4.10 Implementation Schedule

4.10.1 Implementation Schedule for Construction Work

As described in Section 4.4 "Water Demand Projection", the staged development plan for the project is shown in Figure 410-1. Total expansion of water supply capacity for the target year of 2015 by the project is 100,000 m3/day, in order to meet the daily maximum water demand in 2015. Expansion of the water supply capacity will be implemented in two stages. The 1st stage expansion which is due for completion in 2007 is 40,000 m3/day, and the 2nd stage expansion which is due for completion in 2012 is 60,000 m3/day. The completion of each expansion was estimated from an implementation schedule for construction work as shown in Figure 410-2.

Figure 410-1 Stage-Wise Development Plan

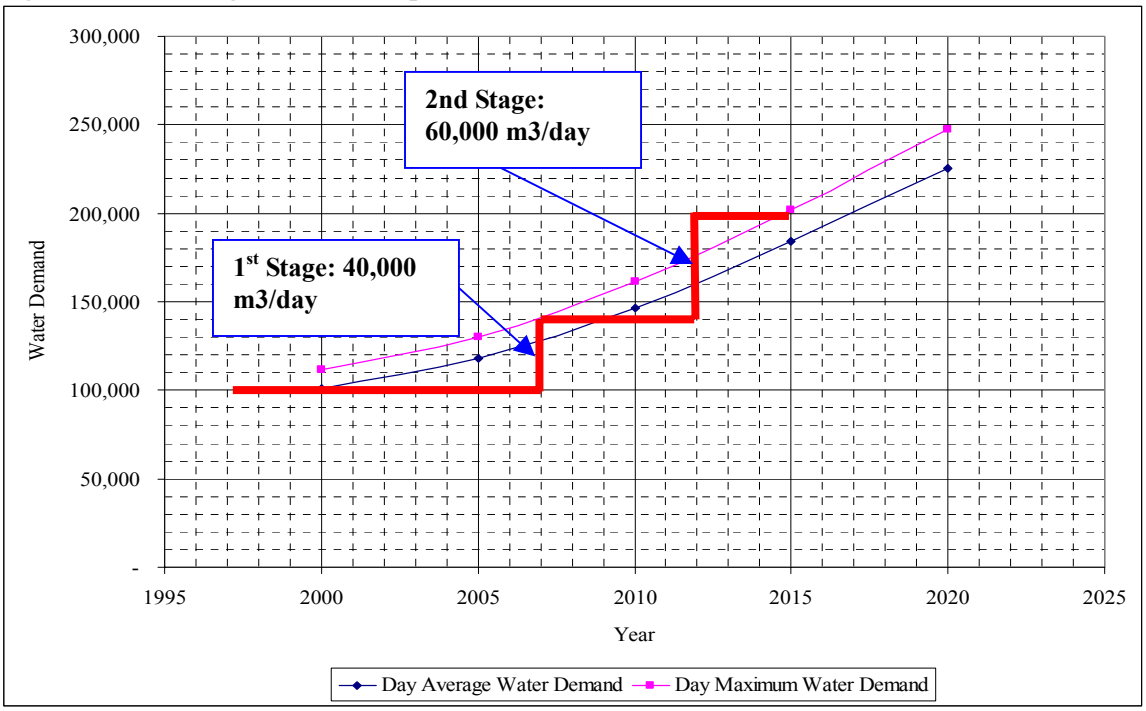
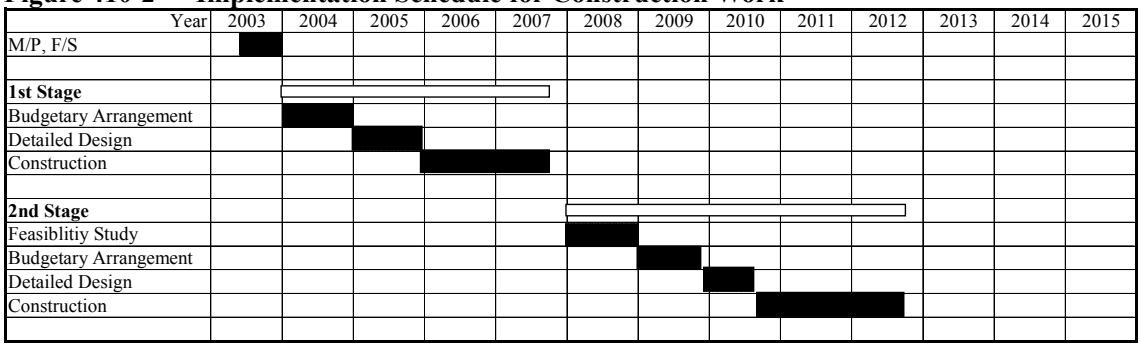


Figure 410-2 Implementation Schedule for Construction Work



4.10.2 Implementation Schedule for Reduction of Unaccounted-for Water

To reduce the UFW ratio from 33 % down to 25% by 2010, and to maintain the UFW ratio of 25 % up to 2015, the following measures should be conducted according to the implementation schedule as shown on Figure 410-3.

(1) First Stage (present to 2007)

- Visible leakage repair (mains and service pipes to house connections)
- Zoning and installation of district meters (in the pilot zones and newly formed zones)
- Replacement of defective water meters

(2) Second Stage (year 2008 to 2012)

- Invisible leakage repair (mains and service pipes to house connections) detected by the district metering, waste water metering, the Step Test, and specialised equipment
- Zoning and installation of district meters (in the zones newly formed during the second stage)
- Replacement of defective water meters

(3) Third Stage (year 2013 to 2015)

- Invisible leakage repair detected by district metering, waste water metering, the Step Test, and specialised equipment
- Zoning and installation of district meters (in the zones newly formed during the third stage)

Figure 410-3 Implementation Schedule for Reduction of UFW

4.10.3 Disbursement Schedule

Based on the implementation schedule for the construction works, reduction of the UFW and human resource development, the overall disbursement schedule of the project up to 2015 is shown in Table 410-1. This disbursement schedule will be reviewed during feasibility study based on preliminary design and cost estimates.

