*	--
66	Shimul		*Bombax ceiba L. (Bombacaceae)*	--
67	Shonali Lota			--
68	Sofeda	Sopodilla	*achras Manilkara*	--

No.	Local Name	English Name	Scientific Name	IUCN Global Status
69	Supari	Colloq	*Areca catechu*	--
70	Tal	Palm tree	*Borassus flabellifer L. (Palmae)*	--
71	Tentul	Tamarind	*Tamarindus indica*	--
72	Thankuni		*Centella asiatica*	--
73	Topa pana		*(Pistia stratiotes)*	--
74	Ulatkambal		*Abroma augusta*	--

Source： PSMP Study Team

2) Fauna

The animals found around the site include a total 65 species – 18 species of mammalian animals, 33 species of birds, 12 species of reptiles and 2 species of amphibians. Out of those animals on the Red List of the International Union for Conservation of Nature (IUCN) there are 17 species of LC, 3 species of NT[1], 1 species of EN[2], 1 species of CR[3]. APTable 18-23 shows a list of animals found around the B-K-P-D site. Special attention must be paid to the protection of the Painted Roofed Turtle (CR) and Fishing Cat (ER).

APTable 18-23 List of animals found around the B-K-P-D site

No.	Local Name	English Name	Scientific Name	IUCN Global Status
MAMMALS				
1	Badur/Daini	Greater False Vampire Bat	Megaderma Lyra	LC
2	Bagdash	Large Indian civet	Viverra Zibetha	NT
3	Bara Benji	Indian Gray Mongoose	Herpestes edwardsi	LC
4	Bhera	Sheep	Bovidae: Ovis	--
5	Biral	Cat	Felis: Catus	--
6	Bon Biral/Wab	Jungal Cat/Swamp Cat	Felis chaus	--
7	Indur	Common House Rat	Rattus rattus	--
8	Gadha	Ass	--	--
9	Ghora	Horse	Equus caballus	--
10	Goru	Cow	--	--
11	Kathbirali	Black giant squirrel/Malayan giant squirrel	Ratufa bicolor	NT
12	Khek Shiyal	Bengol Fox/Indian Fox	Vulpes bengalensis	LC
13	Khargosh/Shashak	Rufous-tailed Hare	Lepus nigricollis	--
14	Kukur	Dog	Cannis Familiaris	--
15	Mecho Biral/Mecho Bagh	Fishing cat	Proionailurus viverrinus	EN
16	Mohish	Bafallow	--	--
17	Sagol	Goat	Capra Hircus	--
18	Shojaru	Indian crested Porcupine	Hystrix Indica	LC
BIRDS				
1	Babui-Batan	Small Pratincole	Glareola Lactea	--
2	Bok	Intermediate Egret	Mesophoyx intermedia	--
3	Banspaati	Green Bee-eater	merops orientails	--
4	Baj	Crested Groshawk	Accipiter trivirgatus	--
5	Bulbuli	Red-vented Bulbul	Pycnonotus cafer	LC

[1] Near Threatened
[2] Endangered
[3] Critically endangered

No.	Local Name	English Name	Scientific Name	IUCN Global Status
6	Hutum Pecha	Rock Eagle Owl	Bubo bengalensis	LC
7	Chil	Pariah Kite	Passer domesticus	--
8	Chorui	House Sparrow	Passer Domesticus	--
9	Dahuk	White Breasted water hen	Amaurornis phoenicurus	LC
10	Doyel	White-eyed Buzzard	Butastur teesa	LC
11	Eagal	Bazzard -Eagal	Dicrurus macrocercus	--
12	Fingey	Black Drongo	Dicrurus macrocercus	--
13	Ghughu	Oriental Turtle Dove	Streptopelia orientails	LC
14	Hash	Duck	Anatidae Anseriformes	--
15	Hot-titi	River Lapwing	Vanellus duvaucelii	LC
16	Jalali Kobutor	Rock Pigon	Columba Livia	LC
17	Kak	House Crow	Corvus splendens	--
18	Kana Bok	Indian Pond Heron	Ardeola grayii	--
19	Kat Tokra	Woodpecker	Picoides pubescens	--
20	Kokil	Asian Koel	Eudynamys scolopacea	--
21	Konch Bak.	Pond Heron.	Ardeola grayii	--
22	Machhranga	White Throated Kingfisher	Halcyn smyrensis	--
23	Mohanchura	Hoopoe	Upupa epops	--
24	Moutusi	Purple rumped Sunbird	Nectarinia zeylonica	--
25	Paira	Pigeon	Columba livia domestica	--
26	Pankouri	Great Cormorant	Phalacrocorax carbo	LC
27	Pencha	Spot-bellied Eagle-owl	Bubo nipalensis	LC
28	Rajhans	Bar-headed Goose	Anser indicus	LC
29	Shalik	Indian mynah	--	--
30	Shonkho Chil	Brammoni Kite	Haliastur Indus	--
31	Sipahi Bulbuli	Red –whiskered Bulbul	Pycnonotus jocosus	--
32	Tia	Roseringed parakeet	Psittscula krameri	--
33	Tuntuni	Tailor bird	Orthotomus sutorius	--
REPTILE				
1	Tiktiki	House Lizard	Hemidactylus brokii	--
2	Kasim	Painted Roofed Turtle	Kachuga Kachuga	CR
3	Ajogor	Rock Python	Python molurus	NT
4	Gui Shap	Bengal Monitor	Varanus bengalensis	--
5	Daraj	Green Rat Snake	Coluber nigromarginatus	--
6	Dudhraj	Common Trinket Snake	Elaphe Helena	--
7	Sabuj Dhora	Green Keel back Snake	Macropisthodon plumbicolor	--
8	Laldhora Shap	Red-necked Keelback	Rhabdophis subminiatus	--
9	Kalo Mete Dhora Shap	Dark-Bellied Marsh Snake	Xenochrophis cersogaster	--
10	Shakini Shap	Banded Krait	Bungarus fasciatus	LC
11	Gokhra Shap	Monocellate Cobra	Naja kaouthia	--
12	Raj Gokhra	King Cobra	Ophiophagus Hannah	LC
AMPHIBIA				
1	Beng	Frog	Anura: Ranidae	--
2	Brischik	Scorpion	Archinida1 Scorpionida	--

Source： PSMP Study Team

(b) Aquatic Communities

1) Aquatic Flora

The freshwater dependent plants such as helencha (Altermanthere philoxeroides), kalmi (Ipomoea aquatica), daokalmi (Ipomoea fistulosa), ichadal (Potamo seton) and water hyacinth (Eichhomia crassipes) are common among the ponds, canals and rivers near the B-K-P-D site. The Khuda pana (Lemna minor), topapana, (Pistia stratiotes) and chaicha (Saipus articulatus) are also common.

2) Aquatic Fauna

The crabs inhabit the Little Jamuna and Atrai river, ditches and ponds near the B-K-P-D site. The fresh water snails (Charonia Variegate) and mussels (Mytilus Edilis) are also common. APTable 18-24 shows a list of fishes available near the B-K-D-P site.

APTable 18-24 List of Fishes Available B-K-D-P site

No.	Local Name	English Name	Scientific Name	IUCN Global Status
River fish				
1	Bata	Giantscale Mullet	Lizamelinoptera	--
2	Bele	Scribbled goby	Awaous grammepomus	--
3	Bhagna	--	--	--
4	Bhol/Bol	Indian Trout	Raiamas bola	--
5	Chanda	Elongate glass perchlet	Chanda nama	--
6	Chingri	Shimp	--	--
7	Chitol	Humped Featherback	Nototeruse chitala	--
8	Dhela/ Dipali/ ketti (Cotio)	Cotio	Osteobrama cotio	--
9	Foli	Grey Featherback	Notopterus notopterus	--
10	Gojar/ Gojal	Giant snake head	Channa marulius	--
11	Jhinuk	--	---	--
12	Kajli / Banshpata	Jamua ailia	Ailia punctata	--
13	Kalibaush (kalbasu)	Orange-fin labeo	Labeo calbasu	--
14	Katla	--	Catla Cattla	--
15	Khailsha	Banded gourami	Colisa fasciata	--
16	Meni / Bheda/ Rayan/ Bheduri	Mottled Nandus	Nandus nandus	--
17	Mrigal	Mrigal	Cirrhinus mrigala	--
18	Napit Koi/ Koi Banedi	Dwarf chemeleon fish badis	Badis badis	--
19	Pabda	Pabo Cat fish	Ompak pabo	--
20	Piali	--	---	--
21	Pungash (river)	Yellowtail catfish	Pangasius pagasius	--
22	Puti	Fry	Puntius puntio (Hamilton)	--
23	Rui	Rohu	Labeo rohita	--
24	Sarputi / Swarnaputi	(Olive barb)	Puntias Sarana	--
25	Shal baim/ Baim /Bam(Tire track spiny eel)	Tire trach spinyeel	Mastecembelus armatus	--
26	Shol	Banded Snakehead	Channa striatus	--
27	Sisor / Chenua	Sisor cat fish	Sisor rhabdophorus	--
28	Tara Baim	One Strip spiny eel	Macroganthus aral	--

No.	Local Name	English Name	Scientific Name	IUCN Global Status
29	Tatkini/Bata/Bangla	Reba carp	Cirrhinuss reba	--
30	Telo Taki / Rana Cheng/ Ganchua	Asiatic snake head	Channa Orientalis	--
31	Titpunti	Ticto barb	Puntias Ticto	--

Source： PSMP Study Team

18.2.2 Detailed Information on Meetings with Local Stakeholders

APTable 18-25 Profile of Household Interviewees (B-K-D-P Site)

No	Sex	Age	Village	Distance from Power Plant	Education	Occupation	Household Monthly Income
1	M	47	Rhimapur	500m	Five Pass	Agriculture	4,000
2	M	60	Nundonpur	500m	Nil	Agriculture	3,000
3	F	28	Nundonpur	500m	Seven	Business	4,000
4	F	25	Nundonpur	500m	Nil	Agriculture	4,000
5	M	43	Nundonpur	500m	B A	Teacher	10,000
6	M	45	Nundonpur	500m	Seven	Agriculture	4,000
7	F	30	Rhimapur	500m	Five Pass	Business	10,000
8	M	40	Rhimapur	500m	Nil	Agriculture	3,000
9	F	28	Rhimapur	500m	Nil	Business	4,000
10	F	37	Rhimapur	500m	Nil	Van Puller	4,000
11	F	35	Rhimapur	500m	Nil	Agriculture	5,000
12	M	32	Rhimapur	500m	Nil	Van Puller	4,000
13	F	28	Rhimapur	500m	S.S.C (Pass)	Agriculture	4,000
14	F	45	Rhimapur	500m	Nil	Business	4,000
15	F	30	Rhimapur	500m	Six	Business	7,000

Source: Household interview

APTable 18-26 Profile of FGD Participants (B-K-D-P Site)

No	Age	Education	Occupation	Household Monthly Income
Male Participants				
1	26	S.S.C.	Farmer	4,000
2	37	VIII	Businessman	3,000
3	25	IV	Farmer	1,500
4	34	VI	Farmer	5,000
5	23	VII	Farmer	5,000
6	24	VI	Farmer	5,000
7	26	Signature Only	Van Driver	2,000
8	35	X	Farmer	5,000
9	42	S.S.C.	Farmer	5,000
10	42	V	Farmer	3,000

11	43	V	Farmer	3,000
12	26	S.S.C.	Farmer	3,000
1	50	None	Housewife	4,000
2	50	None	Housewife	5,000
3	30	Signature Only	Housewife	3,000
4	32	V	Housewife	4,000
5	32	Signature Only	Housewife	8,000
6	23	VI	Housewife	4,000
7	27	Signature Only	Housewife	4,000
8	55	Signature Only	Housewife	5,000

Source: Focus group discussions

APTable 18-27 Participants Profile of Local Stakeholder Meeting (B-K-D-P Site)

No.	Designation and Organization
Participants from B-K-D-P site	
1	Chairman, No.7, Daudpur Union Porishad, Nowabgonj, Dinajpur.
2	Member, No.7 Daudpur UP, Nawabgonj, Dinajpur,
3	Professor, Nowabgonj, Dinajpur
4	Professor, Daudpur Technical College, Dinajpur
5	Agriculture & business, Nowabgonj, Dinajpur
6	Imam, Nowabgonj, Dinajpur
7	Teacher, Nowabgonj, Dinajpur
8	Businessman, Nowabgonj, Dinajpur
9	Businessman, Nowabgonj, Dinajpur
The Government of Bangladesh	
1	Joint Chief, Power Division,
2	Asst. Chief, Power Division
PSMP Study Team and Local Consultant	
1	PSMP Study Team
2	EAL, Executive Director
3	EAL, Engineer
4	EAL, Social Specialist
5	EAL
6	EAL
7	EAL

Source: PSMP Study Team

18.2.3 Problem Analysis and Problem Solution

Problem analysis on environmental pollution and natural environment is as found in AP Table 18-28.

AP Table 18-28 Problem Analysis: Assessment Results on Environmental Impact (B-K-D-P)

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
1	Air Pollution	Air pollution can be caused by exhausted gas from transportation vehicles and construction machinery. And dust particles may be scattered near the construction site and construction vehicle road.	B	Planned coal-fired power plant burns domestic coal which is mined from the adjacent coal mine as the main fuel. And it burns light oil as auxiliary fuel (fuel for starting up). NO_X, SO_X and soot will be generated due to the combustion of these fuels. And coal transportation may generate coal dust.	A
2	Water Contamination	Drainage caused by rainfall, equipment washing drainage, and sewage will be generated during the work. And if waste management isn't appropriately conducted, effluents from waste may be generated.	B	Thermal discharge will be produced when using river water as cooling water. If cooling tower is used, condensed cooling water effluent will be generated. Plant effluent and domestic waste water will be generated through plant operation. In case waste management methods aren't appropriately conducted, effluents from waste may be generated.	A
3	Soil pollution	Soil pollution can occur due to lubrication oil or fuel oil spillage from transportation vehicles and construction machinery.	B	Soil pollution can occur due to lubrication oil or fuel oil spillage for unit operations. When an ash pond is used, it is necessary to pay attention to the contaminations from the pond.	B
4	Bottom Sediment	As the proposed site is located inland, there is no possibility of bottom sediment.	C	As the proposed site is located inland, there is no possibility of bottom sediment.	C
5	Noise and vibration	Noise and vibration arise due to vibrations from transportation vehicles and construction machinery. AP Table 18-61 shows the list of the general noise level of transportation vehicles and construction machinery. Steam blowing during commissioning will also generate significant noise.	A	Noise and vibration will be generated through the operation of power facilities. If a cooling tower is used, there is significant noise and vibration from the cooling fan of the tower. For periodic inspections, noise and vibration may arise due to vibration from transportation vehicles and construction machinery. When using vehicles for coal transportation, noise and vibration may occur.	A
6	Offensive Odor	If the domestic waste management isn't applicable at worker stations, offensive odor may be generated due to waste decomposition.	B	If ammonia which is used at SCR leaks, may be a source of offensive odor. If the domestic waste management isn't applicable at worker stations for maintenance work etc., offensive odor may be generated due to waste decomposition.	B

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
7	Waste	Construction work will generate metal chips, waste plastic, wood shavings, waste glass and waste oil. Domestic wastes such as cans, bottles and food residue will be generated by construction workers at their work stations.	B	By-products generated through the operation of coal-fired power plant are coal ash, gypsum (if limestone-gypsum FGD is used), sludge from waste water treatment facility, and cooling water canal fouling (if the river water or sea water is used for the cooling water). These by-products will be wasted if they are discarded without recycling. Maintenance work will generate metal chips, waste plastic, wood shavings, waste glass and waste oil. And domestic waste such as cans, bottles, and food residue will be generated at the workers' stations.	A
8	Ground Subsidence	If the underground water level decreases due to water being used for construction work, there is a possibility of ground subsidence occurring. However, water usage during construction work stays minimum, and such possibility is small.	C	There is a large possibility of ground subsidence occurring if ground water is used as cooling water.	A
9	Geographical Feature	There is little impact since the proposed site is plain and doesn't have any outstanding geographical features.	C	There is little impact since the proposed site is plain and doesn't have any outstanding geographical features.	C
10	Biota and Ecosystem	There is a possibility of Painted Roofed Turtle existing in the site which is categorized CR in IUCN Red list. Site location and transmission line route should be carefully examined in order to avoid the reserved forests in Dinajpur District (see AP Fig.18-6) not to bring adverse impact to the natural environment.	B	There is a possibility of Painted Roofed Turtle existing which is categorized CR in IUCN Red list. Site location and transmission line route should be carefully examined in order to avoid the reserved forests in Dinajpur District (see AP Fig.18-6) not to bring adverse impact to the natural environment.	B
11	Water Usage	People in the surrounding areas of the proposed site use tube well water for their daily life needs. If the underground water level decreases due to water used during construction work, there is a possibility of adverse impact to life water usage. Because water usage for construction work is not so large, the impact of underground water level reduction on water usage will be small.	C	People in the surrounding area of the proposed site uses tube well water for daily life. If underground water is used for cooling water, it will have a large impact on water usage by decreasing underground water level.	A

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
12	Accident	Construction accidents may be caused due to the defects of health and safety management of construction work. It is necessary to pay attention especially to high altitude areas where accidents from falling may occur as well as construction vehicle road accidents and electricity accident.	A	There is possibility of accidents occurring such as fires due to oil spillage or instantaneous combustion of coal, accidents due to leakage or spillage of chemicals like caustic soda and sulfuric acid, accidents or incidents involving maintenance work.	B
13	Global Warming	Transportation vehicles and construction machinery will emit CO_2.	C	It is estimated that approximately 3.54 million tons of CO_2 will be emitted from per 600MW unit per year through operation of coal-fired power plant. Domestic coal is classified bituminous coal which exhausts less amount of CO_2 compared with sub-bituminous coal and brown coal.	B

Source： PSMP Study Team

Problem analysis on social impact is as found in AP Table 18-29.

