7.2.2 Natural Environment

1) General

The Routes1, 2 and 3 neither pass over any natural forests nor any natural forest exist in the adjacent areas. The embankment and the bridge pass through several distinctly different ecosystems, e.g. rural homesteads, agricultural land, and swampland on alluvial younger materials and urban area consisting of residential, commercial, industrial and recreational areas. Innumerable ill maintained borrow pits may create environmental problems. The rural homesteads are found scattered throughout the flood plain area. These are situated on man made platforms and are usually densely covered by different tree species in rural and suburban areas. Urban structures are more or less well planned. The agricultural lands in flood plain area are tidally flooded and possess a narrow range of aquatic biodiversities and weed species. Perennial water bodies surrounded by a swampland occur locally within the area. The flood plain soils are coarse loamy on the ridges and fine loamy to clayey in basis.

2) Soil Erosion

As a common practice in this region, homestead land is made raising above tidal flood level by digging borrow pits in the adjacent areas. The pits are used for storing potable water and captive fisheries for household consumption. Road embankment material will be also obtained in similar way. Therefore, careful usage and maintenance of those excavated pits shall be made.

3) Soil

The Naihati Union Parishad (UP) under Rupsa thana, Jalma UP under Baitaghata thana and part of Mohammad Nagar mouza in Khulna Kotwali thana over which the proposed RBP is likely to be aligned are included under the Lower Ganges Tidal Floodplain. Soils of the project site are poorly or very poorly drained, grey clays with variable range of seasonal salinity. Except for homesteads, man-made platforms and ridge tops this landscape is seasonally or tidally flooded. Even on the highland part, rainwater is caught by field bunds during the Kharif-II season for paddy cultivation. Physico-chemical data of soil analyses are given in Table 7.2.10. The soils are fine loamy on ridges and clayey in basins.

Table 7.2.10 Physico-chemical Properties of the Topsoil, Khulna

Soil series	PH	Salinity (mmhos)	Organic Matter (%)	Exchangeable cations Meq/100 cm3 soil			P	S	B	Mn	Zn
				Ca	Mg	K	µg/g				
Iswardi	7.3	-	2.5	11.3	5.7	0.22	9	128	2.2	9	1
Gopalpur	6.9	5.6	0.95	12.9	5.1	0.12	30	165	1.8	22	2
Barisal	7.2	-	2.5	17.3	2.8	0.11	2	106	1.0	15	1
Bajra	7.3	5.5	1.6	14.2	4.0	0.12	3	250	2.5	29	2

Ca:calcium, Mg:magnesium, K: potassium, P: phosphorus, S: sulphur, B: boron, Mn:manganese, Zn: zinc.

Souce: Bhumi-O- Mrittika Shampad Babohar Nirdeshika, Rupsa and Baitaghata thana, 1989.

The soil and water salinity of the RBP site shows a rhythmic seasonal variation. Both soil and water salinity increases from December and reaches peak in May and falls sharply in June with the beginning of the monsoon because of rain water flushing. This happens due to local rainfall and run-off that is received from the catchment areas from within and out side Bangladesh boundary. Soil salinity during November-May period in the project affected site varies from slight to moderate range as per USDA (Anon 1972) classification. These ranges are as follows:

Salinity	Conductivity (ms/cm)
None saline	0.0 - 2.0
Slightly saline	2.0 - 4.0
Moderately saline	4.0 - 8.0
Strongly saline	> 8.0

Soil salinity decreases steadily with the passage of time inside the poldered area due to rainwater flushing. The gradual loss of soluble salts from the profile. This may create an undesirable low bearing capacity of the soil profile unless properly managed with addition of organic matter and gypsum during the tillage operation.

4) Groundwater

In Bangladesh until 1960's, the groundwater resource was largely neglected, but now is extensively exploited. Groundwater is the dominant source of drinking water, the principal source of irrigation water, and provides for most industrial needs. However, detailed studies of the hydrology and groundwater resources of Bangladesh began only in the 1970's.

In the study area, the upper 300 m of sediments are divided into two aquifer units separated by low permeability horizons (probably mainly silty fine sands rather than clay) that may contain brackish water. The recent sands forming the shallow aquifer are often contaminated by residual salinity

and generally contain high iron concentrations. Nevertheless it is extensively exploited by hand tubewells for drinking water, although in the last ten years increasing number of hand tubewells have been sunk in the deep aquifer from which almost all of the municipal production wells draw their water. The age of the sediments forming the deep aquifer is unknown, is believed to be much older than the shallow aquifer. The water it contains is fresher as well as having lower iron content.

Previous Studies and analyses of the existing data suggest that most of the surface water of the study area is contaminated and it is suitable only for some domestic and selected industrial uses. Groundwater is found that beside the deeper aquifer (more than 300 m deep) both the shallow and the deep aquifer of the study area are contaminated due to (1) high level of salinity as sea water intrusion is a common phenomenon in a coastal area, (2) greater concentration of iron and (3) much discussed "Arsenic Contamination". Tables 7.2.11 and 7.2.12 show available data on water chemistry in vicinity of the project site.

Table 7.2.11 Average Groundwater Chemistry of the Study Area

Aquifer	°C	EC	pH	Eh	Ca	Mg	Na	K	Mn	Fe	HCO3	SO4	Cl	Br	SiO2	NO3
Shallow	27.2	1,470	7.21	-	97	32	256	11.0	0.64	2.2	639	5.0	356	-	27	0.4
Deep	29.1	960	7.47	-	39	20	197	12.1	0.06	0.2	436	1.6	143	-	19	0.8
Salinity about 2000 micro semen/cm									Average well depth for deep aquifer is about 249 meters							

Source: Groundwater studies for Arsenic contamination in Bangladesh. Main report, January 1999.
British Geological Survey and Mot MacDonald Ltd. (UK)

Table 7.2.12 Arsenic Contamination

Area	No. of Wells Tested	Contaminated		Max As (mg/l)	
		No.	%	WHO Standard	BD Standard
				0.01	0.05
Khulna Metro	76	10	13	0.500	
Rupsha thana	94	30	32	0.650	
Dighalia thana	109	20	18	0.430	

Source: Groundwater studies for Arsenic contamination in Bangladesh. Main report, January 1999.
British Geological Survey and Mott MacDonald Ltd. (UK)

5) Hydrological Situation

Various data on river bank erosion around/near the project site were collected. Based on the analysis on the data from topographic maps, aerial photographs and Landsat Images since 1924, it

might be said that the west bank seems to be fairly stable and the east bank seems somewhat to be being eroded. Thus, the implementation of the project shall not affect to the river situation directly.

6) Fauna and Flora

Fauna and flora in the project site like other parts of Bangladesh are closely linked with the ecological subsystems e.g. homesteads, agriculture lands, urban and suburban lands and wetlands as their habitats. The routes do not pass over any natural forests or wetlands. Hence, the wildlife species of the area will not be disturbed significantly due to project activities.

A few terrestrial and avifaunal species that might migrate to the adjacent areas for safety to avoid the disturbances caused by movement of vehicles, piling operation and noise of blasting machinery during the construction phase. The faunal and avifaunal species that migrate during the construction phase of the project to the neighboring areas are likely to return after completion of construction related activities.

Wildlife species identified through a reconnaissance and generalized survey along the proposed routes include i) the mammals- jackal, jungle cat, fox and mongoose; ii) reptiles-water snake and darkish snake; iii) amphibians- common toad, bullfrog iv) lizards- water monitor, three gecko, house lizard and v) rodents-rat, mouse, squirrel, mole etc. The bird species reported from the field survey include crow, mynas, stork, brahmani, kite, sparrow, weaves birds, water hen, parakeet, robin, bulbul, black drongo, vulture, pied cuckoo, owls etc.

Indiscriminate use of agro-chemicals in paddy and vegetable cultivation has affected the insectivorous bird species of the agriculture, homestead and urban ecosystems. The population of the Gangetic Dolphin in Rupsa, Atharabaki, Bhairab and other rivers of Rupsa bridge site declined sharply due to shortage of food, pollution, indiscriminate poaching, disruption between feeding and breeding areas and intrusion of saline water deep inland due to faulty water management. According to IUCN, the breeding center of Gangetic Dolphin that occurs in the estuarine area has been disrupted too many nets along the passage. This is also responsible for decline of dolphin population in the inland rivers.

Several species of birds belonging to the Geese, Duck, Pelican, Egret, Heron and Stork, Wader groups visit the nearby wetlands in the winter season especially in the Beel Dakatia that occur few km north-west of the project site. Nearly 250 fish species and 20 shellfishes are found in the southwest region including the Sundarbans. Out of these 120 fish species and seven shellfish species are of commercial importance. The fish habitats in the Rupsa bridge site include ponds, borrow pits, closed channel and rivers and channels. In addition, the deeply flooded tidal basins

and bottom lands are also the seasonal fish habitats. Locally, the medium high or low lands are also used as 'ghers' for aquaculture during Kharif-1 and Kharif-2 seasons with irrigated borrow or T Aman. Common fish species of the project site is shown in Fig. 7.2.10

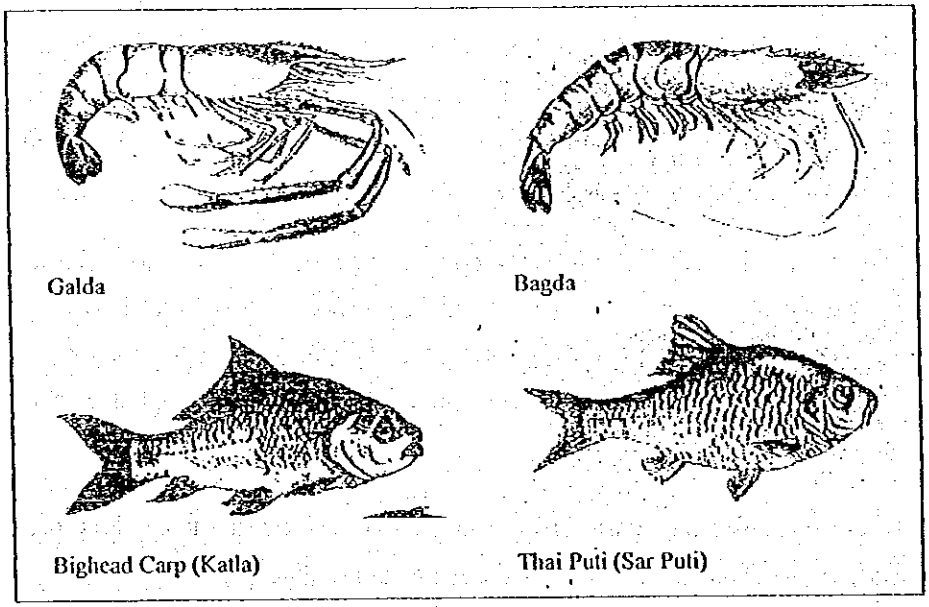


Fig. 7.2.10 Common Fish Species in the Project Site

The Routes 1, 2 and 3 will not pass over any recognizable wetland or beel. Neither it will block any open water body and hence, will not affect capture fisheries in open water bodies or in beels. However, some sections will affect ponds/borrow pits and 'gher' area.

Cow, bull, bobin, buffalo are reared by big and small farmers, and landless households rear goat and sheep. Nearly all types of households rear chicken, duck and some other poultry birds e.g. geese, pigeon, Chinese duck, etc. A flock of 100 pig heads was found grazing during the field visit outside Project affected site within Rupsa thana. A member of low caste Hindu community owned those pigs.

Livestock health in the project site appeared to be poor. This was due to shortage of quality green feed during large part of the year, poor living condition and inadequate health care. Animals are mostly confined in the cattle sheds or on homestead platforms for large part of the year. Fallow crop lands, roadside slopes and other waste lands are used for grazing the livestock under watch during the dry season.

No natural forest exist in the project site or in surrounding areas. Despite that several hectare of homestead garden and orchard will be affected and several thousand trees will require to be cut. Tree species in homestead and also roadside are as follows:

and ships and the petroleum products leaked or discharge by the huge number of water transports have already polluted the river water of this region. Water of these rivers may become unsuitable to sustain aquatic lives unless appropriate environmental management measures are adopted. The borrow pits in rural, sub-urban, and urban areas that are used for dumping of solid wastes are stinky. These pits are the breeding places for innumerable insects that may cause a health hazard to the people who live around.

2) Objectives of the Pollution Survey

The primary objectives of the pollution survey are:

(a) To collect primary base data (i.e. pre-project conditions) by conducting field survey of the surrounding area on air, water, soil and noise levels in pre-monsoon, mid-monsoon and after monsoon period,

(b) To perform quantitative analysis of field data for indicating concentration/level of pollutants as baseline data (which will be compared with during-construction and after-completion of project data) for EIA, and

(c) To suggest mitigation or minimization measures of the anticipated impact, if any.

3) Methodology and Pollution Parameters

Since pollution of air, noise, water and soil constitutes serious threat to public health, scientific studies on the estimation of pollution parameters e.g. (a) air, (b) noise level, (c) riverwater and (d) soil have been planned along the proposed Rupsa Bridge route. The concentration of pollution parameters might vary due to seasonal changes. Variation in temperature, rainfall, humidity and extent of fossil fuel burning (or incomplete oxidation) may have direct bearing on the concentration of the pollution parameters in different seasons and as such the survey of the pollution parameters had been planned for (a) pre-monsoon, (b) mid-monsoon, and (c) after-monsoon period.