Table 410-1 Disbursement Schedule of the Project

Item		Qty.	Unit	Total	Foreign	Local	2004 Sub Total	2004 Foreign	2004 Local	2005 Sub Total	2005 Foreign	2005 Local	2006 Sub Total	2006 Foreign	2006 Local	2007 Sub Total	2007 Foreign	2007 Local	2008 Sub Total	2008 Foreign	2008 Local
Case K-1														Existing	←┤	├→	Expanded (1st Stage)				
2007:Kaolieo 40,000 m3/day & 2012:Thangone 60,000 m3/day												├→		Construction	←┤						
Year								2004			2005			2006			2007			2008	
Day Average			m^3/day					114,899			118,302			123,963			129,625			135,286	
Day Maximum			m^3/day					126,389			130,132			136,360			142,587			148,815	
Plant Scale			m^3/day					100,000			100,000			100,000			140,000			140,000	
Number of Connection			nos.				1	47,925	0.2	2	50,081	0.3	3	53,397	0.3	4	56,713	0.2	5	60,029	
1. Construction Cost	Sub Total			**67,611**	**45,923**	**21,688**	**604**	**403**	**201**	**2,916**	**1,910**	**1,006**	**12,464**	**8,188**	**4,276**	**10,064**	**6,621**	**3,443**	**673**	**476**	**197**
1.1 Treatment Plants	Minor Total			**28,508**	**17,748**	**10,760**	0	0	0	1,507	905	602	7,541	4,528	3,013	6,033	3,622	2,411	0	0	0
Expansion of Kaolieo T.P.		40,000	m^3/day	**9,624**	**5,762**	**3,862**	0	0	0	962	576	386	4,812	2,881	1,931	3,850	2,305	1,545	0	0	0
Construction of Thangone T.P.		60,000	m^3/day	**13,427**	**8,693**	**4,734**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rehabilitation of Kaolieo T.P. (1st Stage)		1	L.S.	**3,023**	**1,951**	**1,072**	0	0	0	302	195	107	1,512	976	536	1,209	780	429	0	0	0
Expansion of Reservoir in Chinaimo T.P. (1st Stage)		1	L.S.	**2,434**	**1,342**	**1,092**	0	0	0	243	134	109	1,217	671	546	974	537	437	0	0	0
1.2 Clear Water Transmission Pipelines	Minor Total	13.4	km	**8,755**	**7,182**	**1,573**	0	0	0	123	98	25	617	492	125	494	394	100	0	0	0
For the 1st Stage		2.8	km	**1,234**	**984**	**250**	0	0	0	123	98	25	617	492	125	494	394	100	0	0	0
For the 2nd Stage		10.6	km	**7,521**	**6,198**	**1,323**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.3 Distribution Center	Minor Total	5,000	m3	**4,376**	**2,984**	**1,392**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 1st Stage			m3	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 2nd Stage		5,000	m3	**4,376**	**2,984**	**1,392**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.4 Booster Pump Station	Minor Total	2	set	**1,103**	**901**	**202**	0	0	0	74	61	13	368	303	65	295	243	52	0	0	0
For the 1st Stage		1	set	**737**	**607**	**130**	0	0	0	74	61	13	368	303	65	295	243	52	0	0	0
For the 2nd Stage		1	set	**366**	**294**	**72**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5 Distribution Trunk Mains	Minor Total	97.8	km	**17,549**	**11,974**	**5,575**	0	0	0	639	469	170	3,196	2,347	849	2,558	1,878	680	0	0	0
For the 1st Stage		24.2	km	**6,393**	**4,694**	**1,699**	0	0	0	639	469	170	3,196	2,347	849	2,558	1,878	680	0	0	0
For the 2nd Stage		73.6	km	**11,156**	**7,280**	**3,876**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.6 Secondary and Tirtially Distribution Mains	Minor Total	160,076	km	**1,808**	**1,521**	**287**	115	97	18	108	91	17	196	165	31	187	157	30	177	149	28
For the 1st Stage		112,283	km	**606**	**510**	**96**	115	97	18	108	91	17	196	165	31	187	157	30	0	0	0
For the 2nd Stage		47,792	km	**1,202**	**1,011**	**191**	0	0	0	0	0	0	0	0	0	0	0	0	177	149	28
1.7 House Connection Installation	Minor Total	38,170	concs.	**2,626**	**2,164**	**462**	148	122	26	148	122	26	228	188	40	228	188	40	228	188	40
For the 1st Stage		10,943	concs.	**752**	**620**	**132**	148	122	26	148	122	26	228	188	40	228	188	40	0	0	0
For the 2nd Stage		27,227	concs.	**1,874**	**1,544**	**330**	0	0	0	0	0	0	0	0	0	0	0	0	228	188	40
1.8 Unaccounted-for Water Reduction	Minor Total			**2,886**	**1,449**	**1,437**	341	184	157	317	164	153	318	165	153	269	139	130	268	139	129
For the 1st Stage				**1,245**	**652**	**593**	341	184	157	317	164	153	318	165	153	269	139	130	0	0	0
For the 2nd Stage				**1,641**	**797**	**844**	0	0	0	0	0	0	0	0	0	0	0	0	268	139	129
2. Consulting Services	Sub Total	↓ BaseCost		**5,327**	**4,494**	**833**	**364**	**308**	**56**	**547**	**462**	**85**	**547**	**462**	**85**	**364**	**308**	**56**	**595**	**496**	**99**
2.1 D/D and S/V for Stage 1 (2004 - 2007)	**(7)%**	26,048	k$	**1,822**	**1,540**	**282**	364	308	56	547	462	85	547	462	85	364	308	56	0	—	—
2.2 Feasibility Study for Stage 2 (2008)		595	k$	**595**	**496**	**99**	0	—	—	0	—	—	0	—	—	0	—	—	595	496	99
2.3 D/D and S/V for Stage 2 (2009 - 2012)	**(7)%**	41,563	k$	**2,910**	**2,458**	**452**	0	—	—	0	—	—	0	—	—	0	—	—	0	—	—
3. Contingencies	Sub Total			**23,668**	**16,448**	**7,220**	**128**	**94**	**34**	**578**	**396**	**182**	**2,628**	**1,747**	**881**	**2,483**	**1,650**	**833**	**349**	**267**	**82**
3.1 Physical Contingency = (1.+2.)×	**(10)%**			**7,294**	**5,041**	**2,253**	97	71	26	346	237	109	1,301	865	436	1,043	693	350	127	97	30
3.2 Price Contingency = (1.+2.+3.1)×rate$^{2004\sim}$	**(3)%**			**16,374**	**11,407**	**4,967**	31	23	8	232	159	73	1,327	882	445	1,440	957	483	222	170	52
4. Administration Cost = (1.+2.+3.)×	**(5)%**			**4,831**	**0**	**4,831**	**55**	**0**	**55**	**202**	**0**	**202**	**782**	**0**	**782**	**646**	**0**	**646**	**81**	**0**	**81**
Total Project Costs = (1.+2.+3.+4.)	Sub Total			**101,437**	**66,865**	**34,572**	**1,151**	**805**	**346**	**4,243**	**2,768**	**1,475**	**16,421**	**10,397**	**6,024**	**13,557**	**8,579**	**4,978**	**1,698**	**1,239**	**459**
5. Operation and Maintenance Cost	Sub Total			**24,870**	**4,317**	**20,553**	**1,471**	**294**	**1,177**	**1,493**	**294**	**1,199**	**1,527**	**294**	**1,233**	**1,891**	**346**	**1,545**	**1,975**	**362**	**1,613**
5.1 Electricity	Minor Total			**11,236**	**0**	**11,236**	604	0	604	604	0	604	604	0	604	858	0	858	892	0	892
Existing Kaolieo T.P.				**1,842**	**0**	**1,842**	174	0	174	174	0	174	174	0	174	146	0	146	153	0	153
Expanded Kaolieo T.P.				**1,944**	**0**	**1,944**	0	0	0	0	0	0	0	0	0	215	0	215	225	0	225
Existing Chinaimo T.P.				**2,987**	**0**	**2,987**	377	0	377	377	0	377	377	0	377	206	0	206	215	0	215
Improved Chinaimo T.P.				**1,590**	**0**	**1,590**	0	0	0	0	0	0	0	0	0	176	0	176	184	0	184
Thangone T.P.				**1,030**	**0**	**1,030**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Distribution Center				**809**	**0**	**809**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Booster Pump Station				**1,034**	**0**	**1,034**	53	0	53	53	0	53	53	0	53	115	0	115	115	0	115
5.2 Chemical Cost	Minor Total			**4,317**	**4,317**	**0**	294	294	0	294	294	0	294	294	0	346	346	0	362	362	0
Existing Kaolieo T.P.	Minor Total			**622**	**622**	**0**	59	59	0	59	59	0	59	59	0	49	49	0	52	52	0
Alum				**432**	**432**	**0**	41	41	0	41	41	0	41	41	0	34	34	0	36	36	0
Polymer				**12**	**12**	**0**	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
Chlorine				**178**	**178**	**0**	17	17	0	17	17	0	17	17	0	14	14	0	15	15	0
Expanded Kaolieo T.P.	Minor Total			**895**	**895**	**0**	0	0	0	0	0	0	0	0	0	99	99	0	104	104	0
Alum				**620**	**620**	**0**	0	0	0	0	0	0	0	0	0	69	69	0	72	72	0
Polymer				**18**	**18**	**0**	0	0	0	0	0	0	0	0	0	2	2	0	2	2	0
Chlorine				**257**	**257**	**0**	0	0	0	0	0	0	0	0	0	28	28	0	30	30	0
Existing Chinaimo T.P.	Minor Total			**2,487**	**2,487**	**0**	235	235	0	235	235	0	235	235	0	198	198	0	206	206	0
Alum				**1,726**	**1,726**	**0**	163	163	0	163	163	0	163	163	0	137	137	0	143	143	0
Polymer				**45**	**45**	**0**	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0
Chlorine				**716**	**716**	**0**	68	68	0	68	68	0	68	68	0	57	57	0	59	59	0
Thangone T.P.	Minor Total			**313**	**313**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alum				**154**	**154**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorine				**159**	**159**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.3 Salary	Minor Total			**4,169**	**0**	**4,169**	261	0	261	271	0	271	285	0	285	303	0	303	317	0	317
Treatment Plant	Minor Total			**782**	**0**	**782**	54	0	54	54	0	54	54	0	54	58	0	58	58	0	58
Existing Kaolieo T.P.				**330**	**0**	**330**	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27
Expanded Kaolieo T.P.				**36**	**0**	**36**	0	0	0	0	0	0	0	0	0	4	0	4	4	0	4
Existing Chinaimo T.P.				**321**	**0**	**321**	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27
Thangone T.P.				**96**	**0**	**96**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meter Reader				**577**	**0**	**577**	35	0	35	37	0	37	39	0	39	42	0	42	44	0	44
Administration/Engineering				**2,810**	**0**	**2,810**	172	0	172	180	0	180	192	0	192	203	0	203	215	0	215
5.4 Others				**5,148**	**0**	**5,148**	312	0	312	324	0	324	344	0	344	384	0	384	404	0	404
6. Human Resource Development				**213**	**0**	**213**	**11**	**0**	**11**	**12**	**0**	**12**	**13**	**0**	**13**	**17**	**0**	**17**	**17**	**0**	**17**
Total Costs				**126,520**	**71,182**	**55,338**	**2,633**	**1,099**	**1,534**	**5,748**	**3,062**	**2,686**	**17,961**	**10,691**	**7,270**	**15,465**	**8,925**	**6,540**	**3,690**	**1,601**	**2,089**

