Table 2.5.3 Summary of Questionnaire Survey on Operation and Maintenance of River Structures (1/2)

No.	Divisional Office	Zone	Prepared by	No. Pjts	Summary of Response			
					Flood Warning	OM Manual	Need of FFWS	Avoidable Damage by
1	Bogra	NW	Md. Mukhlesur Rahman	2	Partly	None	?	50.0%
2	Sirajganj	NW	Md. Abdul Hamid, Md.Nizamul Haque Bhuivan, Tanan Kumar	1	Received	Ready	Necessary	50.0%
3	BRE, O&M Sirazgonj	NW	Tapan Kumar Saha	?	Received	Instruction	Necessary	90.0%
4	Pabna	NW	Md. Kamalur Rahman Talukder	1	Not received	None	Not necessary	50.0%
5	Bera	NW						
6	Barisal	S	Md. Akhtar Husain, EE	?	Received	None	Necessary	55.0%
7	Patuakhali	S						
8	Barguna	S	Md. Shajhan Md.Abdul Malek Mia	17	Received	None	Necessary	80.0%
		S	Md. Abdul Baset Sarker	?	Received	None	Necessary	45.0%
9	Dinajpur	N	Md. Afsur Ali Md. Amjad Hossain	12	Sometimes	Partly ready by Pjt	Necessary	27.5%
10	Bhola-1(S.D)	S	Shelim Ahsan	2	Received	None	Better than nothing	20.0%
11	Bhola, S.D, II	S						
12	Rangpur	S						
13	Gaibandha	N	Md. Mokhlesur Rahman	?	Not received	None	Necessary	75.0%
14	Kwigram	N						
15	Lalmonirhat	N						
16	Dalia, Nilphamari	N						
17	Nilphamari	N	No mentioned	2	Not received	None	Necessary	50.0%
		N	Md. Yeasin Ali	?	Sometimes	None	Necessary	75.0%
18	Shedpur, Nilphamari	N						
19	Thakurgaon	N	Md. Shahid Hossain Chowdhury	4	Not received	None	Necessary	27.5%
		N	Md. Mozaffar	?	Not received	None	Necessary	80.0%
		N	Md. Golam Sawar	?	Not received	None	Necessary	90.0%
20	Panchagar	N	Md.Matiur Rahman	4	Not received	None	Necessary	15.0%
21	Moulvibazar	NE	Kaji Abu Bakar Siddique, Siddiqur	11	Sometimes	None	Necessary	30.0%
22	Snargonj	NE	Sunil Baran Debny	?	Received	None	Necessary	20.0%
23	Slhet	NE						
24	Hobigonj	NE						
25	Tangail	C	Syed Ahsan Ali	?	Not received	None	Necessary	50.0%
26	Jamalpur	C						
27	Netrokona	C	Md. Abdul Batn	?	Not received	None	Necessary	50.0%
28	Mymensingh	C	A.K.M. Azherul Islam	?	Not received	Ready	Necessary	60.0%
29	Cht. I	SE						
30	Cht.II	SE						
31	Comilla	NE						
32	Ghumati	NE						
33	Faridpur	SW						
34	Ramgamati	SE						
35	Luxmipur	SE						
36	Naokhali	SE	S.M. Ataur Rahman	2	Sometimes	None	Necessary	55.0%
37	Cox's Bazar	SE	Shambha Nath Biswas	1	Not received	None	Better than nothing	25.0%
38	Feni	NE	?	1	Received	Ready	Necessary	70.0%

Table 2.5.3 Summary of Questionnaire Survey on Operation and Maintenance of River Structures (2/2)

No.	Divisional Office	Zone	Prepared by	No. Pjts	Summary of Response			
					Flood Warning	OM Manual	Need of FFWS	Avoidable Damage by
39	Dhaka O&M-I	C	Md. Mokibur Rahman / Mashiur Rahman / I.M. Reazul Iaasan/ Ashraf Jamal	4	Received	None	Necessary	50.0%
40	Dhaka O&M-II	C	Md. Sajidul Rahman Sarder	1	?	?	Necessary	60.0%
41	Rajbari	SW						
42	Gopalgonj	SW						
43	Madaripur	SW	Md. Nazrul Islam MD.Mainnddin	4	?	?	?	50.0%
44	Saritpur	SW						
45	Khulna-I O&M	SW	Proddyut Kurna Saba Md.Lutfor Rahman Ensrdyut Kr.Saha	11	Sometimes	None	Necessary	31.0%
46	Khulna-II O&M	SW						
47	Satkhira-I O&M	SW						
48	Satkhira-II O&M	SW						
49	Bagerhat	SW	Rezaul Mustafa Ashafudula Md. Abdul	9	Sometimes	None	Necessary	30.0%
50	Jessore	SW						
51	Narail	SW						
52	Nababgonj	NW						
53	Naogaon	NW	Md. Afzal Hossain	10	Sometimes	None	Necessary	21.0%
54	Natore	NW	Md. Sanaullah, Md.Montezer Rahman	7	Received	None	Necessary	80.0%
55	Rajshahi	NW	Md.Abu Bakr Khan Md.Mohsin Shaik	?	Sometimes	None	Necessary	50.0%
56	Magura	SW						
57	Jhenaidah	SW						
58	Chuadanga	SW						
59	Kushita	SW						
60	Chandpur	NE	Amanullah	1	Received	Ready	Necessary	80.0%
A	Interviewed		Number of OM Divisional Offices	14	Rate of Interviewed	23.3%		
B	Received Responses		Number of OM Divisional Offices	21	Rate of Response	35.0%		
	Total (A+B)		Interview + Responded	35		58.3%		
			Total Number of Projects	107				
	Evaluation		Positive answer /Highest		11	4	28	90.0%
			Negative answer /Lowest		10	25	1	15.0%
			Medium answer		14	6	6	51.3%

Notes:

1. Flood warning message: Received / Sometime received / Not received
2. OM Manual for emergency operation: Ready / Under preparation / No Manual / Instruction only
3. Need of FFWS: Necessary / Better than nothing / No need
4. Avoidable damage by FFWS: Mitigation of flood damage by FFWS in %, rate of avoidable damage to total damage
5. ?: No response
6. Evaluation

	Flood warning	OM Manual	FFWS	Avoidable Damage
Possitive answer /Highest	Received	Ready	Necessary	Maximum
Negative answer /Lowest	Not received	None	Not necessary	Minimum
Medium answer	Others	Others	Others	Average

From interview survey only, but no response to questionnaire survey

Table 2.6.1 Historical Performance of Losses and Damage by Flood in Bangladesh

Year	Affected Area		No. of Deaths	Flood Damage		Exchange Rate (Tk./US$)
	(km^2)	Share in Total Area (%)		Million Tk.	Million US$	
1954	36,800	24.9	112	1,200	343	3.5
1955	50,500	34.2	119	1,230	351	3.5
1956	35,400	24.0	N.A.	900	257	3.5
1957	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1958	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1959	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1960	28,400	19.2	N.A.	N.A.	N.A.	N.A.
1961	28,800	19.5	N.A.	N.A.	N.A.	N.A.
1962	37,200	25.2	117	560	140	4.0
1963	43,100	29.2	N.A.	N.A.	N.A.	N.A.
1964	31,000	21.0	N.A.	N.A.	N.A.	N.A.
1965	28,400	19.2	N.A.	N.A.	N.A.	N.A.
1966	33,400	22.6	N.A.	N.A.	N.A.	N.A.
1967	25,700	17.4	N.A.	N.A.	N.A.	N.A.
1968	37,200	25.2	126	1,160	290	4.0
1969	41,400	28.1	N.A.	N.A.	N.A.	N.A.
1970	42,400	28.7	87	1,100	220	5.0
1971	36,300	24.6	120	N.A.	N.A.	N.A.
1972	20,800	14.1	N.A.	N.A.	N.A.	N.A.
1973	29,800	20.2	N.A.	N.A.	N.A.	N.A.
1974	52,600	35.6	1,987	28,490	2,849	10.0
1975	16,600	11.2	N.A.	N.A.	N.A.	N.A.
1976	28,300	19.2	N.A.	N.A.	N.A.	N.A.
1977	12,500	8.5	N.A.	N.A.	N.A.	N.A.
1978	10,800	7.3	N.A.	N.A.	N.A.	N.A.
1979	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1980	33,000	22.4	N.A.	N.A.	N.A.	N.A.
1981	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1982	3,140	2.1	N.A.	N.A.	N.A.	N.A.
1983	11,100	7.5	N.A.	N.A.	N.A.	N.A.
1984	28,200	19.1	N.A.	N.A.	N.A.	N.A.
1985	11,400	7.7	N.A.	N.A.	N.A.	N.A.
1986	4,600	3.1	N.A.	N.A.	N.A.	N.A.
1987	57,300	38.8	1,657	35,000	875	40.0
1988	89,970	61.0	2,379	100,000	2,500	40.0
1989	6,100	4.1	N.A.	N.A.	N.A.	N.A.
1990	3,500	2.4	N.A.	N.A.	N.A.	N.A.
1991	28,600	19.4	N.A.	N.A.	N.A.	N.A.
1992	2,000	1.4	N.A.	N.A.	N.A.	N.A.
1993	28,742	19.5	N.A.	N.A.	N.A.	N.A.
1994	419	0.3	N.A.	N.A.	N.A.	N.A.
1995	32,000	21.7	N.A.	N.A.	N.A.	N.A.
1996	35,800	24.3	N.A.	N.A.	N.A.	N.A.
1997	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1998	100,250	67.9	918	160,000	3,556	45.0
1999	32,850	22.3	N.A.	N.A.	N.A.	N.A.
2000	35,700	24.2	N.A.	N.A.	N.A.	N.A.
2001	4,000	2.7	N.A.	N.A.	N.A.	N.A.

Source : FFWC and News in published in the Daily Ittefaq

Note : Total land area of Bangladesh is 147,000 km^2

Table 2.6.2 Suitable Crops by Land Class and Flood Depth

Land Class	Flood Depth	Suitable Crops		Remarks
		Kharif-I	Kharif-II	
High Land	Up to 0.3m	B.Aus, HYV Aus, Jute, Sugarcane, HYV Boro (overlap)	HYV Amon, L.T. Aman	
Medium High Land	0.3 - 0.9m	B.Aus, Jute, HYV Boro (overlap)	L.T.Aman	0.3m up to for HYV Boro
Medium Low Land	0.9 - 1.8m	Mixed Aus Aman, HYV Boro (overlap)	Mixed Aus Aman, B.Aman	1. Rate of rise & fall of flood level have to be gradual. 2. HYV Boro grown on these land types continue up to K-I and require that flood-depth do not exceed 0.3m up to end of May
Low Land	Greater than 1.8m	B. Aman, HYV Boro (overlap)	B.Aman	

Source: Agricultural Division of BWDB.

Table 2.6.3 Feature and Average Damages of House Types by Material of Construction in Urban Area

Type	Life Span (Year)	Roof	Wall	Floor	Average Damage Cost	
					Urban	Rural
Pucca (Permanent House)	50	Concrete	Brick	Cement/Mosaic	35,000	25,000
Semi-Pucca	20	C.I/Tile/Wood	Brick	Cement/Mosaic	20,000	15,000
Katcha	15	C.I/Tile/Wood	C.I.	Cement/Mosaic	4,000	2,000
Kacha	5	Thach/Straw /Bamboo	Mud	Mud / Bamboo / Wood	3,500	1,800
Jhupris (Temporary House)	1 or less	Thach/Leaves /Waste Materials, Polythene	Mud	Mud / Debris / Polythene	1,000	500

Source: 1. GOB and ADB Housing Sector Institutional Strengthening Project
2. The 1998 Flood : Impact on Environmental of Dhaka City, Department of Environment, IUCN-The World Conservation Union, Ministry of Environment and Forest, Bangladesh Country Office.

Note : 1. The average damage cost for urban area was up dated by the JICA Study Team
2. The average damage cost for rural area was estimated by the JICA Study Team

Table 2.6.4 Flood Damages by District(Zilla) in 1998 (1) - Houses, Death and Agricultural Sector (Crops :Area)

Name of Division	Name of Zila (District)	Total Area (ha)	No. of Affected Family	No. of Affected (Person)	Affected Homestead			No.of Death	Damages in Agricultural Sector (Area:ha)					
					Partially	Fully	Total		Rice	Jute	Vegetable	Trees	Other Crops	Total
Barisal	Barguna	183,200	0	0	0	0	0	0	2,137	0	400	0	563	3,100
	Barishal	279,000	146,888	646,452	32,012	75,016	107,028	14	76,983	0	1,074	1,200	5,025	84,282
	Bhola	340,300	14,400	254,707	8,157	33,403	41,560	1	7,169	0	0	100	500	7,769
	Jhalakati	75,800	0	0	0	0	0	0	13,087	0	880	50	1,640	15,657
	Patuakhali	320,500	0	0	0	0	0	0	4,893	0	0	50	0	4,943
	Pirozpur	130,800	74,300	445,802	21,243	23,889	45,132	4	23,953	0	485	600	904	25,942
	Subtotal- A	*1,329,600*	*235,588*	*1,346,961*	*61,412*	*132,308*	*193,720*	*19*	*128,222*	*0.00*	*2,839*	*2,000*	*8,632*	*141,693*
Chittagong	*Bandarban*	*448,000*	*0*	*1,805*	*0*	*500*	*500*	*0*	*10*	*0*	*6*	*0*	*11*	*27*
	Brahmanbaria	192,700	292,476	1,379,523	29,054	165,689	194,743	52	53,804	2,791	524	1,500	976	59,595
	Chandpur	170,400	300,354	1,393,113	30,145	173,432	203,577	40	50,969	629	546	1,500	1,016	54,660
	Chittagong	528,500	140,000	380,000	0	19,580	19,580	11	4,532	0	147	100	173	4,952
	Comilla	308,400	320,977	1,477,450	49,395	158,590	207,985	74	102,643	1,302	1,143	1,500	2,131	108,719
	Cox's Bazar	249,200	0	331,400	0	0	0	6	2,038	0	173	100	323	2,634
	Feni	92,800	118,000	470,000	13,861	31,176	45,037	0	4,109	0	294	50	499	4,952
	Khagrachari	269,900	0	0	0	0	0	0	66	0	29	0	54	149
	Lakshmipur	145,600	120,854	715,954	3,766	37,625	41,391	11	48,392	0	113	900	2,210	51,615
	Noakhali	360,100	86,350	531,533	0	15,830	15,830	0	15,742	0	683	50	1,565	18,040
	Rangamati	611,600	27,393	126,968	9,390	11,850	21,240	6	537	0	0	0	0	537
	Subtotal- B	*3,377,200*	*1,406,404*	*6,807,746*	*135,611*	*614,272*	*749,883*	*200*	*282,842*	*4,722*	*3,658*	*5,700*	*8,958*	*305,880*
Dhaka	Dhaka	146,400	455,176	3,038,867	31,069	20,713	51,782	125	22,144	1,477	3,237	1,100	8,037	35,995
	Faridpur	207,200	115,463	537,574	23,360	101,851	125,211	20	33,667	19	1,662	165	3,983	39,496
	Gazipur	174,100	0	593,350	3,572	9,154	12,726	20	24,634	814	1,165	300	2,171	29,084
	Gaopalganj	149,000	150,108	751,805	17,276	54,574	71,850	5	42,085	0	1,753	900	3,267	48,005
	Jamalpur	203,200	229,135	1,132,820	17,088	44,426	61,514	18	44,452	3,103	999	900	1,862	51,316
	Kishoreganj	268,900	154,586	721,167	17,234	79,380	96,614	33	22,465	478	1,390	900	2,743	27,976
	Madaripur	114,500	191,660	1,035,000	87,000	63,000	150,000	51	31,046	140	1,358	1,000	2,530	36,074
	Manikganj	137,800	86,635	776,923	25,692	48,133	73,825	50	38,022	305	1,290	1,100	3,263	43,980
	Munshiganj	95,500	112,793	594,249	7,078	63,212	70,290	46	9,502	274	887	800	1,654	13,117
	Mymensingh	436,200	263,550	1,057,320	4,510	23,749	28,259	29	49,792	1,260	1,546	900	2,881	56,379
	Narayanganj	*75,900*	*251,349*	*1,512,797*	*7,445*	*127,865*	*135,310*	*29*	*11,144*	*346*	*1,888*	*800*	*4,662*	*18,840*
	Narsingdi	114,100	135,106	715,755	4,633	36,829	41,462	15	38,541	1,260	3,006	1,100	7,892	51,799
	Netrokona	281,000	50,152	254,060	3,692	11,663	15,355	9	16,619	27	124	300	230	17,300
	Rajbari	111,900	36,801	178,061	3,285	9,870	13,155	16	26,300	564	1,745	800	3,250	32,659
	Shariatpur	118,200	153,351	787,621	73,786	82,159	155,945	64	33,413	1,893	841	735	1,567	38,449
	Sherpur	136,400	71,776	338,568	1,737	7,008	8,745	6	28,033	446	566	800	1,054	30,899
	Tangail	341,400	127,229	637,374	7,797	47,478	55,275	23	54,952	691	1,514	1,000	2,822	60,979
	Subtotal- C	*3,111,700*	*2,584,870*	*14,663,311*	*336,254*	*831,064*	*1,167,318*	*559*	*526,811*	*13,097*	*24,971*	*13,600*	*53,868*	*632,347*
Khulna	Bagerhat	396,000	49,011	268,790	0	11,504	11,504	8	24,369	0	325	300	606	25,600
	Chuadanga	*115,800*	*32,613*	*133,680*	*3,000*	*11,100*	*14,100*	*1*	*8,889*	*0*	*767*	*50*	*1,428*	*11,134*
	Jessore	256,700	0	0	0	0	0	0	2,808	0	70	0	129	3,007
	Jhenaidah	196,100	0	0	0	0	0	0	3,297	0	46	0	87	3,430
	Khulna	439,400	0	0	0	0	0	0	0	0	0	0	0	0
	Kushtia	162,000	116,028	555,601	24,261	125,449	149,710	15	18,080	7	1,372	600	2,556	22,615
	Magura	104,900	18,330	110,000	0	0	0	0	5,022	58	124	30	230	5,464
	Meherpur	71,600	0	0	0	0	0	0	4,229	0	363	100	675	5,367
	Naril	99,000	0	75,030	0	10,141	10,141	2	12,058	0	88	500	164	12,810
	Satkhira	385,800	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal- D	*2,227,300*	*215,982*	*1,143,101*	*27,261*	*158,194*	*185,455*	*26*	*78,752*	*65*	*3,155*	*1,580*	*5,875*	*89,427*
Rajshahi	Bogra	292,000	54,647	266,508	4,288	20,770	25,058	5	43,723	2,382	217	1,000	1,044	48,366
	Dinajpur	343,900	0	0	0	0	0	0	20,795	0	38	800	591	22,224
	Gaibandha	217,900	0	538,487	19,318	41,598	60,916	14	48,473	1,710	934	1,200	1,739	54,056
	Joypurhat	96,500	17,124	84,752	237	2,105	2,342	0	5,561	33	203	200	379	6,376
	Kurigram	229,600	86,260	359,784	21,170	58,387	79,557	9	37,853	1,139	839	1,000	1,082	41,913
	Lalmonirhat	124,200	10,555	46,763	840	6,117	6,957	0	5,625	0	37	200	68	5,930
	Naogaon	343,500	28,140	117,958	2,500	8,057	10,557	4	53,967	80	455	1,500	849	56,851
	Naotore	189,500	56,600	305,164	5,919	20,132	26,051	2	34,456	61	611	1,000	1,138	37,266
	Nawabganj	170,200	188,458	1,186,314	90,816	56,077	146,893	24	66,588	221	1,706	12,000	3,178	83,693
	Nilphamari	164,200	12,680	63,500	48,125	41,015	89,140	1	32,831	0	22	900	41	33,794
	Pabna	237,100	45,145	283,338	31,525	80,882	112,407	2	36,396	122	3,749	1,200	9,849	51,316
	Panchagarh	140,400	0	0	0	0	0	0	8,165	6	248	120	589	9,128
	Rajshahi	*240,700*	*73,564*	*341,698*	*33,021*	*45,771*	*78,792*	*10*	*9,290*	*0*	*908*	*800*	*1,692*	*12,690*
	Rangpur	230,800	9,877	44,053	2,402	686	3,088	1	39,428	45	166	1,000	310	40,949
	Serajganj	249,800	385,768	2,000,859	140,500	284,645	425,145	25	67,105	1,575	2,084	1,200	4,855	76,819
	Thakurgaon	180,900	0	0	0	0	0	0	14,176	0	552	600	1,103	16,431
	Subtotal- E	*3,451,200*	*968,818*	*5,639,178*	*400,661*	*666,242*	*1,066,903*	*97*	*524,432*	*7,374*	*12,769*	*24,720*	*28,507*	*597,802*
Sylhet	Habiganj	263,600	196,490	797,110	12,510	25,136	37,646	12	43,524	0	153	900	286	44,863
	Moulvi Bazar	279,900	33,867	161,760	1,959	12,331	14,290	0	6,239	0	1,007	300	1,014	8,560
	Sunamganj	367,000	69,943	279,678	4,093	7,320	11,413	5	23,599	0	408	700	760	25,467
	Sylhet	348,900	0	57,500	810	2,448	3,258	0	36,389	0	1,000	500	1,000	38,889
	Subtotal- F	*1,259,400*	*300,300*	*1,296,048*	*19,372*	*47,235*	*66,607*	*17*	*109,751*	*0*	*2,568*	*2,400*	*3,060*	*117,779*
Grand Total (A-F)		**14,756,400**	**5,711,962**	**30,896,345**	**980,571**	**2,449,315**	**3,429,886**	**918**	**1,650,810**	**25,258**	**49,960**	**50,000**	**108,900**	**1,884,928**

Source : Report on Bangladesh Flood 1998 (Chronology, Damages and Reponse), Management Information & Monitoring (MIM) Div. DMB