River water samples were analysed for: pH, SS, TS, BOD, COD, DO, EC, oil and grease, NO3-N, NO2-N, PO4, Cr, Ni, Cu, Pb, As, Fe and Cl. The water samples were collected in pre-sterile bottles during low tide except for samples to be determined for chloride (Cl) which was sampled during high tide. Samples for arsenic determination was acidified with a few drops of nitric acid. The water samples were put in insulated ice box so as to avert any probable changes in physico-chemical parameters mediated by the microbial activity. The samples were then brought to Dhaka by air. Water samples were examined in the laboratories of the Dept. of Soil Science, Dept. of

and ships and the petroleum products leaked or discharge by the huge number of water transports have already polluted the river water of this region. Water of these rivers may become unsuitable to sustain aquatic lives unless appropriate environmental management measures are adopted. The borrow pits in rural, sub-urban, and urban areas that are used for dumping of solid wastes are stinky. These pits are the breeding places for innumerable insects that may cause a health hazard to the people who live around.

2) Objectives of the Pollution Survey

The primary objectives of the pollution survey are:

(a) To collect primary base data (i.e. pre-project conditions) by conducting field survey of the surrounding area on air, water, soil and noise levels in pre-monsoon, mid-monsoon and after monsoon period,

(b) To perform quantitative analysis of field data for indicating concentration/level of pollutants as baseline data (which will be compared with during-construction and after-completion of project data) for EIA, and

(c) To suggest mitigation or minimization measures of the anticipated impact, if any.

3) Methodology and Pollution Parameters

Since pollution of air, noise, water and soil constitutes serious threat to public health, scientific studies on the estimation of pollution parameters e.g. (a) air, (b) noise level, (c) riverwater and (d) soil have been planned along the proposed Rupsa Bridge route. The concentration of pollution parameters might vary due to seasonal changes. Variation in temperature, rainfall, humidity and extent of fossil fuel burning (or incomplete oxidation) may have direct bearing on the concentration of the pollution parameters in different seasons and as such the survey of the pollution parameters had been planned for (a) pre-monsoon, (b) mid-monsoon, and (c) after-monsoon period.

River water samples were analysed for: pH, SS, TS, BOD, COD, DO, EC, oil and grease, NO3-N, NO2-N, PO4, Cr, Ni, Cu, Pb, As, Fe and Cl. The water samples were collected in pre-sterile bottles during low tide except for samples to be determined for chloride (Cl) which was sampled during high tide. Samples for arsenic determination was acidified with a few drops of nitric acid. The water samples were put in insulated ice box so as to avert any probable changes in physico-chemical parameters mediated by the microbial activity. The samples were then brought to Dhaka by air. Water samples were examined in the laboratories of the Dept. of Soil Science, Dept. of

Microbiology, Dept. of Environment (DoE) and in the Aftab Biotech Centre following the internationally accepted methods of the US EPA as described in Greenberg et. al. (1992), Baruah and Barthakur (1997) and Jackson (1973).

Air sampling was done on two sites across the banks of the river Rupsa along the proposed bridge site. The air pollution parameters e.g. suspended particulate matter SPM, NOx and SOx were sampled and analysed in the regional laboratory of the DoE at Khulna. Owing to lack of facilities, laboratory analyses for CO and Pb could not be carried out. A 12-h consecutive collection was done using a high volume air sampler. The standard methods as described in Greenberg *at. el.*, (1992) were followed.

Noise survey was done both on working days and holidays for 10 minutes /h and for a total of 120 minutes per site/day using a hand-held noise monitoring meter. The DoE Khulna laboratory assisted in the noise pollution survey following the methods as described in Greenberg et al., (1992).

Soil samples were collected from the surface (0-15 cm depth) near the right and left banks (about 50 m away) of the river and were put in polythene bags. The soil chemical parameters were examined for: pH, Ca, Mg, NH4-N, NO3-N, Fe, Pb, Cu, Ni, As, Cr, SO4 and PO4. The analyses were done following the methods as described in Baruah and Barthakar (1997) and Jackson (1973).

Soil microbiological parameters that reflect pollution were examined for: (a) total coliform, (b) faecal coliform, (c) faecal streptococci (d) total heterotrophic count (e) and Shigella spp. and (f) Salmonella spp. The microbiological parameters were quantitatively determined following the Standard Method for the Examination of Water and Wastewater (Greenberg et al., 1992). The sampling sites of various pollution parameters are illustrated in Fig. 7.2.11.

4) Riverwater Pollution

Rupsa river water survey has been conducted in all the three sampling periods e.g. pre-monsoon mid-monsoon and after-monsoon period. Eighteen physico-chemical parameters of water from each of the three sampling sites e.g. right bank, left bank and from the middle of the river were analyzed in each sampling season. The results of the river water analysis have been presented in Table 7.2.13.

Table 7.2.13 Analytical Results of Water Samples Collected from the Rupsa River Bridge Site (pre-monsoon, mid-monsoon and after-monsoon)

Sl. No.	Parameters	Unit	Pre-monsoon			Mid-monsoon			After-monsoon		
			R Bank	Middle	L Bank	R Bank	Middle	L Bank	R Bank	Middle	L Bank
1	pH	-	7.08	7.09	7.08	7.00	7.10	7.05	7.20	7.15	7.15
2	TS	mg/l	1116	1114	1122	1210	1200	1220	1010	998	1025
3	SS	mg/l	1577	707	732	845	830	835	785	778	780
4	DOD	mg/l	0.7	1.0	1.2	1.20	1.25	1.30	1.10	0.95	1.12
5	COD	mg/l	4.9	4.7	4.2	5.10	5.21	5.11	4.45	4.44	4.42
6	DO	mg/l	3.7	4.0	3.9	4.25	4.32	4.22	5.12	5.25	5.42
7	EC	µS/cm	2370	2280	2360	2120	2210	2145	1827	1933	1879
8	Oil & grease	mg/l	0.47	0.44	0.46	0.66	0.88	064	0.53	0.47	0.74
9	NO_3-N	mg/l	1.35	1.20	1.40	1.45	1.40	1.42	0.96	1.12	1.10
10	NO_2-N	mg/l	0.012	0.014	0.117	0.02	0.019	0.022	0.017	0.015	0.016
11	PO_4	mg/l	0.041	0.018	0.020	0.044	0.148	0.056	0.024	0.027	0.022
12	Cr	mg/l	Nil	0.008	0.56	0.008	Nil	0.026	0.003	Nil	0.004
13	Ni	mg/l	0.012	Nil	Nil	0.0006	Nil	0.0085	0.022	0.035	0.049
14	Cu	mg/l	0.026	0.019	0.037	0.0043	0.0017	0.014	0.018	0.026	0.016
15	Pb	mg/l	0.16	0.13	0.23	0.097	0.0047	0.047	0.17	0.095	0.5
16	As	mg/l	0.0082	0.0082	0.0077	0.023	0.022	Nil	0.17	0.016	0.17
17	Fe	mg/l	0.13	0.17	0.16	0.20	0.19	0.18	0.14	0.15	0.14
18	Cl	mg/l	ND	ND	ND	68.16	69.12	68.50	25.10	26.22	27.09

ND-- Not done (chloride analysis was included only during the mid-monsoon and after-monsoon sampling)

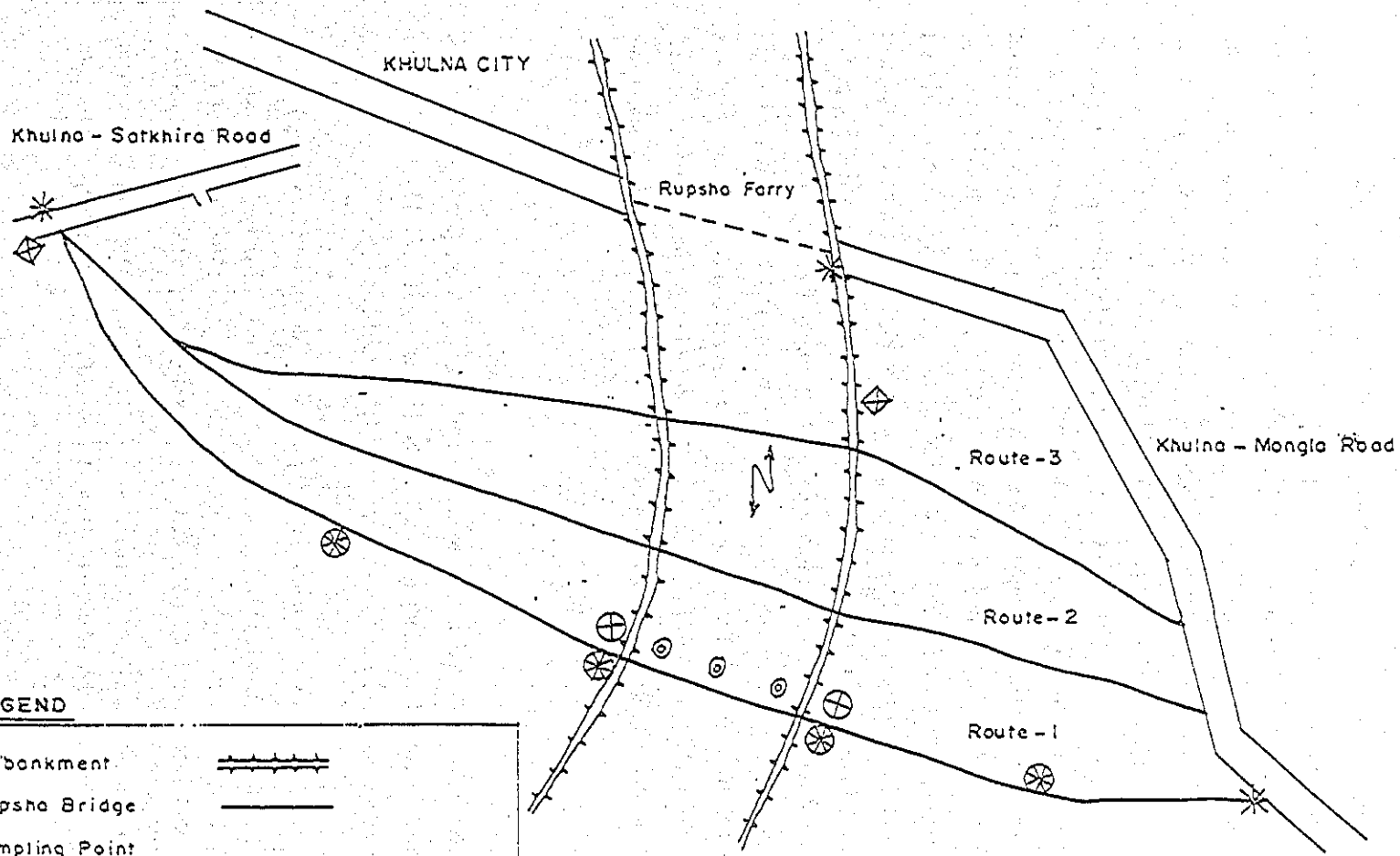


Fig.7.2.11

SITES OF POLLUTION SURVEY

(NOT IN SCALE)

Interpretation

Rupsa river water appeared to be highly turbid particularly during the pre-monsoon and mid-monsoon period. The concentration of most of the physico-chemical parameters fall within the permissible limits except for suspended solids (SS), lead (Pb), oil and grease and electrical conductivity (EC) during all the three sampling period. The values of most of the water quality parameters decreased slightly in the after-monsoon period, but still the values for SS, Pb, EC and oil and grease exceeded the European Commission (EC) and DoE standard. The conductivity values were higher when compared with BS (1000 µS/cm) and EC standard (400 µS/cm) but were close to German standard (2000 µS/cm). A higher EC value indicates total concentration of ionized chemical constituents in water. The concentration of lead in water in most cases exceeded the limit value of BS (0.05 mg/l). The slightly higher concentration of Pb could probably be due to the discharge of lead bearing petroleum products into the river e.g. lubricant, petrol, octane etc. The oil and grease content of the river water was found to be about four times higher than DoE standard (0.1mg/l) (cited by ISPAN, 1995). There are scores of oil depots, processing industries, power generation plant, Khulna shipyard and other industries on the banks of the river Rupsa that might have contributed to the pollution of river water by oil and grease. The BOD values were all within the limit values of BS (10mg/l) that indicate lower organic fraction or decomposed organic matter as resultant activity of degradable microbial population. COD and DO values also appear to be well within tolerable limit that reflect favourable chemical oxidation and lower organic contaminants respectively.

5) Air Pollution

Air pollution survey was conducted in mid-monsoon and after-monsoon period on two sites flanking the banks of the river Rupsa along/near the proposed bridge site (Fig.7.2.11). The details of air pollution survey data, frequencies and sites are presented Table 7.2.14 and 15.