AP Table 18-29 Problem Analysis: Assessment Results on Social Impact (B-K-D-P)

No	Item	Impact during Construction Stage		Impact during Operation Stage	
1	Involuntary Resettlement	Land acquisition is anticipated for 200 acres that require approximately 1,250 households to be relocated.	A	Damage to houses and health hazards can be caused by smoke extraction, noise pollution, water pollution and land subsidence when the resettlement action plan is not appropriately planned and implemented. Political intervention and/or local movement against the operation of the power station can occur when adverse impacts on local residents' lives and livelihoods are severe.	B
2	Local Economy such as Employment and Livelihood etc.	Loss of employment and livelihoods can be caused by temporary loss of agricultural lands during the construction period.	B	Permanent loss of employment and livelihoods can be caused by land acquisition due to power station construction and surrounding areas.	B
		The Bangladesh regulation stipulates that displaced persons are entitled to compensation for loss of land, property and standing crops in monetary terms at the fixed rates. It however does not compensate for loss of employment or livelihoods.		The Bangladesh regulation stipulates that displaced persons are entitled to compensation for loss of land, property and standing crops in monetary terms at the fixed rates. It however does not for loss of employment or livelihoods. The destitute, poor and landless farmers as agricultural laborers and wage laborers can become further distressed when job opportunities or at least skill training opportunities for them are not secured.	
3	The Poor, Indigenous and	There are no ethnic minorities living on site grounds.	B	There are no ethnic minorities living on site grounds.	B

No	Item	Impact during Construction Stage		Impact during Operation Stage	
	Ethnic People	The destitute, poor and landless farmers can lose their jobs when agricultural land is lost due to the construction of power station.		The destitute, poor and landless farmers can become further distressed when job opportunities or at least skill training opportunities for them are not secured.	
4	Misdistribution of Benefit and Loss	Disparity between the land owners and the rest (landless farmers, wage laborers etc.) can be widened.	B	Landless farmers and wage laborers can become further distressed and the disparity between the land owners and them can be widened when job opportunities and skill training opportunities are not given to them.	B
		In case an ample number of job opportunities and skill training opportunities are not provided to meet the demand, the disparity between those with such opportunities and those without may widen.		Local livelihoods can be affected and health hazards can be caused by land subsidence, smoke extraction, noise pollution, water pollution and water shortage in case the environmental management plan is not appropriately planned and implemented.	
5	Local Conflict of Interests	Local conflict can occur between the relocated people and the host community.	B	Local conflict can become constant between the relocated people and the host community.	B
		Excessive interventions by various stakeholders can trigger local conflict among residents, and the disruption of the local community.		-	
6	Gender	Appropriate information and knowledge may not be properly disseminated to the illiterate, particularly women.	B	Appropriate information and knowledge may not be properly disseminated to the illiterate, particularly women.	B
		Gender gaps can occur in job opportunities.			
7	Children's Rights	Child labor may occur due to their parents' loss of job.	C	Child labor may occur due to their parents' loss of job.	C
		Children may lose education opportunities.		Children may lose education opportunities.	
		Playgrounds for children may be lost.		Playgrounds for children may be lost.	
		Children may catch infectious diseases triggered by outsiders' entry into the community.		Children may catch infectious diseases triggered by outsiders' entry into the community.	
8	Land Use and Utilization of Local Resources	The present potential site that has been selected is away from the city center, residential areas, local markets, and protected forests. Land use and utilization of local resources however may be affected by the selected location and transmission line route.	C	The present potential site that has been selected is away from the city center, residential areas, local markets, and protected forests. Land use and utilization of local resources however may be affected by the selected location and transmission line route.	C
		Temporary loss of present land use pattern and/or economic infrastructure may occur.		Permanent loss of present land use pattern and/or economic infrastructure may occur.	

No	Item	Impact during Construction Stage		Impact during Operation Stage	
9	Social Institutions such as Social Infrastructure and Local Decision Making Institutions	Disruption of local community can be caused via a conflict of interests among politicians, government offices, and residents. It might cause a delay in procedures of land acquisition and resettlement.	B	-	C
10	Existing Social Infrastructure	Temporary loss of existing social infrastructure can occur due to the construction works.	C	Traffic to/from power station may become heavier. Social services may become insufficient.	C
11	Cultural Heritage	There is no cultural heritage existing in the site. A careful consideration however should be given to Seeta Kuthuri located near the site.	C	A careful consideration however should be given to Seeta Kuthuri located near the site.	C
		Landscape may be lost.		-	
12	Infectious Diseases such as HIV/AIDS	Infectious diseases may be spread via the construction workers into the community.	C	Infectious diseases may be spread via the operation workers into the community.	C

Source: PSMP Study Team

Mitigation measures on environmental pollution and natural environment are as found in AP Table 18-30.

AP Table 18-30 Mitigation Measures for Environmental Impact (B-K-D-P)

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
1	Air pollution	Countermeasures for air pollution by exhaust gas from transportation vehicles and construction machinery, and dust scattering from construction traffic are studied as in AP Table 18-67 and AP Table 18-68. As for the reduction of exhaust gas from transportation vehicles and construction machinery, idling stops and keeping proper exhaust condition by routine inspection of vehicles are judged to be applied. As for countermeasures for dust scattering, load cover, periodical vehicle washing and periodic peripheral road cleaning are judged to be applied.	AP table 18-62 shows countermeasures for NO_X, AP Table 18-63 shows countermeasures for SO_X, AP Table 18-64 shows countermeasures for Soot, and AP Table 18-66 shows countermeasures for coal dust. Besides conducting flue gas treatment by system including FGD, SCR, and ESP etc., mitigation of coal dust scattering is paid attention to. It is desirable to apply covered conveyer to prevent coal dust with coal transfer.
2	Water contamination	Countermeasures for water contamination due to excavation waste soil outflow are suitable via a fence installation utilizing sandbags etc. As for the effluent due to equipment washing, it is suitable to install a temporary precipitation tank and to drain the supernatant water. As for sewage, it is suitable to put up a septic tank. In addition, as for waste, water contamination can be prevented if waste treatment is conducted promptly and the waste is not left for long time.	There will be no warm effluent water generation since cooling tower or air cooled condenser will be adopted as cooling system. Plant effluent and sewage according to plant operations are discharged after waste water treatment including coagulating sedimentation, neutralization, and oil separation. Appropriate waste water facility capacity design is needed especially if air cooling tower is adopted as condensed cooling water blow effluent is a large amount.

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
3	Soil pollution	AP Table 18-69 shows the study result of countermeasures for soil pollution due to oil spillage from transportation vehicles and construction machinery. As a result, periodic maintenance implementation and conducting pre-operational machinery checks of machinery is judged important to be applied.	Oil and grease treatment procedures make it clear to prevent the spillage of lubrication oil or fuel oil. In addition, the management organization has been established to implement works according to designated procedures. And action procedures should be prepared in order to not to spread the adverse impact in case of an oil spillage occurrence. An oil dike has been set around the oil storage tank. It is necessary to dump ash properties in dumping site with water proof seat to prevent bottom sediment leakage out of the ash pond.
4	Noise and vibration	AP Table 18-70shows the study result of countermeasures for noise and vibration due to vibrations from transportation vehicles and construction machinery. As a result, leveling the construction process, using low-noise machinery, and lowering vehicle speed in residential areas are judged to be proper countermeasures. As for countermeasures for noise due to steam blowing during commissioning, the establishment of a work schedule without the blowing of steam during the night time is judged to be applied.	Developing the green belt along the site border is a costless and effective way to mitigate noise and vibrational impact. To avoid noise and vibration due to coal transportation, covered conveyor is desirable to use. If the boundary noise simulated in the detail EIA exceeds the noise regulations which is decided on each category (AP Table 18-8), the introduction of a green belt, sound insulating material and a sound insulating wall will be examined. B-K-D-P site is categorized in Residential Zone[1].
5	Offensive odor	Offensive odor caused by domestic waste decomposition from workers camps can be prevented by the separate collection and periodic disposal of waste.	NOx mitigation without SCR which uses ammonia is effective measure against offensive odor. When using ammonia, storage tanks, pipes, and valves must be inspected periodically. In addition to preventing operational mishaps, operations of the ammonia facility are to be managed by the person in charge. With regards to garbage treatment, it is suitable to dump it periodically and not have it in storage for a long time.
6	Waste	Reduction of waste amount can be conducted by establishing a waste management program including reduction, reuse and recycling. Implementation of a separate collection of waste, especially for paint sludge and batteries will be required. These items should be collected separately and disposed in designated areas.	Reduction of waste amount can be conducted by establishing a waste management program including reduction, reuse, and recycling. Because by-products due to plant operations are large amount, they should be recycled as much as possible. AP Table 18-71 shows examples of by-products recycling.
7	Ground subsidence	-	Ground subsidence should be prevented by adopting a cooling tower or air cooled condenser as a cooling system.

[1] Information source is DoE.

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
8	Biota and Ecosystem	Painted Roofed Turtle's nest building should be investigated in detail EIA. The nest relocation should be conducted when detected. Existence of Painted Roofed Turtle should be carefully paid attention to during construction stage and necessary protection actions should be conducted if detected. The site location and transmission line route should avoid protected forests.	Painted Roofed Turtle nest building should be investigated in detail EIA. The nest relocation should be conducted when detected. Existence of Painted Roofed Turtle should be carefully paid attention to during operation stage, and necessary protection actions should be conducted when detected
9	Water Usage	-	Air cooled condenser or cooling tower will be adopted as cooling system. Underground water drawdown for power plant operation should be prevented by using river water even if adopting the cooling tower. It is difficult to avoid a groundwater drawdown due to coal mine development. At the timing of pilot mining, mitigation measures should be confirmed of ground water drawdown by reinjection of drainage.
10	Accidents	A suitable OHS organization (policy, manual, announcement of policy, safety training and safety patrol) should be established to prevent accidents. It is also important to conduct quality control in construction work to prevent accidents during commissioning and operation period.	A suitable OHS organization (policy, manual, announcement of the policy and manuals, safety training, safety patrols) should be established for accident prevention. It is also important to conduct quality control in maintenance work in order to prevent accidents.
11	Global warming	-	It is estimated that approximately 3.54 million ton of CO_2 will be emitted from per 600MW unit per year through the operation of a coal-fired power plant. An ultra-super critical boiler with high thermal efficiency is being planned to be introduced into this master plan. Due to the introduction of a high efficiency unit, 1.07 million tons of CO_2 can be reduced per 600MW unit per year compared with the case of the Barapukuria class unit introduction. These figures are calculated based on designed value. It is important to keep designed output and efficiency from adequate O&M.

source： PSMP Study Team

18.3 Chittagong Site Information

18.3.1 Site Overview

The proposed Chittagong site (Chittagong South) is expected to be located on land covering several mauzas of Banskhali Upazilla under Chittagong District, on the southern mouth of the Sangu River pouring into the Bay of Bengal. It is 15 km away from Chittagong town in the south-eastern direction. A map showing the site has been given in APFig. 18-11.

Source： http://www.banglapedia.org/httpdocs/HT/B_0273.HTM (Accessed May 2010)

APFig. 18-11 Chittagong Site

(1) Health and Sanitation Environment

Local residents usually go to the village doctor for treatment. They also go to M.B.B.S. doctor and visit government hospitals and private hospitals for complicated health and medical treatment. They used to drink water from tube well, which is arsenic-free. They have slab latrines, brick-built latrines.

(2) Housing Condition

They have tin-made house ceilings. Some have walls constructed out of brick, tin, clay, bamboo and wood. Some of them have clay floors and brick-built floors. Some of them have separate kitchens.

(3) Income and Expenditure, and Job Opportunity

People are involved in businesses, farming, pulling rickshaws, daily labor and are also self-employed. Some households are associated with some Samity and five have already taken loans from samity for business purposes.

(4) Climate condition

APTable 18-31, APTable 18-32, APTable 18-33, APTable 18-34, APTable 18-35 and APTable 18-36 show the monthly maximum and minimum air temperature, monthly precipitation, monthly maximum and minimum relative humidity, and monthly average wind speed and prevailing wind direction at Chittagong (Patenga) station from 2000 to 2002 and from 2008 to 2009. Colored cell in each table indicates maximum and minimum value.

As for the air temperature, it is as hot as the maximum air temperature is over 28°C throughout the year. The minimum air temperature is under 20°C from November to March. The monthly maximum temperature is 39.5°C in May 2001 and the monthly minimum temperature is 9.0 °C in January 2001.

The annual precipitation reaches a level of 2,100mm to 3,500mm. The precipitation is at its most concentrated in the months from May to September. Conversely, there is no rainfall in some of the months from November to March. As described above, there is a marked difference in the rainfall between the rainy season and the dry season.

As for the humidity, it is relatively high, the monthly minimum relative humidity exceeds 50% in the period from May to October

As for the wind speed and wind direction, there are large influences from monsoons. It is clear that the wind blows from north from November to January, and the wind blows from south or southeast from April to September. The wind direction fluctuated between February and March. The average wind speed is not high, below 5m/s throughout a year. However, the Chittagong port experienced 12 times as many major cyclonic storms in the past 50 years. The maximum wind speed of the major cyclonic storm in 1991 was 62.5m/s.

APTable 18-66 shows a past record of the Major Cyclonic storms in Bangladesh.

APTable 18-31 Monthly maximum air temperature at Chittagong

Unit: °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	30.2	30.6	36	34.9	35	35.5	35	35	34.4	35.8	34	29.6
2001	30	32.4	36.7	38.5	39.5	33	33.3	34.5	36	36	34	30.8
2002	31.2	35.2	37.2	34.5	35.4	33.5	33	33.5	35.2	35.4	35	30.6
2008	28	29.5	33.6	34	34.3	34.2	32.4	33.3	33.5	34	31.7	30.5
2009	29.5	31	34	34.3	35	34.2	34.5	—	—	—	—	—

Source： BMD, Dhaka

APTable 18-32 Monthly minimum air temperature at Chittagong

Unit: °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	12	13	17	19.4	19.8	21.4	21.5	22.3	22	21.5	15.6	13
2001	9	11.6	14	22.5	21.2	22.8	25.5	24.5	22.8	22.8	16.5	14.2
2002	12.5	12.5	17.2	17.3	21	23	24	24	22.5	20.5	17.5	12.2
2008	12.6	11.8	17.6	20.5	22.1	24.2	24	24.2	23.4	20.6	17	14.5
2009	12.8	14	18.2	18.8	21.4	22.2	24	—	—	—	—	—

Source: BMD, Dhaka

APTable 18-33 Monthly precipitation at Chittagong (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
2000	17	0	16	108	748	643	713	689	138	416	15	0	3503
2001	0	12	1	41	423	—	385	238	224	242	81	0	—
2002	1	0	70	67	453	366	920	456	145	129	128	10	2745
2008	64	7	6	1	244	538	963	757	250	171	31	0	3032
2009	0	2	3	114	373	434	1244	—	—	—	—	—	—

Source： BMD, Dhaka

APTable 18-34 Monthly maximum relative humidity at Chittagong (%)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	100	98	98	98	98	100	100	100	100	100	100	100
2001	100	100	100	93	94	98	96	96	100	100	100	100
2002	91	100	93	98	97	97	95	96	96	95	93	—
2008	100	100	100	98	96	98	100	100	100	100	98	100
2009	100	100	98	97	98	97	100	—	—	—	—	—

Source： BMD, Dhaka

APTable 18-35 Monthly minimum relative humidity at Chittagong (%)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	23	26	28	48	45	59	64	57	60	61	41	38
2001	31	22	16	34	46	54	62	60	56	59	33	29
2002	29	32	23	34	54	55	57	63	58	43	45	36
2008	31	20	31	26	40	60	67	69	52	48	41	44
2009	20	25	16	47	43	59	60	—	—	—	—	—

Source： BMD, Dhaka

APTable 18-36 Monthly average wind speed (m/s) and prevailing wind direction at Chittagong

Year	Jan		Feb		Mar		Apr		May		Jun	
	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir
2000	1.7	N	2.1	N	3.8	S	4.9	S	2.7	SE	4.0	S
2001	1.4	N	4.2	S	2.5	W	4.3	S	2.7	SE	4.2	SE
2002	2.2	NE	3.3	W	3.2	W	4.4	S	5.2	S	3.6	SE
2008	2.7	N	2.9	N	2.9	WSW	2.7	S	3.7	SSE	4.4	SSE
2009	3.2	WSW	3.9	WSW	3.2	WSW	4.4	SSE	3.7	SSE	3.3	E
Year	Jul		Aug		Sep		Oct		Nov		Dec	
	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir
2000	4.1	SSE	2.7	SE	3	S	2.3	W	1.7	NNE	1.7	N
2001	5.3	S	3.4	SE	3.1	SE	2.7	W	2.6	NNE	2.1	NE
2002	4.3	S	4.5	S	2.7	SE	2.7	WNW	2.2	NE	2.1	NE
2008	4.4	SE	4.3	ESE	3.1	E	2.5	NNW	2.6	NNW	2.5	NNW
2009	4.5	E	-	-	-	-	-	-	-	-	-	-

Source： BMD, Dhaka

(5) Topography and Underground water

Bangladesh's topography and earthquake situation of Bangladesh is shown in APFig. 18-5 and APTable 18-65. The land form around the proposed site is almost a flat land with some high spots. The Chittagong site area is located in Zone II as seismic zones.

(a) Geology and water quality

Geological data has been obtained from boring survey results conducted at our near proposed site by the DPHE Territorial Division. The boring survey conducted in 2008 in the Deotala village under the Paraikora Union of Anowara Upazilla, which is close to the proposed site. APTable 18-37 and APTable 18-38 shows the result of the boring survey. The drilling depth was 208.23m. The results indicate that there is an Aquifer under 150m in depth. In addition, as for water quality, the iron concentration present exceeds the Bangladeshi Standard for drinking water, 1.0mg/l out of 3 measured items.

APTable 18-37 Boring result in Anowara (1)

Depth to Top (m)	Depth to Base (m)	Lithologic Description	
0.00	20.00	Silty clay	Aquitard 1
20.00	60.00	Silty	
60.00	100.00	Silty clay	
100.00	150.00	Silty	
150.00	180.00	Fine to Medium Sand	Aquifer 1
180.00	200.00	Medium to Coarse Sand	
200.00	208.23	Coarse Sand with gravel	

Source: DPHE

APTable 18-38 Boring result in Anowara (2)

Sl. No.	Parameters	Unit	Concentration Present	Bangladesh Standard for Drinking water
1	Iron, Fe	mg/L	3.0	0.3 – 1.00
2	Arsenic, As	ppb	0.0 (mg/l)	50
3	Chloride	mg/L	200	150 – 600

Source: DPHE

(6) Ecological situation

Data on the ecological situation has been obtained from the Department of Botany and Zoology of Dhaka University, Respective Upazila offices and local consultant.

(a) Terrestrial Communities

1) Flora

The area is well vegetated with planted trees. 75 species of the plants were found around the site. According to the Red List of the International Union for Conservation of Nature (IUCN), 2 species of them are identified as Least Concern (LC). A list of plants near the proposed site is provided in APTable 18-39.

