CHAPTER 8

PROJECT COST

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8.1 CONDITIONS FOR COST ESTIMATE

The project cost was estimated based on the preliminary design of water supply facilities. Unit prices and lump sum prices were established considering local construction conditions, availability of construction materials and equipment, suitability of the construction method as well.

Assumptions and conditions applied for the cost estimate were as follows;

Price Level : as of December 2001

Foreign Exchange Rate : 500 Kyat = 1.00 US$ = 120 Japanese Yen

8.2 PROJECT COST

As aforementioned, the project implementation period was divided into two (2) phases and each phase was separated into two (2) stages as follows;

Phase	Implementation Year
Phase 1	2003 to 2010
Phase 2	2011 to 2020

Based on the phased project implementation plan shown in the previous sections, project cost was calculated. Summary of the project cost is shown in Table 8.1. Detail project costs are shown in Table 8.2 and 8.3 while the implementation schedule is shown in Table 8.4 and 8.5, respectively.

Table 8.1 Summary of Project Cost

Unit : US$

	L/C	F/C	Total
Phase-1	110,075,000	720,173,000	830,248,000
Phase-2	111,708,000	541,083,000	652,791,000
Total	221,783,000	1,261,256,000	1,483,039,000

Major unit costs and details are shown in Appendix N.

Figure 8.1 shows the relation between water demand and available water supply amount in every five years up to the target year of 2020.

Table 8.2 Project Cost (Phase 1) (1 of 4)

(unit : thousand US$)

No.	Facility	Dimension	Phase 1										
			2003	2004	2005	2006	2007	2008	2009	2010	L/C	F/C	Total
1	**Rehabilitation**	**Dia. 75 to 450 mm**											
1.1	**Replacement of aged distribution pipe < 80 years old**	**L = 348,900 m**											
1.1.1	Botataung, Kyauktada, Lanmadaw, Latha, Pabedon,			350	350	350	351	351			1752		6555
	Pazundaung			960	960	961	961	961				4803	
1.1.2	Tamwe			96	96	97	97	97			483		865
				76	76	76	77	77				382	
1.1.3	Ahlone, Kyeemyindaing			150	150	150	151	151			752		1217
				93	93	93	93	93				465	
1.2	**Replacement of aged distribution pipe**												
	< 80 and > 50 years old												
1.2.1	Sanchaung					104	105	105	105	105	524		992
						93	93	94	94	94		468	
1.2.2	Mingalartaungnyunt					68	68	69	69	69	343		1423
						216	216	216	216	215		1080	
1.2.3	Dagon, Bahan, Yankin					279	279	279	279	280	1396		3745
						469	470	470	470	470		2349	
2	**Development of Reservoir System**												
2.1	**Ngamoeyeik reservoir System**												
2.1.1	Transmission line	Dia.1800 x 30.75 km		1078	1078	1078					3234		64677
				20481	20481	20481						61443	
2.1.2	Pumping station	409,000 m3/d				371					371		7033
						6662						6662	
2.1.3	*Duplication of dia.1100 mm line*	Dia.1100 x 13.28 km					586				586		11724
							11138					11138	
2.2	**Strengthen of existing reservoir system**												
2.2.1	Gyobyu pump rehabilitation (3 pumps)	9,930 m3/hr		25							25		500
				475								475	
2.2.2	Phugyi additional 1 pump	5,160 m3/hr		20							20		400
				380								380	
3	**Hlaing River System**												
3.1	**Intake facility**												
3.1.1	Intake facilities								291	292	583		2917
									1167	1167		2334	
3.2	**Hlaing river system (1/2)**												
3.2.1	Raw water main	Dia.2500 x 7km								978	978		19560
										18582		18582	
3.2.2	Pumping station	491,000 m3/d								267	267		5342
										5075		5075	
3.2.3	Water treatment plant	470,000 m3/d						10979	10980	10980	32939		123899
								30319	30320	30321		90960	
3.2.4	Transmission pumping station	470,000 m3/d								352	352		7042
										6690		6690	
3.2.5	Transmission main	Dia.2000 x 33.3km						1435	1435	1435	4305		86109
								27268	27268	27268		81804	
4	***Terminal System***												
4.1	**Connections**												
4.1.1	Intake facilities and raw water main				339						339		1637
					1298							1298	

Table 8.2 Project Cost (Phase 1) (2 of 4)

(unit : thousand US$)

No.	Facility	Dimension	Phase 1										
			2003	2004	2005	2006	2007	2008	2009	2010	L/C	F/C	Total
4.1.2	Gyobyu connection pipe	Dia.1400 x 4.2km				283					283		5662
						5379						5379	
4.1.3	Connection to existing transmissions	Dia.1650 x 1.0 km				148					148		2955
		Dia.1100 x 1.3 km				2807						2807	
4.2	**Terminal reservoir (TR)**												
4.2.1	TR (2/4)	40,000 m3				1400					1400		7000
						5600						5600	
4.2.2	TR (1/4)	20,000 m3								700	700		3500
										2800		2800	
4.2.3	Water treatment plant					3309				1654	4963		24813
						13233				6617		19850	
4.3	**Transmission pumping station**												
4.3.1	PS for Downtown	400 m3/min				352					352		7042
						6690						6690	
4.3.2	PS for Central-West, DT East, East South	480 m3/min					308				308		6162
							5854					5854	
4.3.3	PS for Central North, Hlawga and East North and Central	640 m3/min							136	136	272		5431
									2579	2580		5159	
5	**Transmission and Distribution System**												
5.1	**Downtown (Zone 1)**												
5.1.1	*Stengthening of transmission line*	*Dia. 1400 x 1.35 km*		91							91		1820
				1729								1729	
5.1.2	Rehabilitation of central reservoir	45,450 m^3 (10 MG)									0		0
												0	
5.1.3	Distribution network				201	215	191	191	191	190	1179		13381
					2115	2381	1928	1928	1928	1922		12202	
5.2	**Downtown East (Zone 2)**												
5.2.1	Transmission line (from CB West SR)	Dia.1800 x 12.2 km					641	641			1282		25661
							12189	12190				24379	
5.2.2	Service reservoir	50,000 m^3						2343			2343		6336
								3993				3993	
5.2.3	Distribution pumping station	474 m3/min						235			235		4708
								4473				4473	
5.2.4	Distribution network						371	371	372	354	1458		6410
							1315	1315	1319	993		4942	
5.3	**Central West (Zone 3)**												
5.3.1	Transmission line (From TR)	Dia.2700 x 7.5 km				840	840				1680		33605
						15962	15963					31925	
5.3.2	Service reservoir	50,000 m^3					833				833		4166
							3333					3333	
5.3.3	Distribution network					284	340	340	340	340	1644		9164
						1276	1561	1561	1561	1561		7520	
5.4	**Hlawga zone (Zone 4)**												
5.4.1	Transmission line (From TR)	Dia.2200 x 3.9 km							426	0	426		8515
									8089	0		8089	
5.4.2	Service reservoir	50,000 m^3							833	0	833		4166
									3333	0		3333	
5.4.3	Distribution network						135	356	356	356	1203		7454
							41	2070	2070	2070		6251	

Table 8.2 Project Cost (Phase 1) (3 of 4)

(unit : thousand US$)

No.	Facility	Dimension	Phase 1										
			2003	2004	2005	2006	2007	2008	2009	2010	L/C	F/C	Total
5.5	**Central North (Zone 5)**												
5.5.1	*Transmission line (From CB Hlawga SR)*										0		0
												0	
5.5.2	Service reservoir										0		0
												0	
5.5.3	Distribution network								24	24	48		62
									7	7		14	
5.6	**East South (Zone 6)**												
5.6.1	Transmission line (From DT East)	Dia.1200 x 7.6 km						391			391		7821
								7430				7430	
5.6.2	Service reservoir	25,000 m^3						1213			1213		3370
								2157				2157	
5.6.3	*Distribution pumping station*	210 m3/min						49			49		983
								934				934	
5.6.4	Distribution network							216	216	216	648		2883
								745	745	745		2235	
5.7	**East Central (Zone 7)**												
5.7.1	Transmission line (From East North)										0		0
												0	
5.7.2	Service reservoir										0		0
												0	
5.7.3	Distribution pumping station										0		0
												0	
5.7.4	Distribution network								132	132	264		1624
									680	680		1360	
5.8	**East North (Zone 8)**												
5.8.1	Transmission line (From CB Hlawga SR)										0		0
												0	
5.8.2	Service reservoir										0		0
												0	
5.8.3	Distribution pumping station										0		0
												0	
5.8.4	Distribution network							112	112	112	336		1920
								528	528	528		1584	
5.11	**West North (Zone 11) - Hlaingthaya**												
5.11.1	Groundwater development					587	587	588			1762		24804
	(including GW transmission line)					7681	7681	7680				23042	
5.11.2	Service reservoir	30,000 m^3						1867			1867		4731
								2864				2864	
5.11.3	Distribution pumping station							44			44		875
								831				831	
5.11.4	Distribution network	188 m3/min				30	114	114	114	114	486		3426
						568	593	593	593	593		2940	
5.11.5	Transmission line (From TR)												
6	**Connections**												
6.1	Connection to Hlawga No1 PS to 36 inch pipe now under construction for Dagon Myothit area	Dia.1,200 x 2.0 km							181		181		3614
									3433			3433	

Table 8.2 Project Cost (Phase 1) (4 of 4)

(unit : thousand US$)

No.	Facility	Dimension	Phase 1										
			2003	2004	2005	2006	2007	2008	2009	2010	L/C	F/C	Total
7	Groundwater management in Central Block				4	1	1	2	2	2	12		75
					63							63	
		L/C	0	1,810	2,218	9,946	5,998	22,539	16,594	19,088	78,193		
		F/C	0	24,194	25,086	90,628	63,506	110,790	86,400	110,979		511,583	
		Total	0	26,004	27,304	100,574	69,504	133,329	102,994	130,067	78,193	511,583	589,776
		Indirect Cost	0	5,981	6,280	23,132	15,986	30,666	23,689	29,915	17,984	117,664	135,648
		Engineering Service	0	2,879	3,023	11,134	7,694	14,760	11,401	14,398	8,656	56,632	65,288
		Contingencies	0	1,743	1,830	6,742	4,659	8,938	6,904	8,719	5,242	34,294	39,536
		Grand Total	0	36,607	38,437	141,582	97,843	187,692	144,988	183,100	110,075	720,173	830,248

Table 8.3 Project Cost (Phase 2) (1 of 3)

(unit : thousand US$)

No.	Facility	Dimension	Phase 2												
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	L/C	F/C	Total
3	**Hlaing River System**														
3.3	**Hlaing river system (2/2)**														
3.3.1	Raw water main	Dia.2500 x 7km									978	0	978		19560
											18582	0		18582	
3.3.2	Pumping station	491,000 m3/d									200	0	200		4006
											3806	0		3806	
3.3.3	Water treatment plant	470,000 m3/d							6233	6233	6234	0	18700		77917
									19739	19739	19739	0		59217	
3.3.4	Transmission pumping station	470,000 m3/d									282	0	282		5633
											5351	0		5351	
3.3.5	Transmission main	Dia.2000 x 33.3km							1435	1435	1435	0	4305		86109
									27268	27268	27268	0		81804	
4	**Terminal System**														
4.2	**Terminal reservoir (TR)**														
4.2.1	TR (1/4)	20,000 m3									700		700		3500
											2800			2800	
4.2.2	Water treatment plant	820,000 m3/d								9333	9334		18667		76310
										28821	28822			57643	
4.3	**Transmission pumping station**														
4.3.1	PS for Downtown												0		0
														0	
4.3.2	PS for Central West, DT East, East South	160 m3/min					103						103		2054
							1951							1951	
4.3.3	PS for Central North, Hlawga and East North	80 m3/min					54						54		1086
	and Central						1032							1032	
5	**Transmission and Distribution System**														
5.1	**Downtown (Zone 1)**														
5.1.1	Stengthening of transmission line												0		0
														0	
5.1.2	Rehabilitation of central reservoir	45,450 m^3 (10 MG)	1283										1283		6417
			5134											5134	
5.1.3	Distribution network		91	91	91	91	91	90	90	90	90	71	886		1159
			28	28	28	28	28	28	28	28	28	21		273	
5.2	**Downtown East (Zone 2)**														
5.2.1	Transmission line (from CS West SR)												0		0
														0	
5.2.2	Service reservoir	50,000 m^3						2343					2343		6337
								3994						3994	
5.2.3	Distribution pumping station												0		0
														0	
5.2.4	Distribution network		355	355	355	355	355	355	354	354	354	372	3564		13524
			994	994	994	994	993	993	993	993	993	1019		9960	
5.3	**Central West (Zone 3)**														
5.3.1	Transmission line (From TR)												0		0
														0	
5.3.2	Service reservoir	50,000 m^3					833						833		4167
							3334							3334	

Table 8.3 Project Cost (Phase 2) (2 of 3)

(unit : thousand US$)

No.	Facility	Dimension	Phase 2												
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	L/C	F/C	Total
5.3.3	Distribution network		343	340	340	340	340	340	340	340	339	334	3396		19039
			1625	1561	1561	1561	1561	1561	1561	1561	1561	1530		15643	
5.4	**Hlawga zone (Zone 4)**														
5.4.1	Transmission line (From TR)												0		0
														0	
5.4.2	Service reservoir	50,000 m^3							833				833		4167
									3334					3334	
5.4.3	Distribution network		356	356	356	356	356	356	356	356	355	359	3562		24223
			2071	2071	2071	2070	2070	2070	2070	2070	2070	2028		20661	
5.5	**Central North (Zone 5)**														
5.5.1	Transmission line (From CB Hlawga SR)	Dia.900 x 6.1 km			190								190		3808
					3618									3618	
5.5.2	Service reservoir	10,000 m^3	216										216		1083
			867											867	
5.5.3	Distribution network		45	44	44	24	24	24	24	23	23	18	293		1544
			401	400	403	7	7	7	7	7	7	5		1251	
5.6	**East South (Zone 6)**														
5.6.1	Transmission line (From DT East)												0		0
														0	
5.6.2	Service reservoir	25,000 m^3					1213						1213		3377
							2164							2164	
5.6.3	Distribution pumping station												0		0
														0	
5.6.4	Distribution network		202	202	202	202	202	202	202	201	201	190	2006		6675
			470	470	470	470	470	470	470	470	470	439		4669	
5.7	**East Central (Zone 7)**														
5.7.1	Transmission line (From East North)	Dia.1350 x 7.3km			461								461		9216
					8755									8755	
5.7.2	Service reservoir	50,000 m^3		2427									2427		6753
				4326										4326	
5.7.3	Distribution pumping station	195 m3/min		45									45		900
				855										855	
5.7.4	Distribution network		133	133	133	132	132	132	132	132	132	127	1318		8107
			679	679	679	680	680	680	680	680	680	672		6789	
5.8	**East North (Zone 8)**														
5.8.1	Transmission line (From CB Hlawga SR)	Dia.1400 x 15.2km	512	512									1024		20492
			9734	9734										19468	
5.8.2	Service reservoir	20,000 m^3	874						875				1749		3938
			1094						1095					2189	
5.8.3	Distribution pumping station	120 m3/min	28										28		558
			530											530	
5.8.4	Distribution network		112	112	112	112	112	112	111	111	111	99	1104		6389
			529	529	528	528	528	528	528	528	528	531		5285	
5.9	**West South (Zone 9)**														
5.9.1	Groundwater development		643					257					900		8509
	(including GW transmission line)		5435					2174						7609	

Table 8.3 Project Cost (Phase 2) (3 of 3)

(unit : thousand US$)

No.	Facility	Dimension	Phase 2												
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	L/C	F/C	Total
5.9.2	Service reservoir	10,000 m^3	1196										1196		2490
			1294											1294	
5.9.3	Distribution pumping station	48 m3/min	11										11		225
			214											214	
5.9.4	Distribution network		46	46	39	38	38	38	38	38	38	31	390		793
			158	157	12	12	11	11	11	11	11	9		403	
5.10	**West Central (Zone 10) - S.khanaungto**														
5.10.1	Groundwater development			643				257					900		6509
	(including GW transmission line)			5435				2174						7609	
5.10.2	Service reservoir	10,000 m^3		1196									1196		2490
				1294										1294	
5.10.3	Distribution pumping station	46 m3/min		11									11		217
				206										206	
5.10.4	Distribution network				55	55	55	55	55	54	54	49	432		561
					17	17	16	16	16	16	16	15		129	
5.11	**West North (Zone 11) - Hlaingthaya**														
5.11.1	Groundwater development				154				154				308		2445
	(including Gw transmission line)				1068				1069					2137	
5.11.2	Service reservoir												0		0
														0	
5.11.3	Distribution pumping station												0		0
														0	
5.11.4	Distribution network		114	114	113	113	113	113	113	113	113	108	1127		7050
			594	594	594	594	593	593	593	593	593	582		5923	
5.11.5	Transmission line (From TR)	Dia. 500 x 9.8 km								59	60		119		2380
										1130	1131			2261	
7	Groundwater management in Central Block												0		0
														0	
		L/C	6,560	6,627	2,645	1,818	4,021	4,674	11,345	18,872	21,033	1,758	79,353		
		F/C	31,851	29,333	20,798	6,961	15,438	15,299	59,462	83,915	114,456	6,851		384,364	
		Total	38,411	35,960	23,443	8,779	19,459	19,973	70,807	102,787	135,489	8,609	79,353	384,364	463,717
		Indirect Cost	*8,635*	*8,271*	*5,392*	*2,019*	*4,476*	*4,594*	*16,286*	*23,641*	*31,162*	*1,980*	*18,251*	*88,404*	*106,655*
		Engineering Service	4,252	3,981	2,595	972	2,154	2,211	7,838	11,379	14,999	953	8,784	42,549	51,333
		Contingencies	2,575	2,411	1,572	589	1,304	1,339	4,747	6,890	9,083	577	5,319	25,766	31,085
		Grand Total	54,073	50,622	33,002	12,359	27,393	28,117	99,677	144,697	190,733	12,119	111,708	541,083	652,791

