Environmental Impact of Coal based Power Plant of Rampal on the Sundarbans (World Largest Mangrove Forest) and Surrounding Areas

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Abstract

The physico-chemical conditions of air, water and soil, and biological conditions of the proposed Coal based Power Plant area (Rampal), Mongla and the Sundrabans were studied from August 2011 to July 2013 to assess the possible environmental impact on the Sundarbans and surrounding areas. Environmental Impact Assessment (EIA) of physical, biological, social and economic environment of the study areas indicate that most of the impacts of coal-fired power plant are negative and irreversible (-81) which can't be mitigated in any way. It is indicating that climate, topography, land use pattern, air and water quality, floral and faunal diversity, aquatic ecosystems, capture fisheries and tourism of the Sundarbans and the surroundings areas would be affected permanently due to proposed coal fired power plant. Increasing of water logging conditions, river erosion, noise pollution and health hazards; decreasing of ground water table; loss of culture fisheries, social forestry and major destruction of agriculture would be happened due to coal fired power plant. The benefits of proposed coal fired power plant of Rampal is very poor (S+19) than that of negative irreversible impact (-81). So the proposed area is not suitable to establish the coal based power plant as the Sundarbans and surrounding areas would be affected permanently by establishing the proposed coal power plant.

Keywords: Coal; Power Plant; Rampal; The Sundarbans; Environmental Impact

Research Article

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Introduction

Coal based power plant produce electricity by burning coal in a boiler to heat water to produce steam. The steam, at tremendous pressure, flows into a turbine, which spins a generator to produce electricity. A typical 500-megawatt coal power plant creates more than 125,000 tons of ash and 193,000 tons of sludge each year which contain arsenic, mercury, chromium, and cadmium etc. and more than 75% of this waste is disposed of in unlined, unmonitored onsite landfills and surface impoundments as a result source of drinking water (ground water) is being contaminated and damage vital human organs and the nervous system[1]. According to the studies of Billings [1-3] ecosystems have been damaged sometimes severely or by the disposal of coal plant waste and heat. A coal power plant uses only 33-35% of the coal's heat to produce electricity and rest of the heat is released into the atmosphere and absorbed by the cooling water [4]. Once the 2.2 billion gallons of water have cycled through the coal-fired power plant, they are released back into the lakes, rivers, or oceans with chlorine or other toxic chemicals which water is hotter (by up to 20-25° F) than the natural water that receives it and this "thermal pollution" can decrease fertility and increase heart rates in fish [1].

According to [2], burning coal is a leading cause of smog, acid rain, global warming, and air toxics. Bangladesh government has decided to establish 1320MW coal-fired power plant at the mouth of the Sundarbans under Rampal upazila of Bagerhat district beside the Poshur river. The Bangladesh government signed a joint venture agreement with India's state-run electricity generation company (National Thermal Power Company) on 29 January 2012 to implement this project. By implementing this coal-fired power plant the Sundarbans will be affected as the sundarbans situated only 9km downstream from the project site [5,6]. The Sundarbans- the largest single tract mangrove forest has been declared Ramsar Site and Natural World Heritage which is situated in the South-West area (21º 31'-22º 38'N and 89º 00'-89º 55' E) of Bangladesh. It is intersected by a network of tidal canals, creeks and rivers. It is covered an area of 6000 km^2 of which 3956 km^2 mangrove forest lands and more than 1800 km^2 water bodies [7]. This tidal forest is very rich with natural resources especially floral and faunal diversity like 66 species of plants, more than 200 fish species, 42 mammals, 234 birds, 51 reptiles, 8 amphibians, a lot of invertebrates etc.[8,9]. More than 500 thousand peoples are directly and indirectly depending on the Sundarbans for their livelihoods as well as socio-economic purposes. Around 200 thousand people go to the Sundarbans regularly to collect the resources for their livelihoods; less than 200 thousand collect the resources seasonally and around 100 thousand people are doing business of the collected resources and they never go to the Sundarbans directly for resources extraction; roughly 22% people's livelihoods are involved with the collection of wood resources; 5% are involved with the non-timber forest

product; 69% are involved with the aquatic resources and 4% are involved with other purposes [10,11]

Government has acquired 1,834 acres of agriculture land in Satmari-Katakhali and Koigordashkathi areas under Rampal upazila to establish the power plant. Only 86 acres lands are *kash* land and rest of the lands are public lands which were used for rice and fish cultivations by the land owners. The government has also taken an initiative for dredging 10 kilometers of the Poshur river to allow easy access of ships carrying coal for the plant [8,12]. Due to an inadequate supply of local coal, the operator suggests to use imported coal. The Bangladesh government has decided to bring coal inside the Sundarbans through the Mongla sea port. Indian National Thermal Power Company and Bangladesh Power Development Board are the two signatories of the project. The proposed power plant will burn around 4.75 million tonnes of coal annually when more or less 0.71 million tonnes ashes and around 0.5 million tonnes sludge and liquid waste may be produced (CEGIS 2013). It would also emit a good amount of carbon dioxide (CO_2) - key factor for global warming - some other toxic gases and airborne particles, according to Union of Concerned Scientists, a USA-based group. [5,12] discussed on the types and levels of pollution of coal-fired power plant. The ground water and water of the Poshur river may be polluted by the huge amount of waste produced due to burning of the coal. Whereas the existence of strict laws to protect the environment and the wildlife, the government has recently decided to declare a part of the Poshur and Andharmanik rivers sanctuaries for dolphins (Sankar 2012). Due to the Ecologically Critical Area (ECA) rules no power plant should be set up within 12km of the Sundarbans buffer zone [13]. The proposed project is 4km away from the buffer zone of the Sundarbans. According to Ministry of Environment and Forests (2010) of India, any thermal power plant can't be established within 25 km from any natural forest or wild life habitats. But no such data or information on the possible environmental impact of proposed coal based power plant on the Sundarbans and Rampal areas are available. Under the circumstances, it has become imperative to institute an investigation on the estimation of coal-fired power plant hazards and their impacts on the floral and faunal communities of the Sundarbans and surroundings of the project area. The present study deals on the possible impact of coal-fired power plant of Rampal on the ecological and biological conditions of the Sudarbans and surroundings areas of the power plant. The findings of the study will help scientifically to assess the suitability of the coal based power plant in the proposed site.