Table 2.6.5 Flood Damages by District(Zilla) in 1998 (2) - Agricultural Sector (Crops: Ton & Taka)

Name of Division	Name of Zila (District)	Damages in Agricultural Sector(Production Loss:Ton)						Damages in Agricultural Sector (Lac Taka)					
		Rice	Jute	Vegetable	Trees	Other Crops	Total	Rice	Jute	Vegetable	Trees	Other Crops	Total
Barisal	Barguna	0	0	4,000	0	2,815	6,815	299	0	160	0	113	572
	Barishal	114,589	0	10,740	6,000	25,125	156,454	17,467	0	430	300	1,005	19,202
	Bhola	11,599	0	0	500	2,500	14,599	1,841	0	0	25	100	1,966
	Jhalakati	19,442	0	8,800	250	8,200	36,692	2,946	0	352	13	328	3,639
	Patuakhali	0	0	0	250	0	250	685	0	0	13	0	698
	Pirozpur	32,175	0	4,850	3,000	4,520	44,545	5,095	0	194	150	181	5,620
	Subtotal- A	177,806	0	28,390	10,000	43,160	259,356	28,334	0	1,136	500	1,726	31,696
Chittagong	Bandarban	9	0	60	0	55	124	2	0	2	0	2	6
	Brahmanbaria	56,723	5,023	5,240	7,500	4,880	79,366	8,687	482	210	375	195	9,949
	Chandpur	57,636	1,132	5,460	7,500	5,080	76,808	8,808	109	218	375	203	9,714
	Chittagong	3,022	0	1,470	500	865	5,857	703	0	59	25	35	822
	Comilla	109,571	2,344	11,430	7,500	10,655	141,500	17,198	225	457	375	426	18,681
	Cox's Bazar	1,734	0	1,730	500	1,615	5,579	401	0	69	25	65	559
	Feni	3,248	0	2,940	250	2,495	8,933	649	0	118	13	100	879
	Khagrachari	31	0	290	0	270	591	10	0	12	0	11	32
	Lakshmipur	65,928	0	1,130	4,500	11,050	82,608	10,059	0	45	225	442	10,771
	Noakhali	20,144	0	6,830	250	7,825	35,049	3,176	0	273	13	313	3,775
	Rangamati	600	0	0	0	5	605	95	0	0	0	0	95
	Subtotal- B	318,646	8,499	36,580	28,500	44,795	437,019	49,788	816	1,463	1,425	1,792	55,284
Dhaka	Dhaka	24,936	2,659	32,370	5,500	40,185	105,650	3,784	255	1,295	275	1,607	7,217
	Faridpur	38,318	34	16,620	825	19,915	75,712	5,751	3	665	41	797	7,257
	Gazipur	31,331	1,465	11,650	1,500	10,855	56,801	4,819	141	466	75	434	5,935
	Gaopalganj	43,970	0	17,530	4,500	16,335	82,335	6,611	0	701	225	653	8,190
	Jamalpur	60,215	5,585	9,990	4,500	9,310	89,600	9,331	536	400	225	372	10,864
	Kishoreganj	27,491	860	13,900	4,500	13,715	60,467	4,325	83	556	225	548	5,736
	Madaripur	33,128	252	13,580	5,000	12,650	64,610	4,983	24	543	250	506	6,306
	Manikganj	39,349	549	12,900	5,500	16,315	74,613	5,920	53	516	275	653	7,417
	Munshiganj	9,502	493	8,870	4,000	8,270	31,136	1,425	47	355	200	331	2,358
	Mymensingh	68,455	2,268	15,460	4,500	14,405	105,088	10,639	218	618	225	576	12,277
	Narayenganj	12,691	623	18,880	4,000	23,310	59,504	1,918	60	755	200	932	3,866
	Narsingdi	55,496	2,268	30,060	5,500	39,460	132,784	8,521	218	1,202	275	1,578	11,794
	Netrokona	23,760	49	1,240	1,500	1,150	27,699	3,730	5	50	75	46	3,905
	Rajbari	35,154	1,015	17,450	4,000	16,250	73,869	5,288	97	698	200	650	6,934
	Shariatpur	35,595	3,407	8,410	3,675	7,835	58,922	5,386	327	336	184	313	6,547
	Sherpur	43,421	803	5,660	4,000	5,270	59,154	6,630	77	226	200	210	7,344
	Tangail	70,269	1,244	15,140	5,000	14,110	105,763	10,791	119	606	250	564	12,331
	Subtotal- C	653,081	23,575	249,710	68,000	269,340	1,263,706	99,853	2,263	9,988	3,400	10,772	126,277
Khulna	Bagerhat	37,740	0	3,250	1,500	3,030	45,520	5,661	0	130	75	121	5,987
	Chuadanga	14,903	0	7,670	250	7,140	29,963	2,236	0	307	13	286	2,840
	Jessore	4,280	0	700	0	645	5,625	642	0	28	0	26	696
	Jhenaidah	5,836	0	460	0	435	6,731	875	0	18	0	17	911
	Khulna	0	0	0	0	0	0	0	0	0	0	0	0
	Kushtia	27,581	13	13,720	3,000	12,780	57,094	4,137	1	549	150	511	5,348
	Magura	7,721	104	1,240	150	1,150	10,365	1,158	10	50	8	46	1,271
	Meherpur	6,749	0	3,630	500	3,375	14,254	1,012	0	145	25	135	1,318
	Naril	16,665	0	880	2,500	820	20,865	2,500	0	35	125	33	2,693
	Satkhira	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal- D	121,476	117	31,550	7,900	29,375	190,418	18,222	11	1,262	395	1,175	21,065
Rajshahi	Bogra	71,190	4,288	2,170	5,000	5,220	87,868	10,679	412	87	250	209	11,636
	Dinajpur	37,431	0	380	4,000	2,955	44,766	5,615	0	15	200	118	5,948
	Gaibandha	72,263	3,078	9,340	6,000	8,695	99,376	11,259	295	374	300	348	12,576
	Joypurhat	9,643	59	2,930	1,000	1,995	14,627	1,474	6	81	50	76	1,687
	Kurigram	52,716	2,050	8,390	5,000	5,410	73,566	8,460	197	336	250	216	9,459
	Lalmonirhat	9,848	0	370	1,000	340	11,558	1,499	0	15	50	14	1,577
	Naogaon	82,123	144	4,550	7,500	4,245	98,562	12,430	14	182	375	170	13,170
	Nagtore	44,190	110	6,110	5,000	5,690	61,100	6,649	11	244	250	228	7,381
	Nawabganj	100,192	398	17,060	60,000	15,890	193,540	15,029	38	682	3,000	636	19,385
	Nilphamari	58,226	0	220	4,500	205	63,151	8,745	0	9	225	8	8,987
	Pabna	42,674	220	37,490	6,000	49,245	135,629	6,417	21	1,500	300	1,970	10,207
	Panchagarh	14,566	11	2,480	600	2,945	20,601	2,189	1	99	30	118	2,437
	Rajshahi	13,471	0	9,080	4,000	8,460	35,011	2,021	0	363	200	338	2,922
	Rangpur	63,993	81	1,660	5,000	1,550	72,284	9,650	8	66	250	62	10,036
	Serajganj	85,418	2,835	20,840	6,000	24,275	139,368	13,133	272	834	300	971	15,510
	Thakurgaon	25,452	0	5,920	3,000	5,515	39,887	3,823	0	237	150	221	4,430
	Subtotal- E	783,396	13,273	128,090	123,600	142,535	1,190,894	119,070	1,274	5,124	6,180	5,701	137,349
Sylhet	Habiganj	48,686	0	1,530	4,500	1,430	56,146	7,392	0	61	225	57	7,735
	Moulvi Bazar	8,072	0	10,070	1,500	5,070	24,712	1,335	0	403	75	203	2,016
	Sunamganj	30,768	0	4,080	3,500	3,800	42,148	4,733	0	163	175	152	5,223
	Sylhet	39,971	0	10,000	2,500	5,000	57,471	6,336	0	400	125	200	7,061
	Subtotal- F	127,497	0	25,680	12,000	15,300	180,477	19,796	0	1,027	600	612	22,035
Grand Total (A-F)		2,181,901	45,464	500,000	250,000	544,505	3,521,870	335,061	4,364	20,000	12,500	21,779	393,704

Source : Report on Bangladesh Flood 1998 (Chronology, Damages and Reponse), Management Information & Monitoring (MIM) Div. DMB

Table 2.6.6 Flood Damages by District (Zilla) in 1998 (3)
- Agricultural Sector (Livestock: Affectecd and Died Heards)

Name of Division	Name of Zila (District)	Damages in Livestock Sector (Affected Heads)				Damages in Agricultural Sector (Died Heads)			
		Cattle	Goats	Poultry	Total	Cattle	Goats	Poultry	Total
Barishal	Barguna				0	57	23	34	114
	Barishal	10,000	0	30,000	40,000	63	57	603	723
	Bhola	1,190	638	9,021	10,849	90	196	3,510	3,796
	Pirozpur	31,150	16,750	57,000	104,900	52	126	22,155	22,333
	Sub total- A	42,340	17,388	96,021	155,749	262	402	26,302	26,966
Chittagong	Bandarban	2,399	655	890	3,944	16	20	420	456
	Brahmanbaria	251,528	155,730	1,130,696	1,537,954	118	105	5,487	5,710
	Chandpur	228,522	81,179	1,207,671	1,517,372	118	322	75,601	76,041
	Chittagong	624	1,160	5,768	7,552	0	0	5,078	5,078
	Comilla	462,996	169,687	1,395,557	2,028,240	397	340	7,128	7,865
	Cox's Bazar	1,027	70	0	1,097	56	94	738	888
	Feni	96,021	20,600	453,238	569,859	0	0	625	625
	Lakshmipur	43,870	14	150,000	193,884	12	14	86	112
	Noakhali	51,500	51,000	227,000	329,500	10	8	50	68
	Rangamati	0	0	0	0	0	0	0	0
	Sub total- B	1,138,487	480,095	4,570,820	6,189,402	727	903	95,213	96,843
Dhaka	Dhaka	30,752	10,232	743	41,727	57	13	743	813
	Faridpur	102,033	20,303	1,178	123,514	33	155	1,178	1,366
	Gazipur	4,914	940	4,574	10,428	62	25	4,574	4,661
	Gaopalganj	101,120	21,556	5,795	128,471	99	126	5,795	6,020
	Jamalpur	164,055	180,417	1,092	345,564	104	82	1,092	1,278
	Kishoreganj	200,000	100,000	49,500	349,500	307	164	49,500	49,971
	Madaripur	166,236	44,726	5,430	216,392	93	97	5,430	5,620
	Manikganj	632,325	89,905	8,668	730,898	210	141	8,668	9,019
	Munshiganj	50,340	10,478	75	60,893	22	5	75	102
	Mymensingh	87,859	16,561	7,021	111,441	56	129	7,021	7,206
	Narayanganj	3,354	10	1,515	4,879	32	52	1,515	1,599
	Narsingdi	7,773	3,001	4,743	15,517	86	185	4,743	5,014
	Netrokona	4,215	580	25,090	29,885	809	106	25,090	26,005
	Rajbari	50,553	2,503	2,295	55,351	13	58	2,295	2,366
	Shariatpur	2,044	233	455	2,732	59	43	455	557
	Sherpur	25,047	10,906	236	36,189	14	1	236	251
	Tangail	2,498	390	619	3,507	31	89	619	739
	Sub total- C	1,635,118	512,741	119,029	2,266,888	2,087	1,471	119,029	122,587
Khulna	Bagerhat	23,000	1,700	98,000	122,700	0	1	152	153
	Chuadanga	0	0	0	0	0	0	0	0
	Kushtia	65,501	4,270	188,938	258,709	3	2	271	276
	Magura	13,740	7,577	145,000	166,317	5	5	200	210
	Naril	40,500	350	140,000	180,850	0	1	170	171
	Sub total- D	142,741	13,897	571,938	728,576	8	9	793	810
Rajshahi	Bogra	230,554	145,800	894,276	1,270,630	13	17	103	133
	Dinajpur	180	70	700	950	31	72	9,012	9,115
	Gaibandha	272,265	220,009	972,299	1,464,573	56	124	2,048	2,228
	Joypurhat	59,251	108,549	287,149	454,949	8	11	111	130
	Kurigram	777,801	677,989	2,212,595	3,668,385	41	64	1,483	1,588
	Lalmonirhat	71,536	54,391	181,636	307,563	8	45	32	85
	Naogaon	118,000	80,470	564,472	762,942	2	142	142	286
	Naotore	63,587	6,400	187,341	257,328	2	80	148	230
	Nawabganj	98,060	19,462	507,590	625,112	22	305	12,006	12,333
	Nilphamari	31,977	19,350	309	51,636	2	83	309	394
	Pabna	68,126	59,467	406,772	534,365	14	66	301	381
	Panchaghar	300	1,000	500	1,800	150	500	500	1,150
	Rajshahi	255,117	103,160	138,678	496,955	7	3	83	93
	Rangpur	4,670	5,030	26,700	36,400	62	57	20,635	20,754
	Serajganj	564,035	259,625	2,131,584	2,955,244	190	2,736	3,398	6,324
	Thakurgaon	36,141	21,717	873,642	931,500	0	0	15,300	15,300
	Sub total- E	2,651,600	1,782,489	9,386,243	13,820,332	608	4,305	65,611	70,524
Sylhet	Habiganj	24,926	78	144,776	169,780	204	305	2,636	3,145
	Sylhet								
	Maulavibazar	11,825	4,460	49,300	65,585	38	39	1,518	1,595
	Sunamganj	55,815	37,470	318,990	412,275	102	122	1,990	2,214
	Sub total- F	92,566	42,008	513,066	647,640	344	466	6,144	6,954
	Grand Tot (A-F)	5,702,852	2,848,618	15,257,117	23,808,587	4,036	7,556	313,092	324,684

Source : Report on Bangladesh Flood 1998 (Chronology, Damages and Reponse), Management Information & Monitoring (MIM) Div. DMB

Table 2.6.7 Damage Rate of Buildings and Indoor Movabales by Inundation Depth

Inundation Depth	Structure of Building		Indoor Movables	
	Normal Flood	Flash Flood	Normal Flood	Flash Flood
0.00	0.000	0.000	0.000	0.000
0.01	0.000	0.010	0.000	0.010
0.06	0.000	0.017	0.000	0.018
0.11	0.000	0.024	0.000	0.026
0.16	0.000	0.031	0.000	0.034
0.21	0.000	0.038	0.000	0.042
0.26	0.000	0.045	0.000	0.050
0.30	0.000	0.052	0.000	0.058
0.35	0.000	0.059	0.000	0.066
0.40	0.000	0.066	0.000	0.074
0.45	0.000	0.073	0.000	0.082
0.50	0.000	0.080	0.000	0.090
0.55	0.013	0.085	0.020	0.101
0.60	0.026	0.090	0.040	0.112
0.65	0.039	0.095	0.060	0.123
0.70	0.052	0.100	0.080	0.134
0.75	0.065	0.105	0.100	0.145
0.80	0.078	0.110	0.120	0.156
0.85	0.091	0.115	0.140	0.167
0.90	0.104	0.120	0.160	0.178
0.95	0.117	0.125	0.180	0.189
1.00	0.130	0.130	0.200	0.200
1.05	0.135	0.135	0.207	0.207
1.10	0.140	0.140	0.214	0.214
1.15	0.145	0.145	0.221	0.221
1.20	0.150	0.150	0.228	0.228
1.25	0.155	0.155	0.235	0.235
1.30	0.160	0.160	0.242	0.242
1.35	0.165	0.165	0.249	0.249
1.40	0.170	0.170	0.256	0.256
1.45	0.175	0.175	0.263	0.263
1.50	0.180	0.180	0.270	0.270
1.55	0.189	0.189	0.294	0.294
1.60	0.198	0.198	0.318	0.318
1.65	0.207	0.207	0.342	0.342
1.70	0.216	0.216	0.366	0.366
1.75	0.225	0.225	0.390	0.390
1.80	0.234	0.234	0.414	0.414
1.85	0.243	0.243	0.438	0.438
1.90	0.252	0.252	0.462	0.462
1.95	0.261	0.261	0.486	0.486
2.00	0.270	0.270	0.510	0.510
2.05	0.327	0.327	0.559	0.559
2.10	0.384	0.384	0.608	0.608
2.15	0.441	0.441	0.657	0.657
2.20	0.498	0.498	0.706	0.706
2.25	0.555	0.555	0.755	0.755
2.30	0.612	0.612	0.804	0.804
2.35	0.669	0.669	0.853	0.853
2.40	0.726	0.726	0.902	0.902
2.45	0.783	0.783	0.951	0.951
2.50	0.840	0.840	1.000	1.000
3.00	1.000	1.000	1.000	1.000

Source: 1. The Eonomic Survey for Flood Damages, The Ministry of Land and Transportation, Japan
2. The "Residents-Hpusehold Survey" as a part of "Survey on Evacuation Condition and Awareness of Flood Victims" conucted by JICA Study Team during the first study in Bangladesh.

Table 2.6.8 Estimates of Flood Damages for Human Life, Fisheries and Livestock (1998)

I .Damages for Building		
Structure	Indoor Movables	Sub-Total
40,308	12,501	52,810

Source:"Report on Bangladesh Flood 1998", (Chronology, Damages and Response), compiled by Management & Monitoring (MIM) Div. Disater Management Bureau

Note : The assumptions for estimation are as follows;

(1) Structure		
1) Average Constructioon Cost of Bulding(Structure)	30,000	Taka
2) Average Depreciation Ratio	50	%
3) Average Unit Value of Building(Structure)	15,000	Taka
(2) Indoor Movables		
1) Average Value per Building (30% of Structure)	7,500	Taka

II. Damages for Livestock

No. of							
No. of				No. of			
Cattle	Goat	Poultry	Total	Cattle	Goat	Poultry	Total
5,702,852	2,848,618	15,257,117	23,808,587	4,036	7,556	313,092	324,684
Damages(La							
No. of Affected				No. of Death			
Cattle	Goat	Poultry	Sub-Total	Cattle	Goat	Poultry	Sub-Total
124,362	6,212	879	131,453	880	165	180	1,225

Source:The same as of Damages for Building

Note : The assumptions for estimation are as follows;

(1) Unit of Damages to Affected Livestocks(Taka)		
Cattle	Goat	Poultry
2,180.7	218.1	5.8
(2) Unit of Damages to Died Livestocks(Taka)		
Cattle	Goat	Poultry
21,807	2,181	58

(3) Inflation Rate (1998-2002) :	20	%
(4) No. of Household which lost cattle :	8	Household
(5) Total Damages of Cattle Lost :	726,900	Taka
(6) Damages per HH :	90,863	Taka
(7) No. of Cattle per Household :	5	Head
(8) Damages per Cattle :	18,173	Taka
(9) No. of Household which lost Poultry :	203	Household
(10) Total Damages of Poultry Lost :	194,885	Taka
(11) Damages per HH :	960	Taka
(12) No. of Poultry per Household :	20	Head
(13) Damages per Poultry :	48	Taka

III.Damages for Fisheries (Lac)

Private Sector (Ponds)	GOB Sector	Private Sector (Fish Firm)	Fishermen Families	Total
20,839	208	558	385	21,990

Source:The same as of Damages for Building

Note : Inflation Rate (1998-2002) : 20%

IV. Damages for Human Life

No. of Injuries	No. of Death	Total	Damages(Lac)		
			Injuries	Death	Total
9,180	918	10,098	83	2,282	2,364

Source:The same as of Damages for Building

Note : Assumptions for estimation are as follows:

(1) Rate of No. of Injuries to No. of Death :	10	
(2) Unit of Damages of Injuries :	902	Taka/Person
(3) Unit of Damages of Death :	248,545	Taka/Person
(4) Average Year of Death :	30	Year
(5) Average Annual Income Per Capita :	6,904	Taka
(6) Average Year to Work :	30	Year
(7) Average Income to Earned Per Capita :	207,121	Taka
(8) Inflation Rate (1998-2002) :	20	%

Table 2.6.9 Total Flood Damages by Category(1998)

Items	Unit	Building			Agriculture				Infrastructure					
										BWDB Project				
		Structure	Indoor Movables	Sub-Total	Crops	Livestock	Fisheries	Sub-Total	Road	Rehabilitation Cost	Emergency Requirement	Sub-Total	Telecommunication	Total
Flood Damages in 1998	Million Taka	40,308	12,501	52,810	55,119	123	2,199	57,440	9,901	8,114	1,036	9,151	281	19,333
Sructure of Flood Damages	%	25.9	8.0	33.9	35.4	0.1	1.4	36.9	6.4	5.2	0.7	5.9	0.2	12.4

Items	Unit	Damages to Human Lives			Total Damages of All Assets	Other Damages	Grand Total
		Injuries	Death	Sub-Total			
Flood Damages in 1998	Million Taka	8	228	236	129,582	25,916	155,735
Sructure of Flood Damages	%	0.0	0.1	0.2	83.2	16.6	100.0

Note : The flood damages in 1998 are considered to be 50 year of return period in this study.