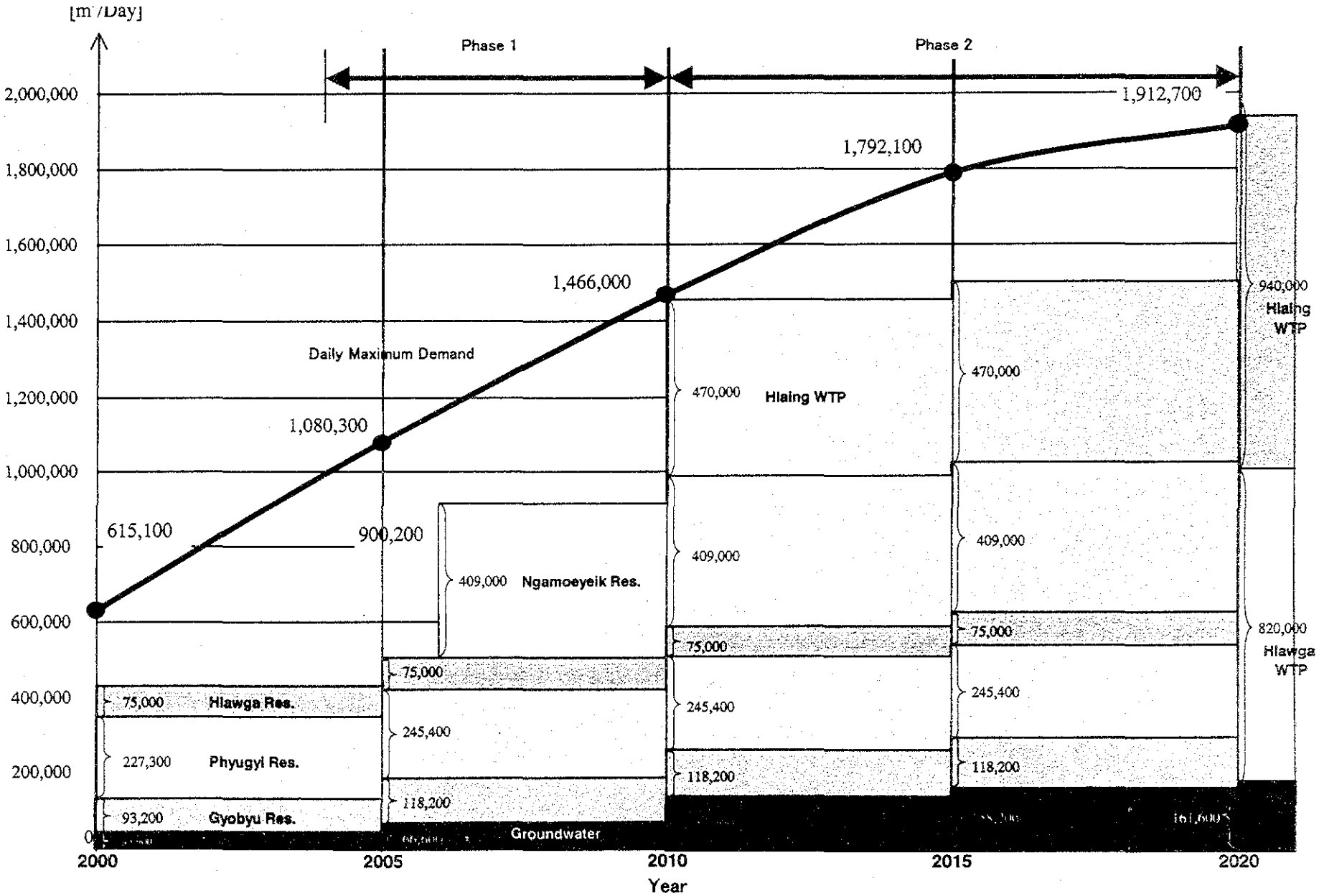


Figure 8.1 Demand Supply Curve

8.3 PROJECT IMPLEMENTATION PLAN

Project implementation plan in Phase-1 and Pgase-2 is shown in Table 8.3 and Table 8.4, respectively. As shown in the tables, the whole Project was classified into several sub-projects and those having higher priority and higher project effects were allocated to Phase-1 for earlier implementation.

Table 8.4 Project Implementation Schedule (Phase-1)

No.	Facility	Dimension	Phase I							
			Stage 1				Stage 2			
			2003	2004	2005	2006	2007	2008	2009	2010
1	**Rehabilitation**	Dia. 75 to 450 mm, L = 348,900 m								
1.1	**Replacement of aged distribution pipe < 80 years old**									
1.1.1	Botataung, Kyauktada, Lanmadaw, Latha, Pabedan, Pazundaung									
1.1.2	Tamwe									
1.1.3	Ahlone, Kyeemyindaing									
1.2	**Replacement of aged distribution pipe < 80 and > 50 years old**									
1.2.1	Sanchaung									
1.2.2	Mingalartaungnyunt									
1.2.3	Dagon, Bahan, Yankin									
2	**Development of Reservoir System**									
2.1	**Ngamoeyeik reservoir System**									
2.1.1	*Transmission line*	Dia.1600 x 30.75 km								
2.1.2	Pumping station	409,000 m3/d								
2.1.3	Duplication of dia.1100 mm line	Dia.1100 x 13.26 km								
2.2	**Strengthen of existing reservoir system**									
2.2.1	Gyobyu pump rehabilitation (3 pumps)	9,930 m3/hr								
2.2.2	Phugyi additional 1 pump	5,160 m3/hr								
3	**Hlaing River System**									
3.1	**Intake facility**									
3.1.1	Intake facilities									
3.2	**Hlaing river system (1/2)**									
3.2.1	Raw water main	Dia.2500 x 7 km								
3.2.2	Pumping station	491,000 m3/d								
3.2.3	Water treatment plant	470,000 m3/d								
3.2.4	Transmission pumping station	470,000 m3/d								
3.2.5	Transmission main	Dia.2000 x 33.3 km								
4	**Terminal System**									
4.1	**Connections**									
4.1.1	Intake facilities and raw water main									
4.1.2	Gyobyu connection pipe	Dia.1400 x 4.2 km								
4.1.3	Connection to existing transmissions	Dia.1650 x1.0 km, Dia. 1100 x 1.3 km								
4.2	**Terminal reservoir (TR)**									
4.2.1	TR (2/4)	40,000 m3								
4.2.2	TR (1/4)	20,000 m3								
4.2.3	TR (1/4)	20,000 m3								
4.3	**Transmission pumping station**									
4.3.1	PS for Downtown	460 m3/min								
4.3.2	PS for Central West, DT East, East South	460 m3/min								
4.3.3	PS for Central North, Hlawga and East North and Central	840 m3/min								
5	**Transmission and Distribution System**									
5.1	**Downtown (Zone 1)**									
5.1.1	Stengthening of transmission line	Dia. 1400 x 1.35 km								
5.1.2	Rehabilitation of central reservoir	45,450 m3 (10 MG)								
5.1.3	Distribution network									
5.2	**Downtown East (Zone 2)**									
5.2.1	Transmission line (from Central West SR)	Dia. 1800 x 12.2 km								
5.2.2	Service reservoir	50,000 m3					(1/2)			
5.2.3	Distribution pumping station	474 m3/min								
5.2.4	Distribution network									
5.3	**Central West (Zone 3)**									
5.3.1	Transmission line (From TR)	Dia. 2700 x 7.5 km								
5.3.2	Service reservoir	50,000 m3				(1/2)				
5.3.3	Distribution network									
5.4	**Hlawga zone (Zone 4)**									
5.4.1	Transmission line (From TR)	Dia. 2200 x 3.9 km								
5.4.2	Service reservoir	50,000 m3						(1/2)		
5.4.3	Distribution network									
5.5	**Central North (Zone 5)**									
5.5.1	Transmission line (From TR)									
5.5.2	Service reservoir									
5.5.3	Distribution network									
5.6	**East South (Zone 6)**									
5.6.1	Transmission line (From DT East)	Dia. 1200 x 7.6 km								
5.6.2	Service reservoir	25,000 m3					(1/2)			
5.6.3	Distribution pumping station	210 m3/min								
5.6.4	Distribution network									
5.7	**East Central (Zone 7)**									
5.7.1	Transmission line (From East North)									
5.7.2	Service reservoir									
5.7.3	Distribution pumping station									
5.7.4	Distribution network									
5.8	**East North (Zone 8)**									
5.8.1	Transmission line (From TR)									
5.8.2	Service reservoir									
5.8.3	Distribution pumping station									
5.8.4	Distribution network									
5.11	**West North (Zone 11) - Hlaingthaya**									
5.11.1	Groundwater development									
5.11.2	Transmission line for groundwater									
5.11.3	Transmission line from central system									
5.11.4	Service reservoir	30,000 m3								
5.11.5	Distribution pumping station	188 m3/min								
5.11.6	Distribution network									
6	**Connections**									
6.1	Connection to Hlawga No1 PS to 36 inch pipe now under construction for Dagon Myothit area	Dia. 1200 x 2.0 km								
7	Groundwater management in Central Block									
	Annual Construction Cost (million US$)	**Total 830 million $**			37	38	141	98	168	145	183

Table 8.5 Project Implementation Schedule (Phase-2)

No.	Facility	Dimension	Phase 2									
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
3	**Hlaing River System**											
3.3	**Hlaing river system (2/2)**											
3.3.1	Raw water main											
3.3.2	Pumping station											
3.3.3	Water treatment plant											
3.3.4	Transmission pumping station											
3.3.5	Transmission main	Dia.2000 x 33.3km										
4	**Terminal System**											
4.2	**Terminal Reservoir**											
4.2.1	TR (1/4)	20,000 m3										
4.2.2	**Water Treatment Plant**	820,000 m3/d										
4.3	**Transmission pumping station**											
4.3.1	PS for Downtown											
4.3.2	PS for Central West, DT East, East South	160 m3/min										
4.3.3	PS for Central North, Hlawga and East North and Central	80 m3/min										
5	**Transmission and Distribution System**											
5.1	*Downtown (Zone 1)*											
5.1.1	**Strengthening of transmission line**											
5.1.2	Rehabilitation of central reservoir	45,450 m3 (10 MG)										
5.1.3	Distribution network											
5.2	**Downtown East (Zone 2)**											
5.2.1	Transmission line (from Central West SR)											
5.2.2	Service reservoir	50,000 m3					(2/2)					
5.2.3	Distribution pumping station											
5.2.4	Distribution network											
5.3	**Central West (Zone 3)**											
5.3.1	Transmission line (From TR)											
5.3.2	Service reservoir	50,000 m3				(2/2)						
5.3.3	Distribution network											
5.4	**Hlawga zone (Zone 4)**											
5.4.1	Transmission line (From TR)											
5.4.2	Service reservoir	50,000 m3						(2/2)				
5.4.3	Distribution network											
5.5	**Central North (Zone 5)**											
5.5.1	Transmission line (From TR)	Dia. 900 x 8.1 km										
5.5.2	Service reservoir	10,000 m3										
5.5.3	Distribution network											
5.6	**East South (Zone 6)**											
5.6.1	Transmission line (From DT East)											
5.6.2	Service reservoir	25,000 m3				(2/2)						
5.6.3	Distribution pumping station											
5.6.4	Distribution network											
5.7	**East Central (Zone 7)**											
5.7.1	Transmission line (From East North)	Dia. 1,350 x 7.3 km										
5.7.2	Service reservoir	50,000 m3										
5.7.3	Distribution pumping station	195 m3/min										
5.7.4	Distribution network											
5.8	**East North (Zone 8)**											
5.8.1	Transmission line (From TR)	Dia. 1,400 x 15.2 km										
5.8.2	Service reservoir	20,000 m3		(1/2)				(2/2)				
5.8.3	Distribution pumping station	120 m3/min										
5.8.4	Distribution network											
5.9	**West South (Zone 9)**											
5.9.1	Groundwater development											
5.9.2	Service reservoir	10,000 m3										
5.9.3	Distribution pumping station	48 m3/min										
5.9.4	Distribution network											
5.10	**West Central (Zone 10) - S.khanaungto**											
5.10.1	Groundwater development											
5.10.2	Service reservoir	10,000 m3										
5.10.3	Distribution pumping station	46 m3/min										
5.10.4	Distribution network											
5.11	**West North (Zone 11) - Hlaingthaya**											
5.11.1	Groundwater development											
5.11.3	Transmission line from central system	Dia. 500 x 9.8 km										
5.11.4	Service reservoir											
5.11.5	Distribution pumping station											
5.11.6	Distribution network											
	Annual Construction Cost (million US$)	**Total 653 million $**	**54**	**51**	**33**	**12**	**27**	**28**	**100**	**145**	**191**	**12**

CHAPTER 9

PROJECT EVALUATION

CHAPTER 9 PROJECT EVALUATION

9.1 ECONOMIC EVALUATION

9.1.1 Basic Concept and Methodology

(1) Basic Concept of Economic Analysis for Water Supply System

An economic analysis appraises a project under study in terms of a national and/or a regional social economy by comparing and measuring its economic costs and benefits. In other words, economic analysis evaluates a degree of economic impacts on a project under study that would bring about in the national and/or regional social economy.

The economic justification for the project is usually measured by (1) the net present value (NPV or B - C), (2) the benefit cost ratio (B/C ratio) and (3) the economic internal rate of return (EIRR) as indicators as results of comparison of economic benefits and costs.

Generally, there are three methods for estimation of economic benefit as (1) the method of long run marginal cost (the LRMC method), (2) the method by means of an alternative water supply system (the AWS method) and (3) the method by means of willingness of people to pay (the WTP method).

Among the above methods, the WTP method is the most suitable one for this kind of project on improvement of water supply system. Following description is an outline to estimate the basic unit of potable water price based on this method.

(2) Basic Concept of Economic Benefit in WTP Method

Generally, existing water price is to set as a lower limit of the willingness to pay, and the cost for alternative water sources paid by people who do not have public water supply systems yet is to set as an upper limit of willingness to pay. The applicable economic water price taking water scarcity into account may be in between these lower limit and upper limit of the willingness of people to pay.

When the applicable economic water price taking water scarcity into account is in between those lower limit and upper limit of the willingness to pay, how do we do to strike an exact amount of the willingness to pay? In this case, a concept of "consumer surplus" and "producer surplus" is needed to understand this method.

Assuming that demand and supply are balanced at the point P_0 in the following figure, the area ABP_0 is called as "consumer surplus". In this case, if the price is increased until the point B, namely the price is maximized, demand D will become zero. As the price goes down toward the P_0 from the point B, the demand is gradually increased.

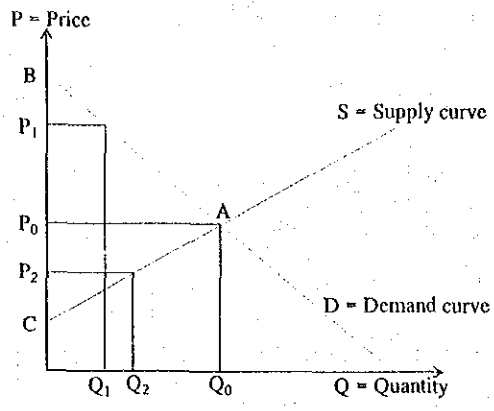


Fig. 9.1 Relationship between Demand and Supply

For example in potable water supply sector, it means that there are consumers who want to buy the water with higher price, namely the price level at the point of P_1, than the existing price level of water, and these consumers have their willingness to pay with higher price than P_0. In other words, these consumers have their surpluses expressed by "$P_0 - P_1$" against the point P_0. Namely, they have a reserve ability to purchase the water.

In WTP method, the economic water price is estimated by means of the said consumer surplus adding to the existing water price. However, people living in the targeted area have already paid some amount for alternative water sources, this amount of payment may assume directly as the total amount consisting of the consumer surplus and the existing water price. This amount of payment is usually called as the amount of "affordability of people to pay (ATP)".

(3) Estimation of Applicable Economic Price of Water

Estimation of the economic water price in the WTP method should be made stepwise through following 5 stages as:

- Estimation of Lower Limit of Willingness to Pay,
- Estimation of Upper Limit of Willingness to Pay,
- Estimation of Water Demand Structure at the Beginning of Commercial Operation of Water Supply Systems,
- Study on Demand Elasticity, and
- Calculation of Applicable Economic Price of Water

1) Estimation of Lower Limit of Willingness to Pay

As mentioned above, existing average water price should be estimated based on statistics on water. The formula is:

$$LLWTP = \frac{R_t}{V_m}$$

Where, $LLWTP$ = Lower limit of willingness to pay,
R_t = Revenue in total
V_m = Total water sold in m^3

2) Estimation of Upper Limit of Willingness to Pay

First of all, actual condition to take water should be studied through a direct interview survey for household in targeted areas who do not have accessibility yet to public water supply systems. The alternative water sources are usually used for both washing and drinking and/or cooking. After making clear a part of fixed cost as capital cost and the other part of variable cost like operation and maintenance cost, unit-cost of water should be estimated. This unit-cost of water is the upper limit of willingness of domestic users to pay.