Item	2009 Sub Total	2009 Foreign	2009 Local	2010 Sub Total	2010 Foreign	2010 Local	2011 Sub Total	2011 Foreign	2011 Local	2012 Sub Total	2012 Foreign	2012 Local	2013 Sub Total	2013 Foreign	2013 Local	2014 Sub Total	2014 Foreign	2014 Local	2015 Sub Total	2015 Foreign	2015 Local
Case K-1										├→	Expanded (2nd Stage)										
2007:Kaolieo 40,000 m3/day & 2012:Thangone 60,000 m3/day						├→		Construction	←┤												
Year		2009			2010			2011			2012			2013			2014			2015	
Day Average		140,948			146,609			154,057			161,504			168,952			176,399			183,847	
Day Maximum		155,043			161,270			169,463			177,655			185,847			194,039			202,232	
Plant Scale		140,000			140,000			140,000			200,000			200,000			200,000			200,000	
Number of Connection	6	63,345	0.2	7	66,662	0.3	8	70,117	0.3	9	73,573	0.2	10	77,029		11	80,485		12	83,940	
1. Construction Cost	**617**	**429**	**188**	**7,977**	**5,512**	**2,465**	**19,045**	**13,157**	**5,888**	**11,601**	**8,041**	**3,560**	**560**	**404**	**156**	**550**	**395**	**155**	**540**	**387**	**153**
1.1 Treatment Plants	0	0	0	2,686	1,739	947	6,713	4,346	2,367	4,028	2,608	1,420	0	0	0	0	0	0	0	0	0
Expansion of Kaolieo T.P.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction of Thangone T.P.	0	0	0	2,686	1,739	947	6,713	4,346	2,367	4,028	2,608	1,420	0	0	0	0	0	0	0	0	0
Rehabilitation of Kaolieo T.P. (1st Stage)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Expansion of Reservoir in Chinaimo T.P. (1st Stage)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.2 Clear Water Transmission Pipelines	0	0	0	1,505	1,240	265	3,760	3,099	661	2,256	1,859	397	0	0	0	0	0	0	0	0	0
For the 1st Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 2nd Stage	0	0	0	1,505	1,240	265	3,760	3,099	661	2,256	1,859	397	0	0	0	0	0	0	0	0	0
1.3 Distribution Center	0	0	0	875	597	278	2,188	1,492	696	1,313	895	418	0	0	0	0	0	0	0	0	0
For the 1st Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 2nd Stage	0	0	0	875	597	278	2,188	1,492	696	1,313	895	418	0	0	0	0	0	0	0	0	0
1.4 Booster Pump Station	0	0	0	73	59	14	183	147	36	110	88	22	0	0	0	0	0	0	0	0	0
For the 1st Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 2nd Stage	0	0	0	73	59	14	183	147	36	110	88	22	0	0	0	0	0	0	0	0	0
1.5 Distribution Trunk Mains	0	0	0	2,231	1,456	775	5,578	3,640	1,938	3,347	2,184	1,163	0	0	0	0	0	0	0	0	0
For the 1st Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 2nd Stage	0	0	0	2,231	1,456	775	5,578	3,640	1,938	3,347	2,184	1,163	0	0	0	0	0	0	0	0	0
1.6 Secondary and Tirtially Distribution Mains	168	141	27	158	133	25	159	134	25	150	126	24	140	118	22	130	109	21	120	101	19
For the 1st Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 2nd Stage	168	141	27	158	133	25	159	134	25	150	126	24	140	118	22	130	109	21	120	101	19
1.7 House Connection Installation	228	188	40	228	188	40	238	196	42	238	196	42	238	196	42	238	196	42	238	196	42
For the 1st Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 2nd Stage	228	188	40	228	188	40	238	196	42	238	196	42	238	196	42	238	196	42	238	196	42
1.8 Unaccounted-for Water Reduction	221	100	121	221	100	121	226	103	123	159	85	74	182	90	92	182	90	92	182	90	92
For the 1st Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For the 2nd Stage	221	100	121	221	100	121	226	103	123	159	85	74	182	90	92	182	90	92	182	90	92
2. Consulting Services	**582**	**492**	**90**	**873**	**737**	**136**	**873**	**737**	**136**	**582**	**492**	**90**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2.1 D/D and S/V for Stage 1 (2004 - 2007)	0	—	—	0	—	—	0	—	—	0	—	—	0	—	—	0	—	—	0	—	—
2.2 Feasibility Study for Stage 2 (2008)	0	—	—	0	—	—	0	—	—	0	—	—	0	—	—	0	—	—	0	—	—
2.3 D/D and S/V for Stage 2 (2009 - 2012)	582	492	90	873	737	136	873	737	136	582	492	90	0	—	—	0	—	—	0	—	—
3. Contingencies	**376**	**289**	**87**	**3,123**	**2,205**	**918**	**7,836**	**5,466**	**2,370**	**5,303**	**3,714**	**1,589**	**268**	**193**	**75**	**289**	**207**	**82**	**307**	**220**	**87**
3.1 Physical Contingency	120	92	28	885	625	260	1,991	1,389	602	1,218	853	365	56	40	16	56	40	16	54	39	15
3.2 Price Contingency	256	197	59	2,238	1,580	658	5,845	4,077	1,768	4,085	2,861	1,224	212	153	59	233	167	66	253	181	72
4. Administration Cost	**79**	**0**	**79**	**599**	**0**	**599**	**1,388**	**0**	**1,388**	**874**	**0**	**874**	**41**	**0**	**41**	**42**	**0**	**42**	**42**	**0**	**42**
Total Project Costs	**1,654**	**1,210**	**444**	**12,572**	**8,454**	**4,118**	**29,142**	**19,360**	**9,782**	**18,360**	**12,247**	**6,113**	**869**	**597**	**272**	**881**	**602**	**279**	**889**	**607**	**282**
5. Operation and Maintenance Cost	**2,055**	**376**	**1,679**	**2,079**	**373**	**1,706**	**2,116**	**373**	**1,743**	**2,454**	**376**	**2,078**	**2,503**	**393**	**2,110**	**2,602**	**410**	**2,192**	**2,702**	**426**	**2,276**
5.1 Electricity	924	0	924	918	0	918	918	0	918	1,195	0	1,195	1,192	0	1,192	1,239	0	1,239	1,288	0	1,288
Existing Kaolieo T.P.	159	0	159	158	0	158	158	0	158	128	0	128	134	0	134	139	0	139	145	0	145
Expanded Kaolieo T.P.	234	0	234	233	0	233	233	0	233	188	0	188	197	0	197	205	0	205	214	0	214
Existing Chinaimo T.P.	224	0	224	222	0	222	222	0	222	179	0	179	188	0	188	196	0	196	204	0	204
Improved Chinaimo T.P.	192	0	192	190	0	190	190	0	190	154	0	154	161	0	161	168	0	168	175	0	175
Thangone T.P.	0	0	0	0	0	0	0	0	0	241	0	241	252	0	252	263	0	263	274	0	274
Distribution Center	0	0	0	0	0	0	0	0	0	230	0	230	185	0	185	193	0	193	201	0	201
Booster Pump Station	115	0	115	115	0	115	115	0	115	75	0	75	75	0	75	75	0	75	75	0	75
5.2 Chemical Cost	376	376	0	373	373	0	373	373	0	376	376	0	393	393	0	410	410	0	426	426	0
Existing Kaolieo T.P.	53	53	0	53	53	0	53	53	0	43	43	0	45	45	0	48	48	0	49	49	0
Alum	37	37	0	37	37	0	37	37	0	30	30	0	31	31	0	33	33	0	34	34	0
Polymer	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
Chlorine	15	15	0	15	15	0	15	15	0	12	12	0	13	13	0	14	14	0	14	14	0
Expanded Kaolieo T.P.	108	108	0	107	107	0	107	107	0	87	87	0	91	91	0	94	94	0	98	98	0
Alum	75	75	0	74	74	0	74	74	0	60	60	0	63	63	0	65	65	0	68	68	0
Polymer	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0	2	2	0
Chlorine	31	31	0	31	31	0	31	31	0	25	25	0	26	26	0	27	27	0	28	28	0
Existing Chinaimo T.P.	215	215	0	213	213	0	213	213	0	173	173	0	180	180	0	188	188	0	196	196	0
Alum	149	149	0	148	148	0	148	148	0	120	120	0	125	125	0	131	131	0	136	136	0
Polymer	4	4	0	4	4	0	4	4	0	3	3	0	3	3	0	3	3	0	4	4	0
Chlorine	62	62	0	61	61	0	61	61	0	50	50	0	52	52	0	54	54	0	56	56	0
Thangone T.P.	0	0	0	0	0	0	0	0	0	73	73	0	77	77	0	80	80	0	83	83	0
Alum	0	0	0	0	0	0	0	0	0	36	36	0	38	38	0	39	39	0	41	41	0
Chlorine	0	0	0	0	0	0	0	0	0	37	37	0	39	39	0	41	41	0	42	42	0
5.3 Salary	332	0	332	346	0	346	362	0	362	400	0	400	415	0	415	430	0	430	445	0	445
Treatment Plant	58	0	58	58	0	58	58	0	58	82	0	82	82	0	82	82	0	82	82	0	82
Existing Kaolieo T.P.	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27
Expanded Kaolieo T.P.	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4	4	0	4
Existing Chinaimo T.P.	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	27	0	27
Thangone T.P.	0	0	0	0	0	0	0	0	0	24	0	24	24	0	24	24	0	24	24	0	24
Meter Reader	47	0	47	49	0	49	52	0	52	54	0	54	57	0	57	59	0	59	62	0	62
Administration/Engineering	227	0	227	239	0	239	252	0	252	264	0	264	276	0	276	289	0	289	301	0	301
5.4 Others	423	0	423	442	0	442	463	0	463	483	0	483	503	0	503	523	0	523	543	0	543
6. Human Resource Development	**18**	**0**	**18**	**19**	**0**	**19**	**20**	**0**	**20**	**20**	**0**	**20**	**21**	**0**	**21**	**22**	**0**	**22**	**23**	**0**	**23**
Total Costs	**3,727**	**1,586**	**2,141**	**14,670**	**8,827**	**5,843**	**31,278**	**19,733**	**11,545**	**20,834**	**12,623**	**8,211**	**3,393**	**990**	**2,403**	**3,505**	**1,012**	**2,493**	**3,614**	**1,033**	**2,581**