Materials and Methods

The research was studied from August 2011 to July 2013 in 10 permanent stations of each study area (Rampal, Mongla and the Sundarbans). Monthly sampling was carried out and air, water, soil and biological samples were studied in the field and laboratory. Secondary data were collected from published documents and different government offices. All data were analyzed and potential environmental impacts were indentified and calculated by using standard tools and methodologies [14]. The samples of the river Pashur and Maidara were collected by using a country boat. Water samples were collected from 10-25 cm depth by using a scale [15] for physico-chemical analysis. A standard Secchi disc was used to measure the transparency of water while for water temperature a digital thermometer was used (Model No. 950). In situ measurements of total dissolved solids (TDS), conductivity, salinity, pH, and dissolved oxygen (DO) were carried out with the help of respective portable field meters. Titrimetric methods were used to determine free CO_2, CO_3 and HCO_3 alkalinities (Welch 1948). BOD_5, COD, NO_3.N and other chemical parameters were measured following APHA (1989). Total hardness, calcium and magnesium were estimated following [16]. Phosphate and silicate were measured following [17]. Air and Noise Pollution have been measured by using instruments with the help of Environmental Science Discipline, Khulna University, Khulna. Emission rate of Suspended Particle Matter (SMP), SO_X and NO_X were measured by using High volume sampler (Envirotech APM-415). Noise pollution was measured using Sound Level Meter (Lutorn, SL-4010). The sound level meter consists of microphone that converts the pattern of sound pressure fluctuations into an electrical voltage, amplifier and a voltage meter that is normally calibrated to read the decibel (dB). Shovels and large ladders were used to collect the soil samples according to [18] Soil quality was determined in the laboratory by following [19,20]. The populations of aquatic and terrestrial plants in field were measured by following quadrat method (Ambasht 1974). Standard observations and monitoring methods [21] (Foot/Pug marks per quadrat area/ a standard area curve) were followed for different faunal study. Latitude and longitude were measured by using a hand GPS meter (model GARMIN GPSMAP® 78s). Statistical analysis among the different parameters was done by following [22].

Environmental impact assessment (EIA)

Most of the development projects produce impacts on or changes in the state of natural environment. Of which some are positive and some are negative. Similarly, some positive and negative impacts have been identified for the Coal based Power Plant Project. The DOE (1997) guidelines for industries, ADB (2003) environmental assessment guidelines for initial environmental evaluation (IEE) and FPCO (1992) EIA guidelines were followed during impact assessment. Screening and scoping were used to determine the environmental issues and impacts for Coal fired Power Plant Project and identified as IECs. These issues and impacts had been evaluated in terms of distribution, quantity, quality, seasonality, ecological and socio-economic importance.

The sources of information for the scoping process were

1. Field visits and environmental survey;

2. Collected data from KDA, Khulna University, DPHE, BWDB, Meteorological Department, Bangladesh Atomic Energy Center, Upazilas, UPs, NGOs etc.

3. Meeting with chairmen, members, local people, govt. officials, teachers, social workers.

Selection of important environmental components (IECs)

Through the screening and scoping process (ADB 2003), the IECs relevant to environmental study of the proposed coal fired power plant project had been identified and presented in vertical column of table 15. The IECs are climate, topography, land use, flood, river erosion, drainage congestion, surface water

pollution, groundwater table depletion, groundwater pollution, loss of wetlands, air pollution, noise pollution, loss of habitats and biodiversity, loss of capture fisheries and agriculture, human population, literacy, status of women, water supply, sanitation, electricity and telephone facilities, health services, human diseases, solid waste, urbanization, industrialization, employment, business opportunity, housing, transportation, markets and bazaars, traffic congestion, fire hazard and tourism.

Impact assessment matrix

The impact assessment matrix is presented in table 15 identified the potential impacts of coal based power plant of Rampal. The assessment matrix was done in consultation with multi-disciplinary team members. When an impact could not be quantified, qualitative judgment was used based on professional experience. The scoring was done within a 21 point score scale ranging from –1 to –10 for negative impacts and +1 to +10 for positive impacts while "0" was used for no impact (neutral impact) (Pastakia and Jensen 1998).

Results and Discussion

The physico-chemical conditions of air, water and soil of the proposed coal fired area (Rampal), Mongla and Sundrabans were studied and data are presented in Tables(1-6). The biological components of the study area had also been studied (Tables 7-14) which are presented in the following pages. Wind direction for the last ten years of the study areas was north to south or north-west to south-east facing from the month of November to February in every year. In the study areas monthly average air temperature varied from 13.5 to 35 °C; relative humidity and rainfall varied from 65 to 86% and 7 to 320mm; SPM, NOx and SOx varied from 145 to 312 mg/m^3, 12 to 109 µg/m^3 and 9 to 61 µg/m^3 respectively. Surface water temperature, TDS, conductivity, salinity, pH, DO, BOD_5, COD, total hardness and PO_4 varied from 22 to 35.5°C, 3 to 23 g/l, 4 to 16.6 ms/cm, 2 to 22 ppt, 7.1 to 8.9, 6.1 to 8.1 mg/l, 1.3 to 2.4 mg/l, 3.5 to 9.1 mg/l, 660 to 1210 mg/l and 1.53 to 2.55 mg/l respectively. Ground water arsenic varied from 0.01 to 0.21 mg/l. Soil pH, Sulpher and Iron were recorded from 7.3 to 8.1, 44.5 to 1031 micro-gram/g soil and 16 to 108 micro-gram/g soil respectively. During the period of study total 24 herbs, grasses and shrubs were recorded and among them 8 were rare in the project area and 2 were also rare outside of the project area. A total 47 natural woody plants and fruit trees were recorded and among them 5 were in extinct condition, 15 natural woody and fruit trees, and 8 natural woody and fruit trees were recorded as rare in the project and outside the project area respectively. Out of 36 medicinal plants and non-fruit trees 8 species were in extinct condition and 20 were recorded as rare in the project area; 14 medicinal plants and non-fruit trees were also recorded as rare outside of the project area. 6 aquatic macrophytes were recorded as rare out of 14 species. A total 59 species of shrimp, crab, mollusks and fishes were recorded but 18 fishes were extinct and 10 fishes were rare in the project area. 7 species of shrimp, crab and mollusks were also rare in the project area. During the period of study only 3 amphibians were recorded in the project area but 2 were rare. 11 reptiles were recorded in the project area but 2 were extinct and 4 were rare species. In the period of study 24 terrestrial and 10 wetlands birds were recorded but among them 7 rare and 3 extinct terrestrial birds, and 6 extinct and 2 rare wetlands birds were recorded. Only 11 mammals were recorded during the period of study but most of them were extinct in the project area and those were also threatened outside of the project area.