In the direct interview survey, following items should be included in the questionnaire:

On Equipment, Facilities and Tools for Getting Water: Costs for these items are equivalent to capital cost in water supply systems. In case that people living in the area usually use private tube well as an alternative water sources, they consist of costs for construction of wells, pumping facilities consisting of electric motor and compressor together with casing pipe, water tank in case of newly constructing and their life times, spare-parts and consumables, repair cost, cost for replacement of spare-parts, and average hours of their usage per month or per day together with electricity cost for motor as a operation and maintenance cost. These items are not always fully got in the interview survey, so the data and/or information should be supported by statistical data on consumable goods and services. Especially, because it is quite rare they have an accurate grasp on the lifetimes of the facilities, it should be surveyed by another means. Average volume of water they have usually consumed is also needed to survey. In this case, the costs concerning the wells themselves and costs concerning to house-connection should be separated.

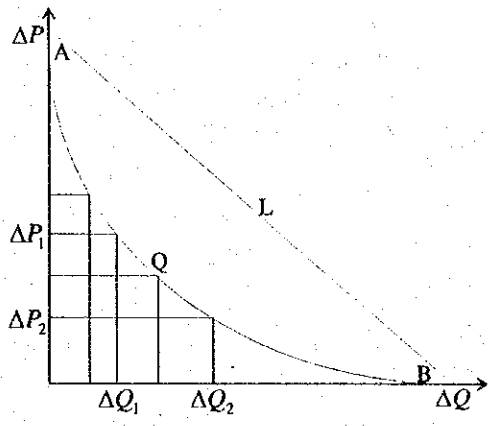
After making clear the above data and information, the average unit cost of water per m^3 can be estimated by using the lifetime of equipment, facilities and tools and their prices at the time of purchase, and the average volume of water consumed. In case that the lifetime is not available, average duration of usage or standard lifetime can be applied as the second best. In this case, repair cost and cost for replacement of spare-parts should be taken into account because sometimes they use them over their lifetime.

Equivalent value of operation and maintenance can be estimated based on working hours per day and basic electricity price usually they pay, and intervals of repair, cleaning of water tank, and/or replacement together their costs per time.

3) Estimation of Water Demand Structure at the Beginning of Commercial Operation of

Improved Water Supply Systems

Because of making clear an existing actual water price structure by kind of customers, it should be needed to estimate the existing demand structure. However, this kind of improvement of water supply system project in developing countries may not always be usually applied.



Where,
△Q: increased volume of supply due to the project under study,
△P: difference between the existing water price (= the lower limit of willingness to pay) and the upper limit of willingness to pay,
$\triangle Q_1$, $\triangle Q_2$: changes in demand, and
$\triangle P_1$, $\triangle P_2$: changes in price.

Here,
Even $\triangle P_1 = \triangle P_2$, $\triangle Q_1 < \triangle Q_2$.

Fig. 9.2 Elasticity of Demand

4) Study on Demand Elasticity

The elasticity of demand means that a change against the water price is not always constant. Namely, because that the demand curve is usually non-linear, tendency of increasing ratio of demand are different in cases of high level and low level in water price. Actually, the area showing the consumer surplus is smaller than the area indicated in Fig. 9.2 above. Generally speaking, the actual consumer surplus is in between 25 % and 35 % of product of increased volume of supply, ΔQ, and increased price, ΔP in the above figure.

5) Calculation of Applicable Economic Price of Water

The applicable economic water price may usually be calculated by the following steps:

- Capable incremental water volume to be supplied is estimated at the beginning of operation of the improved water supply systems by the recommended water supply systems of the project under study. In this case, the water can not always be supplied to all the potential customers and also the water supply volume is depending upon the recommended improved water supply systems. That is why the term "capable" is used.
- The consumer surplus per unit volume is estimated from the balance of existing average water price, namely the lower limit of willingness to pay, and the upper limit of willingness to pay multiplied by a percentage of consumer surplus (for example 30 % in average) taking the said capable water volume to be supplied into consideration in case that the

consumer surplus can not be cleared.

- The applicable economic water price is estimated based on this consumer surplus added by the existing average water price. When the amount of ATP has been cleared, the ATP can be applied as the applicable economic water price.

(5) Methodology of Economic Evaluation

In the water supply project, several benefits can be identified as saving amount of peoples' expenditures for potable water from alternative water resources and/or expenditures for medical costs due to water environmental improvement. In this case, the saving amount of medical cost consists of medical cost itself to hospitals and decrease of personal income loss of inpatients and outpatients because of necessity to come to hospitals more if suffering rate of water borne diseases are decreased.

Therefore, the above mentioned several basic units for estimating economic benefit should be clarified first.

The economic internal rate of return (EIRR) is calculated using the above mentioned benefits and the construction cost converted into economic cost, and used as an index of economic feasibility of the project. This EIRR is defined by the following formula:

$$\sum_{t=1}^{t=T} \frac{C_t}{(1+R)^t} = \sum_{t=1}^{t=T} \frac{B_t}{(1+R)^t}$$

Where, T = the last year of the project life,
C_t = an annual economic cost flow of the project under study in year t,
B_t = an annual benefit flow derived from the project in year t, and
R = the Economic Internal Rate of Return (EIRR).

In this case, the project life is assumed at 50 years after completion of the project.

In developing countries, they sometimes can not burden full water price consisting the initial investment and costs for operation and maintenance, and replacement of facilities, and in this case EIRR can not be calculated because of function of the formula mentioned above. In this case, NPV and/or B/C ratio are usually applied as factors for project evaluation. The NPV and B/C ratio are defined by the following formulas:

$$NPV = \sum_{t=1}^{t=T} \left\{ \frac{B_t}{(1+R)^t} \right\} - \sum_{t=1}^{t=T} \left\{ \frac{C_t}{(1+R)^t} \right\} \text{ and,}$$

$$B/C\,ratio = \frac{\sum_{t=1}^{t=T} \frac{B_t}{(1+R)^t}}{\sum_{t=1}^{t=T} \frac{C_t}{(1+R)^t}}$$

9.1.2 Identification of Economic Benefit

(1) Basic Unit of Economic Water Price

The World Bank has developed a system called as ECOWAT model introduced for estimation of an economic benefit in potable water supply. This approach may also be applied to this Project because that the Project is almost similar to it. Basic concept of ECOWAT model to be applied to this Project may roughly be given as follows:

1) Premise

The water supplied by YCDC is not always potable. Almost of the people has already known that the water should be boiled for making drinkable one even if the water is distributed by YCDC. Nevertheless the people have recognized that the water distributed by YCDC is the best water source for keeping comfortable human life. From this viewpoint, the water distributed by YCDC has dual value so called as (1) basic value and (2) economic value as saving amounts of people's burden to get water from other sources.

2) Basic Value of Water

Following Table 9.1 shows a summary of result of the Consumer Survey made by JICA Study Team in July 2001. Details are shown in Appendix M.1.

Table 9.1 Estimation of Existing Water Price Based on Household Expenditure

Description	Expenditure per HH (Kyats/month)	Existing water price estimated based on expenditure (Kyats/m^3)
Overall simple average	367	11.82
Average in HHs who connect with YCDC water supply	293	8.22
Average in HHs who do not connect with YCDC water supply systems	579	25.39
Private piped water	841	36.91
Common Tube Well	827	36.28
Protected dug well	13	0.59
Private water tanker	1,025	44.99
Neighbor's tap/well	1,512	66.38
Bottled water	1,052	46.18

(Note 1)

Average volumeof water consumed:	Per day (gallons/HH)	Per month (gallons/HH)	Equivalent (m^3)*	Consumed water volume per person (litres/day)
Overall simple average of Yangon City Area	228	6,832	31	190
Average in HHs who connect with YCDC water supply systems	261	7,843	36	219
Average in HHs who do not connect with YCDC water supply systems	167	5,012	23	126

* 1 gallons = 4.546 litres.

(Note 2)

Average family size:

Overall simple average	5.44	(persons/HH)
Average in HHs who connect with YCDC water supply systems	5.41	(persons/HH)
Average in HHs who do not connect with YCDC water supply systems	6.01	(persons/HH)

Source: Consumer Survey made by JICA Study Team, July 2001.

According to the above Table, the people who do not connect with YCDC's piped water obtain the water from (1) private piped water, (2) common tube well, (3) protected dug well, (4) private water tanker, (5) neighbors' tap and/or well, (6) bottled water, and (7) water vendors with a rate of 25 Kyats/m^3 of payment in average ranging from 1 Kyat/m^3 to 66 Kyats/m^3, and a volume of this water to be consumed is around 167 gallons/HH/day (equivalent to 22.775 m^3/month, and 126 *l*/capita.day).

However, if they have no any systematic ways to take water as mentioned above, the people must take water from neighbor's tap and/or well at least with a rate of 66 Kyats/m3 of payment for drinking water and a volume of this water to be consumed is around 126 l/day per person. Furthermore, when they have no neighbors to give them water, they should buy water from water vendors with a rate of 1,320 Kyats/m3 as shown in the following Table 9.2. Therefore, this amount should be assumed as the upper limit of willingness of people to pay.

Table 9.2 Water Price in Case of Water Vendor

Description	Figures
Water volume packed in a drum	50 gallons
Equivalent to:	227 litres
Water price per drum	300 Kyats in avergae
Water volume to be consumed	5,012 gallons/HH/month
Total amount of expenditure	30,070 Kyats/HH/month
Unit price equivalent to:	1,320 Kyats/m^3

Source: Field investigation made by JICA Study Team in Nov. 2001.

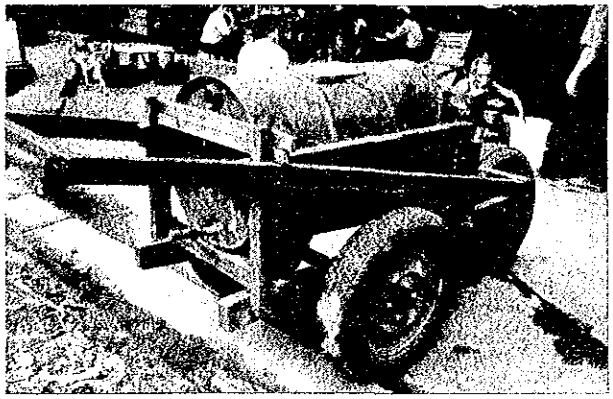


Figure 9.3 Water Tank of Water Vendor

In addition to the above, if they want to take direct drinkable water, they should buy bottled water with a rate of 6,000 Kyats/m3 as shown below:

Table 9.3 Price of Bottled Water

Description	Figures
Unit price of bottled water	120 Kyats/20ℓ bottle
Buying number of bottle	10 bottles/month
Expenditure	1,200 Kyats/HH/month
Unit price equivalent to:	6,000 Kyats/m^3

Sources: Field investigation made by JICA Study Team in Nov. 2001.

And these amounts of payment for water should be a saved amount of water for people because that, once people have connected with the piped water, people do not have to pay this amount again.

These values of water may also be regarded as saved amount of medical expenditure of the people because the said amount of water getting from the other sources for keeping good health will not be needed to pay again once people have connected with the piped water.

3) Economic Value of Water

It is assumed that a ground water is an alternative water source as a representative. At present, the people living in the Yangon City area have to pay at amount of 136 Kyats/m3 for total volume of water consumed. In this case, existing water volume to be consumed is 126 l/day per person as shown in the following Table 9.1. Following Table 9.4 shows

Table 9.4 Water Price in Case of Private Deep Well

A. Capital Cost

Description	Unit	Capital cost						
		Cost of well to be newly constructed	Pumping facilities with compressor for well to be newly constructed	Cost of casing pipe for well	Under-ground water tank to be newly constructed	Pumping facilities from under-ground water tank to HH to be newly constructed	Cost of pipe from well to under-ground water tank	Total
Initial investment cost of well facilities	Kyat	30,000	115,000	48,576	200,000	35,000	25,500	
Price increasing rate	%	13.00%	13.00%	13.00%	13.00%	13.00%	13.00%	
Life time	Year	10	10	10	20	10	10	
Capital recovery factor		0.18429	0.18429	0.18429	0.14235	0.18429	0.18429	
Annualized cost	Kyat/annum	5,529	21,193	8,952	28,471	6,450	4,699	
Annualized capital cost per HH***	Kyat/HH.annum	691	2,649	1,119	3,559	6,450	4,699	19,168

B. OM Cost

Description	Unit	Capital cost					
		Expenditure for electricity for pumping facilities for well**	Repairing cost of pumping facilities for well to be newly constructed	Cleaning for under-ground water tank*	Expenditure for electricity for pumping facilities for HH from under-ground water tank**	Repairing cost of pumping facilities for HH from under-ground water tank	Total
Annualized capital cost of well facilities	Kyat	36,500	15,000	2,000	5,475	6,500	
Price increasing rate	%		13.00%				
Life time	Year		2				
Capital recovery factor			0.59948				
Annualized cost	Kyat/annum	36,500	8,992	2,000	5,475	6,500	
Annual OM cost per HH***	Kyat/HH.annum	4,563	1,124	250	5,475	6,500	17,912
Monthly expenditure for water per *HH* consisting of capital and OM costs						3,090	(Kyat/HH/month)
Equivalent to						136	(Kyats/m^3)
Monthly expenditure for water per HH OM costs only						1,493	(Kyat/HHmonth)
Equivalent to						66	(Kyats/m^3)

(Note) *: 2 persons ordered out per time. 1,000 Kyat per person. Once a year.
**: Electricity tariff: 25 Kyat/kWh for compressor and 10 Kyat/kWh for HHs' pump, and 4 hours working per day for well and 1.5 hours per day for HH.
***: Number of family members are 8 persons according to a result of the interview survey. So, the calculation results are rather

Source: Field interview survey made by JICA Study Team in Nov. 2001.

Accordingly, a unit price of water is a sum of 136 Kyats/m3 as a water cost for using private wells in average. This price consists of construction cost of wells and operating cost for drawing up and/or pumping up the water from the wells to each household in the collective house (like apartment house). This means that the public distributed water generally has an economic value by this amount.

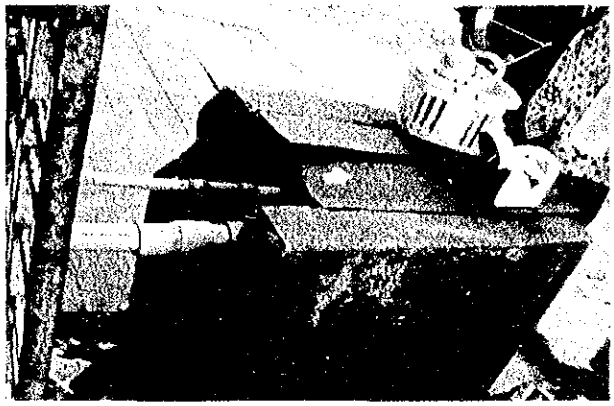


Figure 9.4 Private Deep Well

4) Basic Cost of Supplied Water as an Incremental Benefit for the People

Principally, the basic unit cost of supplied water should be estimated taking an existing water transportation/distribution system into account for making estimation of incremental benefit for the people because the system exists already. However, the cost for this existing system is not clear at present, so that the initial investment cost of this system can not be made clear. Therefore, it should be necessary to take another approach to estimate the basic unit cost of the supplied water.

According to the result of the Consumer Survey made by JICA Study Team in July 2001, an end price of potable water connected with YCDC water supply system may be set at 8 Kyats/m3 as indicated in the above Table 9.1, and it has been cleared that around 24 % of the amount is the operation and maintenance cost (OM cost) for distribution according to the financial situation of the Water Supply Sector of YCDC as mentioned in Chapter 3. This proportion of the OM cost of the water price has been decreased from 40 % in 1991/92. However, the cost for house connection works itself should be burdened by people themselves without any subsidy from YCDC. Therefore, OM cost is no need to consider, but 50 % of an average distribution loss of water so called as an average unaccounted for water (UfW) should be taken into account as mentioned in Chapter 3.

On the other hand, it has also been cleared that the total common facilities cost consisting of capital and OM costs is around 68 Kyats/m3 with share rate of 50 % in private deep well as shown in the following Table 9.5.

Table 9.5 Breakdown of Water Cost in Private Deep Well

A. Total Cost of Water in Private Deep Well

	Kyats/HH per annum	Kyats/HH per month
Capital cost	19,168	1,597
Common facilities	12,717	1,060
Domestic facilities	6,450	538
OM cost	17,912	1,493
Common facilities	5,937	495
Domestic facilities	11,975	998
Total		3,090

B. Breakdown of Water Cost in Private Deep Well

	Kyats/HH per month	Equivalent to Kyats/m^3	Share rate (%)
Common facilities	1,555	68	50%
Capital cost	1,060	47	
OM cost	495	22	
Domestic facilities	1,535	67	50%
Capital cost	538	24	
OM cost	998	44	
Total	3,090	136	100%

(Remarks) Refer to Table 9.4.
(Note) Domestic facilities means households own facilities.