Table 3.2.1 Summary of Status, Problems and Conceivable Solutions of Current FFWS (1/3)

Component	Present Status	Problems Encountered	Conceivable Solutions
1. Observation System	• 91 water level gauging stations (manual operation) • 56 rainfall gauging stations (manual operation) • 13 automatic water level gauging stations (float type) • 6 automatic rainfall gauging stations (tipping bucket type) • The interval of manual observation of water level is 3 hours (from 0600hrs. To 1800hrs). In case of abnormal flood situation, the interval is 1 hour. • The interval of manual observation of rainfall is 24 hours (the gauge is checked 0600hrs. Every morning). • The interval of automatic observation (water level and rainfall) is 1 hour (transmitted by means of telemeter system). • Eight automatic water level stations out of 13 are not operational as of February 2003. • Four automatic rainfall gauging stations out of 6 are not operational as of February 2003.	• Miss reading of manual gauging equipment • Default of observation and inconsistency of time of observation due to lack of gauge reader • Default of observation and inconsistency of time of observation due to lack of accessibility. • Insufficient clearance of rainfall gauging stations • Interruption of water level observation in the night time • Sifting of the location of staff gauges in accordance with the rising and lowering of water level • Insufficient operation and maintenance (O&M) of automatic gauging equipment • Being washed out or being buried due to the frequent river course sifting	• Strengthening of the reliability of observed hydrometeorological data and ensuring of regular observation by installation of automatic gauging equipment • Acquisition of sufficient clearance for rainfall gauging stations • Prevention of washing out or burying of water level gauging station by installations of stations at existing river structures • Strengthening of operation and maintenance system for gauging equipment
2. Data Communication System	• The manually observed hydrometeorological data is transmitted to FFWC through voice communication by means of HF-shortwave wireless. • Although there are 14 telemetric observatories, those data are not utilized for current FFWS. • Data of 5 observatories out of 14 are available at FFWC.	• Transmission of wrong information due to noise or miss operation of wireless equipment • Weak operation and maintenance system due to lack of budget and manpower • Unexpected interruption of public telecommunication lines of BRTA and BTTB	• Installation of telemeter system • Establishment of digital data transmission system from the manually operated hydrometeorological ganging stations • Strengthening of operation and maintenance system for telecommunication equipment • Establishment of own telecommunication lines

(to be continued)

Table 3.2.1 Summary of Status, Problems and Conceivable Solutions of Current FFWS (2/3)

Component	Present Status	Problems Encountered	Conceivable Solutions
3. Analysis System	• Quasi-2-dimensional hydrodynamic calculation by means of MIKE11-Supermodel2001 is conducted. • Time consumption for hydraulic calculation: 20 minutes • Generation of flood inundation maps by means of MIKE11-GIS • Time consumption for generation of inundation map: 60 minutes (including import of the result of hydraulic calculation) • Real-time simulation and forecast simulation (24, 48, 72 hours) are conducted. • Number of modeled branches: 272 • Number of link channels (virtual water ways): 227 • Weirs: 38, Culverts: 15 • Number of river cross sections input in the model: about 1,100 (Survey result of BWDB) • Number of sub-catchments for rainfall-runoff model: 114 • Number of rainfall gauging stations for input of rainfall-runoff model: 37 • Number of boundary conditions (water level, discharge) required for model run: 52 • Actual (observed) data of 23 stations out of 52 is available, and the boundary conditions for remaining 29 stations are estimated based on the observed data from nearby stations. • Number of water level forecast points: 54 (as of December 2002) • Evaluation of the forecasting accuracy at each forecast point is made every year after the end of flood season. • The model shows excellent accuracy in monsoon flood area, but the accuracy is sometimes poor in flash flood areas. • The update and expansion of analysis model are conducted by IWM (Institute of Water Modeling).	• Input errors due to manual input operation • Insufficient use of exiting telemetric data due to lack of interface • Insufficiency for short cycle flood phenomena such as flash flood due to one day interval of model simulation • There is a model requirement that future hydrological status of boundary stations should be input for future water level forecast, and those future boundary conditions are estimated by FFWC staff based on the experiences. • Low accuracy of generated flood inundation maps due to old topographic information • Impossibility of water level forecast more than 72 hours ahead due to limitation of hydrometeorological information in the upstream countries • Difficulties in staff training due to the complication of setting up and running of simulation model • Non-availability of manuals for operation of supermodel (Only the manuals for original software published by DHI are available.)	• Development of automatic input system • Update of topographic information • Strengthening of applicability for flash flooding by more frequent operation of the forecasting model • Extension of lead time and establishment of the method of accurate boundary forecast by collection of continuous hydrometeorological information of upstream countries • Training of staff for the ability of model operation and update and preparation of operation manual

(to be continued)

Table 3.2.1 Summary of Status, Problems and Conceivable Solutions of Current FFWS (3/3)

Component	Present Status	Problems Encountered	Conceivable Solutions
4. Warning Dissemination System	• Flood warning is issued by FFWC based on the monitoring and simulation. • Flood bulletin is issued by FFWC in daily basis in monsoon (May – October). • FFWC sends flood bulletin or warning to office of PM, local government authorities, the media, NGOs, and donors by means of telephone, facsimile, e-mail and so on. • Flood information is also disseminated through FFWC's web page. • The types of information are, observed rainfall, observed water level, water level forecast (24 and 48 hours ahead), flood inundation map and so on. • Observed water level in m PWD and the gap between observed water level and Danger Level (DL) is reported. • Officially, the flood warning issued by FFWC is transmitted to local inhabitants through Disaster Management Committee (DMC) of each District, Upazilla, Union etc.	• Flood warning information does not reach local inhabitants (there are missing links between Upazilla and Union levels). • There is no enough time for local inhabitants to take necessary actions due to insufficient lead time. • People do not understand the meaning of flood warning due to unclearness of warning messages. • The information on the safety of river related structures is not included in the warning messages. • The recipients do not understand the accuracy or reliability of forecasted water level because the accuracy and reliability are not mentioned in the flood warning issued by FFWC.	• Establishment of reliable dissemination route from FFWC to local inhabitants • Definition (clarification) of responsibilities of concerned agencies in the flood situations • Extension of the lead time • Clarification of the contents of flood warning messages (visualization by means of flood hazard maps in local level, review of danger levels, etc.) • Indication of current and forecasted safety level of major river structures • Clarification of the forecast accuracy by forecast point and making the accuracy official
5. Response System	• Officially, the response activity is headed and supported by DMC of each local authority. • Dissimilar to cyclone response, there are no organizations for response or flood fighting, inhabitants therefore take actions based on their own experiences and judgements. • In case of abnormal flood situation, inhabitants evacuate on highways, flood dikes, or other relevant buildings.	• There is no organization for flood response and flood fighting. • There is no flood evacuation shelter, while totally 1,841 cyclone shelters are effectively used. • People do not want to evacuate due to lack of security of their houses and properties. • Lack of transportation for flood evacuation • Bad environmental conditions for living at evacuated places • Lack of knowledge of inhabitants for flood response and flood fighting • Lack of space for the evacuation of livestock • Lack of guidelines for the mitigation of flood damages • Lack of guidelines for prevention of damage for river structures	• Establishment of organizations for flood response and flood fighting (effective assistance of DMC, NGOs, etc.) • Establishment of flood shelters (flood evacuation centers) • Ensuring of security or houses and properties of local inhabitants • Ensuring of transportation in flood situation • Management and improvement of environment at the places where people evacuate • Strengthening of the people's awareness on flood response and flood fighting • Ensuring of space for evacuation of livestock and agricultural products • Preparation of guidelines for prevention of flood damages for river structures

Table 3.3.1 Existing Conditions of FFWC Hydrometeorological Network

	Manual Rainfall	Manual Water Level	Automatic Rainfall [3]	Automatic Water Level [3]
Number of Stations Survey	67	88 [1]	15	17
Number of Stations:				
• Operational	64	87	5	5
• Poor Site Conditions Possibly Affecting Data Accuracy	32	3	1	0
• Instruments In Good Condition	62	80	5	8
Method of Real-Time Data Transfer [2]:				
• Wireless	39	61	NA	NA
• Telephone	2	13	NA	NA

Note: (1) Three stations from list provided by FFWC (91 sites) were not surveyed in detail as they did not operate in dry season (during inspections).

(2) Real time data sent by wireless or telephone. Data also later sent by post to FFWC/BWDB.

(3) Excludes telemetry stations (see Table 3.5.2 for these details).

NA Not Applicable as continuous recorder charts collected and sent to BWDB.

Table 3.3.2 Status of Existing Automatic Telemetry Network

Station Name	Data Type	Current Status Recorder Equipment	Current Status Telemetry Equipment	Comments
Millbarak (Dhaka Region) (1)	Water Level	WL Not Operating	Not Operating	Station being moved (Feb, 2003).
Narayanganj (Dhaka Region) (1)	Water Level Rainfall	WL Operating RF Operating	Operating Operating	-
Tongi (Dhaka (Dhaka Region) (1)	Water Level	WL Operating	Operating	-
Rekabi Bazaar (Dhaka Region) (1)	Water Level	WL Operating	Operating	-
Mirpur (Dhaka Region) (1)	Water Level	WL Operating	Operating	-
Nayerhat (Dhaka Region) (1)	Water Level	WL Operating	Operating	-
Zakiganj (Sylhet Region) (1)	Water Level Rainfall	WL Operating RF Operating	Not Operating	Telecommunication equipment removed, WL and RF recorders checked by FFWC and operational at that time.
Pankha (Padma R. Border) (1)	Water Level Rainfall	WL Not Operating RF Not Operating	Not Operating	Telecommunication equipment removed, WL recorder originally destroyed in 1998 flood. New station now totally silted, no possibility of becoming operational. RF recorder removed.
Jatrapur 1 (Jamuna R. Border) (1)	Water Level (Low Flow)	WL Not Operating	Not Operating	Telecommunication equipment removed, WL recorder destroyed by flood, no possibility of future operation.
Jatrapur 2 (1)	Water Level (High Flow) Rainfall	WL Not Operating RF Not Operating		WL recorder badly damaged by flood, local erosion a serious problem, unlikely to become operational. RF recorder removed.
Shaistaganj (Sylhet Region) (2)	Water Level	WL Operating	Not Operating	Antenna badly directed, telecommunication problem, WL recorder checked by FFWC and operational at that time.
Manu (Sylhet Region) (3)	Water Level Rainfall	WL Not Operating RF Operating	Operating	Intermittent telecommunication problems, currently under investigation. WL recorder operating intermittently, RF recorder operating.
Dhalai (Sylhet Region) (2)	Water Level	WL Operating	Not Operating	Telecommunication equipment removed, WL recorder checked by FFWC and operational at that time.
Sherpur (Sylhet Region) (2)	Water Level	WL Not Operating	Not Operating	Telecommunication equipment removed, WL recorder destroyed in 1992 flood.
Kamalganj (Sylhet Region) (3)	Rainfall	RF Not Operating	Not Operating	Telecommunication equipment removed.

Note: (1) Installed in 1996 by BWDB (2) Installed around 1985 (3) Installed around 1985, upgraded in 1996

Table 3.4.1 Information Collected by FFWC

Big Item	Detail Item	Communication tool to FFWC	Received from	Remarks
Rainfall	Cloud information of Rader	BMD Data network	BMD	
	Rainfall information of BMD Gauging Station	BMD Data network	BMD	
	India Rainfall data	Internet	India home page	
		BMD Data network	BMD	
	BWDB Rainfall (For FFWS)	Wireless Radio Telephone Mobile phone		Every 3hours (Flood season)
	BWDB Rainfall (For Telemeter)	Telemeter		Hourly
	BWDB Rainfall (For analyzing)	Post mail		Monthly
Water-level	India Water-level data	BMD Data network Telex(Back Up)	BMD	When W.L reaches 50 cm below D.L
	India Water-level data (near boarder)	Wireless Radio	India wireless gauging station	When W.L reaches 50 cm below D.L
	BWDB Water-level (For FFWS)	Wireless Radio Telephone Mobile phone		Every 3hours (Flood season)
	BWDB Water-level (For Telemeter)	Telemeter		Hourly
	BWDB Water-level (For analyzing)	Post mail		Monthly
Satellite Weather information	NOAA	Satellite		
	GMS, WAFS, NOAA	BMD Data network	BMD	

Table 3.4.2 Information Disseminated by FFWC

Item	Communication Tool for Dissemination	Disseminating Agency
Flood Bulletin	Fax and E-Mail	Television Newspaper Radio Internet EOC BWDB Divisional Office NGO Relative Governmental organizations

Table 3.4.3 Detailed Condition of Telemeter System (1/2)

No	Station Name	Condition	Cause	Others
Dhaka Area				
Control Center		**Working**		
Repeater	Ramna	**Working**		
1	Tongi	**Working**		
2	Mirpur	**Working**		At Survey, Gauging Station was not working for the reason of destroyed solar panel. But, solar panel was repaired later .
3	Rikabibazar	**Working**		
4	Millbarack	Under Shifting	The gauging house is shifting to another place.	The Place where the station was installed is planned on the new road.
5	Nayarhat	**Working**		
6	Narayanganj	**Working**		Battery water was shortage.
Jatrapur Area				
Repeater	Kurigram	Not Working	Receiving data from Dhaka is good. But, sending data to Dhaka is not good. There is doubt of BTTB Line's reliability.	BWDB requested BTTB many times to check and recover the line. But, BTTB have never replied.
7	Jatrapur	Not Working	Water Level Gauging Pipe was destroyed by flood (2002). Telecommunication equipment was removed.	The river structure was also destroyed by flood. More strong structure should be designed.
Panka Area				
Repeater	Nawabganj	Not Working	Equipment was flooded (1998), and has not been repaired.	
8	Panka	Not Working	Gauging station has not been operated because the water flow of branch river moved. Telecommunication equipment was removed.	Gauging Station was installed not at Padma river but at branch river(1995).

Table 3.4.3 Detailed Condition of Telemeter System (2/2)

No	Station Name	Condition	Cause	Others
Maulvibazar Area				
Repeater	Maulvibazar	**Working**		For these two years, the connection between BWDB repeater equipment and BTTB Multiple equipment was disconnected few times.
9	Sherpur	No Working	Equipment has had many troubles because the equipment was old type installed in 1985. Equipment was removed.	Old type equipment cannot be repaired, because spare parts are out of stock and old type parts are not available in Japan.
10	Shayestaganj	No Working	The direction of antenna is not for repeater station.	We heard the equipment is good.
11	Dhalai	No Working (Equipment is old and removed)	Equipment has had many troubles because the equipment was old type installed in 1985. Equipment was removed.	Old type equipment cannot be repaired, because spare parts are out of stock and old type parts are not available in Japan.
12	Manu	Partially Working (one problem)	Transmitting Rainfall data is good, but transmitting Water-level is not good.	The problem is now under investigation.
13	Kamalganji	No Working	Equipment has had many troubles because the equipment was old type installed in 1985. Equipment was removed.	Old type equipment cannot be repaired, because spare parts are out of stock and old type parts are not available in Japan.
Bianibazar Area				
Repeater	Bianibazar	No Working (Bad connection between BTTB and BRTA)	The connection between BRTA and BTTB has been bad (1995). BWDB has not used the relay line and Zakiganji gauging station since 1995. The BWDB equipment was removed to a small room and gathers rust.	The data from gauging station was received at BRTA repeater station first, and send to BTTB repeater station. For the first, the connection between BRTA and BTTB was good. But few days later, the connection was bad. After Connection was bad, BWDB requested BTTB and BRTA to check and recover the line many times. But, BTTB and BRTA have never replied.
14	Zakiganji	No Working	Condition of Equipment is good. BWDB has not used the gauging station because the repeater line has been bad.	

Table 3.5.1 NAM Catchments Incorporated in the Supermodel 2001

Sl. No.	Catchment ID	Area (km^2)	Sl. No.	Catchment ID	Area (km^2)	Sl. No.	Catchment ID	Area (km^2)
1	NC-1	1,211	41	NW-16	562	81	NE-19	502
2	NC-2	801	42	NW-17	542	82	NE-20	416
3	NC-3	373	43	NW-19	300	83	NE-21	572
4	NC-4A	282	44	NW-21	1,126	84	NE-23	469
5	NC-4	767	45	NW-22	575	85	NE-24	747
6	NC-5	374	46	NW-23	583	86	NE-25	414
7	NC-6	845	47	NW-24	1,479	87	NE-22	231
8	NC-7	815	48	NW-26	1,351	88	NE-26	1,507
9	NC-8	1,374	49	NW-27	1,039	89	NE-27	483
10	NC-9	1,008	50	NW-28	379	90	NE-28	202
11	NC-10	661	51	NW-30	1,156	91	NE-29	814
12	NC-11	713	52	NW-31	728	92	NE-30	1,743
13	NC-12	968	53	NW-32U	1,527	93	NE-31	144
14	NC-13	802	54	NW-32L	2,355	94	NE-32	1,530
15	NC-14	369	55	NW-33	984	95	NE-33	391
16	NC-15	275	56	NW-34	575	96	NEX-01	1,003
17	NC-16	1,502	57	NW-35	410	97	NEX-01A	340
18	NC-17	342	58	NW-38	2,527	98	NEX-02	840
19	NC-18	515	59	NW-39	1,686	99	NEX-06	537
20	CJAM-1	1,886	60	NW-40	1,923	100	NEX-11	609
21	CJAM-2	1,333	61	NE-01	915	101	NEX-19A	456
22	CJAM-3	840	62	NE-02	1,320	102	NEX-48	2,241
23	CGAN-1	1,037	63	NE-03	406	103	NEX-03A	771
24	CPAD-1	1,553	64	NE-05	392	104	NEX-40	1,186
25	CMEG-1	2,130	65	NE-04	502	105	GM_SW1	4,547
26	NC-19	890	66	NE-13A	241	106	GM_SW2	1,567
27	CGAN-2	2,013	67	NE-11	636	107	GM_SW3	3,033
28	NW-1	1,186	68	NE-12	678	108	GM_SC1	2,184
29	NW-2	1,455	69	NE-07	1,010	109	GM_SC2	1,435
30	NW-3	527	70	NE-08	1,022	110	GM_SC3	2,359
31	NW-4	749	71	NE-06	617	111	GM_SC4	1,883
32	NW-5	535	72	NE-09	425	112	GM_SE1	1,597
33	NW-7	395	73	NE-10	640	113	GM_SE2	2,148
34	NW-10	1,639	74	NE-13	339	114	GM_SW6	2,361
35	NW-11	1,159	75	NE-15	400			
36	NW-12U	852	76	NE-16	443			
37	NW-12L	633	77	NE-16A	257			
38	NW-13	528	78	NE-14	761			
39	NW-14	1,378	79	NE-17	721			
40	NW-15	374	80	NE-18	682			

Table 3.5.2 Summary of Flood Forecasting Errors Period 2001-2003

Location	Average Error (m) Exceeded For Given Percentage of Time					Av. MAE (m)	Av. Max. (m)
	50%	40%	30%	20%	10%		
Flash Flood Areas (6 Stations)							
24hr	0.15	0.20	0.26	0.38	0.56	0.25	1.66
48hr	0.29	0.38	0.51	0.66	0.93	0.43	2.29
72hr	0.36	0.49	0.66	0.89	1.20	0.55	2.70
Monsoonal Flood Areas (26 Stations)							
24hr	0.05	0.06	0.08	0.11	0.16	0.07	0.49
48hr	0.09	0.12	0.15	0.20	0.28	0.13	0.74
72hr	0.14	0.18	0.23	0.29	0.41	0.20	1.05

Table 3.5.3 Summary of Boundary Estimation Errors Period 2002-2003

Location	Average Error (m) Exceeded For Given Percentage of Time					Av. MAE (m)	Av. Max. (m)
	50%	40%	30%	20%	10%		
Flash Flood Areas (12 Stations)							
24hr	0.18	0.24	0.31	0.40	0.61	0.29	1.60
48hr	0.27	0.35	0.47	0.64	0.90	0.42	2.04
72hr	0.34	0.44	0.59	0.82	1.11	0.51	2.21
Monsoonal Flood Areas (4 Stations)							
24hr	0.06	0.07	0.09	0.13	0.20	0.09	0.63
48hr	0.12	0.16	0.20	0.25	0.36	0.17	0.89
72hr	0.19	0.24	0.29	0.39	0.52	0.25	1.03
Tidal Flood Areas (5 Stations)							
24hr	0.14	0.19	0.24	0.31	0.43	0.21	0.95
48hr	0.20	0.26	0.31	0.40	0.52	0.25	0.97
72hr	0.25	0.30	0.37	0.46	0.60	0.30	1.34

Table 3.5.4 Maximum Changes in Observed Flood Levels at Water Level Stations

Year	Maximum Annual Change in Water Level (m) When Flood Level Within 1m of Danger Level																
	Bhairab Bazar (1)	Sylhet (2)		Kanaighat (2)		Monu Rly Bridge (2)		Durgapur (2)		Hardinge Bridge (1)		Pankha (1)		Noonkhawa (1)		Sirajganj (1)	
	24hr	3hr	24hr	3hr	24hr	3hr	24hr	3hr	24hr	3hr	24hr	3hr	24hr	3hr	24hr	3hr	24hr
1980	0.10	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1981	0.13	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1982	0.15	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1983	0.19	NR	0.38	1.14	1.79	NR	NR	1.00	2.14	0.05	0.19	NR	NR	NR	NR	0.07	0.30
1984	0.29	0.31	0.65	0.46	2.08	NF	NF	0.95	2.30	**0.06**	0.26	NR	NR	NR	NR	0.08	0.58
1985	0.14	0.10	0.43	NF	NR	NF	NF	1.25	2.00	**0.06**	**0.41**	NR	NR	NR	NR	**0.10**	0.40
1986	0.20	0.30	0.94	0.73	1.61	1.00	3.00	1.05	1.87	0.04	0.30	NR	NR	NR	NR	0.03	0.25
1987	0.18	0.17	0.87	NF	NR	0.35	3.89	1.20	1.74	0.04	0.24	NR	NR	NR	NR	0.09	0.32
1988	**0.35**	0.21	1.40	NF	NR	NF	NF	1.30	2.83	0.04	0.17	NR	NR	NR	NR	0.07	0.40
1989	0.18	0.28	0.74	NF	NR	0.78	1.88	1.10	1.70	0.02	0.05	NR	NR	NR	NR	**0.10**	0.41
1990	0.22	**0.38**	0.60	NF	0.79	NF	3.25	1.50	**3.41**	0.03	0.21	NR	NR	NR	0.30	0.09	0.36
1991	0.20	0.17	0.67	0.90	**4.88**	0.85	2.02	1.49	1.69	0.02	0.14	0.04	0.25	0.05	0.31	0.05	0.45
1992	0.08	0.17	0.53	0.77	4.24	2.08	3.45	1.09	2.43	0.03	0.25	0.02	0.22	0.05	0.44	0.06	0.35
1993	NF	0.30	1.02	0.96	3.45	**2.18**	3.16	0.76	1.60	0.01	0.09	0.04	0.25	**0.12**	**0.59**	**0.10**	0.49
1994	NF	0.30	0.84	0.46	1.45	1.98	3.70	0.78	1.86	0.05	0.20	0.13	0.36	NF	NF	0.02	0.18
1995	NF	0.35	1.30	0.70	2.31	1.45	**4.77**	1.58	2.06	NR	0.40	0.06	0.58	0.06	0.38	NR	NR
1996	NR	NR	NR	0.40	2.75	1.28	3.85	0.85	2.28	0.05	NR	0.04	0.32	0.06	0.46	NR	NR
1997	0.21	**0.38**	0.91	**1.79**	2.20	0.98	3.72	**1.60**	1.16	0.03	0.24	**0.20**	**0.85**	0.06	0.42	0.07	0.35
1998	0.21	0.08	0.53	0.35	3.72	1.70	4.56	1.00	0.63	0.04	0.20	0.05	0.34	0.05	0.35	0.03	0.26
1999	0.30	0.20	0.61	0.99	1.73	1.45	3.30	0.89	0.97	0.04	0.30	0.07	0.55	0.06	0.48	0.05	**0.64**
2000	0.15	0.21	1.05	0.58	1.91	1.45	2.97	0.90	1.49	0.04	0.31	0.07	0.47	0.06	0.50	0.08	0.59
2001	0.15	0.18	**1.81**	0.49	2.88	0.78	2.13	0.80	1.39	0.03	0.23	0.08	0.44	0.00	0.08	0.05	0.34
2002	0.20	0.08	0.46	0.43	1.12	1.92	3.70	1.12	1.83	0.02	0.19	0.05	0.35	0.06	0.52	0.04	0.38