4.11 Economic and Financial Evaluation

4.11.1 Economic Evaluation

(1) Overview of Economic Evaluation

The project proposed in this study is analysed on the basis of two quantitative analyses: (1) the economic analysis, and (2) the financial analysis. In the economic analysis, an economic evaluation is a major part. The aim of the economic evaluation is to examine the proposed project from the economic point of view, that is, the viability of a social investment in the national economy. In other words, the system alternatives are prioritised from the economic point of view through the economic evaluation. The aim of the financial evaluation is to inspect the proposed project from the financial point of view, that is, tests of earning capacity and financial efficiency. This is the fundamental difference between the two analyses. The procedure of these project analyses is illustrated in Figure 411-1.

The project evaluation is conducted in accordance with the conventional methodology that is commonly applied for the evaluation of development projects financed by the World Bank and other international agencies like the Asian Development Bank (ADB). The methodology suggests that the project evaluation have two steps for quantifying evaluation factors in general. At first, the project cost and benefit are identified and quantified in monetary terms, which arise from the implementation of the proposed project. Then, they are compared and condensed into evaluation indices. The indices used are the Economic Internal Rate of Return (EIRR) for a main index, the Net Present Value (NPV) and the Benefit-Cost Ratio (B/C) as supplementary indices.

The EIRR is defined as a special rate of discount that satisfies the following conditions:

1) The present value of cost is obtained through discounting all the costs incurred during the economic life of the proposed project at the special rate.
2) The present value of benefit is obtained through discounting all the benefits accruing from the project during the same lifetime at the special rate.
3) As a result, the present value of cost is equal to the present value of benefit.

In the case that the EIRR exceeds the opportunity cost of capital, the proposed project could be judged as economically viable. The NPV shows the magnitude of the project incremental benefit. The B/C indicates the gap between the project efficiency and the opportunity cost of capital.