APTable 18-39 List of animals found around Chittagong site

No.	Local Name	English Name	Scientific Name	IUCN status
1	Ada	Ginger	*Zingiber officinale*	--
2	Am	Mango	*Mangifera indica L.* (Anacard)	--
3	Arjun		*Terminalia arjuna*	--
4	Ashoke		*Saraca asoca*	--

No.	Local Name	English Name	Scientific Name	IUCN status
5	Ashwagondha		*Withania somniferum*	--
6	Babla		*Acacia nilotica*	--
7	Bansh pata		*Podocarpus nerifolia*	--
8	Basak		*Adhatoda zeylanica*	--
9	Bash	Bamboo	*Podocarpus nebifolia*	LC
10	Beet	Can Tree	*Beta vulgaris*	--
11	Bel	Indian apple	*Aegle marmelos* (*L*).	--
12	Beli		*Jasmin sambac* Ait (Olea)	--
13	Bokul	(Mimusops Elengi)	*Mimusops elengi L*	--
14	Boroi	Indian Jujube	*Zizyphus rugosa Lam*	--
15	Bot	Banayan tree	*Ficus benghalensis L.* (Mora)	--
16	Chameli		*Jasminum grandiflorum L.* (Oleace)	--
17	Chandan	Sandal	*Santalum album L.* (Santalaceae)	--
18	Dalim	Pomegranate	*Punica granatum L.*	--
19	Debdaru	Pine	*Polyalthia longifolia*	--
20	Dhol Kalmi		*Ipomoea fistolosa*	--
21	Dhutra	Thorn Apple	*Barringtonia acutangula*	--
22	Dumur		*Ficus hispida*	--
23	Gashpul		*Zephyranthes tubispatha Herb.* (Amaryllidaceae)	--
24	Golap	Rose	*Rosa centifolia L.* (Rosaceae)	--
25	Halencha		*(Altermanthere philoxeroides)*	--
26	Hyacinth		*(Eichhomia crassipes)*	--
27	Ipil Ipil	Ipil Ipil	*Leucaena Latisiliqua*	--
28	Jaba		*Hibiscus rosa sinensis L.* (Malvaceae)	--
29	Jam	Black Berry	*Syzygium cumini skiel.* (Myrtaceae)	--
30	Jambura	Citron	*Citrus grandis*	--
31	Jamrul	Star apple	*Syzygium samraogense* (*Bl.*)	--
32	Jhau	Poplar	*Thysanolaena maxima*	--
33	Kachu		*Colocasia esculenta* (*L.*)	--
34	Kadbel	Wood Apple	*Feronia limonia* (*L.*)	--
35	Kalmi		*(lpomoea aquatica)*	--
36	Kalo Dhutra		*Datura metel*	--
37	Kamranga	Carambola	*Averrhoa carambola*	--
38	Kathal	Jack Fruit	*Artocarpus heterphyllus Lamk*	--
39	Khejur	Date Plam	*Phoenix sylvestris*	--
40	Kola	Banana	*Musa Paradisica*	--
41	Koroi		*Derris robusta Benth.*	--
42	Kowa nim		*Melia sempervirens*	--
43	Krishnachura	Delonix regia	*Delonix regia* (*Boj.*) *Raf.* (Leguminosae)	--
44	Lazzaboti		*M. pudica L*	--
45	Lebo	Lemon	*Citrus aurantifolia*	--
46	Madar		*Erythriana variegata L.* var. *orientalis Merr.*	--
47	Man Kochu		*Alocasia indica*	--
48	Mankata		*Xeromphis spinosa*	--
49	Mehedi		*Lawsonia inermis*	--
50	Mehogoni		*Swietenia mahagoni*	--
51	Methi		*Trigonella foenum-graecum*	--
52	Muktajhuri		*Abroma augusta*	--

No.	Local Name	English Name	Scientific Name	IUCN status
53	Narikel	Coconut	*Cocos nucifers L.* (Palmae)	--
54	Neem		*Azadirachta indica*	--
55	Pakur		*Ficus Infectoria*	--
56	Patabahar	Patabahar	*Codiaeum Variegateum*	--
57	Pepe	Papaya	*Carica papaya L* (caricaceae)	--
58	Peyara	Guava	*Psidium Guajava (L)* Bat. (Myrtaceae)	--
59	Pui Shak		*Basella alba L.*	--
60	Radhachura		*Caesalpinia pulcherrima* Sw. (Leguminosae)	--
61	Rain tree		*Samea Samon*	--
62	Rangan		*Ixora rosea Will* (Rubiceae)	--
63	Rashun	Garlic	*Allium sativum*	--
64	Sajina		*Moringa Oleifera Lamk.* (Moringa)	--
65	Shal		*Shorea robusta*	LC
66	Shatamuli		*Asparagus racemosus*	--
67	Shimul		*Bombax ceiba L.* (Bombacaceae)	--
68	Shonali Lota			--
69	Sofeda	Sapodilla	*Achras Manilkara*	--
70	Supari	Colloq		--
71	Tal	Palm Tree	*Borassus flabellifer L.* (Palmae)	--
72	Tentul	Tamarind	*Tamarindus indica*	--
73	Thankuni		*Centella asiatica*	--
74	Topa pana		*(Pistia stratiotes)*	--
75	Ulatkambal		*Abroma augusta*	--

Source : PSMP Study Team

2) Fauna

The animals found around the site include a total of 73 species - 24 species of mammalian animals, 39 species of birds, 8 species of reptiles and 2 species of amphibians. Out of those animals on the Red List of the International Union for Conservation of Nature (IUCN) there are 8 species of LC, 1 species NT, 1 species of VU[1], 3 species of EN, 1 species of CR. Special care is needed for the protection of the Panited Roofed Turtle (CR) and Fishing Cat, Ganges River dolphin, Blue Whale (ER). APTable 18-40 shows a list of all the animals found around the Chittagong site.

APTable 18-40 List of animals found around Chittagong site

No.	Local Name	English Name	Scientific Name	IUCN Global Status
MAMMALS				
1	Badur/Daini	False Vampire	*Megaderma Lyra*	--
2	Bagdash	Large Indian civet	*Viverra Zibetha*	--
3	Bara Benji	Common Mongoose	*Herpestes edwardsi*	--
4	Bhera	Sheep	*Bovidae : Ovis*	--
5	Biral	Cat	*Felis : Catus*	--
6	Bon Biral/Wab	Jungal Cat/Swamp Cat	*Felis chaus*	--
7	Indur	Common House Rat	*Rattus rattus*	--
8	Gadha	Ass	--	--
9	Gecho Chucho	Common Tree shrew	*Tupaiaglis*	--
10	Ghora	Horse	*Equus caballus*	--

[1] Vulnerable

No.	Local Name	English Name	Scientific Name	IUCN Global Status
11	Goru	Cow	--	--
12	Kathbirali	Malayan Giant Squirrel	*Ratufa bicolor*	--
13	Khek Shiyal	Bengol Fox/Indian Fox	*Vulpes bengalensis*	--
14	Khargosh/Shashak	Rufous-tailed Hare	*Lepus nigricollis*	--
15	Kukur	Dog	*Cannis Familiaris*	--
16	Mecho Biral/Mecho Bagh	Fishing cat	*Prionailurus viverrinus*	EN
17	Mohish	Bafallow	--	--
18	Sagol	Goat	*Capra Hircus*	--
19	Shojaru	Indian crested Porcupine	*Hystrix Indica*	LC
20	Shesu	Ganges River dolphin	*Platanista gangetica gangetica*	EN
21	Shial	Jackal	*Canis Aureus Linnaeus*	--
22	Shukor	Pig	--	--
23	Timi	Blue Whale	*Balaenoptera musculus*	EN
24	Uod Biral	Oriental Small-clawed Otter	*Aonyx cinerea*	VU
BIRDS				
1	Babui-Batan	Small Pratincole	*Glareola Lactea*	--
2	Bali Hash	--	--	--
3	Banspaati	Green Bee-eater	*merops orientalis*	--
4	Baj	Crested Groshawk	*Accipiter trivirgatus*	--
5	Bok	Intermediate Egret	*Mesophoyx intermedia*	--
6	Bulbuli	Red-vented Bulbul	*Pycnonotus cafer*	--
7	Hutum Pecha	Rock Eagle Owl	*Bubo bengalensis*	--
8	Chil	Pariah Kite	*Passer domesticus*	--
9	Chorai	House Sparrow	*Passer Domesticus*	--
10	Dahuk	White Breasted water hen	*Amaurornis phoenicurus*	LC
11	Doyel	Magpie Robin	*Butastur teesa*	--
12	Eagal	Bazzard -Eagal	*Butastur teesa*	LC
13	Fingey	Black Drongo	*Dicrurus macrocercus*	LC
14	Gang Shalik	Bank Myna	*Acridotheres ginginianus*	--
15	Ghughu	Oriental Turtle Dove	*Streptopelia orientails*	--
16	Gung Chil	Whiskered Tern	*Chlidonias hybridus*	--
17	Hash	Duck	*Anatidae Anseriformes*	--
18	Hot-titi	River Lapwing	*Vanellus duvaucelii*	--
19	Jalali Kobutor	Rock Pigon	*Columba Livia*	LC
20	Kak	House Crow	*Corvus splendens*	--
21	Kana Bok	Indian Pond Heron	*Ardeola grayii*	--
22	Kat Tokra	Woodpecker	*Picoides pubescens*	--
23	Kokil	Asian Koel	*Eudynamys scolopacea*	--
24	Konch Bak.	Pond Heron.	*Ardeola grayii*	--
25	Machhranga	White Throated	*Halcyn smyrensis*	--

No.	Local Name	English Name	Scientific Name	IUCN Global Status
		Kingfisher		
26	Mohanchura	Hoopoe	*Upupa epops*	--
27	Moutusi	Purple rumped Sunbird	*Nectarinia zeylonica*	--
28	Paira	Pigeon	*Columba livia domestica*	--
29	Pankouri	Great Cormorant	*Phalacrocorax carbo*	--
30	Pencha	Sport-bellied Owl	*Bubo nipalensis*	--
31	Rajhans	Bar-headed Goose	*Anser indicus*	LC
32	Shalik	Indian mynah	--	--
33	Shamuk Bhanga, Shamuk Khol.	Open Bill Stork	*Anastomus oscitans*	--
34	Shonkho Chil	Brammoni Kite	*Haliastur Indus*	--
35	Sipahi Bulbuli	Red –whiskered Bulbul	*Pycnonotus jocosus*	--
36	Baro Tia	Large Indian Parakeet	*Psittacula eupatria*	--
37	Kalim	Purple Moorhen	*Porphyrio porphyrio*	--
38	Tuntuni	Tailor bird	*Orthotomus sutorius*	--
REPTILE				
1	Tiktiki	HouseLizard	*Hemidactylus bowringii*	--
2	Ajogor	Rock Python	*Pyhon molurus*	NT
3	Kasim	Painted Roofed Turtle	*Kachuga Kachuga*	CR
4	Gui Shap	Bengal Monitor/ Grey Monitor Lizard	*Varanus bengalensis*	--
5	Sabuj Dhora	Green Keel back Snake	*Macropisthodon plumbicolor*	--
6	Kalo Mete Dhora Shap	Dark-Bellied Marsh Snake	*Xenochrophis cersogaster*	--
7	Gokhra Shap	Monocellate Cobra	*Naja kaouthia*	--
8	Raj Gokhra	King Cobra	*Ophiophagus hannah*	--
AMPHIBIAN				
1	Beng	Frog	*Anura : Ranidae*	--
2	Geso Beng	Canyon treefrog	*Hyla arenicolor Cope*	--

Source : PSMP Study Team

(b) Aquatic Communities

1) Aquatic Flora

The freshwater dependent plants such as helencha (Altermanthere philoxeroides), kalmi (Ipomoea aquatica), daokalmi (Ipomoea fistulosa), ichadal (Potamo seton) and water hyacinth (Eichhomia crassipes) are common among the ponds, canals and rivers near the Chittagong site. The Khuda pana (Lemna minor), topapana, (Pistia stratiotes) and chaicha (Saipus articulatus) are also common.

2) Aquatic Fauna

The fishes found around the site include a total of 56 species of river dwellers and 15 species of sea dwellers. Out of those animals on the Red List of the International Union for Conservation of Nature (IUCN) contain 1 species of NT. APTable 18-41 shows confirmed species of fishes.

APTable 18-41 List of Fishes Available Chittagong site.

No.	Local Name	English Name	Scientific Name	IUCN Global Status
RIVER FISH				
1	Ayer	Long Whiskered cat fish	*Aorichthys aor*	--
2	Bacha	(Batchwa Bacha)	*Eutropicchthys vhacha*	--
3	Baghair	Gangetic goonch	*Bagarius Yarrellii sykes*	--
4	Bamos / Baobaim	(Indian Long Fin Eel)	*Anguilla bengalensis*	--
5	Banshpata	Sind danio	*Devario devario*	--
6	Bata	Giantscale Mullet	*Lizamelinoptera*	--
7	Bele	Scribbled goby	*Awaous grammepomus*	--
8	Bhagna	--	--	--
9	Bhangon Bata/Bata	(Bata labeo)	*Labeo Bata*	--
10	Bhol/Bol	Indian Trout	*Raiamas bola*	--
11	Chanda	Elongate glass perchlet	*Chanda nama*	--
12	Cheka / Chega (Indian Chaca)	Indian Chaca	*Chaca chaca*	--
13	Chitol	Humped Featherback	*Nototeruse chitala*	--
14	Darkina	Flying barb	*Esomus Danricus*	--
15	Dhela/ Dipali/ ketti(Cotio)	Cotio	*Osteobrama cotio*	--
16	Ek Thota	Wrestling halfbeak	*Dermogenys pusillus*	--
17	Elong/Sefatia	(Bengal barb)	*Bengala Elanga*	--
18	Foli	Grey Featherback	*Notopterus notopterus*	--
19	Ghaura	(Gaura Bacha)	*Clapisoma gaura*	--
20	Ghonia/Gonainya	(Kuria baleo)	*Labeo gonius*	--
21	Gojar/ Gojal	Great snake head	*Channa marulius*	--
22	Golsa/ Golsa Tengra	Gangetic Mystus	*Mystus cavasius*	--
23	Guijja Air	Giant River Cat Fish	*Aorichthys (Mystus) seenghala*	--
24	Ilish	Hilsa	*Tenualosa ilisha*	--
25	Kajli / Banshpata	Jamua ailia	*Ailia punctata*	--
26	Kala Bata	(Gan Getic latia)	*Crossocheilus latius*	--
27	Kalibaush (kalbasu)	Orange-fin labeo	*Labeo calbasu*	--
28	Kani Pabda / Boali Pabda	(Indian Butter cat fish)	*Ompak bimaculatus*	--
29	Kash Khaira	(Indian Glass barb)	*Chela laubuca*	--
30	Katla	Catla	*Catla Cattla*	--
31	Khailsha	Banded gourami	*Colisa fasciata*	--
32	Khorshola		*Labeo dero*	--
33	Kucha / Kuchia	Gangetic Mudeel Cuchia	*Monopterus cuchia*	--
34	Meni / Bheda/ Rayan/ Bheduri	Mottled nandus, mud perch	*Nandus nandus*	--
35	Mrigal	Mrigal	*Cirrhinus mrigala*	--
36	Nandina / Nandil	(Nandi Labeo)	*Labeo nondina*	--

No.	Local Name	English Name	Scientific Name	IUCN Global Status
37	Napit Koi/ Koi Banedi	Dwarf chemel confish Badis	*Badis badis*	--
38	Neftani	Indian Paradise Fish	*Clenops nobolis*	--
39	Pabda	Pabo Cat fish	*Ompok pabo*	--
40	Pungash (River)	Yellowtail catfish	*Pangasius pangasius*	--
41	Puti	Fry	*Puntius puntio (Hamilton)*	--
42	Raikh bata	---	*Rhinomugil corsula*	--
43	Ranga Chanda / Lal Chanda	(Indian Glassy Fish)	*Pseudembassis ranga*	--
44	Rani / Beti	(Necktie Loach)	*Batia Dario*	--
45	Rani/ Putul /Beti	(Y-Loach)	*Botia Iohachata Chaudhuri*	--
46	Rui	Rohu	*Labeo rohita*	--
47	Sarputi / Swarnaputi	(Olive barb)	*Puntius sarana*	--
48	Shal baim/ Baim Bam	Tire trach spinyeel	*Mastecembelus armatus*	--
49	Shillong	Silondia V acha	*Silonla Silondia*	--
50	Shol	Banded Snakehead	*Channa striatus*	--
51	Sisor / Chenua	Sisor cat fish	*Sisor rhabdophorus*	--
52	Tara Baim	One Strip spiny eel	*Macroganthus aral*	--
53	Tatkini/Bata/Bangla	Reba carp	*Cirrhinuss reba*	--
54	Telo Taki / Rana Cheng/ Ganchua	Asiatic snake head	*Channa Orientalis*	--
55	Tengra	Assamese Batasio	*Batasio Tengana*	--
56	Titputi	(Ticto barb)	*Puntias Ticto*	--
Sea Fish				
1	Bagair	Gangetic Goonch	*Bagarius yarrelli*	--
2	Chingri	Shimp	--	--
3	Choto Shark	Small Shark Fish	--	--
4	Fasha	Fasha Fish	--	--
5	Hangar	Whitetip reef shark	*Triaenodon obesus (Ruppell)*	NT
6	Ilish	Hilsa shad	*Hilsa ilisha*	--
7	Jhinuk	--	--	--
8	Kakra	Crabs	--	--
9	Korat	Karat Fish	--	--
10	Nuna Bailla	Bumblebee Goby	*Brachygobius nunus*	--
11	Nuna Tangra	Long whiskers catfish	*Mystus gulio*	--
12	Poa	Pama croaker	*Otolithoides pama*	--
13	Potka	Green pufferfish	*Tetraodon fluviatilis*	--
14	Rita	Rita	*Rita Rita*	--
15	Rup Chanda	Elongate glass perchlet	*Chanda nama*	--

Source： PSMP Study Team

18.3.2 Detailed Information on Meetings with Local Stakeholders

APTable 18-42 Profile of Household Interviewees (near Chittagong Site)

No	Sex	Age	Village	Distance from Power Plant	Education	Occupation	Household Monthly Income
1	F	35	Gobadiya	400m	Nil	Agriculture	7,500
2	F	30	Dud Kumra	250m	Nil	Business	4,000
3	M	27	Dud Kumra	300m	S.S.C	Business	8,000
4	F	35	Gobadiya	500m	Nil	Riksha Puller	3,000
5	F	30	Gobadiya	500m	Nil	Riksha Puller	4,000
6	F	20	Dud Kumra	300m	Class V	Business	4,000
7	M	30	Dud Kumra	300m	S.S.C	Business	10,000
8	F	27	Dud Kumra	300m	Nil	Day labor	4,000
9	F	30	Dud Kumra	300m	Class V	Day labor	5,000
10	M	55	Dud Kumra	200m	Class V	Agriculture	4,000
11	M	38	Dud Kumra	250m	H.S.C	Service	70000
12	M		Gobadiya	300m	Class VIII	Service	6,000
13	M		Gobadiya	350m	Class IV	Business	6,000
14	M	23	Gobadiya	400m	Class VII	Business	6,000
15	M	35	Gobadiya	450m	S.S.C	Business	6,000

Source: Household interview

APTable 18-43 Profile of FGD Participants (near Chittagong Site)

No	Age	Education	Occupation	Household Monthly Income
Male Participants				
1	75	Nil	Rickshaw Puller	3,000
2	54	VI	Job	8,000
3	61	VIII	Unemployed	10,000
4	28	Only Signature	Business	3,000
5	32	VI	Business	6,000
6	37	V	Electrician	5,000
7	36	Only Signature	Rickshaw Puller	4,000
8	57	VIII	Business	8,000
Female Participants				
1	26	V	Housewife	4,000
2	60	None	Housewife	4,000

No	Age	Education	Occupation	Household Monthly Income
3	50	None	Housewife	10,000
4	18	IX	Student	5,000
5	25	None	Housewife	5,000
6	27	S.S.C.	Housewife	6,000

* 'business' describes shop running, tea store etc.