Note: NR No Record NF No water level within 1m of Danger Level during year

(1) Subject to Flash Flooding (2) Subject to Monsoonal Flooding

Table 3.8.1 Flood Sector Institutional Relation Matrix (1/7)

Parameters	National Water Resources Council (NWRC)	National Economic Council (NEC)	Ministry of Planning and Finance	Ministry of Water Resources	Ministry of Education
Policy making	Approves water sector national policy	Prepares national level development policy framework	Helps NEC in national development policy formulation	Prepares water resources management and development policy	X
Laws and regulation	Approves water sector laws and regulations	X	Prepares regulations on implementation, expenditure, and procurement	Prepares water sector laws and regulations, and procurement procedures	X
Strategic planning	Directive roles in water sector planning	Prepares long term national development plan		Prepares national level sector planning	X
Implementation	X	Approval of all major projects	Acts as the clearing house of all projects	Small scale project approval, sector coordination	X
Monitoring and Information Management	X	Project implementation monitoring on national basis	Project implementation monitoring, expenditure control, implementation evaluation	Expenditure control, project execution monitoring	X
Awareness raising	X	X	X	Prepares guidelines	Disaster (including flood) management is incorporated in the curriculum
Research, education and training	X	X	X	Prepares guidelines	X
Resource mobilization	X	Makes investment policy decision	Resource allocation, delegation of financial power	Budget recommendation	X

Table 3.8.1 Flood Sector Institutional Relation Matrix (2/7)

Parameters	Water Resources Planning Organization (WARPO)	Bangladesh Water Development Board (BWDB)	Hydrology Services of BWDB	Flood Forecasting and Warning Center (FFWC)	Joint Rivers Commission (JRC)
Policy making	Acts as secretariat of NWRC	Operational policy preparation	X	X	X
Laws and regulation	X	Design criteria, internal rules of procedures	X	X	X
Strategic planning	Prepares national water resources program and regional planning	Project based planning and design	X	X	X
Implementation	X	Apex implementation body Procurement of services	Relevant project implementation Hydrological data acquisition, processing, archiving and dissemination	Real time data collection, data processing, and issue flood warning	Deals with trans boundary water issues, carry out negotiations, maintain liaison
Monitoring and Information Management	Water resources need assessment	Project monitoring, Water resources monitoring	Hydrological monitoring	Self assessment	Monitors trans boundary water issues
Awareness raising	X	Formation of water management groups Small scale programs	Through FFWC	Small scale program	X
Research, education and training	Undertakes research projects	Arrange in-house training	Specialized training	Undertakes specific research	X
Resource mobilization	X	Project wise fund allocation Collection of water levies	X	X	X

Table 3.8.1 Flood Sector Institutional Relation Matrix (3/7)

Parameters	Institute of Water Modeling (IWM)	Center for Environment and GIS (CEGIS)	Disaster Management Bureau (DMB)	Directorate of Relief and Rehabilitation	Emergency Operation Center (EOC)
Policy making	X	X	X	X	X
Laws and regulation	X	X	X	X	X
Strategic planning	X	X	Planning on disaster management, preparation of guidelines, Preparation of Local Disaster Action Plan	Planning on relief and rehabilitation	X
Implementation	Work as out sourced body	Work as out sourced body	Pre-disaster preparedness	Apex body for relief distribution and post disaster rehabilitation	Information dissemination Emergency coordination Relief requirement information collection and compilation
Monitoring and Information Management	In-house monitoring	In-house monitoring	Disaster monitoring	Monitors relief and rehabilitation operation	Emergency situation monitoring Relief monitoring
Awareness raising	X	X	Comprehensive program on awareness raising Disaster management training Curriculum preparation	X	X
Research, education and training	Various research projects	Various research projects	Relevant research	X	X
Resource mobilization	Self generating	Self generating	X	X	X

Table 3.8.1 Flood Sector Institutional Relation Matrix (4/7)

Parameters	District Administration	Upa Zilla Administration	Union Council	NGO	Ministry of Health
Policy making	X	X	X	X	Prepares health related development policy
Laws and regulation	X	X	X	X	Prepares health related laws and regulations
Strategic planning	X	X	Union level planning	Internal planning	Health sector planning
Implementation	Coordination of district level development activities Warning dissemination and evacuation coordination Law and order Disaster management Relief Coordination	Warning dissemination and evacuation management body Coordination of Upa-Zilla level development activities Act as a link between District and Union Law and order Disaster management Relief corodination	Front line warning dissemination body; and major evacuation implementation body Small scale infra structure development Relief distribution Law and order through community police Birth and death registration	Works in warning dissemination evacuation Relief distribution Rehabilitation program	Health sector coordination including emergency field hospitals and other related health services
Monitoring and Information Management	Disaster monitoring Relief situation monitoring Law and order monitoring	Disaster monitoring Relief situation monitoring Law and order monitoring	Disaster monitoring Relief situation monitoring Law and order monitoring	Field level monitoring	Health situation monitoring
Awareness raising	Through District Disaster Management Committee (DMC)	Through Upa-Zilla Disaster Management Committee (DMC)	Through Union Disaster Management Committee (DMC)	Major force in awareness raising	Health related awareness building
Research, education and training	X	X	X	Extensive research	Relevant research
Resource mobilization	X	X	Can retain holding tax	Self generating	Budget recommendation

Table 3.8.1 Flood Sector Institutional Relation Matrix (5/7)

Parameters	Space Research & Remote Sensing Organization (SPARRSO)	Bangladesh Meteorology Department (BMD)	Telecommunication Service Providers	Research and Education Institutions	Media
Policy making	X	X	X	X	X
Laws and regulation	X	X	X	X	X
Strategic planning	X	X	X	X	X
Implementation	Provides data to BWDB (satellite image) Satellite image based damage assessment	Provides data to BWDB (rainfall, radar image) Providing weather forecast	Telecommunication licensing Ensures data and information communication Maintaining communication service during disaster Arrange temporary communication channel during disaster	Research on each step of planning and implementation	Plays major role on flood warning dissemination
Monitoring and Information Management	Indirect monitoring	X	X	X	Informal monitoring
Awareness raising	X	X	X	Indirect awareness building	Principal player of public awareness building
Research, education and training	Relevant research	Relevant research	X	Human resource development	X
Resource mobilization	X	X	X	Partly self generated	Self generating

Table 3.8.1 Flood Sector Institutional Relation Matrix (6/7)

Parameters	Department of Public Health Engineering (DPHE)	Local Government Engineering Department (LGED)	Bangladesh Inland Water Transport Authority (BIWTA)	Roads and Highways Department (RHD) / Bangladesh Railway (BR)	Private Sector
Policy making	X	X	X	X	X
Laws and regulation	X	X	X	X	X
Strategic planning	Planning on water supply, sanitation and urban drainage	Rural infrastructure planning	River navigation management related planning	Transport planning	X
Implementation	Implementation of nationwide water supply, sanitation and urban drainage projects except Dhaka and Chittagong Emergency disaster response	Flood proofing and small scale flood protection works (up to 1000 ha) Rural infrastructure implementation	Navigation route maintenance River dredging Ferry terminal and inland port operation	Construction and maintenance of roads, highways, small ferry terminals, bridges	Discrete participation in various steps, but mostly as out sourced contractor
Monitoring and Information Management	Sector monitoring	Sector monitoring	X	Sector monitoring	X
Awareness raising	Health related awareness raising	Own program	X	X	X
Research, education and training	X	X	X	X	X
Resource mobilization	X	X	X	X	X

Table 3.8.1 Flood Sector Institutional Relation Matrix (7/7)

Parameters	Red Cross Society	Armed Forces Services	Fire Service and Civil Defense	Police services	Department of Environment (DOE)
Policy making	X	X	X	X	X
Laws and regulation	X	X	X	X	X
Strategic planning	Provides input for government planning	X	X	X	Environmental sector planning
Implementation	Disaster assessment, relief distribution, Cyclone warning dissemination, cyclone evacuation,	Helps civil administration for emergency flood fighting, rescue, and evacuation Relief distribution	Emergency flood fighting, rescue, and evacuation Relief distribution	Emergency flood fighting, rescue, and evacuation Relief distribution Maintain law and order	Environmental degradation prevention Improvement of environment Assessment of environmental impact due to flood
Monitoring and Information Management	Disaster monitoring	X	X	X	Monitoring environmental issues
Awareness raising	Extensive public awareness program	X	X	X	Own program
Research, education and training	Training for CPP volunteers	X	X	X	Own program
Resource mobilization	National and international fund mobilization	X	X	X	X

Table 3.8.2 Comparative Analysis of Organizational Setup of Hydrology in Relation to FFWS

Components of FFWS	Decentralized System	Centralized System
1. Observation and data collection	a. Better monitoring of gauge readers b. Quick maintenance response for gauge stations	a. Difficult to closely monitor gauge readers. b. Inefficient maintenance response
2. Data transmission and communication	a. Shorter transmission path to regional office, so less prone to disruption b. Quick maintenance response for wireless or other equipment	a. Longer transmission path, so more chance for disruption b. Inefficient maintenance response
3. Processing and flood forecasting	a. Possible to use regional model b. Local context can be taken into consideration easily c. More qualified staff for model operation will be required d. More equipment will be required	a. Super model is used b. Difficult to taken into consideration the local context c. Existing staff is sufficient d. Existing equipment is sufficient
4. Warning dissemination	a. Better interaction for warning dissemination b. Possible to involve with local administration c. Easier to have warning feedback mechanism	a. Less interaction for warning dissemination b. Not possible to involve with local administrative c. Difficult to have warning feedback mechanism
5. Response system	a. Closer monitoring of evacuation situation b. Better involvement with response system for river structures	a. Inefficient monitoring of evacuation b. Difficult to involve with response system for river structure

Table 4.2.1 Result of the Assessment of the Importance of Gauging Stations

Sl. No.	ID*	Name	Scores by Criteria*				Total Score	Sl. No.	ID*	Name	Scores by Criteria*				Total Score	Sl. No.	ID*	Name	Scores by Criteria*				Total Score
			C-1	C-2	C-3	C-4					C-1	C-2	C-3	C-4					C-1	C-2	C-3	C-4	
1	**1**	**Kurigram**	**2**	**3**	**4**	**2**	***11***	32	37	Rohanpur	1	3	0	1	*5*	63	74	Chandpur	3	2	0	1	*6*
2	**2**	**Dalia**	**3**	**3**	**0**	**4**	***10***	33	38	Mohadevpur	1	2	3	1	*7*	**64**	**75**	**Sarighat**	**5**	**2**	**5**	**4**	***16***
3	3	Kaunia	1	3	4	1	*9*	34	39	Chak Rahimpur	1	3	0	1	*5*	65	76	Sherpur	1	2	0	1	*4*
4	**5**	**Noonkhawa**	**1**	**3**	**5**	**5**	***14***	35	40	Phulbari	2	3	0	1	*6*	66	**77**	**Jaria Jhanjail**	**5**	**2**	**3**	**1**	***11***
5	6	Chilmari	1	3	3	2	*9*	36	41	Badarganj	2	3	0	1	*6*	**67**	**78**	**Nakuagaon**	**5**	**3**	**5**	**4**	***17***
6	7	Bahadurabad	1	4	3	1	*9*	37	42	Bhushirbandar	3	3	0	1	*7*	68	79	Jibonpur/Compani	3	4	0	2	*9*
7	**9**	**Sirajganj**	**1**	**4**	**3**	**3**	***11***	38	43	Kamarkhali	1	3	3	1	*8*	**69**	**80**	**Laurergarh**	**5**	**2**	**5**	**4**	***16***
8	10	Aricha	1	2	3	3	*9*	39	44	Madaripur	1	3	3	1	*8*	70	81	Parshuram	4	1	0	4	*9*
9	11	Taraghat	1	3	3	1	*8*	40	50	Atrai	1	4	0	1	*6*	71	82	Narayanhat	4	4	0	1	*9*
10	13	Jamalpur	1	4	3	1	*9*	**41**	**52**	**Hariharpara**	**2**	**5**	**3**	**1**	***11***	**72**	**83**	**Panchapukuria**	**5**	**4**	**0**	**1**	***10***
11	14	Mymensingh	1	4	3	1	*9*	42	53	Rekabi Bazar	2	4	0	3	*9*	73	84	Bandarban	2	1	0	1	*4*
12	**15**	**Dhaka(Mill Barrak)**	**1**	**6**	**3**	**1**	***11***	43	54	Kalaroa	2	3	0	1	*6*	74	85	Dohazari	2	4	0	1	*7*
13	**16**	**Narayanganj**	**2**	**5**	**3**	**1**	***11***	44	55	Kaliganj(Jessor)	2	3	0	1	*6*	75	**91**	**Lama**	**5**	**1**	**0**	**1**	***7***
14	**17**	**Mirpur**	**1**	**5**	**3**	**1**	***10***	45	56	Kodalkatiga	2	3	0	4	*9*	76	92	Chiringa	3	2	0	1	*6*
15	**18**	**Tongi**	**1**	**5**	**3**	**1**	***10***	46	57	Shakra	3	1	0	4	*8*	77	93	Ramgarh	3	1	0	4	*8*
16	19	Jagir	1	3	0	1	*5*	47	58	Hatboalia	1	3	0	1	*5*	78	94	Teknaf	3	2	0	1	*6*
17	20	Gaibandha	1	3	0	1	*5*	48	59	Chuadanga	1	3	0	1	*5*	**79**	**95**	**Chittagong**	**3**	**6**	**0**	**2**	***11***
18	21	Bogra	2	4	0	1	*7*	49	60	Jhikargacha	2	3	0	1	*6*	80	96	Kaptai	3	1	0	1	*5*
19	22	Demra	1	5	0	1	*7*	50	61	Khulna	3	6	0	1	*10*	**81**	**97**	**Daulatkhan**	**3**	**1**	**5**	**2**	***11***
20	23	Nayarhat	1	5	0	1	*7*	51	62	Giba	2	3	0	4	*9*	**82**	**98**	**Patharghata**	**3**	**1**	**5**	**2**	***11***
21	**24**	**Panchagarh**	**2**	**3**	**5**	**4**	***14***	**52**	**63**	**Kanaighat**	**3**	**2**	**3**	**4**	***12***	**83**	**99**	**Mongla**	**3**	**2**	**5**	**2**	***12***
22	25	Dinajpur	2	2	0	1	*5*	**53**	**64**	**Sylhet**	**1**	**6**	**3**	**1**	***11***	**84**	**100**	**Rayenda**	**3**	**3**	**5**	**2**	***13***
23	26	Chapai-Nawabganj	1	3	3	1	*8*	54	65	Sunamganj	1	2	3	1	*7*	**85**	**101**	**Dasmina**	**3**	**1**	**5**	**2**	***11***
24	28	Naogaon	1	4	0	1	*6*	**55**	**66**	**Amalshid**	**1**	**2**	**5**	**4**	***12***	86	102	Shaistaganj	4	2	0	1	*7*
25	**29**	**Pankha**	**2**	**3**	**5**	**5**	***15***	56	67	Sheola	2	2	3	1	*8*	87	103	Ballah	4	2	0	3	*9*
26	30	Rajshahi	1	3	0	2	*6*	**57**	**68**	**Monu Rly. Br.**	**4**	**2**	**5**	**4**	***15***	88	104	Kamalganj	3	2	0	1	*6*
27	32	Hardinge Br.	1	3	3	2	*9*	58	69	Moulvi Bazar	3	2	3	1	*9*	**89**	**105**	**Chatlaghat**	**4**	**2**	**0**	**4**	***10***
28	33	Goalunda Transit	1	3	0	3	*7*	59	70	Habiganj	4	2	0	1	*7*	**90**	**106**	**Jibanpur**	**5**	**4**	**0**	**1**	***10***
29	34	Bhagyakul	1	4	3	1	*9*	**60**	**71**	**Durgapur**	**4**	**4**	**5**	**4**	***17***	**91**	**107**	**Kangsanagar**	**5**	**4**	**0**	**1**	***10***
30	35	Gorai Rly Br	1	3	3	1	*8*	**61**	**72**	**Bhairab Bazar**	**1**	**5**	**3**	**2**	***11***								
31	36	Faridpur	1	3	0	1	*5*	**62**	**73**	**Comilla**	**4**	**4**	**5**	**4**	***17***								

Notes: 1) IDs of stations coinceide with those on **Figure 3.3.1**.

2) The criteria employed in this screening are as follows, and detailed description is made in the text:

Criteria-1: Flood Characteristics
Criteria-2: Extent of Social Development
Criteria-3: Model Requirement
Criteria-4: Hydrological Strategic Point

3) The stations indicated in the bold letter are the ones passed this screening (total score of 10 or more).

Table 4.2.2 Characteristics of Catchments of Proposed Telemetry Stations

WL Stat. No.	Name	Station Type	Catchment Area (km^2) (1)	Max. Change in WL in 3hr (m)	R/F (mm)	Comments on Flood Discharges (2), (3)
1	Kurigram	Boundary, NW Flash Flood	Approx. 4,500	0.50	>2400	Large flow (large area, high rainfall)
2	Dhalia	Boundary, NE Flash Flood	Approx. 13,000	1.06	>2600	Large flow (large area, high rainfall)
9	Sirajganj	Internal on the Jamuna River		0.19		
5	Noonkhawa	Boundary	585,000	0.15		Large flow (Jamuna River)
15	Dhaka (Mill Barrak)	Internal in Dhaka		0.42		
24	Panchagarh	Boundary, NW Flash Flood	Approx. 1,000	0.82	>2400	Large flow (large area, high rainfall)
29	Pankha	Boundary	Approx. 1,555,000	0.57		Large flow (Padma River)
63	Kanaighat	Boundary, NE Flash Flood	771 + Kushiyara c/m overflow	1.44	>5000	Large flow (smaller area, very high rainfall)
66	Amalshid	Boundary, NE Flash Flood	Approx. 10,000 (Kushiyara c/m)	0.43	>4000	Large flow (large area, very high rainfall)
68	Monu Railway Br	Boundary, NE Flash Flood	Approx. 2,000	1.70	>3000	Large flow (large area, high rainfall)
71	Durgapur	Boundary, N Flash Flood	Approx. 2,000	1.60	>3000	Large flow (large area, high rainfall)
72	Bhairab Bazar	Internal near NE Flash Flood		0.28		
73	Comilla	Boundary, E Flash Flood	Approx. 1,200	1.91	>2400	Large flow (large area, high rainfall)
75	Sarighat	Boundary, NE Flash Flood	840	3.90	>5000	Large flow (smaller area, very high rainfall)
78	Nakuagaon	Boundary, N Flash Flood	Approx. 450	2.41	>2400	Large flow (small area, high rainfall)
80	Lourergorh	Boundary, N Flash Flood	2,241	2.25	>4500	Large flow (large area, high rainfall)
97	Daulatkhan	Boundary, Tidal		3.04		
98	Pathargarta	Boundary, Tidal		3.52		
99	Mongla	Boundary, Tidal		3.81		
100	Rayenda	Boundary, Tidal		2.40		
101	Dasmina	Boundary, Tidal		1.83		
83	Panchapukuria	Boundary, SE Flash Flood	Approx. 750	2.08	2600	Large flow (smaller area, high rainfall)
95	Chittagong	Boundary, Tidal		No Record		

Notes: (1) Internal station type has no catchment area. This is used to monitor real-time flood levels and model forecasting.
Tidal station type has no catchment area. This is used to monitor real-time tidal surge levels and downstream boundary conditions for model forecasting.

(2) Large area defined as exceeding around $1000km^2$.

(3) Lower rainfall defined as up to 1500mm per year, average from 1500 to 2000mm per year, high from 2000 to 4000 mm per year, very high greater than 4000mm/year.