Table 1: Monthly prevailing winds speed in knots and direction of the study areas from 2003-2012.

Year	Jan.		Feb.		Mar.		Apr.		May.		Jun.		Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir
2003	3.4	N	2.9	NW	3.8	NW	4.7	S	5.2	S	4.8	S	4.0	S	3.8	S	3.4	S	3.0	S	2.6	N	2.3	NW
2004	3.3	NW	3.3	NW	3.4	S	4.9	S	4.8	S	3.4	S	3.3	S	3.3	S	4.1	SE	3.6	E	2.1	NW	2.5	NW
2005	2.9	NW	3.0	N	4.0	S	4.6	S	4.1	S	3.9	S	3.6	S	3.5	S	3.0	S	2.4	S	2.1	NW	2.3	NW
2006	2.8	NW	2.8	NW	3.0	S	5.0	S	3.9	S	3.8	S	3.4	S	2.9	S	2.8	S	2.4	S	2.3	N	2.5	N
2007	2.7	N	3.6	N	3.9	S	4.8	S	4.4	S	3.2	S	3.0	S	3.0	S	2.6	S	2.7	N	2.5	N	2.4	N
2008	3.1	N	3.3	NW	3.6	S	4.8	S	4.0	S	4.1	S	3.5	S	3.0	S	2.6	S	3.4	E	2.2	NW	2.9	N
2009	3.6	N	2.9	NW	3.9	S	5.3	S	3.2	S	2.8	S	3.3	S	4.0	SE	3.7	S	2.3	NW	2.2	NW	2.4	N
2010	2.8	N	2.7	S	2.8	S	2.9	S	3.2	S	3.5	S	3.3	S	2.7	S	4.3	SE	3.0	S	2.3	NW	2.4	NNW
2011	2.6	N	2.6	S	2.1	SW	2.8	S	3.7	S	3.9	S	2.9	S	2.9	S	4.4	S	2.8	S	4.0	N	3.2	N
2012	2.8	N	3.4	S	3.2	S	3.5	S	3.0	S	3.1	S	3.3	S	2.9	S	3.4	S	2.4	W	2.5	N	2.3	N

Source: Bangladesh Metrological Department, 2013

Table 2: Climatic conditions of the study areas (10 years average).

Parameters	Month											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Temp. Avg. Max. (°C)	25.1	30	32.6	34.9	35	34.9	32.8	32.7	31.9	31.9	29.8	26.4
Temp. Avg. Min. (°C)	13.5	17.3	22.1	25.2	25.9	27.3	27.1	25.6	23.8	23.8	18.5	14.5
Temp. Mean (°C)	17.2	20.4	25.2	29.3	29.8	29.8	29.3	29.4	28.9	27.4	23.7	19.2
Relative Humidity Mean (%)	69	65	72	76	79	86	83	81	79	77	72	70
Rainfall Mean (mm)	7	10	148	47	215	103	314	246	320	110	18	9
Sunshine Hour (hr)	6.9	8	8.3	8.3	7.2	5.5	4.5	4.8	5.3	7.2	7.9	7.6
Wind Speed Avg.(Nautical miles/hr)	7.6	10.7	9.7	13	14.2	12.7	12.5	9.6	11.6	7.9	7	6.7

Source: Khulna Meteorological Office, 2013

Table 3: Air Quality of study Areas.

Study Location	SPM (mg/m^3)		NO_x ($\mu g/m^3$)		SO_x ($\mu g/m^3$)	
	Working Day	Holiday	Working Day	Holiday	Working Day	Holiday
Rampal area	172-292	268	53-85	72	37-52	45
Mongla area	183-312	314	65-109	98	45-61	52
Sundarbans area	145-179	-	21-Dec	-	15-Sep	-
EQS- Bangladesh	400		80		80	

Table 4: Physico-chemical conditions of water of the study areas.

Parameter		Rampal		Mongla		Sundarbans	
		Range	Mean Value	Range	Mean Value	Range	Mean Value
Air temp.	°C	24-37.5	30.6±0.8	24- 38.5	30.7±1.1	24-38.5	30.8±1.1
Water temp.	°C	22-35	28±0.6	22.5-35.5	28.3±0.4	22.5-35.5	28.5±0.7
Transparency	cm	19-37	25±2	18-33	21±3	17-32	20±2
TDS	g/l	3-20 g/l	10±1 g/l	8.2-23 g/l	16±5 g/l	10-23 g/l	17±6 g/l
Conductivity	ms/cm	4- 16.5	9.95±0.42	7.78-14.1	11.44±0.93	9.91-15.6	12.26±0.49
Salinity	ppt	19-Feb	12±3	21-Aug	14±4	22-Aug	15±5
pH	-	7.1- 8.7	7.4±0.3	7.3-8.9	7.5±0.7	7.5-8.9	7.7±0.7
DO	mg/l	6.1- 7.5	6.4±0.2	6.3-8.1	6.5±0.6	6.3-7.9	6.5±0.4
BOD_5	mg/l	1.3-2.3	1.4±0.5	1.7-2.4	1.6±0.5	1.3-2.4	1.4±0.6
COD	mg/l	7.5-8	7.7±0.4	8.6-9.1	8.9±0.4	3.53-4.02	3.8±0.4
CO_2	mg/l	0-6	2.5±3.5	-	-	-	-
CO_3 alk.	mg/l	16-Jun	11±7	14-30	22±11	9-Jun	8±2
HCO_3 alk.	mg/l	100-148	133±22	99-128	110±15	61-77	69±11
Total Hard	mg/l	660-1022	710±25	910-1190	955±34	920-1210	990±103
Ca^{2+}	mg/l	476-641	511±33	519-683	566±66	535-716	615±22
Mg^{2+}	mg/l	377-385	378±6	330-412	371±58	413-460	437±33
PO_4	mg/l	1.53-1.87	1.63±0.19	1.65-1.78	1.71±0.12	1.76-2.55	1.82±0.11
Silicate	mg/l	4.96-6.93	5.74±0.26	5.78-6.99	5.95±0.27	6.01-7.12	6.26±0.24
NO_3.N	mg/l	2.51-3.93	3.18±0.53	2.49-3.73	2.86±0.53	2.33-3. 51	2.75±0.47

- = Not detected

Table 5: Physico-chemical conditions of groundwater of the study areas.