Source: Focus group discussions

APTable 18-44 Participants Profile Local Stakeholder Meeting (Chittagong Site)

No.	Designation and Organization
Participants from Chittagong Site	
1	Chairman, Banskhali Upazila
2	Banskhali (Villager)
3	Banskhali (Villager)
4	Banskhali (Villager)
5	UNO, Banskhali
6	Principal, Banskhali
7	Banskhali (Villager)
8	UAO, Banskhali
9	SUFO (DOF), Banskhali
10	Chairman, 3No. Khankhanabad
GOB	
1	Additional Secretary
2	Asst. Chief, Power Division
3	EGCB Ltd.
4	Assistant Engineer, Design & Inspection-I, BPDB
PSMP Study Team and Local Consultant	
1	PSMP Study Team
2	PSMP Study Team
3	EAL, Executive Director
4	EAL, Engineer
5	EAL, Social Specialist
6	EAL
7	EAL

Source: PSMP Study Team

18.3.3 Problem Analysis and Problem Solution

Problem analysis on environmental pollution and natural environment is as found in APTable 18-48.

AP Table 18-45 Problem Analysis: Assessment Results on Environmental Impact (Chittagong)

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
1	Air Pollution	The occurrence of air pollution is possible due to exhausted gas from transportation vehicles and construction machinery. And dust particles may be scattered near the construction site and construction vehicle road.	B	Planned coal-fired power plant burns domestic coal which is mined from the adjacent coal mine as main fuel. And it burns light oil as auxiliary fuel (fuel for starting up). NO_X, SO_X and soot will be generated due to the combustion of these fuels. And coal transportation may generate coal dust.	A

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
2	Water Contamination	Rainfall drainage equipment washing drainage and sewage will be generated during the construction work. If waste management isn't appropriate, effluent from waste may be generated.	B	Thermal discharge will be produced when using river water as cooling water. Plant effluent and domestic waste water will be generated through plant operations. If a cooling tower is used, a large amount of condensed cooling water effluent will be generated. If waste management isn't appropriate, effluents from waste may be generated.	A
3	Soil pollution	Soil pollution can occur due to lubrication oil or fuel oil spillage generated by transportation vehicles and construction machinery.	B	Soil pollution can occur due to lubrication oil or fuel oil spillage for unit operations.	B
4	Bottom Sediment	There is a possibility of bottom sediment if effluent due to construction work flow out to the Bay of Bengal or the Sangu River.	B	There is a possibility of bottom sediment if the plant effluent and domestic waste water discharge after inadequate treatment. If an ash pond is used, it is necessary to pay attention to the bottom sediment of the pond.	B
5	Noise and vibration	Noise and vibration arise due to the vibration of transportation vehicles and construction machinery (see AP Table 18-61). And steam blowing during commissioning will generate significant noise.	A	Noise and vibration will be generated through the operation of the power facilities. If a cooling tower is used, there is significant noise and vibration from the cooling fan of the tower. During periodic inspections, the noise and vibration arise due to the vibration of the transportation vehicle and construction machinery.	A
6	Offensive Odor	If domestic waste management isn't applicable to workers' stations, offensive odors may be generated due to waste decomposition.	B	Ammonia, which is used at SCR leaks, may be the source of offensive odor. If the domestic waste management isn't applicable to the workers' stations for maintenance work etc., offensive odor may be generated due to waste decomposition.	B
7	Waste	Construction work will generate metal chips, waste plastic, wood shavings, waste glass and waste oil. And domestic waste such as cans, bottles, and food residue will be generated from construction workers' stations.	B	By-products through the operation of coal-fired power plant are coal ash, gypsum (if limestone-gypsum FGD is used), sludge from waste water treatment facility, and cooling water canal fouling (if the river water or sea water is used for the cooling water). These by-products will be wasted if they are discarded without recycling. Maintenance work will generate metal chips, waste plastic, wood shavings, waste glass and waste oil. And domestic waste such as cans, bottles, and food residue will be generated from workers' stations.	A
8	Ground Subsidence	Ground subsidence will not occur since water will be taken from the Sangu River to use for construction works, not from the underground water.	C	Ground subsidence will not occur since cooling water and makeup water will be taken from the Sangu River, not from the underground water.	C

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
9	Geographical Feature	There is little impact since the proposed site is plain and doesn't possess any outstanding geographical features.	C	There is little impact since the proposed site is plain and doesn't have any outstanding geographical features.	C
10	Biota and Ecosystem	Though the proposed site and its surrounding area have already been converted into the agricultural land, there is a possibility of Painted Roofed Turtle which is categorized CR in IUCN Red List and Fishing Cat which is categorized EN in IUCN Red List existing around the site. Around sea area, Ganges River Dolphin and Blue Whale which are categorized EN in IUCN Red List may Exist.	B	Though the proposed site and its surrounding area have already been converted into the agricultural land, there is a possibility of Painted Roofed Turtle which is categorized CR in IUCN Red List and Fishing Cat which is categorized EN in IUCN Red List existing around the site. Around sea area, Ganges River Dolphin and Blue Whale which are categorized EN in IUCN Red List may exist.	B
11	Water Usage	There is no impact to water usage as the Sangu River water is available as water for construction work.	C	There is no impact to water usage as the Sangu River water is available as cooling water and makeup water of power plant.	C
12	Accident	Construction accidents can occur due to the oversights of health and safety management during construction work. It is necessary to pay attention especially to falling accidents from high altitude locations, road accidents of construction vehicles and electrical accidents.	A	Fires due to oil spillage or instantaneous combustion of coal, accidents due to leakage or spillage of chemicals like caustic soda and sulfuric acid, and accidents or incidents involving maintenance work can occur.	B
13	Global Warming	Transportation vehicles and construction machinery will exhaust CO_2.	C	It is estimated that approximately 3.79 million ton of CO_2 will be exhausted from per 600MW unit per year through the operations of coal-fired power plant. In light of its cost-effectiveness, brown coal will be imported. Brown coal emits more CO_2 than domestic coal which has been classified as bituminous coal.	B

Source： PSMP Study Team

Social impact assessment results can be found in AP Table 18-46

AP Table 18-46 Problem Analysis: Assessment Results on Social Impact (Chittagong Site)

No	Item	Impact during Construction Stage		Impact during Operation Stage	
1	Involuntary Resettlement	Land acquisition is anticipated for 1,000 acres that require approximately 1,000 households to be relocated.	A	Damage to houses and health hazards can be caused by smoke extraction, noise pollution, water pollution and land subsidence when the resettlement action plan is not appropriately planned and implemented. Political intervention and/or local movement against the operation of power stations can occur when adverse impacts on local residents' lives and livelihoods are severe.	B

No	Item	Impact during Construction Stage		Impact during Operation Stage	
2	Local Economy such as Employment and Livelihood etc.	Residents around the site are mainly involved in the secondary and the tertiary industries. There are much more seaport workers than there are agricultural laborers. The temporary loss of agricultural lands can cause loss of employment and livelihoods, particularly among agricultural laborers during the construction period.	C	Land acquisition for power station operations and surrounding areas can cause permanent loss of employment and livelihoods, particularly among agricultural laborers. In case water treatment is not properly conducted, adverse impacts may occur to local fishing industry.	C
		The Bangladesh regulation stipulates that displaced persons are entitled to compensation for loss of land, property and standing crops in monetary terms at the fixed rates. It however does not compensate for the loss of employment or livelihoods.		The Bangladesh regulation stipulates that displaced persons are entitled to compensation for loss of land, property and standing crops in monetary terms at the fixed rates. It however does not compensate for the loss of employment or livelihoods. The destitute and poor, particularly landless farmers can become further distressed when job opportunities or at the least, skill training opportunities for them are not secured.	
3	The Poor, Indigenous and Ethnic People	There are no ethnic people living in the site.	C	There are no ethnic people living in the site.	C
		The destitute, poor and landless farmers can lose their jobs when agricultural land is lost due to the construction of power station.		The destitute, poor and landless farmers can become further distressed when job opportunities or at the least skill training opportunities for them are not secured.	
4	Misdistribution of Benefit and Loss	Disparity between land owners and the rest (landless farmers, wage laborers etc.) may widen.	C	Landless farmers and wage laborers can become further distressed and the disparity between land owners and them can be widened when job opportunities and skill training opportunities are not provided.	C
		In case an ample number of job opportunities and skill training opportunities are not provided to meet the demand, the disparity between those with such opportunities and those without can be widened.		Local livelihoods can be affected and health hazards can be caused by land subsidence, smoke extraction, noise pollution, water pollution and water shortages when the environmental management plan is not appropriately planned and implemented.	
5	Local Conflict of Interests	Local conflict can occur between the relocated people and the host community.	C	Local conflict can become constant between the relocated people and the host community.	C
		Excessive interventions by various stakeholders can trigger local conflict among residents, and the disruption of the local community.			
6	Gender	Appropriate information and knowledge may not be properly communicated to the illiterate, particularly women.	C	Appropriate information and knowledge may not be properly communicated to the illiterate, particularly women.	C
		Gender gaps can occur in terms of job opportunities.			

No	Item	Impact during Construction Stage		Impact during Operation Stage	
7	Children's Rights	Child labor may occur due to their parents' loss of job.	C	Child labor may occur due to their parents' loss of job.	C
		Children may lose education opportunities.		Children may lose education opportunities.	
		Playgrounds for children may be lost.		Playgrounds for children may be lost.	
		Children may catch infectious diseases triggered by outsiders' entry into the community.		Children may catch infectious diseases triggered by outsiders' entry into the community.	
8	Land Use and Utilization of Local Resources	The present potential site that has been selected is away from the city center, residential area, local market, and the protected forest.	C	The present potential site that has been selected is away from the city center, residential area, local market, and the protected forest.	C
		Temporary loss of present land use patterns and/or economic infrastructure may occur.		Permanent loss of present land use patterns and/or economic infrastructure may occur.	
9	Social Institutions such as Social Infrastructure and Local Decision Making Institutions	Disruption of local community may be caused by a conflict of interests among politicians, government offices, and residents. It might cause a delay in procedures of land acquisition and resettlement.	C	-	C
10	Existing Social Infrastructure	Temporary loss of existing social infrastructure may occur due to the construction works.	C	Traffic to/from power station may become heavier. Social services may become insufficient.	C
11	Cultural Heritage	There is no cultural heritage existing on the site. Careful consideration however should be given to Mazan of Peer Mohsin Aulia located near the site.	C	Careful consideration however should be given to Mazan of Peer Mohsin Aulia located near the site.	C
		Landscapes may be lost.		-	
12	Infectious Diseases such as HIV/AIDS	Infectious diseases may spread via the construction workers into the community.	C	Infectious diseases may spread via the operation workers into the community.	C

Source: PSMP Study Team

Mitigation measures are examined for environmental pollution and natural environmental impacts are as found in APTable 18-47 .

APTable 18-47 Mitigation Measures for Environmental Impact (Chittagong)

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
1	Air pollution	Countermeasures for air pollution due to exhaust gas from transportation vehicles and construction machinery and dust scattering due to construction traffic are studied as in AP Table 18-67 and AP Table 18-68. As for the reduction of exhaust gas from transportation vehicles and construction machinery, idling stops and keeping proper exhaust condition by routine inspection of vehicles are judged to be applied. As for countermeasures for dust scattering, load cover, periodical vehicle washing, and periodic peripheral road cleaning are judged to be applied.	AP Table 18-62 shows countermeasures for NO_X, AP Table 18-63 shows countermeasures for SO_X, AP Table 18-64 shows countermeasures for Soot, and AP Table 18-66 shows countermeasures for coal dust. Besides conducting flue gas treatment by system including FGD, SCR and ESP etc., mitigation of coal dust scattering should be paid attention to.
2	Water contamination	Countermeasures for water contamination due to excavation waste soil outflow are suitable via a fence installation utilizing sandbags etc. As for the effluent due to equipment washing, it is suitable to install a temporary precipitation tank and to drain the supernatant water. As for sewage, it is suitable to put up a septic tank. In addition, as for waste, water contamination can be prevented if waste treatment is conducted promptly and the waste is not left for long time.	There is no warm effluent water generation since cooling tower or air cooled condenser will be adopted as a cooling system from consideration to impact of warm effluent water and local fishery. Plant effluent and sewage according to plant operations are discharged after waste water treatment including coagulating sedimentation, neutralization, and oil separation. Appropriate waste water facility capacity design is needed especially because condensed cooling water blow effluent is a large amount.
3	Soil pollution	AP Table 18-69 shows the study result of countermeasures for soil pollution by oil spillage from transportation vehicles and construction machinery. As a result, periodic maintenance implementation and conducting pre-operational machinery checks of machinery is judged important to be applied.	Oil and grease treatment procedures make it clear to prevent the spillage of lubrication oil or fuel oil. The management organization should be established to implement works according to designated procedures. And action procedures should be prepared in order not to spread the adverse impact in case of an oil spillage occurrence. An oil dike should be set around the oil storage tank.
4	Bottom sediment	Implement measures described in 2)Water contamination.	It is necessary to dump ash properties in dumping site with water proof seat to prevent bottom sediment leakage out of the ash pond.

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
5	Noise and vibration	AP Table 18-70 shows the study result of countermeasures for noise and vibration due to vibrations from transportation vehicles and construction machinery. As a result, leveling the construction process, using low-noise machinery, and lowering vehicle speed in residential areas are judged to be proper countermeasures. As for countermeasures for noise due to steam blowing during commissioning, the establishment of a work schedule without the blowing of steam during the nighttime is judged to be applied.	Developing the green belt along the site border is a costless and effective way to mitigate noise and vibrational impact. If the boundary noise simulated in the detail EIA exceeds the noise regulations which is decided on each category (AP table 18-8), the introduction of a green belt, sound insulating material and a sound insulating wall will be examined. Chittagong site is categorized in Mixed Zone[1]
6	Offensive Odor	Offensive odor caused by domestic waste decomposition from workers camps can be prevented by separate collection and periodic disposal of waste.	NOx mitigation without SCR which uses ammonia is an effective measure against offensive odor. In the case of use ammonia, storage tanks, pipes, and valves must surely be inspected periodically. In addition to preventing operational mishaps, operations of the ammonia facility are to be strictly managed by the person in charge. With regards to garbage treatment, it is suitable to dump periodically and not keep in storage for a long time.
7	Waste	Reduction of waste amount can be conducted by establishing a waste management program including reduction, reuse, and recycling (3R). Implementation of a thorough separate collection of the waste is needed, especially for paint sludge and batteries. These items should be collected separately and disposed in designated areas.	Reduction of waste amount can be conducted by establishing a waste management program including reduction, reuse, and recycling (3R). Because by-products through plant operations are large amount, they should be recycled as much as possible. APTable 18-71 shows examples of by-products recycling
8	Biota and Ecosystem	Nest building of Painted Roofed Turtle, Fishing Cat, Ganges River Dolphin, and Blue Whale should be examined in detail EIA. The nest relocation should be conducted if there are any. Existence of each endangered species should be carefully paid attention to during construction stage, and necessary protection action should be conducted if there are any.	Nest building of Painted Roofed Turtle, Fishing Cat, Ganges River Dolphin, and Blue Whale is examined in detail EIA. The nest relocation should be conducted if there are any. Existence of each endangered species should be carefully paid attention to during operation stage and necessary protection action should be conducted if there are any
9	Accident	A suitable OHS organization (policy, manual, announcement of policy, safety training and safety patrol) should be established to prevent accidents. It is also important to conduct quality control in construction work to prevent accidents during commissioning and operation period.	A suitable OHS organization (policy, manual, announcement of the policy and manuals, safety training, safety patrols) should be established for accident prevention. It is also important to conduct quality control in maintenance work to prevent accident.

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
10	Global warming	-	It is estimated that approximately 3.54 million ton of CO_2 will be emitted from per 600MW unit per year through the operation of a coal-fired power plant. An ultra-super critical boiler with high thermal efficiency is being planned to be introduced into this master plan. The introduction of a high efficiency unit can reduce 1.07 million tons of CO_2 per 600MW unit per year compared with the case of the Barapukuria class unit introduction. These figures are calculated based on designed value. It is important to keep designed output and efficiency from adequate O&M.

Source: PSMP Study Team

18.4 Meghnaghat Site Information

18.4.1 Site Overview

The proposed Meghnaghat power plant is close to Dhaka City, located on the bank of the Meghna River, to the south of Sonargaon Upazilla center. It is expected to be located at Islampur and Ganganagar villages in Pirojpur Union under Sonargaon Upazilla of Narayanganj District. A map showing Meghhaghat is given in APFig. 18-12

Source: http://www.banglapedia.org/httpdocs/HT/N_0057.HTM (accessed May 2010)

APFig. 18-12 Proposed Meghnaghat Site

(1) Health and Sanitation Environment

Local people suffer from diseases like colds, asthma, headaches, fevers, etc. They consult with local pharmacists, medical doctors or go to public hospital. For more serious problems, they go to Dhaka or visit the Sheba Clinic as there's no hospital in town.

They used to drink arsenic free water from the tube-well which is also used for cooking and use the river water for bathing and washing clothes. The present layer of water is 100 feet below, although it was around a depth of 60 feet in the past. All respondents have hygienic slab latrines in their houses.

(2) Housing Condition and Surrounding Area

The floors of houses are made out of brick and clay. The walls of houses are brick-made and the ceilings are tin-made. Electricity is distributed for 24 hours a day except during irrigation periods and they are very conscious about the proper consumption of electricity.

(3) Income, Expenditure and Job Opportunities

They do business, are self-employed, and work in other professions. Some of them are associated with samity (Association) and have taken out loans from samity to start their own businesses.

(4) Climate condition

The Dhaka station is the nearest station of the Bangladesh Meteorological Department (BMD) from Meghnaghat. APTable 18-48, APTable 18-49, APTable 18-50, APTable 18-51, APTable 18-52 and APTable 18-53 show the monthly maximum and minimum air temperature, monthly precipitation, monthly maximum and minimum relative humidity, and monthly average wind speed and prevailing wind direction at the Dhaka station from 2000 to 2009. Colored cell in each table indicates maximum and minimum value.

As for the air temperature, it is as hot as the maximum air temperature is over 27°C throughout the year. The minimum air temperature is under 10°C from November to March, so the difference between maximum and minimum temperature is large. The monthly maximum temperature is 39.6°C as of April 2009 and the monthly minimum temperature is 8.1 °C in January 2003.

The annual precipitation reaches a level of 1,700mm to 2,900mm. The precipitation is at its most concentrated between May and September. Conversely, there is no rainfall during some of the months from November to March. As described above, there is a marked difference in the rainfall between the rainy season and the dry season.