Based on the above mentioned information and data, the amount of 68 Kyats/m3 is a suitable economic water price consisting of consumer surplus and lower limit of willingness of people to pay from the viewpoint that this amount is in between lower limit of WTP of 8 Kyats/m3 indicated in Table 9.1 and upper limit of WTP of 1,320 Kyats/m3 indicated in Table 9.2. The amount of 6,000 Kyats/m3 in case of bottled water should be excluded as a special case.

Therefore, a basic unit cost of supplied water in front of gates of households and/or buildings of collective houses (by the end of the second distribution main), in other words "domestic gate price of water" is estimated at amount of 68 Kyats/m3. Based on this amount, the economic benefit may be estimated taking the improved UfW and annual increased volume to be consumed into account.

(2) Basic Unit Cost Amount of Income Loss and Medical Expenditure

The Project may contribute for improving a water environment for the people living in Yangon. It means that a part of people's living environment could be improved.

If living environment is improved by these kind projects, some of water borne diseases may be decreased and, people's burden for medical cost or fees, or some amount of budget to use for hospitals may be decreased too.

According to information from Department of Health, total patients in 1998 were 479,444 persons consisting of 241,871 of outpatients and 237,573 of inpatients. A suffering rate of diseases to the total population was around 13 % of the total population.

Also according to the information from Department of Health, annual average number of patients caused by water borne disease was 34,701 persons during last 10 years since 1991, and share rate to the total patients was 7.24 %.

On the other hand, the annual average revenue of hospitals in Yangon City area may be estimated at amount of 529.47 million Kyats per annum in average. Based on this information, unit medical cost per patient can be estimated at amount of 1,104 Kyats/patient. This amount of medical cost consists of revenue from patients (namely, the amount of *medical expenditure of patients) and from subsidies the Government.*

Following Table 9.6 shows a summary of the information. Details are shown in Appendix M.2.

Table 9.6 Number of Patients and Medical Expenditure

Description	Figures	Suffering rate of overall disease to total population (%)	Remarks
Population	3,691,941		
Overall diseases	479,444	12.99%	To total population
Outpatients	241,871		
Inpationts	237,573		
Water borne disease	34,701		To overall diseases
Unit cost per patient		(Kyats/patient)	1,104

(Note) *Annual average revenue of hospitals in Yangon City area consisting* revenue from patients and subsidies from the Government.

1999/00	(million Kyats)	368.40
2000/01	(million Kyats)	600.00
2001/02	(million Kyats)	620.00
Annual average since 1999/00		529.47

Source: Ministry of Health.

Using the above mentioned data and information, an average saved amount of medical cost per patient can be estimated. The result is shown in Table 9.10 hereunder.

There should be another kind of benefit concerning the improvement of living environment. If people suffer diseases and should go to a hospital, they should not come to their working places. But in Yangon, if they can get a certificate from such hospitals, salaries or wages are not deducted in case of monthly basis of salaries and wages. However, owners of shops, offices or such working places as companies should pay salaries or wages to their employees without any productive activities of them.

According to the result of the Consumer Survey as mentioned above, per capital income per month has been estimated at an amount of 22,364 Kyats/month. Following Table 9.7 shows its detail.

Table 9.7 Monthly Per Capita Income

Description	Family size (persons/HH)	Working members (persons/HH)	Income per HH (Kyats/m)
Overall township average	5.44	1.76	39,260
Township average in both of HHs who connect and do not connect with YCDC water supply system	5.41	1.78	36,404
Township average in HHs who do not connect with with YCDC water supply system	6.01	1.95	38,692
Per capita income in overall township average			22,364

Source: Results of the Consumer Survey made by JICA Study Team, July 2001.

From this monthly per capita income, daily per capita income can be estimated at 1,017 Kyats/day (= 22,364 Kyats/month ÷ 22 working days). Saving amount of salaries and/or wages to be decreased due to diseases can be estimated by using the above mentioned unit income per day multiplying the above mentioned suffering rate of water borne diseases and following number of days to visit to hospitals for outpatients, and average duration of stay in hospitals in days for inpatients according to the designed service population.

Table 9.8 Visited Days of Outpatients and Duration of Stay of Inpatients To and In Hospitals

Description	Figures
Outpaties	
Administration	241,871
Total outpatients in a year as of 1998	576,756
Average days visited to hospitals	2.38
Inpatients	
Total inpatient-days	1,903,482
Number of discharges and deaths	237,573
Average duation of stay in hospitals	8.01

Source: Hospital Statistics Annual Report 1998, Ministry of Health.

Generally speaking, the proposed project can be told to decreasing by around 30 % of water borne diseases according to the similar projects of water supply systems and sanitation systems in developing countries. In this Project, only the water supply systems are included, so that it is assumed that the Project can contribute to decreasing the suffering rate of water borne diseases by only 15 %.

(3) Identification of Economic Benefit

In the Project, 4 kinds of construction works are proposed for improvement of water supply systems in Yangon City as (1) rehabilitation works of existing distribution networks, (2) facilities to take water from the Hlaing River, (3) facilities to take water from reservoirs, and (4) facilities to take water utilizing ground water. Therefore, from the technical viewpoint, the whole construction works is divided into 2 phases. After that, water supply volume and service population can be clarified. Annual economic benefits may be estimated from the water supply volume and services population multiplying the said basic unit amount of the benefits.

1) Economic Benefit in Potable Water Supply

As mentioned above, the basic unit of economic benefit for potable water supply is a sum of 68 Kyats/m^3 (equivalent to US¢14/m^3) as of 2000. In this case, the incremental benefit may be estimated at 60 Kyats/m^3 (= 68 Kyats/m^3 – 8 Kyats/m^3) for economic evaluation. And, this amount should be converted into present value. As indicated in Table 9.25 hereunder, average price increasing ratio was around 18 % per annum during last 17 years. Conservatively, it can be estimated at 73 Kyats/m^3 (= 60 Kyats/m^3 × $(1+0.1)^2$) as an incremental economic benefit of potable water as of the year 2002.

The construction may be divided into 2 phases as (1) from the beginning of the construction works to the end of 2010 and (2) from the beginning of the year 2011 to the end of 2020 as mentioned above. According to the construction schedule, each construction phase brings about an effect to supply water with different volume. Using this water volume to be supplied, annual economic benefit can be estimated. Following Table 9.9 shows an estimation result of economic benefit due to water supply in each phase.

Table 9.9 Annual Economic Benefit in Potable Water Supply by Phase

Phase	Year	Water volume to be supplied due to the completion of the works (m^3/day)	Incremental water volume to be supplied due to the completion of the works (m^3/day)	Leaked volume to be improved (m^3/day)	Total	Incremental annual water volume to be supplied (m^3/annum)	Annual economic benefit (Million Kyats)	Annual economic benefit (Equivalent to US$1,000)
	2003	219,700					0	0
Phase-1	2004	232,900	13,200	150,145	163,345	59,620,938	4,352	8,705
	2005	277,900	58,200	160,063	218,263	79,666,047	5,816	11,631
	2006	512,000	292,300	169,976	462,276	168,730,851	12,317	24,635
	2007	521,100	301,400	179,885	481,285	175,668,851	12,824	25,648
	2008	530,200	310,500	189,788	500,288	182,605,050	13,330	26,660
	2009	539,400	319,700	199,686	519,386	189,575,950	13,839	27,678
	2010	823,000	603,300	209,580	812,880	296,701,051	21,659	43,318
Phase-2	2011	836,700	617,000	219,468	836,468	305,395,500	22,294	44,588
	2012	850,400	630,700	229,352	860,052	310,396,000	22,659	45,318
	2013	864,100	644,400	239,230	883,630	315,396,500	23,024	46,048
	2014	877,800	658,100	249,104	907,204	320,397,000	23,389	46,778
	2015	908,400	688,700	258,973	947,673	331,566,000	24,204	48,409
	2016	936,300	716,600	268,837	985,437	341,749,500	24,948	49,895
	2017	964,300	744,600	278,696	1,023,296	351,969,500	25,694	51,388
	2018	992,200	772,500	288,550	1,061,050	362,153,000	26,437	52,874
	2019	1,020,200	800,500	298,400	1,098,900	372,373,000	27,183	54,366
	2020	1,221,200	1,001,500	308,244	1,309,744	445,738,000	32,539	65,078

(Note 1) Unit value of benefit: 73 (Kyats/m^3)
(Note 2) Exchange rate: 500 Kyats = US$1.00

2) Saving Amount of Medical Expenditure

The unit value of the medical expenditure is a sum of 1,104 Kyats/patient as mentioned above. Saving amount of medical expenditure as the other kind of economic benefit of the Project can be estimated on the basis of this amount multiplying the number of patients.

Number of patients may be estimated by the water volume to be supplied divided by the average water consumption volume of 140 l/day per person as mentioned above taking suffering rate of water borne diseases. Following Table 9.10 shows the estimation result.

Table 9.10 Annual Economic Benefit in Saving of Medical Expenditure by Phase

(Figures are incremental ones and after completion of works of each phase)

Phase	Incremental annual water volume to be supplied (m^3/annum)	Service population (persons)	Number of patients*		Medical expenditure by water borne diseases (Million Kyats)	Annual saving amount of medical expenditure	
			Overall diseases	Water borne diseases		(Million Kyats)	(Equivalent to US$1,000)
Phase-1	296,701,051	4,064,398	527,965	38,225	42	6	13
Phase-2	149,036,949	2,041,602	265,204	19,201	21	3	6

(Note 1) Average volume of water consumption 140 (l/day)
(Note 1) Share rate of water consumption of domestic suctomers 70% (of the total water volume)
(Note 2) Suffering rate of overall diseases 12.99% (to the total population)
(Note 3) Suffering rate of water borne diseases: 7.24% (to the overall diseases)
(Note 4) Unit value of medical expenditure: 1,104 (Kyats/patient per year)
(Note 5) Contribution rate of the Project to water borne diseases: 15.00% (to the total water borne diseases)
(Remarks) *Number of patients consist of outpatients and inpatients.

3) Saving Amount of Personal Income Loss

The unit value of the personal income is a sum of 1,017 Kyats/day per working member of household per day as mentioned above. When the people have to visit hospitals, and/or to stay in hospitals, their income should be deceased by this amount daily. Even their actual salaries/wages might not be decreased caused by these medical cares, the employers have to pay salaries/wages to their employees without any productive activities for the working places, and this may also be called as an income loss.

Saving amount of income loss due to the medical cares as the another kind of economic benefit of the Project can be estimated on the basis of this unit value multiplying the number of patients and their number of days to visit to the hospitals (= 2.37 days/annum in average) for outpatients, and duration in days in hospitals (= 8.01 days/annum in average) for inpatients both as mentioned above.

Number of patients may be estimated based on the service population derived from the water volume to be supplied divided by the average water consumption volume of 140 l/day per

person as mentioned above taking suffering rate of water borne diseases. Following Table 9.11 shows the estimation result.

Table 9.11 Annual Economic Benefit in Saving of Income Loss by Phase

(Figures of water volume to be supplied are incremental ones and after completion of works of each phase)

Phase	Incremental annual water volume to be supplied (m^3/annum)	Service population (persons)	Working population (persons)	Number of inpatients*		Number of outpatients*		Income loss in total (Million Kyats/annum)			Annual saving amount of income loss	
				Overall diseases	Water borne diseases	Overall diseases	Water borne diseases	Inpatients	Outpatients	Total	(Million Kyats)	(Equivalent to US$1,000)
Phase-1	296,701,051	4,064,398	1,319,654	84,943	6,150	266,349	19,284	50	47	97	15	29
Phase-2	149,036,949	2,041,602	662,880	42,668	3,089	133,791	9,686	25	23	49	7	15

(Note 1) Average volume of water consumption 140 (l/day)
(Note 2) Suffering rate of overall diseases 12.99% (to the total population)
(Note 3) Average number of inpatients per year: 237,573 (persons/annum)
(Note 4) Average number of outpatients per year: 241,871 (persons/annum)
(Note 5) Suffering rate of water borne diseases: 7.24% (to the overall diseases)
(Note 6) Unit value of income: 1,017 (Kyats/day per capita)
(Note 7) Contribution rate of the Project to water borne diseases: 15% (to the total water borne diseases)
(Note 8) Number of days to be needed to visit hospitals for outpatients: 2.38 (days/annum)
(Note 9) Average duration to stay in hospitals for inpationts: 8.01 (days/annum)
(Remarks) * Number of patients consist of outpatients and inpatients.

9.1.3 Identification of Economic Cost

(1) Assumptions for Identifying the Economic Cost

Economic cost of a project is identified as opportunity cost of the project. In this case, if goods and services would be invested in the project under study, they could no longer be utilized for other projects. This implies that the benefits of the other projects could have been created would be sacrificed. These sacrificed benefits of the other projects are called opportunity cost of the project.

Firstly, a gross construction cost is estimated based on unit prices and work volume, and this gross construction cost includes net construction cost, engineering cost for detailed design and supervision, cost for administration, corporation tax, compensation cost for land and/or building to be removed, physical contingency and price contingency.
A project cost consists of foreign currency portion and local currency portion. For calculation of the construction cost of the Project, a foreign exchange rate of 500 Kyats = US$1.00 = Yen 120.00 is applied.

1) Foreign Currency Portion

Using the said financial gross construction cost, an economic cost of the Project is estimated. In this study, the net construction cost includes labor cost, cost for materials, and cost for equipment. For the foreign currency portion, these costs for labor, materials and equipment are usually estimated in Cost-Insurance-Freight price (CIF-price) as the border price. These international prices are assumed to reflect economic cost directly.

Corporation tax is not included in the foreign currency portion because the said tax should be paid by local currency based on the taxation regulation in Myanmar.

For economic evaluation of the Project, such transfer cost as contractor's overhead and profit should be deducted from the local currency portion, and price contingency should be excluded because comparison of cost and benefit is made by present value.

2) Local currency portion

Because it is presumed that price controls and other regulations distort local markets in developing countries, prices in the domestic markets do not reflect economic scarcity of goods and services. This means that the prices can not be used to identify economic costs of local procurement and have to be converted into economic prices.

In economic analysis of a project, conversion factors are used to convert the costs in domestic markets into economic costs of the project.

Usually using export and import statistics, and the record of import customs and/or export duties as a part of the Government revenue, a standard conversion factor (SCF) is estimated first.

Table 9.12 Summary of Central Government Budget During Last 10 Years since 1990/91

(Million Kyats)

Items of revenues and expenditures	1990/91	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000
Revenues	14,837.0	21,472.0	28,145.0	32,766.4	40,370.9	55,253.6	88,695.7	118,034.7	107,666.5
Internal Receipts	14,584.2	20,993.9	27,525.2	32,187.3	39,594.1	54,832.3	86,783.2	116,961.4	107,005.8
Current account	14,045.1	19,323.0	26,013.6	31,308.1	38,447.1	54,089.0	85,728.7	115,814.3	106,422.9
Taxes	9,416.7	12,562.6	17,036.1	20,101.2	22,643.7	31,357.0	49,429.2	56,653.0	49,919.8
Ministries and Departments	1,194.6	1,763.6	2,341.4	3,012.1	5,294.8	6,089.6	9,435.3	15,472.1	12,085.5
Earnings from the State enterprises	3,433.8	4,996.8	6,636.1	8,194.8	10,508.6	16,642.4	26,864.2	43,689.2	44,417.6
Capital account (Ministries/Departmenyts)	44.6	892.0	1,198.4	599.0	850.8	490.9	803.4	79.5	407.6
Financial account	494.5	778.9	313.2	280.2	296.2	252.4	251.1	1,067.6	175.3
Public debt	492.8	364.2	304.1	276.4	241.7	241.5	213.0	191.9	171.2
Investment	1.7	414.7	9.1	3.8	54.5	10.9	38.1	875.7	4.1
Foreign Receipts	252.8	478.1	619.8	579.1	776.8	421.3	1,912.5	1,073.3	660.7
Foreign loans	141.1	120.2	163.6	149.7	32.0	0.0	301.4	549.3	183.2
Current loans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital loans	141.1	120.2	163.6	149.7	32.0	0.0	301.4	549.3	183.2
Foreign grants and aids	111.7	357.9	456.2	429.4	744.8	421.3	1,611.1	524.0	477.5
Current receipts	26.6	289.9	377.5	333.9	678.4	380.1	1,581.4	464.5	422.7
Capital receipts	85.1	68.0	78.7	95.5	66.4	41.2	29.7	59.5	54.8
Expenditures	21,708.2	28,494.9	35,888.6	48,493.2	65,527.5	80,439.6	98,462.0	124,751.9	145,403.3
Current Account	15,381.6	18,045.6	23,280.3	27,654.0	32,875.3	37,009.9	47,836.7	62,953.2	84,523.4
Ministries and Departments	12,841.4	16,419.5	20,089.4	23,983.8	27,426.2	29,599.2	37,567.5	43,267.9	51,997.9
Interest	159.6	1,056.5	1,994.4	2,411.3	3,566.4	5,617.4	7,625.0	11,587.7	17,706.9
Contributions	2,380.6	569.6	1,196.5	1,258.9	1,882.7	1,793.3	2,644.2	8,097.6	14,818.6
Capital Account (Ministries and Departments)	6,050.1	9,756.8	12,303.9	20,145.4	31,820.9	42,919.6	50,365.0	60,918.7	60,396.1
Financial Account	180.4	676.5	303.7	615.4	818.5	510.1	260.3	880.0	383.8
Public debt	125.6	151.3	289.2	250.2	639.8	452.5	227.0	221.9	266.1
Investment	54.7	525.2	14.4	365.1	178.7	57.6	33.3	656.8	117.7
Savings	0.1	0.0	0.1	0.1	0.0	0.0	0.0	1.3	0.0
Reserve fund	96.1	16.0	0.7	78.4	12.8	0.0	0.0	0.0	100.0
Pre-financing deficit/surplus	-6,871.2	-7,022.9	-7,743.6	-15,726.8	-25,156.6	-25,186.0	-9,766.3	-6,717.2	-37,736.8

Source : Statistical Year Book 2000, Central Statistic Organization.