Parameter	Units	Value		
		Rampal	Mongla	Sundarbans
Depth	m	60-125	75-140	75-140
pH	-	7.5-7.9	7.4-8.1	7.5-8.2
TDS	mg/l	454-1660	617-2584	635-2610
E. Conductivity	µs/cm	908-3270	1170-3654	1126-3709
Salinity	ppt	00-13	16-May	16-May
Arsenic	mg/l	0.01-0.21	0.01-0.17	0.01-0.12
Total Iron	mg/l	0.16-2.89	0.34-3.24	0.18-3.29
HCO_3	mg/l	315-651	244-632	229-645
Ca^+	mg/l	39-122	37-151	29-154
Mg^+	mg/l	15-63	22-82	23-89
Na^+	mg/l	135-514	154-642	164-657
Uranium	Ppb	4.46-11.58	-	-

Source: Field study 2011-2013.

Table 6: Chemical properties of the soils of the study areas.

Type of soil associations														
Study area	pH	Salinity ppt	Org. Mat %	N %	P	S	Zn	Br	K	Ca	Mg	Cu	Fe	Mn
					micro-gram/g soil				mv/100g soil			micro-gram/g soil		
Rampal	7.3-8.1	2.3-7.8	1.7-2.7	0.07-0.15	Sep-60	170-476	1.6-3.3	0.76-	0.59-0.85	8.3-3	1-6.33	4.7-9.3	21-108	12-46.6
Mongla	7.3-8.1	5-8.5	1.63-2.23	0.07-0.11	4.2-8.2	280-1031	0.4-0.6	0.53-1.55	0.57-1.24	11-21.5	5.05-9.75	2.8-6.2	16-66	22-Apr
Sundarbans	7.6-8.1	3.0-19	1.37-2.8	0.07-0.15	4.1-7.5	44.5-387.3	0.56-0.99	0.56-2.54	0.27-1.16	3-34.5	5-12.5	3.91-7.67	20.5-72	10.6-35

Source: Field study 2011-20013

Table 7: Herbs, grasses and shrubs of the study areas (except the Sundarbans).

Local Name	Scientific Name	Status	
		Outside the project area	Project area
Herbs and grasses			
Assamlata/Baraty	*Eupatorium odoratum*	Vc	C
Bish-katali	*Polygonum hydropiper*	C	R
Badaeya	*Andropogon aciculatus*	C	F
Banna danga shak	*Amaranthus viridis*	F	F
Bilai achra	*Mucuna pruriens*	F	F
Dubba ghas	*Cynodon dactylon*	Vc	C
Fenkachu/Mankachu	*Alocasia indica*	F	R
Fanimonasha	*Euphorbia neriifolia*	R	R
Gimashak	*Glinus oppositifolius*	C	R
Kukurmuta	*Blumea lacera*	C	F

Khuirakata/Kata danga	*Amaranthus spinosus*	F	F
Kachu	*Colocasia esculenta*	Vc	C
Kashjar	*Saccharum spontaneum*	F	R
Lajjabati	*Mimosa pudica*	R	R
Marich (Banna)	*Croton bonplandianum*	C	F
Shealmotra	*Vernonia patula*	F	F
Telakucha	*Coccinea cordifolia*	C	F
Shrubs			
Varanda/Venna	*Ricinus communis*	F	R
Bhat	*Clerodendrum viscosum*	C	F
Bet	*Calamus sp.*	F	E
Dhaincha/Dhanchi	*Sesbania cannabina*	F	R
Gagra	*Xanthium strumarium*	C	F
Chitki	*Phyllanthus reticulatus*	C	F
Titabegun	*Solanum torvum*	F	F

Status: Vc-very common, C-common, F-fairly common, R-rare, E-endangered, T-threatened, Et-extinct

(Source: Field study 2011-2013).

Table 8: Natural woody plants and fruit trees of the study areas (except the Sundarbans).

Local Name	Scientific Name	Status	
		Outside the Project Area	Project Area
Natural woody plants			
Bannay	*Crataeva religiosa*	R	Et
Debdaru	*Polyalthia longifolia*	R	R
Jobb dumur	*Ficus racemosa*	F	R
Kharajura	*Litsea monopetala*	F	R
Kadam	*Anthocephalus chinensis*	F	R
Gab	*Diospyros peregrine*	F	Et
Gudu/Pitadonga/Medda	*Trewia nudiflora*	F	F
Khoksha/dumur	*Ficus sp.*	C	F
Kharchuna/Teet gila	*Derris indica*	R	R
Chattim/Chaitan	*Alstonia scholaris*	R	R
Shaora	*Streblus asper*	F	R
Titijam	*Eugenia sp.*	F	Et
Iika	*Alangium salvifolium*	F	Et
Pitraj	*Amoora rohituka*	C	F
Jarul	*Lagerstroemia speciosa*	F	R
Hijal	*Barringtonia acutangula*	E	Et
Harhari/Shola	*Trema orientalis*	F	F
Nim	*Azadirachta indica*	F	R
Shimul	*Salmalia malabarica*	F	R
Fruit trees			

Aam	*Mangifera indica*	Vc	C
Amloki	*Phyllanthus emblica*	R	R
Amrah	*Spondias pinnata*	F	F
Ata (Sharpha)	*Annona squamosa*	F	F
Ata (Nuna)	*Annona reticulata*	F	F
Bel	*Aegle marmelos*	F	F
Boroi/Kul	*Ziziphus jujuba*	C	F
Chalta	*Dillenia indica*	R	R
Dalim	*Punica granatum*	F	F
Deophal	*Artocarpus lacucha*	R	E
Jam	*Syzygium cumini*	C	F
Jambura	*Citrus grandis*	F	R
Jamrul	*Eugenia javanica*	F	F
Kala	*Musa* spp.	C	F
Kamranga	Averrhoa carambola	F	F
Karamcha	*Carissa carandas*	R	R
Kadbel	*Feronia elephantum*	C	C
Kanthal	*Artocarpus heterophyllus*	C	F
Khejur	*Phoenix sylvestris*	C	F
Lebu	*Citrus* spp.	C	C
Narikel	*Cocos nucifera*	C	C
Pepe	*Carica papaya*	C	F
Peyara	*Psidium guajava*	C	C
Sajna	*Moringa oleifera*	C	F
Supari	*Areca catechu*	C	C
Safeda	*Achras zapota*	C	C
Tal	*Borassus flabellifer*	C	F
Tetul	*Tamarindus indica*	F	R

Status: Vc-very common, C-common, F-fairly common, R-rare, E-endangered, T-threatened, Et-extinct

(Source: Field study 2011-2013).

