

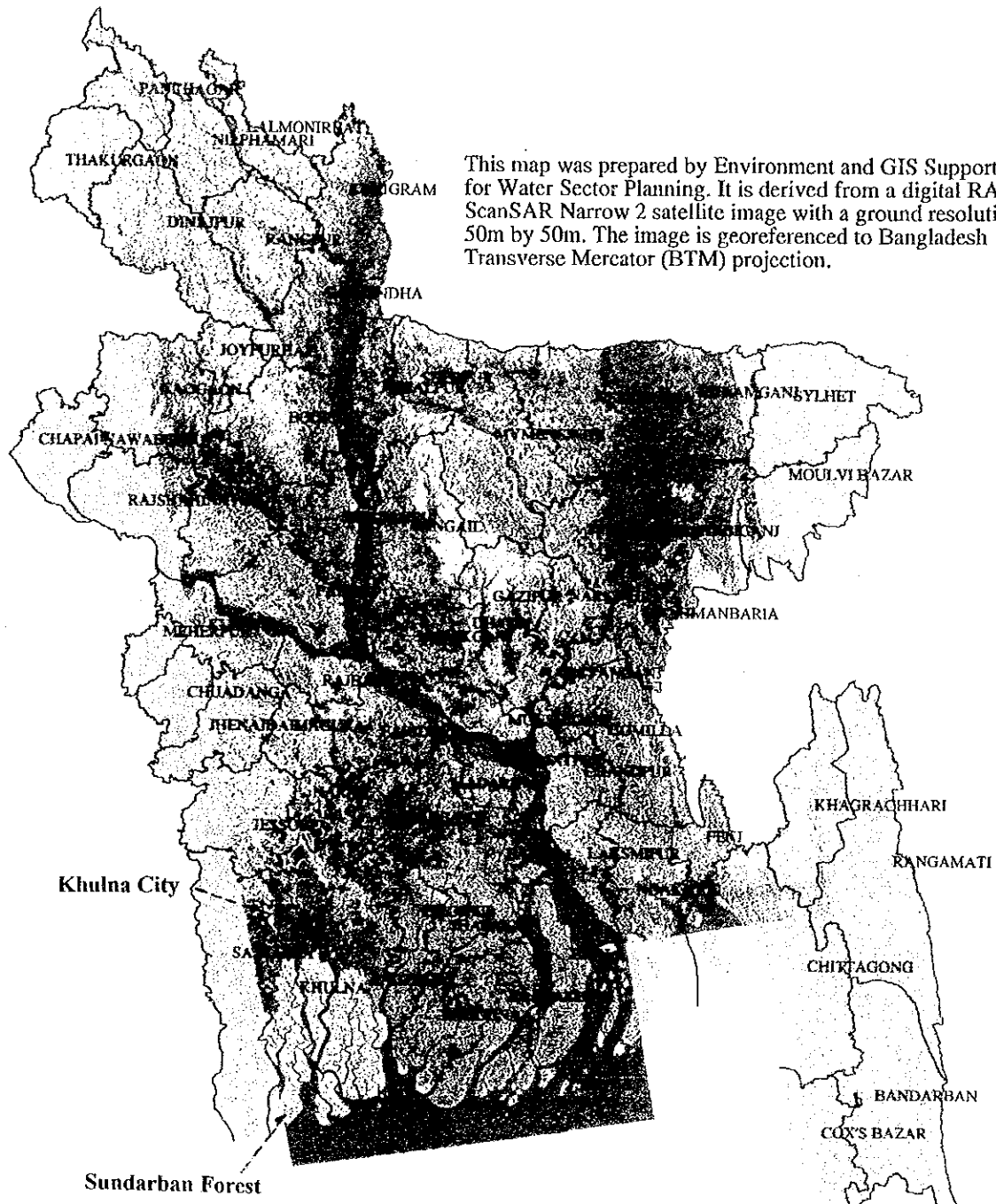
13.2.2 Natural environment

(1) Hydrology




Flood in Bangladesh occurs from three different sources e.g. direct rainfall, over bank spillage from the major international rivers and over bank spillage from the internal regional rivers. Each phenomenon occurs during the monsoon rain either separately or in combination. The pattern of river level rise generally shows a 2-peaked response, the first peak being generated by internal regional excess that occurs normally in June / July and the second peak resulting from high cross-boundary flows in the major international rivers, that normally occurs in early September. Fig.13.2.6 is a classified flood map from RADASAT image of 10 September 1998, which shows vast area covered by flood water. Unusual coincidence of the two peak floods in the rivers Jamuna and Ganges causes devastating floods like that of 1988 (Anon. 1997) like this year (1998). The topography, local rainfall and local drainage pattern characterize hydrology of the proposed Rupsa Bridge project area. The tidal floodplain lying around the city of Khulna is occupied by lowland with nearly 2-m difference in elevation between the ridge top and basin bottoms. Tidal flood of this area has been restricted by poldering on both sides of the major rivers. Drainage congestion has been created locally due to closure of the minor rivers and subsequent rise of riverbeds by siltation. In general, the tidal flood plain to which the Khulna City area is a component has been protected from inundation by poldering. Hence, occasional floods, like other floodplain areas are not a serious problem for the project area.

(2) Ecology and Forest

The project area under Alignment A and B does not pass through any reserve or protected forest land. Only few species of littoral plants that occur along the canal and riverbanks are mostly non-commercial ones. Hence, the moratorium imposed on felling of trees in reserve forests, sal forests, and mangrove forests of the Sundarbans in 1990 may not create any hindrance in implementing the proposed Rupsa Bridge Project. As shown in Fig.13.2.6, the Sundarban Forest is not submerged during the flood and rather act as a flood barrier also in cyclones. The ecological sub units included in the project area are homesteads, agriculture land, and low land that occupy the basin bottoms.



This map was prepared by Environment and GIS Support Project for Water Sector Planning. It is derived from a digital RADARSAT ScanSAR Narrow 2 satellite image with a ground resolution of 50m by 50m. The image is georeferenced to Bangladesh Transverse Mercator (BTM) projection.

- Legend**
-  Open Water Flooding
 -  Others
 -  Area outside image

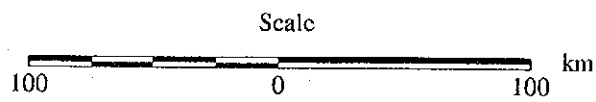


Fig.13.2.6 CLASSIFIED FLOOD MAP FROM RADARSAT IMAGE OF 10 SEPTEMBER 1998, 6.05 am

13.2.3 Pollution

(1) Water Quality

Water in open water bodies becomes polluted mainly from industries, processing units, trading centers and from drainage out falls. There exist a large number of these units on both sides of Bhairab–Rupsa river channel in southern part of the project area. The toxic liquid affluent and solid waste of these industrial units affect the river based bio diversity and public health of the people who use river water. The Old Mayur river, the only water body in the west of Khulna city is under serious threat due to discharge of industrial wastes. Oil spill from increasing number of mechanized vessels pollutes the river water.

Water from shallow ground water table in Khulna city is not good enough either for drinking or for irrigation due to salinity. No information is available regarding the arsenic content of water in shallow ground water table (Anon 1998).

Water pollution levels at four sampling sites and EQS for Bangladesh are shown in Tables 13.2.5 and 13.2.6 respectively. These values except in Gabtala Ghat indicate marginal pollution level. The sampling sites are shown in Fig.13.2.7.

Table 13.2.5 Results of Water Quality Analyses at Four Selected Sites

Type of analyses	Sampling sites	Locations			
		Karerhat Ghat	Gilatala Ghat	Laban Chara Ghat	Beel Dakatia
pH	Bank	7.9	7.8	7.9	7.0
	Mid-river	7.9	7.7	7.9	7.3
Ec (mohos)	-do-	700	6800	7.25	800
		650	6900	800	850
Chloride (mg/l)	-do-	50	3190	130	180
		50	3210	150	180
Iron (mg/l)	-do-	0.2	0.2	0.2	0.2
		0.2	0.2	0.2	0.2
T.S. (mg/l)	-do-	600	4000	600	600
		600	4100	600	600
T.D.S. (mg/l)	-do-	400	3360	400	400
		400	3400	400	400
S.S.(mg/l)	-do-	200	640	200	200
		200	700	200	200
D.O. (mg/l)	-do-	4.7	6.2	5.65	4.31
		4.7	6.4	5.70	4.12
B.O.D. (mg/l)	-do-	0.52	1.8	1.15	1.89
		0.34	1.9	1.23	1.81

Source: DOE Khulna, samples between April 1998 and October 1998

Table 13.2.6 Environmental Quality Standards for different types of water in Bangladesh

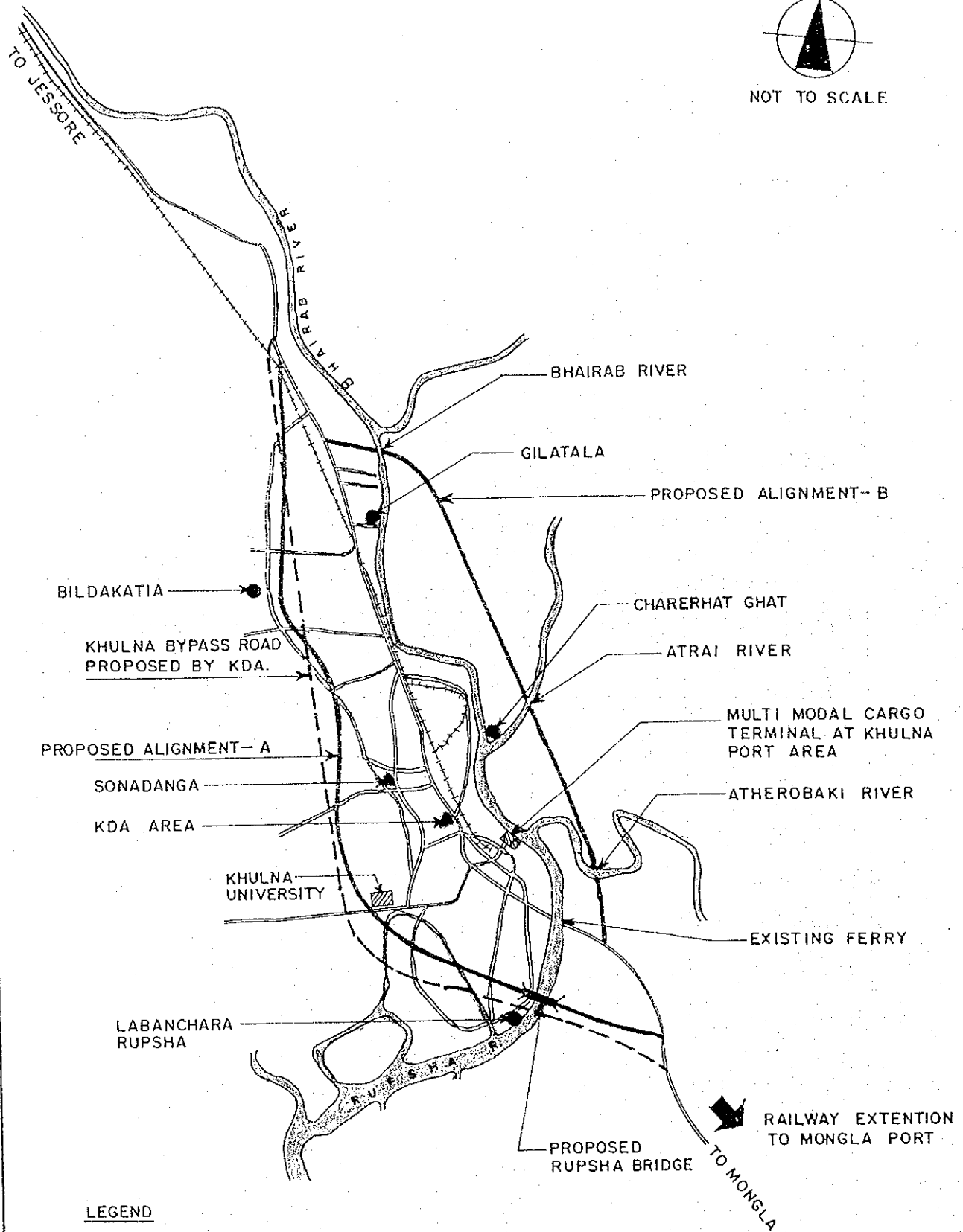
Type of analyses	Drinking water	Irrigation water	Fisheries water	Industries water
pH	6.5-8.5	6.0-8.5	6.5-8.5	6.0-9.5
Ec (mohos)	-	750	800-1000	-
Chloride (mg/l)	150-600	600	600	NYS
Iron (mg/l)	0.3	0.5	NYS	NYS
T.S. (mg/l)	NYS	NYS	NYS	NYS
T.D.S. (mg/l)	1000	2000	NYS	1500
S.S.(mg/l)	10.0	25.0	20.0	75
D.O. (mg/l)	6.0	5.0	4.0-6.0	5.0
B.O.D. (mg/l)	0.2	10.0	6.0	10.0