Table 7.2.14 Air Quality Determination of the Rupsa Bridge Site (mid-monsoon data)

Date	Sampling Site	SPM (mg/m3)	NOx (µg/m3)	SOx (µg/m3)
21.8.99 (Holiday)	Krishana Nagar (Khulna-Satkhira road)	306 (400)	56.02 (100)	29.42 (100)
25.8.99 (Working day)	Krishana Nagar (Khulna-Satkhira road)	318 (400)	59.86 (100)	32.18 (100)
21.8.00 (holiday)	Char Rupsa (near Jahanabad Sea Food factory)	491 (500)	47.99 (100)	43.30 (120)
25.8.99 (Working day)	Char Rupsa (near Jahanabad Sea Food factory)	364 (500)	60.22 (100)	43.04 (120)

Table 7.2.15. Air Quality Determination of the Rupsa Bridge Site (After-monsoon data)

Date	Sampling Site	SPM (mg/m3)	NOx (µg/m3)	SOx (µg/m3)
19.10.99 (working day)	Krishana Nagar (Khulna-Satkhira road)	265.7 (400)	12.49 (100)	26.5 (100)
20.10.99 (Holiday)	Krishana Nagar (Khulna-Satkhira road)	216.4 (400)	10.88 (100)	23.6 (100)
19.10.99 (Working day)	Char Rupsa (near Jahanabad Sea Food factory)	799.5 (500)	15.37 (100)	34.49 (120)
25.8.99 (Holiday)	Char Rupsa (near Jahanabad Sea Food factory)	319.1 (500)	15.76 (100)	29.46 (120)

Note: Figures in parentheses indicate limit values of BS.

Interpretation

The suspended particulate matter (SPM) concentrations were within the acceptable limit values for both commercial and industrial sites in mid-monsoon and after-monsoon period except for one value e.g. 799.5 mg/m3 at Char Rupsa near the Jahanabad Sea Food Processing Factory that was above the BS standard for industrial site (500 mg/m3). The SPM values in mid-monsoon ranged between 306 mg/m3 and 491mg/m3 whereas in the after-monsoon period this value mostly fluctuated between 216.4 mg/m3 and 319.1 mg/m3. In all cases, values of working days were slightly higher than holidays. All the values (except for the value of 799.5 mg/m3 near the industrial site) fell within the limit values of BS.

The values of NOx was slightly higher in the mid-monsoon survey that ranged between 47.99 µg/m3 and 60.22 µg/m3 as compared to the relatively lower values in the after-monsoon period (10.88 µg/m3 to 15.76 µg/m3) regardless of sites and days of sampling. The concentration of sulfur oxides (SOx) followed almost similar trend seasonwise. The SOx values of 32.16 µg/m3 to 43.30 µg/m3 were recorded in the mid-monsoon period and a relatively lower concentration range e.g. 23.61 to 34.49 µg/m3 was recorded in the after-monsoon period. All the values of NOx and SOx fell well within the limit values set by BS. This indicates that emission gases (e.g. NOx and SOx) from automobiles and industries may not pose any health hazard for people exposed to commercial and industrial sites.

6) Noise Pollution

Noise pollution survey was conducted in both mid-monsoon and after-monsoon period. In mid-monsoon, three sites were surveyed namely (a) Kudir Battala, (b) Rupsa Ferry Ghat and (c) Krishna Nagar. Which the after-monsoon survey was conducted in four sites along the proposed bridge alignment. Details of survey sites, days and noise levels are shown in Table 7.2.16 and 17. In mid-monsoon surveys, maximum average noise levels ranged between 89.00 dB and 98.30 dB whereas

values for after-monsoon period were relatively lower and fluctuated between 49.83 to 83.66 dB. All the maximum average noise levels irrespective of sites and days fell within the acceptable limit values of BS (85 dB).

Table 7.2.16. Determination of Noise Level (dB) (mid-monsoon survey)

Site	Date	Place	Min. Average level (12)	Max. Average level (12)
1	21.8.99 (Holiday)	Kudir Battala (Rupsa-Mongla Road)	60.58	95.75
	25.8.99(Working Day)	Kudir Battala (Rupsa-Mongla Road)	68.00	97.25
2.	21.8.99 (Holiday)	Rupsa Ferry Ghat	70.40	97.50
	25.8.99(Working Day)	Rupsa Ferry Ghat	71.83	96.08
3.	21.8.99 (Holiday)	Krishna Nagar (Khulna-Satkhira Road)	49.16	89.00
	25.8.99(Working Day)	Krishna Nagar (Khulna-Satkhira Raod)	49.75	98.30

Note: BS standard for noise pollution is 85 dB

Table 7.2.17. Determination of Noise Level (dB) (after-monsoon survey)

Site	Date	Place	Min. Average level (12)	Max. Average level (12)
1	19.10.99 (working day)	Laban Chara	35.0	52.6
	20.10.99 (Holiday)	Laban Chara	34.33	54.00
2.	19.10.99 (working day)	Harin Tana	36.9	52.8
	20.10.99 (Holiday)	Harin Tana	33.41	56.25
3.	19.10.99 (working day)	Jabusa (near Unique Ice factory)	33.6	53.83
	20.10.99 (Holiday)	Jabusa (near Unique Ice factory)	30.86	49.83
4.	19.10.99 (working day)	Jabusa (near Elipur Vangon Para)	30.75	83.66
	20.10.99 (Holiday)	Jabusa (near Elipur Vangon Para)	33.33	81.33

Note: BS Standard for noise pollution is 85 dB.

Interpretation

The higher noise values in the mid-monsoon period were recorded in the highways and in the Rupsa Ferry Ghat areas obviously owing to intense movement and honking by buses, trucks and other vehicles. In the after-monsoon survey, at four new places, the noise levels were relatively lower (30.75 to 35.0 dB) except for values at Jabusa, near Elipur Vangon para road (83.66 dB) where movement of some vehicular traffic along the proposed bridge alignment was observed. Values at other sites were much lower because of little or no vehicular traffic along the proposed bridge alignment.

7) Soil Chemical Analysis

Two soil samples were collected across the two banks of the river Rupsa (about 50 m away from the banks on each side) in both the mid-monsoon and after-monsoon period. Thirteen chemical

parameters including a number of heavy metals were analyzed, the details of which have been presented in Table 7.2.18.

Table: 7.2.18. Analytical Results of Soil Chemistry of the Rupsa River Banks (mid-monsoon and after monsoon sampling)

Sl. No.	Parameters	Unit	Mid-monsoon		After-monsoon	
			Right Bank	Left Bank	Right Bank	Left Bank
1	pH	-	7.12	7.05	7.20	7.12
2	Ca	mg/Kg	2632	2411	2321	2122
3	Mg	mg/Kg	1322	1477	1212	1355
4	NH4-N	mg/Kg	10.15	7.78	7.10	9.10
5	NO3-N	mg/Kg	5.50	5.99	4.75	5.34
6	Fe	mg/Kg	750	851	737	813
7	Pb	mg/Kg	53.5	56.0	23.0	63.0
8	Cu	mg/Kg	36.5	37.0	34.0	21.00
9	Ni	mg/Kg	39.0	36.5	21.0	27.00
10	As	mg/Kg	18.28	13.24	19.15	14.85
11	Cr	mg/Kg	107.5	32.5	52.0	81.00
12	SO4	mg/Kg	14.0	12.0	15.0	16.15
13	PO4	mg/Kg	630	655	592	534

Interpretation

The thirteen chemical parameters of river bank soils were examined of which none of the values showed excessive concentration that could be labeled as toxic or can act as pollutant. The concentration of major nutrient elements and particularly heavy metals were within acceptable limits of EC (European Commission) standard. Probable pollutants like ammonium and nitrate-nitrogen levels including the heavy metal concentrations (e.g. Cu, Ni, Cr, Pb and As) fell within limit values of EC.

8) Microbiological Analysis

The two soil samples were also examined for pollution indicator bacteria e.g. total coliform, faecal coliform, faecal streptococci, total heterotrophs including pathogenic bacteria like Shigella and Salmonella species.

The experimental results of the microbiological analyses are presented in Table 7.2.19.

Table 7.2.19. Results of Microbiological Analysis of the Rupsa River Bank Soils (mid-monsoon and after-monsoon sampling)

Sl. No.	Pollution indicator bacteria/ pathogen	Unit	Mid-monsoon		After-monsoon	
			Right Bank	Left Bank	Right Bank	Left Bank
1.	Total Coliform	cfu/g	3.0X104	2.17X104	2.1X104	1.2X104
2.	Faecal Coliform	cfu/g	0.25X102	0.21X102	0.19X102	1.0X102
3.	Faecal streptococci	cfu/g	0.15X102	0.18X102	0.11X102	0.16X102
.	Total heterotrophs	cfu/g	3.6X107	5.7X107	3.0X107	4.1X107
5.	Shigella spp.	cfu/g	<1.0	<1.0	<1.0	<1.0
6.	Salmonella spp.	cfu/g	<1.0	<1.0	<1.0	<1.0

Note: i) Total coliform cells mainly comprised of E coli. ii) cfu -colony forming units (number of bacterial colonies per plate)

Interpretation

The results of the bacterial pollution indicator study reveals that the density of the total coliform (bacteria) in the two sampling period did not vary appreciably as much as it was apparent with the other indicators. The number of viable cells of total coliform bacteria was higher and ranged between 1.2X104 cfu/g and 3.0 X 104 cfu/g which indicate that the soils have been faecally contaminated recently or the coliform bacteria might have been adapted and survived in the environment (basically they are enteric organism). Faecal coliform and faecal streptococci cell density (cfu/g) appears to be very low and do not indicate any pollution problem. The pathogenic bacteria e.g. Shigella and Salmonella could not be detected in any soil sample regardless value of BS (0.05 mg/l).

7.3 Environmental Impact Assessment

7.3.1 General

Implementation of the project needs to acquire homestead land including land for different uses and other movable and immovable. This acquisition process will also cause dislocation and displacement of habitats on the acquired land. So, execution of the proposed project will have some direct and indirect impact on socio-environmental condition of the area.

Environmental impacts was assessed based on intensive on-field data collection. This was done through discussion with the local GoB and NGO staff, interview with local people and public as well and through filling up of the structured questionnaires. Loss of land, loss of production, loss of trees, loss of dwelling houses, disruption of movement between the fields with agricultural implements and cattle, etc. were identified as areas where the project may cast some adverse impact. However, the project has definitely some positive impacts on land transportation, socio-political aspects, commerce and industries, urbanization rate and generation of employment in the area both in formal and informal sectors. The impact assessment indicates and support by local social desirability indicates that the beneficial impacts of the project will surpass its adversities in the long run provided that the Environmental Monitoring (EM) aspects are planned and implemented properly. The loss of crop land and loss of productivity though have long term impacts but these may not be considered as too significant from the national or regional considerations.

However, due stress is given in preparing Environmental monitoring Plan(EMP) of the project to lessen or to avoid the projected cumulative impacts and to ensure the optimum social, economic and environmental benefits from the implementation and operation of project. Mitigation of the social impacts e.g. loss of profession, loss of homesteads, psychological stress due to loss of dwelling houses and separation form family clans, etc. during the construction phase of the project deserve due consideration.

7.3.2 Overall Evaluation on Environmental Impacts on Three Routes

Social environmental survey has been carried out through the alternative routes 1, 2 and 3. Each proposed route area has been surveyed for affected households and persons

lived in. The results the survey are presented in Table 7.3.1. All along the 36 m ROW, numbers of homesteads which sometimes consist of kin family group households within same property are recognized as one cluster formation that will be affected by the Project. In most cases, property of these homestead will be affected partly but in very few cases completely. Table 7.3.1 shows the number of affected households and persons within the cluster that is recognized as a homestead, with directly affected household. Within the affected cluster homestead very few indirectly affected households are also recognized in case of the Route 2.

Table 7.3.1 Affected Households and Persons within 36 meter ROW

Route No.	Affected Households	Affected persons	Nos. of cluster (Homestead)	Nos. of household within cluster
Route 1	53	242	27	53
Route 2	114	520	42	116
Route 3	348	1560	126	348

In order to clarify the magnitude of the impact implications concerning the resettlement, all affected items of land, structures and planted tree categories are listed in Table 7.3.2 along with the magnitude of implications for each three routes.

Impact implications are estimated to be severe on agricultural lands followed by residential areas, commercial sites and so on. Regarding the affected settlement sites, semi pucca (semi-permanent building) and kucha (bamboo hut style building) will have to absorb distinguishable implications when compared to other structures.

Table 7.3.2 Magnitude of Impact Implication in 3 Routes

Items and Categories	Route-1	Route-2	Route-3
1. Land:	Quantity/No.(m^2)	Quantity/No.(m^2)	Quantity/No.(m^2)
a. Agricultural	354,931	240,433	121,120
b. Residential	11,620	71,605	129,150
c. Commercial	2,423	3,316	7,764
d. Industrial	2,150	-	12,782
e. Pond	6,232	7,005	13,668
f. Shrimp Gher	15,040	7,318	5,461
g. Low Land	6,512	8,663	5,255
2. Structures	No.-(m^2)	No.-(m^2)	No.(m^2)
a. Dwelling houses	60-1,508	136-3,267	391-8,656
i. Pucca	3-194		49-1,821
ii. Semi Pucca	3-194	21-927	101-3,096
iii Kucha	54-1175	115-2,341	241-3,740
b. Kitchen	26-179	34-326	165-733
c. Latrine	33-41	63-105	192-391
d. Cowshed	3-656	11-122	13-110
e. Commercial	-	1-15	5-189
f. Others	-	4-65	6-560
3. Trees	No.	No.	No.
a. Timber	1,452	1,089	948
b. Fruit	2,668	1,180	2,113
c. Fire wood	1,714	1,743	1,381

Socio- economic impacts above-mentioned are summarized in Table 7.3.3.