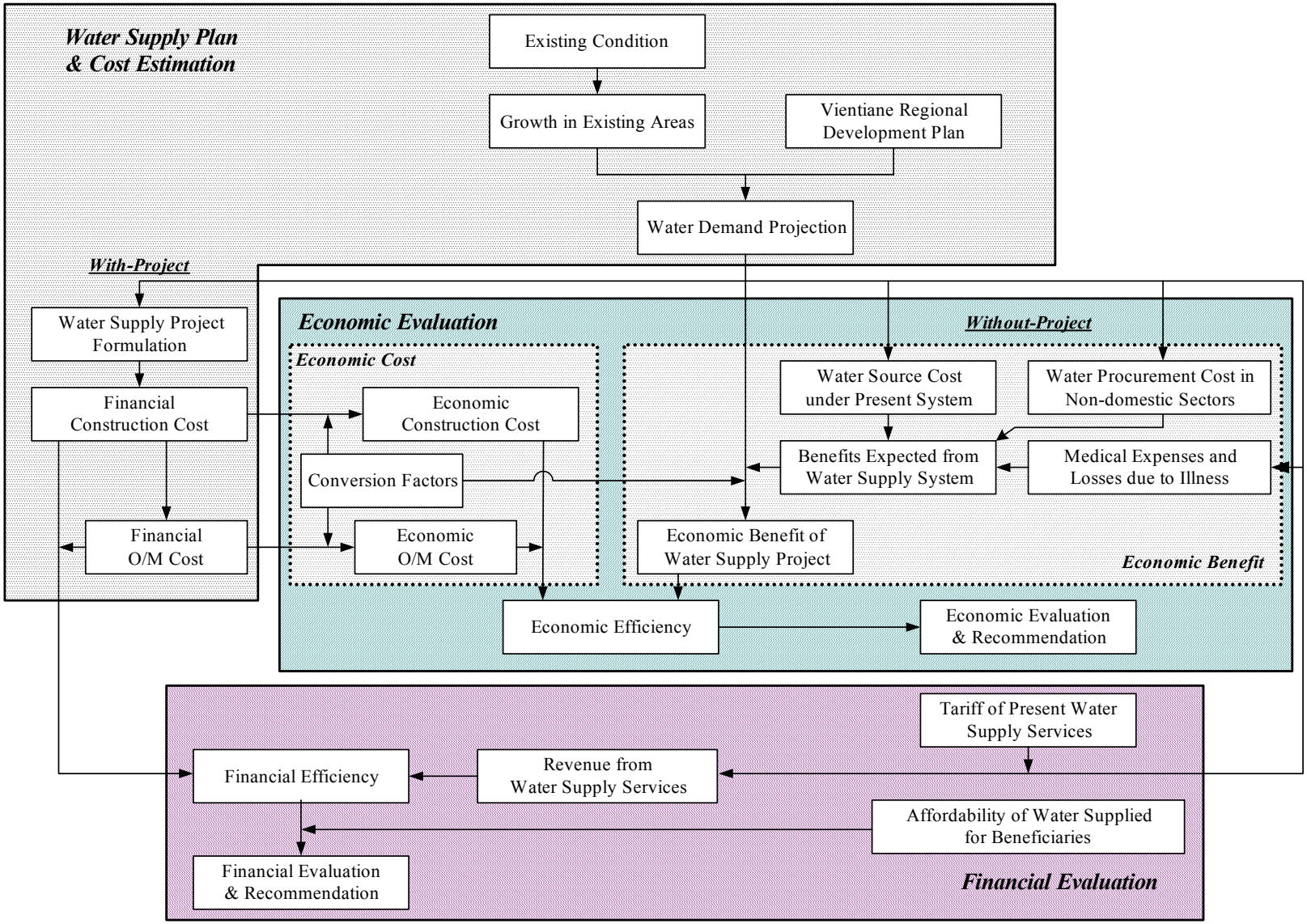


Figure 411-1 Evaluation Procedure of Water Supply Project

(2) Assumptions for Economic Evaluation

In an economic evaluation, the costs and benefits are estimated on the basis of economic values instead of market values which are applied for a financial analysis. The economic values are converted from the financial values through applying conversion factors.

For the economic evaluation, the following criteria and assumptions are applied to calculate economic values and evaluation indicators in this study.

(a)	Base Year	The year 2004
(b)	Construction Period	Three years (200 to 2007) for the first stage and three years (2010 to 2012) for the second stage
(c)	Economic Life and Evaluation Period	30 years after the completion of the proposed projects
(d)	Timing of Accruing Benefits	The benefits will appear after the completion of the project. The matured benefits are attained in the target year 2015.
(e)	Price Level	Costs and benefits of the project are set in May 2003.
(f)	Prevailing Exchange Rate	10,720 Kip per US$ 1.00 and ¥119 per US$ 1.00 at the end of April 2003
(g)	Land Value	Nothing, because the lands are diverted for other purposes and they are not utilized for productive activities, even in the future
(h)	Conversion Factor	90% of financial market value
(g)	Opportunity Cost of Capital	12% per annum (set up by ADB in 1996)

(3) Economic Benefits

1) Benefits of Proposed Projects

One of important main goals of the water supply project is to improve public health and well-being. In particular, the urban poor would receive benefit from the project. Currently they rely on turbid groundwater or polluted streams, rivers and lakes for their water supply within the project site. Besides these basic benefits, the water supply project gives various advantages to the people and the regional economy in and around the project areas. The following Table 411-1 lists the benefits accruing from the water supply project.

Table 411-1 Benefits Accruing from Water Supply Project

(1) Improvement of Public Health	(a) Elimination of poor quality water sources in service areas (b) Elimination of poor quality water sources during stoppage of water supply during dry season (c) Reduction of water related diseases (d) Reduction of medical expenses
(2) Enhancement of Amenity and Well-being	(a) Elimination of equipment for procuring water source (b) Time-savings associated with procuring water source (c) Energy-savings associated with boiling water for disinfection (d) Elimination of stoppage of water supply during dry season (e) Reduction of absence from work because of water related illness
(3) Social Issues Related to Water Supply	(a) Effective use of alternative water resources (b) Efficient operation of water supply equipment (c) Stimulation of the project investment to regional economy (d) Prevention of urban disaster by means of provision of fire hydrants (e) Improvement of degree of freedom for urban planning (f) Increase of land values

Among these benefits above, benefits in lines with (1) and (2) are considered as direct benefits. The proposed project directly brings about these benefits to the beneficiaries. Benefits in line with (3) are considered as indirect benefits. The project has ripple effects for people and the regional environment in relation to the project. On the other hand, the proposed project may bring about negative effects to the people and the regional socio-economy.

2) Quantifiable Direct Benefits

The benefits listed in the table above are furthermore classified into two categories. They are quantifiable or tangible benefits, and non-quantifiable or intangible benefits. To calculate evaluation indicators for an economic evaluation, only tangible benefits are quantified as project benefits. In this study, the following

benefits are selected as tangible benefits, and they are bound into three components.

a) Benefits of (2)-(a), (b) and (c) Water source saving benefit for residents
b) Benefits of (1)-(b) & (c) and (2)-(d) Public health improvement benefit for residents
c) Benefit of (2)-(a) Water source saving benefit for non-residential water consumers

The benefit of the water supply project is described as the difference between a situation with a with-project condition, and a without-project condition. Under the with-project condition, the beneficiaries within the service areas can enjoy the effects of the proposed water supply project. Under the without-project condition, on the other hand, the people outside the service areas of the water supply system have to get water sources by means of the present water procurement methods as discussed in the household survey conducted by the JICA study team in March 2003. Then, the difference between the two cases is identified as a project benefit.

Benefits include various factors, not only tangible benefits but also intangible ones. The tangible benefits selected above are only some parts of the various components. In this study, the project benefit is estimated on the basis of the tangible benefits above. Benefit is estimated for two main categories, i.e., (a) domestic water for domestic use and (b) water for non-domestic use.

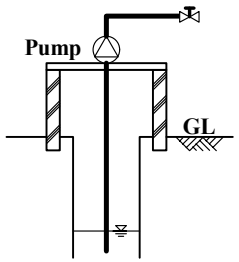
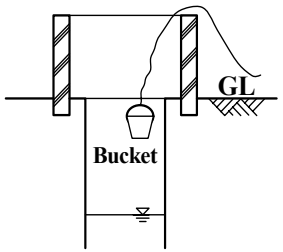
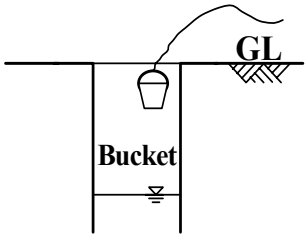
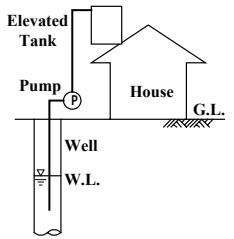
The benefit for domestic users is assumed as a sum of (i) the water source saving benefit, (ii) public health improvement benefit and (iii) other intangible direct benefits. Hence, other intangible direct benefits are assumed as being 10% of the sum of benefit (i) and (ii). The benefit for non-domestic users is assumed as a sum of (i) the water source saving benefit and (ii) other intangible direct benefits. In the same manner as for domestic users, for non-domestic users, other direct benefits are assumed as being 10% of the sum of benefit (i).