Table 4.4.1 Total Investment Cost by Alternatives

(Unit: Million Taka)

Alternative	Central						Regional		
	1-1	1-2	1-3	1'-1	1'-2	1'-3	2-1	2-2	2-3
Telemeter	0	All	23	0	All	23	0	All	23
Manual	All	0	Rest	All	0	Rest	All	0	Rest
A Direct Installation Cost									
1.1 Equipment	582.4	981.5	698.4	325.6	725.4	441.6	374.8	773.9	494.6
1.1.1 AntennaSystem	85.9	90.2	88.7	19.9	24.1	22.7	20.9	25.1	23.7
1.1.2 Radio Equipment	185.1	284.0	213.4	62.7	162.4	91.0	67.2	166.1	99.3
1.1.3 I/F system	49.3	35.8	62.8	49.3	35.8	62.8	65.5	52.0	79.0
1.1.4 Analysis system	94.6	94.6	94.6	94.6	94.6	94.6	94.6	94.6	94.6
1.1.5 Sensor	0.0	276.4	58.9	0.0	276.4	58.9	0.0	276.4	58.9
1.1.6 Monitoring system	32.3	34.6	34.6	32.3	34.6	34.6	32.3	34.6	34.6
1.1.7 Power supply	107.8	138.5	118.0	39.4	70.1	49.6	59.4	90.1	69.6
1.1.8 Transportation	27.5	27.5	27.5	27.5	27.5	27.5	35.0	35.0	35.0
1.2 Civil works	99.0	401.0	179.0	48.0	350.0	128.0	64.0	366.0	144.0
1.3 Installation	51.3	184.1	94.4	51.3	184.1	94.4	51.3	184.1	94.4
1.4 Maintenance tool	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
1.5 Spare parts	116.5	196.3	139.7	65.1	145.1	88.3	75.0	154.8	98.9
1.6 Ocean and inland transportati	58.2	98.2	69.8	32.6	72.5	44.2	37.5	77.4	49.5
1.7 Office Equipment	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4
Total of Direct Installation Cost	950.9	1904.5	1224.8	566.0	1520.5	839.9	646.0	1599.6	924.8
B Administration Cost	9.5	19.0	12.2	5.7	15.2	8.4	6.5	16.0	9.2
C Engineering	142.6	285.7	183.7	84.9	228.1	126.0	96.9	239.9	138.7
D Training	6.3	11.7	7.9	3.8	9.1	5.4	4.3	9.6	5.9
E Contingency	46.5	118.4	66.5	26.0	98.0	46.0	30.9	102.8	51.1
Total	1155.9	2339.3	1495.1	686.3	1870.9	1025.6	784.5	1967.9	1129.7

Table 4.4.2 Total Annual Operation and Maintenance Cost by Alternatives

(Unit: Million Taka)

Alternative	Central						Regional		
	1-1	1-2	1-3	1'-1	1'-2	1'-3	2-1	2-2	2-3
Telemeter	0	All	23	0	All	23	0	All	23
Manual	All	0	Rest	All	0	Rest	All	0	Rest
A Staff	26.9	20.5	19.0	26.9	20.5	19.0	31.5	24.0	23.0
B O&M									
1 Transportation cost	2.4	3.0	2.6	2.4	3.0	2.6	1.9	1.9	1.9
2 Communication cost	1.9	1.7	1.9	6.4	6.1	6.3	4.1	3.8	4.0
3 Vehicle operation cost	5.0	5.0	5.0	5.0	5.0	5.0	3.8	3.8	3.8
4 Boat operation cost	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5 Repair & maintenance cost	43.3	47.6	46.4	21.9	26.2	25.0	24.0	28.3	27.1
6 Light,fuel,water cost	0.6	0.9	0.6	0.6	0.9	0.6	0.8	1.1	0.8
7 Consumables	0.3	0.6	0.4	0.3	0.6	0.4	0.5	0.7	0.5
8 Advertisement	0.2	0.4	0.3	0.2	0.4	0.3	0.3	0.4	0.3
9 Social expenses	0.2	0.4	0.3	0.2	0.4	0.3	0.3	0.4	0.3
10 Social welfare	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.2
11 House & land rental	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
12 Training cost	0.5	0.9	0.6	0.5	0.9	0.6	0.7	1.0	0.7
13 Insurance	0.5	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4
14 Sundry	2.7	3.1	2.9	1.9	2.2	2.1	1.8	2.1	2.0
Total of O&M	58.3	64.7	62.1	40.3	46.7	44.1	39.2	44.8	42.6
C Depreciation	140.4	279.3	181.0	83.4	222.5	124.0	95.4	234.3	136.8
Total	225.6	364.4	262.1	150.7	289.7	187.2	166.1	303.1	202.4

Table 4.4.3 Staff Costs by Alternatives

No		Salary	Central			Regional			Existing
			1-1	1-2	1-3	2-1	2-2	2-3	
Staffing									
	SE		1	1	1	1	1	1	0.4
	XEN/SA		3	3	3	8	8	8	2.3
	SDE/Programer		9	9	9	17	17	17	12.0
	AE/AD		14	21	17	17	17	17	6.3
	Technical staff		39	88	45	46	96	51	9.9
	Generarl staff		35	61	40	42	67	47	70.0
	(Sub Total)		101	183	115	131	206	141	100.9
	Gauge Reader		223	21.6	90	223	21.6	90	108.0
	T.C.O		0	0	0	0	0	0	85.0
	Total		324	204.6	205	354	227.6	231	293.9
Staff Cost (Unit: Taka)									
	SE	20,000 x 14(man-year)	280,000	280,000	280,000	280,000	280,000	280,000	112,000
	XEN/SA	17,000 x 14(man-year)	714,000	714,000	714,000	1,904,000	1,904,000	1,904,000	554,540
	SDE/Programer	15,000 x 14(man-year)	1,890,000	1,890,000	1,890,000	3,570,000	3,570,000	3,570,000	2,520,000
	AE/AD	10,000 x 14(man-year)	1,960,000	2,940,000	2,380,000	2,380,000	2,380,000	2,380,000	886,200
	Technical staff	6,500 x 14(man-year)	3,549,000	8,008,000	4,095,000	4,186,000	8,736,000	4,641,000	903,630
	Generarl staff	6,000 x 14(man-year)	2,940,000	5,124,000	3,360,000	3,528,000	5,628,000	3,948,000	5,875,800
	(Sub Total)		11,333,000	18,956,000	12,719,000	15,848,000	22,498,000	16,723,000	10,852,170
	Gauge Reader	5,000 x 14(man-year)	15,610,000	1,512,000	6,300,000	15,610,000	1,512,000	6,300,000	7,560,000
	T.C.O	5,000 x 14(man-year)	0	0	0	0	0	0	5,950,000
	Total		26,943,000	20,468,000	19,019,000	31,458,000	24,010,000	23,023,000	24,362,170

Table 4.5.1 Task of Improved FFWS

	Operation		Maintenance	
Task of FFWS	Item	Division in charge	Item	Division in charge
Observation	*Gauge Reading*	Regional FH	Discharge measurement	Surface Water (Region)
			Measurement of the cross section	River Morphology (Region)
			Restoration of gauging structure Set Stuff gauge and measure the level Automatic gauge maintenance Telemeter system maintenance	Regional FH
			Correction of gauging tool (Discharge) Making gauging tool (Stuff gauge, Rainfall gauge)	Instrumentation Division
Transmitting	HF Tanciever Operation	Central FHC Regional FH	HF Tranceiver Maintenance	Central FHC Regional FH
Analysis	Collect the observed data Analysis Supervise Edit	Central FHC Regional FH	Store the Posted data Store the cross section data Store the discharge data	Processing Division
			Modification of analysing model Modification of Hazard map System Hardware Maintenance	Central FHC Regional FH
Dissemination	Send Fax and E-mail	Central FHC Regional FH		
Response	Help in the evacuation	Regional FH		

Hatched: Task of Improved Organization or New Organization

Not Hatched: Task of Surface Water(Reagion) and River Morphology (Region) (the same task as exsisting.)

Table 4.5.2 Staffing of Improved FFWS

Division	Operation Task	Maintenance Task	Manager				Technical Staff	Support Staff	Gauge Reader
			SE	XEN	SDE	AE			
Regional FH	(Data Collection Division)	(Data Collection Division)		1x5	1x5	1x5	3x5	8x5	85 (Mannual)
	Gauge Reading and Sending by mobile (or HF Tranciever)	Restoration of gauging structure							5 (Telmeter)
		Set staff gauge and measure the level							
	(Data Transmission Division)	(Data Transmission Division)			1x5	1x5	3x5		
		Automatic gauge Maintenance							
		Telemeter system Maintenance							
		HF Tranciever Maintenance							
		FFWS Hardware Maintenance							
		Mobile sets Manage							
	(Forecasting Division)	(Forecasting Division)			1x5	1x5	3x5		
	Set boundary condition	Validation of analysing model							
	Run the Regional Model (Making Regional BULLETIN)	Computer System Maintenance							
	Edit the BULLETIN	FFWS Software Maintenance							
	Confirm dissemination of Fax, E-mail								
	Communicate with local O&M staff								
Central FHC	(Data Collection Division)	(Data Collection Division)	1	1				7	
	(Data Transmission Division)	(Data Transmission Division)		1	1	1	3		
		HF Tranciever Maintenance							
		FFWS Hardware Maintenance							
	(Forecasting Division)	(Forecasting Division)		1	1	1	3		
	Set boundary condition	Validation of analysing model							
	Run the Super Model (Making Country BULLETIN and Hazard Map)	Modification of Hazard map							
		Compyuter System Maintenance							
		FFWS Software Maintenance							
	Edit the BULLETIN								
	Confirm dissemination of Fax, E-mail, and WebSite-Upload								
Total			1	8	17	17	51	47	90
Grand Total									231

Table 5.3.1 History of Negotiations and Implementations on the Sharing of the Ganges Waters at Farakka (1/3)

The classification of the phases in this table follows the one provided by A. Nishat (2001), which is based on the approaches and progress at the bilateral negotiations.

Phase I: 1951-74 (Negotiations and the establishment of the Joint Rivers Commission)	
1951	Pakistan called Indian attention to reports on India's plan to build a barrage at Farakka to divert 40,000 cusec out of a dry season average flow of 50,000 cusec into the Bhagirathi-Hooghly tributary to provide silt-free flow into Calcutta bay.
1957	Pakistan proposed the services of the UN for the cooperative development of the eastern river systems.
1960 -62	Expert-level meetings held to "exchange data on projects of mutual interests."
1961	India informed Pakistan that the construction of the Farakka barrage had begun. A series of attempts were made by Pakistan to arrange a minister-level meeting.
1963	The two sides agreed to have one more expert-level meeting.
1968	The meeting of experts was finally held. Pakistan concluded that reaching an agreement on sharing the data was not possible.
1968 -70	Meetings at the level of secretary were held.
1970	India completed the construction of the Farakka barrage.
1972	India and Bangladesh agreed to establish the Indo-Bangladesh **Joint Rivers Commission** to "develop the waters of the rivers common to the two countries on a cooperative basis." The question of Ganges was excluded and would be handled only by the two prime ministers.
Phase II: 1974-76 (An initial agreement and negotiations)	
1975	India asked Bangladesh that the feeder canal at Farrakka be run during the current period of low flow. The two sides agreed to a limited trial operation of the barrage (discharge between 11,000 and 16,000 cusec in ten-day periods from 21 April to 31 May 1975 with the remainder of the flow guaranteed to reach Bangladesh).
1975 - 76	India continued to divert the Ganges waters at Farakka after the trial run and a full capacity of the diversion (40,000 cusec) without a new agreement.
1976	Bangladesh lodged a formal protest against India with the UN General Assembly, which adopted a consensus statement encouraging the parities to meet urgently at the ministerial level for negotiations with a view to arriving at a fair and expeditious settlement.
Phase III: 1977-82 (The first Treaty)	
1977	**The first Ganges Water Treaty** (for five years) was signed. The treaty was comprised of the following three parts: Part A: A schedule of sharing of the water reaching Farakka from 1 January to 31 May on a 10-day basis (34,500 cusec for Bangladesh and 20,500 cusec for the Calcutta port were provided during the leanest 10-day period of 21-30 April). Part B: JRC carrying out an investigation into and a study of schemes proposed by either government for augmentation of the dry season flows of the Ganges. Part C: A review of the agreement after the expiry of three years.
1978	Under the Part B of the Treaty, the two governments exchanged their **proposals for a long-term solution for augmenting the dry season flow of the Ganges.** The Indian proposal: to construct a barrage on the Brahmaputra at Jogighopa with a gravity-link canal falling into the Ganges at Farakka. The gravity-link canal was to be supplemented at appropriate stages with storage on Brahmaputra and Barak rivers.

Table 5.3.1 History of Negotiations and Implementations on the Sharing of the Ganges Waters at Farakka (2/3)

	The Bangladesh proposal: to construct a number of storage dams in the upper reaches of the Ganges basin in Nepal and India. (The data and information used were taken from "India's Water Wealth" by Dr. KL Rao's and the statements on storage potential and notes handed over in different meetings by India and the information and data collected from Nepal.) (No decision was reached regarding these proposals.)
Phase IV: 1982-88 (Two MoUs)	
1982	Before the expiration of the 1977 Treaty in November, the two governments signed an **MoU** for continuing the arrangement to share the flows of the Ganges for another two dry seasons in 1983 and 1984. *It was agreed that a further and final sharing agreement would be reached* immediately after the completion of a pre-feasibility study of the augmentation schemes proposed earlier. (The studies were exchanged in 1983 but did not result in an agreed recommendation for the optimum solution for augmentation. The MoU expired in 1984.)
1985	A second **MoU** signed on the sharing of the Ganges dry seasons flow through 1988 based on the same formula as in the 1977 Treaty and establishing a Joint Committee of Experts (JCE) to work out a long-term scheme(s) for the Ganges flow augmentation and to identify alternatives for the sharing of the water resources.
1986	JCE approached Nepal with a proposal to acquire data on storage sites of Nepal. When the Nepalese side raised questions about Nepal's involvement and mutuality, JCE's response was not positive and as a result the data were not made available to JCE. As a result the work of JCE ended inconclusively. (The MoU expired in 1988.)
Phase V: 1988-96 (Negotiations in the absence of any agreement)	
1988	A meeting of the two heads of governments decided to assign the secretaries of water resources to work out an integrated formula for long-term sharing of flows of all the common rivers.
1990	The secretaries' committee held six meetings over three years from 1990. The need for immediate allocation of the Ganges and Teesta waters was emphasized. In the wake of 1988 flood, the relationship between sharing agreements and augmentation proposals became a critical issue.
1991	Nepal proposed to involve Bangladesh in the Saptakosi High Dam Storage Project, but it did not receive positive response from India.
1992	The two prime ministers discussed the issue of Ganges water sharing and directed their respective ministers to renew their efforts for a long-term solution.
Phase VI: 1996 to date (The second Treaty)	
1996	**The second Ganges Water Treaty** (for 30 years) was signed, providing the following: - An allocation of the Ganges water flows at Farakka by 10 day periods from 1st January to 31 May every year based on a specific formula (which is more streamlined than the earlier version provided in the 1977 Treaty). - Agreements to (i) cooperate in finding a solution to the long-term problem of augmenting the flows of the Ganges and (ii) conclude water-sharing arrangements with regard to other common rivers.
1996	1st meeting of the Joint Committee for Joint Inspection and Monitoring of the sharing of the Ganges Waters at Farakka was held and agreed on the procedures of the Joint Committee, procedures for sharing the waters, setting up of the teams at Farakka and Hardinge Bridge, relevant guidelines, etc.
1997	During the third 10-day period of March 1997, the availability of Ganges flow at Farakka fell below 50,000 cusecs. Consultations were held between the two governments in accordance with Article II of the Treaty. India proposed adjustments to Article II to reflect one of the

Table 5.3.1 History of Negotiations and Implementations on the Sharing of the Ganges Waters at Farakka (3/3)

	following options: (i) sharing will be on a 50:50 basis when the flows are below 50,000 cusecs; (ii) sharing in a manner so that the minimum flow for either side does not fall below 20,000 cusecs; or (iii) sharing in a manner that the minimum flow for either side will not be reduced below15,000 cusecs. Bangladesh responded that Bangladesh needs to receive 35,000 cusecs as guaranteed in the Treaty for technical reasons and the Treaty provisions should be maintained. During 1-10 April Bangladesh received an average of 15,737 cusecs, falling below the minimum provided in the Treaty. It was found that the data recorded at Farakka and Hardinge Bridge had discrepancies. JRC established a Joint Scientific Study Team (JSST) to examine the reasons.
1998	(June) 1st meeting of Joint Scientific Study Team (JSST) was held and agreed on a workplan. The final report was to be completed by December 2000. *(November) 2nd meeting of JSST agreed on technical details of the study and on a joint reconnaissance survey of the Ganges river and areas adjacent to the river banks between Farakka and Hardinge Bridge.*
1999	3rd meeting of JSST decided: (a) joint observation of flows of the Ganges at intermediate points between Farakka and Hardinge Bridge during the lean season of 2002 at Nimtita and Bhatupara; (b) during February-March 2000, joint cross-sectional surveys at the Ganges at locations between Farakka and Hardinge Bridge would be undertaken. A JSST status report was prepared. JSST requested the two governments to extend the time of submission of the final report till December 2001. (The report has not been completed yet as of September 2003.)
2001 April	In the Joint Committee meeting, India again proposed to consider adjustments to Article II(iii) in the even of flows falling below 50,000 cusecs. Bangladesh responded that the matter is beyond the mandate of the Joint Committee and needs to be referred to the two governments.

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- The 1977 Treaty
- The 1982 MoU
- The 1985 MoU
- The 1996 Treaty
- Interviews with the Bangladesh JRC during the JICA FFWS study

Table 5.3.2 Quantity of Water Received by Bangladesh at Hardinge Bridge Point

Time-frame		Indicative share of Bangladesh as mentioned in the 1996 Treaty (Annexure II)	Quantity of water received by Bangladesh at Hardinge Bridge Point (1999, 2000 and 2002)		
			1999	2000	2002
January	01-10	67,516	95,934	94,975	72,146
	11-20	57,673	85,728	79,568	61,281
	21-31	50,154	81,480	62,238	55,047
February	01-10	46,323	64,873	55,903	57,733
	11-20	42,859	61,760	53,292	52,240
	21-28	39,106	53,185	46,909	53,301
March	01-10	35,000	41,600	44,573	51,177
	11-20	35,000	35,683	39,320	40,424
	21-31	29,688	33,832	35,509	35,628
April	01-10	35,000	35,376	37,026	39,031
	11-20	27,633	30,725	35,528	39,846
	21-30	35,000	n.a.	41,535	n.a.
May	01-10	32,351	n.a.	56,126	n.a.
	11-20	35,000	n.a.	50,344	n.a.
	21-31	41,854	n.a.	85,271	n.a.

(Source: Press releases of Bangladesh Joint Rivers Commission on the quantities of water received at Hardinge Bridge Point in Bangladesh under the Ganges Water-sharing Treaty, 21 April 1999, 31 May 2000, and 23 April 2002.)

n.a.: not available in the above mentioned press releases.