Table 7.3.3 Genial Comparison of Three Alternative routes

	Route 1	Route 2	Route 3
Location	About 2.6 km south of Rupsa Ferry Ghat	About 2 km south of Rupsa Ferry Ghat	About 1 km south of Rupsa Ferry Ghat
Charactor of the Route	Passing through Rural Area	Passing through Peri-Urban Area in the vicinity of west bank of the Rupsa River	Passing through Urban Area in the vicinity of west bank of the Rupsa River
Number of Household and Population Affected	53households (2 kutcha houses) 242 persons	114 households (No kutcha house) 523 persons	325 households (49 kutcha houses) 1,557 persons
Land Area for ROW	398,908 m²	338,400 m²	295,200 m²
State of Land Use	Agriculture 89% Commercial & Industrial 1% Residential 3% Shrimp Gher 4% Others	Agriculture 71% Residential 21% Swamp 3% Shrimp Gher 2% Others	Residential 44% Agriculture 41% Commercial & Industrial 7% Pond 5% Others
Rate of Indigenous Population in/near the Route	4%	3%	8%
Rate of Population Mainly Engaged in Agriculture	None	None	0.2%
Number of School	0	0	1 (Primary School)
Number of Masque	0	0	1

Overall environmental impacts on each proposed routes are summarized and presented in Table 7.3.4 and Route 1 can be adjudged as having less negative impact implication than other two routes.

Table 7.3.4 Summary of Environmental Impacts on Proposal Routes

			No.	Environmental Item		Route 2		Route 3		Remarks
				Construction Stage	Operation Stage	Construction Stage	Operation Stage	Construction Stage	Operation Stage	
socio-economic Environment	1.	Resettlement	Resettlement due to land occupancy (transfer of rights of residence/land ownership)	○	○	△	△	▲	▲	Household affectedR-1-53,(242persons) R2-114, R3-348
	2.	Economic Activities	Loss of bases of economic activities, such as land, and change of economic structure	○	○	△	△	▲	▲	Farm land and nursery ponds ; R1-40ha, R2-34ha,R3-30ha
	3.	Traffic and Public Facilities	Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion and accidents	○	○	△	△	▲	▲	Transport/Waterway should be secured on embankment section. Traffic conditions will be improved.
	4.	Split of Communities	Community split due to interruption of area traffic	○	○	△	△	▲	▲	
	5.	Cultural Property	Damage to or loss of the value of churches, temples, shrines, archaeological remains or other cultural assets	○	○	○	○	△	△	One primary school and one mosque exist on Route 3.
	6.	Water Rights and Rights of Common	Obstruction of fishing rights, water rights, rights of common	◎	◎	◎	◎	◎	◎	
	7.	Public Health Condition	Deterioration of public health and sanitary conditions due to generation of garbage and the increase of vermin	○	○	△	△	△	△	Water will be stagnated if waterway is blocked by embankment.
	8.	Waste	Generation of construction and demolition waste, debris and logs	△	○	△	○	△	○	Impacts during construction.
	9.	Hazards (Risk)	Increase in risk of landslides, cave-ins and accidents	○	○	○	○	○	○	Waterway shall be supplied adequately.
Natural Environment	10.	Topography and Geology	Changes of valuable topography and geology due to excavation or filling work	◎	◎	◎	◎	◎	◎	
	11.	Soil Erosion	Topsoil erosion by rainfall after reclamation and vegetation removal	△	△	△	△	△	△	Ponds and puddles will be made by excavation for embanking materials.
	12.	Groundwater	Change of distribution of groundwater by large-scale excavation	◎	◎	○	○	○	○	
	13.	Hydrological Situation	Changes of river discharge and riverbed condition due to landfill and drainage inflow	○	○	○	○	○	○	
	14.	Coastal Zone	Coastal erosion and sedimentation due to landfill or change in marine condition	◎	◎	◎	◎	◎	◎	
	15.	Fauna and Flora	Obstruction of breeding and extinction of species due to changes of habitat conditions	◎	◎	◎	◎	◎	◎	
	16.	Meteorology	Changes of temperature, precipitation, wind; etc. due to large-scale land reclamation and building construction	◎	◎	◎	◎	◎	◎	
	17.	Landscape	Change of topography and vegetation due to reclamation. Deterioration of aesthetic harmony by structures	○	○	○	○	○	○	
Pollution	18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	○	○	△	△	△	△	Generated during construction and by traffic after construction.
	19.	Water Pollution	Pollution by inflow of silt, sand and effluent into rivers and groundwater	○	○	○	○	○	○	〃
	20.	Soil Contamination	Contamination of soil by dust and chemicals, such as herbicides	○	○	○	○	○	○	〃
	21.	Noise and Vibration	Noise and vibration generated by vehicles	○	○	△	△	▲	▲	〃
	22.	Land Subsidence	Deformation of land and land subsidence due to the lowering of groundwater table	○	○	○	○	○	○	Where organic soil layer develop under embankment section.
	23.	Offensive Odor	Generation of exhaust gas and offensive odor by facility construction and operation	○	○	△	△	△	△	Generated during construction and by traffic after construction.

◎ No negative impact expected, ○ Less impact expected, △ Some negative impact expected, ▲ Serious impact expected

Table 7.3.5 presents section-wise data of affected households on route 1. The highest concentration of affected households is found in section 3 at Labon Chara Area at the west bank of the Rupsa River.

Table 7.3.5 Number of Household with Population, Commercial and Industrial Establishment under different Section-wise for route-1

Name of Section	No. of House holds	Commercial/Shrimp Gher Establishment	Industrial establishment	Community facilities	Populatin		
					Populatin	Male	Female
Section-1. Satkhira road to Hatia river ;1850m	9	-	1	-	39	20	19
Section-2. Hatia River to Khatra Khal ;3,415m	-	1	-	-	0	0	0
Section-3. Khatra Khal to west bank of Rupsa River ; 1,055m	43	-	-	-	198	101	97
Section-4. East bank of Rupsa to Jabusa Road ; 1,674m	1	1	-	-	5	4	1
Section-5. Jabusa Road to Khulna Mongla Road ; 1,529m	-	7	-	-	0	0	0
Total	53	9	1	-	242	125	117

Table 7.3.5 reveals that only section 1, 3 and 4 have population with the highest numbers of 198 in section 3 having 43 households.

7.3.3 Impact During Construction Stage

1) Social Environment

The implementation of the project comprise of the bridge over the river Rupsa, approach road of about 10.1 Km length and the embankments. The Right of Way (RoW) width required for land acquisition is about 36 metre or more at some intersection points. Considering the above, the following consequences are expected as an impact of the project.

① Loss of Land

The construction of bridge with approach road will require considerable amount of land area. So, the primary impact by the project will be on land having agricultural, residential, shrimp gher, and industrial/commercial characters.

The total land area under different uses is 3,98,908 sqm. in route-1, 3,38,400 sqm. and 2,95,200 sqm. respectively in route-2 and 3. On the other hand, the land affected due to the project is mostly under agricultural production. The impact on residential land and

shrimp gher is only 2.92% and 3.77% found affected in route-1. Details for other routes can be found in Table 7.2.2.

② Loss of Residence of the PAPs

The project will affect residential land including the dwelling structure of the PAPs. The implementation of the project will displace 53 households in route-1, 114 and 325 households respectively in route-2 and 3 from their present place of residence and they are to be relocated elsewhere. So the impact due to the loss of residence can not be ignored but this loss has been considered relatively less.

③ Commerce and Industry

The RoW acquisition for the project is not affecting any major industry or commerce in different routes. In route-1 only one newly built rice mill and a village market (almost abandoned) are going to be affected causing no serious impact.

④ Loss of Workdays/employment due to dislocation

It is very likely that the acquisition of the homestead will dislocate some households from the present place of residence. During relocation to new places, normally these people will loose some workdays consequently some loss of income which cannot be ignored under the involuntary displacement.

⑤ Indirectly Affected Households

The families who are living on the RoW alignment as tenants or in any other arrangement are not loosing any property except the residential facilities are considered as indirectly affected households. More than 50% of located families are residing under this arrangement. The people to be relocated during implementation of the project will be affected temporarily due to displacement from residence immediately.

⑥ Split of Community

Most of the affected people are likely to be relocated in the same village or on the residual land. No serious impact is expected in this regard. However, in Labon Chara area at the west bank of the Rupsa river, construction of high embankment road and interruption of existing road give significant impacts during and after construction inconvenience caused in daily activities of inhabitant and effect on economic activity.

⑦ Transportation

Some negative impact is expected in transportation system of the area during construction in both land and navigation.

⑧ Employment Opportunity

The implementation of the project will have positive impact on employment of the

people. The people of the area is expecting to get additional employment opportunity in different activities of the project.

2) Natural Environment

① Topography and Geology

Any change in topographical features due to excavation and filling work will be temporary and no negative impact is expected.

② Drainage Congestion/Water Logging

The surface water drainage is usually disrupted by all major earthworks such as access roads, diversion roads, stockpiles that may have to be built during the construction of the Rupsa bridge and road embankment. The embankment may hold water back during the floods or after heavy shower that usually flow through as thick sheet of water across the flooded land causing drainage congestion.

Agricultural land, homesteads, other real estates and roads on the river sides would be flooded under such condition causing hardship and economic loss to people living in the project area. On the contrary, farmers of basin areas region would also be affected due to lack of availability of water in time for agricultural practices. This may affect the cropping pattern in the down slope areas of floodplain affected by the Rupsa Bridge Project. However, all these if at all happen will affect only a narrow belt along the newly constructed road embankment near the Khulna City.

③ Hydrological Aspects

- Ground Water

Ground water is the main source of water for irrigation and household uses in the project area. There is an increased demand of groundwater with time both by private wells and hand tubewells. The road/embankment will occupy a very insignificant portion of the total tidal flood plain of the area and hence no reduction in groundwater extent and level will result from the project. There are no evidences of subsidence of land because of over exploitation of ground water resource in Khulna region.

- Water Quality

Most of the surface water of the study area is contaminated and it is suitable only for some domestic and selected industrial uses. Both shallow and deep aquifers of the areas are contaminated by high level of salinity, greater concentration of iron and arsenic. Pumping of construction spoils, including accidental leakage of oil, grease and fuel in equipment yards, may contaminate both surface and ground water temporarily during

the construction phase. The project may not therefore, have any significant impact on the already contaminated water.

- Tidal Action

The rivers of the project area are tidal in nature with the tidal range varying from 0.57 m (lowest tide) to 3.25 m (highest tide). The tidal phenomenon does not have any impact on the project.

- Hydrological Condition

The Khulna area is affected by the regular ebb and flow of the tide with a complicated flow regime in rainy and cyclonic seasons. Route-1 alignment would pass across the flow direction of run off and tidal flood but the project may not affect the regional hydrology of the flood plain further by creating drainage congestion.

④ Soil Erosion

The project site after taking soil for embankment material will become ponds and puddles. Excavation plan should be made carefully considering best utilization of such lands. PAPs, for instance, may be encouraged to practice aquaculture in the borrow pits dug within or outside RoW.

⑤ Erosion and Siltation

- It is observed from morphological studies that the Rupsa channel though slightly drifted toward east since 1924 but it remained largely stable in the westbank along the route 1,2,and 3 during this period.
- The river Rupsa being a tidal channel the change of fan formation along the down stream side of the piers that will take place on the north side of the bridge during the high tide and on the south during the low tide. Hence, filling of the riverbed due to siltation will be counteracted with the change of tide and will maintain a low rate Consequently, the chance of accelerated erosion in the east bank of the Rupsa River may not occur due to construction of the Rupsa bridge.

⑥ Agriculture

- Loss of Agriculture Land

  The RBP may involve nearly 35.5 hectare of agriculture land along the route-1 alignment. These are mostly single and double cropped Moreover, due to non-availability of irrigation water low yielding transplanted aman paddy varieties are cultivated here. Hence, the loss of land involved for completion of the project though may hurt the individual PAPs seriously but may not affect national or even regional food production seriously.

⑦ Forestry

- The project at its present routes 1,2 and 3 do not pass over any natural forests. Neither any type of natural forests occurs at the adjacent areas of the project within 30 km radius. Sundarbans, the world's largest commercial mangrove forest occurs in the south-west part of Bangladesh. The shortest distance of the Sundarbans from the project site is nearly 30 km south.
- The community forests that include homestead plantations, orchards and stripe plantations occupy considerable area in the project site. However, the alignments avoid these plantations to a great extent. Hence, impact of the project on forestry may not be considered as serious. Rather, planting space for nearly 10,000 tree seedlings will be available along the highway embankment sides after completion of the project.
- The felling of 5,814, 4,017 and 4,442 trees on routes 1, 2 and 3 respectively may be required for constructing the highway embankment will cause temporary economic loss to PAPs and slight ecological impacts.

⑧ Fisheries

- The project site includes (i) capture fisheries in open water bodies, perennially inundated basin bottoms and flooded tidal lands, (ii) captive fisheries in tanks and borrow pits and (iii) aquaculture in crop fields during kharif-I and II seasons, in ghers and closed water bodies. The project road embankment lies inside the polder and is aligned along the tide direction (east-west). Hence, this will not disturb fish movement between feeding and breeding areas. The project will also not pass over any recognizable perennial water bodies or wetland and therefore will not disturb capture fisheries. A few tanks and ponds that may be affected by the project will affect captive fisheries to a limited extent. Few hectares of aquaculture gher areas disturbed by the project will hinder fisheries output temporarily.