The SCF is expressed by the following formula:

$$SCF = \frac{I + E}{(I + I_{customs}) + (E - E_{tax} + E_{subsidy})}$$

Where, SCF= standard conversion factor,
I= import amount,
E= export amount
$I_{customs}$= import customs
E_{tax}= export tax, and
$E_{subsidy}$= export subsidies.

Following tables show the actual revenue and expenditure of Myanmar and a situation of tax revenue of the nation.

Table 9.13 Situation on Tax Revenue of the Nation

(million Kyat)

Taxes and Duties	1990/91	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00
Taxes on Production and Expenditures	3,941.5	5,723.8	7,302.4	8,318.8	9,593.0	13,284.4	23,990.1	29,136.2	28,434.3
Commodities and services taxes	199.2	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0
Import license fees	160.5	148.0	200.0	203.0	217.4	220.0	173.9	214.0	170.0
State lottery	423.5	1,119.4	1,335.3	1,494.7	1,530.0	2,166.4	3,684.1	4,223.8	4,500.0
Stamps	97.6	261.3	279.7	348.6	490.3	930.4	1,169.0	769.7	600.3
Transportation tax	46.3	60.8	78.6	78.1	116.1	346.5	758.1	985.3	964.0
Excise	19.2	46.3	75.7	102.4	117.5	142.3	172.8	223.8	200.0
Commercial tax	2,995.2	4,088.0	5,333.1	6,092.0	7,121.7	9,478.8	18,029.3	22,719.6	22,000.0
Customs Duties	2,031.4	2,771.2	3,938.4	4,021.6	4,465.3	7,807.6	8,579.0	5,175.9	5,000.0
Taxes on Income and Profit	2,806.3	3,180.3	4,640.6	6,740.9	7,793.3	9,216.8	15,276.2	20,514.8	14,910.1
Taxes on Use of State Properties*	637.5	887.3	1,154.7	1,019.9	792.1	1,048.2	1,583.9	1,826.1	1,575.4
Land revenue	45.1	49.2	47.0	70.2	59.8	59.2	64.2	66.6	65.0
Taxes on extraction of forest produce	355.5	503.7	666.2	490.1	275.0	427.1	732.6	692.3	809.4
Taxes on extraction of mineral produce	5.2	5.8	10.9	13.1	13.2	14.1	16.7	15.3	13.0
Taxes on fisheries	212.8	308.6	416.9	417.6	418.4	525.2	741.1	1,028.5	665.5
Water and irrigation tax	18.7	18.4	13.7	26.7	21.9	19.6	26.1	22.4	22.0
Taxes on rubber	0.2	1.6	0.0	2.2	3.8	3.0	3.2	1.0	0.5
Total	9,416.7	12,562.6	17,036.1	20,101.2	22,643.7	31,357.0	49,429.2	56,653.0	49,919.8

Source: Statistical Yearbook 2000, Central Statistic Organization.

(Note) *: Principally, land and all the things on the land are the Government properties. Therefore, the Government levies the taxes on utilizing these things. But some development committees have been transferred these right to use. For example, YCDC has its own water tariff system.

International trade institution is also needed to make clear as a factor for calculation of the SCF. Following Table 9.14 shows a summary of the international trade of Myanmar.

Table 9.14 Summary of International Trade of Myanmar

(million Kyat)

Year	Export	Import	Trade balance
1985/86	2,566.1	4,802.0	-2,235.9
1990/91	2,952.6	5,522.8	-2,570.2
1992/93	3,590.0	5,365.3	-1,775.3
1993/94	4,227.8	7,923.3	-3,695.5
1994/95	5,405.2	8,332.3	-2,927.1
1995/96	5,032.7	10,301.6	-5,268.9
1996/97	5,487.7	11,778.8	-6,291.1
1997/98	6,446.8	14,366.1	-7,919.3
1998/99	6,755.8	16,871.7	-10,115.9
1999/00	7,103.3	16,264.8	-9,161.5
Annual increasing rate	7.54%	9.11%	

Source : Statistical yearbook 2000, Central Statistic Organization.

Among the custom duties as shown in Table 9.13, following detail can be obtained from the other source:

Table 9.15 Summary of Custom Duties

(million Kyat)

Year	Domestic trade		Foreign trade		Total	
	Export tax	Import duty	Export tax	Import duty	Export tax	Import duty
1995/96	72.8	3,910.0	25.0	457.4	97.8	4,367.4
1996/97	76.2	6,997.0	35.4	698.9	111.6	7,695.9
1997/98	72.4	6,925.4	109.2	1,472.0	181.6	8,397.4
1998/99	64.6	4,034.3	1.5	1,075.6	66.1	5,109.9
1999/00	5.1	4,489.4	0.0	679.2	5.1	5,168.6

Source: Selected Monthly Economic Indicators, Nov.-Dec. 2000, Central Statistical Organization.

Using these data, the SCF can be estimated as shown in the following Table:

Table 9.16 Standard Conversion Factor

Year	Import amount	Export amount	Import duties	Export tax	Excise
1995/96	10,301.6	5,032.7	457.4	25.0	117.5
1996/97	11,778.8	5,487.7	698.9	35.4	142.3
1997/98	14,366.1	6,446.8	1,472.0	109.2	172.8
1998/99	16,871.7	6,755.8	1,075.6	1.5	223.8
1999/00	16,264.8	7,103.3	679.2	0.0	200.0
Total	69,583.0	30,826.3	4,383.1	171.1	856.4
				SCF=	0.95195

However, the SCF is applied to only tradable goods. The economic cost of non-tradable goods and services has to be separately evaluated. Conversion factors of land, skilled and non-skilled labors are respectively estimated.

Economic wage of unskilled laborers to be employed for the construction works is assumed to be 50 % of the actual market wage, taking of the employment opportunity of laborers in the study area.

It is assumed that the opportunity cost of land is no need to take into account.

Such transfer items as personal and/or corporation income tax, contractors profit and so on should be deducted from the financial cost in case of converting into economic cost. It is temporary assumed that tax rate and contractors profit are respectively 10 % of the construction cost.

(2) Identification of Economic Cost

On the basis of the above mentioned assumptions, the economic cost of the Project as the initial investment cost is estimated by using the financial cost as mentioned in Chapter 7.

Table 9.17 Annual Disbursement of Financial and Economic Cost by Phase

(US$1,000)

Phase	Year	Overall Project	
		Finan-cial	Eco-nomic
Phase-1	2003	0	0
	2004	33,585	29,293
	2005	35,264	30,594
	2006	129,892	111,774
	2007	97,844	84,967
	2008	187,693	157,302
	2009	144,989	121,934
	2010	183,101	154,949
Phase-1 total		812,366	690,813
Grand total		1,465,161	1,237,415

(US$1,000)

Phase	Year	Overall Project	
		Finan-cial	Eco-nomic
Phase-2	2011	54,073	45,284
	2012	50,622	42,143
	2013	33,002	28,338
	2014	12,359	10,186
	2015	27,393	22,581
	2016	28,117	22,895
	2017	99,678	83,861
	2018	144,697	120,497
	2019	190,733	160,815
	2020	12,120	10,001
Phase-2 total		652,795	546,602

Detail of estimation of economic cost converted from financial cost is shown in Appendix M.3.

Operation and maintenance cost (OM cost) is to be considered. The OM cost consists of personal cost, electricity cost, cost of chemicals and costs for inspection and repairing for water purification plant and other facilities to be newly constructed. The OM cost is estimated by each item as shown in Appendix M.3. Following Table 9.18 shows its detail.

Table 9.18 Annual Operation and Maintenance Cost by Phase

(US$1,000)

OM work items	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Personal cost	5	5	5	5	6	6	6	6	7	7	7	7	7	7	7	9	9
Electricity cost	10	10	89	117	144	144	216	216	216	233	233	233	239	239	239	239	295
Chemical cost	192	192	600	600	928	928	8,666	8,666	8,666	8,666	8,666	8,677	8,677	8,677	8,677	8,677	16,324
Inspection/repairing cost					0			0	0		0	0	0		0	0	0
Financial total	207	207	694	723	1,078	1,078	8,888	8,888	8,889	8,906	8,906	8,917	8,923	8,923	8,923	8,925	16,627
Economic cost	104	104	348	362	936	540	4,451	4,624	4,990	4,460	4,955	4,666	5,007	4,468	4,964	8,126	15,483

Remarks:

Gyobyu:	167	Phugyi:	400	Terminal-Kokine:	7,042	Terminal CBW:	8,217	Ngamoyeik:	6,900	CBDT East:	4,708	
East Block S:	983	Terminal to CB:	6,517	Hlaing WTP:	5,342	Transmission:	7,042	West Block N:	875	East Block N:	558	
West Block S:	225	East Block C:	900	West Block C:	217							

Replacement cost is assumed at 35 % of the direct construction cost. And it is needed at every 20th years after completion of every works.

9.1.4 Economic Evaluation

The economic benefit and cost should be compared for economic evaluation of the Project. In this case, the benefit and cost should be compared with their present values. For converting into the present value, a discount rate of 10 % is assumed based on similar projects.

Project life is set as 50 years after the completion of the construction works based on the similar project.

The detail economic evaluation processes are shown in Appendixes M.4 through M.6

Generally, EIRR of the project under study should be higher than the applied discount rate as an opportunity cost of capital. As indicated in the above Table, the resulted EIRRs are lower than the said discount rate in any phases.

As suggested by such international institutions as the World Bank, an EIRR is expected to at least be cleared a hurdle of 5.0 % of EIRR from a viewpoint of basic human needs even such a project is in developing countries. From this viewpoint, the resulted EIRR which is cleared right on the said hurdle is only in the case of Phase-1. Namely, the Project is sound from the viewpoint of basic human needs in case of Phase-1.

In this kind of project, there is no point in making a sensitivity analysis because that the said resulted EIRR is too much low comparing with the said rate of opportunity cost of capital.

9.2 FINANCIAL EVALUATION

9.2.1 Basic Concept and Methodology

Financial analysis appraises the degree of financial return of a project under study that is expected to earn and is carried out in terms of profitability for the authoritative institution, as the Water and Sanitation Department of YCDC, of the project.

Project inputs are evaluated in terms of market prices. The inputs thus evaluated are called as "financial costs." Project outputs are also evaluated in terms of market prices. The outputs thus evaluated are called as "financial benefit."

Financial costs and benefits throughout the project life are compared in terms of present values. If the total present value of financial cost equals that of financial benefit (namely, when B/C=1), the discount rate used to calculate the present value is called as "financial internal rate of return (FIRR)."

Financial costs include direct construction cost, taxes, compensation, physical contingency, administration, and engineering expenses. However, price escalation is excluded from the costs. FIRR is calculated and used as a main index of financial feasibility of the project with NPV and B/C ratio. This FIRR is defined by the following formula:

$$\sum_{t=1}^{t=T} \frac{C_t}{(1+R)^t} = \sum_{t=1}^{t=T} \frac{B_t}{(1+R)^t}$$

Where, T = the last year of the project life,
C_t = an annual financial cost flow of the project under study in year t,
B_t = an annual benefit in year t, and,
R = the Financial Internal Rate of Return.

In this case, the project life is set as 50 years same manner as in the economic evaluation.

In case that the project profitability can not be gained from the FIRR method, namely in the case that initial investment cost for the project can not be covered by a charge for water supply system, the said project cost should be covered by such other financing sources as subsidies from the local Government (in this case, YCDC itself) or from the central Government, and a repayment capability of the Government for loan amount should be clarified.

And then, a capability of project owner to operate and maintain should be clarified by B/C ratio using a cash flow of the Operation and maintenance cost (OM cost) and replacement cost and, revenue by the charge mentioned above because the project operation and maintenance is usually carried out by the project owner itself (YCDC). This B/C ratio is defined by the following formula:

$$B/C = \frac{\sum_{t=1}^{t=T} \frac{B_t}{(1+R)^t}}{\sum_{t=1}^{t=T} \frac{C_t}{(1+R)^t}}$$

Where, T = the last year of the project life,
C_t = the annual OM cost and replacement cost in year t,
B_t = the annual benefit in year t,
R = a discount rate, and
B/C = B/C ratio.

9.2.2 Water Price

For estimation of a financial benefit for the proposed project, tariff system should be set first.

(1) Existing Tariff System

The water supply systems are operated by the Water and Sanitation Department of YCDC, and its existing tariff system is set as:

Table 9.19 Existing Water Tariff system in Yangon City

Rate system	Domestic customers (Kyats)	Government offices (Kyats)	Commercial/ industries (Kyats)	Foreign customers (US$)	Remarks
Flat rate	120	80 to 107,000	405 to 25,000	25	Per month
Specific rate	30	20	135	*	Per 1,000 gallons

(Note) * US$ 2.00 for HH, and US$4.00 for commercial/industries.

Therefore, people should pay for water based on this tariff system.

(2) Willingness of People to Pay for Potable Water Supply System at Existing Income Level

Appendix M.7 shows another result of the said Consumer Survey. As indicating in this Table, the amount of willingness of people to pay (WTP) ranges from 321 Kyats/month per HH in case of people who connects with piped water supply system at present to 797 Kyats/month per HH in case of people who do not connect yet with YCDC's piped water supply system for 24 hours drinkable water supply both at existing income level. And the Project has a plan to supply 24 hours drinkable water supply. Following Table 9.20 shows the summary the said result:

Table 9.20 Summary of Willingness of People to Pay

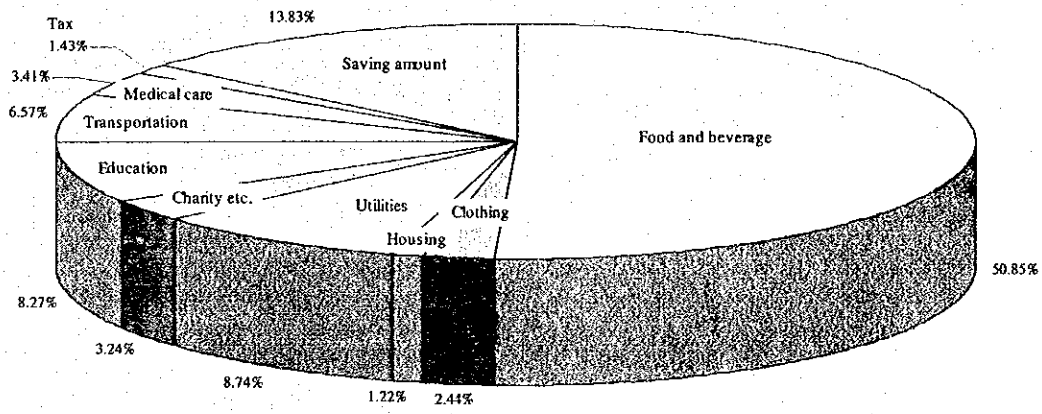
(Kyats/month per HH)

Kind of households	Willingness to pay	
	24 hours clean water supply	24 hours drinkable water supply
Overall simple average	576	746
Average in HHs who connect with YCDC water supply systems	321	383
Average in HHs who do not connect with YCDC water supply systems	559	797

Source: The Consumer Survey made by JICA Study Team, July 2001.

(3) Affordability of People to Pay for Potable Water Supply System

Following Table and Figure show a proportion of average expenditures by item of people living in Yangon City:



Source: The Consumer Survey made by JICA Study Team, July 2001

Fig. 9.5 Share Rate of Expenditure by Item per Household in Yangon City

Table 9.21 Expenditure by Item per Household in Yangon City

(Kyats/month per household)

Expenditure item	Food and beverage	Clothing	House rent and repairs	Utilities	Charity and ceremonials	Education / School	Transportation	Medical care	Tax	Saving amount	Total income
Amount	19,965	960	480	3,430	1,272	3,245	2,578	1,338	562	5,431	39,260
(%)	50.85%	2.44%	1.22%	8.74%	3.24%	8.27%	6.57%	3.41%	1.43%	13.83%	100.00%

Furthermore, following Table 9.22 shows breakdown of expenditures for utilities per household in Yangon as a result of the said Consumer Survey.