3) Estimate of Unit Economic Benefits

(a) Benefits of Domestic Water

The water source saving benefit is estimated based on the factual data of how the people in the project areas presently procure their water. According to the "Household Survey" conducted by the JICA Study Team in March 2003, procurement methods of water sources in Vientiane Capital City are classified into five types. They are (1) protected well with a motorised pump (Type A); (2) protected well (Type B); (3) shallow open well (Type C); (4) deep well with pump (Type D); and (5) surface water intake (Type E). They are illustrated in Table 411-2.

Table 411-2 Systems' Specification of Potable Water Source Procurement in Residence in Urban Areas of Vientiane Capital City

Item	Type A	Type B	Type C	Type D	Type E
System	Protected Well with Pump	Protect Well without Pump	Unprotected Well	Deep Well with Pump	Surface Water
Well	Depth: 5 ~ 10 m Diameter: 1.0 ~ 1.5 mφ	Depth: 5 ~ 10 m Diameter: 1.0 ~ 1.5 mφ	Depth: 3 ~ 5 m Diameter: 1.0 ~ 1.5 mφ	Depth: 10 ~ 20 m Diameter: 200 ~ 300 mmφ	-
Pump	$1m^3/h \times 10m \times 100W$	-	-	$2m^3/h \times 30m \times 400W$	-
Pump Operation	Manual Only	-	-	Manual On/Off Switching (Without Automatic Control)	-
Water Tank	-	-	-	Steel Made Tank of 800 litres	-
Potable Water	Bottled Water	Bottled Water	Boiled with Firewood	Bottled Water	Boiled with Firewood
Family Labour for Fetching Water per Day*1	Wet Season: 15 minutes-man Dry Season: 15 minutes-man	Wet Season: 20 minutes-man Dry Season: 30 minutes-man	Wet Season: 20 minutes-man Dry Season: 30 minutes-man		Wet Season: 30 minutes-man Dry Season: 45 minutes-man
System Flow Chart					
Composition *2	35%	35%	20%	8%	2%

Source: Socio-economic Survey, April 2003, JICA Study Team

Remark: *1 Assumed on the basis of the survey above.

*2 Assumed the composition in the service area on the basis of the survey above.

The water source costs consist of two main factors: investment cost and operation cost. In the case of Type A, for instance, the investment cost includes a protected well, an electric pump, an elevated tank, and connection pipes linking these facilities. The operation cost consists of electric power, firewood for boiling to disinfect the groundwater, and some maintenance costs. On the other hand, Type E has no investment cost. However, it needs family labour to transfer the water to their house from the source. It also needs firewood for boiling to disinfect the water. The water source costs under present conditions were estimated as follows: 4,930 kip/m^3 for Type A; 3,150 kip/m^3 for Type B; 1,260 kip/m^3 for Type C; 16,820 kip/m^3 for Type D; and 1,090 kip/m^3 for Type E. Figure 411-2 illustrates the source costs of the respective types.

The cost components are furthermore classified into two parts: the visible portion and the invisible portion. In type A, for example, operation costs such as electric power and bottled water are paid every month. The family usually realizes these costs themselves. These costs are perceived as the visible portion. This portion is estimated as 2,620 kip/m^3 for Type A. For Type E, the cost becomes only 500 kip/m^3. The water source cost for the visible portion even for Type E, however, is higher than the present average water price for connected consumers of the NPVC (384 kip/m^3) for category 1 (domestic user) approved in December 2001.

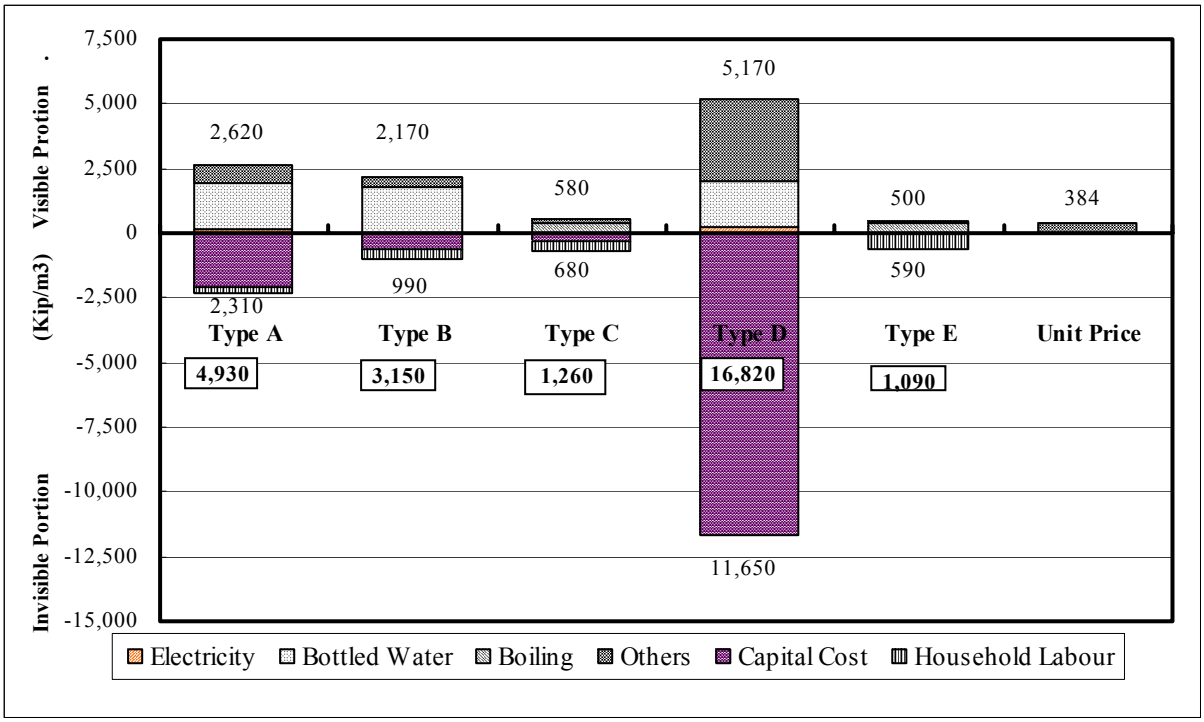


Figure 411-2 Water Unit Cost of Domestic Use by Type

The capital cost is paid at the initial investment time, so it is not perceived as monthly charges. However, it should be counted as a part of water source costs. It is converted to an annualized cost, applying the Capital Recovery Factor (CRF). For Type A, the annualized capital cost is estimated at 2,310 kip/m^3.

Furthermore, the cost of family labour (233 kip/m^3) is not charged as a water procurement cost in general. Thus, these costs are considered as invisible portion. For Type E, the family labour cost is estimated at 590 kip/m^3.

As mentioned above, the total water source costs are estimated as 4,930 kip/m^3 for Type A; 3,150 kipm^3 for Type B; 1,260 kip/m^3 for Type C; 16,820 kip/m^3 for Type D; and 1,090 kip/m^3 for Type E. These costs could be eliminated once the water supply project is introduced in the service areas of the proposed project. According to the household survey in 2003, these types are composed as follows: 35% for Type A, 35% for Type B, 20% for Type C, 8% for Type D and 2% for Type E. Finally, the weighted average water source cost was estimated as 4,450 kip/m^3. However, the water source value was estimated at market prices. In an economic evaluation, these values are converted to an economic value. Applying conversion factors of 0.90 for the market prices, the economic source water value was converted to 4,005 kip/m^3 in economic terms.