⑨ Wildlife

- A few terrestrial wildlife and avifaunal species that might migrate to the adjacent areas for safety and to avoid the disturbances caused by movement of vehicles, piling operation and noise of heavy machinery during the construction phase. The faunal and avifaunal species that migrate during the construction phase of the project to the neighboring areas are likely to return after completion of construction related activities. Hence, no persistent adverse impacts on wildlife population and diversity are anticipated from implementation of the project during the operation phase.

⑩ Wetlands

Wetlands at the project site that include the river Rupsa and several tidal channels will have no adverse impact by the project at any of the phases. However, the project will affect 0.65 hectare of pond and 1.50 hectare of fisheries 'gher' during construction phase. This will definitely cause some loss to fisheries but the affect on wetland will be insignificant. Alternatively, earth for constructing the embankment may be collected from outside RoW area by digging big ponds on poor agricultural land.

3) Pollution

① Air Pollution and Offensive Odor

During construction period, impacts on air quality is anticipated by exhaust gas from construction equipment and vehicles, and dust generated by earthwork. Of course, exhaust gas becomes continuos source of air pollution, once the operation starts and the degree of pollution shall increase as traffic volume does in future. If the gradient of slope is larger, the concentration of exhaust gas from running vehicles will be higher.

However, dust shall be a real problem during earthwork of embankment. Warm temperatures and the presence of heavy traffic on the roads supply fostered conditions to create a high level dust in the atmosphere.

It affects not only public health but also the yield of crops harvested. Compensations even may be inevitable to the peoples for the value of lost production. If hauling of embankment material is made through residential areas, dust shall create serious problem.

② Water Pollution

The inhabitants in the area rely their drinking water on wells. River water is used for irrigation widely. Flush out of dust and oils in rains during construction and from the road surface in operation stage may affect the quality of water.

③ Noise and Vibration

Operation of equipment and vehicles during construction and after completion generates noise and vibration to the certain degree.

The inhabitants located close to the work area and the hauling route will be affected mostly during construction. Noise and vibration are inevitable but minimal in operation stage, unless traffic volume may increase drastically. Especially, operation by noise and vibration at nighttime shall disturb sound sleep of the people nearby.

Therefore, some restriction and countermeasure shall be taken during construction period.

7.3.4 Impact after Construction (Operation Stage)

1) Social Environment

① Commerce/Business and Industry

Completion of the project will extend communication network of the region. This improvement in communication will pave the way to increase commerce/business and industry. This increase in above activities will bring some positive impact in the area.

② Social Facilities

After construction of the bridge, social facilities like education, health, sanitation etc. will improve to some extent. People will be careful about these things when their economic conditions improve.

③ Transportation

The construction of the Rupsa Bridge will definitely enhance road communication of the region. This improvement in communication will pave the way for the development of other sectors also.

④ Employment

Influx of different new development activities is being expected after the construction of the bridge. This development in different sectors will open new avenues for additional employment opportunity for the people of the area.

⑤ Commutative Loss

Construction of the Rupsa Bridge and the connecting highways on both sides of the bridge may cause cumulative land loss at a certain scale. This may happen due to subsequent improvement and construction of feeder roads connected with the highway, development of slums, growth centres and commercial and industrial structures along the highway. Moreover, the land buyers apprehending steep rise of land price along the highway will purchase land for non-agricultural uses.

2) Natural Environment

① Trees and Plantation

Trees and plantation may increase, after the construction of the bridge, due to planned roadside plantation on the approach road. This will bring positive impact to some extent.

② Biodiversity

The volume of riverbed at the project site may not change due to construction of the bridge. Hence, the river flows-situations both up and downstream sides of the bridge

will remain unaffected. As a result, neither fisheries nor the aquatic biodiversity in the Rupsa river will be affected in operation stages of the Rupsa Bridge except some during construction.

③ Movement of Cattle and machinery

The high embankment of the connecting roads on both sides of the Rupsa bridge shall disrupt movement of cattle and agricultural machinery. This will cause certain inconvenience especially to those farmers whose lands lie on both sides of the highway embankment.

3) Pollution

① Water

Monitoring of water quality parameters should be continued and any probable adverse affect identified. Data obtained during pre-project and during-construction period will be compared with the after-construction data (impact) and mitigation measures should be suggested accordingly.

②Air

Air quality determination during pre-project and during-construction period will facilitate comparative evaluation as to whether commissioning of the bridge has caused any direct or indirect affect on aerial environment along or around the bridge site. It is expected that mechanized transport movement, commercial and industrial activity will steadily increase resulting in emission of high concentration of SMP, NOx, SOx, CO etc. Baseline and during-construction data when compared with the after-construction monitoring, will quantitatively reveal as to whether any significant administrative/legal measures are warranted to minimize air pollution. It is well known that the main source of air pollution in Dhaka is the two-stroke engine vehicles (TSEVs), commonly known as scooters and temps used by public. These TSEVs are also used commonly and 20% of traffic volumes expected in the forecast and it is assumed serious affection to this area in future also. However, these solutions need to be combined with social mobilization.

③ Noise

After-construction impact on noise pollution will be measured and compared with the pre-project and during-construction data. It is assumed that with the gradual increase in plying of mechanized vehicles and human activity with uncontrolled honking, possibility of concurrent increase in noise levels/noise pollution is apparent.

④ Soil

Increased human activity, earthwork, uncontrolled disposal of solid/liquid wastes may pollute the soil environment. Baseline data for chemical and pollution indicator microbiological parameters have been obtained. A comparative and quantitative assessment with during-construction and after-construction data will reveal extent of any pollution that might have occurred.

4) An Assumption of Future Air Pollution and Noise Level

Fig.7.3.1 shows households distribution at Labon Chara Area at the west bank of the Rupsa River. The area is most anticipated to be affected area on air and noise by increased traffic in future. Traffic demand study forecasts that 11,094 vehicle/day pass through the Rupsa Bridge. Fig.7.3.2.and 7.3.3 show prediction of air pouution and noise level in Year 2015.

These prediction formula for air and noise pollution are methods established in Technical Guidelines for Environmental Impact Assessment for Road Projects under the jurisdiction of the Ministry of Construction:

① Prediction for Air Pollution ;

Feature : Prediction formula is a simple Plume model method. This method is being used most widely. This method assumes diffusion of regularly distributed smoke clouds against vertical / horizontal directions on a cross section at a right angle to wind direction. Puff model method is, in addition, also considering a diffusion of regularly distributed smoke clouds against the direction of the flow of smoke. It is considered, therefore, more realistic.

Advantages : The formula is simpler with Plume model.

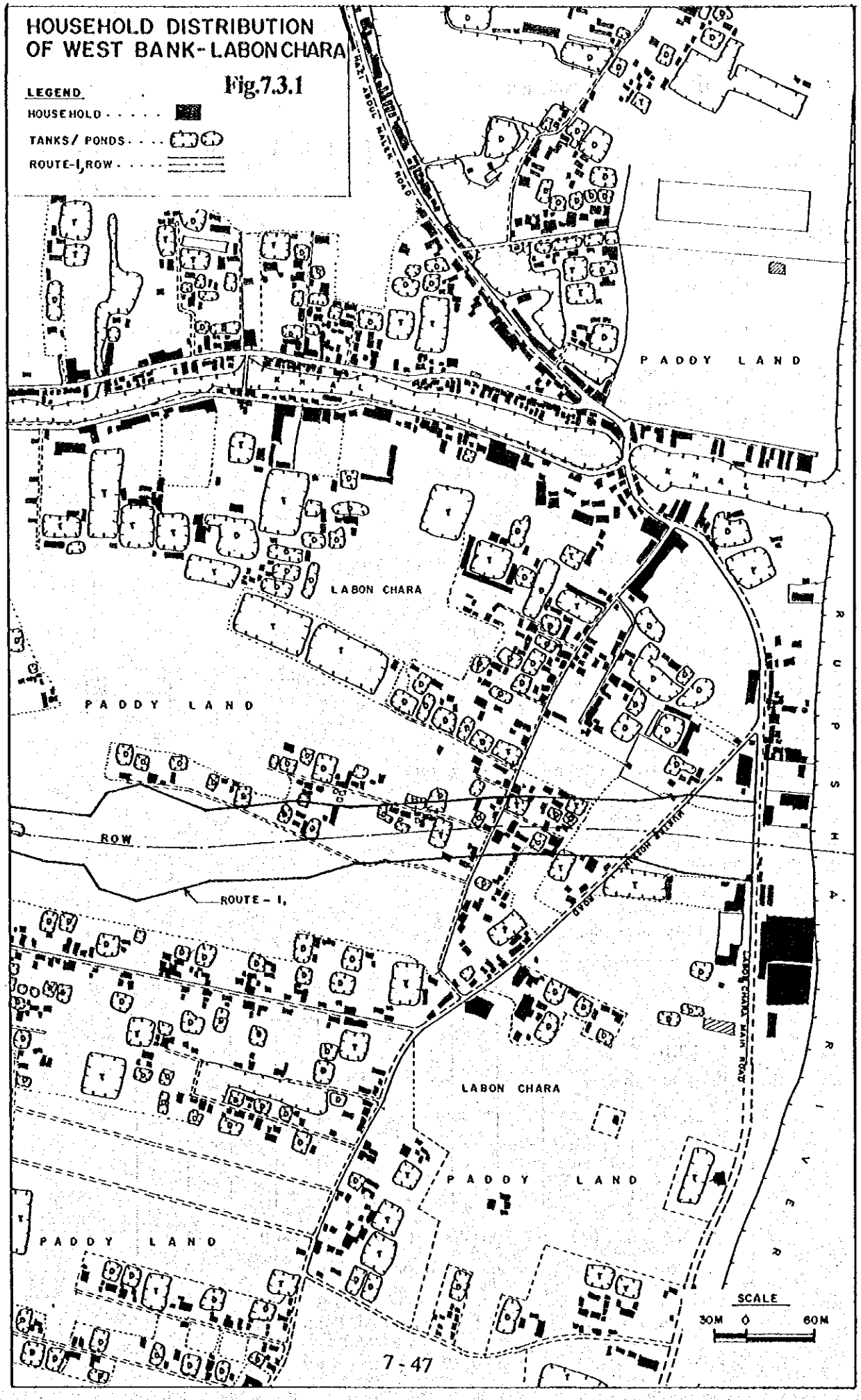
Use : It has been widely used in the field of environmental assessment, such as prediction of diffusion of smokes discharged from factories and incineration plants, not to mention of exhaust gases from motor vehicles on a road construction projects.

Precaution : A most important factor in the formula would be Coefficient of Average Exhaust by Different Type of Vehicles and a Traffic Volume. This formula is used for predicting annual average density under an annual average condition given by using a statistically processed data (traffic volume, etc.) and not to be used for predicting any specific condition.

② Noise

Feature : This is a method established by Japan Acoustics Society and is adopting a sound from the aspect of its energy.

Advantages : Simple calculation and practical.


HOUSEHOLD DISTRIBUTION
OF WEST BANK-LABONCHARA
Fig.7.3.1
LEGEND
HOUSEHOLD
TANKS/ PONDS
ROUTE-I, ROW
PADDY LAND
LABON CHARA
ROW
ROUTE - I,
SCALE
30M 0 60M

Calculation of Difusion of Air Pollution

$$c(x,y,z) = \frac{Q}{2\pi \cdot u \cdot \sigma_y \cdot \sigma_z} \exp\left(-\frac{y^2}{2\sigma_y^2}\right) \exp\left[-\left\{\frac{(z+H)^2}{2\sigma_z^2}\right\} + \exp-\left\{\frac{(z-H)^2}{2\sigma_z^2}\right\}\right]$$

c(x,y,z) =	Concentration (x,y,z)	ppm	0.00086	
Q	Volume of Exaust at source mL/s			
	Q = Vw x 1/ 3600 / 1000 x Σ (Ei x Nit)			
	Q : Emmission	mL/(m·s)	0.065	
				0.9g/km
	Ei : Exaust Coefficient	g/(km·N)	0.9	Std.
	Nit : Traffic Volume	No./h	500	
	Vw : Volume Coefficient	mL/g	523	
	Nox = 523 mL / g at 20°C			
	CO = 850 mL / g at 21°C			
u	Ave. wind velocity	m/s	1	
σz	Width of diffusion in vertical direction			
	$\sigma z = 1.5 + 0.31 \times L^{0.83}$		1.81	
	L : Distance from road edge	m	1	
	L = X - W/2			
	X : Leeward distance along wind direction	m	10	
	W : Width of roadway	m	18	
	σz = 1.5m in X < W			
σy	Width of diffusion in horizontal direction			
	$\sigma y = W/2 + 1.46 \times L^{0.81}$		9.0	
	σy = W / 2 in X < W			
y	Horizontal distance at V to X	m	0	
z	Vertical distance at V to x (Height)	m	1.5	
	Height of exaust source		1	