Table 5.3.3 Second Track Activities for Possible External Assistance

1. Bangladesh Unnayan Parishad (BUP=Bangladesh Development Council)

Chairman:	Q K Ahmad (Economist)
Executive Director:	Kalilur Rahman (former JRC member, Engineer)
Address:	House No.50, Block D, Niketon, Gulshan-1, Dhaka-1212, Bangladesh
Tel:	+880-2-9890439
E-mail:	bup@citechco.net
Website:	www.bup-bd.org
Main activities:	As a non-governmental academic organization established in 1980, it has been engaged in research, policy dialogue and advocacy on various socio-economic, technical and international issues. Since 1990, BUP has been conducting a series of research and dialogue on regional cooperation on the GBM rivers in collaboration with like-minded institutions: Center for Policy Research (CPR) in India and Institute for Integrated Development Studies (IIDS) in Nepal. Members of CPR include Ramaswamy R. Iyer, former Secretary of Indian Ministry of Water Resources and R. Rangachari, former member of Central Water Commission. Incumbent officials of the three governments (including India) also participated in some of the workshops conducted for the purpose, making the process a fusion of official and second track diplomacy. Their work helped creating a positive momentum toward the conclusion of the Ganges Treaty and Mahakali Treaty in 1996.
Financial assistance:	Ford Foundation for the river related issues in the 1990s. Other donors provided funds for different projects include Government of the Netherlands, CIDA, SDC, ADB, ILO, FAO and UNDP. Global Infrastructures Research Foundation of Japan (GIF) is in contact with BUP for possible assistance.
Activities that can be supported by GOJ:	**1. Flood Forecasting and Management System in the GBM Region:** As follow up to the development of a sustainable development framework for the GBM region (which was published in 2001), BUP, CPR and IIDS in close cooperation with the Third World Center for Water Management (President: Asit K. Biswas) are currently planning to carry out an integrated three country flood management study. The approach needs care and sensitivity and can be conducted in two phases: i) a high-level invitation only workshop involving 25-30 people including government officials using the extensive political contacts of Prof. Biswas and Dr. Ahmad in the three countries (Prof. Biswas is already in discussion with Indian high officials); and ii) commissioning of 8-10 papers from the three countries on specific, inter-linking subjects of flood management, including technical, economic, institutional and social issues. Consolidated conclusions of these works will be sought to achieve through workshops. (Note: The Dutch Government was considering support to this initiative but has withdrawn it due to a recent drastic budget reduction.) Estimated budget: Approx. USD 125,000 Period: to be determined **2. Eastern Himalayan Rivers Study: Phase III** The propose d program is a follow-up to the activities conducted in the 1990s and consists of two parts: i) dissemination of the outputs of earlier studies and the results of the Ganges and Mahakali Treaties; and ii) in-depth studies focusing on the following themes: a. In-depth analyses of water based integrated development in the GBM; b. Modalities for cooperation in energy exchange between Nepal, India

Table 5.3.3 Second Track Activities for Possible External Assistance

	and Bangladesh; c. Multi-modal transport development with focus on waterway transport; d. Integrated approach to environmental protection and bio-diversity conservation; e. Environmental implications of Tipaimukh project for India and Bangladesh; and f. Assessment of long term potentials of Kosi river basin for Nepal, India and Bangladesh with a view toward integrated water development. (Note: The proposal has been submitted to Ford Foundation but the funding is unlikely, mainly due to their closing down of the Dhaka office.) Estimated budget: to be determined Period: 2.5 years

2. Global Water Partnership South Asia Chapter (GWP-SAS)

President:	Quamrul Islam Siddique (former Chief Engineer, former Chairman, BPDB, Currently President of Institution of Engineers, Bangladesh President)
Programme Coordinator	Reba Paul
Address:	Secretariat: LGED Annex Building (Level-5), Agargaon, Sher-e-Bangla Nagar, Dhaka 1207 Bangladesh
Tel:	+880-2-8116668, 9124027
E-mail:	qis@bol-online.com, gwp-sas-rwp@cgscomm.net
Website:	http://www.gwpforum.org
Main activities:	Global Water Partnership (GWP), established in 1996 with its secretariat in Stockholm, promotes Integrated Water Resources Management (IWRM) by creating forums at global, regional and national levels to disseminate knowledge on Dublin-Rio principles on water and sustainable development, to exchange experiences, and to mobilize financial and human resources. GWP is an international network open to all organizations involved in water resources management: developed and developing county governmental institutions, UN agencies, multilateral development banks, research institutes, NGOs and the private sector. Bangladesh Water Partnership (BWP) was formed in 1998 under the GWP umbrella involving different government, quasi-government, and non-government organizations and since 2002 has been serving as the secretariat of GWP's South Asia chapter. On-going and planned areas of activities include: i) water security, ii) awareness raising on water valuation, iii) dissemination of IWRM best practices, iv) promotion of dialogue on thematic issues, v) development of action plans and forging alliances, vi) gender mainstreaming, and vii) analysis of links between water and poverty.
Financial assistance:	GWP global activities are funded by UNDP, the World Bank and SIDA. (Funding can be provided directly to the South Asia Chapter.)
Activities that can be supported by GOJ:	A program on **Joint Activities to Reduce Flood Vulnerability in South Asia (Phase I)** is under preparation and seeks funding. Bangladesh Unnayan Parishad (BUP) has been identified as a "driver" of this program and will work with partner institutions in five countries in South Asia (Bangladesh, India, Nepal Pakistan, and Sri Lanka). During the first phase, country studies will be undertaken in each country with focuses on: flood risk assessment, flood-plan management measures, public awareness and community-based disaster preparedness and response, flood fighting,

Table 5.3.3 Second Track Activities for Possible External Assistance

	post-flood relief and reconstruction, possibilities of introducing flood insurances, assessment of human and institutional capacities for flood management. Country studies will be synthesized leading to a regional report. A regional workshop will be convened to review the regional report, involving relevant experts, parliamentarians and bureaucrats as well. Estimated total budget: Approx. USD 628,350 Period: 2 years

3. Fellowship in South Asian Alternatives (FISAA)

Executive Director of the Dhaka Chapter:	Imtiaz Ahmed (Executive Director, Center for Alternatives, Professor of International Relations, Dhaka University)
Address:	House No.75, Apt. A3E, Road 8A, Dhanmondi, Dhaka 1209 Bangladesh
Tel:	8112484, 0173-001400
E-mail:	imtiaz@bangla.net, imtiazalter@hotmail.com
Main activities:	FISAA has six regional centers in South Asia, one in each of the six countries (Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka). It promotes research, interaction and networking among scholars and institutions in South Asia on selected areas of public interest. It is also a forum for alternative thinking, committed to putting the people first in the public policy process. It also aims at challenging the prevailing "intellectual isolation" in South Asia and developing regional perspectives on socio-economic and political issues that are common to the region. In 1997, it produced a booklet titled "Water, Power and People: A South Asian Manifesto on the Politics and Knowledge of Water," outlining key principles and visions for water governance. (The work was a joint collaboration of an engineer, a political scientist and a clinical psychologist.) In 2000, it organized a workshop of about 20 children (aged 14-16) selected through open competition from the six countries to discuss water issues in the region. Hostile atmosphere among the children (e.g. between Pakistani and Indian children) prevailing at the beginning of the workshop was transformed into friendship and enthusiasm through joint activities. The event was also participated by UNICEF and gained wide media coverage.
Financial assistance:	Ford Foundation
Activities that can be supported by GOJ:	FISAA wishes to conduct similar **workshops for children** as described above as well as for selected groups of adults on a regular basis, aiming at making long-term impacts through changing perceptions and mindsets of future as well as current policy makers. A roadmap and work plan can be developed jointly with GOJ.

4. Bangladesh Environment Lawyers' Association (BELA)

Executive Director:	Syeda Rizaana Hasan (Founder: late Mohiuddin Farooque, eminent lawyer of the Supreme Court of Bangladesh)
Address:	House No. 15A, Road No.3, Dhanmondi, Dhaka
Tel:	+880-2-8614283, 8618706
E-mail:	bela@bangla.net
Main activities:	- Established in 1992, BELA is a group of lawyers undertaking study, research, advocacy, public interest litigation, publication, etc. with the objective of ensuring a sound environmental and ecological order for all using legal mechanism as a tool.

Table 5.3.3 Second Track Activities for Possible External Assistance

	- On 10 September 2003, its senior advocate, M. Iqbal Kabir, together with other environmental and human rights lawyers and activists in Bangladesh, wrote a letter to the Chief Justice of the Indian Supreme Court protesting its decree in 2002 on the river linking project. - BELA's Executive Director, Dr. Ainun Nishat, and some other leading experts in the country are in the process of organizing a committee to protest against India's river-linking project and to raise awareness of the international community.
Financial assistance:	UNDP and others (no financial assistance identified yet for the river issue).
Activities that can be supported by GOJ:	To be identified.

5. South Asia Consortium for Interdisciplinary Water Resources Studies (SaciWATERs)

Convenor: Project Director:	Peter P. Mollinga Jasveen
Address:	Quarter No.20B, College Park Quarters, Road No.3, Banjara Hills Hyderabad 500 034 Andhra Pradesh, India
Tel:	+91-40-23544142
E-mail:	saciwaters@rediffmail.com
Website:	www.saciwaters.org
Main activities:	SaciWATERs is a consortium comprising of scholars, academic institutions and NGOs in the six countries of South Asia to tap interdisciplinary inputs across the boundaries of natural and social sciences with a view toward improving capacities for water resources management in the region. The organization places emphasis on pro-people, human development perspectives and promotes such civil society initiatives to reflect the views and voices of grassroots and marginalized sections of societies Recently it completed a publication titled "Higher Education on Water Resources in South Asia: Towards Capacity Building for IWRM," which reviewed existing institutions and curriculums of water resources related education and set out directions for reforms. A workshop in Dhaka was held in June 2002 preceding this publication. Second and third publications are currently in progress focusing on flood and draught respectively.
Financial assistance:	Government of the Netherlands
Activities that can be supported by GOJ:	To be identified.

Table 7.2.1 Detailed Information on Proposed Telemetric Gauging Sites

Sl. No.	Station Name	River Name	Coordinate		District	Upazilla	Union	Village	Existence of Suitable Structure	Proposed Location of Facilities			Accessibility to the Site*
			Longitude	Latitude						Water Level Gauge	Rainfall Gauge	House	
1	Panchagarh	Karatoa	88°33' E	26°19' N	Panchagarh	Panchagarh	Dhakkamara	Puraton Panchagarh	Road Br.	Bridge Pier (Right Bank Side)	Right Bank Side	Right Bank Side	A
2	Dalia	Teesta	89°03' E	26°09' N	Nilphamari	Dimla	Khalisa Chapani	Dalia	Barrage, Revetment	Right Bank Side	Right Bank Side	Right Bank Side	A
3	Noonkhawa	Brahmaputra (Du Kumar)	89°46' E	25°54' N	Kurigram	Nageswari	Noonkhawa	Pattala	-	Right Bank Side	Right Bank Side	Right Bank Side	C
4	Kurigram	Dharla	89°40' E	25°50' N	Kurigram	Kurigram	Kurigram	Jurigram	Road Br. (under construction)	Bridge Pier (Right Bank Side)	Right Bank Side	Right Bank Side	A
5	Sirajganj	Jamuna	89°43' E	24°27' N	Sirajganj	Sirajganj	Sirajganj	Ghurka	Revetment	Right Bank Side	Right Bank Side	Right Bank Side	A
6	Pankha	Upper Padma	88°07' E	24°39' N	Nawabganj	Sibganj	Pankha	Sahupur	Spur	Spur (Left Bank Side)	Left Bank Side	Left Bank Side	C
7	Nakuagaon	Bhugai	90°13' E	25°10' N	Sherpur	Nalitabari	Nayabil	Nakuagaon	-	Right Bank Side	Right Bank Side	Right Bank Side	A
8	Durgapur	Someswari	90°40' E	24°07' N	Netrakona	Durgapur	Birisiri	Dakshin Bhanaripur	-	Right Bank Side of New Mainstream	Left Bank Side of New Mainstream	Left Bank Side of New Mainstream	C
9	Laurergarh	Jadukata	91°15' E	25°12' N	Sunamganj	Tahirpur	Baddal	Rajat	-	Right Bank Side	Right Bank Side	Right Bank Side	C
10	Sarighat	Sarigowain	92°07' E	25°06' N	Sylhet	Jaintapur	Nizpat	Dhupi	Road Br.	Bridge Pier (Right Bank Side)	Right Bank Side	Right Bank Side	A
11	Kanaighat	Surma	92°16' E	25°00' N	Sylhet	Kanaighat	Kanaighat	Nandirai	-	Left Bank Side	Left Bank Side	Left Bank Side	B
12	Amalshid	Kushiyara	92°28' E	24°52' N	Sylhet	Zakiganj	Baratakuri	Amalshid	-	Right Bank Side	Right Bank Side	Right Bank Side	B
13	Chatlaghat	Monu	91°57' E	24°22' N	Moulvi Bazar	Kulaura	Sharifpur	Chatlapur	Road Br. (under construction)	Bridge Pier (Left Bank Side)	Left Bank Side	Left Bank Side	B
14	Bhairab Bazar	Upper Meghna	91°00' E	24°02' N	Kishoreganj	Bhairab	Bhairab	Bhairab	Road Br., Railway Br	Rly. Bridge Pier (Right Bank Side)	Right Bank Side	Right Bank Side	A
15	Comilla	Gumti	91°13' E	23°28' N	Comilla	Comilla	Commila	Sangrais	-	Left Bank Side	Left Bank Side	Left Bank Side	A
16	Dhaka (Mill Barak)	Buriganga	90°30' E	23°43' N	(Dhaka City)				Revetment	Left Bank Side	Left Bank Side	Left Bank Side	A
17	Mongla	Pasur	89°36' E	22°28' N	Bagerhat	Mongla	Mongla	Galachipa Digraj	Wharf (Mongla Port)	Left Bank Side	Left Bank Side	Left Bank Side	A
18	Rayenda	Baleswar	89°51' E	22°19' N	Bagerhat	Sarankhola	Rayenda	Rayenda	Road Br. (under constuction)	Bridge Pier	Right Bank Side	Right Bank Side	B
19	Patharghata	Bishkhali	89°59' E	22°03' N	Barguna	Patharghata	Patharghata	Patharghata	-	Right Bank Side	Right Bank Side	Right Bank Side	C
20	Dasmina	Tetulia	90°34' E	22°14' N	Patuakhali	Dasmina	Dasmina	Sayed Jafar	Foot Br.	Right Bank Side	Right Bank Side	Right Bank Side	C
21	Daulatkhan	Shahbazpur	90°45' E	22°36' N	Bhola	Daulatkhan	Bhabanipur	Bhabanipur	Intake Gate	Right Bank Side of Intake Canal	Right Bank Side of Intake Canal	Right Bank Side of Intake Canal	C
22	Panchapukuria	Halda	91°47' E	22°40' N	Chittagong	Fatikchhari	Sundarpur	Panchapukuria	-	Left Bank Side	Left Bank Side	Left Bank Side	B
23	Chittagong	Karnafuli	91°46' E	22°10' N	(Chittagong City)				Wharf (Chittagong Port)	Right Bank Side	Right Bank Side	Right Bank Side	A

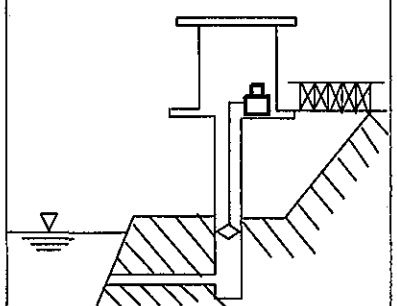
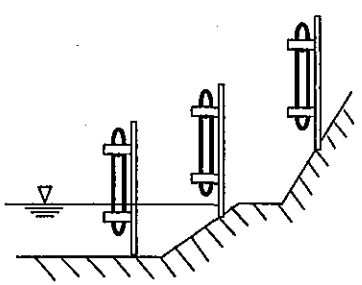
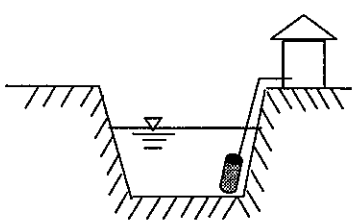
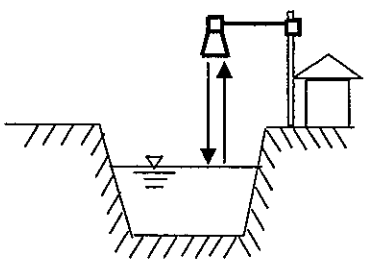
Note*

A : Accessible to the site by truck with load of 10t.

B : Accessible to the neighboring point (within 500m) to the site by truck with load of 10t.

C : Accessible only to the remote point (more than 500 m) to the site by truck with load of 10t.

Table 7.2.2 Comparison of Automatic Water Level Gauging Method

Items/Methods	Float Type with Well	Float Type (Sensing Pole)	Water Pressure Type (Crystal)	Supersonic Sensor Type
Measuring method	Rotation of the pulley that connected to the float is to measure the water level.	On/off response of the lead switches installed inside the pole is controlled by the permanent magnet attached on the float.	Variation of water pressure (water depth) is sensed as the variation of frequency of the crystal sensor.	Water level is measured (calculated) based on the traveling time of supersonic pulse between transmitter / receiver and water surface.
Accuracy (Error)	± 1cm ~ 5cm	± 1cm	0.05% of full scale (FS)	± 1cm + α
Maintenance	Routine inspection for removal of sediment deposit especially in conduit tube is necessary.	Routine inspection for cleaning up inside pole is necessary.	Routine inspection (clean up, etc.) for sensor is not necessary in principle.	Routine inspection of transmitter/receiver and thermometer is necessary.
Outline of typical installation				
Features in the Installation	Well (diameter of more than 600 mm) and related civil construction works are necessary.	It is easy to install on a supporting wall/pier in vertical.	It is easy to install only inside a protective pipe and a sensor can measure in case of under earth and sand in a river.	It is easy to install, but periodic maintenance work is required.
Working Examples	Widely applied in the world, and also in Bangladesh	No examples in Bangladesh (widely used in the world)	Few examples in Bangladesh (widely used in the world)	No examples in Bangladesh
Equipment Cost	5 Lakh Taka	2~7 Lakh Taka/unit	5 Lakh Taka	3 Lakh Taka
Civil Work Cost [1)]	High	Medium (variable in accordance with the number of units)	Low	Low

Note: 1) The cost for civil work is variable according to the site conditions.

Table 7.2.3 Recorded Highest and Lowest Water Levels of Proposed Telemetric Stations

Sl. No.	Station Name	River Name	DL[1] (m.PWD)	RHWL[2] (m.PWD)	RLWL[3] (m.PWD)	RLWL (m.PWD) (May-Oct)	WL Range to be Covered[4] (m)
1	Panchagarh	Karatoa	70.75	72.65	67.10	67.40	6.8
2	Dalia	Teesta	52.25	52.97	47.71	49.80	4.7
3	Noonkhawa	Brahmaputra	27.89	28.10	19.45	20.96	8.6
4	Kurigram	Dharla	26.50	27.50	20.91	22.10	6.9
5	Sirajganj	Jamuna	13.75	15.12	6.05	7.88	8.7
6	Pankha	Upper Padma	21.50	24.14	12.25	12.25	13.4
7	Nakuagaon	Bhugai	22.40	26.01	NA	19.95	7.6
8	Durgapur	Someswari	13.00	15.15	6.99	10.46	6.2
9	Laurergarh	Jadukata	8.53	11.85	5.44	5.87	7.5
10	Sarighat	Sarigowain	12.80	13.96	5.09	5.76	9.7
11	Kanaighat	Surma	13.20	15.26	3.07	4.55	12.2
12	Amalshid	Kushiyara	15.85	18.28	5.82	5.98	13.8
13	Chatlaghat[5]	Monu	21.75	25.10	16.97	17.30	9.3
14	Bhairab Bazar	Meghna	6.25	7.66	0.93	1.63	7.5
15	Comilla	Gumti	11.75	13.56	6.70	7.08	8.0
16	Dhaka (Mill Barrac)	Buriganga	6.00	7.58	0.52	1.14	7.9
17	Mongla	Rupsa-Passur	NA	3.28	-1.77	-1.25	6.0
18	Rayenda	Madhumati	3.25	3.95	-0.20	0.00	5.5
19	Patharghata	Bishkhali	NA	3.80	-1.17	-0.44	5.7
20	Dasmina	Tentulia	2.59	4.76	0.05	0.05	6.2
21	Daulatkhan	Lower Meghna	3.43	5.11	-0.54	-0.05	6.7
22	Panchapukuria	Halda	9.50	11.55	3.61	3.61	9.4
23	Chittagong	Karnafuli	5.00	10.00	0.22	0.37	11.1

Notes: 1) DL : Danger Level
2) RHWL : Recorded Highest Water Level
3) RLWL : Recorded Lowest Water Level
4) WL range to be covered is set as the difference between RHWL and RLWL (May-Oct) plus 1.5 m.
5) Since the water level observation at Chatlaghat commenced in 2002, the figures shown in the table except for DL is estimated based on the record of Monu Railway Bridge.

Table 7.2.4 Proposed Gauge Types and Data Transmission Method by Observatories

Sl. No.	Station Name	Rainfall Gauge		Water Level Gauge	
		Gauge Type	Data Transmission Method*	Gauge Type	Data Transmission Method*
1	Panchagarh	Tipping Bucket	Cable	Sonar	Cable
2	Dalia			Sensing Pole	Wireless
3	Noonkhawa			Sensing Pole	Wireless
4	Kurigram			Sonar	Cable
5	Sirajganj			Sensing Pole	Wireless
6	Pankha			Sonar	Cable
7	Nakuagaon			Sensing Pole	Wireless
8	Durgapur			Sensing Pole	Wireless
9	Laurergarh			Sensing Pole	Wireless
10	Sarighat			Sonar	Cable
11	Kanaighat			Sensing Pole	Wireless
12	Amalshid			Sensing Pole	Wireless
13	Chatlaghat			Sonar	Cable
14	Bhairab Bazar			Sonar	Cable
15	Comilla			Sensing Pole	Wireless
16	Dhaka (Mill Barak)			Sensing Pole	Wireless
17	Mongla			Sensing Pole	Wireless
18	Rayenda			Sensing Pole	Wireless
19	Pathargata			Sensing Pole	Wireless
20	Dasmina			Sensing Pole	Wireless
21	Daulatkhan			Sensing Pole	Wireless
22	Panchapukuria			Sensing Pole	Wireless
23	Chittagong			Sonar	Cable

Note: Data transmission method shown above is that from gauging equipment to gauge (telemeter) house located nearby.