Source: MOEF Gazette 1998

PROPOSED ROAD ALIGNMENT A & B FOR THE RUPSHA BRIDGE PROJECT



NOT TO SCALE



LEGEND

- ▲ Air Pollution Sample Site
- Water Pollution Sample Site

Fig.13.2.7

(2) Air Quality

Concentration of NO_x in ambient air has been found 73-202 mg/m³ in commercial areas while the Bangladesh standards are 80 mg/m³ at residential site and 100 mg/m³ at commercial areas. Air pollution is caused due to industrial emission, automobile exhaust, smoke emitted from the kitchen that use bio mass energy and bio gas emitted from the city dumping grounds, drains, market places, agriculture fields and closed borrow pits that occur in large number in the Khulna city (US-AID 1998).

Data on air pollution level is shown in Table 13.2.7. The NO_x values are higher than EQS Values and the SPM value is 20 times higher compared to EQS value at Sonadanga bus stop. Study conducted under US-AID (1998) project showed SPM value between 107 and 266 mg/m³ and NO_x level between 73 and 202 mg/l in KCC area.

Table 13.2.7 Quality monitoring data at two locations (Figure 13.2.7)

Location	SPM (mg/m ³)	SO _x (mg/m ³)	NO _x (mg/m ³)
KDA area	316.42	71.8	199.36
Sonadanga bus stop	2908.73	79.4	140.64
EQS, Bangladesh	400.0	100.0	100.00

Source: DOE Khulna, Sampled in February 1998

Noise and vibration data was not available near the project area.

13.3 Impacts and Countermeasures for Implementing the Project

The potential impacts on each item are shown in Table 13.3.1 but summarized as follows:

13.3.1 Impact on Social Environment

In field survey, Cadastral Survey map (Mauza Map: scale 1:3,970) was obtained from District Commissioner Office of Khulna and the alignments were drawn on those maps, which is also being kept by Land registry office and those maps are base information in Land Acquisition procedure. The survey was performed segment by segment as shown in Fig.13.3.1. and the results were summarized. The details of segment wise information on annual income are presented in Table 13.3.2.

Table 13.3.2: Average Annual Income of the Affected Household

Alignment -A

Types of Occupation	Segment -I		Segment -II		Segment -III		Segment -IV		Segment -V		Total	
	Taka	%	Taka	%	Taka	%	Taka	%	Taka	%	Taka	%
Agriculture	31,000	13.36	0	0.00	-	-	455,700	6.4	1,068,000	21.6	1,554,700	11.70
Service	197,000	84.91	846,600	83.96	-	-	5,683,003	80.03	2,715,800	54.91	9,442,403	71.06
Fish Farm	4,000	1.72	0	0.00	-	-	688,000	9.69	461,000	9.32	1,153,000	8.68
Livestoc/ Poultry	0	0.00	29,700	2.95	-	-	73,000	1.03	166,000	3.36	268,700	2.02
Others	0	0.00	132,000	13.09	-	-	201,000	2.83	535,200	10.82	868,200	6.53
Total	232,000	100.0	1008,300	100.00	-	-	7,100,703	100.00	4,946,000	100.00	13,287,003	100.00
Average Annual income	46,400.00		50,450.00		-		107,600.00		59,600.00		76,400.00	

Alignment -B

Types of Occupation	Segment -I		Segment -II		Segment -III		Segment -V		Total	
	Taka	%	Taka	%	Taka	%	Taka	%	Taka	%
Agriculture	101,000	4.33	758,000	12.75	2,879,100	24.2	176,400	12.7	3,914,500	18.14
Profession	1402,000	60.16	4,921,000	82.80	7,184,000	60.28	762,400	54.82	14,269,400	66.12
Fish Farm	31,000	1.33	48,500	0.82	625,502	5.25	0	0.00	705,002	3.27
Livestoc/poul try	33,000	1.42	39,700	0.67	314,400	2.64	0	0.00	387,100	1.79
Others	763,500	32.76	175,900	2.96	915,200	7.68	452,000	32.50	2,306,600	10.69
Total	2,330,500	100.00	5,943,100	100.00	1,1918,202	100.00	1390,800	100.00	21,582,602	100.00
Average Annual Income	68,550.00		104,270.00		66,250.00		53,500.00		72,670.00	

Source: Field Survey, November 1998

Table 13.3.1 Results of Initial Environmental Examination and Initial Social Impact Examination

Environment Item		Rating	Road Alignment A	Rating	Road Alignment B	
Social Environment	1	Resettlement	B	25 houses (135 persons) are in ROW.	B	297 houses (1,685 persons) are in ROW.
	2	Economic Activities	B	Farm lands and nursery ponds will be lost and fishing on rivers be affected.	B	Same as left. Small ferries will be affected.
	3	Traffic and Public Facilities	B	Transport/waterway should be secured on embankment section. Traffic conditions will be improved.	B	Same as left.
	4	Split of Community	B	Life pattern of village/homestead will be affected.	B	Same as left.
	5	Cultural Property	B	Mosques and schools are found but no remains.	B	Same as left.
	6	Water Right and Right of Common	D		D	
	7	Public Health Condition	B	Water will be stagnated if waterway is blocked by embankment.	B	Same as left.
	8	Wastes	B	Effects during construction.	B	Same as left.
	9	Hazard (Risk)	B	Flood disaster will be increased when waterway is blocked by embankment.	B	Same as left.
Natural Environment	10	Topography and Geology	D	Insignificant	D	Insignificant
	11	Soil Erosion	B	Ponds and puddles will be made by excavation of embankment material.	B	Same as left.
	12	Groundwater	D	Insignificant	D	Insignificant
	13	Hydrological Situation	B	Study is needed as this area is subject to the ebb and flow of the tide.	B	Study is needed, as there were cases of erosion and movement in the riverside of the Atai.
	14	Coastal Zone	D		D	
	15	Fauna and Flora	B	Trees and nursery ponds for homestead and river fishes will be affected.	B	Same as left.
	16	Meteorology	D		D	
	17	Landscape	B	Environment should be harmonized with high embankment and bridges.	B	Same as left.
Pollution	18	Air Pollution	B	Generated during construction and traffic after construction.	B	Same as left.
	19	Water Pollution	B	Generated during construction and traffic after construction.	B	Same as left.
	20	Soil Contamination	B	Generated during construction and traffic after construction.	B	Same as left.
	21	Noise and Vibration	B	Generated during construction and traffic after construction.	B	Same as left.
	22	Land Subsidence	B	Especially when the banking ground is of organic soil.	B	Same as left.
	23	Offensive Odor	B	Generated during construction and traffic after construction.	B	Generated during construction and traffic after construction.

Evaluation Categories

A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown. D: No impact is expected.

KHULNA MASTER PLAN AREA

ROAD ALIGNMENT OF A, & B, (SECTION) ON MOUZA MAP

Fig.13.3.1

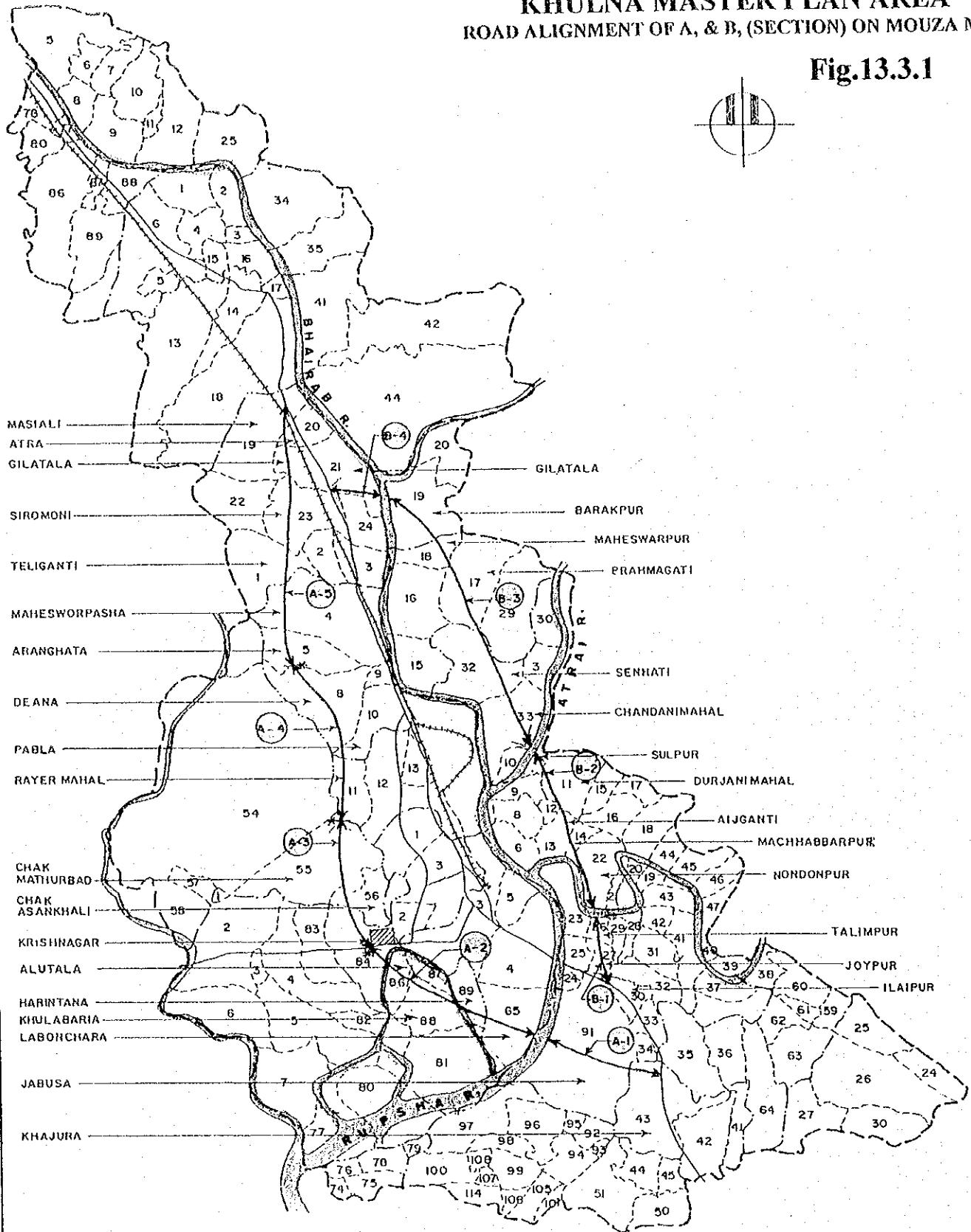
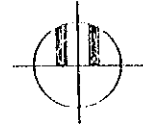


Table 13.3.3 and Table 13.3.4 present the results of landuse survey on Alignment A and Alignment B respectively.