Table 9.22 Average Amount of Expenditures in Utilities per Household in Yangon City

(Kyats/month per household)

Potable water	Waste water disposal	Solid waste disposal	Telephone	Gas	Electricity	Fuel	Total
367	17	67	585	152	1,492	761	3,430

In this case, the amount of expenditure for portable water, 367 Kyats/month per household is an average of overall households' payment for water consisting of households with and without the YCDC's water supply system. Following 2 figures show a relationship between their income level and amount of expenditure for water according to the Consumer Survey.

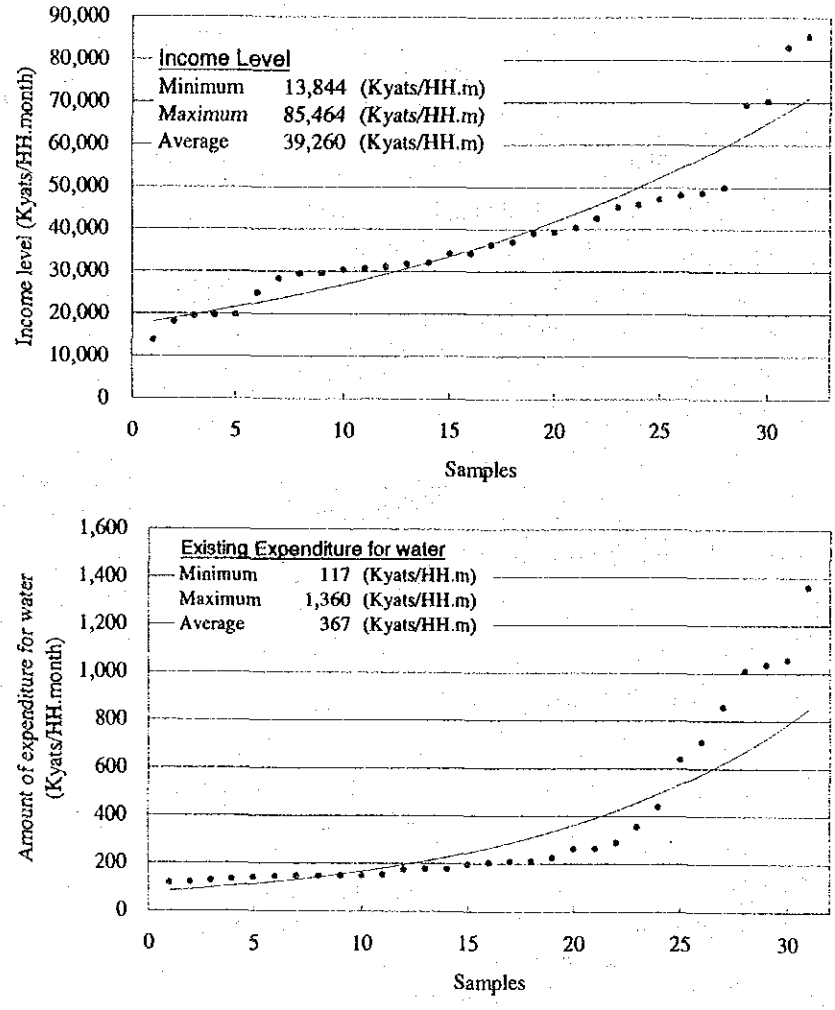


Fig. 9.6 Relationship between Income Level and Expenditure for Water

On the other hand, the Central Statistic Organization has made a Household Income and Expenditure Survey in 1997. According to this survey, the income levels of Yangon Division and Yangon City are as shown as of that year in the following Table 9.23.

Table 9.23 Income and Expenditure Level in Yangon Division and in Yangon City

(Kyat)

Income and Expenditure	Yangon Division*			Yangon City**
	Urban	Rural	Division	Urban
Average monthly HH's income	18,174	12,306	16,660	18,997
Average number of employed persons per HH	1.89	2.32	2.22	1.90
Source in percentage				
Wages & salaries	86.33%	63.34%	80.41%	-
In cash	85.46%	61.98%	79.41%	-
In kind	0.87%	1.36%	1.00%	-
Enterpreneurial income	6.23%	31.50%	12.75%	-
Pension	0.53%	0.31%	0.47%	-
Rent	1.28%	0.19%	1.00%	-
Interest	0.66%	0.07%	0.51%	-
Reminttance	3.60%	1.90%	3.16%	-
Bonus & others	1.31%	0.77%	1.17%	-
Other (in kind)	0.05%	1.92%	0.54%	-
Total	99.99%	100.00%	100.01%	-
Expenditure	16,053	13,906	15,500	16,235
Food and beverages	10,337	9,414	10,099	10,417
Non-food	5,716	4,492	5,400	5,818
Tobacco	148	187	158	146
Fuel & light	750	815	767	753
Travelling expenses	1,161	277	933	1,373
Journey travelling expenses	117	57	101	-
Clothing & apparel	569	443	536	577
Personal goods	364	414	376	359
Cleansing & toilet	425	329	401	433
Crockeries	20	34	24	19
Other household goods	268	247	262	253
Furniture	54	68	58	55
House rent & repairs	436	421	432	423
Stationary & school supplies	78	32	66	79
Education	271	165	244	282
Medical care	273	286	277	276
Recreation	53	45	51	57
Charity & ceremonials	611	557	597	613
Other expenses	120	115	119	121

Source:

* Report of 1997 Household Income and Expenditure Survey, Central Statistic Organization.

** Agricultural Statistics (1987/88 - 1997/98), Central Statistic Organization in Collaboration with Department of Agricultural Planning, for HH's expenditures.

\- Lack of data.

A simple comparison can not be made between the JICA's Survey result and the above mentioned official survey result made by the Central Statistical Organization because of difference of accuracy.

However, if the consumer price index of the item "General", namely around 18 % per annum indicated in the Table 9.24 hereunder, is applied to convert the income level in 1997 into that in 2001, it becomes 36,830 Kyats/HH per month as of 2001. In case of comparing the average income level resulted at 39,260 Kyats/HH per month in overall average from the Consumer Survey, this result of the Consumer Survey may be reliable.

Such international institutions as the World Bank or Asian Development Bank[1] recommend that the total expenditures for potable water can be paid out 5 % of the total income at the maximum. In this case, households belonging to minimum income level should be taken into consideration.

The target year of the Project is 2020. Therefore, the envisaged income level for the basis of the targeted water price should also be that as of the year 2020.

Generally speaking, the income level is increased corresponding to the consumer price index. Since the year 1980/81, the said consumer price index is 17.9 % in annual average in item "General" as follows:

Table 9.24 Consumer Price Index in Yangon City

(1986 = 100)

	General	Food	Fuel & light	Clothing & apparel	Housing	Education	Medicine	Cleans-ing & toilet	Change in % against previous year
1980/81	71.9	75.6	57.4	66.4	75.2	76.0	57.7	64.8	-
1985/86	90.4	93.7	84.0	92.6	93.6	98.5	74.7	83.9	-
1988/89	155.0	164.2	145.2	120.1	103.2	98.8	175.4	151.4	-
1989/90	191.7	204.7	182.9	146.7	116.0	100.7	210.0	192.9	23.70%
1990/91	233.7	256.8	221.1	184.9	142.4	103.1	257.9	187.2	21.91%
1991/92	301.8	340.6	281.9	230.6	198.0	104.6	324.2	227.5	29.12%
1992/93	369.1	418.7	353.1	310.7	220.5	106.2	327.9	287.2	22.29%
1993/94	493.0	585.8	419.9	351.1	256.4	109.5	331.5	284.9	33.58%
1994/95	603.7	691.9	670.6	397.9	315.8	114.9	354.3	283.3	22.45%
1995/96	735.5	856.7	773.0	454.5	396.3	129.4	396.7	315.9	21.84%
1996/97	882.8	1,052.0	852.7	534.0	439.2	155.7	456.0	404.7	20.03%
1997/98	1,182.1	1,405.5	1,023.1	718.2	590.7	250.3	580.5	532.1	33.90%
Annual average change	17.90%	18.76%	18.46%	15.03%	12.89%	7.26%	14.55%	13.19%	-

Statistical Yearbook 1998, Central Statistic Organization.

Of course, no body can estimate how to increase these prices over the future because of a lot of uncertainties. Because of this, it is assumed that the prices in item "General" will be increased by 10 % annually in average, and this increasing ratio may be applied to estimate the envisaged income level in 2020.

[1] ADB ed. "Handbook for Economic Analysis of Water Supply Project" March, 1998.

Table 9.25 Envisaged Income Level of Yangon City

(Kyats/HH.month)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Household income										
Minimum level	13,844	15,228	16,751	18,426	20,269	22,295	24,525	26,978	29,675	32,643
Maximum level	85,464	94,010	103,411	113,752	125,127	137,640	151,404	166,544	183,199	201,519
Average	39,260	43,186	47,505	52,255	57,481	63,229	69,552	76,507	84,158	92,574

(Kyats/HH.month)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Household income										
Minimum level	35,907	39,498	43,448	47,792	52,572	57,829	63,612	69,973	76,970	84,667
Maximum level	221,671	243,838	268,222	295,044	324,548	357,003	392,703	431,973	475,171	522,688
Average	101,831	112,014	123,216	135,537	149,091	164,000	180,400	198,440	218,284	240,113

Based on the above mentioned condition, upper limit of affordability of people to pay for water may be estimated at 4,233 Kyats/HH.month (= 84,667 Kyats × 5 %) as of 2020 in the households belonging to the minimum income level.

9.2.3 Financial Evaluation of Project

(1) Conventional Way

Identification of Financial Benefit

People living in Yangon have the affordability to pay until 692 Kyats/month per household in total (= 13,844 Kyats × 5 %) for water in 2001 in the case of minimum income level as indicated in the above Table 9.26.

On the other hand, willingness of people to pay for water ranges from 383 Kyats/HH per month to 797 Kyats/HH per month also in 2001 according to the Consumer Survey as mentioned above.

From this viewpoint, it is assumed that following 3 options of water price are applied for financial evaluation in a conventional case as:

- Option-1 380 Kyats/month per household (equivalent to 12.93 Kyats/m^3 and US¢2.59/m^3) as the minimum rate of WTP of people in Yangon City for 24 hours drinkable water supply.
- Option-2 690 Kyats/month per household (equivalent to 23.47 Kyats/m^3 and US¢4.69/m^3) as the affordability of people to pay in case of minimum income level.
- Option-3 800 Kyats/month per household (equivalent to 27.21 Kyats/m^3 and US¢5.44/m^3) as the maximum rate of WTP of people in Yangon City for 24 hours drinkable water supply.

In this case, it is assuming that per capita water volume to be consumed is 140 ℓ/day and average family size is 7 persons per HH in every option.

Also in this case, the said water price of each case of options is to be in overall average in whole Yangon. When the water price is to set as tariff system, these water prices should be broken down, and should be re-built into a set of structure by sector as domestic, commercial, industry and so on. So, the said water prices as 380 Kyats, 800 Kyats and 980 Kyats do not mean the actual amount of expenditure of household.

In the financial analysis, the financial benefit means an amount of revenue due to charge collection for potable water supply services.

Based on the above mentioned assumed water price, the financial benefit is estimated in 3 options as shown in the following Table 9.26:

Table 9.26 FINANCIAL Benefit in Conventional Case

Construction package	Water volume to be supplied due to the completion of the works (m^3/day)	Effective water volume to be supplied (m^3/day)	Annual water volume to be supplied due to completion of the works (m^3/annum)	Annual financial benefit by option					
				Option-1		Option-2		Option-3	
				(Million Kyats)	(Equivalent to US$ 1,000)	(Million Kyats)	(Equivalent to US$ 1,000)	(Million Kyats)	(Equivalent to US$ 1,000)
Phase-1	603,300	812,880	296,701,051	3,835	7,670	6,963	13,927	8,073	16,147
Phase-2	398,200	496,864	181,355,521	2,344	4,688	4,256	8,513	4,935	9,870
Overall Project	1,001,500	1,309,744	478,056,572	6,179	12,358	11,220	22,439	13,008	26,017

(Note 1) Unit value of benefit: 13 (Kyats/m^3) 380 (Kyats/m.HH) for option-1.
23 (Kyats/m^3) 690 (Kyats/m.HH) for option-2.
27 (Kyats/m^3) 800 (Kyats/m.HH) for option-3.
(Note 2) Exchange rate: 500 Kyats = US$1.00
(Note 3) Effective water volume includes existing water supply volume.

Identification of Financial Cost

Annual financial construction cost by phase according to the work schedule is already shown in Table 9.17. Detail of estimation of financial cost is shown in Appendix M.3. Following table shows the initial investment and designed effective water volume to be supplied.

Table 9.27 Effective Water Volume to Be Supplied Corresponding to Necessary Costs by Phase

Package	Initial investment cost (US$1,000)*	Effective water volume to be supplied (m^3/day)
Phase-1	812,366	823,000
Phase-2	652,795	617,900
Overall works	1,465,161	1,440,900

Financial Evaluation of Project in Conventional Way

Using cash flow of the construction cost based on the work schedule and OM cost, and financial benefit as shown in above Table 9.27, a financial evaluation is made for each phase in the said 3 options. In this case, the project life is set as 50 years just after completion of each works as the same manner of the economic evaluation. Followings are the result of the evaluation:

Table 9.28 Summary of Financial Evaluation of Project by Phase in Each Option

Package	Option-1			Option-2			Option-3		
	NPV (US$1,000)	FIRR	B/C	NPV (US$1,000)	FIRR	B/C	NPV (US$1,000)	FIRR	B/C
Phase-1	-402,571	Uncountable	0.10	-365,870	Uncountable	0.18	-352,847	Uncountable	0.21
Phase-2	-163,889	Uncountable	0.09	-151,416	Uncountable	0.15	-146,990	Uncountable	0.18
Overall works	-562,056	Uncountable	0.09	-515,296	Uncountable	0.17	-498,704	Uncountable	0.19

(Note 1) Unit value of benefit:
Option-1 13 (Kyats/m^3) 380 (Kyats/month.HH)
Option-2 23 (Kyats/m^3) 690 (Kyats/month.HH)
Option-3 27 (Kyats/m^3) 800 (Kyats/month.HH)

As indicated in the above Table, FIRRs are acalculia because almost of all cash balances are negative as shown in Appendixes M.8 through M10. It means that the Project is not viable to execute from the financial viewpoint even if in case of using the maximum amount of WTP as a tariff for the water supply system as a whole.

However, in this case, the said water price of each case of options is to be in overall average in whole Yangon at existing level. When the water price is to set as tariff system, these water prices should be breakdown, and should be re-built into a set of structure by sector as domestic, commercial, industry, and so on as mentioned above taking envisaged income level of household into account.

From this viewpoint, the other financial evaluation of the project is to be made based on the new tariff setting by sector.

(2) Financial Evaluation of Project Based on Modified Tariff Structure

Water Price for Recovering the Full Cost to Be Needed

In the financial evaluation of the project by means of the above conventional way, tariff setting by sector and envisaged income level over the future are not taking into consideration. Therefore, because that accumulated cash balance during the Project life becomes negative, FIRRs are unable to calculate by reason of function of formula of the internal rate of return in any options.

Then, the other financial evaluation of the project is to be made based on the new tariff setting by sector taking into account of envisaged income level of household over the future.

First of all, necessary amount of expenditure for water supply (in other word, the unit cost of water) by sector should be estimated. The unit cost of water to be supplied is estimated at amount of US¢29.87/m^3 (equivalent to 149 Kyat/m^3) as a specific cost (levelized cost)* of capital and operation and maintenance as shown in Appendix M.11 for the whole works completed in the initial investment cost portion in case assuming that per capita water volume to be consumed is 140 ℓ/day and average family size is 7 persons/HH.

Development of Recommendable Tariff Structure

Water price should recover the full cost from the fundamental viewpoint. So, the new tariff system should be set taking also this principle into consideration.

In this case, the water demand is projected based on to the water consumption survey. The design criteria of the water supply facilities are based on this projection. According to this projection, share rates of water demand by sector to the total water demand may be summarized as follows:

Table 9.29 Share Rate of Water Demand by Sector for the Future

Customers	2005		2010		2015		2020	
	Water demand (m^3/day)	Share rate	Water demand (m^3/day)	Share rate	Water demand (m^3/day)	Share rate	Water demand (m^3/day)	Share rate
Domestic customers	330,225	66.69%	505,410	68.95%	684,314	70.49%	862,260	72.13%
Government offices	63,838	12.89%	76,101	10.38%	88,624	9.13%	101,080	8.46%
Commercial/industrial customers	101,068	20.41%	151,501	20.67%	197,800	20.38%	232,116	19.42%
Total	495,131	100.00%	733,012	100.00%	970,738	100.00%	1,195,456	100.00%

Source: Estimated based on information of present situation taken from YCDC.

Based on the above projection, it is assumed that the water volume to be consumed by domestic customers is to be 70 %, government offices: 10 %, and commercial/ industries: 20 % for making clear envisaged water price for the future.

Following Table 9.30 shows a development process of modified tariff system taking above share rates into consideration.

As indicated in the said Table, increasing rate comparing with existing tariff system for domestic customers is to be 13.6 times (= 407 ÷ 30), government offices: 13.6 times (= 272 ÷ 20), and also commercial/ industries: 13.6 times (= 1,833 ÷ 135) respectively. The amount of 407 Kyats/1,000 gallons for households may be converted into the expenditure of household

* "*The costs of Generating Electricity in Nuclear and Coal Fired Power Stations*" – A Report by an Expert Group of the Nuclear Energy Agency, OECD, 1983, and Kam W. Li and A. Paul Priddy Ed. "*Power Plant System Design*" John Wiley & Sons, Inc., 1985, USA.

at amount of 2,634 Kyats/HH.month for the cost of initial investment and operation and maintenance.