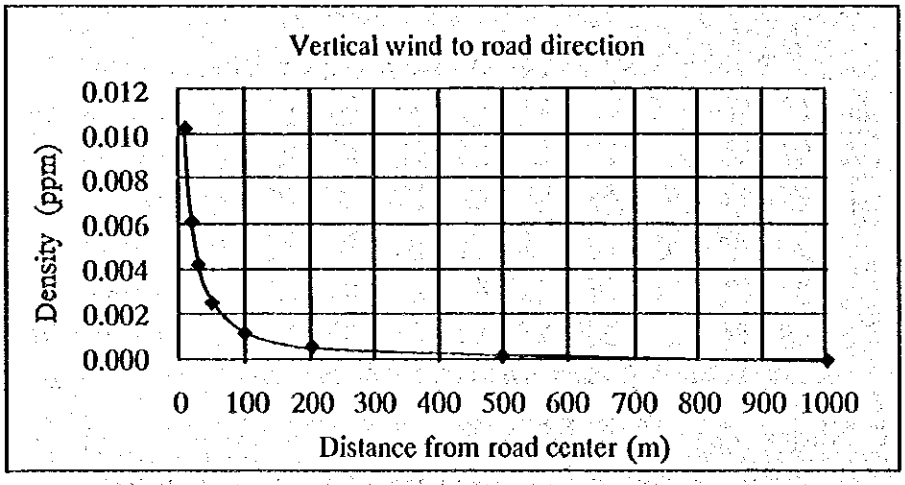


Fig. 7.3.2 Prediction of Diffusion of Air Pollution in Year 2015

Prediction of Noise Level

$$L_{50} = Lw - 8 - 20\log_{10} l + 10\log_{10}\left\{\pi \frac{l}{d} \tanh\left(2\pi \frac{l}{d}\right)\right\} + \alpha_d + \alpha_i$$

$$Lw = 87 + 0.2V + 10\log_{10}(a_1 + 10\,a_2)$$

L_{50}	Noise level at road center	dB(A)	68.8	
Lw	Ave. power level by each vehicle	dB(B)	106.4	
l	Distance between Source and point	m	10	
d	Ave. interval between vehicles	m	130	
N	Hourly traffic volume	No./h	462	
V	Ave. speed	km/h	60	
a_1	Small car raito		0.5	
a_2	Large car raito ($a_1 + a_2 = 1$)		0.5	
α_d	Corection by diffractive decrease	dB(A)		Neglected
α_i	Corection by various factors	dB(A)		Neglected

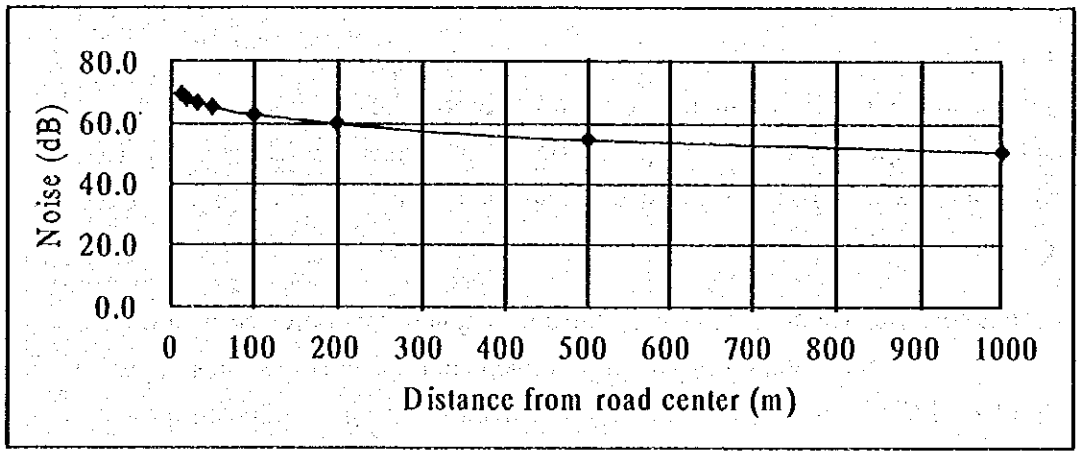


Fig. 7.3.3 Prediction of Future Noise Level in Year 2015

Use : To be used for Impact Assessment of new road construction.
Precaution : This method is applicable for roads and vehicles made under the Japanese Industrial Standard and, therefore, it is not applicable for calculation of noise from the roads with many pot holes and vehicles without mufflers.

The above assumption are only indication purpose, besides levels of Bangladesh Standards attached to Environmental Conservation Rule are rather severe if the area is regarded as residential zone. Therefore, mitigation measure such as plating of trees inside RoW in the area is particularly recommended.

7.3.5 Social Cost Estimation

For the economic analysis for Feasibility Study, the following cost items are counted as social cost and presented in Table 7.3.6 :

Information on the quantities and numbers of affected land, structures and trees have been collected through socio-economic survey. The price of affected land under 1) was calculated through consultation with the local people and officials concerned on area (m^2) basis. Items 2) and 3) were calculated on area (m^2) and per tree basis respectively. resettlement

Miscellaneous costs such as transfer costs, allowance and administrative costs, hiring of implementing NGO and monitoring of the implementation arrangements were estimated after taking into consideration experiences in different resettlement projects such as Jamuna Multipurpose Bridge project, Third Road Improvement Project, Rupsa Bridge project Phase I, and etc, and also through field survey and consultation with the people concerned.

Table 7.3.6 Social Cost by Route (1)

Compensation Items	Route-1			Route-2			Route-3		
	Quantity / No. (in Sqm.)	Value (per sqm. In Tk.)	Total Value	Quantity / No. (in Sqm.)	Value (per sqm. In Tk.)	Total Value	Quantity / No. (in Sqm.)	Value (per sqm. In Tk.)	Total Value
1. Land									
a. Agriculture	354,931	375	133,099,125	240,433	500	120,216,500	121,120	600	72,672,000
b. Residential	11,620	430	4,996,600	71,605	575	41,172,875	129,150	625	80,718,750
c. Commercial	2,423	475	1,150,925	3,316	625	2,072,500	7,764	750	5,823,000
d. Industrial	2,150	475	1,021,250			0	12,782	750	9,586,500
e. Pond	6,232	375	2,337,000	7,005	575	4,027,875	13,668	600	8,200,800
f. Shirmp Gher	15,040	400	6,016,000	7,318	500	3,659,000	5,461	550	3,003,550
g. Low Land	6,512	350	2,279,200	8,663	400	3,465,200	5,255	450	2,364,750
Sub-Total of 1.	398,908		150,900,100	338,340		174,613,950	295,200		182,369,350
2. Structure									
a. Dwelling houses									
i.Pucca	193.6	5,790	1,120,944			0	1,820.7	5,845	10,641,992
ii) Semi pucca	139.9	2,802	392,000	926.8	1,875	1,737,750	3,095.7	2,100	6,500,970
iii) Kutcha	1,194.7	725	866,158	2,340.6	625	1,462,875	3,739.5	1,005	3,758,198
b. Kitchen	192.2	475	91,295	325.9	360	117,324	733.4	1,850	1,356,790
c. Latrine	41.2	2,457	101,228	105.0	1,960	205,800	390.7	3,255	1,271,729
d. Cowshed	52.4	706	36,994	122.1	195	23,810	109.6	345	37,812
e. Commercial	656.4	1,590	1,043,676	15.0	1,000	15,000	189.0	465	87,885
f. Others	1,092.9	945	1,032,791	64.9	310	20,119	560.0	495	277,200
Sub-Total of 2.	3,563		4,685,086	3,900		3,582,678	10,074		23,932,576
3. Trees									
a. Timber	1,452	650	943,800	1,089	315	343,035	948	1,925	1,824,900
b. Fruit	2,668	350	933,800	1,180	438	516,840	2,113	775	1,637,575
c. Fire wood	1,714	175	299,950	1,743	15	26,145	1,381	55	75,955
Sub-Total of 3.	5,834		2,177,550	4,012		886,020	4,442		3,538,430
Total (1.+2.+3.)			157,762,736			179,082,648			209,840,356

Table 7.3.6 Social Cost by Route (2)

Compensation Item	Route-1		Route-2		Route-3	
	Quantity/ No.	Amount in Tk.	Quantity/ No.	Amount in Tk.	Quantity/ No.	Amount in Tk.
Total (1.+2.+3.)		157,762,736		179,082,648		209,840,356
4. Relocation Grant @ 10% of the structure value assessed by the DC office	53	466,500	114	358,500	325	2,393,000
5. House Construction Grant @ 10% of the struc. Value assessed by the DC office.	53	466,500	114	358,500	325	2,393,000
6. Relocation Grant for rental and others households @ Tk. 2000 (Lump sum)	30	60,000	72	144,000	200	400,000
7. Additional cash grant to match market value for purchase of homestead land (subject to purchase of replacement land, @ 130/-- per sqm.	11,620	1,510,000	71,605	9,309,000	129,150	16,790,000
8. Stamp duty for land registration (22% of transaction price)		1,431,000		11,106,000		21,452,000
9. Loss of Income of Households @ Tk. 70/per day X 90 days)	53	334,000	114	718,200	325	2,047,500
10. Additional Assistance for Female headed households (considering gender issues) @ Tk. 2500 per family	4	12,500	7	17,500	23	57,500
11. Loss of standing crops (considering paddy) @ 0.6 K.g. per Sqm. X Tk. 10/per Kg.	354,931 (Sqm.)	2,130,000	240,433 (Sqm)	1,443,000	121,120 (Sqm)	727,000
12. Administrative cost for RHD resettlement unit (Lump sum)		2,000,000		2,000,000		2,000,000
13. NGO contract for Resettlement implementation (lump sum)		4,500,000		4,500,000		4,500,000
14. Contingency (lump sum)		32,890,000		6,000,000		6,000,000
Sub-Total (4 – 14)		45,800,500		35,954,700		58,760,000
Grand Total (1-14)		203,563,236		215,037,348		268,600,356

Note: Contingency for Route-1 includes additional land acquisition cost related to variation of Right-of-Way more than 36m due to selection of desirable road embankment structure.

7.4 Mitigation Measures and Environmental Monitoring Plan

7.4.1 General

The provisions and concerns regarding the negative environmental impacts by the project should be initiated during preparation of tender documents. Because, several of the mitigation measures are to be accomplished by the prospective contractor who might prepare the bridge as well as the connecting highway embankments on both sides of the Rupsa bridge.

However, the main activities of Monitoring Plan shall be carried out con-currently with the bridge and connecting road construction activities.

7.4.2 Pre-Construction and Construction Phase

1) Loss of Land:

Loss of land can be mitigated by:

i) payment of adequate cash compensation to PAPs at specified rates.

ii) buying of soil from non-agriculture land outside ROW area for digging large size borrow pit of 2-3 meter deep for construction of the highway embankment instead of digging narrow pits within ROW area or buying the topsoil from the agriculture lands. The local landowners may prefer the former method of collecting earth for embankment construction. These pits can subsequently be used for fish culture, a flourishing and profitable landuse in the locality. The freshwater accumulated in the ponds and borrow pits can also be used for irrigated agriculture during the dry season.

iii) the unused lands and borrow pits within ROW should be released to PAPs for productive and viable utilization immediately after completion of work.

iv) the disturbed land within ROW should be cleared and rehabilitated for productive uses.

v) buying of soil through local contractor for building the connecting road is not advisable because the local contractors usually collect soil from the farmers by scraping the topsoil.

All lands within and outside ROW used for the project should be restored for agricultural and other productive uses soon after completion of work.

2) Loss of Crop Production

Loss of field crops can be mitigated by:

i) building the access roads, storage sites, labour camp and other construction related activities within ROW area.

ii) paying compensation of crop loss caused to PAPs for all project related activities.

iii) leasing back the rehabilitated agriculture land progressively to the farmers for productive

uses.

iv) avoiding the crop loss due to deposition of silt on adjacent fields and by dust blowing by proper maintenance, watering and carpeting of the highway embankment. Cash compensation should be paid to PAPs where crop loss is unavoidable.

v) recruiting the labors from amongst the local people or PAPs so that erection of large size labor camps to the disgust of project site villagers can be kept at a minimum level.

3) Loss of Trees/Plantation

Loss of trees on homesteads shall be compensated by paying cash compensation and by:

i) planting of specific tree seedlings on embankment sides as per prescription of Bangladesh Forest Department , e.g. 10 % fruit, 30 % long rotation and 60 % hort rotation tree species.

ii) distributing seedlings or propagules of site specific timber trees, fruit trees and multi-purpose tree species (MPTS), such as jack fruits, berries, mango, koroi, nim, and etc., for planting on homesteads, crop fields, wastelands, pond banks and resettlement sites.

iii) planting mulberry along the highway embankment for sericulture that may be attractive to the rural poor women.

4) Embankment Erosion and Dust Blowing

Crop loss caused by:

i) embankment erosion, siltation and dust blowing along wind direction should be compensated in cash.

ii) embankment sides should be carpeted with suitable productive grass sap and the embankment top should be watered regularly to avoid wind blowing.

5) Health Care and Disease Contamination

Health hazards at construction site, workers camp and in adjacent areas can be minimized or avoided by:

i) arranging hygienic disposal of human waste, solid waste at campsite, using insect killers and preventive inoculations.

ii) arranging safe drinking water in workers camp.

6) Traffic Hazards

Traffic hazards that may be caused by the project associated vehicles shall be mitigated by:

i) operating and maintaining all project vehicles in safe manners.

ii) closing the project site for free trafficking of the pedestrians and onlookers.

iii) developing awareness amongst all project personnel at construction site regarding the safety measures by organizing training seminars.

iv) keeping the construction site equipped with First Aid equipment and trained up personnel. Arrangement should be made for shifting the accident victims quickly to the hospital.