Table – 13.3.3 : Landuse of Alignment-A (Area in m²)

Section	A ₁	A ₂	A ₃	A ₄	A ₅	Total Area
Pure Agricultural Land	175,624.70	236,191.00	160,810.10	163,073.40	260,270.70	995,970.00
Residential Area	2,887.92	34,641.17	8,535.68	95,228.40	25,465.00	166,758.17
Shrimp Pond	14,795.80	--	986.40	5,041.50	6,795.00	27,618.70
Pond	1,643.95	12,583.96	1,092.60	2,520.75	3,397.54	21,238.80
Mixed Vegetation	--	4,966.50	--	3,287.92	--	3,287.92
Brick Field	--	203.00	--	--	--	--
Religious	--	--	--	--	885.25	1,067.33
Recreational	--	2,210.56	--	--	6,247.15	8,457.71
Industrial	--	2,137.15	57,939.13	--	--	60,076.28
Educational	--	183.76	--	--	--	183.76
Health	--	--	--	--	--	--
Commercial	--	--	--	--	--	--
Road	--	4,656.00	3,287.92	--	--	3,287.92
Total	--	--	--	--	--	1,340,554.00

Source: Landuse Survey Data

Table – 13.3.4: Landuse of Alignment-B (Area in m²)

Section	B ₁	B ₂	B ₃	B ₄	Total Area
Pure Agricultural Land	122,171.58	230,094.72	276,396.08	--	628,662.38
Residential Area	41,377.66	35,821.96	67,236.38	38,420.65	182,856.65
Shrimp Pond	6,793.31	754.81	--	--	7,548.13
Pond	987.06	4,586.94	17,012.31	--	22,586.32
Mixed Vegetation	4,296.63	9,870.63	34,779.44	15,000.00	63,946.70
Brick Field	--	27,173.25	--	--	27,173.25
Religious	--	464.50	--	--	464.50
Recreational	--	6,619.13	--	--	6,619.13
Industrial	--	3,484.75	--	--	3,484.75
Educational	--	--	696.75	--	695.75
Health	--	--	--	174.19	174.19
Commercial	--	--	--	9,986.75	9,986.75
Total					954,198.50

Source: Landuse Survey Data.

The most important problems for both Alignment A and B lie with dividing these homesteads and other surrounding communities. However, moving to adjacent farmlands seems relatively easy as the land holding rate shows nearly 90% with less tenant farmers and non-land holding farmers. Meanwhile, the construction of the roads will make big merits. The reasons are that the income of these families through agricultural products shares only 3% on the Alignment A South Section and that only 18% on the Alignment B. These figures show that they are of the typical periurban (urban-neighboring) societies. It is also judged by the

facts that there are few shops and most of residents should go to towns for shopping. The people on the Alignment B go and return by the use of small boats as exist everywhere from the upper stream to down stream. The outline of each Alignment is as follows:

(1) Alignment A

This Alignment is near from Khulna City and is convenient for daily life. It crosses on some 89% of agricultural land including culture ponds, shared mainly by paddy fields. This area is low and 30% of the land is submerged in rainy season. They are raising three crops a year and Aman rice species is particularly suited to such deep-water conditions. However, they can have only small harvest as most of them are not full-time farmer and under such land conditions. The household nos. to be affected is 25 – 135 persons – on the South Section (total 174 households with 886 persons) on this Alignment. Excluded in these figures are 1 rice mill, 1 mosque and 2 schools in addition to private houses. Average family size is 5.8, and 58% of the PAPs are original inhabitants, ratio between men and women shows 1.67. Many are single laborers came from their home villages and go to Khulna to get work but still more than 50% of PAPs have work place within 2 km. Housewives work for housework and farm works. Averaged annual income of one family is US\$1,600 (converted) which is higher than the national average. Food expense for such income shares 70%.

(2) Alignment B

Agricultural land including culture ponds occupies 76% of the Project Area, which shows larger housing area than the Alignment A. The land is rather high and submersion rate is 10% making it possible for use other than paddy fields. PAPs are increased than the Alignment A and showing 297 households with 1,685 persons. Excluded are 4 brick factories, 2 rice mills, 5 mosques, 6 schools, 2 shops and 1 hospital. Averaged family members are 5.7 and 62% of the PAPs are original inhabitants. The ratio between men and women shows 1.25, closer to normal than the Alignment A. More than 50% of PAPs have work place within 1 km. Averaged annual income of one family is US\$1,500, which is higher than the national average. Food expense for such income shares 62%.

(3) Railway Alignment

The big difference with the road alignment is that the high embankment for rail bridge approach is longer (more than about 700 m/bridge) and impacts upon Community Split and Traffic will be larger than the roads alignment. It will be necessary to design underpass taking

into account the traffic of small boats in rainy season. Choice for alignment is limited compared to the roads, as many more households will be required to relocate.

(4) Gender Issues--Existing Participation

There is no reliable data on the women involvement in the development activities of Khulna city and its adjacent area. However, it can be said in Khulna city, that the participation of the women in the developmental activities is not much pronounced. At present, in Khulna University the male-female student ratio 120:100. Also from common observations, it is seen that in the formal sector activities of Khulna city the participation of the women is around 5-10 per cent. Moreover, due to general poverty particularly in and around the Khulna city, women's participation in the informal sector activities are increasing gradually. The informal sector activities include working as maidservant, day laborers in construction work, small traders, etc.

Particularly, the present study results show that both in alignments A and B the involvement of women working as housewives has been neither included nor calculated in the household income. In reality, these women take part actively in managing household activities including helping the male members activities such as cultivation of paddy, poultry and fish feeding etc.

It is also to be noted that ignorance, lack of information and opportunity, illiteracy and social barriers are the main causes of poor participation of the women in the development activities of Khulna city and its adjacent areas.

It is expected that with expansion of education among the women, their participation in all socio-economic activities will be increased. At present, the non-governmental organizations (NGOs) are playing a vital role in increasing the participation of the women in uplifting the socio-economic condition of their families. Not only this, the NGOs are actively advocating the women to participate in all local as well as in the national elections.

13.3.2 Impacts on Natural Environment

(1) Soil Erosion

The sites after taking soil for embankment material will become ponds and puddles. Therefore, excavation plan shall be made carefully considering best utilization of such lands. For instance, the PAPs should be encouraged to practice aquaculture in the borrow pits dug within or outside ROW. Borrow pits for this purpose should be of 200 m² within ROW and

larger outside ROW area. Training of the youths for skill development may be needed for this purpose.

(2) Hydrological Situation

Khulna City is included in the area as affected by the ebb and flow of the tide. Complicated flow regime is seen in rainy and cyclone season and large erosion was reported in the Atai River.

The Rupsa Bridge Project may not seriously affect the regional hydrology of the floodplain further by creating drainage congestion. Because, the embankment as per Alignment A and B though passes across the flow direction of run-off and tidal flood but remain semi-parallel along natural levees. Drainage situations under such condition will remain relatively unchanged.

(3) Ecosystem

Sundarbans Mangrove Reserved Forests as developed from the down stream of Mongla Port through the seashore of the Bay of Bengal are valuable woods, which are designated as the World's Heritage. But there are no natural forests near Khulna City. In this sense, the woods in homesteads play important role. There is no wildlife as designated by the Wildlife Protection Law and those as extinct species. No waterfowl and migratory birds are confirmed in broad Swamp (Bil Dakatia), which was artificially produced in the West Side of the Alignment A. Freshwater dolphin as broadly inhabit in the Padma River and other domestic rivers are also seen in the Rupsa River and capturing is prohibited. But the numbers are drastically decreased by the water quality contamination and poaching. Senior Researcher of the Ministry of Environment and Forestry presumes that 25 or 30 dolphins are inhabiting in the region up to the down stream of Mongla Port. Wildlife Order (1973) and Forest Act (1994) include provision for conservation and rehabilitation of Wildlife and their habitats. Dolphin has not been considered as endangered species though its population is sharply falling.

The adverse impact on environment due to felling of trees can be overcome by initiating at forestation program on homesteads, resettlement sites, and roadsides and on other waste and marginal lands. Site specific MPTS and high value timber species can be selected for this purpose with the help of BFD and Mangrove Silviculture Research, Division of BFRI.

13.3.3 Water Pollution

There are sewerage systems in Khulna City but much sewage flows into rivers and the contamination is nearly the upper limit of the standard value. Therefore, the fishery catch in the rivers is decreasing. According to Department of Fishery, Khulna Division, no data on fish product in the rivers in the project area is available as fishermen village exist.

13.3.4 Mitigation

(1) Social Environment

More precise baseline survey should be conducted at the time of Feasibility Study and further detailed land acquisition plan and countermeasures for PAPs. In this case, tenant farmers (5%), shops and nurseries should be taken into account for supplementing their income. The opinion of Hindus (some 5%) as one of the minority ethnic should also be taken into consideration. In case of Alignment B, which is similar to Alignment A, income supplement may be considered for small ferry boat people on three rivers where the alignment crosses additionally. The unbalanced ratio between men and women on the Alignment and other problems such as women laborers should also be made clear. For this purpose, NGO, universities and other general citizens in addition to central/local governments officers should participate in the study. Particularly, NGO's role is important in it.

(1) Natural Environment

The Alignments will go across largely agricultural lands (including nurseries) and will have no serious impacts upon natural environment but major consideration should be taken into account for pollution to be caused by the construction upon the lands and rivers. Productive agricultural lands should be avoided as much as possible in selecting the Alignment and the sites after taking soil should be utilized as nursery ponds. Tree planting should be encouraged for roadsides. Change in flow regime and erosion is not reported on the Alignment A but careful consideration should be made.

(2) Pollution and Environmental Monitoring

In the present study, relatively not serious adverse impacts of the project on environment are expected. However, the impacts require regular monitoring in this area with or without project are:

- ① cumulative loss of agriculture land that may consequently affect food production,
- ② silting of the local rivers channels and water ways that may consequently block drainage and cause water logged condition in low lying areas,
- ③ pollution of the open water system by petroleum products leaked or released from mechanized boats and ships,
- ④ release of solid and liquid industrial wastes and discharge of sewerage and solid wastes from the cities and other urban areas,
- ⑤ pollution of air from the exhausts of automobiles
- ⑥ soil and water pollution by increased doses of agrochemical used for intensification and diversification of agriculture,
- ⑦ aquatic biodiversities in open water bodies,
- ⑧ population dynamic and social impacts within the project areas, etc.