Table 9: Wild medicinal plants and non-fruit trees of the study areas (except the Sundarbans).

Local Name	Scientific Name	Status	
		Outside the project area	Project area
Wild medicinal plants			
Akanda	*Calotropis procera Br.*	R	Et
Anantamul	*Hemidesmus indicus L.*	R	Et
Apang/Shisakanda	*Achyranthes aspera L.*	C	R
Bandhonia/Chinigura.	*Scoparia dulcis L.*	C	F
Basak	*Adhatoda vasica Nees.*	R	R
Chui Jhal	*Piper chaba Hunter*	F	R
Dhutura	*Datura metel Linn.*	F	R
Durba ghas	*Cynodon dactylon Pers*	C	C
Ghritakumari	*Aloe indica Willd.*	R	R

Hatisur	*Heliotropium indicum L.*	C	F
Kalokasunda.	*Cassia occidentalis L.*	C	R
Kalokeshi	*Eclipta alba (Hassk).*	F	R
Kalomegh	*Andrographis paniculata*	R	Et
Kumarilata.	*Smilax zeylanica L.*	F	R
Lajjabati (white)	*Mimosa pudica Linn.*	R	Et
Mehedi.	*Lawsonia inermis L.*	F	R
Nayantara.	*Catharanthus roseus.*	F	F
Nisinda	*Vitex negundo L.*	F	R
Olotkombol	*Abroma augusta L.*	F	R
Pathor kuchi	*Kalanchoe pinnata (Lam.)*	C	F
Pipul	*Piper longum Linn.*	R	Et
Pudina	*Mentha arvensis L.*	F	R
Sharpagandha.	*Rauwolfia serpentina*	R	Et
Shoti	*Curcuma zedoaria Rosc.*	R	Et
Shotomuli	*Asparagus racemosus L.*	R	Et
Telakucha	*Coccina cordifolia (L)*	C	R
Thankuni	*Centella asiatica (L) Urban.*	C	R
Tulshi	*Ocimum basilicum Linn.*	C	F
Non-fruit trees			
Arjun	*Terminalia arjuna*	R	F
Asawatha	*Ficus religiosa*	R	R
Bansh	*Bambusa spp.*	C	R
Bot	*Ficus benghalensis*	R	R
Jilapi	*Acacia sp.*	F	R
Krishnachura	*Delonix regia*	R	F
Mandar	*Erythrina variegata*	F	R
Zigha	*Lannea coromandelica*	C	R

Status: Vc-very common, C-common, F-fairly common, R-rare, E-endangered, T-threatened, Et-extinct

(Source: Field study 2011-2013).

Table 10: Social forest plants and aquatic plants of the study area (except the Sundarbans).

Local Name	Scientific Name	Status	
		Outside the project area	Project area
Social forest plants			
Akashmoni	*Acacia moniliformis*	F	F
Rendi koroi	*Samanea saman*	C	C
Shil koroi	*Albizia sp.*	F	R
Mahogany	*Swietenia mahagoni*	C	C
Piya	*Melia sempervirens*	F	R
Eucalyptus	*Eucalyptus citriodora*	F	F
Shegun	*Tectona grandis*	R	R
Shishu	*Dalbergia shishu*	C	C
Babla	*Acacia arabica*	C	F

Ipil ipil	*Leucaena latisiliqua*	C	F
Aquatic plants			
Azola	*Azolla pinnata*	R	R
Buripana	*Spirodela polyrhiza*	C	C
Chaicha	*Scirpus articulatus*	C	C
Dhol kalmi	*Ipomoea fistulosa*	F	F
Helencha	*Alternanthera philoxeroides*	C	F
Jhanji	*Utricularia aurea*	R	R
Kachuri pana	*Eichhornia crassipes*	C	F
Kalmi	*Ipomoea aquatica*	F	R
Keshordam	*Ludwigia adscendens*	C	F
Khudipana	*Lemna minor*	C	C
Malanchi	*Enhydra fluctuans*	F	R
Shapla	*Nymphaea stellata*	F	R
Shusni shak	*Marsilea quadrifolia*	C	F
Topapana	*Pistia stratiotes*	F	R

Status: Vc-very common, C-common, F-fairly common, R-rare, E-endangered, T-threatened, Et-extinct

(Source: Field study 2011-2013).

Table 11: Shrimp, crab, molluscs and fishes of the study areas (except the Sundarbans).

Bangla Name	Scientific Name	Habitat	Status	
			Outside the project area	Project area
Shrimp, crab and mollusks				
Golda- chingri	*Macrobrachium rosenbergii*	RB	C	R
Bagda- chingri	*Penaeus monodon*	RB	C	R
Harina-chingri	*Metapenaeus monoceros*	RB	C	R
Guara-chingri	*Palaemon spp.*	RBP	C	F
Boro- kakara	*Scylla serrata*	RBP	F	R
Choto-kakra	*Gelasimus annulipes*	RBP	C	F
Boro- shamuk	*Pila globosa*	BP	F	R
Guli- shamuk	*Vivipara bengalensis*	BP	C	F
Choto- shamuk	*Lymnaea spp.*	BP	C	F
Choto- shamuk	*Bithynia tentaculata*	RBP	C	F
Lamba- shamuk	*Melania tuberculata*	RB	F	R
Zinuk	*Lamellideus marginalis*	RBP	F	R
Fishes				
Kakila	*Xenentodon cancila*	RBP	C	R
Shol	*Channa striatus*	RB	C	R
Taki	*Channa punctatus*	RB	C	F
Gazar	*Channa marulius*	RB	R	Et
Darkina	*Esomus danricus*	RB	C	F
Chela	*Onygaster phulo*	RB	F	Et
Mola	*Amblypharyngodon mola*	RB	F	R