As for the humidity, it is relatively high; the monthly minimum relative humidity exceeds 50% during the period between May and September.

As for the wind speed and wind direction, there are large influences from the monsoon. It is clear that the wind blows from the north or northeast between November and February, and the wind blows from the south to the southeast between March and September. The average wind speed is not that high, below 3m/s throughout a year.

APTable 18-48 Monthly maximum temperature of Dhaka station (°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	28.7	28.2	34	35.1	36.6	35.2	35.2	35	34.4	34.9	32.5	27.3
2001	28	31.4	35.8	37.5	35	33.8	34	34	34.2	34.8	32	28.4
2002	28.2	33.5	35.5	34.3	35.4	34.4	35.2	34.1	35	34.2	32	29.5
2003	27.5	31.6	34	36.2	36.3	36.7	35.3	35.1	34.2	34	32.1	29.2
2004	27.5	32.8	35.7	35.2	38.1	35.2	34.5	34.6	34	34.5	31.1	29.4
2005	28.5	32.1	35.6	37	36.4	36.6	33.7	34	35.1	34.6	31.4	29
2006	28.2	35.9	38.5	37.1	36.8	35	35.6	35.2	35.7	34.7	32.6	30.1
2007	28.8	30.8	36.7	35.9	37.5	35.9	34.8	35.9	34.9	35.6	31.8	28.2
2008	29	30.6	34.6	36.9	36.7	35.4	34	36	34.8	34.8	32.3	29
2009	28.1	33.9	36	39.6	37.8	36.5	35.7	34.3	—	—	—	—

Source： BMD, Dhaka

APTable 18-49 Monthly minimum temperature of Dhaka station (°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	10	13.2	15.4	18	19.5	23.8	24	23.6	23	19.3	16.8	13.4
2001	9.8	12.4	16.6	20.9	19.9	24	24	22.5	21.5	19.7	15.5	12.6
2002	11.2	11.5	15.8	16.6	19.4	22	22.8	23.3	22	18.3	17.5	11.7
2003	8.1	14.2	13.5	17.8	19.6	22.5	23.4	24.2	23.5	23	14	13.2
2004	10.7	10.4	16.3	18.5	20.2	22.4	21.5	24.8	22.7	21.5	15.8	11.5
2005	11.4	11.5	19	19.6	19.7	22.5	24	24.3	23.8	20.8	16	12.2
2006	10.4	15.4	16.3	20.2	20.4	22.3	24.6	22.7	23.8	21.8	13.3	12.6
2007	9.6	12.6	15	18.1	22.5	22	23.4	24.2	24.5	19.5	16.8	11.3
2008	10.5	10.8	16.5	19.6	20.3	22.5	24.6	23.6	24.4	18	16.3	13
2009	11.1	12.2	15.8	20.4	21.6	22.6	24.4	24.3	—	—	—	—

Source： BMD, Dhaka

APTable 18-50 Monthly precipitation of Dhaka station (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
2000	13	44	172	189	491	165	197	359	216	278	0	0	2124
2001	0	1	33	46	402	386	202	205	209	177	18	0	1679
2002	22	4	51	111	272	373	446	272	156	52	116	0	1875
2003	0	25	96	123	140	473	191	202	264	134	0	45	1693
2004	0	0	9	167	162	476	295	191	839	208	0	0	2347
2005	1	3	155	91	291	259	542	361	514	417	3	0	2637
2006	0	0	0	181	185	326	331	167	663	61	5	0	1919
2007	0	30	11	163	185	628	753	505	179	320	111	0	2885
2008	23	56	45	91	205	577	563	319	279	227	0	0	2385
2009	1	1	43	14	168	170	676	482	—	—	—	—	—

Source： BMD, Dhaka

APTable 18-51 Monthly maximum relative humidity of Dhaka station (%)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	99	97	98	97	99	98	98	100	98	98	98	99
2001	99	99	96	96	98	99	98	98	98	99	99	99
2002	98	94	94	98	98	98	98	99	98	97	99	99
2003	100	99	98	98	98	98	98	99	98	98	96	98
2004	100	97	98	98	98	99	99	98	98	98	98	98
2005	97	97	98	94	98	98	99	97	98	98	98	98
2006	100	98	96	96	98	99	98	95	99	98	95	97
2007	100	100	96	95	98	98	99	98	98	98	99	98
2008	98	96	95	94	96	98	98	97	98	98	97	99
2009	99	98	97	95	95	95	98	98	—	—	—	—

Source： BMD, Dhaka

APTable 18-52 Monthly minimum relative humidity of Dhaka station (%)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	24	14	11	39	43	49	45	52	51	47	28	28
2001	20	22	13	16	51	55	54	59	51	38	36	30
2002	26	18	16	35	47	49	55	52	45	32	28	33
2003	28	26	13	28	31	45	56	52	51	47	21	28
2004	25	17	16	40	15	50	54	52	58	32	27	27
2005	28	17	18	27	44	46	57	55	52	34	32	24
2006	21	15	6	28	40	57	55	52	51	38	26	29
2007	20	23	14	32	33	52	55	50	42	31	35	28
2008	25	13	28	23	37	51	61	57	53	32	29	33
2009	24	9	10	21	39	36	45	56	—	—	—	—

Source： BMD, Dhaka

APTable 18-53 Monthly average wind speed (m/s) and prevailing wind direction at Dhaka

Year	Jan		Feb		Mar		Apr		May		Jun	
	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir
2000	0.8	N	1	N	1.2	S	1.7	S	1.3	S	1.3	S
2001	1.1	NW	0.9	NE	1.9	S	2.1	S	1.7	S	1.6	S
2002	1.3	N	1.3	NW	2	S	2.1	S	1.8	S	1.4	S
2003	1.6	NW	1.8	N	2	S	2.6	S	2.5	S	2.1	SE
2004	1.8	W	2	W	2.9	S	3	S	2.8	S	1.9	S
2005	2.1	NNW	2.2	W	2.4	S	2.3	S	2.3	S	2.3	SE
2006	1.5	N	1.9	S	2.6	NNW	2	S	2	S	1.1	S
2007	1.5	NW	1.6	NW	2.2	NW	2	S	1.8	S	1.6	S
2008	1.9	N	1.6	N	2	S	1.7	S	1.7	S	1.7	S
2009	1.7	W	2.1	W	2.1	W	2.1	S	2	S	1.6	S
Year	Jul		Aug		Sep		Oct		Nov		Dec	
	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir
2000	1.2	S	1.2	S	1.1	S	1.7	NE	0.8	N	0.8	N
2001	2	S	1.3	S	1.5	S	1.3	S	0.9	N	1	N
2002	1.4	S	1.4	S	1.5	SE	1	N	3.3	NE	1.2	N
2003	2.1	S	2.2	SE	2.2	SE	1.7	NE	1.4	N	1.6	W
2004	2.2	SE	2.1	SE	3.2	E	2.2	SE	1.6	W	1.7	NNW
2005	2.4	SE	1.8	S	2.4	SE	2.5	SE	1.7	NW	1.9	NNW
2006	1.1	SE	2.3	SE	2.8	SE	1.2	N	1.1	NW	1.2	NW
2007	1.6	S	1.6	S	1.6	S	2.1	NE	2.8	NE	1.5	NW
2008	1.7	S	1.4	S	1.4	S	4.9	NE	1.3	NE	1.7	W
2009	2.2	SE	1.4	S	-	-	-	-	-	-	-	-

Source： BMD, Dhaka

(5) Topography and Underground water

The Topography and Earthquake situation in Bangladesh is shown in APFig. 18-5 and APTable 18-65. The Land form around the proposed site is almost a flat land with some high spots. The Meghnaghat site area is located in Zone II as seismic zones.

The geological data has been obtained from boring survey results which have been conducted at a nearby proposed site under the DPHE R&D Division. The boring survey conducted in 1997 in Uchitpur village under Uchitpur union, Araihazar Upazilla, Narayanganji which is close to the proposed site. The drilling depth was 182.87m., APTable 18-54 shows the result of boring investigation. The drilling depth was 182.87m. The result indicates there are three Aquiferes between the depths to 121.91m.

APTable 18-54 Boring result of near Meghnaghat site

Depth to Top (m)	Depth to Base (m)	Lithologic Description	
0.00	6.10	Silty clay	Aquitard 1
6.10	12.19	Very Fine sand	Aquifer 1
12.19	18.29	Medium sand	
18.29	42.67	Fine sand	
42.67	48.77	Fine to Medium Sand	
48.77	54.86	Silty Clay	Aquitard 2
54.86	60.96	Clay	
60.96	73.15	Silty Clay	
73.15	79.24	Medium sand	Aquifer 2
79.24	82.29	Clay	Aquitard 3
82.29	85.34	Silty Clay	

Depth to Top (m)	Depth to Base (m)	Lithologic Description	
85.34	97.53	Fine to medium sand	Aquifer 3
97.53	106.67	Fine Sand	
106.67	121.91	Fine to medium sand	
121.91	128.01	Silty Clay	Aquitard 4
128.01	137.15	Very Fine sand	
137.15	167.63	Silty Clay	
167.63	182.87	Clay	

Source: DPHE

(6) Surface water

APTable 18-55 shows the water quality of the Meghna River which is measured in the Meghnaghat combined cycle power plant EIA in 1999.

Chromium (total), COD, BOD_5 $20^{O}C$ do not satisfy the standard of drinking water of Bangladesh.

APTable 18-55 Water quality of Meghna River upstream of Meghnaghat site (1999)

No.	Parameter	Unit	Concentration	Bangladesh Standard for drinking water
1	Arsenic	mg/l	<0.001	0.05
2	BOD_5 $20^{O}C$	mg/l	7.2	0.2
3	Chromium (total)	mg/l	0.071	0.05
4	Chlorine (residual)	mg/l	—	0.2
5	COD	mg/l	15.2	4
6	Copper	mg/l	0.224	1
7	DO	mg/l	3.31	6
8	Hardness (as $CaCO_3$)	mg/l	40.0	200-500
9	Lead	mg/l	0.19	0.05
10	Mercury	mg/l	—	0.001
11	Nickel	mg/l	0.025	0.1
12	Oil & Grease	mg/l	—	0.01
13	pH		7.2	6.5-8.5
14	Suspended particulate matters	mg/l	2.0	10
15	Total dissolved solids	mg/l	79.0	1000
16	Turbidity	NTU	18.4	10(JTU)
17	Zinc	mg/l	0.479	5

Source： Meghnaghat Power Project Final Environmental Impact Assessment, AES Meghnaghat Limited

(7) Ecological situation

Data of the ecological situation has been obtained from the Department of Botany and Zoology of Dhaka University, Respective Upazila offices and local consultants. According to the EIA examination of the Meghnaghat gas combined power station in 2000, there is the possibility of existence of 6 species of NT, 2 species of VU, 2 species of EN, and 1 species of CR. However, the report states that the power station has no impact on these species and their respective habitats.

(a) Terrestrial Communities

1) Flora

There seems to be 53 species of land plants around the proposed site. Out of them, there is 1 species of LC on the IUCN Red List. A list of plants near the proposed site is provided in APTable 18-56.

APTable 18-56 List of plants near Meghnaghat site

No.	Local Name	English Name	Scientific Name	IUCN Global Status
1	Am	Mango	Mangifera indica L. (Anacard)	--
2	Arjun	--	Terminalia arjuna	--
3	Bansh pata	--	Podocarpus nerifolia	--
4	Bash	Bamboo	Podocarpus nebifolia	LC
5	Bel	Indian apple	Aegle marmelos (L).	--
6	Beli	--	Jasmin sambac Ait (Olea)	--
7	Bokul	(Mimusops Elengi)	Mimusops elengi L	--
8	Boroi	Indian Jujube	Zizyphus rugosa Lam	--
9	Bot	Banayan tree	Ficus benghalensis L. (Mora)	--
10	Debdaru	Pine	Polyalthia longifolia	--
11	Dhol Kalmi	--	Ipomoea fistolosa	--
12	Dhutra	--	Barringtonia acatangula	--
13	Golap	Rose	Rosa centifolia L. (Rosaceae)	--
14	Halencha	--	(Altermanthere philoxeroides)	--
15	Hyacinth	--	(Eichhomia crassipes)	--
16	Jaba	--	Hibiscus rosa sinensis L. (Malvaceae)	--
17	Jam	Black berry	Syzygium cumini skiel. (Myrtaceae)	--
18	Jambura	Citron	Citrus grandis	--
19	Jamrul	Star apple	Syzygium samraogense (Bl.)	--
20	Jhau	Poplar	Thysanolaena maxima	--
21	Kachu	Date Plam	Colocasia esculenta (L.)	--
22	Kadbel	Wood apple	Feronia limonia (L.)	--
23	Kalmi	--	(lpomoea aquatica)	--
24	Kamranga	Carambola	Averrhoa carambola	--
25	Kathal	Jack fruit	Artocarpus heterphyllus Lamk	--
26	Khejur	Date palm	Phoenix sylvestris	--
27	Kola	Banana	Musa Sapientum	--
28	Krishnachura	Delonix regia	Delonix regia (Boj.) Raf. (Leguminosae)	--
29	Lazzaboti	--	M. pudica L	--
30	Lebo	Lemon	Citrus aurantifolia	--
31	Madar	--	Erythriana variegata L. var. orientalis Merr.	--
32	Man Kochu	--	Alocasia indica	--
33	Mehedi	--	Lawsonia inermis	--
34	Mehogoni	--	Swietenia mahagoni	--
35	Narikel	Coconut	Cocos nucifers L. (Palmae)	--
36	Nim	--	Azadirachta indica	--
37	Pakur	--	Ficus Infectoria	--
38	Patabahar	Patabahar	Acalypha welkesiana (Euphorbiaceae)	--
39	Pepe	Papaya	Carica papaya L (caricaceae)	--
40	Peyara	Guava	Psidium Guajava (L) Bat. (Myrtaceae)	--
41	Pui Shak	--	Basella alba L.	--
42	Radhachura	--	Caesalpinia pulcherrima Sw. (Leguminosae)	--
43	Rain tree	--	Samea Samon	--

No.	Local Name	English Name	Scientific Name	IUCN Global Status
44	Rashun	Garlic	Allium sativum	--
45	Sajina	--	Moringa Oleifera Lamk. (Moringa)	--
46	Shimul	--	Bombax ceiba L. (Bombacaceae)	--
47	Sofeda	Sapodilla	Manilkara Achras	--
48	Supari	Colloq		--
49	Tal	Palm tree	Borassus flabellifer L. (Palmae)	--
50	Tentul	Tamarind	Tamarindus indica	--
51	Thankuni	--	Centella asiatica	--
52	Topa pana	--	(Pistia stratiotes)	--
53	Ulatkambal	--	Abroma augusta	--

Source : PSMP Study Team

2) Fauna

The animals found within a 1km circumference around the site include a total 55 species – 17 species of mammalian animals, 30 species of birds, 7 species of reptiles and 1 species of amphibian. Out of the animals on the 2007 Red List of the International Union for the Conservation of Nature (IUCN), there are 16 species of LC, 1 species of NT, 1 species of EN, and 2 species of CR. Special care must be given to the protection of Red Headed Vultures, Panited Roofed Turtles (CR) and Fishing Cats, (ER). APTable 18-57 is a list of animals found around the Meghnaghat site.

APTable 18-57 List of animals found around Meghnaghat site

No.	Local Name	English Name	Scientific Name	IUCN Global Status
MAMMALS				
1	Badur/Daini	False Vampire	Megaderma Lyra	--
2	Bagdash	Large Indian civet	Viverra Zibetha	--
3	Bon Biral/Wab	Jungal Cat/Swamp Cat	Felis chaus	--
4	Bara Benji	Common Mongoose	Herpestes edwardsi	--
5	Bhera	Sheep	Bovidae : Ovis	--
6	Biral	Cat	Felis : Catus	--
7	Indur	Common House Rat	Rattus rattus	--
8	Ghora	Horse	Equus caballus	--
9	Goru	Cow	--	--
10	Kathbirali	Malayan Giant Squirrel	Rataufa bicolor	--
11	Khek Shiyal	Bengol Fox/Indian Fox	Vulpes bengalensis	LC
12	Khargosh/Shashak	Rufous-tailed Hare	Lepus nigricollis	LC
13	Kukur	Dog	Cannis Familiaris	--
14	Mecho Biral/Mecho Bagh	Fishing cat	Prionailurus viverrinus	EN
15	Mohish	Bafallow	--	--
16	Sagol	Goat	Capra Hircus	--
17	Shojaru	Indian crested Porcupine	Hystrix Indica	LC
BIRDS				
1	Babui-Batan	Small Pratincole	Glareola Lactea	LC
2	Baj	Crested Groshawk	Accipiter trivirgatus	LC
3	Bok	Intermediate Egret	Mesophoyx intermedia	--
4	Bulbuli	Red-vented Bulbul	Pycnonotus cafer	--
5	Hutum Pecha	Rock Eagle Owl	Bubo bengalensis	LC
6	Chil	Pariah Kite	Passer domesticus	--

No.	Local Name	English Name	Scientific Name	IUCN Global Status
7	Chorai	House Sparrow	Passer Domesticus	--
8	Dahuk	White Breasted water hen	Amaurornis phoenicurus	LC
9	Doyel	Magpie Robin	Copsychus saularis	LC
10	Eagal	Bazzard -Eagal	Butastur teesa	LC
11	Fingey	Black Drongo	Dicrurus macrocercus	--
12	Gang Shalik	Bank Myna	Acridotheres ginginianus	LC
13	Ghughu	Oriental Turtle Dove	Streptopelia orientalis	LC
14	Gung Chil	Whiskered Tern	Chlidonias hybridus	LC
15	Hash	Duck	Anatidae Anseriformes	--
16	Jalali Kobutor	Rock Pigon	Columba Livia	LC
17	Kak	House Crow	Corvus splendens	--
18	Kana Bok	Indian Pond Heron	Ardeola grayii	--
19	Kat Tokra	Woodpecker	Picoides pubescens	--
20	Kokil	Asian Koel	Eudynamys scolopacea	--
21	Konch Bak.	Pond Heron.	Ardeola grayii	--
22	Machhranga	White Throated Kingfisher	Halcyn smyrensis	--
23	Mohanchura	Hoopoe	Upupa epops	--
24	Paira	Pigeon	Columba livia domestica	--
25	Pencha	Sport-bellied Owl	Bubo nipalensis	LC
26	Rajhans	Bar-headed Goose	Anser indicus	LC
27	Shalik	Indian mynah	--	--
28	Raj Shokun	Red Headed Vulture	Sarcogyps calvus	CR
29	Tia	Rose-ringed Parakeet	Psittacula krameri	LC
30	Tuntuni	Tailor bird	Orthotomus sutorius	--
REPTILE				
1	Tiktiki	House Lizard	Hemidactylus brookii	--
2	Ajogor	Rock Python	Python molurus	NT
3	Kasim	Painted Roofed Turtle	Kachuga Kachuga	CR
4	Gui Shap	Bengal Monitor	Varanus bengalensis	--
5	Sabuj Dhora	Green Keel back Snake	Macrophistodon plumbicolor	--
6	Kalo Mete Dhora Shap	Dark-Bellied Marsh Snake	Xenochrophis cersogaster	--
7	Gokhra Shap	Monocellate Cobra	Naja kaouthia	--
AMPHIBIA				
1	Beng	Frog	*Anura : Ranidae*	

Source : PSMP Study Team

(b) Aquatic Communities

1) Aquatic Flora

The freshwater dependent plants such as the helencha (Altermanthere philoxeroides), kalmi (Ipomoea aquatica), daokalmi (Ipomoea fistulosa), ichadal (Potamo seton) and water hyacinth (Eichhomia crassipes) are common in the ponds, canals and rivers near the Meghnaghat site. Khuda pana (Lemna minor), topapana, (Pistia stratiotes) and chaicha (Saipus articulatus) are also common.