Monitoring activities covering limited areas may be necessary both during the construction and operational stages for maintaining the Environmental Standards within project area.

13.3.5 Environmental Impacts and Mitigative in Site Proposed for Multi Modal Terminal (MMT)

The proposed site from the railway terminal up to the Roosevelt Jetty in the north is largely occupied by the Bangladesh Railway (BR) and the remainder is the lot for Mongla Port. The site faces with the west bank of the Bhairab River. More than half of the BR's lots are unused at present, and there are no houses except squatters. Therefore, only slight effects on natural and social environments are expected. But much impact is foreseen upon the adjacent roads reaching MMT to be caused by increased traffic. In this case, KCC City Bypass through Majid Saran Road will be used for large vehicles. At the junction of the National Highway with KDA Avenue and Majid Saran Road, grade separation and new traffic signals will be required. Traffic congestion will be much mitigated with these countermeasures but currently heavy congestion is seen at this junction with uncontrolled traffic. For air pollution, NO_2 has already shown 199.36 mg/m^3 , which is above the regulated value for industrial and commercial areas. Smooth traffic flow should be secured and exhaust gas be mitigated.

13.4 Environmental Laws and Guidelines of Bangladesh and International Institutions

13.4.1 Environmental Policy and Laws of Bangladesh

(1) Environmental Policy

The Government of Bangladesh enacted its Environment Policy in 1992 whose Preamble reads as follows:

The existence and progress of life on earth depend on nature and environment. In recent times, gradual degradation of the natural environment has posed a serious threat to the existence of all living beings and to the progress of human civilization.

In view of the various adverse impacts on environment, the Government of Bangladesh have attached special importance to its protection and improvement. A number of environmental problems, which inter-alia include natural disasters like recurrent floods, droughts, cyclones, tidal bores etc., primary signs of desertification in the northern districts, intrusion of salinity in the rivers, land erosion, fast depletion of forest resources, instability of the weather and climatic conditions etc. are prevalent in the country. Against this backdrop, the Government has established the Ministry of Environment and Forest (MOEF) and upgraded the Department of Environment (DOE) in order to coordinate and supervise the activities concerning protection and improvement of the environment. Simultaneously, major problems related to environmental pollution and degradation have also been clearly identified.

Since various socio-economic malaise like poverty, population pressure, illiteracy, inadequate health care, lack of public awareness etc. have emerged as serious impediments to the protection of environment, it is necessary that these problems are adequately addressed simultaneously along with issues concerning to improvement of environment in an integrated manner. Implementation of government's commitment to environment and mitigation of other environment related problems are possible only through a well defined national policy.

(2) Environment Conservation Act, 1995

In these decades, nearly all the countries of the world have been working towards the creation of adequate legal framework to prevent the gradual decline of the environment and conserve the natural resources. In order to meet the present changed circumstances, the revision and

upgrading of the Environment Pollution Control Ordinance 1977 has become necessary. Thus the Government introduced the Environment Conservation Bill in the parliament in 1994 to prevent escalation of pollution problems in the country. The bill was discussed through 1994 and finally the Environment Conservation Act 1995 (ECA 1995) was enacted by the parliament and gazetted in February 1995 and came into force in June 1995.

The ECA 1995 is defined as “Law Enacted for Conservation, Improvement of Quality Standard, and Control and Mitigation of Pollution of the Environment”. The ECA 1995 contains mainly the following regulations and stipulations:

- Department of Environment, and power and function of the Director General
- Declaration of ecologically critical area
- Regulation in respect of driving vehicles emitting smoke harmful to the environment
- Information to the Director General regarding environmental pollution or degradation
- Formulation of environmental guideline
- Offenses committed by companies

(3) Environment Conservation Rule, 1997

While the enacting of ECA 1995 was most certainly an achievement, in order to enforce the Act in practice, Environmental Conservation Rule came into force on 28 August, 1997. In the Rule, proposed projects are classified into 4 categories depending on the extent of impact on the environment and accompanying complexity of obtaining Environmental Clearance; namely Green, Orange A, Orange B and Red. • @List No. 68 of Red Category is of Bridge construction (length 100 m or more) and List No.67 is of Road construction (regional and national). For this the application must be accompanied by the Feasibility report and Initial Environmental Examination (IEE) report. For the Red Category, IEE report must also include the terms of Reference for the Environmental Impact Assessment (EIA), which too must be completed and submitted for obtaining Environmental Clearance.

These activities are managed by the Department of Environment (DOE), but the total staff of DOE is only 173 presently and there are no responsible departments in RHD and other ministries. DOE has 4 divisional offices in Dhaka, Chittagong, Khulna and Rajshahi in addition to its headquarters in Dhaka. For this Project, environment clearance application should be submitted to Khulna Office.

(4) The Acquisition and Requisition of Immovable Property Ordinance-1982 (Partially Amended in 1994)

This Ordinance stipulates for mainly the acquisition of property and award of compensation. In determining the amount of compensation to be awarded for any property to acquire, the Deputy Commissioner (including an Additional Deputy Commissioner and any other officer specially appointed by the Government) shall take into consideration the market value of the property at the date of publication of the notice provided that in determining such market value to be calculated in the prescribed manner of the properties of similar description and with similar advantages in the vicinity during the twelve months preceding the date of publication of the notice.

The above Ordinance 1982 stipulated that in addition to the market value of the property, the Deputy Commissioner shall in every case award a sum of twenty per centum on such market value in consideration of the compulsory nature of the acquisition. However it was amended for fifty per centum by the Amendment of 1994.

(5) Other Laws and Regulations Relevant to the Project

The State Acquisition and Tenancy Act, 1950

The Acquisition of Waste Land Act, 1950

The Protection and Conservation of Fish Act, 1950

The Public Safety Ordinance, 1953

The Inland Water Transport Authority Ordinance, 1958

The Khulna Development Authority Ordinance, 1961

The Bangladesh Wildlife (Preservation) Order, 1973

The Territorial Water and Maritime Zones Act, 1974

The Mongla Port Authority ordinance, 1976

The Jamuna Multipurpose Bridge Authority Ordinance, 1985

13.4.2 Environmental Guidelines of International Institutions

(1) Japan International Cooperation Agency (JICA)

ENVIRONMENTAL GUIDELINES FOR INFRASTRUCTURE PROJECT III
ROADS, January 1994

With regard to environmental consideration, JICA's basic principles are to promote sustainable development aimed at improving the living standard of the residents, and

harmonize the development with a desirable environment based on the country's willingness. It is necessary, therefore, to try to ensure the sustainable development by harmonizing the development project with natural resources and the base of livelihood and subsistence of the residents in the area. The guidelines describe screening and scoping procedures at the preparatory study stage to deal with the negative impacts of a development project on the environment of the project site and its surrounding area.

(2) The Overseas Economic Cooperation Fund, Japan (OECF)

OECF ENVIRONMENTAL GUIDELINES (2nd Version) August 1995

The objective of environmental consideration in development assistance is to assist the self-help efforts of developing countries directed towards attaining sustainable development. Responsibility with regard to environmental consideration of a project rests ultimately with the recipient country. The Guidelines give guiding principles related to environmental consideration by the OECF in its appraisal of a project. They also give the environmental matters to be considered and environmental measures to be prepared by the recipient country in the planning and preparation stages of a project.

(3) Asian Development Bank (ADB)

ENVIRONMENTAL GUIDELINES FOR SELECTED INFRASTRUCTURE PROJECTS 1993

The purpose of the guidelines is to facilitate the work of the ADB project staff as related to incorporation of the environmental protection parameter into the project preparation process. Thus, the project staff will be in a better position (a) for preparing the ADB covenants for the project on necessary environmental constraints; and (b) for strengthening the overall project context through improvements in aspects relating to environment, including for example, public health, control of pollution emissions, preserving valuable natural ecology, and improving quality of life.

(4) The World Bank (IBRD)

THE WORLD BANK'S OD 4.30 ON INVOLUNTARY RESETTLEMENT

Among the guidelines and regulations of the major International Institutions, this OD is the most important in planning the Project at hand as Jamuna Multipurpose Bridge Project (JMBP) was also implemented based on this OD and embodied its principles. JMBP recognized two broad categories of Project-Affected Persons (PAPs) i.e., (i) directly affected, who include private or legal owners of the acquired properties and (ii) indirectly affected, who include those who have been affected due to the acquisition of the private properties as well as requisition of the public properties or khas lands. The PAPs in the second category

include those who have lost tenancy and wage earning opportunities due to the acquisition of agricultural lands; employees of acquired businesses on private and public properties; and those who may have lost homesteads on public and private lands.

13.4.3 Present Land Acquisition Practice in RHD Projects

Under the said Ordinance Deputy commissioner (DC) of the Division is empowered to acquire any property owned by any private person.

Procedures commence with submission of application to the Regional DC after the Ministry of Communication approved a land acquisition plan including compensation items as applied by RHD. DC shall be responsible up to the time when such land is delivered.

The following sequence is commonly practiced for RHD projects:

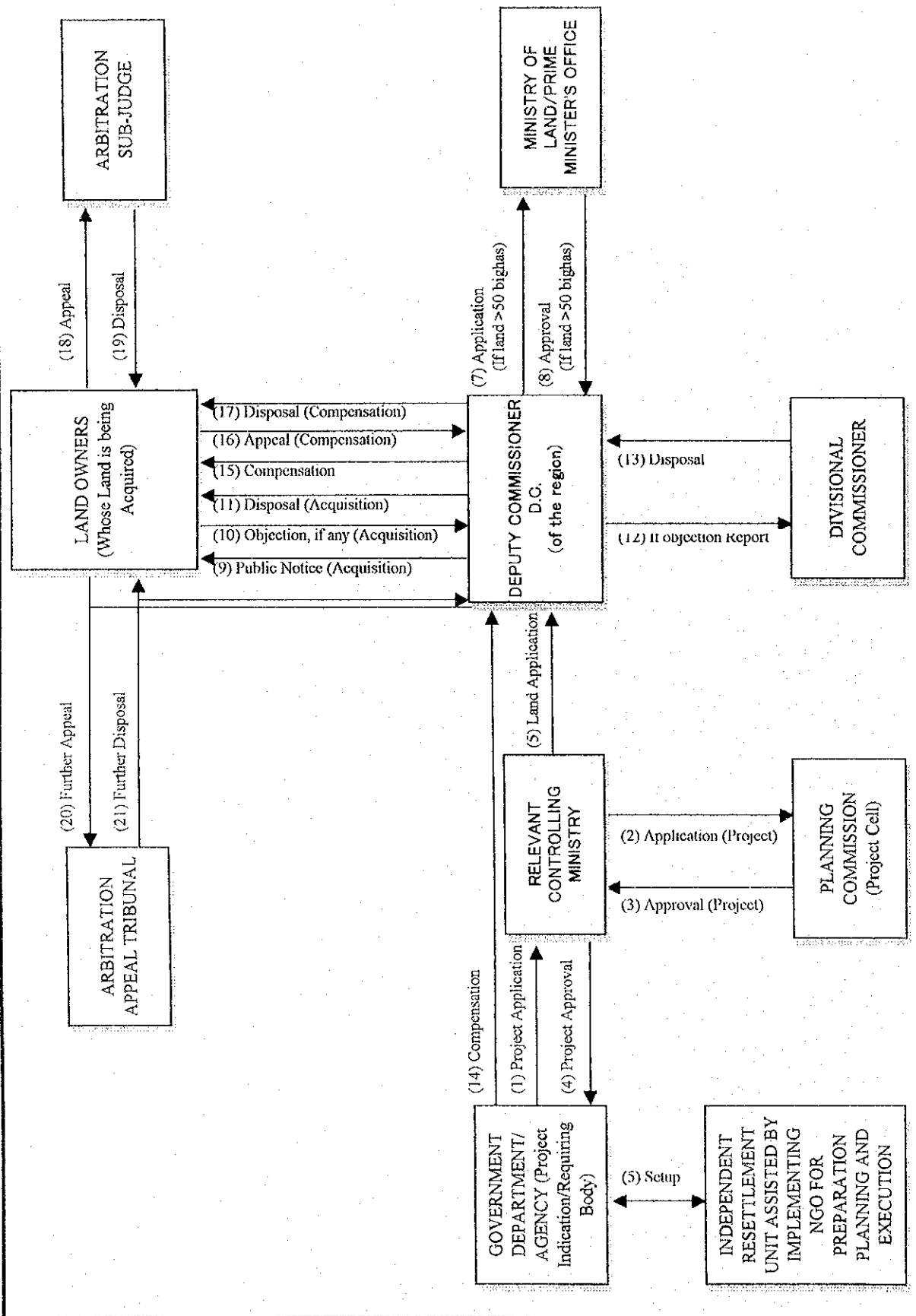
Land Acquisition Procedures

1. Requiring Body (RHD) prepares Land Acquisition Map.
2. MOC approves the proposal of RHD on the acquisition proposal.
3. RHD sends the proposal to Deputy Commissioner (DC) of the District and perform Joint Physical Verification for the lands to be acquired.
4. DC, as the Chairman of the District Land Allotment Committee, is to approve the proposal of RHD. Above 16.67-acre project, the same shall be done to Ministry of Land.
5. After the approval of proposal by DC and MOL, the formalities start by District Land Acquisition Office (LAO) under administrative control of DC.
6. A committee consisted of each of the representatives from RHD, LAO, and NGO complete joint verification of the acquisition map.
7. DC send notices to the affected landowners.
8. The land acquisition proposal is sent to Prime Minister's Office for final approval and to Ministry of Land.
9. DC Office estimates land acquisition cost and sends to RHD.
10. RHD arrange the necessary fund for DC Office.
11. DC make payment to the affected landowners.
12. Simultaneously, DC takes over the land and hand over to RHD for execution.

Fig.13.4.1 shows the above procedure in flow diagram.

GOVERNMENT LAND ACQUISITION PROCEDURE AS GOVERNED BY THE ACQUISITION AND REQUISITION OF IMMOVABLE PROPERTY ORDINANCE, 1982

Fig.13.4.1



Land cost should originally be decided based upon the data kept at the Land Registry Office, however, costs largely below market value are declared for countermeasures of personal tax. It usually makes problem for the balance with the value decided by the Land Evaluation Committee in land expropriation. One of the cases was that RHD raises funds and paid the difference through NGO. In general, it takes 6 months through 1 year for obtaining approval of land delivery after application.

13.5 Primary Social Cost Estimation

13.5.1 Social Impact Aspect

(1) Resettlement and Compensation Procedure

① Involuntary Resettlement

Involuntary resettlement is often a consequence of planned change generated by major development projects. In a land-scarce country like Bangladesh, acquiring of private land is unavoidable for any development interventions. By its nature, displacement is always an extra-ordinarily disruptive and painful process, economically and culturally. Because it dismantles production systems, it disorganize entire human communities and it breaks up long established social networks. Since displacement is unavoidable in Rupsha Bridge Project, resettlement plans shall have to be developed to mitigate sufferings of the people to be affected due to the bridge.

② Directly and Indirectly Affected Persons

The Directly Affected Persons are those who have lost cultivable land and/or homestead land and structure in the project area and who generally resides in the project area. Direct by Affected Persons have an Award as per Deputy Commissioners (DC) Award book and receives compensation from DC.

The Indirectly Affected Persons are those who will loss their place of residence (Uthulis and Squatters) and whose primary source of income is dependent on the area to be acquired for the project. This includes squatters and Uthulis, Sharecropper, wage earner etc.

The Indirectly Affected Person gets compensation from the project implementation authority and they have no title on acquired land.

(2) Procedure Adopted in the Jamuna Bridge Project

① General

In order to describe the procedure, Jamna Bridge is taken as a recent sample.

Jamuna Multipurpose Bridge Authority (JMBA) has acquired 7,316 acres of land on both sides of the Jamuna River for construction of various components and facilities, including the East and West Guide Bunds for river training and protection. As a result of land acquisition, about 16,000 households have lost their agricultural land, homestead structure and/or other properties while indirectly affected households have lost their sources of income like farm/non-farm workers, tenant cultivators, squatters and uthulis. In accordance with the World Bank Operating Directive 4.30 a resettlement plan called RRAP (Revised Resettlement Action Plan) was prepared to mitigate the adverse impacts of land acquisition and displacement.

JMBP recognized two broad categories of Project Affected Persons (PAPs) i.e.:(i) directly affected, who include private or legal owners of the acquired properties and (ii) indirectly affected, who include those who have been affected due to the acquisition of the private properties as well as requisition of the public properties or khas lands.

Of the 16,000 households, 3,600 households needed to be resettled; the rest lost agricultural land only. All affected households, irrespective of ownership titles, are eligible for compensation as defined by the Entitlement Matrix, which classifies 14 compensation items. Nearly two-thirds of those requiring resettlement have resettled in the pre-existing villages, where additional infrastructure (e.g. schools, mosques/temples, roads, tubewells for drinking water, and sanitary latrines) have been provided by JMBA for the host villages.

② Compensation rate in JMBP

- i) Compensation for lost land: In order to determine the market price of land in accordance with the proviso of land acquisition act, sales figure of land from the sub-registrar's office should be taken. A sum of 50% should be awarded in addition to the market value of land.

In JMBP, average price of land is as below:

- Agricultural land : Tk. 74, 454/acre.
- Homestead land : Tk.114, 412/ acre.
- Sandy land : Tk. 20, 023/acre.

- Ditch/Fallow land: Tk. 17, 949/acre.

JMBA has acquired land mostly in erosion prone area for which price of land might be less.

ii) Loss of Structures:

Assessment of market price of affected house(s), manufactory, building(s) and other living and commercial structure(s) is done on the basis of price of the Public Works Department (PWD). A sum of 50% should be awarded on the market value of property.

iii) Loss of Crops:

Assessment of price of affected crops is done on the basis of the price of :

- The Agriculture Department - Production rate of crops
- The Marketing Department - Market price of crops

iv) Loss of Trees:

Assessment of price of trees is done on the basis of market price given by the forest department.

Note: JMBA has acquired 7633 acres of land and paid compensation Tk.728million.

Therefore, the average rate of compensation (land+tree+structure) is Tk. 95,375/acre.

Table 13.5.1 presents 14 types of loss stipulated in the Resettlement policy matrix of JMBA.

The concept of PAPs (Project-Affected Persons) is now known in general as used for Jamuna Bridge Project which was completed through the co-finance of international lending institutions from OECF, ADB and WB and also GOB. Legally, however, the Acquisition and Requisition of Immovable Property Ordinance (1982) is still applied. Therefore, PAPs should move at their own responsibility once compensation money is received under the present Ordinance, except that donor(s) in case of foreign assisted projects do not require such consideration.

13.5.2 Direct Social Cost Included in Economic Analysis

In calculating the social cost, the data were collected and arranged separately for direct social cost included in the economic analysis of this Master Plan and indirect social cost not included therein. The results are summarized and shown in Table 13.5.2.

For the field survey, Mouza Map (Cadastral Survey Map scale 1=3,960) obtained from DC Office of Khulna was used. This Mouza map, which is kept at Land Registry office,

Table 13.5.1 Resettlement : Compensation and Rehabilitation Policy

Sl No.	Type of loss or disturbance	Nature of Entitlement(\$)	Rate/amount	Remarks
1.	Loss of Agri. land	<ul style="list-style-type: none"> Cash Compensation as per Law (CCL) Stamp Duty Maximum Allowable Replacement value (MARV) 	<ul style="list-style-type: none"> CCL-rate of Agri. land Actual amount incurred during land transaction Difference between MARV and compensation received from DC. 	<ul style="list-style-type: none"> CCL-DC Affected person is to buy land MARV is Tk. 191,092/- per acre. MARV is Conditional. Affected person should buy land to get MARV.
2.	Loss of Homestead land	<ul style="list-style-type: none"> CCL Stamp Duty Maximum Allowable Replacement value (MARV) Plot at project sponsored Resettlement Site (RS) 	<ul style="list-style-type: none"> CCL - rate of Homestead land Actual amount incurred during land transaction Difference between MARV and compensation received from DC 	<ul style="list-style-type: none"> CCL-DC Affected person is to buy land MARV is Tk. 191,092/- per acre. MARV is Conditional. Affected person should buy land to get MARV
3.	Loss of living structures & other physical structures	<ul style="list-style-type: none"> CCL Transfer Grant (TG) House Construction Grant (HCG) 	<ul style="list-style-type: none"> a) CCL : 1m/C.I. sheet roof - Tk. 106 per sq. ft. Kutcha/batched - Tk. 42 per sq. ft. Pucca - Tk. 515 per sq. ft. b) @Tk. 300/- per HH member (mini. Tk. 1000/- Maxi. Tk. 3000/-) c) @Tk. 10/- per sq. ft. of Pinth area (Tk. 2500/- - Tk. 7500/-) 	<ul style="list-style-type: none"> CCL-DC Uthuli & squatter will get TG and HCG @ Tk. 2000/- +2000/-=4000/- EP is allowed to take the salvageables free of cost
4.	Loss of economically valuable perennial	<ul style="list-style-type: none"> CCL of tree EP is allowed to cut and take the tree Free samplings 	<ul style="list-style-type: none"> Large tree - Tk. 1750/- Medium - Tk. 300/- Small tree - Tk. 22/- 	<ul style="list-style-type: none"> CCL-DC Free sapling @ 10-20 nos/EP
5.	Loss of occupied homestead (Uthuli & Squatter)	<ul style="list-style-type: none"> Plot at RS site Transfer Grant HCG 	<ul style="list-style-type: none"> a) 2.5 decimal plot b) Tk. 2000/- per family c) Tk. 2000/- per family 	<ul style="list-style-type: none"> Affected persons will also get training & credit facilities
6.	Loss of tenant contract for farming	One Time Cash Grant (OTCG)	Tk. 3600/- per family	Training+credit facilities
7.	Loss of wage income	OTCG	Tk. 3600/- per family	Training+credit facilities
8.	Loss of commercial plots	<ul style="list-style-type: none"> CCL Stamp duty MARV benefit 	<ul style="list-style-type: none"> a) Rate depends on the type of loss b) actual amount spent c) differential amount 	<ul style="list-style-type: none"> CCL-DC SD-RU MARV-Tk. 191,092/-
9.	Loss of structures used for commercial or industrial activity	<ul style="list-style-type: none"> CCL Dismantling & removal costs (DRG) reconstruction grant (RG) One Time Moving Assistance (OTMA) 	<ul style="list-style-type: none"> a) 15% of compensation received from DC b) Tk. 25/- per sq. ft. 	<ul style="list-style-type: none"> CCL-DC DRG-RU RG-RU
10.	Displacement from rented/occupied commercial premises	<ul style="list-style-type: none"> CCL-if applicable 	Tk. 2000/-	Training+credit facilities
11.	Loss of standing crop.	<ul style="list-style-type: none"> CCL-if applicable 	<ul style="list-style-type: none"> Affected Persons will be given 4 months notice 	<ul style="list-style-type: none"> All remaining entitlement-RU
12.	Persons who have already parted with the properties and have relocated elsewhere	<ul style="list-style-type: none"> Remaining entitlement 	<ul style="list-style-type: none"> Applicable to persons evicted before payment of RU grants 	<ul style="list-style-type: none"> No individual entitlement as a whole will get benefit. Community
13.	Adverse Impact on host population	Assistance for host-quest interaction	<ul style="list-style-type: none"> Construction/extension/renovation of new and existing facilities such as educational institutions, religious facilities, common facilities, graveyard, community centre etc. 	<ul style="list-style-type: none"> Applicable if the land is eroded in the defined geographical area in the upstream or downstream of the bridge
14.	People adversely affected by bridge i.e. change in water levels upstream, or downstream, or in unforeseeable ways	<ul style="list-style-type: none"> Relocation grant Land grant-if eroded 	<ul style="list-style-type: none"> Tk. 700/- per HH member. Min. Tk. 3000/- maxi. Tk. 4500/- Tk. 563/- per decimal 	<ul style="list-style-type: none"> Applicable if the land is eroded in the defined geographical area in the upstream or downstream of the bridge