Rui	*Labeo rohita*	RBP	C	C
Catla	*Catla catla*	RBP	C	C
Mrigal	*Cirrhinus mrigala*	RBP	C	C
Tatkini	*Cirrhinus reba*	RB	F	Et
Silver carp	*Hypophthalmichthys molitrix*	RBP	C	C
Grass carp	*Ctenopharyngodon idella*	RBP	F	F
Carpio	*Cyprinus carpio*	RBP	E	Et
Tit punti	*Puntius ticto*	RBP	F	R
Punti	*Puntius stigma*	RB	C	F
Thai punti	*Puntius gonionotus*	RBP	F	F
Gutum	*Lepidocephalus guntea*	RB	F	R
Shingi	*Heteropneustes fossilis*	RB	C	F
Magur	*Clarias batrachus*	RB	R	Et
Boal	*Wallago attu*	RB	C	Et
Kani pabda	*Ompok bimaculatus*	RB	R	Et
Pangas	*Pangasius pangasius*	RBP	C	C
Rita	*Rita rita*	RB	F	Et
Ayre	*Mystus aor*	RB	C	Et
Tengra	*Mystus vittatus*	RB	C	F
Chitol	*Notopterus chitala*	RB	R	Et
Foli	*Notopterus notopterus*	RB	F	Et
Chapila	*Gudusia chapra*	RB	C	Et
Baim	*Mastacembelus armatus*	RB	C	Et
Gochi baim	*Mastacembelus pancalus*	RB	C	F
Tara baim	*Macrognathus aculeatus*	RB	R	Et
Khalisha	*Colisa fasciatus*	RB	C	F
Chata/Boichn	*Colisa lalius*	RB	F	R
Koi	*Anabas testudineus*	RB	F	R
Telapia	*Oreochromis niloticus*	RBP	C	C
Baila	*Glossogobius giuris*	RB	C	R
Baro chanda	*Chanda nama*	RB	R	R
Choto chanda	*Chanda ranga*	RB	F	R
Khorshula	*Rhinomugil corsula*	RB	F	Et
Vetki	*Lates calcarifer*	RB	C	F
Parshe	*Liza spp.*	RB	C	F
Datina	*Pomadasys hasta*	RB	C	F
Roop chanda	*Pampus chinensis*	R	F	Et
Taposhi	*Polynemus paradiseus*	R	F	Et
Khorkuno	*Mugil spp.*	RBP	C	F
Ilish	*Hilsa ilisha*	R	F	Et

Habitat: R=River, B=Beel/ Gher and P=Pond; Status: Vc =Very Common, C = Common, F =Fairly Common,

R =Rare and T =Threatened, Et = Extinct (Source: Field study 2011-2013).

Table 12: Amphibians and reptiles of the study areas (except the Sundarbans).

Bangla Name	English Name	Scientific Name	Status	
			Outside of the project area	Project area
Amphibians				
Kotkoti/Baiya bang	Skipper frog	*Rana cyanophlyctis*	F	R
Sonalibang	Bull frog	*Rana tigrina*	F	R
Kunobang	Toad	*Bufo melanostictus*	F	F
Reptiles				
Tiktiki	Wall lizard	*Hemidactylus flaviviridis*	C	C
Anjali/Nenja	Shink	*Mabuya carinata*	C	F
Kalo Gui shap	Monitor lizard/Grey lizard	*Varanus bengalensis*	C	F
Sonali/Haldey Gui	Yellow lajnd monitor	*Varanus flavescens*	F	R
Bara-kasim	Soft shell turtle	*Trionyx gangeticus*	R	Et
Kaitta /Kori kaitta	Roofed turtle	*Kachuga tecta*	F	R
Saundi kasim	Spotted flap shell tortoise	*Lissemys punctata*	F	Et
Paina/Matia shap	Common water snake	*Enhydris enhydris*	C	F
Dora Shap	Checkered keelback	*Xenochrophis piscator*	C	F
Daras shap	Rat snake	*Ptyas mucosus*	F	R
Gokhra shap	Cobra	*Naja naja*	F	R

Status: Vc =Very Common, C = Common, F =Fairly Common, R =Rare and T =Threatened, Et = Extinct (Source: Field study 2011-2013).

Table 13: Birds of the study areas (except the Sundarbans).

Bangla Name	English Name	Scientific Name	Status	
Amphibians			Outside of the Project Area	Project Area
Kotkoti/Baiya bang	Skipper frog	*Rana cyanophlyctis*	F	R
Sonalibang	Bull frog	*Rana tigrina*	F	R
Kunobang	Toad	*Bufo melanostictus*	F	F
Reptiles				
Tiktiki	Wall lizard	*Hemidactylus flaviviridis*	C	C
Anjali/Nenja	Shink	*Mabuya carinata*	C	F
Kalo Gui shap	Monitor lizard/Grey lizard	*Varanus bengalensis*	C	F
Sonali/Haldey Gui	Yellow lajnd monitor	*Varanus flavescens*	F	R
Bara-kasim	Soft shell turtle	*Trionyx gangeticus*	R	Et
Kaitta /Kori kaitta	Roofed turtle	*Kachuga tecta*	F	R
Saundi kasim	Spotted flap shell tortoise	*Lissemys punctata*	F	Et
Paina/Matia shap	Common water snake	*Enhydris enhydris*	C	F
Dora Shap	Checkered keelback	*Xenochrophis piscator*	C	F
Daras shap	Rat snake	*Ptyas mucosus*	F	R
Gokhra shap	Cobra	*Naja naja*	F	R
Bhuban cheel	Black kite	*Milvus migrans*	F	F
Tila baz	Kestre eagle	*Falco tinnunculus*	R	Et
Mala ghughu	Ring dove	*Streptopelia decaocto*	F	R