2) Aquatic Fauna

The Meghnaghat site is on bank of the Meghna River. The crabs inhabit ditches and ponds on the bank of Meghna River. Fresh water snails (Charonia Variegate) and mussels (Mytilus Edilis) are also common. The fishes found within around the site include a total of 41 species of river fishes. APTable 18-58 shows a list of fishes available near the Meghnaghat site.

APTable 18-58 List of fishes available near Meghnaghat site

No.	Local Name	English Name	Scientific Name	IUCN Global Status
1	Ayer	Long Whiskered cat fish	Aorichthys aor	--
2	Bata	Giantscale Mullet	Lizamelinoptera	--
3	Bele	Scribbled goby	Awaous grammepomus	--
4	Bhol/Bol	Indian Trout	Raiamas bola	--
5	Chanda	Elongate glass perchlet	Chanda nama	--
6	Chingri	Shimp	---	--
7	Chitol	Humped Featherback	Notopterus chitala	--
8	Dhela/ Dipali/ ketti(Cotio)	Cotio	Osteobrama cotio	--
9	Foli	Grey Featherback	Notopterus notopterus	--
10	Ghaura	(Gaura Bacha)	Clapisoma gaura	--
11	Ghonia/Gonainya	(Kuria Lebeo)	Labeo gonius	--
12	Gojar/ Gojal	Giant snake head	Channa marulius	--
13	Golsa/ Golsa Tengra	Gangetic Mystus	Mystus cavaslus	--
14	Ilish	Hilsa	Tenualosa ilisha	--
15	Jhinuk	--	--	--
16	Kajli / Banshpata	Jamua ailia	Ailia punctata	--
17	Kalibaush (kalbasu)	Orange-fin labeo	Labeo calbasu	--
18	Kani Pabda / Boali Pabda	(Indian Butter cat fish)	Ompak bimaculatus	--
19	Katol	Catla	Catla Cattla	--
20	Khailsha	Banded gourami	Colisa fasciata	--
21	Kucha / Kuchia	Gangetic Mud Eel Cuchia	Monopterus cuchia	--
22	Meni / Bheda/ Rayan/ Bheduri	Mottled Nandus	Nandus nandus	--
23	Mrigal	Mrigal	Cirrhinus mrigala	--
24	Napit Koi/ Koi Banedi	Dwarf chemeleon fish badis	Badis badis	--
25	Pabda	Pabo Cat fish	Ompak pabo	--
26	Poa	Pama croaker	Otolithoides pama	--
27	Potka	Green pufferfish	Tetraodon fluviatilis	--
28	Pungash (river)	Yellowtail catfish	Pangasius pagasius	--
29	Puti	Fry	Puntius puntio (Hamilton)	--
30	Rui	Rohu	Labeo rohita	--
31	Sarputi / Swarnaputi	(Olive barb)	Puntias Sarana	--
32	Shal baim/ Baim Bam	Tire trach spinyeel	Mastecembelus armatus	--
33	Shamuk	Snail	--	--
34	Shol	Banded Snakehead	Channa striatus	--

No.	Local Name	English Name	Scientific Name	IUCN Global Status
35	Sisor / Chenua	Sisor cat fish	Sisor rhabdophorus	--
36	Tara Baim	One Strip spiny eel	Macroganthus aral	--
37	Tatkini/Bata/Bangla	Reba carp	Cirrhinuss reba	--
38	Telo Taki / Rana Cheng/ Ganchua	Asiatic snake head	Channa Orientalis	--
39	Tengra	Assamese Batasio	Batasio Tengana	--
40	Titpunti	Ticto barb	Puntias Ticto	--
41	Darkina (Gangetic scissortail rasbora)	Flying barb	Esomus Danricus	--

Source： PSMP Study Team

18.4.2 Detailed Information on Meetings with Local Stakeholders

APTable 18-59 Profile of Household Interviewees (Meghnaghat Site)

No	Sex	Age	Village	Distance from Power Plant	Education	Occupation	Household Monthly Income
1	M	45	Islampur	100 m	Nil	Business	8,000
2	M	35	Islampur	100 m	Nil	Business	4,000
3	M	52	Islampur	200 m	Nil	Service	6,000
4	M	32	Islampur	100 m	four	Carpentar	6,000
5	M	27	Islampur	100 m	Nil	Service	4,000
6	M	35	Islampur	100 m	Nil	Business	5,000
7	M	50	Islampur	100 m	Nil	Boat man	6,000
8	M	37	Islampur	100 m	Nil	Service	4,000
9	M	25	Gonga Nogar	400 m	Six	Service	6,000
10	M	30	Gonga Nogar	500 m	Eight	Business	6,000
11	M	40	Gonga Nogar	500 m	three	Service	8,000
12	M	49	Gonga Nogar	400 m	Nil	Business	6,000
13	M	42	Gonga Nogar	500 m	Nil	Business	6,000
14	M	30	Gonga Nogar	500 m	Yes	Business	6,000
15	M	41	Gonga Nogar	500 m	Nil	Agriculture	4,000

Source: Household interview

APTable 18-60 Profile of FGD Participants (Meghnaghat Site)

No	Age	Education	Occupation	Household Monthly Income
Male Participants				
1	57	Only Signature	Unemployed	6,000
2	46	Only Signature	Day Labourer	5,000
3	32	V	Business	6,000

No	Age	Education	Occupation	Household Monthly Income
4	77	Only Signature	Unemployed	15,000
5	65	Only Signature	Business	30,000
6	50	Only Signature	Unemployed	15,000
Female Participants				
1	36	Only Signature	Housewife	6,000
2	20	S.S.C.	Housewife	7,000
3	30	V	Housewife	6,000
4	38	Only Signature	Housewife	6,000
5	46	VI	Housewife	9,000
6	23	IX	Job	5,000
7	18	IV	Housewife	9,000
8	40	Only Signature	Housewife	5,000

Source: Focus group discussions

APTable 18-61 Participants Profile of Local Stakeholder Meeting (Meghnaghat Site)

No.	Designation and Organization
Participants from Meghnaghat	
1	Asst. Commissioner (Land), Sonargaon
2	Upazila Chairman
3	Chairman, Pirozpur Upazila
4	Upazila Statistical Officer
5	LGED, UE, Sonargaon
6	Asst. Accountant Upazila Office
7	UP. Vice Chairman
8	Head Teacher, Mograpara H.G.G.S. Smriti Biddyaloy
9	Credit Supervisor
10	Sr. UP. Fisheries Officer, Sonargaon
11	UD Asst. Jr. Accountant
12	Sub-Asst. Secondary Education Office
13	Sub-Asst. Settlement Office
14	Member
15	Electrician
16	Imam (Religious leader)
17	Islampur (Villager)
18	Islampur (Villager)
19	Islampur (Villager)
20	Islampur (Villager)
21	Islampur (Villager)
22	Islampur (Villager)
23	Gonga Nagar (Villager)
24	Islampur (Villager)
25	Islampur (Villager)
26	Islampur (Villager)
27	South Sonargaon
28	Gonga Nagor (villager)
29	Nuner Tek (villager)
30	Villager

No.	Designation and Organization
31	Dohor Para (villager)
GOB	
1	Asst. Chief, Power Division
2	EGCB Ltd.
3	BPDB, Sub-Divisional Engineer
PSMP Study Team and Local Consultants	
1	PSMP Study Team
2	PSMP Study Team
3	EAL, Executive Director
4	EAL, Engineer
5	EAL, Social Specialist
6	EAL
7.	EAL
8	Computer Operator, EAL
9	Sound Operator

Source: PSMP Study Team

18.4.3 Problem Analysis and Problem Solution

Problem analysis on environmental pollution and natural environment is as found in the following table.

AP Table 18-62 Problem Analysis: Assessment Results on Environmental Impact (Meghnaghat)

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
1	Air Pollution	Air pollution can occur due to the exhausted gas from transportation vehicles and construction machinery. And dust particles may be scattered near the construction site and roads.	B	Planned coal-fired power plant burns imported coal as main fuel. And it burns light oil as an auxiliary fuel (fuel for starting up). NOX, SOX and soot will be generated due to combustion of these fuels. Coal transportation may generate coal dust. If there are no adequate measures taken for these air pollutant, operation of adjacent Meghnaghat CCPP will be affected due to clogging of the gas turbine inlet filter.	A
2	Water Contamination	Rainfall drainage, equipment washing drainage, and sewage will be generated during the construction work. And if waste management isn't appropriate, effluents from waste may be generated.	B	Thermal discharge will be produced during those cases where river water is used as cooling water. Plant effluent and domestic waste water will be generated according to plant operation. And if waste management isn't appropriate, effluents from waste may be generated.	A
3	Soil pollution	Soil pollution can occur due to lubrication oil or fuel oil spillage from transportation vehicles and construction machinery.	B	Soil pollution can occur due to lubrication oil or fuel oil spillage through the unit operation.	B
4	Bottom Sediment	In case of discharged water spillage to the Meghna River, there is a possibility of bottom sediment accumulation.	C	There is a possibility of bottom sediment accumulation if plant effluent and domestic waste water discharges after inadequate treatment. If an ash pond is used, it is necessary to pay attention to the bottom sediment of the pond.	B

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
5	Noise and vibration	There will be noise and vibrations due to transportation vehicles and construction machinery. And steam blowing during commissioning will generate significant noise.	A	Noise and vibration will be generated through the operation of the power facilities. If a cooling tower is used, there will be significant noise and vibration from the cooling fan of the tower. During periodic inspections, noise and vibration will arise due to the vibration of the transportation vehicle and construction machinery.	A
6	Offensive Odor	If the domestic waste management isn't applicable to workers' stations, offensive odor may be generated due to waste decomposition.	B	If ammonia, which is used at SCR leaks, it may be a source of offensive odor. If domestic waste management isn't applicable to workers' stations for maintenance work etc., an offensive odor may be generated due to waste decomposition.	B
7	Waste	Construction work will generate metal chips, waste plastic, wood shavings, waste glass and waste oil. And domestic wastes such as cans, bottles and food residue will be generated from construction workers' station.	B	By-products through the operation of coal-fired power plant are coal ash, gypsum (if limestone-gypsum FGD is used), sludge from waste water treatment facility, and cooling water canal fouling (if the river water or sea water is used for the cooling water). These by-products will be wasted if they are discarded without recycling. Maintenance work will generate metal chips, waste plastic, wood shavings, waste glass and waste oil And domestic wastes such as cans, bottles, and food residue will be generated from workers' stations.	A
8	Ground Subsidence	There will be no impact to water usage as the Meghna River water is available as cooling water and makeup water of power plant.	C	Ground subsidence will not occur as cooling water and makeup water can be taken from the Meghna River, not from the underground water.	C
9	Geographical Feature	There is little impact since the proposed site is plain and doesn't possess any outstanding geographical features.	C	There is little impact since the proposed site is plain and doesn't possess any outstanding geographical features.	C
10	Biota and Ecosystem	There is a possibility of Red Headed Vulture and Painted Roofed Turtle categorized CR and Fishing Cat categorized EN in IUCN Red List existing around the site.	B	There is a possibility of Red Headed Vulture and Painted Roofed Turtle categorized CR and Fishing Cat categorized EN in IUCN Red list existing around the site.	B
11	Water Usage	There is no impact to water usage as the Meghna River water is available as water for construction work.	C	There is no impact to water usage as the Meghna River water is available as cooling water and makeup water of power plant.	C

No.	Item	Impact during Construction Stage		Impact during Operation Stage	
12	Accident	Construction accidents can occur due to the defects of the health and safety management of construction work. It is necessary to pay attention to especially potential accidents due to falling from high-places, construction vehicle road accidents and electrical accidents.	A	There is a possibility of accidents occurring such as fires due to oil spillage or instantaneous combustion of coal, accidents due to leakage or spillage of chemicals like caustic soda and sulfuric acid, accidents or incidents involving maintenance work.	B
13	Global Warming	Transportation vehicles and construction machinery will emit CO2.	C	It is estimated that approximately 3.79 million ton of CO2 will be exhausted from per 600MW unit per year through the operations of coal-fired power plants. In light of its cost-effectiveness, brown coal will be imported. Brown coal emits more CO2 than domestic coal which has been classified as bituminous coal.	B

source： PSMP Study Team

Social impact assessment results can be found in AP Table 18-63.

AP Table 18-63 Problem Analysis: Assessment Results of Social Impact (Meghnaghat Site)

No	Item	Impact during Construction Stage		Impact during Operation Stage	
1	Involuntary Resettlement	Involuntary resettlement can be caused by land acquisition. The degree of adverse impact on local residents however is not expected to be large-scale since the potential site is located in the bank of the Meghna River.	B	Damage to houses and health hazards can be caused by smoke extraction, noise pollution, water pollution and land subsidence if the environmental management plan is not appropriately planned and implemented. Political intervention and/or local movement against the operation of power stations can occur when the adverse impacts to local residents' lives and livelihoods are severe.	C
2	Local Economy such as Employment and Livelihood etc.	Loss of employment and livelihoods can be caused by temporary loss of agricultural lands during the construction period.	B	Permanent loss of employment and livelihoods can be caused by land acquisition for the power station operation and surrounding areas. Further, agricultural laborers may lose their jobs. In case water treatment is not properly conducted, local fishing industry may be affected.	C
		The Bangladesh regulation stipulates that displaced persons are entitled to compensation for loss of land, property and standing crops in monetary terms at the fixed rates. It however does not compensate for loss of employment or livelihoods.		The Bangladesh regulation stipulates that displaced persons are entitled to compensation for loss of land, property and standing crops in monetary terms at the fixed rates. It however does not compensate for loss of employment or livelihoods. The destitute and poor, particularly landless farmers can become further distressed in case job opportunities or at the least, skill training opportunities for them are not secured.	

No	Item	Impact during Construction Stage		Impact during Operation Stage	
3	The Poor, Indigenous and Ethnic People	There are no ethnic minorities living in the site.	C	There are no ethnic minorities living in the site.	C
		The destitute, poor and landless farmers may lose their jobs when agricultural land is lost due to the construction of power station.		The destitute, poor and landless farmers can become further distressed if job opportunities or at least skill training opportunities for them are not secured.	
4	Misdistribution of Benefit and Loss	The disparity between land owners and the rest (landless farmers, wage laborers etc.) may widen.	B	Landless farmers and wage laborers may become further distressed and the disparity between land owners and them can be widened when job opportunities and skill training opportunities are not provided to them.	C
		In case an ample number of job opportunities and skill training opportunities are not provided to meet the demand, the disparity between those with such opportunities and those without may widen.		Local livelihoods may be affected and health hazards may be caused by land subsidence, smoke extraction, noise pollution, water pollution and water shortage if the environmental management plan is not appropriately planned and implemented.	
5	Local Conflict of Interests	Local conflict may occur between the relocated people and the host community.	C	Local conflict can become constant between the relocated people and the host community.	C
		Excessive interventions by various stakeholders can trigger local conflict among residents, and the disruption of the local community.			
6	Gender	Appropriate information and knowledge may not be properly disseminated to the illiterate, particularly women.	C	Appropriate information and knowledge may not be properly disseminated to the illiterate, particularly women.	C
		Gender gap may widen in terms of job opportunities.			
7	Children's Rights	Child labor may occur due to their parents' loss of job.	C	Child labor may occur due to their parents' loss of job.	C
		Children may lose education opportunities.		Children may lose education opportunities.	
		Playgrounds for children may be lost.		Playgrounds for children may be lost.	
		Children may catch infectious diseases triggered by outsiders' entry into the community.		Children may catch infectious diseases triggered by outsiders' entry into the community.	
8	Land Use and Utilization of Local Resources	The present potential site that has been selected is away from the city center, residential area, local market, and the protected forest.	C	The present potential site that has been selected is away from the city center, residential area, local market, and the protected forest.	C
		Temporary loss of present land use pattern and/or economic infrastructure may occur.		Permanent loss of present land use pattern and/or economic infrastructure may occur.	
9	Social Institutions such as Social Infrastructure and Local Decision Making Institutions	Disruption of local community may be caused by the conflict of interests among politicians, government offices, and residents. It may cause a delay in procedures of land acquisition and resettlement.	C	-	C

No	Item	Impact during Construction Stage		Impact during Operation Stage	
10	Existing Social Infrastructure	Temporary loss of existing social infrastructure may occur due to the construction works.	C	Traffic to/from power station may become heavier. Social services may become insufficient.	C
11	Cultural Heritage	There is no cultural heritage existing in the site. Careful consideration however should be given to the Tomb of Sultan Giasuddin and Shah Abdul Alla located 4 km away from the site. Landscape may be lost.	C	Careful consideration however should be given to the Tomb of Sultan Giasuddin and Shah Abdul Alla located 4 km away from the site.	C
12	Infectious Diseases such as HIV/AIDS	Infectious diseases may spread via the construction workers into the community.	C	Infectious diseases may spread via the operation workers into the community.	C

Source: PSMP Study Team

Mitigation measures on environmental pollution and natural environment are as found in AP Table 18-64.

AP Table 18-64 Mitigation Measures for Environmental Impact (Meghnaghat)

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
1	Air pollution	Countermeasures for air pollution by exhaust gas from transportation vehicles and construction machinery, and dust scattering due to construction traffic are studied as in AP Table 18-67 and AP Table 18-68. As for the reduction of exhaust gas from transportation vehicles and construction machinery, idling stops and keeping proper exhaust condition by routine inspection of vehicles are judged to be applied. As for countermeasures for dust scattering, load cover, periodical vehicle washing and periodic peripheral road cleaning are judged to be applied.	AP Table 18-62 shows countermeasures for NO_X, AP Table 18-63 shows countermeasures for SO_X, AP Table 18-64 shows countermeasures for soot, and AP Table 18-66 shows countermeasures for coal dust. Besides conducting flue gas treatment by system including FGD, SCR, and ESP etc., mitigation of coal dust scattering is paid attention to.
2	Water contamination	Countermeasures for water contamination due to excavation waste soil outflow are suitable via a fence installation utilizing sandbags etc. As for the effluent due to equipment washing, it is suitable to install a temporary precipitation tank and to drain the supernatant water. As for sewage, it is suitable to put up a septic tank. As for waste, water contamination can be prevented if waste treatment is conducted promptly and the waste is not left for long time.	There is no warm effluent water generation since cooling tower or air cooled condenser will be adopted as cooling system from consideration to impact of warm effluent water and local fishery. Plant effluent and sewage according to plant operations are discharged after waste water treatment including coagulating sedimentation, neutralization, and oil separation. Appropriate waste water facility capacity design is needed as condensed cooling water blow effluent is a large amount.