has been used since British Era for land registration and being revised periodically. Fig.13.3.1 shows the segment divisions on the alignments used as reference for field survey. Usually Land Acquisition procedures are performed basing on the maps.

The following items are included:

① Land acquisition costs – lands for farming, housing, commerce, shrimp and fish nursery ponds, and others, ② Compensation of property – house, factory, school, mosque, and shop, ③ Trees ④ Compensation for crops – cultivation, woods as fuel, ⑤ Compensation for income – shop, ferry, tenant farmer, day laborer, ⑥ Cost for moving, ⑦ Costs for relocation sites

(1) Land Acquisition Cost

Breakdown of the land acquisition cost is shown in Table 13-5-2.

The unit costs currently registered at the Land Registry Office are much lower than market values by about 1/10. This is because the selling prices are intentionally declared lower for their personal tax payment.

(2) Compensation Cost

The following items are calculated for obtaining the compensation cost:

① Structures

Basically, the standards of the Ministry of Public Works are applied. It was classified as commercial (shops), residential, industrial (brick factory, rice mill), institutional (school, Madrasha-Islamic School), and mosque. It was also classified by construction materials as brick-built, semi-brick-built and wooden/straw house. Prices are decreased according to the degree of deterioration and decided for each structure.

② Trees

It was calculated as fruit tree-Tk.800/No., timber tree-Tk.700/No. and bamboo-Tk.50/No.

③ Nursery Pond

Excavation cost of ponds was calculated for shrimp and fish culture and for daily life. For shrimp/fish products, no payment upon the yield are considered, as advance notice will be issued for yield with sufficient period usually.

④ Compensation for Products

Compensation will not be paid for agricultural products for the same reasons as above. For wooden products, three years' fuel costs were calculated.

⑤ Moving Expenses

Tk.5, 000 was appropriated for each household in a lump as moving expenses.

⑥ Compensation for Income

Three months' income were calculated for shop keepers (4 ranks), hawkers (5 ranks) and small ferryboats. For laborer, it was so calculated that three months' income would be compensated for day laborer, agricultural laborer and share cropper (tenant worker) respectively.

⑦ Provision of Relocation Site

It was calculated as Tk.10 Million for land acquisition cost, development cost and for those of infrastructure in case that 100 families are to move into newly prepared land with 150 m² plot each. In this case, it will be Tk.100, 000 for each family. Prices for housing are not included as they have been paid already.

- Land Price Including Development

$$100 \text{ Families} \times 150 \text{ m}^2 \times \text{Tk.}500/\text{m}^2 = \text{Tk.}7, 500,000$$

- Infrastructure Services and Utilities

$$15,000 \text{ m}^2 \times \text{Tk.}150 = \text{Tk.}2, 250,000$$

13.5.3 Indirect Social Cost Excluded from Economic Analysis

The items regarded as Indirect Social Cost are listed in Table 13.5.3, and each item is discussed as below:

① Permanent Loss of Productive Agricultural Land and Nursery Pond

Averaged annual products of farmlands is Tk.2, 200/ha. or so. The product per area is not known for nursery pond. As total, Tk.2.5 Million/year for shrimp and Tk.1.3 Million/year for fish are yielded on Alignment A, and Tk.1.3 Million/year for shrimp and Tk.3.8 Million/year for fish are yielded on Alignment B. It is not known if such differences are caused by output volume or prices due to grade (quality).

② Utilization of Road Side in ROW

Currently, RHD permits in its circular notice that vacant and unused lands, mainly the sites

after borrow pit, may be leased at prices lower than market value for the use of agricultural, fishing and passage purposes, on conditions that they should be returned within 30 days when a notice is given.

③ Creation of Employment during Construction

It is calculated as 1,000 laborers/day x Tk.60 during construction.

④ Creation of Employment in Case MMT is Made

It is reported that about 10,000 laborers/day are working in Noapara at present. Calculation is made as 10,000 laborers/day x Tk.60.

⑤ Population Stability and Commercial Development by Activation of Mongla Port

The biggest positive impact is expected.

⑥ Increase in Land Cost along the Road

⑦ New Land Preparation for Those Submerged Lands along the Road

KDA offers for sale by 67 m² at Tk 450/m² as 1 lot and, when the numbers of lot are increased, the unit price is reduced to Tk120/m². Tk.30, 000/lot is the cheapest.

⑧ Increase in Productivity in Commercial and Small Industry on These Lands

The efficiency will be high as they are located along the motorway.

⑨ Improvement of Access for Automobiles

Access through automobiles and rikisha will be much improved to go to hospital, senior school, market and workplace. Especially, effects will be remarkable in rainy season.

⑩ Mental Stress by Moving into New Place

Mental stress may be caused by parting from acquaintances and problems with residents in new places. For this Project, however, the ratio of landowners is high and it was assumed that 5% of affected houses might move into remote places. In this case, 2 houses on Alignment A and 15 houses on Alignment B are used for assumption..

⑪ Time and Economic Loss for Buying Fruits and Fuel, if There Are No Woods in New Places.

Eucalyptus is fast to grow and can be used after 4th year of planting. Assistance for planting will be necessary.

⑫ Relative Decrease in Common Resource (Water, Wood) in New Places

This will affect agricultural and stock raising industries which may cause decrease in income.

⑬ Sickness due to Mental Stress

It will require medical expenses, unable to get to work, and income be decreased.

⑭ Loss of Support Organization and Family Division

When 2-3 families in a homestead cannot be relocated, the whole homestead comprising 5 – 6 families should move.

⑮ Increase in Sundarbans Tourism due to Improvement of Traffic

The number of tourists is estimated at 15,000/year making a base in Khulna where hotels are available. But it takes much time while foreign tourists are increasing as it has come to better-known as a World Heritage. At present, entrance fees are paid to the Ministry of Environment and Forestry at Tk.20/day for foreign tourists and Tk.4/day for domestic people. Earnings including transportation costs are estimated at Tk.5, 000/person x 15,000 persons/year x 2 times.

Table 13.5.2 Social Cost

Unit: Million Taka

No.	Alignment	Land Acquisition					Compensation Cost										Total	No. Affected Homes
		Agri.	Home	Farming Pond	Other	Sub. T	Struct.	Trees	Pond	Crops	Moving	Income	Reloc.	Sub. T				
1	Alignment A South Section	61.8	9.4	0.8	1.2	73.20	6.6	0.8	5.6	1.7	0.1	4.7	0.2	19.70	92.90	25		
2	Alignment B	72.3	68.6	3.5	23.2	167.60	71.4	8.1	4.9	18.7	1.5	1.5	1.5	107.60	275.20	297		
3	Rail Alignment A					198.70								97.09	295.79			
4	Rail Alignment B					205.08								131.65	336.73			

Note 1: The width of Road ROW and Rail ROW are assumed 50m and 30m respectively.

Note 2: Excluding the river widths, the length of road alignment are 9,320m for A-South, 17,540m for A-North, and 19,100m for Alignment B. The length of rail alignment are 20,400m for Rail A, 19,500 for Rail B. Meantime, 30m wide section between Khulna-Mongla is 6,900m in length and 15m wide section is 25,100m in length. Thus, the total length of Rail A is 52,400m and that of Rail B is 51,500m.

Note 3: For calculation purpose, the width of ROW is assumed 50m for road and 30m/15m for rail uniformity including structures/high embankment.

Note 4: The costs are calculated proportionally based on the actual survey results obtained on Alignment A and Alignment B.

Reference

5	Alignment A North Section	87.6	32.3	2.0	16.2	138.1	28.7	1.7	13.5	2.2	0.7	1.5	0.8	49.1	187.2	149
6	Alignment A	149.0	41.7	2.8	17.4	210.9	35.3	2.5	19.1	3.9	0.8	6.2	1.0	68.8	279.7	174

Table 13.5.3 Indirect Social Cost

No.	Item	Positive Impacts	Negative Impacts	Remarks
1	Permanent loss of productive agricultural land and nursery pond		-5	Alignment A South Section : 440,000 m ² x TK150 Alignment B : 700,000 m ² x TK115
2	Utilization of road side in ROW	+1		Rental as nursery pond : Taka 20,000(?)/ha.year, tree and grass planting for livestock
3	Creation of employment during construction	+3		1,000 persons/day x TK60
4	Creation of employment in case MMT is made	+5		10,000 persons/day x TK60, an example in Noapara
5	Population stability and commercial development by activation of Mongla Port Area	+5		
6	Increase in land cost along the road	+3		In case of KDA City Bypass, TK120/m ² -TK450/m ² selling by a plot of land
7	New land preparation for those submerged lands along the road	+3		
8	Increase in productivity in commercial and small industry on these lands newly made	+3		
9	Improvement of access for automobiles	+3		Access to hospital, senior school, market, office by automobiles and rikisha will be much improved
10	Mental stress by moving into new places		-1	2 houses for Alignment A and 15 houses for B are assumed. Serious problems but less houses
11	When there are no woods in new places.		-1	Time and economic loss for buying fruits and fuel for minimum 3 years
12	Relative decrease in common resource (water, wood) in new places		-1	Bad effects upon agriculture and stock raising-income decrease
13	Sickness due to mental stress-medical expense-work-income decrease		-1	Serious problems but less houses
14	Loss of support organization, family split(homestead)-change in social structure		-1	Same as above
15	Increase in Sundarbans tourism due to improvement of traffic	+1		At present 15,000/year x Taka 5,000/person x 2 times increase

Note: Degree of Impacts +1, -1 (very low -- low)

+3, -3 (moderate)

+5, -5 (high -- very high)

+ Positive Impacts, - Negative Impacts

13.6 Conclusion and Recommendation

13.6.1 Social Environment

- 1) In case of the road, some 89% for Alignment A and 76% for Alignment B will cross farmlands. On these Alignments, the communities of families and relatives called "homestead" are living but it will make a serious problem of family split. Careful attention is required as the original inhabitant rate shows as high as 60%.
- 2) On Alignment A, 25 private houses with 135 persons will be affected and 297 private houses with 1,685 persons will be affected on Alignment B. Their land holding rate including farm lands shows around 90%, meantime, their income from farming is only 3% on Alignment A and 18% on Alignment B forming periurban (urban-neighboring) societies. Therefore, negative impact upon social environment through land acquisition seems relatively small.
- 3) Men go to town for work and women are engaged in housework and farming. Some unbalanced ratio between men and women on the Alignments was observed. Those issues including women laborers should be further studied and be made clear.
- 4) Careful attention will also be required for sharecroppers (tenant farmers), people with no lands, and Hindus as minority ethnic respectively, although small in numbers.
- 5) For the railway Alignment, ROW width is 30 m., which is narrower than 50 m. of roads. However, the high embankment sections will be longer than those of roads and will have an effect on Community Split and Traffic and PAPs will be increased further according to alignment selection.