In addition to the water source saving benefit, the public health improvement benefit was estimated as the reduction of medical expenses by beneficiaries and at the same time, a reduction of labour opportunity losses due to illness. The amounts of these losses are estimated on the basis of medical data which were provided in the "Summary Report of Patients in Outpatients, Inpatients and Died 2001, 2000 and 1999", Ministry of Health, Headquarters and capital city information, published by the Provincial Department of Public Health in Vientiane Capital City and the Medical Affairs Department of Setthathirath Hospital. The medical annual expenses were estimated at around 882 kip per household in 2003. The annual labour losses were estimated at around 2,750 kip per household. Then, the total annual losses due to illnesses were estimated at 1,030 kip per household. Then, the real total loss is assumed to be a half of the total health losses, because even if the water supply system is introduced in the project areas, the system could not completely eliminate the water-borne diseases in the project areas. Thus, the benefit is estimated at 2,040 kip per household. Since the household consumes 391 m^3 per year, the unit benefit is calculated at 5.2 kip/m^3 only. Applying conversion factors of 0.90 for the market prices, the economic health improvement benefit was converted to 4.9 kip/m^3 in economic terms.

Accordingly, the benefit of domestic water in Vientiane Capital City was estimated as at least 4,010 kip/m^3, which includes not only water source saving benefit but also public health improvement benefit. In other words, the people in Vientiane Capital City pay for around US$ 0.37/m^3 on average to procure water. When consumers recognize the water resource cost, and accept the intangible benefits shown in the benefit table, the project benefit could become more than the estimated value of US$ 0.37/m^3. In this study, it was assumed from the economic point of view that other benefits might be 10% more than the estimated value, taking intangible direct benefits into consideration. With this assumption the estimated value of the projects benefits resulted in US$ 0.41/m^3. Since a household consumes 39m^3 per month on average, the total project benefit was estimated at around US$16 per month per household in economic terms.

(b) Benefits from Non-domestic Water

At present, water demand for the NPVC is comprised as follows: annual consumption of 14.7 million m^3 or 58% of the total demand for category 1 (domestic consumer): 4.9 million m^3 or 19% for category 1 (non-domestic consumers); 3.7 million m^3 or 15% for category 2; 1.5 million m^3 or 6% for category 3; and 0.6 million m^3 or 0.6% for category 4. Thus, non-domestic user consisting of categories 1, 2, 3 and 4 consumed NPVC's water 10.8 million m^3 per annum or 42% of the total consumption, as shown in the Figure 411-3.

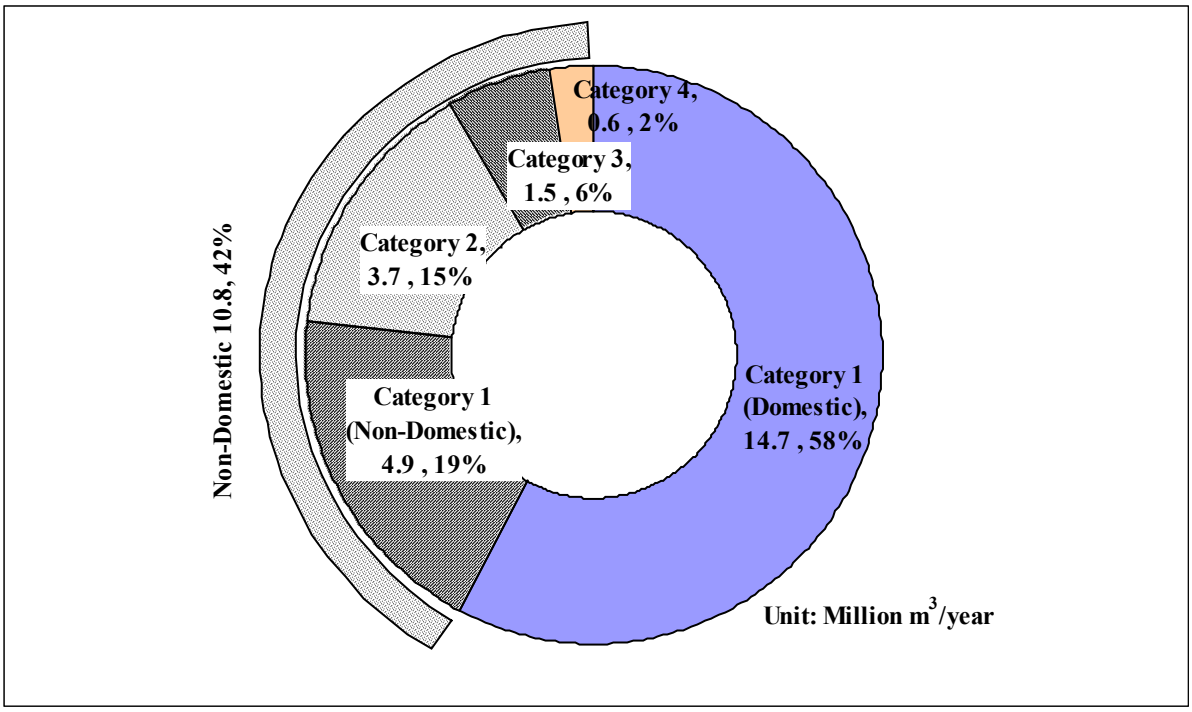


Figure 411-3 Composition of Non-domestic water in NPVC Water Sales

The NPVC supplies water to manufacturing establishments classed as being in category 2 or 3, as mentioned above. According to its sales records in 2002, average water sales were 0.3 million kip per connection for category 2 and 3.0 million kip per connection for category 3. While these costs do not include their own procured water costs, these figures are the minimum amount that manufacturers spend on procuring water. In this part of the study, the water costs are considered as water procurement cost for non-domestic consumers.

In 2002, the unit prices for non-domestic users were calculated at: 462 kip/m^3 for category 1, 586 kip/m^3 for category 2; 1,269 kip/m^3 for category 3 and 3,507 kip/m^3 for category 4, as illustrated in Figure 411-4. The weighted average was calculated at 770 kip/m^3.

According to a survey of manufacturing establishments conducted in May 2003, some manufacturers

consume groundwater as a raw material and or for cleaning their production facilities. The volume of groundwater consumed was estimated at around 10% of the total water consumption. Supposing that a unit cost of groundwater was considered as similar to the system of Type D in Table 411-2, the procurement cost of groundwater might be around 16,820 kip/m^3. As estimated in the previous section, the city water was procured at a unit cost of 770 kip/m^3. The average unit cost for non-domestic water was calculated as 2,270 kip/m^3, i.e., 770 kip/m^3 × 90% + 16,820 kip/m^3 × 10% = 2,375 kip/m^3.