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
3	Soil pollution	AP Table 18-69 shows the study result of countermeasures for soil pollution by oil spillage from transportation vehicles and construction machinery. Periodic maintenance implementation and conducting pre-operational machinery checks of machinery is judged important to be applied.	Oil and grease treatment procedures make it clear to prevent the spillage of lubrication oil or fuel oil. The management organization has been established to implement works according to designated procedures. And action procedures are prepared in order not to spread the adverse impact in case of an oil spillage occurrence. An oil dike has been set around the oil storage tank.
4	Bottom sediment	Implement measures described in 2) Water contamination.	It is necessary to dump ash properties in dumping site with water proof seat to prevent bottom sediment leakage out of the ash pond.
5	Noise and vibration	AP Table 18-70 shows the study result of countermeasures for noise and vibration due to vibrations from transportation vehicles and construction machinery. Leveling the construction process, using low-noise machinery, and lowering vehicle speed in residential areas are judged to be proper countermeasures. As for countermeasures for noise by steam blowing during commissioning, the establishment of a work schedule without the blowing of steam during night time is judged to be applied.	Developing the green belt along the site border is a costless and effective way to mitigate noise and vibrational impact. If the boundary noise simulated in the detail EIA exceeds the noise regulations which is decided on each category (AP Table 18-8), the introduction of a green belt, sound insulating material and a sound insulating wall will be examined. Chittagong site is categorized in Industrial Zone[1].
6	Offensive Odor	Offensive odor caused by domestic waste decomposition from workers' camps can be prevented by the separate collection and periodic disposal of waste.	NOx mitigation without SCR which uses ammonia is an effective measure against offensive odor. When using ammonia, storage tanks, pipes, and valves must surely be inspected periodically. In addition to preventing operational mishaps, operations of the ammonia facility are to be strictly managed by the person in charge. With regards to garbage treatment, it is suitable to dump periodically and not keep in storage for a long time.
7	Waste	Reduction of waste amount can be conducted by establishing a waste management program including reduction, reuse, and recycling. Implementation of a thorough separate collection of the waste is also needed, especially for paint sludge and batteries. These items should be collected separately and disposed in designated areas.	Reduction of waste amount can be conducted by establishing a waste management program including reduction, reuse, and recycling. Because by-products due to plant operations are large amount, they should be recycled as much as possible. AP Table 18-71 shows examples of by-products recycling.

[1] Interviewed with DoE.

No.	Item	Mitigation measures during Construction Stage	Mitigation measures during Operation Stage
8	Biota and Ecosystem	Nest building of Red Headed Vulture, Painted Roofed Turtle and Fishing Cat should be examined in detail EIA, and the nest relocation should be conducted if there are any. Existence of endangered species should be carefully paid attention to during construction stage and necessary protection action should be conducted if there are any.	Nest building of Red Headed Vulture, Painted Roofed Turtle and Fishing Cat is examined in detail EIA, and the nest relocation should be conducted if there are any. Existence of each endangered species is carefully paid attention to during operation stage, and necessary protection act should be conducted if there are any.
9	Accident	A suitable OHS organization (policy, manual, announcement of policy, safety training and safety patrol) should be established to prevent accidents. It is also important to conduct quality control in construction work to prevent accidents during commissioning and operation period.	A suitable OHS organization (policy, manual, announcement of the policy and manuals, safety training, safety patrols) should be established for accident prevention. It is also important to conduct quality control in maintenance work prevent accidents.
10	Global warming	-	It is estimated that approximately 3.54 million ton of CO_2 will be emitted from per 600MW unit per year according to the operations of a coal-fired power plant. An ultra-super critical boiler with high thermal efficiency is being planned to be introduced into this master plan. Due to the introduction of a high efficiency unit, 1.07 million tons of CO_2 can be reduced per 600MW unit per year compared with the case of the Barapukuria class unit introduction. These figures are calculated based on designed value. It is important to keep designed output and efficiency from adequate O&M.

Source： PSMP Study Team

18.5 Other Information

APTable 18-65 Earthquake occurrence record in Bangladesh

Year	Scale								Annual total	Maximum magnitude
	Not clear	M3	M3 to M3.99	M4 to M4.99	M5 to M5.99	M6 to M6.99	M7 to M7.99	Over M8		
1918							1		1	7.6
1923							1		1	7.1
1927						1			1	6.5 ,
1930							2		2	7.1
1932							5		5	7.4
1933							1		1	7.6
1934						1		1	2	8.3
1935						3			3	6.5
1936							2		2	7.5
1938						3	1		4	7.2
1940						1			1	6.5
1941					1	3			4	6.8
1943							1		1	7.2
1954						1	1		2	7.4
1955						1			1	6.8
1956						3			3	6.3
1957						2			2	6.8
1958						1			1	6.4

Year	Scale								Annual total	Maximum magnitude
	Not clear	M3	M3 to M3.99	M4 to M4.99	M5 to M5.99	M6 to M6.99	M7 to M7.99	Over M8		
1959					1	1			2	6.1
1960					1				1	5.7
1963				5	7				12	5.6
1964				4	3	4			11	6.7
1965				1	5				6	5.9
1966				3	4				7	5.7
1967				4	8				12	5.8
1968				2	2				4	5.2
1969		2		3	6				11	5.9
1970				4	6	1			11	6.5
1971				6	5				11	5.5
1972	1			6	2				9	5.0
1973				6	5				11	5.3
1974			2	9	1				12	5.1
1975				4	4	1			9	6.5
1976	2		1	8	1				12	5.3
1977	1				1				2	5.6
1978	3								3	
1979	3								3	
1980	3					1			4	6.0
1982	2								2	
1983	3								3	
1984	1				4				5	5.6
1985	9								9	
1986	5								5	
1987	5								5	
1988	6								6	
1989	24								24	
1990	8								8	
1991	4			2	2				8	5.3
1992	7			12	6				25	5.8
1993	6		1	10	2	1			20	6.3
1994	4			2	3	2			11	6.2
1995	6			3	2	1			12	6.4
1996	7								7	
1997		11	1	1	3			1	17	8.5
1998		9		1					10	4.9
1999	21								21	
2000	14	3	4	6	3				30	5.5
2001	3	2	13	16	4				38	5.5
2002	2	4	16	23	3				48	5.5
2003	1	2	6	5	5				19	5.8
2004			3	8			1		12	7.4
2005		2	10	8	5				25	5.6
2006		1	4	8	3				16	5.9
2007		7	21	19	33	42	11	1	134	8.5
2008		7	16	55	158	73	13		322	7.7

Source： Bangladesh Meteorological Dept.

APTable 18-66 Major cyclonic storms from 1960 to 2007 in Bangladesh

Date of Occurrence	Nature of Phenomenon	Landfall Area	Maximum Wind Speed (m/s)
11.Oct.1960	Severe Cyclonic Storm	Chittagong	44.4
31.Oct.1960	Severe Cyclonic Storm	Chittagong	53.6
09.May.1961	Severe Cyclonic Storm	Chittagong	44.4
30.May.1961	Severe Cyclonic Storm	Chittagong (Near Feni)	44.4
28.May.1963	Severe Cyclonic Storm	Chittagong- Cox's Bazar	58.1

Date of Occurrence	Nature of Phenomenon	Landfall Area	Maximum Wind Speed (m/s)
11.May.1965	Severe Cyclonic Storm	Chittagong-Barisal Coast	44.4
05.Nov.1965	Severe Cyclonic Storm	Chittagong	44.4
15.Dec.1965	Severe Cyclonic Storm	Cox's Bazar	58.3
01.Nov.1966	Severe Cyclonic Storm	Chittagong	33.3
23.Oct.1970	Severe Cyclonic Storm of Hurricane intensity	Khulna-Barisal	45.3
12.Nov.1970	Severe Cyclonic Storm with a core of hurricane wind	Chittagong	62.2
28.Nov.1974	Severe Cyclonic Storm	Cox's Bazar	45.3
10.Dec.1981	Cyclonic Storm	Khulna	33.3
15.Oct.1983	Cyclonic Storm	Chittagong	25.8
09.Oct.1983	Severe Cyclonic Storm	Cox's Bazar	37.8
24.May.1985	Severe Cyclonic Storm	Chittagong	42.8
29.Nov.1988	Severe Cyclonic Storm with a core of hurricane wind	Khulna	44.4
18.Dec.1990	Cyclonic Storm (crossed as a depression)	Cox's Bazar Coast	31.9
29.Apr.1991	Severe Cyclonic Storm with a core of hurricane wind	Chittagong	62.5
02.May.1994	Severe Cyclonic Storm with a core of hurricane wind	Cox's Bazar-Teknaf Coast	77.2
25.Nov.1995	Severe Cyclonic Storm	Cox's Bazar	38.9
19.May.1997	Severe Cyclonic Storm with a core of hurricane wind	Sitakundu	64.4
27.09.97	Severe Cyclonic Storm with a core of hurricane wind	Sitakundu	41.7
20.05.98	Severe Cyclonic Storm with core of hurricane winds	Chittagong Coast near Sitakunda	48.1
28.10.00	Cyclonic Storm	Sundarban Coast near Mongla	23.1
12.11.02	Cyclonic Storm	Sundarban Coast near Raimangal River	18.1-23.6
19.05.04	Cyclonic Storm	Cox's Bazar Coast between Teknaf and Akyab	18.1-25
15.11.07	Severe Cyclonic Storm with core of hurricane winds	Khulna-Barisal Coast near Baleshwar river	61.9

Source： Statistical Yearbook of Bangladesh 2008

APTable 18-67 List of noise level on transportation vehicles, construction machinery[1]

Machine type	Specification	Noise level (dB)
Truck crane (hydraulic)	50t	116
Dump truck	11t	113
Back hoe	0.6m^3	110
Bulldozer	11t	99
Earth auger	25t	98
Hydraulic hammer	4.5t	95
Vibro-hammer	—	80
Concrete pumping car	65～85m^3/h	113
Concrete mixer	4.5 m^3	105
Air compressor	10.5～11.0m^3/min	105

Source: The Study on Bheramara Combined Cycle Power Station in Bangladesh, Final Report

[1]Noise source level has been calculated from the A-characteristic correction value at a distance of 7m from the construction machinery.

APTable 18-68 Countermeasures for NO_X

Countermeasures	Note	Evaluation
Reduction over-rich-air ratio	-	+
Low NO_X burner	-	+
Two-stage combustion	-	+
Flue gas recirculation	-	+
Denitrification equipment (SCR)	-	+
Denitrification equipment (Noncatalytic Reduction)	Low denitrification efficiency	-
Denitrification equipment (Activated carbon adsorption)	Enable to remove SO_X in the same time	+

Source： PSMP Study Team

APTable 18-69 Countermeasures for SO_X

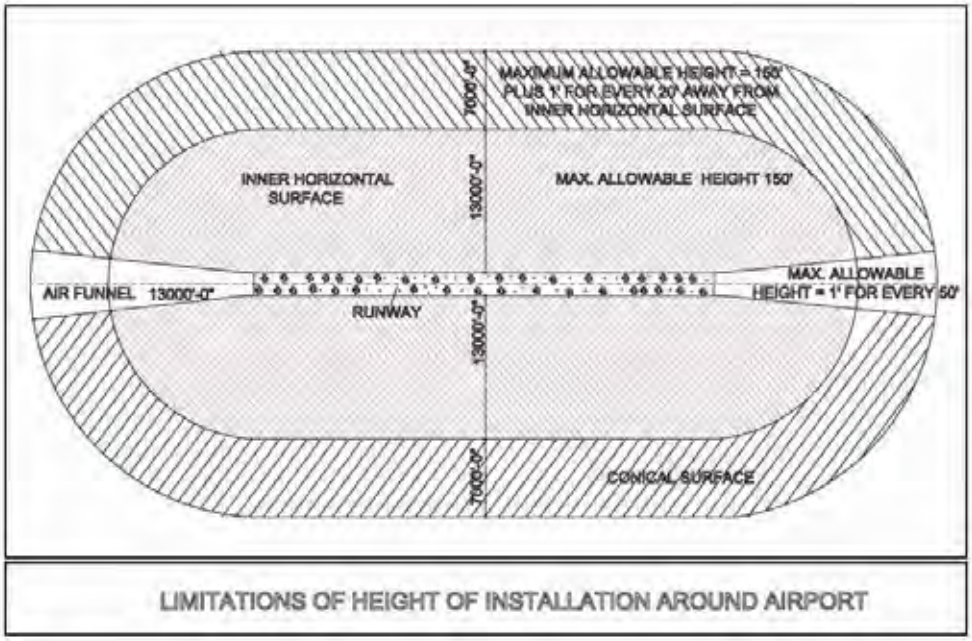
Countermeasure	Note	Evaluation
Reduction of sulfur content of fuel	-	+
FGD (Wet method : limestone gypsum method)	-	+
FGD (Wet method: Sea water scrubber method)	Impossible to get sea water	-
FGD (Dry method: Activated carbon adsorption)	-	+

Source： PSMP Study Team

APTable 18-70 Countermeasure for Soot

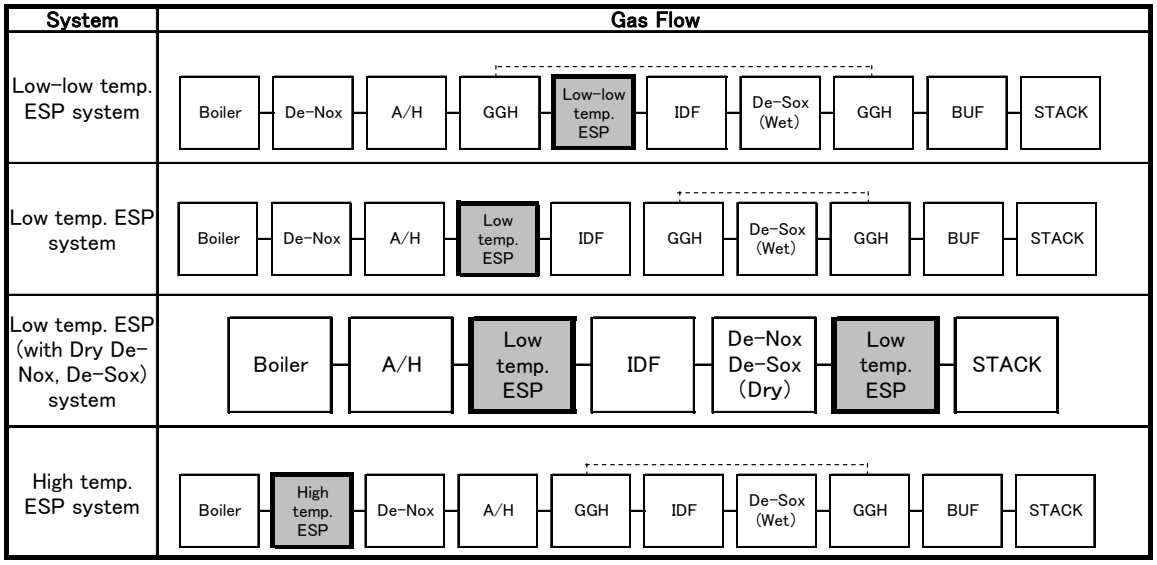
Countermeasures	Note	Evaluation
Dry ESP（high temperature）	There are some issues (increase the amount of treatment gas, heat resistant material for high temperature usage, heat extension and contraction).	-
Dry ESP（low temperature）	Need to pay attention to lower dust collection efficiency due to high resistivity of dust.	+
Dry ESP（low-low temperature）	Enable to compactify by decreasing amount of treatment gas. Adopted with wet FGD.	+
Wet ESP	Need to prepare large amount of water. Not suitable for high concentration dust.	-
Bag filter	It needs to replace the filter periodically and the running cost is high. There is the possibility of clogging according to ash conditions.	-

Source： PSMP Study Team



Source： Traffic service department, Civil Aviation Authority, Bangladesh

APFig. 18-13　Height regulation around airport



Source： PSMP Study Team

APFig. 18-14　Example of flu gas treatment system

APTable 18-71 Study items of flue gas treatment system

No.	Item
1	Desulfurization efficiency
2	Denitrification efficiency
3	Dust collection efficiency
4	Construction cost
5	Running cost ◆ Power consumption of fans and pumps ◆ Chemical consumption (ammonia, limestone) ◆ Water consumption ◆ Cost for catalyst
6	By-products
7	Any other necessary items

Source: PSMP Study Team

APTable 18-72 Countermeasure for coal dust

Countermeasures	Note	Evaluation
Covered conveyer	-	+
Sprinkler for coal storage yard	Effective also as measure for self-ignition	+
Windbreak fence	Average wind speed around site is under 2m/s throughout a year	-
Dust collector for coal conveyer	Effective also as measure for explosion protection	+

Source： PSMP Study Team

APTable 18-73 Countermeasure for air pollution due to exhaust gas from transportation vehicles and construction machinery

Countermeasure	Note	Evaluation
Decrease needles exhaust by idling stop	—	+
Use electric vehicles as transportation vehicles	Impractical	-
Keep proper exhaust condition by routine inspection	—	+

Source： PSMP Study Team

APTable 18-74 Measure for dust scattering due to construction traffic

Countermeasures	Note	Evaluation
Prevent dust scattering by load cover	—	+
Wash a vehicle periodically	—	+
Clean peripheral road periodically	—	+
Water peripheral road	It causes service water consumption increase.	-

Source： PSMP Study Team

APTable 18-75 Countermeasure for oil spillage during construction period

Countermeasure	Note	Evaluation
Implement periodically maintenance of machinery and exchange deteriorated seals	-	+
Check before operation and don't use deteriorated vehicles	-	+
Cover whole traffic area by sheet	Impractical	-

Source： PSMP Study Team

APTable 18-76 Countermeasure for Noise and Vibration during construction period

Countermeasure	Note	Evaluation
Level construction process and limit number of operation machinery at the same time	-	+
Use low-noise machinery (silencer, muffler)	Effective though it costs	+
Lower vehicle speed when passing inhabitant neighborhood such as residential area	-	-
Put temporary sound barrier work place surroundings	Impractical	-

Source： PSMP Study Team

APTable 18-77 Examples of by-product recycling

By-product	Examples of recycling
Coal ash (Fly ash)	Cement mixture material, Soil improvement material, brick, tile
Gypsum	Cement material, Gypsum board

Source： PSMP Study Team

APTable 18-78 Air cooled condenser precedents to 600MW class thermal power plants in China

Plant Name	Capacity
Zangshan Electric Power	2unit of 600MW
Datong Second plant	2unit of 660MW
Yanshan Lake power plant	2unit of 600MW