Table 9.30 Development of Modified Tariff System for Water Supply

Sector	Share rate of water volume to be consumed by sector	Existing tariff structure		Revenue by sector when total sold water volume is 1 m^3 without project	Necessary revenue by sector when total sold water volume is 1 m^3 with project in proportion of the existing tariff structure	Tariff structure with project in proportion of the existing tariff structure		Average expenditure for water per HH per month
		Kyats/ 1,000 gal.	US¢/m^3	US¢	US¢	US¢/m^3	Kyats/ 1,000 gal.	(Kyats/HH. month)
Domestic	0.70	30	1.32	0.92	12.54	17.92	407	2,634
Government	0.10	20	0.88	0.09	1.19	11.95	272	
Industry/commercial	0.20	135	5.94	1.19	16.13	80.65	1,833	
Total revenue when total sold water volume is 1 m^3 (US¢/m^3)				2.20	29.87			

(Note)

Targeted overall average price of water:	29.87	(US¢/m^3) (To cover the initial investment cost)
Conversion rate:	4.546	(l/galon)
Exchange rate:	500	(Ktats/US$)
Per capita water consumption:	140	(l/day/capita)
Average family size:	7	(persons/HH)

This amount of amount of expenditure per household per month is within the said upper limit of affordability, namely 4,233 Kyats/HH per month (refer to Table 9.26 and its explanation there-under), in the case of envisaged income as of 2020 in minimum income level.

The above indicated water tariff is the targeted water price to be realized at the targeted year 2020. So, it is needed to set stepwise tariff revision schedule. For this, it is assumed that the tariff is to be revised by every 5 years by formulas as shown in the following Fig.9.7.

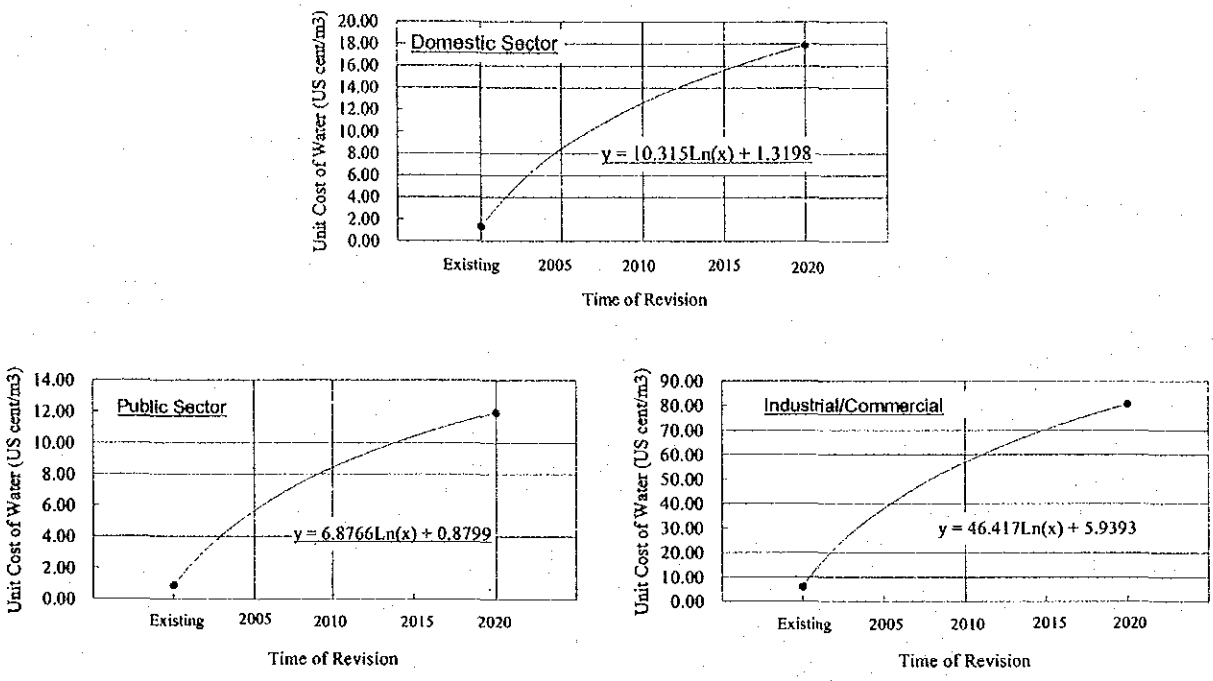


Fig. 9.7 Increasing Patterns of Unit Cost of Water Over the Future

Following table shows a stepwise tariff revision schedule based on the said formulas:

Table 9.31 Tariff Schedule Over the Future

Description	Tariff schedule							
	2005		2010		2015		2020	
	(Kyats/m^3)	(Kyats/ *1,000 Gal*)	(Kyats/m^3)	(Kyats/ *1,000 Gal*)	(Kyats/m^3)	(Kyats/ *1,000 Gal*)	(Kyats/m^3)	(Kyats/ *1,000 Gal*)
Domestic sector (Metered rate)	42.35	193	63.26	288	78.10	355	89.61	407
(Equivalent to US¢/m^3)	8.47		12.65		15.62		17.92	
Public sector (Metered rate)	28.23	128	42.17	192	52.06	237	59.74	272
(Equivalent to US¢/m^3)	5.65		8.43		10.41		11.95	
Industrial/commercial sector (Metered rate)	190.57	866	284.67	1,294	351.43	1,598	403.23	1,833
(Equivalent to US¢/m^3)	38.11		56.93		70.29		80.65	
(Remarks)								
Average monthly expenditure for water per household (Kyats/month per HH):	1,245		1,860		2,296		2,634	
Increasing ratio (existing: 194 Kyats/HH.m):	542%		49%		23%		15%	
(Note) Exchange rate:	500 (Kyats/US$)							

Using this tariff revision schedule, project evaluation is made again in case of modified tariff system. The result is shown in the following Table 9.32. Detail of evaluation processes are shown in Appendixes M.12, M13, and M.14.

Table 9.32 Evaluation Result by Phase Based on Tariff To Be Revised for Future in Every 5 Years

Package	Evaluation result		
	NPV (US$1,000)	FIRR	B/C
Phase-1	-70,463	8.03%	0.84
Phase-2	-66,806	3.89%	0.63
Overall works	-128,230	7.24%	0.79

The result of financial evaluation in case of the new tariff schedule indicates rather higher FIRR than those of the above conventional way, but still low feasibility as shown in the above Table for Phase-1, Phase-2 and overall works. However, as suggested by such international institutions as the World Bank as mentioned in economic evaluation of the project, an FIRR is expected to at least be cleared a hurdle of 5.0 % from a viewpoint of basic human needs even such a project is in developing countries and even in case of non-commercial projects. From this viewpoint, the Project under study satisfies this expectation with the resulted FIRRs in overall Project and in Phase-1 Works as 7.24 % and 8.03 % respectively as indicated in the above Table. Namely, the Project is financially sound too from the viewpoint of the basic human needs.

In this financial evaluation, basic unit amount of financial benefit, namely basic unit amount of revenue due to water charge collection according to the revised tariff system, is revised every 5 years from the year 2005. According to this revision, water expenditure per household per month rise with the rate of 542 % up (namely, 6.4 times against previous year) in 2005 against previous household expenditure corresponding the existing tariff system, 49 % up in 2010, 23 % up in 2015 and 15 % up in 2020. In the year 2020, the amount of household monthly expenditure will rise up to 13 times comparing with that corresponding to the existing tariff system, and this amount is continued until the end of the 50 years of the Project life.

In other words, revenue of YCDC is increased with the same rate. Namely, The revenue due to water charge collection based on the said revised tariff system makes financial benefit be increased over the Project life of 50 years.

There is no point in making a sensitivity analysis because that the said resulted FIRR is low comparing with the applied rate of opportunity cost of capital.

9.2.4 Tariff System to be Recommended

Following Table 9.33 and Fig.9.8 show relationships between income and expenditure for water of the households in minimum income level:

Table 9.33 Relationships between Monthly Income and Expenditure for Water of Households in Minimum Income Level

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
A. Household income*1											
(1) Minimum level	Kyats/HH/month	13,844	15,228	16,751	18,426	20,269	22,295	24,525	26,978	29,675	32,643
(2) Maximum level	Kyats/HH/month	85,464	94,010	103,411	113,752	125,127	137,640	151,404	166,544	183,199	201,519
(3) Average	Kyats/HH/month	39,260	43,186	47,505	52,255	57,481	63,229	69,552	76,507	84,158	92,574
B. Water consumption*2	m^3/HH/month	29	29	29	29	29	29	29	29	29	29
	gallons/HH/month	6,467	6,467	6,467	6,467	6,467	6,467	6,467	6,467	6,467	6,467
C. Water tariff	US¢/m^3	1.32	1.32	1.32	1.32	8.47	8.47	8.47	8.47	8.47	12.65
	Kyats/m^3	6.60	6.60	6.60	6.60	42.35	42.35	42.35	42.35	42.35	63.26
	Kyats/10^3 gallon	30	30	30	30	193	193	193	193	193	288
Revised rate						541.71%					49.38%
D. Expenditure for wat	US¢/HH.month	38.80	38.80	38.80	38.80	249.01	249.01	249.01	249.01	249.01	371.97
(4)	Kyats/HH.month	194	194	194	194	1,245	1,245	1,245	1,245	1,245	1,860
Expenditure share rate; (4)/(1)		1.40%	1.27%	1.16%	1.05%	6.14%	5.58%	5.08%	4.62%	4.20%	5.70%
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
A. Household income*1											
(1) Minimum level	Kyats/HH/month	35,907	39,498	43,448	47,792	52,572	57,829	63,612	69,973	76,970	84,667
(2) Maximum level	Kyats/HH/month	221,671	243,838	268,222	295,044	324,548	357,003	392,703	431,973	475,171	522,688
(3) Average	Kyats/HH/month	101,831	112,014	123,216	135,537	149,091	164,000	180,400	198,440	218,284	240,113
B. Water consumption*2	m^3/HH/month	29	29	29	29	29	29	29	29	29	29
	gallons/HH/month	6,467	6,467	6,467	6,467	6,467	6,467	6,467	6,467	6,467	6,467
C. Water tariff	US¢/m^3	12.65	12.65	12.65	12.65	15.62	15.62	15.62	15.62	15.62	17.92
	Kyats/m^3	63.26	63.26	63.26	63.26	78.10	78.10	78.10	78.10	78.10	89.61
	Kyats/10^3 gallon	288	288	288	288	355	355	355	355	355	407
Revised rate						23.45%					14.74%
D. Expenditure for wat	US¢/HH.month	371.97	371.97	371.97	371.97	459.21	459.21	459.21	459.21	459.21	526.88
(4)	Kyats/HH.month	1,860	1,860	1,860	1,860	2,296	2,296	2,296	2,296	2,296	2,634
Expenditure share rate; (4)/(1)		5.18%	4.71%	4.28%	3.89%	4.37%	3.97%	3.61%	3.28%	2.98%	3.11%

*1 Increasing ratios of income level is assumed at 10 % based on CPI taking moderate case into account comparing with per capita GDP increasing ratio. The base income level is based on the Consumer Survey as shown in Appendix M.1.

*2 Per capita water consumption: 140 /day.capita
Average family size: 7 /HH
Conversion rate: 4.546 /gallon

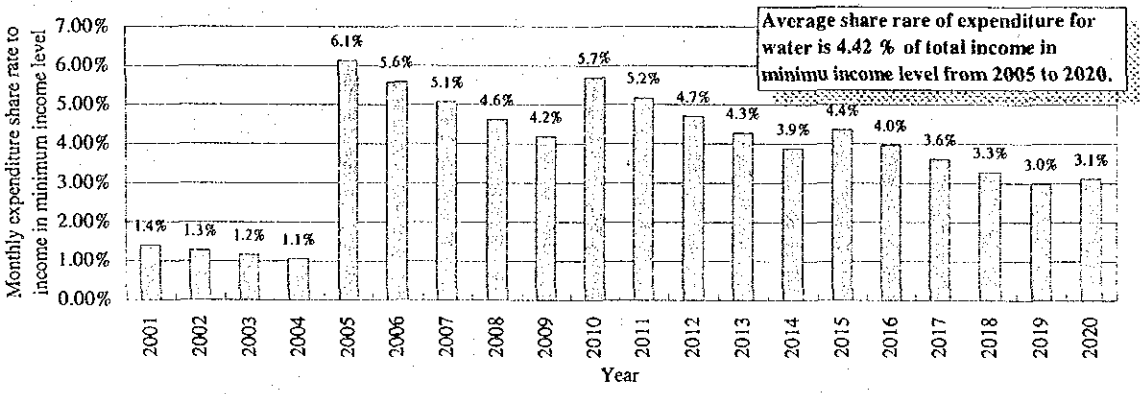


Fig. 9.8 Share Rates of Expenditure for Water to Average Income

Five (5) % of total income is the upper limit of affordability of people to pay for water as mentioned above. As indicated in the above Table and Figure, monthly share rates of expenditure for water against monthly income level exceed the 5 % at 5 times in 2005 (6.1 %), 2006 (5.6 %), 2007 (5.1 %), 2010 (5.7 %), and 2011 (5.2 %). However, the average share rate during the period from 2005 to 2020 is lower than 5 % as 4.4 %.

Furthermore, as mentioned above, the trial tariff schedule indicates a financial sustainability from the viewpoint of basic human needs. Therefore, the JICA Study Team recommends this trial tariff

schedule as indicated in Table 9.31 to YCDC, and the Team would like to ask YCDC to make necessary procedures including a development of law and/or regulation to be needed as soon as possible.

In addition to those specific water charge mentioned above, a house connection fee consisting of (1) basic charge, (2) approval fee for sanitation and (3) approval fee for tapping from YCDC pipe should be collected from customers according to the existing house connection system.

9.2.5 Analysis of Repayment Ability of the Project

The Project cost as an initial construction cost is a huge amount. Therefore, it seems that the preparation of this cost is to be quite difficult for the municipal authority of Yangon City or YCDC and/or the Central Government of Myanmar by themselves.

Therefore, the analysis for repayment ability of the Project is to be made assuming that the necessary initial cost is financed by a loan from some donors based on the said recommended tariff system.

Because that the analysis of repayment ability for Phase-1 may be enough for making clear the repayment ability of the Project (namely, YCDC) from the viewpoint of the economic evaluation too, the analysis for repayment ability of YCDC is made for Phase-1.

(1) Loan Amount

Usually, a loan amount excludes such local cost as costs to be needed for land acquisition, housing compensation, administration cost, but should includes a price contingency because the time of commencement of the construction works is generally several years later than the time when the cost is estimated, so if price contingency is not included, the construction works themselves might not be executed. In this case, a price escalation rate should firstly be set for both the FC portion and LC portion.

The price fluctuation rate in these several years in Myanmar is actually 18 % per annum according to the statistical data as mentioned in previous sub-clause. Nevertheless, if a Japanese loan can be utilized, there is an example that the price escalation rates for FC portion and LC portion have been as 0.8 % per annum and 0.1 % per annum respectively in a similar developing country for the similar project.

Accordingly, in this Project, the price escalation rates are applied as 1.0 % per annum for FC portion and 0.5 % per annum for LC portion tentatively because that the loan policy is usually depending upon countries' situation and disbursement timing.

Following Table 9.34 shows a summary of a result of loan amount estimation.

Table 9.34 Annual Disbursement of Loan Amount for Phase-1

(US$1,000)

Year	For Phase-1		
	FC	LC	Total
2003	0	0	0
2004	31,875	2,361	34,236
2005	33,380	2,908	36,288
2006	121,799	13,105	134,903
2007	94,693	7,943	102,635
2008	168,339	29,994	198,333
2009	132,470	22,193	154,663
2010	171,576	25,656	197,233
Total	754,131	104,160	858,291

(2) Loan Repayment Ability of YCDC by Revenue Due to Water Charge Collection

Following Table 9.35 shows a part of cash flow for Phase-1 from the construction works to the end of repayment of loan as an example. The entire cash flow is shown in Appendix M.15. In this case, it is assumed that the financing source is Japan Bank for International Cooperation (JBIC).