Tila ghughu	Spotted dove	*Streptopelia chinensis*	F	R
Jalali cobutor	Blue R. pigeon	*Columba livia*	C	C
Teya	Parakeet	*Psittacula krameri*	F	R
Kokil	Koel	*Eudynamys scolopacea*	F	F
Kanakoka	Lesser coucal	*Centropus bengalensis*	F	Et
Lokhi pecha	Bran owl	*Tyto alba*	F	R
Bhutum pecha	Spotted owlet	*Athene brama*	F	R
Katthokra	Golden-backed wood pecker	*Dinopium javanense*	F	R
Ababil	House swift	*Apus affinis*	C	C
Shipahi-bulbul	Red-whiskerdbulbul	*Pycnonotus cafer*	C	C
Doyal	Magpic robin	*Copsychus saularis*	C	C
Tuntune	Tailor bird	*Orthotomus sutorius*	F	F
Fingae	Black drongo	*Dicrurus macrocercus*	C	C
Pati kak	House crow	*Corvus splendens*	C	C
Dar kak	Jungle corw	*Corvus macrorhynchos*	C	C
Baht salik	Common myna	*Acridotheres tristis*	C	C
Jhuti-salik	Pied myna	*Sturnus contra*	C	C
Chorui	House sparrow	*Passer domestica*	C	C
Babui	Baya	*Ploceus philippinus*	C	F
Kutum	Black headed oriole	*Oriolus chinensis*	F	R
Shakun	White backed vulture	*Gyps bengalensis*	R	Et
Wetlands bird				
Pancowri	Little cormorant	*Phalacrocorax niger*	F	Et
Kani bok	Pond heron	*Ardeola grayii*	C	F
Sada bok	Little egret	*Egretta garzetta*	C	F
Bali hash	Lesser Whistling duck	*Dendrocygna javanica*	F	Et
Chota machranga	Common kingfisher	*Alcedo atthis*	F	R
Machranga	White throated kingfisher	*Halcyon smyrnensis*	C	R
Dahuk	Water hen	*Gallicrex cinerea*	F	Et
Kora	Water cock	*Amaurornis phoenicurus*	F	Et
Shamuk banga	Openbill stork	*Anastomus oscitans*	T	Et
Pancowri	Little cormorant	*Phalacrocorax niger*	F	Et

Status: Vc =Very Common, C = Common, F =Fairly Common, R =Rare and T =Threatened, Et = Extinct (Source: Field study 2011-2013).

Table 14: List of mammals the project area (except the Sundarbans).

Bangla Name	English Name	Scientific Name	Status	
			Out of the Project Area	Project area
Borobadur	Flying fox	*Pteropus giganteus*	F	R
Shial	Jackal	*Canis aureus indicus*	R	Et
Khak shial	Fox	*Vulpes bengalensis*	T	Et
Beji	Mongoose	*Herpestes edwardsii*	T	R
Banbiral/Bona	Jungle cat	*Felis chaus*	T	Et

Khorgosh	Black-naped hare	*Lepus nigricollis*	Et	Et
Katbirali	Irrawadedy squirre	*Callosciurus pygeregthrus*	R	Et
Udd	Otter	*Lutra lutra*	T	Et
Gaso indur	L.bandicoot rat	*Bandicota bengalensis*	C	F
Indur	G.bandicoot rat	*Bandicota indica*	Vc	C
Chika/Sucho	House shrew	*Suncus murinus*	C	C

Status: Vc =Very Common, C = Common, F =Fairly Common, R =Rare and T =Threatened, Et = Extinct

(Source: Field study 2011-2013).

On the basis of present conditions of the study areas like physico-chemical conditions of air, water and soil; meteorological data (Tables 1-6) and, floral and faunal status (Tables 7-14) it can be concluded that inside and outside of the project area such as Rampal, Mongla and the adjacent Sundarbans are free from different types of pollution except salinity intrusion. More or less similar observations were also made by [22-25] recorded dolphins, crocodile, Maskedfinfoot, migratory birds, wild boar, deer, snakes, fishes, different mammals etc. inside the Sundarbans, in and around the rivers and their connected canals and creeks of the Sundarbans. Floral and faunal statuses (Table 7-14) are indicating that some plants and animals are already in extinct conditions and some are in rare conditions due to natural climatic hazards. Due to pollution of the coal fired power plant rest of the floral and faunal diversity will be destroyed by changing air, water and soil quality of the study areas. According to EIA study of CEGIS (2013) the proposed coal based power plant will discharge 51830 Metric Tons (MT) Sulfur di-oxide (SO_x) yearly and 17277 MT SO_x during dry season (16 November to 15 March) if power plant burn less sulfur content (<0.6%) coal; emission of Nitrigen di-oxide (NO_x) will be 31025 MT yearly and 10342 MT during dry season; 711750 MT ash will produce yearly and 237250 MT will produce during dry seasons; yearly 23783184060 gallons and during dry season 7927728020 gallons water will intake by this power plant from the Pashur river; yearly 10397020354 gallons water will be consumed and 13386163706 gallons cooling/ waste water will be discharged to the Pashur river directly or indirectly and ultimately polluted water flows to the Sunderbans as the Pashur meets the sea by flowing inside the Sundarbans. CEGIS (2013) also mentioned that after starting the Rampal coal based power plant the SO_x level will be reached 50.4 - 53.4 ìg/m^3 and NO_x level will be reached 47.2- 51.2 ìg/m^3 inside the Sundarbans if use best quality coal; whereas present SO_x level is 8 - 11 ìg/m^3 and NO_x level is 16 - 20 ìg/m^3 inside the Sundarbans. Last ten years wind flows directions (Table 1) and CEGIS (2013) produced wind flows diagram indicate that during dry season (from 16 November to 15 March) the Sundarbans will receive directly SO_x, NO_x and other gases from the power plant. As a result floral and faunal diversity of the Sundarbans will be affected gradually day by day and endangered species will be injured seriously in aquatic and forest floors as during dry season there is no possibility of dilute of gases by rainfall. Dispersion models of different gases of CEGIS (2013) indicate that SO_x, NO_x and other gases will flows up to 35 km inside the Sundarbans during dry season in every year. Surrounding agricultural (rice, shrimp etc.) lands and wetlands (the river Pashur, Maidara and other tidal canals) of the coal power plants will be affected by the leaching of toxic substances from deposited coal burned ashes; the ashes contain many heavy metals including arsenic, lead, mercury, nickel, vanadium, beryllium, barium, cadmium, chromium, selenium and radium, which are dangerous if released into environment (CEGIS 2013). These heavy metals can change the soil and water quality of the Sundarbans by mixing runoff rain water during rainy reason. [12] described on the emission level of different toxic gases and heavy metals of coal fired power plant. Human health hazards and possible impact on the Sundarbans due to coal-fired power plant have also been discussed by [5]. The wind flow is indicating that the total study area i.e. Rampal, Mongla and the Sundarbans will be affected by the toxic gases and ashes of the coal based power plant in different seasons. Especially the Sundarbans will be affected during pick tourism period in the month of December to February. It is a matter to be concerned when the Sundarbans reserve forest is already facing threats from natural calamity, deforestation, rise in salinity and extinction of many species mainly due to human carelessness, ignorance and lack of implementation of laws, poaching and illegal wildlife trade [26,27]. Study of [28-30] on the impacts of oil spill on the Sundarbans indicates that sink of coal loaded ship created some problems for the biodiversity and ecological conditions of the Sundarbans (15).