Source： PSMP Study Team

APTable 18-79 Items of environmental consideration regarding coal mine development

No.	Item	Content	Example
1	Land Use	Topsoil management	● Scrap the topsoil prior to drilling and blasting ● Scraped topsoil should be used immediately for plantation/agriculture ● If it is not possible to use the topsoil immediately, then it should be stacked at a designated area. ● The topsoil heap's height should not exceed more than 6 meters. Storage must be done in a pyramidal form, with garland drains all around. ● If the topsoil is to be stored for a long duration, it should have a vegetal cover of leguminous species.
		Overburden management	● Backfilling de-coaled areas ● Proper stacking and waste water treatment in the case of internal overburden dump
		Land subsidence management	● Planned subsidence by considering surface structures and human lives ● Simultaneous backfilling de-coaled area ● Fencing of the subsidence zone during active mining operation ● Filling of surface cracks and leveling of the area ● Preparing a subsidence monitoring program that covers the impact of subsidence on surface and ground water and its management ● Compensation to and rehabilitation of the affected people
2	Water Use	Water conservation	● Plan the mines in such a way that the impact on water bodies as well the surface drainage system remain minimal ● The area of influence of the cone of depression of groundwater should be estimated beforehand and the affected settlements should be provided with alternate

			water supply ● Reinjection of prior drainage of the aquifer
		Water pollution prevention	● Reuse of mine seepage water to mining operation ● Effluents from the colony and the workshop should be treated
3	Air environment	Air pollution prevention	● Drills should be provided with dust extractors ● Water spray before blasting ● Covering of the trucks to avoid spillage ● Provision water sprinklers on haul roads ● Use covered crusher unloading point, the crusher should be fitted with bag filter ● Closed conveyor transportation ● Put green belt around coal stock pile
4	Biodiversity	Biodiversity conservation	● Conduct sufficient biodiversity assessment at planning stage ● If it necessary, biodiversity conservation and relocation or rehabilitation of protected species are conducted. ● If the mining activity exercises high adverse impacts, then 'No Mining' is the best alternative.
5	Noise and vibration	Impact mitigation of noise and vibration to surrounding area and workers	● Use of controlled and advanced blasting techniques ● Conducting blasting only during the day time, as per a predetermined time schedule ● Reducing the exposure time of workers by practicing work rotation ● Noise attenuation by green belt
6	Mine closure	Proper mine closure plan	● Plan of environmental pollution prevention after mine closure ● Settling on final closure plan to create productive and sustainable land use of the mined area and accept the plan by stakeholders
7	Occupational health and safety issue	Safety measure of drilling	● Reduce workers exposure to noise and dust ● Wearing helmets, groves, earplugs, and masks ● Setting safety zone ● Prevent overburden collapse ● Prevent mine inundation (under ground mine)
		Mine fires prevention	● Organize initial fire fighting system ● Implement fire fighting training
		Roof collapse prevention (applicable in underground mine)	● Proper roof support design ● Mechanization of loading operations
		Worker's health surveillance	● Health survey programs for workers and local community ● Regular training and awareness of employees

Source：EIA Guidelines for Coal Mining 2009.3 DoE

18.6 Outline of simple diffusion calculation

(1) Summary

A simple diffusion calculation regarding the SO_X, SPM was conducted for the purpose of a rough impact analysis of the air environment by a 600MW coal-fired power plant based on this MP. Detailed diffusion calculation should be conducted after deciding on the site and the arrangements and specification of equipment appropriate to the site location's climate are conducted.

(2) Methodology

(a) Fuel specification

Two kinds of fuels, domestic coal and imported coal are selected as fuel. The specifications of domestic coal are determined from the analysis results of sample coal which were acquired from

the Barapukuria power plant. The PSMP Study Team has proposed the specifications of imported coal. Ash content and sulfur content are assumed to be the highest in the band.

APTable 18-80 Fuel specification

	Domestic Coal	Import Coal
Result of elementary analysis (%)		
Carbon	73.2	74.8
Hydrogen	4.84	5.3
Nitrogen	1.54	1.1
Total Sulfur	0.68	1.2
Sulfur in ash	0.08	-
Phosphorus	0.057	-
Oxygen	7.15	18.0
Industrial analysis(%)		
Water	9.5	17.3
Ash	12.6	11.2
Volatile matter	32.7	38.2
Fixed carbon	54.7	36.0

Source: PSMP Study Team

(b) Emission specification

APTable 18-81shows the emission specifications for this simple diffusion calculation. As for the stack height, it is set to 275m in adherence to emission regulations regarding sulfur dioxide from ECR and 140m in adherence to local stakeholder requirements. Further, in order to satisfy the World Bank guideline of emission concentration, high efficiency FGD and ESP usage is an assumed factor that is part of the calculation.

APTable 18-81 Emission specification

Item	Unit	Mine mouth power plant		Import coal power plant	
		Domestic coal		Import coal	
Emission volume (wet)	Nm^3/h	$1,516\times10^3$		$2,353\times10^3$	
Exhaust temperature	°C	90		90	
Exhaust velocity	m/s	21.5		33.3	
Actual Stock height	M	275	275	275	140
Desulfurization efficiency	%	97		97	
Dust removing efficiency	%	99.6		99.6	
Sulfur Oxide emission	k g/h	59.9		162.3	
Emission of soot and dust	k g/h	72.3		90.9	

Source: PSMP Study Team

APTable 18-82 Emission Concentration

Item	New mine mouth power plant	Import coal power plant	Emission standard of Bangladesh	IFC(WB) guide line
Emission concentration of sulfur dioxide	$39.5mg/m^3$	$45.1mg/m^3$	—	$850mg/m^3$
Emission concentration of soot and dust	$47.7mg/m^3$	$38.6mg/m^3$	$500mg/m^3$	$50mg/m^3$

Source: PSMP Study Team

(c) Other calculation condition

Because this estimation is a simple calculation, special climate conditions such as the inversion layer and down draft are not considered.

(d) Atmospheric diffusion estimation model

The diffusion estimation was conducted with the Plume formula, and it calculated a 10 minute average value and a 24 hour average value for SOx, 8 hours average and 24 hour average values for SPM. The estimation of diffusion width σ_y, σ_z was from the Pasquill STABILITY classification. Stability class A (very unstable) was excluded from the calculation conditions since the stack height was 275m. Further, the diffusion width σ_y is proportional to the p involution of average time s. The P was set 0.2 in the range of 3 minutes to a 1 hour average time, and 0.3 in the range of 1 hour to a 24 hour average time.

(e) Emission concentration formula

$$C = \frac{Q}{2\pi\,\sigma_y\sigma_z u}\exp\left(-\frac{y^2}{2\sigma_y^2}\right)\left\{\exp\left\{-\frac{(z-H_e)^2}{2\sigma_z^2}\right\}+\exp\left\{-\frac{(z+H_e)^2}{2\sigma_z^2}\right\}\right\}$$

symbol

C：Above-ground concentration at a leeward distance R (m)

Q：Emission volume (g/s)

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 the smoke source and calculated point (m)

Z：Above-ground height

He：Effective stack height (m)　He＝H+0.65（H_m+H_t）

H: Actual stack height (m)

Further, effective stack higher 'He' was calculated from Bosanquest's formula.

$$H_m = \frac{4.77}{1+\frac{0.43u}{v_g}}\sqrt{\frac{Q_{T1}v_g}{u}}$$

$$H_t = 6.37g\,\frac{Q_{T1}\Delta T}{u^3 T_1}\left(\log_e J^2+\frac{2}{J}\right) \quad -2$$

$$J = \frac{u^2}{\sqrt{Q_{T1}V_g}}\left(0.43\sqrt{\frac{T_1}{g(d\theta/dz)}}-0.28\,\frac{v_g}{g}\,\frac{T_1}{\Delta T_1}\right)+1$$

Symbol

H_m : Elevation by emission velocity(m)

H_t : Elevation by buoyancy(m)

u : Wind speed(m/s)

v_g : Emission velocity(m/s)

Q_{T1} : Emission volume (m^3/s) at temperature T1

T_1 : Ambient temperature(K)

ΔT : Difference between emission temperature and T_1 (K)

g : Gravity's acceleration(m/s^2)

$d\theta/dz$: Inclination of ambient temperature (°C /m)

(3) Result

As a calculation result, the maximum ground concentration satisfies the ambient air standard for both Bangladesh and World Bank guidelines based on the emissions specifications in AP Table 18-83.

AP Table 18-83 Maximum ground concentration

Item	Average time	Newly mine mouth power plant		Import coal power plant		ECR	IFC(WB guideline)
		275m	140m	275m	140m		
Sulfur oxide	24-hour	0.4μg/m^3	0.5μg/m^3	1.7μg/m^3	2.0μg/m^3	365μg/m^3	20μg/m^3
	10 minute	3.0μg/m^3	3.9μg/m^3	8.4μg/m^3	10.2μg/m^3	-	500μg/m^3
Soot and Dust	24-hour	0.7μg/m^3	1.0μg/m^3	1.1μg/m^3	0.5μg/m^3	65μg/m^3[1]	25μg/m^3[2]
	8-hour	1.3μg/m^3	1.7μg/m^3	2.0μg/m^3	0.9μg/m^3	200μg/m^3[3]	-

Source: PSMP Study Team

As for domestic coal that has low sulfur content, the ground concentration is able to meet World Bank guidelines even if there are no desulfurization conditions with 275m of stack height. However, the SOx concentration at the stack outlet is 1,316mg/Nm^3 and this value has not satisfied World Bank guideline 850 mg/Nm^3. Sulfur content needs to be below 0.4% to satisfy World Bank guidelines pertaining to stack outlet SOx concentration. Further, this result has been acquired from a condition of no other emission source and under sulfur contents other than assumed.

APTable 18-84 Estimated maximum ground concentration in the case of no desulfurization

Item	Average time	Newly mine mouth power plant (0% desulfurization rate)	ECR	IFC(World bank guideline)
Sulfur oxide	24-hour	16μg/m^3	365μg/m^3	20μg/m^3
	10 minute	80μg/m^3	-	500μg/m^3

Source: PSMP Study Team

[1] $PM_{2.5}$
[2] $PM_{2.5}$
[3] SPM

18.7 Terms of Reference for Resettlement Action Plan (DRAFT)

Table of Contents

Definition of Terms

Resettlement Plan is a time-bound action plan with resettlement strategy, objectives, impact, entitlement, socio-economic survey, policy framework, legal framework, measures to minimize impacts, resettlement site, compensation, income restoration, resettlement implementation arrangement, resettlement schedule, participation and consultation, grievance redresses, monitoring and evaluation, monitoring and evaluation, and possibly indigenous people development plan.

Project Affected Persons (PAPs) indicates any juridical person being as it may an individual, a household, a firm or a private or public who, on account of the execution of the project, or any of its components or sub-projects or parts thereof would have their:
right, title or interest in any house, land or any other asset acquired or possessed, in full or in part; or
business, occupation, work, place of residence or habitat adversely affected; or
standard of living adversely affected.

Compensation means payment in cash or n kind to replace losses of land, housing, income, and other assets caused by a project.

Entitlement defines a right to receive mitigation measures such as compensation, income restoration, relocation assistance, and other support.

Income restoration/Livelihood restoration/Rehabilitation means the process to restore income earning capacity, production levels and living standards in a longer term.

Replacement cost is the method of valuation of assets that helps determine the amount sufficient to replace lost assets and cover transaction costs.
For agricultural land, it is the pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
For land in urban areas, it is the pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
For houses and other structures, it is the market cost of the materials to build a replacement structure with an area and quality similar to or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor

and contractors' fees, plus the cost of any registration and transfer taxes.
In determining the replacement cost, depreciation of the asset and the value of salvage materials are not taken into account, nor is the value of benefits to be derived from the project deducted from the valuation of an affected asset.

Census is a data collection technique of completing enumeration of all PAPs and their assets through household questionnaire. Census's objectives are (i) to prepare a complete inventory of PAPs and their assets as a basis for compensation, (ii) to identify non-entitled persons, and (iii) to minimize impact of later influx of "outsiders" to project area.

Socio-economic survey is carried out in order to prepare profile of PAPs and to prepare for Basic Resettlement Plan. About 20 percent sample of PAPs population is surveyed through household questionnaire. The survey result is used (i) to assess incomes, identify productive activities, and plan for income restoration, (ii) to develop relocation options, and (iii) to develop social preparation phase for vulnerable groups.

Cut-off date determine eligibility for entitlement. It is normally the date census begins. The cut-off date could also be the date the project area was delineated, prior to the census, provided that there has been an effective public dissemination of information on the area delineated, and systematic and continuous dissemination subsequent to the delineation to prevent further population influx.

Vulnerable group is defined as the indigenous people, ethnic minorities, the poorest, women, children, the aged, the disabled, and other socially/economically vulnerable groups who would be adversely affected from a project.

Grievance Redress procedures set out the time frame and mechanisms for resolutions of complaints about resettlement from PAPs. Grievance redress can be provided through informally-constituted local committees with representation from key stakeholder groups. Grievances can also be addressed through formal channels, with unresolved grievances being dealt with at progressively higher levels.

Introduction

Project Scope
Project background
Objectives of the project
Project Scope
Project location map
1.2 Objectives of Resettlement
Land acquisition and resettlement principles and objectives
Consideration under the "JBIC Guidelines for Confirmation of Environmental and Social Considerations (2002. 4)"
Legal framework

Scope of Land Acquisition and Resettlement

Land acquisition
Map of the area and villages affected by land acquisition
Total land area acquired for the project
Population/households affected from land acquisition and resettlement
Total number of PAPs
Size of relocation (number of population/households to be relocated)
Size of those who lose their assets
Size of those whose business, occupation, work are adversely affected
Socio-economic profiles of PAPs
Size, gender, age, number of school children of each household
Occupation and means of livelihood
Income level and economic activities of PAPs, including vulnerable groups
Race, language, religion

Social support system, infrastructure of the community
Needs of PAPs regarding the income restoration program and relocation
Perception towards the project and resettlement, etc.
Census and Inventory of losses
Demographic, education, income and occupational profiles of PAPs
Land type and land use(agricultural, residential, commercial land)
Type of crops and trees
Buildings type (size, materials used)
Inventory of common property resources
Inventory of assets to be acquired
Existing civic facilities and infrastructure, etc.
Information on those without legal title to land or assets

Measures to minimize Land Acquisition and Losses

Actions and measures to be conducted for minimizing impact
Consideration of alternatives with special attention to avoid and minimize involuntary resettlement

Resettlement Policy and Entitlement

Compensation policy
Eligibility for compensation/assistance/rehabilitation
Entitlement Matrix
Assistance, support, compensation options
Cut-off date
Compensation/assistance policy towards those who without legal title

Resettlement Site

Method of site selection and site alternatives
Location, layout, and design of resettlement site
Resettlement site development (infrastructure, social service, etc.)

Income Restoration Program

Background of Income Restoration
Objective and policy of income restoration
Income Restoration Program
Constraints and opportunities for income generation
Analysis of needs, capacity, and existing skills of PAPs
Analysis of economic activities of PAPs and communities
Consultation and participation process
On-going income-generating or livelihood development programs (e.g., poverty alleviation) in the project area
Provisions for group-specific, targeted income restoration plans (e.g., microcredit or small development)
Income restoration options
Financial source of income restoration plans
Implementing arrangement of the program (e.g., assistance from government agencies, community organizations, NGO, or CBO)
Consideration of vulnerable people
Program implementing schedule
Monitoring

Implementation Arrangement

Responsibilities and roles of related organization (organizations in charge of Basic Resettlement Plan preparation, resettlement execution, land acquisition, monitoring, consultation, resettlement site preparation, income restoration, etc.)
Description of cooperation between related organization (e.g., coordination between an executing agency and NGO/CBO.

Implementation Schedule
Schedule of resettlement-related activities (see attachment for sample schedule form)

Participation and Consultation
Policy of participation and consultation
Place, timing, method, topics, meeting memorandum of public consultation meeting held in the past (including PAPs' opinion regarding the project and resettlement)
Plan of participation and consultation
Leaflet of resettlement distributed to PAPs, including followings:
Objectives of the Project
Service area of the Project and Project site
Cost estimation and sources of capital
Project Implementation Planning (i.e., F/S, EIA, and Basic Resettlement Plan preparation)
Project Impact
Definition of Eligibility
Resettlement and compensation principles
Compensation policy
Subsidize allowances
Settling complain (Grievance Redress procedure)
Note: Leaflet should be attached in the Annexes.

Monitoring and Supervision
Monitoring of flowing aspects:
Performance monitoring: physical progress against milestones established in the Resettlement Plan
Impact monitoring: assessment for the effects of resettlement (effectiveness of the Resettlement Plan and its implementation in meeting the needs of the PAPs)
Internal performance monitoring process (method, indicators, period, frequency, implementation arrangement of the monitoring)
Methodology of for external monitoring
Frequency of reporting and content for internal and external monitoring
Evaluation method of monitoring result
Process for integrating feedback from internal monitoring into implementation

Grievance Redress
Step-by-step process for registering and addressing grievances and specific details regarding a cost-free process for registering complaints, response time, and communication modes
Mechanism for appeal
Provisions for approaching civil courts if other options fail

Cost Estimate
Statement of financial responsibility and authority
Source of funds and the flow of funds
Estimated budget, by cost and by item, for all resettlement costs including planning and implementation, management and administration, monitoring and evaluation and contingencies
Provisions to account for physical and price contingencies

18.8 Terms of Reference for Environmental Impact Assessment (DRAFT)

18.8.1 Objective:
To conduct an EIA study regarding the coal-fired power project (600MW 2-3units) planned in PSMP2010.

18.8.2 Scope of Work

The scope of work covers mainly the EIA study of proposed project. The study should specifically include the following:

A review of the findings of the IEE study concentrating on important environmental components which are likely to be impacted from the project.
To collect baseline environmental and social condition data from both primary and secondary data.
To conduct a detailed air quality assessment
To conduct ambient noise monitoring
To conduct a surface water and ground water laboratory analysis.
To implement Thermal Plume modeling regarding the proposed coal fired power plant
To conduct a laboratory analysis of the dredged river, sea or pond material
To conduct an ecological survey
To review Bangladesh's cyclonic storms
To conduct a road and river traffic survey
To implement a detailed land-use survey conducted utilizing an appropriate method (e.g. spatial decision support system)
To assess environmental and social impacts and study mitigation or avoidance measures
To prepare an environmental management plan (EMP) which should include mitigation measures, enhancement measures compensation measures and an environmental monitoring plan

18.8.3 Content of EIA study report

EIA study report should include following:

- Policy and Legislation related to environmental issues in Bangladesh
- The role of the Department of Environment in the institutional analysis
- A detailed study on the potential impacts, mitigation measures and environmental management plan
- Environmental monitoring reports and final evaluation report of the project
- Identification and Analysis of Potential Impacts
- Analysis and Description of the Mitigation Measures
- A detailed technical and financial proposal shall be operated by the proponent's own resources (equipments and expertise)
- Other necessary information