Table 7.3.1 Summary of Radio Design (1/5)

(1) Region-NE (Sylhet)

Station	Station	Dist. [km]	Antenna height [m]	Power output [w]	Antenna		Receiving voltage [dBμV]	S/N [dB]	Radio Design Sheet Number (Radio design sheet is attached in ANNEX-VIII.)
					3 elements collinear	5 element yagi			
Sylhet			40	10	*				
	Rajnagar	44	30	10	*		35.0	39.0	Table 1.7
	Beani Bazar	30	30	10	*		38.4	43.7	Table 1.3
	Goainghat	20	30	10	*		41.9	48.2	Table 1.5
	Sunamganj	47	30	10	*		34.5	38.1	Table 1.8
Rajnagar			30	10	*				
	Chatlaghat	18	10	10		*	39.5	46.0	Table 1.6
Beanibazar			30	10	*				
	Amalshid	24	10	10		*	46.0	51.9	Table 1.1
	Kanaighat	30	10	10		*	40.6	45.9	Table 1.2
Goainghat			30	10	*				
	Sarighat	15	10	10		*	50.1	56.9	Table 1.4
Sunamganu			30	10	*				
	Laurergarh	10	10	10		*	53.6	60.9	Table 1.9
	Dhamapsha	44	30	10	*		35.4	39.4	Table 1.1
Dhamapsha			30	10	*				
	Netrakona	30	30	10	*		38.8	44.1	Table 1.11
Netrakona			30	10	*				
	Durgapur	36	10	10		*	35.0	39.7	Table 1.12
	Phulpur	35	30	10	*		37.4	42.2	Table 1.13
Phulpur			30	10	*				
	Sherpur	30	30	10	*		38.8	44.1	Table 1.14
Sherpur			30	10	*				
	Nakuagaon	28	10	10		*	44.7	50.2	Table 1.15

Table 7.3.1 Summary of Radio Design (2/5)

(2) Region-NC (Dhaka)

Station	Station	Dist. [km]	Antenna height [m]	Power output [w]	Antenna		Receiving voltage [dBμV]	S/N [dB]	Radio Design Sheet Number (Radio design sheet is attached in ANNEX-VIII.)
					3 elements collinear	5 element yagi			
Dhaka			45	10	*				
	Narsingdi	40	20	10	*		36.1	40.4	Table 2.1
	Manikganj	37	40	10	*		35.9	40.6	Table 2.6
	Dhaka(Mill Barak	2	10	10		*	67.0	75.1	Table 2.5
Narsingdi			40	10	*				
	Bhairab Bazar	30	10	10		*	44.5	49.8	Table 2.4
	Debidwar	35	20	10	*		38.2	43.0	Table 2.2
Debidwar			20	10	*				
	Comilla	30	10	10		*	44.5	49.8	Table 2.3
Manikganj			40	10	*				
	Tangail	47	40	10	*		34.1	37.7	Table 2.7
Tangail			40	10	*				
	Sirajganj	26	10	10		*	44.9	50.6	Table 2.8

Table 7.3.1 Summary of Radio Design (3/5)

(3) Region-SE (Chittagong)

Station	Station	Dist. [km]	Antenna height [m]	Power output [w]	Antenna		Receiving voltage [dBμV]	S/N [dB]	Radio Design Sheet Number (Radio design sheet is attached in ANNEX-VIII.)
					3 elements collinear	5 element yagi			
Chitagong			30	10	*				
	Chittagong(Sadarghat	5	10	10		*	59.6	67.4	Table 3.3
	Hathazari	15	20	10	*		45.2	52.0	Table 3.2
Hathazari			20	10	*				
	Panchapukuria	25	10	10		*	46.0	51.9	Table 3.1

Table 7.3.1 Summary of Radio Design (4/5)

(4) Region-SW (Barisal)

Station	Station	Dist. [km]	Antenna height [m]	Power output [w]	Antenna		Receiving voltage [dBμV]	S/N [dB]	Radio Design Sheet Number (Radio design sheet is attached in ANNEX-VIII.)
					3 elements collinear	5 element yagi			
Bagerhat			20	10	*				
	Pirojpur	25	30	10	*		40.7	46.6	Table 4.2
	Mongla	25	10	10		*	46.0	51.9	Table 4.1
Pirojpur			30	10	*				
	Rayenda	18	10	10		*	48.5	55.0	Table 4.3
	Patuakhali	45	30	10	*		35.7	39.1	Table 4.4
	Barisal	40	30	10	*		36.3	40.6	Table 4.8
Barisal			30	10	*				
	Bhola	30	10	10	*		39.6	44.9	Table 4.9
Bhola			10	10	*				
	Daulutkhan	15	10	10		*	46.4	53.2	Table 4.1
Patuakhali			30	10	*				
	Dasmina	26	10	10		*	45.3	51.0	Table 4.7
	Barguna	30	10	10	*		39.6	44.9	Table 4.6
Barguna			10	10	*				
	Patuarghata	20	10	10		*	48.4	54.7	Table 4.5

Table 7.3.1 Summary of Radio Design (5/5)

(5) Region-NW (Rangpur)

Station	Station	Dist. [km]	Antenna height [m]	Power output [w]	Antenna		Receiving voltage [dBμV]	S/N [dB]	Radio Design Sheet Number (Radio design sheet is attached in ANNEX-VIII.)
					3 elements collinear	5 element yagi			
Rangpur			30	10	*				
	Kurigram	40	10	10	*		36.3	40.6	Table 5.5
	Nilphamari	45	30	10	*		35.2	39.1	Table 5.4
	Chimari	42	30	10	*		35.8	40.0	Table 5.7
Chimari									
	Gaibandha	30	40	10	*		38.4	43.7	Table 5.8
Gaibandha									
	Sariakandi	47	30	10	*		34.5	38.1	Table 5.9
Sariakandi									
	Bogra	20	30	10	*		42.3	48.6	Table 5.1
Bogra									
	Naogaun	45	30	10	*		35.2	39.1	Table 5.11
Natore			40	10					
	Rajshahi	40	30	10	*		35.9	40.2	Table 5.15
	Naogaun	45	30	10	*		35.2	39.1	Table 5.12
Kurigram			10	10	*				
	Noonkhawa	10	10	10		*	53.6	60.9	Table 5.6
Nilphamari			30	10					
	Boda	40	30	10	*		36.3	40.6	Table 5.2
	Dalia	35	10	10		*	42.7	47.5	Table 5.3
Boda			30	10	*				
	Panchagarh	20	10	10		*	47.6	53.9	Table 5.1
Pankha			10	10		*			
	Nawabganj	30	40	10	*		43.7	49.0	Table 5.13
Nawabganj			40	10	*				
	Rajshahi	39	40	10	*		35.7	40.1	Table 5.14

Table 7.3.2 Summary of Test Result for HF Data Transmission Test

Data	Time	Transmitter	Receiver	Frequency [MHz]															Note
				3.305			4.442			5.089			8.188			8.157 (tested for reference)			
				Successful Trial	Number of Trial	Ratio of Success	Successful Trial	Number of Trial	Ratio of Success	Successful Trial	Number of Trial	Ratio of Success	Successful Trial	Number of Trial	Ratio of Success	Successful Trial	Number of Trial	Ratio of Success	
July 22, 2003	12:24-13:59	Dhaka	Sylhet										12	12	100%	12	12	100%	*1
	11:27-12:19	Sylhet	Dhaka										9	12	75%	12	12	100%	*1
	15:12-15:48	Dhaka	Sylhet										11	12	92%	11	12	92%	*1
	14:24-15:03	Sylhet	Dhaka										6	12	50%	5	12	42%	*1
	20:47-21:57	Dhaka	Sylhet	0	7	0%	5	12	42%	8	12	67%	10	12	83%				*2
July 26, 2003	5:26-6:04	Dhaka	Sylhet	0	7	0%	0	12	0%	0	12	0%	0	12	0%				*2
	6:37-7:22	Sylhet	Dhaka				0	12	0%	2	12	17%	7	12	58%				*2
	8:32-9:04	Dhaka	Sylhet				0	12	0%	0	12	0%	4	12	33%				*2
	7:47-8:29	Sylhet	Dhaka				0	12	0%	0	12	0%	6	12	50%				*2
	9:59-10:31	Dhaka	Sylhet				0	12	0%	0	12	0%	11	12	92%				*2
	10:34-11:08	Sylhet	Dhaka				0	12	0%	0	12	0%	0	12	0%				*2
	20:12-21:02	Sylhet	Dhaka				0	12	0%	0	12	0%	0	12	0%				*2
Total				0	14	0%	5	96	5%	10	96	10%	76	144	53%	40	48	83%	

*1: Voice was not communicated at 3.305, 4.442, 5.089MHz so that data was not considered to be transmitted.
Therefore, data transmission test at these 3 frequencies was omitted.

*2: Due to trouble of test equipment, data transmission test at 3.305MHz was not carried out.
However, voice was not communicated at 3.305MHz so that data was not considered to be transmitted.

**:The successful trial in the above table is summed up at every frequency by the reason
that the success and failure of data transmission does not depend on baud rate and data size.

Table 7.3.3 Summary of Test Result for VHF Interference Measurement

No.	Place	Latitude (N) / Longitude (E	Frequency 149.250 [MHz]					Frequency 166.075 [MHz]				
			Date	Time	The presence or absence of interference radio	Number of presence of interference radio	Average signal level [dBμV]	Date	Time	The presence or absence of interference radio	Number of presence of interference radio	Average signal level [dBμV]
1	Amalshid	24°52'370"/092°22'002"	23-Jul-2003	12:15-15:15	presence /absence			23-Jul-2003	15:16-18:16	presence /absence		
2	Kanaighat	24°59'842"/092°15'699"	24-Jul-2003	10:38-13:38	presence /absence			24-Jul-2003	13:39-16:39	presence /absence		
3	Sarighat	25°05'767"/092°07'253"	25-Jul-2003	10:17-13:17	presence /absence			25-Jul-2203	13:20-16:20	presence /absence		
4	Nakuagaon	25°11'393"/090°10'115"	30-Jul-2003	12:53-14:23	presence /absence			30-Jul-2003	14:24-15:54	presence /absence		
5	Durgapur	25°07'108"/090°40'787"	31-Jul-2003	10:40-13:10	presence /absence			31-Jul-2003	13:12-15:42	presence /absence		
6	Noonkhawa	25°50'716"/089°43'632"	4-Aug-2003	07:25-10:25	presence /absence			4-Aug-2003	11:40-14:40	presence /absence		
7	Kurigram	25°48'519"/089°38'011"	5-Aug-2003	08:58-11:58	presence /absence			5-Aug-2003	12:00-15:00	presence /absence		
8	Dalia	26°09'451"/089°02'211"	6-Aug-2003	09:17-12:17	presence /absence			6-Aug-2003	12:19-15:19	presence /absence		
9	Panchagarh	26°20'293"/088°33'442"	7-Aug-2003	10:04-13:04	presence /absence			7-Aug-2003	13:06-16:06	presence /absence		
10	Pankha	24°38'376"/088°09'836"	9-Aug-2003	09:49-12:49	presence /absence			9-Aug-2003	12:50-15:50	presence /absence		
11	Comilla	23°27'839"/091°11'710"	12-Aug-2003	10:55-13:55	presence /absence			12-Aug-2003	13:56-16:56	presence /absence		
12	Laurergarh	25°11'492"/091°15'224"	15-Aug-2003	11:20-14:20	presence /absence			15-Aug-2003	14:21-17:21	presence /absence		
13	Bhairab Bazar	25°11'486"/091°15'219"	17-Aug-2003	12:18-15:18	presence /absence			17-Aug-2003	15:20-18:20	presence / absence		

Table 7.4.1 Summary of Flood Forecasting Errors Obtained from Trial Simulation

Location	Case	Error (cm) Exceeded For Given Percentage of Time					MAE (m)	Max. Error (m)
		50%	40%	30%	20%	10%		
Flash Flood Areas (Averages Based on 6 Stations)								
24hr	27 Update Stn, Obs. Bound.	0.13	0.17	0.22	0.28	0.40	0.20	1.25
	No Updating, Obs. Bound.	0.15	0.19	0.23	0.34	0.45	0.22	1.13
	27 Update Stn, FFWC Bound.	0.14	0.19	0.26	0.38	0.54	0.24	1.16
48hr	27 Update Stn, Obs. Bound.	0.21	0.27	0.33	0.42	0.60	0.31	1.55
	No Updating, Obs. Bound.	0.23	0.28	0.34	0.47	0.62	0.32	1.39
	27 Update Stn, FFWC Bound.	0.28	0.36	0.46	0.64	0.92	0.41	1.73
72hr	27 Update Stn, Obs. Bound.	0.26	0.35	0.41	0.51	0.69	0.37	1.71
	No Updating, Obs. Bound.	0.28	0.35	0.42	0.58	0.72	0.38	1.55
	27 Update Stn, FFWC Bound.	0.36	0.46	0.63	0.91	1.15	0.54	2.19
Monsoonal Flood Areas (Averages Based on 26 Stations)								
24hr	27 Update Stn, Obs. Bound.	0.05	0.06	0.07	0.09	0.12	0.06	0.28
	No Updating, Obs. Bound.	0.04	0.06	0.07	0.09	0.12	0.06	0.25
	27 Update Stn, FFWC Bound.	0.05	0.06	0.07	0.10	0.13	0.07	0.41
48hr	27 Update Stn, Obs. Bound.	0.08	0.10	0.13	0.16	0.21	0.11	0.46
	No Updating, Obs. Bound.	0.08	0.09	0.11	0.14	0.19	0.10	0.36
	27 Update Stn, FFWC Bound.	0.09	0.12	0.15	0.18	0.26	0.14	0.65
72hr	27 Update Stn, Obs. Bound.	0.12	0.14	0.18	0.22	0.28	0.15	0.58
	No Updating, Obs. Bound.	0.10	0.13	0.16	0.19	0.24	0.13	0.45
	27 Update Stn, FFWC Bound.	0.14	0.18	0.22	0.28	0.40	0.20	0.79

Table 7.6.1 Flood Shelter (Up to June 1999)

	Presented by Private Organization KARITAS	
Sl.	**District Name**	**Number of Shelter**
1.	Gopal Gonj	4
2.	Barishal	2
3.	Madaripur	2
4.	Sherpur	1
5.	Netrokona	3
6.	Mymenshingh	2
7.	Sunamgonj	1
8.	Naogaon	3
9.	Natore	4
10.	Pabna	4
11.	Rajshahi	3
12.	Chapi Nababganj	1
13.	Norail	2
14.	Faridpur	2
15.	Rajbari	2
16.	Kurigram	1
17.	Lalmonirhat	1
18.	Dinajpur	1
19.	Narayangonj	1
20.	Monshigonj	3
21.	Gazipur	6
22.	Sunamgonj	1
23.	Sylhet	1
24.	Dhaka	7
A.	**Total**	**58**

	Constructed By District Administration	
Sl.	**District Name**	**Number of Shelter**
1.	Shirajgonj	4
2.	Gaibandha	5
3.	Brahmman Baria	3
4.	Comilla	25
B.	**Total**	**37**
	Total (A+B)	**95**

Source: DMB.

Table 8.4.1 Staffing of Present FFWS

Division	Operation Task	Maintenance Task	SE	XEN	SDE	AE	Technical Staff	Support Staff	
Field Office	(Surface Water Division)	(Surface Water Division)	1	4	13	22	31	179	108
	Gauge Reading	Maintenance of hydrological survey station	*1 x0.2	x0.2	x0.2	x0.2	x0.2	x0.2	(GaugeReader)
	Set Stuff gauge and measure the level		0.2	0.8	2.6	4.4	6.2	35.8	
Central Office	(PFFC)		1	1	1	2	1	15	
	- SE Office		*2 x0.2	x0.2	x0.2	x0.2	x0.2	x0.2	
	Supervision of C&I and FFWC		0.2	0.2	0.2	0.4	0.2	3	
	-Management & service branch								
	Operation and management of the computer network among the branches of PFFC	Maintenance of the computer network among the branches of PFFC							
	(C&I Division)			1		1	1	15	
	Supervision of C&I Green Road			*3 x0.33		x0.33	x0.33	x0.33	
				0.3		0.3	0.3	5	
	(C&I Green Road)	(C&I Green Road)			1.2	1.2	3.2	11.2	85
	Receiving Data by HF Transceiver	HF Transceiver Maintenance							(HF Operator)
		Automatic gauge Maintenance							
		Telemeter Maintenance							
		Restoration of gauging structure							
	(FFWC)	(FFWC)		1	8			15	
	Receiving Data by HF Transceiver	Validation of analyzing model							
	Set boundary condition	Modification of Hazard map							
	Run the Super Model	Computer System Maintenance							
	(Making Country BULLETIN and Hazard Map)	FFWS Software Maintenance							
	Edit the BULLETIN								
	Dissemination of Fax, E-mail, and WebSite-Upload								
Total		Sub Total	0.4	2.3	12	6.3	9.9	70	193
		Grand Total							293.9

Remark *1 Part Time (Rate for FFWS=0.2)
*2 Part Time (Rate for FFWS=0.2)
*3 Part Time (Rate for FFWS=0.33)

Table 8.4.2 Staffing of Present Hydrology

Division	Circle	Division	Function	Manager					Staff		Field		Others
				CE	SE	XEN	SDE	AE	TS	SS	GR	TCO	
Regional	River Morphology & Research Circle	Mymensingh Division	To carry out the X-section and the Bathymetric survey			1	3	8	14	31			
		Kushitia Division				1	2	6	9	25			
	Surface Water Hydrology Circle	South Eastern Division	To carry out surface water hydrological survey			1	3	5	7	40	38		
		South Western Division				1	4	6	8	48	54		
		North Eastern Division				1	3	5	8	47	52		
		Northern Division				1	3	6	8	44	56		
	Ground Water Hydrology Circle	Div-1	To collect field hydro-geological data			1	8	5	11	40			
		Div-2				1	7	4	11	29			
Regional Total					0	8	33	45	76	304	200	0	
Central	CE Hydrology	CE Office	To provide supervision and technical guidance for the Circles under Hydrology	1		1	1	2	3	12			
	PFFC	SE Office	To supervise the quality control of hydrological &hydro-meteorological data processing		1	1	1	2	1	15			
		River Morphology Processing	To process river morphological data (river section, sounding)			1		3		3			
		Surface Water Processing Branch	To process surface water level data (water level, discharge, rainfall, evaporation)			1		10		6			
		Grand Water Processing Branch	To process ground water data			1		4		3			
		Management & Service Branch	To manage all hardware and software systems including computer network					2		1			
		Index and Publication Branch	To publish annual report etc.					1	1	3			
		FFWC	To collect real time data and prepare warning bulletin			1	8			15			
		C&I(Dhaka)	To supervise C&I(shimarail), C&I(Div-1) and C&I(Div-2)			1		1	1	15			
		C&I(Shimrail))	To repair, maintain and operate watercrafts, vessels, survey instruments for hydrological data collection.				1	2	2	60			
		C&I(Div-1)					1	1	1	6			
		C&I(Div-2)	To construct, operate and maintain wireless stations, wireless receivers and other related equipment.				1	1	3	10		85	
	River Morphology & Research Circle	SE Office	To manage the collection and preservation of raw data		1			3	3	12			
		Mapping Cell	To supervise preparation of maps using PHOCUS software			1		5	13	7			
	Surface Water Hydrology (Dhaka)		To supervise the quality control of hydrological &climatological data collection		1			3	5	10			
	Grand Water Hydrology (Dhaka)		To supervise technical guidance of all field ground data collection network		1	2		1	4	11			
Central Total				1	4	10	13	41	37	189	0	85	
Grand Total				1	4	18	46	86	113	493	200	85	
Total Stuff												1046	

CE:Chief Engineer, SE:Superintending Engineer, XEN:Executive Engineer, SDE:SubDivisional Engineer, AE:Assistant Engineer,
TS:Technical Stuff, SS:Support Stuff, GR:Gauge Reader, TCO:Telecom Operator

Table 8.4.3 Staffing of Improved Hydrology

Division	Circle	Division	Function	Manager					Staff		Field		Others
				CE	SE	XEN	SDE	AE	TS	SS	GR	TCO	
Regional	Regional FHC	(Data Collection)	To maintain gauging station		1	1	1	1	3	8	17		17:Mannual
											1		1:Telemeter
		(Data Transmission)	To operate and maintain data transmission equipment in regional FHC and gauging station				1	1	3				
		(Forecasting)	To forecast water level and prepare regional warning bulletin				1	1	3				
	River Morphology & Research Circle		To carry out the X-section and the Bathymetric survey			1	1	3	5	10			
	Surface Water Hydrology Circle		To carry out surface water hydrological survey			1	3	8	12	15	19		
	Ground Water Hydrology Circle		To collect field hydro-geological data			1	3	2	5	15			
	(Sub Total)				1	4	10	16	31	48	37	0	
Regional Total(Sub Total x 5)					5	20	50	80	155	240	185	0	
Central	CE Hydrology		To provide supervision and technical guidance for the Circles under Hydrology	1		1		2	3	10			
	FHC	(Data Collection)	To supervise regional data collection div.		1	1				7			
		(Data Transmission)	To operate and maintain data transmission equipment in central FHC			1	1	1	3				
		(Forecasting)	To prepare nationwide warning bulletin			1	1	1	3				
	River Morphology & Research Circle		To supervise regional river morphology & research circle and collect river morphology data		1	1		8	15	20			
	Surface Water Hydrology Circle		To supervise regional surface water & hydrology circle and collect surface water data		1	1		3	5	10			
	Ground Water Hydrology Circle		To supervise regional ground water & hydrology circle and collect ground water data		1	1		2	5	10			
	Processing Division		To process all the data (river morphological data, surface water level data and ground water data)			1	5	15	5	15			
	Instrumentation Division		To repair, maintain and operate watercrafts, vessels, survey instruments for hydrological data collection.			1	2	4	5	75			
Central Total				1	4	9	9	36	44	147	0	0	
Grand Total				1	9	29	59	116	199	387	185	0	
Total Stuff												985	

CE:Chief Engineer, SE:Superintending Engineer, XEN:Executive Engineer, SDE:SubDivisional Engineer, AE:Assistant Engineer,
TS:Technical Stuff, SS:Support Stuff, GR:Gauge Reader, TCO:Telecom Operator

Table 9.2.1 Quantities of Main Components

1) Facility

Number of main component		NE Region	NW Region	SE Region	SW Region	Central Region	Central C.ST	Total
A1	Central Office (Dhaka)	0	0	0	0	0	1	1
	- Regional (Dhaka)	0	0	0	0	1	0	1
A2	Regional Office	1	1	1	1	0	0	4
A3	Repeater Station(OM office)	4	9	0	5	3	0	21
A4	Repeater Office(not OM office)	4	0	1	0	1	0	6
A5	Telemeter gauging Station	7	5	2	5	4	0	23
A6	Manual gauging Station	11	19	12	19	24	0	85
	(HF)	5	10	6	10	12	0	43
	(Mobile)	6	9	6	9	12	0	42
A7	Point to Point Direct Dissemination	16	10	6	0	0	0	32

Number of transportation equipment	NE Region	NW Region	SE Region	SW Region	Central Region	Central C.ST	Total
Vehicle	3	3	3	3	0	3	15
Speed Boat	1	1	1	1	0	1	5

Number of office equipment	NE Region	NW Region	SE Region	SW Region	Central Region	Central C.ST	Total
Computer	7	7	7	7	7	9	44
Printer	4	4	4	4	4	9	29
Fax	2	2	2	2	2	3	13
Tel	4	4	4	4	4	5	25
Desk	20	20	20	20	20	13	113
Air conditioner	5	5	5	5	5	9	34

2) Staff

Number of staff	NE Region	NW Region	SE Region	SW Region	Central Region	Central C.ST	Total
SE	0	0	0	0	0	1	1
XEN	1	1	1	1	1	3	8
SDE	3	3	3	3	3	2	17
AE	3	3	3	3	3	2	17
Technical Staff	9	9	9	9	9	6	51
Support Staff	8	8	8	8	8	7	47
Gauge Reader	12	20	13	20	25	0	90
Total	36	44	37	44	49	21	231