Environmental Impact Assessment (EIA) [31-35] of physical, biological, social and economic environment of the Sundarbans and the surrounding areas indicate that most of the impacts of coal-fired power plant are negative and irreversible (-81) which can't be mitigated in any way. It is indicating that climate, topography, land use pattern, air and water (surface and ground both) quality, floral and faunal diversity, aquatic ecosystems, capture fisheries and tourism of the Sundarbans and the surrounding areas will be affected permanently due to proposed coal fired power plant. Increasing of water logging conditions, river erosion, noise pollution and health hazards; decreasing of ground water table; loss of culture fisheries, social forestry and health hazards, and major destruction of agriculture will be happened due to coal fired power plant. These problems may be reversible after long mitigation process except agriculture. But all reversible mitigations are negative (total no. is -67). [36-38] Mitigation of agricultural loss will be very difficult and many people will become land less. Urbanization, development of markets/ bazaars, transportation and industrialization will be developed which may be sustainable but mitigation must be ensured. The total no. of sustainable mitigation is only +14 which indicates that the study area is not suitable for industrialization and urbanization (Table

15). By establishing the coal fired power plant only electrification in the rural area, and very few job and localized business facilities will be increased. The benefits/facilities of proposed coal fired power plant of Rampal is very poor (S+19) than that of negative irreversible impact (-81). So environmentally, physically, socially and economically the selected area is not suitable to establish any type of coal based power plant. On the basis of IECs and EIA, coal based power plant will be act as "to add insult to injure" in the project area as well as on the Sundarbans, Rampal and Mongla areas. A long term research and intensive monitoring must be done to find out the detail information on the long term impact of coal based power plant on the biodiversity and ecological conditions of the Sundarbans before introducing the coal based power plant in Rampal. Otherwise the fragile ecosystem of the Sundarbans including its buffer zone could be threatened by the pollutants of the coal based power plant of Rampal.

Table 15: Environmental Impact Assessment Matrix for Coal based Power Plant Project of Rampal.

IECs	Present Amount/Frequency	Project Impact	Impact Type	Impact Rating
A. Physical Environment				
Climate:				
Temp	Mean temperature varies from 17.2 to 29.8°C.	Will be increased.May slightly decrease and	IR	-6
Rainfall	Annual mean 157 mm.	acid rain may be created.	IR	-1
Topography	Highly disturbed in and around the project areas.	May be highly disturbed in all areas.	IR	-7
Land Use	Agricultural land use dominated Changed into coal based with rural set up.	Changed into coal basedindustrial and unplanned urban land use.	IR	-5
Flooding/water logging *Hazard*	Low in some parts of Rampal.	Flood hazard will be increased due to earthen filling for new construction.	RM	-4
River Erosion	Common in Mongla and Rampal.	Increase river erosion for movement of coal loaded cargoes.	RM	-4
Drainage Congestion	Low	May be increased drainage congestion due to earthen filling in low lands.	RM	-4
Surface Water Pollution	Low	Will be increased due to leaching of coal, discharge of cooling and waste water and dumping of waste.	IR	-8
Groundwater Table	Fall in dry period (Feb.-May).	Water table may further decline due to use of huge amount surface and ground water.	RM	-5
Groundwater Pollution	Polluted by Salinity, Fe and slight As in some places.	Arsenic, mercury, uranium, thorium and other heavy metals content will be increased by absorbing coal leached chemicals.	IR	-6
Water Bodies	Khals, beels, rivers, many ghers and ponds exist.	Water bodies will be reduced by land-filling and for increasing land price due to unplanned urban situation.	IR	-6
Air Pollution	Very poor	Air pollution will be increased by increasing oxides, hydrides and nitrides gases of carbon, sulfur and nitrogen	IR	-4
Noise Pollution	Low	Moderate	RM	-3
B. Biological Environment				
Habitat	About 87% habitats for flora and fauna in rural area	Reduced habitats of flora and fauna of the rural area and the Sundarbans.	IR	-7
Flora	Among the existing species some are decreasing due to salinity.	May endanger and extinct of some natural floral species in Rampal, Mongla and the Sundarbans.	IR	-7
Wildlife	56 species (5 endangered) of the project area.	More wildlife will be endangered and extinct in and around the Sundarbans.	IR	-9

Social Forestry	Common road side, embankments, highland and some homesteads.	May be decreased due to increasing pollution.	RM	-3
Capture Fisheries	Meet the 20-25% of fish demand.	Reduced production for increasing pollution in the Sundarbans and other natural water bodies.	IR	-7
Culture Fisheries	Meet the 80-85% of fish demand.	Reduced production for loss of ghers and ponds for land-filling.	RM	-4
Agriculture	Covered by 60% land area.	Reduced area.	RM	-8
C. Social Environment				
Human Settlement	30-40% area covered by settlement.	Decrease human settlement due to land acquisition.	RM	-4
Population of land less	Poor no.	Population of land less will be increased.	RM	-4
Status of husband less Women	Poor no.	No. of husband less women will be increased.	RM	-4
Electricity Facility	Absent in some villages.	Electricity facility will be available in all villages.	S	8
Health hazards	All most nil in the project areas except salinity.	Health hazards will be increased by increasing air and water pollution.	RM	-7
Human Diseases	Prevalence of diarrhea, skin diseases, worm infection and anemia.		RM	-7
Parasitic Diseases	Dengue, malaria and other parasitic diseases are uncommon.	May increase the parasitic diseases.	RM	-2
D. Economic Environment				
Urbanization	Rural area.	Semi urbanization will be developed.	SM	3
Industrialization	No industries	Increase industrialization and pollution will be increased.	SM	3
Employment:				
Government sector	Average 10 %.	May slightly increase.	S	2
Industrial sector	Average 3 %.	May moderately increase.	S	3
Business	Average 30 % people involved in business.	Business opportunity will increase.	S	6
Transportation	Poor local transportation, rickshaw-van based.	Improve with automotive vehicles; sound and air pollution will be increased.	SM	4
Market and Bazars	Mainly Rampal Bazar; Mongla Port Market and Foylahat.	Increased numbers of small markets/ bazars without sanitation condition.	SM	4
Tourism	Medium.	Tourism will be decreased inside the Sundarbans due to loss of ecosystem and biodiversity of the Sundarbans.	IR	-8
Traffic Congestion	Low	Moderate.	RM	-4

S - Sustainable, SM - Sustainable with Mitigation, RM - Reversible with Mitigation, IR - Irreversible

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