Table 9.35 Repayment Ability of Loan for the Works of Phase-1

(US$1,000) (US$1,000)

Year in order	Year	Outflow						In flow				Subsidy to the Project from YCDC or Central Government of Myanmar
		Construction cost		Foreign borrow		OM cost	Total	Foreign borrow	Revenue in total	In flow in total	Cash balance	
		Loan portion	Local portion	Interest	Principal							
-1	2001	0	0	0	0	0	0	0	0	0	0	0
0	2002	0	0	0	0	0	0	0	0	0	0	0
1	2003	0	0	0	0	0	0	0	0	0	0	0
2	2004	31,875	2,361	0	0	207	34,444	31,875	1,870	33,745	-699	699
3	2005	33,380	2,908	414	0	207	36,910	33,380	14,318	47,699	10,788	
4	2006	121,799	13,105	848	0	694	136,446	121,799	26,380	148,179	11,733	
5	2007	94,693	7,943	2,432	0	723	105,790	94,693	26,849	121,541	15,751	
6	2008	168,339	29,994	3,663	0	1,869	203,865	168,339	27,318	195,657	-8,208	8,208
7	2009	132,470	22,193	5,851	0	1,078	161,592	132,470	27,792	160,262	-1,331	1,331
8	2010	171,576	25,656	7,573	0	8,888	213,693	171,576	63,343	234,919	21,226	
9	2011			9,804	0	8,888	18,691		63,343	63,343	44,652	
10	2012			9,804	0	9,963	19,767		63,343	63,343	43,576	
11	2013			9,804	33,260	8,888	51,951		63,343	63,343	11,392	
12	2014			9,371	33,692	8,888	51,951		63,343	63,343	11,392	
28	2030			1,637	41,427	8,888	51,951		89,724	89,724	37,772	
29	2031			1,098	41,966	8,888	51,951		89,724	89,724	37,772	
30	2032			553	42,511	9,963	53,027		89,724	89,724	36,696	
Total		754,131						754,131				

(Note)

(1) Interest rate of foreign loan: 1.30%

(2) Equal annual repayment amount of capital for foreign loan (US$1,000)): 43,064

In the case indicated in the above Table, an amount of annual equal payment including interest and principal is calculated at US$ 43,064 $\times 10^3$ with an interest rate of 1.30 % per annum and 30 years of repayment period including 10 years of grace period.

As indicated in the above, a subsidy to the Project from General Account of YCDC or from the central Government of Myanmar (or some domestic financing sources) will be needed at the early stage of execution of construction works and at the time to be needed large scale of construction cost to invest. However, when the water charge is collected smoothly, YCDC can caver such deficit in any case.

It means that, if the recommended tariff system will be applied for public water supply system in Yangon City, even the construction cost is a huge amount, the amount of revenue will be more than the said construction cost. Namely, the Project is very sound from the financial viewpoint.

9.2.6 Cash Flow Analysis for Accounting of YCDC

(1) Existing Accounting Status of YCDC

For making financially sound management of fiscal administration, a robust financial outlook is required. However, YCDC has no authorized fiscal statements at present. They are keeping books by means of using a paying-in book and a disbursement record without any balance-sheet and profit and loss statement.

Therefore, there is no any record on their assets and liabilities, and it is very difficult to make clear their actual profits and losses at the present situation.

Overview of the Accounting System of YCDC

Being an institution of Ministerial status in Myanmar, YCDC is a separate financial body in its own right. Similar to other viable financial institutions, the current policy of YCDC is to collect money from customers for the services rendered. This includes the policy of charging for town water supply and other connected services such as connection fees from their customers. The YCDC is empowered to collect revenue and impose penalties on defaulters by the law.

The current budgetary policy envisages that all revenues collected by each of the 21 departments of YCDC including the WSS (Water & Sanitation) Engineering Department are credited to the general account. The Budget and Finance Department is responsible for the management of the general account. Funds from this account are allocated to each of the 21 departments based on their individual annual operational budgetary requirements. Under the current policy, the individual departments including the WSS have no authority to determine areas for capital expenditure within their operations. Similarly, the departments are not authorized to include items of expenditure requiring policy directives in their forecasts. Such matters have to be cleared by the executive committee of the YCDC before sanctioning.

Each department prepares a budgetary forecast of its intended revenue and expenditure for the period 1st April to 31st March of the following year. This is submitted to the Budget and

Accounts department for approval. It is the responsibility of each department to operate within the approved budget during the fiscal year. The annual forecast is reviewed in mid-year in order to determine any financial short falls and/or excess. This exercise is followed by the actual adjustment of revenue and expenditure against the approved annual budget.

The strategy for financial operations involves reimbursement of expenditure already incurred on any item on submission of receipts to the Budget and Accounts Department. In this process, the relevant department prepares a work authority for each potential item of expenditure. This is submitted to the Coordination Department for checking, auditing and making adjustments if necessary before passing over to the Budget and Accounts Department for payment. Actual expenditure against the approved work authority is paid to the relevant department or the work team on submission of claims, in installments.

Furthermore, officers holding specified positions are issued with advance funds to be disbursed on various items of expenditure. For example the district WSS engineer in charge of a district has Ks.50,000 advance accounts while a township engineer has an advance of Ks.10,000 to be spent on urgent small-scale work items.

Although the revenue collected is credited to the General Account and the expenditure incurred in the provision of water service is provided from this account, the actual revenue and expenditure accounts of the WSS are kept separately. This makes it possible to analyze water sector financial position fairly accurately.

Table 9.36 hereunder shows YCDC's Revenue and Expenditure during last 10 years.

Table 9.36 Revenue and Expenditure of YCDC During Last 10 Years

(Million Kyats)

Year	Revenue			Expenditure			Balance
	Current account	Capital account	Total	Current account	Capital account	Total	
1991/92	675	595	1,270	348	834	1,182	87
1992/93	852	375	1,227	453	878	1,330	-103
1993/94	1,070	363	1,432	560	1,076	1,637	-204
1994/95	1,557	712	2,268	694	1,063	1,757	512
1995/96	2,400	635	3,034	915	1,854	2,769	265
1996/97	3,568	1,468	5,036	1,561	3,617	5,178	-142
1997/98	5,517	2,381	7,899	2,528	4,234	6,762	1,136
1998/99	5,899	2,484	8,383	2,925	3,676	6,601	1,782
1999/00	6,539	2,136	8,675	3,766	5,386	9,152	-477
2000/00	7,354	3,150	10,503	5,423	5,358	10,781	-278
Annual average increase (%)			23.53%			24.74%	

Source: YCDC.

Water Sector Revenue and Expenditure

As already mentioned in the above, the WSS Department collects revenue for various services provided to its customers. It receives funds from the General Account to pay for the expenditure incurred.

The WSS Department's annual undiscounted revenue ranged from 58 millions Kyats in 1991/92 to 530 millions Kyats in 2000/01. This represents an increase in revenue by 10 times during the past decade. The undiscounted mean annual revenue for the past ten years stood at Ks. 302.43 millions.

The revenue for WSS operations is brought about by 3 main sources as (1) water tariffs, (2) connection fee and (3) other revenue. The total revenue itself and the contribution to the total by each source have registered a consistent increase (except for 1998/99) over the last 10 years. The possible reason for lower revenue in 1998/99 may be due to the civil disturbance in Yangon in that year.

WSS's expenditure in the provision of water service includes the salaries and wages paid for its staff (personal cost), maintenance cost for infrastructure and the operation cost. The capital expenditure incurred by the WSS Department is not available for analysis because that all assets belong to YCDC. It is to be noted that the maintenance cost does not include operation costs of vehicles in connection with the provision of water services.

Following Table 9.37 shows Revenue and Expenditure of WSS Department during last 10 years.

Table 9.37 Revenue and Expenditure of WSS Department During Last 10 Years

(Million Kyats)

Year	Revenue					Expenditure				Balance
	Government offices	Private customers	Connection fee	Others	Total	Salaries & wages	Overhead expenses	Cost for maintenance	Total	
1991/92	21	28	8	1	58	10	19	20	49	9
1992/93	28	36	10	3	77	13	23	19	55	22
1993/94	28	44	11	1	85	16	25	17	58	27
1994/95	45	97	20	3	164	16	32	15	63	100
1995/96	49	194	60	9	311	15	35	18	67	244
1996/97	58	207	74	9	349	15	35	24	74	275
1997/98	58	282	126	7	473	15	53	31	99	374
1998/99	63	245	104	13	426	16	84	44	144	282
1999/00	74	259	201	18	553	18	92	47	157	395
2000/01	69	249	194	17	530	73	108	60	241	289
Annual average increase (%)	12.77%	24.56%	36.98%	31.32%	24.74%	5.85%	18.86%	11.74%	17.23%	41.59%

Revenue due o water charge collection is supported by the following number of customers as:

Table 9.38 Number of Customers by Sector

Year	Public Sector (Government Offices, etc.)	Industrial/ Commercial Sector	Domestic Sector	Total
1995/96	1,077	8,005	86,950	96,032
1996/97	1,080	7,765	77,037	85,882
1997/98	1,140	6,711	84,945	92,796
1998/99	1,154	7,726	88,684	97,564
1999/00	1,219	9,639	93,027	103,885
2000/01	1,255	9,923	98,785	109,963
Annual average increase (%)	3.11%	4.39%	2.59%	2.75%

Source: YCDC.

(2) Fiscal Projection for Accounting of YCDC in Implementation of Project

Following Table 9.39 shows a result of projection of Profit and Loss of WSS Department until the 2020:

Table 9.39 Projection of Profit and Loss of WSS Department of YCDC

(US$1,000)

	(Note)	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
A. Revenue due to water charge collection		1,321	1,648	2,056	2,564	11,246	23,818	24,797	25,777	26,761	62,564
B. Outstanding collection						1,175	2,489	2,591	2,694	2,796	6,538
Outstanding charge	2.60%					292	619	645	670	696	1,627
Free connection rate	3.45%					388	822	856	889	923	2,158
Non-billing rate	1.80%					202	429	446	464	482	1,126
Communal water tapping	2.60%					292	619	645	670	696	1,627
C. Governmental and/or YCDC cross subsidy		0	0	0	0	0	0	0	0	0	0
D. Subtotal (A -B + C)		1,321	1,648	2,056	2,564	10,070	21,329	22,206	23,083	23,964	56,026
E. OM cost for YCDC own operation		179	210	246	289	0	0	0	0	0	0
F. OM cost for the Project					207	207	694	723	1,869	1,078	8,888
G. Replacement cost		0	0	0	0	651	1,335	3,855	5,752	9,465	12,205
H. Depreciation		0	0	0	0	1,008	2,065	5,962	8,898	14,528	18,878
I. Subtotal (E+F+G+H)		179	210	246	496	1,866	4,095	10,540	16,519	25,071	39,970
J. Profit before Tax (D - I)		1,142	1,438	1,810	2,068	8,204	17,234	11,666	6,564	-1,107	16,056
K. Income tax		0	0	0	0	0	0	0	0	0	0
Net Profit (J - K)		1,142	1,438	1,810	2,068	8,204	17,234	11,666	6,564	-1,107	16,056

(US$1,000)

	(Note)	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
A. Revenue due to water charge collection		64,380	66,195	68,009	69,824	90,046	93,634	97,231	100,819	104,415	142,789
B Outstanding collection		6,728	6,917	7,107	7,297	9,410	9,785	10,161	10,536	10,911	14,921
Outstanding charge	2.60%	1,674	1,721	1,768	1,815	2,341	2,434	2,528	2,621	2,715	3,713
Free connection rate	3.45%	2,221	2,284	2,346	2,409	3,107	3,230	3,354	3,478	3,602	4,926
Non-billing rate	1.80%	1,159	1,192	1,224	1,257	1,621	1,685	1,750	1,815	1,879	2,570
Communal water tapping	2.60%	1,674	1,721	1,768	1,815	2,341	2,434	2,528	2,621	2,715	3,713
C. Governmental and/or YCDC cross subsidy		0	0	0	0	0	0	0	0	0	0
D. Subtotal (A -B + C)		57,652	59,277	60,902	62,527	80,636	83,849	87,071	90,283	93,504	127,867
E. OM cost for YCDC own operation		0	0	0	0	0	0	0	0	0	0
F. OM cost for the Project		9,233	9,964	8,906	9,894	9,318	9,999	8,923	9,911	16,225	30,916
G. Replacement cost		15,756	16,805	17,787	18,427	18,667	19,198	19,743	21,676	24,483	28,182
H. Depreciation		24,371	25,993	27,512	28,502	28,873	29,694	30,538	33,528	37,869	43,591
I. Subtotal (E+F+G+H)		49,360	52,763	54,204	56,823	56,857	58,891	59,204	65,116	78,577	102,689
J. Profit before Tax (D - I)		8,292	6,515	6,698	5,704	23,779	24,958	27,867	25,167	14,926	25,178
K. Income tax		0	0	0	0	0	0	0	0	0	0
Net Profit (J - K)		8,292	6,515	6,698	5,704	23,779	24,958	27,867	25,167	14,926	25,178

(Note)

Communal water tapping is used by lowest income levels with share rate of 3.7 % of total households connected with YCDC Water Supply System. However, total domestic users shared at 70 % of total water volume to be supplied. So, it is assumed that the rate of communal water tapping users is to be 2.6 % of the water volume to be supplied (= 3.7 % * 70 %).

In this case, it is assumed total outstanding collections are to be most pessimistic case as 10 % consisting of (1) outstanding charge: 2.60 %, (2) free connection rate: 3.45 %, (3) non-billing rate: 1.80 % and (4) the rate of communal water tapping: 2.59 % in average as mentioned previous sub-clause. In this case, it is also assumed that the OM cost of YCDC own operation (existing operation) is to be included in the OM cost for the Project since the starting time of water charge collection due to the Project in 2005.

As indicated in the above Table, there is only once to register a deficit in the fiscal year 2009/10 during the period the year 2020 even in case of most pessimistic case from the viewpoint of one-year-budget.

Based on the above projection of profit and loss of WSS Department, a project of fund flow of WSS Department is made. This table indicates a situation of balance sheet in each year over the future. Following Table 3.40 is shown its results:

Table 9.40 Projection of Fund Flow of WSS Department of YCDC

(US$1,000)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
A. Source of Fund (B+G+I)	1,142	1,438	1,810	35,653	44,475	149,191	115,472	203,154	158,410	218,034
B. Internal fund generation (C+D)	1,142	1,438	1,810	2,068	9,212	19,299	17,628	15,461	13,422	34,934
C. Depreciation					1,008	2,065	5,962	8,898	14,528	18,878
D. Net profit	1,142	1,438	1,810	2,068	8,204	17,234	11,666	6,564	-1,107	16,056
G. Credit of International Financing Institution to the Project				31,247	32,399	117,046	90,097	158,583	123,557	158,448
I. Counterpart contribution by YCDC (Local currency portion)				2,338	2,865	12,846	7,747	29,110	21,432	24,653
J. Application of fund (K+L+M)	1,142	1,438	1,810	35,653	44,475	149,191	115,472	203,154	158,410	218,034
K. Investment for the Project			0	33,585	35,264	129,892	97,844	187,693	144,989	183,101
L. Debt retirement				0	406	827	2,349	3,520	5,582	7,188
Repayment of principal for Phase-I				0	0	0	0	0	0	0
Interest payment of loan amount for Phase-I				0	406	827	2,349	3,520	5,582	7,188
M. Working capital	1,142	1,438	1,810	2,068	8,805	18,472	15,279	11,941	7,840	27,746
Available cash	1,431	2,869	4,678	6,747	15,552	34,024	49,304	61,245	69,084	96,830

(US$1,000)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
A. Source of Fund (B+G+I)	86,736	83,131	67,212	46,565	80,045	82,770	158,083	203,393	243,529	80,889
B. Internal fund generation (C+D)	32,663	32,508	34,210	34,206	52,652	54,653	58,405	58,695	52,795	68,769
C. Depreciation	24,371	25,993	27,512	28,502	28,873	29,694	30,538	33,528	37,869	43,591
D. Net profit	8,292	6,515	6,698	5,704	23,779	24,958	27,867	25,167	14,926	25,178
G. Credit of International Financing Institution to the Project	45,600	42,063	29,586	10,011	22,200	22,080	85,025	120,324	163,568	9,849
I. Counterpart contribution by YCDC (Local currency portion)	8,473	8,559	3,416	2,348	5,193	6,037	14,653	24,374	27,165	2,271
J. Application of fund (K+L+M)	86,736	83,131	67,212	46,565	80,045	82,770	158,083	203,393	243,529	80,889
K. Investment for the Project	54,073	50,622	33,002	12,359	27,393	28,117	99,678	144,697	190,733	12,120
L. Debt retirement	9,248	9,841	41,762	42,147	42,277	42,565	42,852	43,958	45,522	47,648
Repayment of principal for Phase-I	0	0	31,374	31,782	32,195	32,614	33,038	33,467	33,903	34,343
Interest payment of loan amount for Phase-I	9,248	9,841	10,388	10,364	10,081	9,951	9,814	10,490	11,619	13,305
M. Working capital	23,415	22,667	-7,552	-7,941	10,375	12,088	15,553	14,738	7,274	21,121
Available cash	120,245	142,912	135,361	127,420	137,795	149,883	165,435	180,173	187,446	208,567

As indicated in the above Table, a deficit of net profit in 2009/10 may be covered by the accumulated available cash. Also, in the year 2013 and 2014, working capitals will be booked in credit side as indicated in the above Table. However, these are also balanced out by the accumulated available cash. Accordingly, YCDC can keep sound accounting until the year 2020 and thereafter.

As indicated in the above table, negative working capitals will be suffered only in the years of 2013 and 2014 just starting repayment of principals, but these negative working capitals can be covered by available cashes from each previous year. And, there are no any other time getting into accounting crisis even after the year 2021 starting repayment of principal for Phase-2 works.

After the year 2021, it is assumed that the net profit will be constant because that the design criteria is based on the situation as of 2020, namely, the all the water supply facilities is designed to serve to water supply by 70 % of the total population in the year 2020. Even though, accumulated available cash will be increased year by year even after the year 2021 too, because that net profit will be larger than the debt retirement.