7) Noise Pollution

Noise that can emanate from construction sites and construction camps may be a nuisance to local villagers, particularly in the early morning and late evening periods. This can be mitigated by:

i) maintaining all the heavy vehicles and other machinery particularly the exhausts properly.

ii) choosing the suitable time for conducting the noise producing activities of the project.

7.4.3 Operation Phase

1) Control of Vegetation

Vegetation of the RoW and adjacent area shall be controlled by:

i) planting site specific tree species on road sides, homesteads and wasteland.

ii) cleaning the noxious plant species periodically from borrow pits and RoW area.

2) Cumulative Loss of Agriculture Land

The cumulative loss of agriculture land shall be mitigated by:

i) discouraging construction of roadside slum, settlement and commercial structures. This can be done by the collective and collaborative efforts of GoB, NGO staff and local volunteers.

3) Traffic Hazards and Accidents

Accidents and hazards can be minimized by:

i) installing proper traffic signs, regulating speed limit enforcing traffic regulation and developing traffic awareness amongst the people.

7.4.4 Environmental Enhancements

RHD and other agencies for pursuing the efforts undertaken to mitigate the environmental impacts during the construction and operation stages shall adopt planned approach during the project operation phase. Skill, experience and reputation of several local NGOs can be utilized for implementation of the environmental enhancement programmes.

1. The RHD can assist PAPs in getting employment in construction related activities of the

project. Technology dissemination through extension network of GoB will promote professional diversification e.g. sericulture, floriculture, cows fattening, livestock rearing and apiculture amongst PAPs. Planting of mulberry trees on highway embankment will promote development of sericulture amongst the poor women. NGO can assist in this respect. Training of the youths at the project site will help professional diversification.

2. Unused and marginally used land within and outside RoW can be utilized by planting site specific MPTS. Bangladesh Forest Department can assist in selecting suitable species, supplying propagates and extending the know how. Tree planting will benefit the local people providing a sustainable supply of fuelwood, fodder, timber and raw materials for cottage industries. Moreover, trees on ROW would be of much aesthetic values for the local people. Grasses like 'napier', 'dal' and 'German' planted at suitable sites on slopes will protect the embankment from gully erosion, rain-cut and provide high quality fodder at the same time.

3. RHD can assist in introducing the planned rural housing models developed by different NGOs for the resettled households. Community facilities e.g. vocational schools, tube-wells, clinics, sanitation and recreation facilities, etc. can be developed for PAPs at resettlement sites or for the host community elsewhere.

4. Implementation of the project will increase movement of mechanized land traffic and heavy vehicles. This will make the area more valuable to traffic accidents. However, adoption of adequate safety measures e.g. traffic signs, well trained auto drivers, proper maintenance of vehicles, traffic awareness, etc. will reduce the number of accidents.

7.4.5 Monitoring

A monitoring plan at the project site may be initiated based on primary data during the IEA and results of the current EIA study. Areas particularly important for this purpose are:-

i) Monitoring activities in resettlement operation

- Information campaign and consultation with the PAP's'
- Status of land acquisition and compensation payments;
- Compensation for lost structures and assets;
- Relocation of PAP's
- Payment of Income Restoration Assistance

ii) Social impact of the project in the region

iii) Silting of the local river channels and water ways that may consequently block drainage and cause water logged conditions in low lying areas.

iv) Rate of siltation in river bed and bank erosion rate at bridge alignment site.

v) Monitoring of susceptible pollution parameters like water, air, noise and surface soil characteristics;

vi) Pollution of the open water system by petroleum products leaked or released from mechanized boats and ships;

vii) Release of solid and liquid industrial wastes and discharges of sewerage and solid wastes from the site and workers camp.

viii) Aquatic biodiversities in open water bodies.

These can be done either by employing a full-time Environmental Monitor by RHD or engaging a local NGO.

7.4.6 Flow Chart for Environmental Monitoring Plan (EMP)

The advice of the Environmental Monitoring Plan's flow chart should be carried out from the pre-construction phase of the project. Several items might be required to attend simultaneously during the project construction and operation phases. This might be monitored to assess the positive and negative environmental impacts of the project. Critical path activities for the EMP are shown in Fig7.4.1.

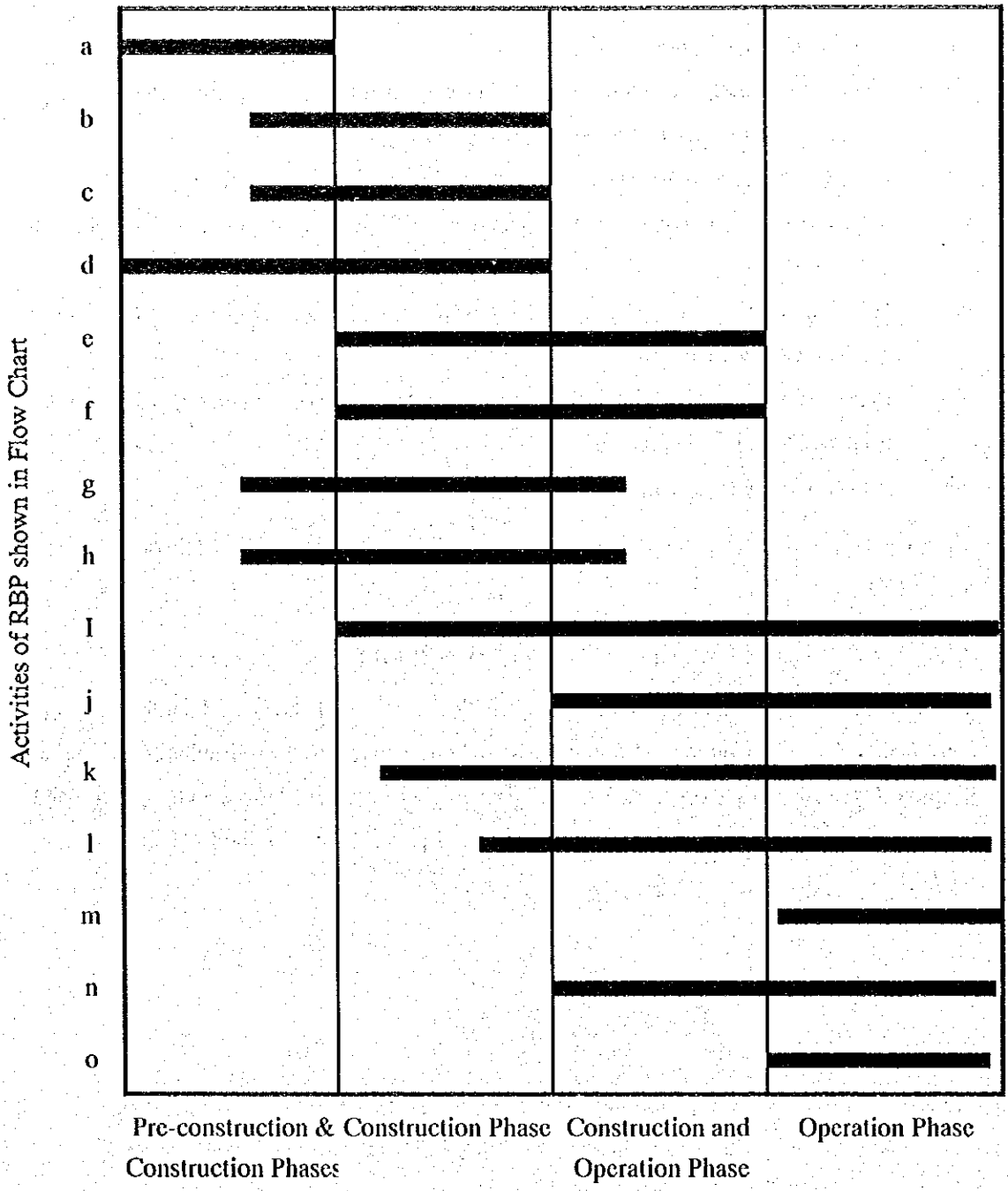


Fig. 7.4.1 Critical Path activities o f RBP shown in Bar Chart

EMP Path Activity Items in Fig.7.4.1 are explained as follows:

a) Compensation for moveable and immovable properties and assets for each PAP is to be paid.

b) Resettlement Plan if there is any should be implemented properly.

c) Possession over RoW area should be ensured timely after payment of compensation as per rule and to the satisfaction of PAPs.

d) Loss of Land and Loss of Production within and outside RoW should be kept at minimum levels during construction and operation phases of the project.

e) Clearing of the junks from construction site, spoils from the workers camps/field office areas and cut materials from the borrow area are to be ensured to the satisfaction of local public after completion of work.

f) Disruption of traditional cattle tracks and village paths during the construction phase should be avoided or kept at a minimum level.

g) Health care requirements as per local standards should be fulfilled and supply of pure drinking water at workers camps, field office site and adjacent areas should be ensured during construction phases of the project.

h) Proper sanitation at workers campsite, hygienic disposal of the human and solid wastes should be ensured.

i) Requirements to control noise pollution and pollution of air, water and soil during construction and operation stages should be fulfilled.

j) Both long and short-term cumulative loss of agriculture land due to implementation of the project shall be monitored during the operation phase.

k) The accident mitigation requirements during construction phase of the project to avoid injuries and loss of human life should be taken care of.

l) Transportation related activities e.g. (I) model development of road ways, (ii) road maintenance standards, traffic density and types, (iii) road transport environment, (iv) road related commercial and industrial developments during the project operation phase are to be monitored.

m) Impact of reduced water transport movement on pollution of water in the river Rupsa and other link channels due to increased movement of road transport after implementation of the project should be studied.

n) Environmental enhancement activities accompanying the implementation of the project by public and private sector agencies are to be monitored. It should be ensured that PAPs resettled are in better condition compared to the life they used to enjoy at their original dwelling homes.

o) Finally, the behaviour and pattern of social changes within the resettlement site and at the project area in totality due to implementation of the project should be kept under vigil to fathom the real impacts of the project qualitatively and quantitatively in respect social,

economic and environmental benefits.

7.4.7 Video Tape and Photographs

As part of the study a detail photography and video have been undertaken to reflect environmental parameters of the Rupsa bridge alignments sites.

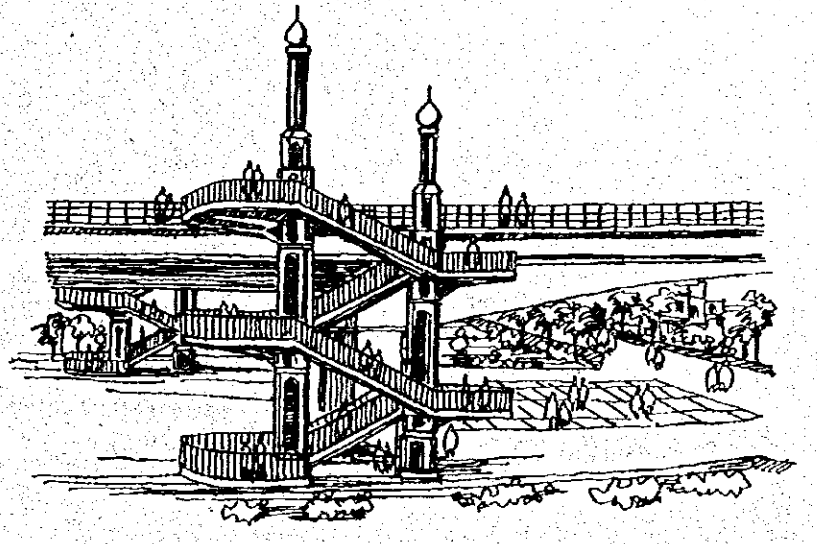
The photographs and video documentation will provide realistic information on the settlements and other existing situations for further use. The settlements in the areas have been photographed in daylight for both still and videos. It was aimed at to take care of salient aspects of social environment as well as natural environment.

The photographs were serialized from one end of the alignment location of the bridge and have been given captions with serial number of the photographs while put them on an album. The names of mouza have also been included in the captions.

The video documentation has been done with discussions about the residency, profession, income, activities and value of assets etc. with the dwellers/owners of the houses/settlements. The adjacent intervening settlements like school, mosque, temple, bazaar (market), mills and factories are documented in both still photographs and videos.

CHAPTER 8

RESETTLEMENT ACTION PLAN AND LANDSCAPE CONSERVATION PLAN



CHAPTER 8 RESETTLEMENT ACTION PLAN AND LANDSCAPE CONSERVATION PLAN

8.1 Resettlement Action Plan on Three Routes in Project Area

8.1.1 Project Affected Area

Site investigation survey was carried out all along the three (3) routes to obtain the information on social conditions and land use of the area for Bypass Routes from the view points of social and environmental issues related to land acquisition and compensation of project sites.

Through three route alternatives of 36-meter width, there are numbers of homestead, which sometimes consists of kin family group households within same property that has to be recognized as one affected, cluster formation. In most of the case, property of these homesteads will be affected partly but very few cases in total. Through the survey the number of households maintained within same homestead land are also confirmed. These three route alternatives are shown in Fig. 8.1.1.