13.6.2 Natural Environment

- 1) Natural forestland exists in the project area and the adjacent area. The proposed alignments pass through mostly agricultural land and homestead trees. Therefore, remarkable impact upon natural environment has not been recognized around the Alignments. But careful consideration is necessary to minimize the felling of trees of homesteads and for sites after taking soil for embankment.
- 2) Change in flow regime and erosion is not reported on Alignment A but large erosion was reported on the Atai River. As the area is affected by the tidal flows, careful consideration should be made.
- 3) Some pollution during and after construction on lands and rivers cannot be avoided and such measures as planting trees along the roadsides will be necessary to keep it to the minimum.

13.6.3 Care and Dialogue with Local People and Project-Affected Peoples (PAPs)

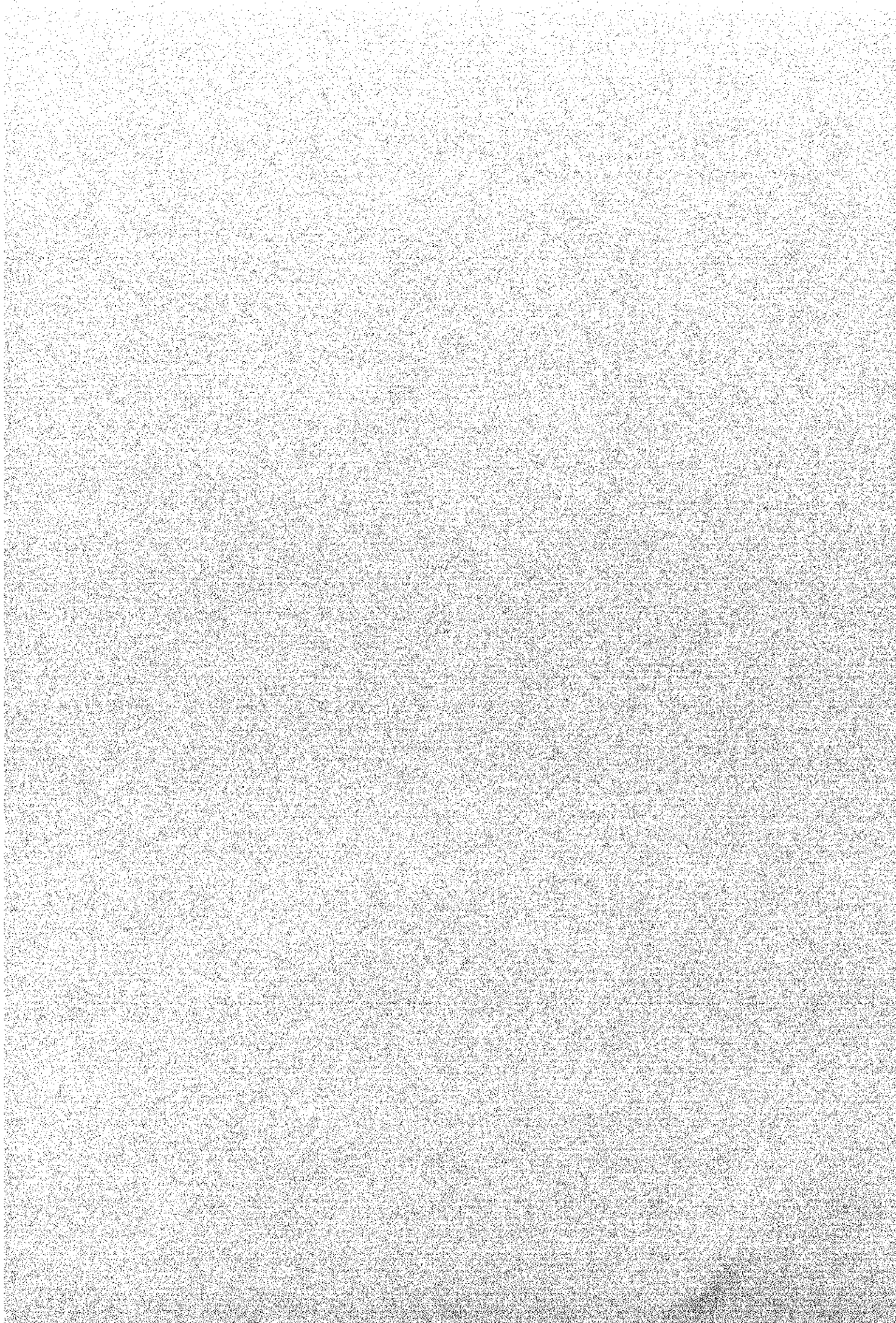
Early realization of the Project will bring about great merits to regional activation. But it will take 6 months through 1 year to acquire the land for commencement of construction after the detailed plan and the applications of acquisition are made to Regional Deputy Commissioner. However, the present LA Ordinance does not provide for rehabilitation or consultation with PAPs, and local people and PAPs were never consulted at any stage of almost all projects in the past. The cooperation of local people and PAPs is indispensable for smooth implementation and also success of the project. Therefore, dialogue including NGO should be made at an early stage without sticking to the existing laws and rules.

13.6.4 Formulation of Further Studies

In view of the foregoing, it should be necessary to conduct and formulate environment impact assessment, resettlement plan, and environment management plan at each suitable stage.

CHAPTER 14

ALTERNATIVE PLANS



CHAPTER 14 ALTERNATIVE PLANS

14.1 Alternative Plans for Rupsa Bridge and Related Transport Facilities

14.1.1 Railway Extension to Mongla Port

(1) Planning Approach for Alternative Plans

(2)

The scheme of Railway Extension to Mongla Port is planned in the Study to connect existing railway to Mongla Port only to accommodate future cargo demand by its own route.

Bangladesh Railway (BR) had studied the rail transportation to Mongla Port in the past. Two routes were studied in the northern part to bypass Khulna, namely the eastern route (B) and the western route (A), and the route in the southern part ran almost parallel to existing Khulna - Mongla Road.

In the Study, the preliminary engineering study is conducted along these two route on the assumption that the scheme of Railway Extension to Mongla Port is assumed to connect existing railway to Mongla Port by its own route and to run parallel to Khulna Bypass only at river crossing points in the northern part.

Financial analysis is required to examine a rational investment scheme as BR pursues Railway Recovery Program (RRP) under ADB program loan since 1993 and it necessitates to ensure that a new investment should have clear commercial justification. On the other hand, although most possible benefit from railway extension is balance of transport costs between road and rail, economic analysis is hardly conducted because the transport cost of cargo to final destination through rail transport is too ambiguous and financial analysis would be pessimistic.

The scheme of rail-cum-road bridge is studied in the stretch where railway is planned to run parallel to Khulna Bypass at river crossing points in the northern part.

(2) Base Case for Railway Extension Plan

The base case (ALT R-1) for railway extension plan is the eastern route (B) in the northern part and the route in the southern part parallel to existing Khulna - Mongla Road, which is recommended by BR.

478,000 tons/year cargo traffic demand for the year 2015 is projected to be generated and attracted at Mongla Port through railway, if Railway is extended to Mongla Port. Such potential rail cargo at Mongla Port is deemed long-haul freight traffic handled at the jetty, mainly comprising North-western Region and Nepalese Transit Cargo.

For the purpose of financial analysis, freight revenue is assumed that tariff between Mongla Port and Rajshahi is regarded as transport cost of jetty cargo for the north-western region and tariff between Mongla Port and the border is for Nepalese transit cargo.

Construction costs for railway extension are estimated comprising minimum civil works such as fill, bridge, ballast, sleeper, rail and signaling. On the other hand, operation and maintenance costs are estimated on the assumption that 5 locomotives and 700 wagons are purchased.

14.1.2 Khulna Bypass and Studied Four Bridges

(1) Precedent Conditions

- 1) The following cases are studied as the base case for alternative setting;

The Western Route (A Route)

ALT 1-1 : Demand Forecast = Case-1, Cost Estimate = The Southern Section of Khulna Bypass (Undivided 2-lane with Sidewalks)

The Eastern Route (B Route)

ALT 3-1 : Demand Forecast = Case-3, Cost Estimate = The Eastern Route of Khulna Bypass (Undivided 2-lane with Sidewalks)

- 2) There are four (4) possible bridges involved in the Study. Every bridge is named referring to river name at river crossing point, namely Rupsa Bridge on ADB's Alignment-A (the Western Route) and Bhairab Bridge/Atai Bridge/Atherobaki Bridge on ADB's Alignment-B (the Eastern Route). The Bridge, so-called "Rupsa Bridge", is referred as a bridge or a group of bridges on Khulna Bypass that the Mongla Port Area Development Project (the MPADP) financed by ADB has studied to solve underutilization of Khulna-Mongla Road, resulted in underutilization of Mongla Port. However, studied 4 bridges are supposed to be located at surveyed points where topographic and bathymetric surveys were conducted by the study team and they are regarded as typical terrain in the vicinity of project site. Boring investigations were also carried out at each river crossing points to obtain subsurface soil condition.

- 3) Two components of bridge are studied from bridge engineering viewpoint, namely Main Bridge and Approach Bridge. The main bridge is located in between dikes of river, and bridge construction works are to be done in the water, while the approach bridge is located outside of dike. It is necessary for the main bridge to be designed taking into consideration navigation clearance, head loss of river flow by piers, scouring & erosion, constructability, construction economy including construction period, aesthetic view and maintenance. On the other hand, the design of approach bridge requires mainly optimization of construction economy.
- 4) The main bridge at the rivers of Rupsa, Bhairab and Atai requires to secure 250 ft (76.22 m) lateral navigation clearance, and accordingly the minimum span length of main bridge is determined 100 m long in addition to allowance of construction and navigation. The main bridge at the Atherobaki river requires 100 ft (30.48 m), thus the minimum span is 50 m long.
On the other hand, vertical clearance for navigation is designated 60 ft (18.30 m) for Rupsa, 40 ft (12.20 m) for Bhairab/Atai and 25 ft (7.62 m) for Atherobaki. The minimum headroom is determined 20 m for Rupsa, 15 m for Bhairab/Atai and 10 m for Atherobaki in addition to allowance of construction and navigation.
- 5) 3% of the maximum grade is adopted to road approach section because of traffic characteristic of the study area. 1% of the maximum grade is adopted to rail approach section because of traction power of BR locomotives with pulling 2,000 tons.
- 6) Since flatter grade of 3% is adopted and it results in rather long bridge section, the curvature of vertical alignment at crest, which governs sight distance on road, is selected 2,000 m that it is the desirable curvature at design speed of 60 km/h in Japan. The curvature of 3,000 m is adopted to vertical alignment of railway according to railway design standard.
- 7) It is possible to share a cross sectional space on main bridge by both road and railway even though some difference of curvature is found. However, it is significantly different in approach section if road and railway should share the space of bridge. It is not reasonable that the vertical alignment of road should comply with considerably flatter grade of that of railway only to share the space of bridge to result in huge increase of bridge cost. Therefore, the scheme of rail-cum-road bridge is studied in case that railway would share a cross sectional space on main bridge of road.