Table 9.2.2 Unit Prices Applied for Project Cost Estimate (1/2)

1 Price Rate (Equipment) *Based on the current price in Japan in July 2003*

Item	(Yen)	(Tk)	Conditions
1.1 Equipment			
1.1.1 Antenna System			
1) HF Antenna(Between Central and Regional)	500,000	250,000	
2) HF Antenna(for Manual gauging station)	500,000	250,000	
3) 3-stage collinear antenna	220,000	110,000	
4) 5-element Yagi antenna(Board Type)	83,000	41,500	
5) Coaxial arrester	33,000	16,500	
6) Coaxial cable with connectors	50,000	25,000	
1.1.2 Radio Equipment			
1) HF tranciver(for Regional)	1,500,000	750,000	
2) HF trancievер(for FFWC)	1,500,000	750,000	
3) HF trancievер(for Manual Gauging Station)	1,500,000	750,000	
4) Mobile Modem	500,000	250,000	
5) Reciever Equipment	2,000,000	1,000,000	
6) HF Equipment	1,500,000	750,000	
7) Telemeter Equipment	900,000	450,000	
8) Mobile	50,000	25,000	
1.1.3 I/F system			
1) T&T I/F(Hard)	1,500,000	750,000	
2) T&T I/F(Soft)	5,000,000	2,500,000	
3) Regional I/F(Hard)	1,500,000	750,000	
4) Regional I/F(Soft)	5,000,000	2,500,000	
5) Central I/F(Hard)	1,500,000	750,000	
6) Central I/F(Soft)	5,000,000	2,500,000	
7) Telemeter I/F(Hard)	1,500,000	750,000	
8) Telemeter I/F(Soft)	5,000,000	2,500,000	
9) Manual I/F(Hard)	1,500,000	750,000	
10) Manual I/F(Soft)	5,000,000	2,500,000	
11) HF terminal I/F	500,000	250,000	
1.1.4 Analysis system			
1) Data Base Central(Hard)	5,000,000	2,500,000	
2) Data Base Central(Soft)	10,000,000	5,000,000	
3) Data Base Regional(Hard)	5,000,000	2,500,000	
4) Data Base Regional(Soft)	10,000,000	5,000,000	
5) Super Model System(Hard)	3,000,000	1,500,000	
6) Super Model System(Soft Improve)	5,000,000	2,500,000	
7) Regional Model System(Hard)	3,000,000	1,500,000	
8) Regional Model System(Soft)	15,000,000	7,500,000	
9) LAN Cable	200,000	100,000	
1.1.5 Sensor			
1) Raingauge	110,000	55,000	
2) Cordar(Rainfall)	300,000	150,000	
3) Water-level Gauge(Float pole type H=3.5m)	760,000	380,000	
4) Water-level Gauge(Sonar Type)	1,850,000	925,000	
5) Transmitter(for Float pole type)	370,000	185,000	
6) Antenna,divider(for Float pole type)	170,000	85,000	
7) Reciever(for Float pole type)	300,000	150,000	
8) Cable(for Sonar type:per m)	1,000	500	
9) Lightning pole	267,000	133,500	
10) Digital Recorder	700,000	350,000	

Table 9.2.2 Unit Prices Applied for Project Cost Estimate (2/2)

Item	(Yen)	(Tk)	Conditions
1.1.6 Monitaling system			
1) Monitor Modify I/F(Hard)	3,000,000	1,500,000	
2) Monitor modify I/F(Soft)	5,000,000	2,500,000	
3) Monitering Equipment	400,000	200,000	
4) Monitaoring panel	100,000	50,000	
1.1.7 Power supply			
1) Power Equipment	10,000,000	5,000,000	
2) DC power supply	660,000	330,000	
3) Isolation Transformer	140,000	70,000	
4) Solar cells panel	120,000	60,000	
5) Power distribution board	80,000	40,000	
6) Battery	130,000	65,000	
7) Batterystand	100,000	50,000	
1.1.8 transportation			
1) Vehicle	3,000,000	1,500,000	
2) Electric Motorboat	5,000,000	2,500,000	

2 Price Rate(Works) *Based on the current price in Bangladesh on July 2002*
Referring to "Standard Schedule of Rates Manual" published by BWDB

Item	(Yen)	(Tk)	Conditions
2.1 Civil works			
2.1.1 Station house			
1) Regional office	5,000,000	2,500,000	
2) station house	1,000,000	500,000	
3) Telemeter station house	1,000,000	500,000	
4) Water level gauge (per 1pole)	270,000	135,000	Average of each Estimate
5) Wiring (per m)	2,000	1,000	Average of each Estimate
7) Road Construction etc.(within 500m)	2,000,000	1,000,000	
8) Road Construction etc.(500m more)	4,000,000	2,000,000	
9) Antenna tower(30m)	3,000,000	1,500,000	

Table 9.2.3 Breakdown of Investment Cost

(Unit: Million Taka)

◆Investment Cost	Foreign	Local	Total	%[1)]	Condition
A Direct Installation Cost					
1.1 Equipment	*494.6*	*0.0*	*494.6*	43.1	
1.1.1 AntennaSystem	23.7	0.0	23.7	2.1	
1.1.2 Radio Equipment	99.3	0.0	99.3	8.6	
1.1.3 I/F system	79.0	0.0	79.0	6.9	
1.1.4 Analysis system	94.6	0.0	94.6	8.2	
1.1.5 Sensor	58.9	0.0	58.9	5.1	
1.1.6 Monitoring system	34.6	0.0	34.6	3.0	
1.1.7 Power supply	69.6	0.0	69.6	6.1	
1.1.8 Transportation	35.0	0.0	35.0	3.0	
1.2 Civil works	*0.0*	*144.0*	*144.0*	12.5	
1.3 Installation	*93.8*	*0.6*	*94.4*	8.2	
1.4 Maintenance tool	*25.0*	*0.0*	*25.0*	2.2	
1.5 Spare parts	*98.9*	*0.0*	*98.9*	8.6	1.1 Equipments x 20%
1.6 Ocean and inland transportation	*44.5*	*4.9*	*49.5*	4.3	1.1 Equipments x 9%(Foregin), x 1%(local)
1.7 Office Equipment	*0.0*	*18.4*	*18.4*	1.6	
Total of Direct Installation Cost	**756.8**	**167.9**	**924.8**	**80.5**	
B Administration Cost	0.0	9.2	9.2	0.8	(A.Direct Installation Cost) x 1.0%
C Engineering	129.5	9.2	138.7	12.1	(A.Direct Installation Cost) x 14.0%(Foreign), x 1%(local)
D Training	5.3	0.6	5.9	0.5	(1.1 Equipment + 1.3 Insallation) x 0.9% Foreign), x 0.1%(local)
E Contingency	46.7	4.4	51.1	4.4	(1.2 Civil works) x 14%(forign), x 1%(local), (1.1Equipment+1.3 Installation)x 4.5%(forign), x0.5%(local)
F Price Escalation	3.8	14.7	18.5	1.6	(1.2 Civil works) x 14%(forign), x 1%(local), (1.1Equipment+1.3 Installation)x 4.5%(forign), x0.5%(local)
Total Investment Cost	*942.2*	*206.0*	*1,148.2*	*100.0*	

Note:1) % : Percentage to Total Investment Cost

Table 9.2.4 Unit Prices Applied for Estimation of Annual O&M Cost (1/2)

Item	Unit		Price	Quantity
1 Transportation cost	Executive staff	x 1	44,000	
1.1 By air				
a) Number of trips				1 trip/y
b) unit fare				10,000 Tk
1.2 By land				
a) Number of trips				12 trip/y
b) unit fare				500 Tk
1.3 By ship				
a) Number of trips				12 trip
b) unit fare				500 Tk
1.4 Travel allowance,etc				22,000 Tk/y
2 Communication cost				
2.1 BTTB line	Central and Regional office	x 1	386,016	
1) Fix charge				
a) Charge for Fix line				150 Tk/Month
b) Month				12 Month
(Sub total)				1,800 Tk/y
2) Call charge :Rainy season				
a) Month				6 month
b) Day				183 day
c) Call,Fax,E-mail (between Ct-Rg :far)				24 times/day
d) Charge for call (far)				50.0 Tk/times
e) Call,Fax,E-mail (for dissemination :near)				480 times/day
f) Charge for call (near)				1.7 Tk/times
(Sub total)				368,928 Tk/y
3) Call charge:Dry season				
a) Month				6 month
b) Day				182 day
c) Call,Fax,E-mail (between Ct-Rg :far)				1 times/day
d) Charge for one call (far)				50.0 Tk/times
e) Call,Fax,E-mail (for dissemination :near)				20 times/day
f) Charge for one call (near)				1.7 Tk/times
(Sub total)				15,288 Tk/y
2.2 Mobile	Manual gauging station	x 1	5,060	
a) Month				12 month
b) Days				365 day
c) Fix charge				300 Tk/month
d) Call charge				4.0 Tk/day
2.3 Post, mail etc.	Central and Regional station	x 1	1,000	
a) Post, mail etc.				1,000 Tk/y
2.4 BRTC				
Payment for BRTC	Central	x1	1,500,000	
3 Vehicle operation cost	Vehicle	x 1	255,000	
3.1 Fuel				120,000 Tk/y
3.2 Wages to driver				120,000 Tk/y
3.3 Repairment				15,000 Tk/y
4 Boat operation cost	Boat	x 1	25,000	
4.1 Fuel				10,000 Tk/y
4.2 Wages to driver				10,000 Tk/y
4.3 Repairment				5,000 Tk/y

Table 9.2.4 Unit Prices Applied for Estimation of Annual O&M Cost (2/2)

Item	Unit		Price	Quantity
5 Repair & maintenance cost				
5.1 Telemeter Equipment	Telemeter Equipment Cost	x	0.5%	
5.2 Computer Equipment	Computer Equipment Cost	x	10.0%	
5.3 Civil Works	Civil Work Cost	x	2.0%	
5.4 Civil Works (Existing)	Civil Works (Existing) Cost	x	5.0%	
6 Light,fuel,water cost	Official staff cost	x	5.0%	
7 Consumables Paper, ink, office stationary etc.	Official staff cost	x	3.0%	
8 Advertisement	Official staff cost	x	2.0%	
9 Social expenses	Official staff cost	x	2.0%	
10 Social welfare	Official staff cost	x	1.0%	
11 House & land rental	Central office	x1	330,000	
11.1 unit price per Area(feet square)				150 Tk/sq.ft
11.2 Rental Area (Dhaka)				2,200 sq.ft
12 Training cost	Number of Official staff	x	5,000	
12.1 Number of training days				10 day
12.2 Fee				500 Tk/day
13 Insurance	Total OM	x	1.0%	
14 Sundry	Total OM	x	5.0%	

Table 9.2.5 Breakdown of Annual Operation and Maintenance Cost of the Proposed Project

(Unit: Million Taka / Year)

◆Annual OM Cost	Foreign	Local	Total	%[1)]	Condition
A Staff		23.0	23.0	2.0	
B O&M					
1 Transportation cost		1.9	1.9	0.2	
2 Communication cost		4.0	4.0	0.4	
3 Vehicle operation cost		3.8	3.8	0.3	
4 Boat operation cost		0.1	0.1	0.0	
5 Repair & maintenance cost		27.1	27.1	2.4	
6 Light,fuel,water cost		0.8	0.8	0.1	
7 Consumables		0.5	0.5	0.0	
8 Advertisement		0.3	0.3	0.0	
9 Social expenses		0.3	0.3	0.0	
10 Social welfare		0.2	0.2	0.0	
11 House & land rental		0.3	0.3	0.0	
12 Training cost		0.7	0.7	0.1	
13 Insurance		0.4	0.4	0.0	
14 Sundry		2.0	2.0	0.2	
Total of O&M		*42.6*	*42.6*	*3.8*	
Total of A+B		**65.6**	**65.6**	**5.8**	
C Depreciation		136.8	136.8	12.1	
Grand Total		***202.4***	***202.4***	***17.9***	

Note:1) % : Percentage to Total Investment Cost

Table 9.2.6 Detailed Breakdown of Annual O&M Cost of the Proposed Project

(Unit: Taka)

Items	Unit	Quantity		rate	Annual O&M Cost
A.Staff					
1 Official staff (SE,XEN,SDE,AE,Technical Staff, Support Staff)					16,723,000
2 Other staff (Gauge Reader)					6,300,000
(sub total)					23,023,000
B.Operation and Maintenance					
1 Transportation cost	Executive staff (SE,XEN,SDE,AI	43	x	44,000	1,892,000
2 Communication cost					
BTTB line	Central and Regional Office	6	x	386,016	2,316,096
Mobile	Mobile station	42	x	5,060	212,520
Post, mail etc.	Central and Regional Office	6	x	1,000	6,000
BRTC rental	Central Office	1	x	1,500,000	1,500,000
. *(sub total)*					*4,034,616*
3 Vehicle operation cost	Vehicle	15	x	255,000	3,825,000
4 Boat operation cost	Boat	5	x	25,000	125,000
5 Repair & maintenance cost					
Telemeter Equipment	(Telemeter Equipment x 0.5%)				1,257,228
Computer Equipment	(Computer Equipment x 10%)				20,815,000
Civil Works	(Civil work x2.0%)				2,880,300
Civil Works (Existing)	(Civil(existing) x 5.0%)				2,175,000
(sub total)					*27,127,528*
6 Light,fuel,water cost	(Official Staff cost x 5.0%)				836,150
7 Consumables	(Official Staff cost x 3.0%)				501,690
8 Advertisement	(Official Staff cost x 2.0%)				334,460
9 Social expenses	(Official Staff cost x 2.0%)				334,460
10 Social welfare	(Official Staff cost x 1.0%)				167,230
11 House & land rental	Central Office				330,000
12 Training cost	Official staff	141	x	5,000	705,000
(Sub total 1-12)					*40,213,134*
13 Insurance	Sub total of (1-12) x 1.0%		%		402,131
14 Sundry	Sub total of (1-12) x 5.0%		%		2,010,657
(Sub total cost of B)					*42,625,922*
C.Depreciation Cost					
Computer depreciation cost	computer/5(year) x 0.9				9,189,000
Equipment depreciation cost	equipment/10(year) x 0.9				123,282,369
Civil depreciation cost	civil/30(year) x 0.9				4,320,450
(Sub total cost of C)					*136,791,819*
Total(A+B+C)					**202,441,000**

Table 9.2.7 Actual Operation and Maintenance Cost for Existing FFWS (1/2)

(Unit: Taka)

Division	Position		Number of office staff	Salary	Amount	Remarks
(A)S.W.H	Salary					
		SE	1	20,000 x 14(man-year)	280,000	
		XEN/SA	4	17,000 x 14(man-year)	952,000	
		SDE/Programer	13	15,000 x 14(man-year)	2,730,000	
		AE/AD	22	10,000 x 14(man-year)	3,080,000	
		Technical staff	31	6,500 x 14(man-year)	2,821,000	
		Generarl staff	179	6,000 x 14(man-year)	15,036,000	
		(Sub Total)	250		24,899,000	100%
					4,979,800	20%
		Gauge Reader	108	5,000 x 14(man-year)	7,560,000	100%
		(Total Salary)			12,539,800	
	O&M Cost					
		TA+DA+office expenses+vehicle(repair,fuel), etc.			11,000,000	100%
					2,200,000	20%
	Salary + O&M Cost				14,739,800	
(B) PFFC	Salary					
		SE	1	20,000 x 14(man-year)	280,000	
		XEN/SA	1	17,000 x 14(man-year)	238,000	
		SDE/Programer	1	15,000 x 14(man-year)	210,000	
		AE/AD	2	10,000 x 14(man-year)	280,000	
		Technical staff	1	6,500 x 14(man-year)	91,000	
		General staff	15	6,000 x 14(man-year)	1,260,000	
		(Sub Total)			2,359,000	100%
					471,800	20%
		(Total Salary)			471,800	
	O&M Cost					
		TA+DA+office expenses+vehicle(repair,fuel), etc.			1,258,000	100%
					251,600	20%
	Salary + O&M Cost				723,400	
(C) C&I division	Salary					
		SE	0	20,000 x 14(man-year)	0	
		XEN/SA	1	17,000 x 14(man-year)	238,000	
		SDE/Programer	0	15,000 x 14(man-year)	0	
		AE/AD	1	10,000 x 14(man-year)	140,000	
		Technical staff	1	6,500 x 14(man-year)	91,000	
		General staff	15	6,000 x 14(man-year)	1,260,000	
		(Sub Total)			1,729,000	100%
					570,570	33%
		(Total Salary)			570,570	
	O&M Cost					
		TA+DA+office expenses+vehicle(repair,fuel), etc.			1,165,000	100%
					233,000	20%
	Salary + O&M Cost				803,570	

Table 9.2.7 Actual Operation and Maintenance Cost for Existing FFWS (2/2)

(Unit: Taka)

Division	Position		Number of office staff	Salary	Amount	Remarks
(D) C&I (Green Road)	Salary					
		SE	0	20,000 x 14(man-year)	0	
		XEN/SA	0	17,000 x 14(man-year)	0	
		SDE/Programer	1.2	15,000 x 14(man-year)	252,000	
		AE/AD	1.2	10,000 x 14(man-year)	168,000	
		Technical staff	3.2	6,500 x 14(man-year)	291,200	
		General staff	11.2	6,000 x 14(man-year)	940,800	
		(Sub Total)			1,652,000	100%
		T.C.O	85	5,000 x 14(man-year)	5,950,000	
		(Sub total of Salary)			7,602,000	
	O&M Cost					
		Electricity bill			250,000	
		Repair, Fuel and Lubricants(for Vehicle)			175,000	
		Payment to BRTC			1,800,000	
		Payment to BTTB			2,500,000	
		Repair and Maintenance of HF Transceivers			1,500,000	
		Repair and Maintenance			120,000	
		(sub total of OM)			6,345,000	
	Salary + O&M Cost				13,947,000	
(E) FFWC	Salary					
		SE	0	20,000 x 14(man-year)	0	
		XEN/SA	1	17,000 x 14(man-year)	238,000	
		SDE/Programer	8	15,000 x 14(man-year)	1,680,000	
		AE/AD	0	10,000 x 14(man-year)	0	
		Technical staff	0	6,500 x 14(man-year)	0	
		General staff	15	6,000 x 14(man-year)	1,260,000	
		(Sub total of Salary)			3,178,000	100%
	O&M Cost					
		TA+DA+office expenses+vehicle(repair,fuel), etc.			650,000	100%
	Salary + O&M Cost				3,828,000	
Grand Total					**34,041,770**	

Note) Existing annual O&M cost is estimated by 2003 budget or actual achievements

Table 9.2.8 Comparison of Annual O&M Cost

Total

(Unit: Million Taka)

No	Item	Actual O&M cost (for existing FFWS)	Required O&M cost (for existing FFWS)	Project O&M Cost (for proposed FFWS)	Remarks
I.	Staff Cost (A)	24.4	24.4	23.0	
II.	Repair, Maintenance (B-2)	1.7	10.5	27.1	
III.	other O&Ms (B-1 + B-3)	8.0	9.4	15.5	
	Subtotal (A+B)	*34.1*	*44.3*	*65.6*	
IV.	Depreciation	0.0	26.3	136.8	
	Total (A+B+C)	**34.1**	**70.6**	**202.4**	

Breakdown

(Unit: Million Taka)

A. Staff Cost (Salary)

No	Item	Actual O&M cost (for existing FFWS)	Required O&M cost (for existing FFWS)	Project O&M Cost (for proposed FFWS)	Remarks
1	Office staff	10.9	10.9	16.7	
2	Gauge reader/HF Operator	13.5	13.5	6.3	
	Total of Staff Cost	*24.4*	*24.4*	*23.0*	

B. Operation and Maintenance

B-1.(Items counted in existing O&M)

No	Item	Actual O&M cost (for existing FFWS)	Required O&M cost (for existing FFWS)	Project O&M Cost (for proposed FFWS)	Remarks
1	Office expenses+vehicle(repair,fuel), etc.	3.7	3.7	8.4	
2	Communication	4.3	4.3	4.0	
	Total of B-1	*8.0*	*8.0*	*12.5*	

B-2.(Repair and Maintenance Cost for effective O&M)

No	Item	Actual O&M cost (for existing FFWS)	Required O&M cost (for existing FFWS)	Project O&M Cost (for proposed FFWS)	Remarks
1	Existing Repair and Maintenance(computer,telemeter)	1.7	-	-	
2	Telemeter	-	1.0	1.3	telemeter x 0.5%
3	Computer	-	5.0	20.8	Computer x 10%
4	Civil	-	4.5	6.0	Civil x 5%
	Total of B-2	*1.7*	*10.5*	*27.1*	

B-3.(Other additional O&M)

No	Item	Actual O&M cost (for existing FFWS)	Required O&M cost (for existing FFWS)	Project O&M Cost (for proposed FFWS)	Remarks
1	House & land rental	-	0.0	0.3	
2	Training cost	-	0.5	0.7	Office staff x 5,000(Tk)
3	Sundry	-	0.9	2.0	other OM x 5%
	Total of B-3	*0.0*	*1.4*	*3.0*	

C. Depreciation

No	Item	Actual O&M cost (for existing FFWS)	Required O&M cost (for existing FFWS)	Project O&M Cost (for proposed FFWS)	Remarks
1	Mobile & Computer (Hardware) depreciation cost	×	2.2	9.2	Mobile&Hard/5(year) x 0.9
2	Other Equipment depreciation cost	×	21.4	123.3	Other Equipment/10(year) x 0.9
3	Civil depreciation cost	×	2.7	4.3	Civil/30(year) x 0.9
	Total of Depreciation	*0.0*	*26.3*	*136.8*	