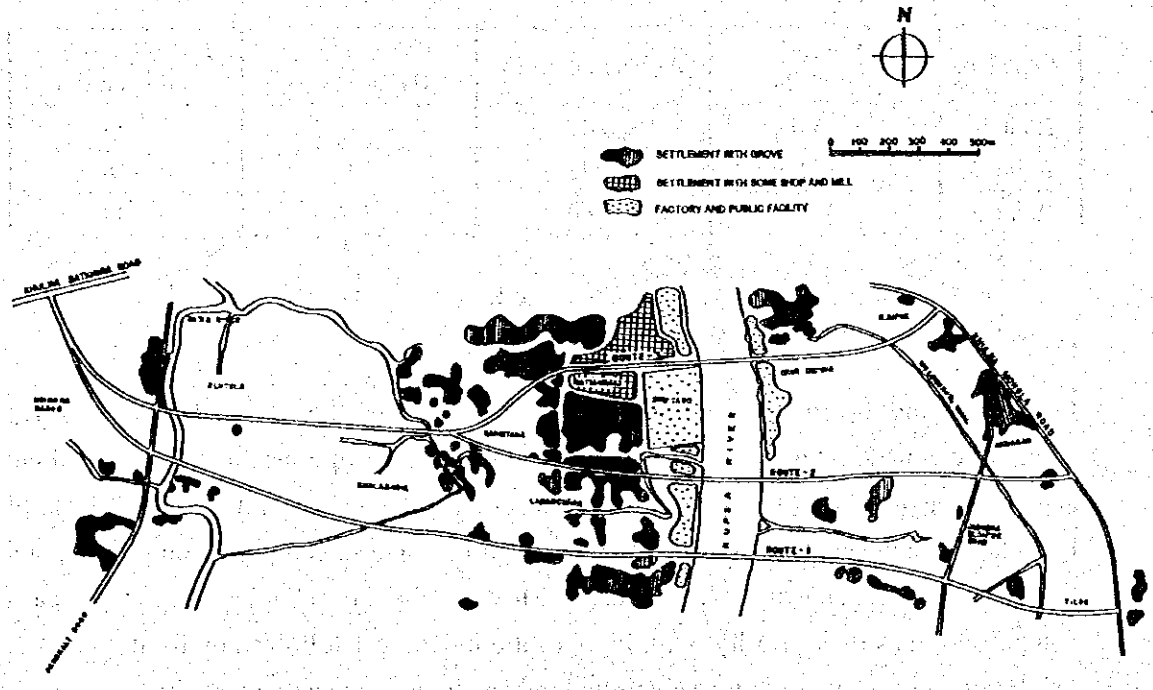


Fig. 8.1.1 Location of Route Alternatives

8.1.2 Homesteads Affected by Three Route Alternatives

Social environmental survey has been carried out through the alternative routes 1, 2 and 3. Each proposed route area has been surveyed for affected households and persons lived in. The results the survey are presented in Table 8.1.1 through 8.1.4., indicating the intentions of project affected persons, which need to be taken into consideration while formulating the resettlement plan.

1) Households and Persons Affected within 36 meter ROW

All along the 36 m ROW, numbers of homesteads which sometimes consist of kin family group households within the same property are recognized as one cluster formation that will be affected by the project. In most cases, property of these homestead will be affected partly but totally in a few cases. Table 8.1.1 shows the number of affected households and persons within the cluster that is recognized as a homestead, with directly affected household. Within the affected cluster, a few homestead indirectly affected are also recognized in case of Route 1.

Table 8.1.1 Affected Households and Persons within Width of 36 Meter

Route No.	Affected Households	Affected persons	Nos. of cluster (Homestead)	Nos. of household within cluster
Route 1	53	242	29	53
Route 2	114	523	42	116
Route 3	348	1560	126	348

2) Householder's Wishes for Project Compensation

Interviews and hearing survey has been carried along the affected area of three alternative routes. Five (5) categories of compensation options for the resettlement and land acquisition were considered in order to comprehend the tendency of householder's wishes for the project compensation. These compensation options and the tendency are shown in Table 8.1.2 Most of the householders expressed cash compensation as their priority, with higher ratio in Route 1 followed by Route 3 and 2. Other wishful priorities are for substitute land and house in resettlement sites.

Table 8.1.2 Tendency of Householder's Wishes for Compensation Options

Option	Route 1 Household Nos.	Percentage	Route 2 Household Nos.	Percentage	Route 3 Household Nos.	Percentage
1: Cash	46	86.7%	65	57.0%	257	79.1%
2: Land for substitute land	3	5.7%	15	13.2%	33	10.2%
3: House lot	2	3.8%	6	5.3%	16	4.9%
4: House in resettlement site	2	3.8%	22	19.2%	19	5.8%
5: Others	0	0.0%	6	5.3%	0	0.0%
Total	53	100.0%	114	100.0%	325	100.0%

3) Preferred Resettlement Area

Table 8.1.3 shows the preferred area for resettlement. Their wish vary from resettlement i) within same village, ii) in Thana area and iii) neighboring village or iv) Khulna town depending on the characteristics of the routes.

Table 8.1.3 Area Wished to Stay for Resettlement Option

Area wished to stay	Route 1 Household Nos.	Percentage	Route 2 Household Nos.	Percentage	Route 3 Household Nos.	Percentage
1: Within same village	37	69.8%	59	51.7%	176	54.2%
2: In Thana area	2	3.8%	6	5.3%	23	7.1%
3: Neighboring village	12	22.6%	9	7.9%	66	20.3%
4: In Khulna town	1	1.9%	12	10.5%	41	12.6%
5: Outside of Khulna district	1	1.9%	5	4.4%	6	1.8%
6: Not known yet	0	0.0%	23	20.2%	13	4.0%
Total	53	100.0%	114	100.0%	325	100.0%

4) Intention to Utilize the Cash Compensation

Table 8.1.4 shows the six characteristic items of spending cash compensation money and the householders' response to individual items. Majority of the householders intend to use the compensation money for buying land, investment in business and building new house. Especially intention of buying land shares high percentage in all the three routes.

Table 8.1.4 Spending Intention of Cash Compensation Money

Spend intendance	Route 1 Household Nos.	Percentage	Route 2 Household Nos.	Percentage	Route 3 Household Nos.	Percentage
1: Buying land	35	66.0%	52	45.6%	200	61.5%
2: Investment in business	14	26.4%	14	12.3%	62	19.1%
3: Building new house	2	3.8%	35	30.7%	16	4.9%
4: Renovation/Repairing of house	0	0.0%	0	0.0%	1	0.3%
5: Repay loan	2	3.8%	5	4.4%	23	7.1%
6: Others	0	0.0%	8	7.0%	23	7.1%
Total	53	100.0%	114	100.0%	325	100.0%

8.1.3 Presumed Resettlement Options

Considering the available compensation options and preferred area to stay, the following tendencies can be clarified.

1) Quite high tendency of the cash compensation option (86.7% for Route 1, 57.0% for Route 2, 79.1% for Route 3) is found among the affected households. These householders are considered to solve resettlement issues by themselves based on their choices.

2) The number of households and their preference for having the land, house lot and house in resettlement site as compensation option for each three routes may be clarified as objectives of resettlement plan. Following number of households need to be considered for inclusion of their wishes in the resettlement plan.

   Route 1: 7 households –13.2%
   (Total number of affected households numbers: 53)
   Route 2: 43 households –37.7%
   (Total number of affected households numbers: 114)
   Route 3: 68 households –20.97%
   (Total number of affected households numbers: 325)

3) As referred to Table 8.1.3, regarding the preferred area for settlement, majority of the people wished to stay within same village, followed by the Thana area, neighboring village and in the Khulna town. So most of the affected householders either may choose cash compensation or land, house lot and resettlement site, who may prefer to stay near the original household location. Following are the objective householders, who wish to stay near original household location.

Route 1: 98.1% of householders
Route 2: 75.4% of householders
Route 3: 94.2% of householders

8.1.4 Extent of Affected Homestead Area-Wise and the Number Of Households

In order to estimate the extent of affected homestead area, typical settlement area are selected in each three routes and surveyed for numbers of affected households. Fig. 8.1.2 through 8.1.4 show typical sections of affected homestead area within 36-m ROW of three alternative routes.

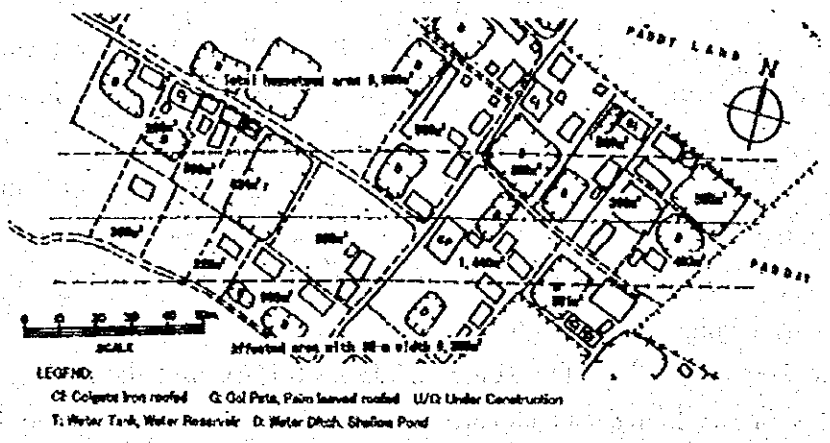


Fig. 8.1.2 A Typical Section of Affected Homestead Area in the Route 1

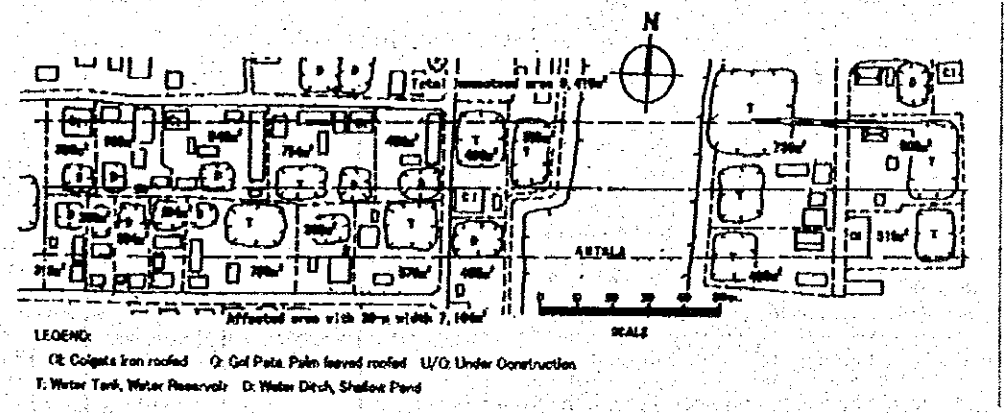


Fig. 8.1.3 A Typical Section of Affected Homestead Area in the Route 2

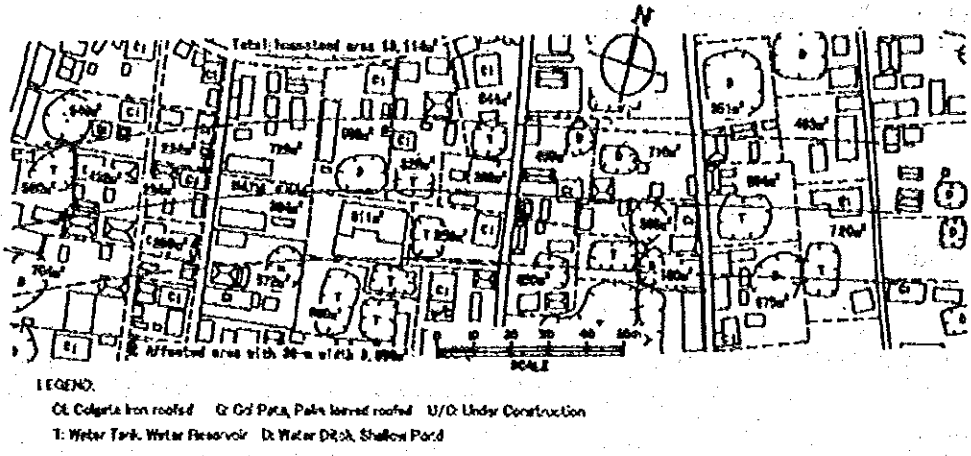


Fig. 8.1.4 A Typical Section of Affected Homestead Area in Route 3

Affected homestead areas within each three Routes have their own characteristics. Homestead of the Route 1 settlement has rather large property size, in an average of 600m^2 due to the fact that the settlement is situated in semi-urban area. These values are around 490 m^2 for the Route 2 and the Route 3 as the settlements are in urban area. Regarding the average number of households in each homestead, the Route 1 has 1.89 household per homestead and 2.71 for the Route 2, and 2.76 for the Route 3. Therefore an average area per household becomes 221.9m^2 for the Route 1, 139.1m^2 for the Route 2 and 118m^2 for the Route 3. Table 8.1.5 shows the average number of households in the homestead and average area available for household in each 3 Routes.

Table 8.1.5 Average Number of Households in the Homestead and Average Household area

Item	Route 1	Route 2	Route 3
Numbers of Homestead in sampling area	15	19	27
Area of Homestead in sampling area	8,998m^2	9.416m^2	13,114m^2
Average homestead area in sampling area	600m^2	496m^2	487m^2
Affected area with 36-m width in sampling area	6,300m^2	7,164m^2	8,856m^2
Affected area ratio to the area of homestead in sampling area	70.00%	76.10%	67.50%
Total affected homestead number through the Route	29	42	126
Total affected household number through the Route	53	114	348
Average household number per homestead through the Route	1.83	2.71	2.76
Average area per household	118.9m^2	139.1m^2	118.8m^2