- 8) Khulna Bypass is planned to be undivided 2-lane road from traffic capacity based on traffic demand forecast for the year 2015. Accordingly, 2-lane two ways of 8.5 m carriageway is designed as basic configuration where heavy vehicle may pass beside the breakdown of car on shoulder only reducing speed. However, divided 4-lane configuration, which on-going Paksey Bridge is designated, is also studied since traffic demand forecast depends on prospective economic growth to deliberate review of past pessimistic studies.
- 9) Additional track for slow-moving vehicles such as auto-rickshaw, motorcycles and so forth is basically provided at both sides, taking into consideration traffic characteristics and traffic safety. Provision of additional track at one side is also studied from viewpoint of construction economy. In this case, it requires box culverts at both ends of bridge to merge and diverge traffic.
- 10) River training is required at each bridge site to protect embankment slope from erosion. In order to inspect and maintain river revetment, inspection road is to be designed on the top of dike and it may require headroom beneath bridge.

(2) Alternative Plans of Bridge

1) Main Bridge

Practical types of bridge for min. 100 m span length which Rupsa/Bhairab/Atai bridges are required are selected as follows;

- Continuous PC Box Girder (Tapered girder depth)
- PC Cable Stayed Girder
- Continuous Steel Box Girder with Steel Deck

They have individual advantage at the aspect of construction economy, aesthetic view and short construction period respectively. On the other hand, practical types of Atherobaki Bridge with min. 50 m span length are selected;

- Continuous PC Box Girder (Uniform girder depth)
- Continuous Steel Box Girder with Steel Deck

All types of bridge are supposed to have cast in-situ concrete pile foundation.

2) Approach Bridge

The type of bridge selected is Composite PC I-Girder with Cast In-Situ Concrete Pile Foundation because of common practices in Bangladesh. An optimum span length of bridge is studied among 20m, 30 m and 40 m to find the most economical one.

3) Selected Types of Bridge

As for Rupsa/Bhairab/Atai bridges, Continuous PC Box Girder (Tapered girder depth) is selected.

As for Atherobaki bridge, Continuous PC Box Girder (Uniform girder depth) is selected.

As for approach bridge, Composite PC I-Girder with 30 m span is selected.

All types of bridge are supposed to have cast in-situ concrete pile foundation.

The selected types of bridge structure are commonly used in cost comparison of alternative plans.

14.2 Alternative Plans from Major Issues Encompassing the Rupsa Bridge

14.2.1 Route Location and Navigation Clearance

- (1) Navigation clearance beneath the Bridge is appropriately reserved to provide space vertically and horizontally for letting design vessel pass safely even on high water level. Four river crossing points have already had specified navigation clearances, and vertical clearance for Rupsa Bridge is the highest of 60 ft (18.30 m) among them. It is no doubt that higher vertical clearance results in increase of bridge cost, but it is necessary to study it totally, considering difference between one bridge on the Western Route and three bridges on the Eastern Route. Table 14.1 presents the comparison of studied four bridges in term of bridge length and cost. It is a matter of fact that totaling of three bridges become longer in bridge length and more expensive in cost, and the bridge cost of the eastern route is 92% higher than that of the western route.

Although the main bridge is located in the river and thus no social impact is found, the approach bridge is located beyond dikes and it requires to acquire land. Land acquisition may bring many social impacts such as property compensation and relocation of affected persons. Table 13.5.2 shows the cost comparison of land acquisition and property

compensation as well as potentially affected number of houses. Such social costs of the eastern route are estimated approximately three (3) times as high as that of the western route. Moreover, number of potentially affected houses become more than ten (10) times due to ribbon development along the river.

(2) Bridge Types such as Road, Rail and Rail-cum-Road

In the Study, the scheme of Railway Extension to Mongla Port is assumed to run parallel to Khulna Bypass only at river crossing points in the northern part, namely Rupsa on the western route and Bhairab/Atai/Atherobaki on the eastern route. Table 14.2 presents the comparison of studied four bridges in term of bridge length and cost. It is estimated that the bridge cost might jump to 3.8 times in case that the scheme rail-cum-road in the whole bridge section should be adopted.

(3) Cross Sectional Configuration

Typical cross section for four bridges is planned basically to be undivided 2-lane road with sidewalks at both sides. However, it is pointed out the necessity that additional track for slow-moving vehicles accommodates commuters and secures traffic safety as well as smooth traffic flow. Divided 4-lane road is also studied just in case of future increase of traffic beyond projection. In addition to these alternative plans, the scheme of rail-cum-road on main bridge is studied.

Table 14.1 shows the comparison of bridge cost among five alternatives. The details & the cost estimates are given in Appendix H. As an example of the western route, compared to the base case of ALT 1-1, ALT 1-2 (plus slow-track at one side) increases 28%, ALT 1-3 (plus slow-tracks at both sides) increases 40%, ALT 1-4 (plus space of rail-cum) increases 59% and ALT 1-4 (4-lane) increases 63%.

Table 14.1 Comparison of Studied 4 Bridges

Route	Studied Bridge			Alternatives and its Bridge Cost (M. Tk.)								
	Name	Main (m)	Approach (m)	Total (m)	2-Lane with Sidewalk		2-Lane with Sidewalk		2-Lane with Sidewalk		4-Lane with Sidewalk	
					No Slow-Track	One Side	Both Sides	Road	Rail-cum	No Slow-Track	No Slow-Track	Road
Western Route (A Route)	Rupsa	640	720	1,360	ALT 1-1		ALT 1-2	ALT 1-3	ALT 1-4	ALT 1-5		
					1,341.1	1,718.1	1,874.4	2,127.0	2,180.2			
					100%	128%	140%	159%	163%			
Eastern Route (B Route)	Bhairab	440	600	1,040	ALT 3-1		ALT 3-2	ALT 3-3	ALT 3-4	ALT 3-5		
	Atai	440	600	1,040	1,059.4	1,358.5	1,482.0	1,644.8	1,724.6			
	Atherobaki	330	240	570	1,059.4	1,358.5	1,482.0	1,644.8	1,724.6			
	Total	1,210	1,440	2,650	462.2	590.2	643.1	722.0	747.0			
					2,581.0	3,307.2	3,607.1	4,011.7	4,196.2			

Note:

- 1) Direct construction cost of bridge covers costs between abutments and excluding 10 % contingency.
- 2) In road-cum-railway bridge, direct construction cost of Approach Bridge for railway is not included.
- 3) 100 m span continuous PC box girder with cast-in-situ concrete pile for Rupsa/Bhairab/Atai Bridge.
- 4) 50 m span continuous PC box girder with cast-in-situ concrete pile for Atherobaki Bridge.
- 5) 30 m span composite PC I-girder with cast-in-situ concrete pile for Approach Bridge.

Table 14.2 Comparison among Road Br. (i=3%), Rail Br. (i=1%) and Rail-cum-Road Br. (i=1%)

Alternative	Studied Bridge			Total (m)	Direct Bridge Cost (M. Tk.)	Remarks
	Name	Main (m)	Approach (m)			
Road Bridge	Rupsa	640	720	1,360	ALT 1-1 1,341.1	3% of road grade Simple road bridge
2-Lane with Sidewalk No Slow-Track					100%	
Rail Bridge	Rupsa	640	3,180	3,820	ALT R-3 1,990.2	1% of rail grade Simple rail bridge
Single Line					148%	
Rail-cum-Road Br.	Rupsa	640	3,180	3,820	ALT 1-6 5,131.8	1% of road grade and 1% of rail grade Rail-cum-road bridge
2-Lane with Sidewalk Single Line					383%	

Note:

- 1) Direct construction cost of bridge covers costs between abutments and excluding 10 % contingency.
- 2) 100 m span continuous PC box girder with cast-in-situ concrete pile for Rupsa Bridge.
- 3) 30 m span composite PC I-girder with cast-in-situ concrete pile for Approach Bridge.

(4) Alternative Plans for Economic and Financial Analysis

Benefits are brought by savings of transport costs stemmed from traffic demand forecast on each alternative route, and they are estimated the same as among alternative plans on each route. Therefore, variation of project cost by each alternative plans can be covered by sensitivity analysis. The followings are the base case for each alternative route.

With Project Case

ALT 1-1 : Demand Forecast = Case-1, Cost Estimate = The Southern Section of Khulna Bypass (Undivided 2-lane with Sidewalks)

ALT 3-1 : Demand Forecast = Case-3, Cost Estimate = The Eastern Route of Khulna Bypass (Undivided 2-lane with Sidewalks)

Without Project Case (Demand Forecast : Case 0)

Standing on the assumption that studied 4 bridges would not exist in the future road network for the year 2015, vehicular traffic might still cross the Rupsa river by ferry. However, all roads proposed by Khulna Master Plan including the northern section of Khulna Bypass are taken into consideration traffic assignment on future road network.

A financial analysis is conducted assuming Rupsa Bridge levying toll. Only ALT 1-1 is analyzed because the Study is still at a master plan level and amount of toll revenue is estimated the same among each alternative plans.

Since amount of freight revenue is estimated the same in both railway routes, sensitivity analysis can cover other alternatives.

ALT R-1 : Demand Forecast = 478,000 tons/year at the year 2015

Cost Estimate = The Eastern Route of Khulna-Mongla Railway Extension

Table 14.3 summarizes alternative plans from major issues encompassing the Rupsa Bridge.

Table 14.3 Alternative Plans from Major Issues Encompassing the Rupsa Bridge

Alternatives	Outline of Alternative Plan		Demand Forecast			
	Route	Bridge		Cross Section	Slow-Track	Rail-cum
1 ALT 1-1	Western Route (A Route)	Rupsa	2-Lane with Sidewalk	X	X	CASE-1
2 ALT 1-2			2-Lane with Sidewalk	One Side	X	
3 ALT 1-3			2-Lane with Sidewalk	Both Sides	X	
4 ALT 1-4			2-Lane with Sidewalk		O	
5 ALT 1-5			4-Lane with Sidewalk		X	
6 ALT 3-1	Eastern Route (B Route)	Bhairab/Atai/Atherobaki	2-Lane with Sidewalk	X	X	CASE-3
7 ALT 3-2			2-Lane with Sidewalk	One Side	X	
8 ALT 3-3			2-Lane with Sidewalk	Both Sides	X	
9 ALT 3-4			2-Lane with Sidewalk		O	
10 ALT 3-5			4-Lane with Sidewalk		X	
11 ALT R-1	Eastern Route (B Route)	Bhairab/Atai/Atherobaki & 6 Br.	Sigle Line	NA	X	478,000 t/yr
12 ALT R-2			Sigle Line	NA	O	
13 ALT R-3	Western Route (A Route)	Rupsa & 6 Br.	Sigle Line	NA	X	
14 ALT R-4			Sigle Line	NA	O	