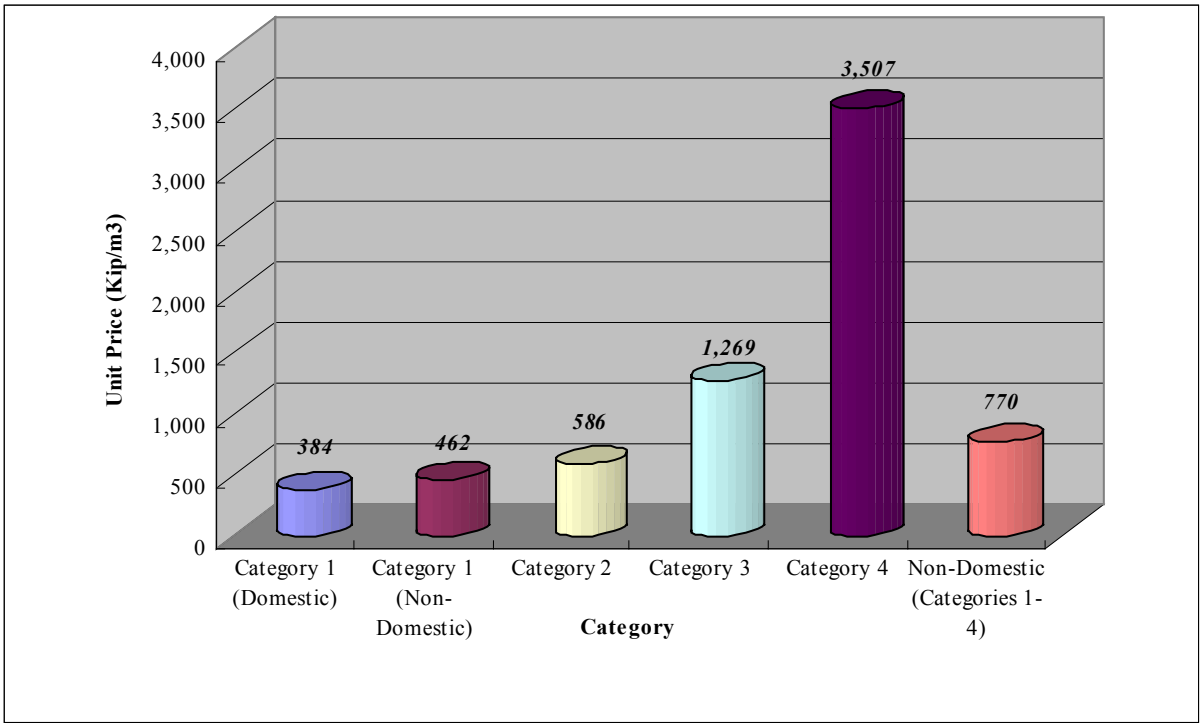


Figure 411-4 Average Prices of Respective Categories in NPVC Water Supply as of May 2003

Accordingly, the benefit of non-domestic water in Vientiane Capital City was estimated as at least 2,375 kip/m^3 in market prices. In this study, it was assumed from the economic point of view that other benefits might be 10% more than the estimated value, taking intangible direct benefits into consideration. Then, the water source value was estimated 2,600 kip/m^3 in market prices. Furthermore, the value was converted to 2,300 kip/m^3 in economic terms, applying the conversion factor of 0.90. Finally, it was re-converted to US$0.21 per m^3 in economic terms.

4) Estimate of Economic Benefits

The benefit of water supply services is calculated as a product of the water volume consumed and the unit economic benefit. As discussed in the previous section, unit benefits are US$ 0.41 per m^3 for domestic water and US$ 0.21 per m^3 for non-domestic water. The total water consumption volume for the respective years during the project life is estimated in the previous section "Water Demand Projection". The actual water demand of beneficiaries is illustrated in Figure 411-5. This was calculated on the basis of the average

water demand of incremental beneficiaries and the water supply capacities of the project proposed.

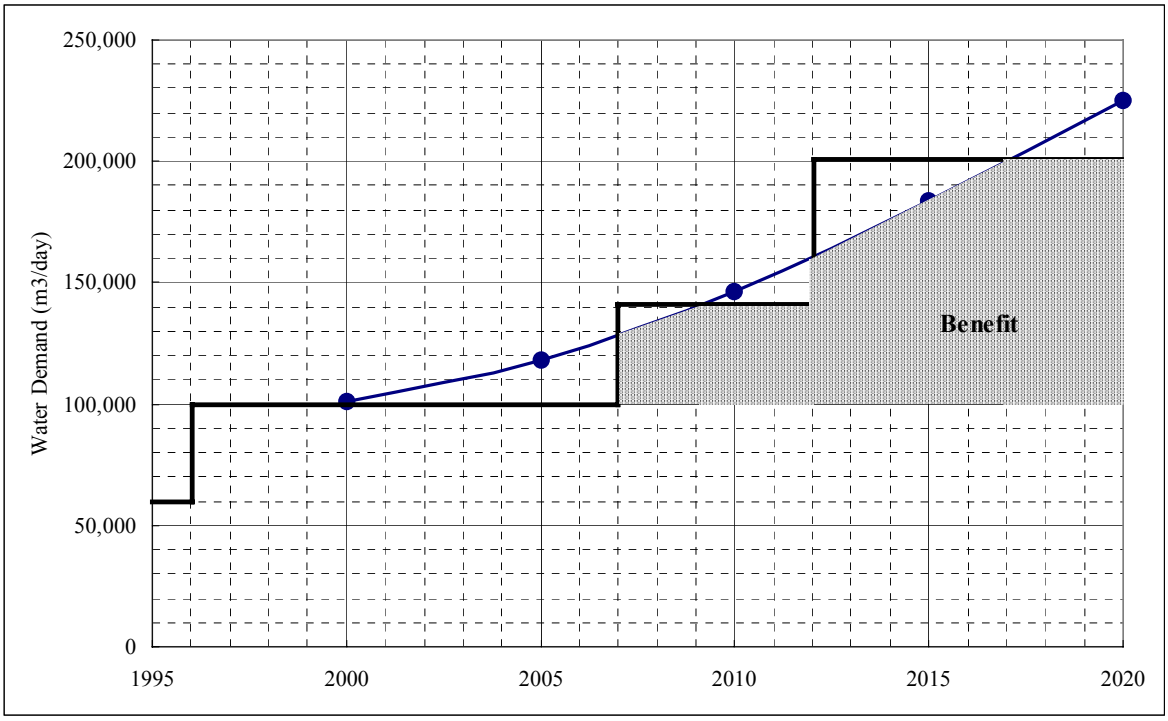


Figure 411-5 Range of Benefit of Project Proposed

The total benefits were calculated as a product of unit economic benefits of the respective categories and total consumption volumes of the corresponding categories. Finally, the total economic benefits were estimated at US$ 3.03 million in 2007 and US$ 9.29 million in 2020, as shown in Table 411-3.

Table 411-3 Estimate of Economic Benefits

Item	2007	2010	2015	2020
I. Water Demand (Million m^3/Year)				
Domestic Demand	18.9	20.4	29.0	29.8
Base Demand	13.5	13.4	13.4	13.4
Increment Demand	5.5	7.1	15.6	16.4
Non-residential Demand*1	14.8	17.2	21.4	22.9
Base Demand	11.1	11.1	11.1	11.1
Increment Demand	3.7	4.5	10.3	11.8
Total	33.8	36.0	50.3	52.7
II. Benefit (US$1000/Year)				
Domestic Demand	2,247	2,865	6,397	6,891
Base Demand	0	0	0	0
Increment Demand	2,247	2,865	6,397	6,891
Non-residential Demand	786	953	2,157	2,401
Base Demand	0	0	0	0
Increment Demand	786	953	2,157	2,401
Total	3,032	3,817	8,553	9,292

Note: *1 Category 4 is included in this category in economic analysis.

*2 Plant capacity is not enough for water demand in the years of 2009 to 2011 and 2016 to 2020.

5) Estimate of Economic Benefits under Future Growth Conditions

As mentioned in the GDP projection, the GDP per capita in the target year 2020 will increase 2.5 times more than that in 2001. In accordance with this expected economic growth, people's living standard will improve in the future. In 2020, the GDP per capita is estimated at 7,060 million kip at 2001 constant prices, compared to 2,914 million kip in 2001. Even outside the areas of the water supply system, then, water source procurement systems could be improved more than those at present system.

It was assumed that the GDP per capita in 2001 was distributed into quintile in proportion to that of real consumption per capita in 1997/98, which was analysed in the report, "Poverty in Lao PDR during the 1990's, 2002, NSC". The respective GDP per capita was assumed to grow at similar rates estimated for the each quintile in the said report. The distribution of the GDP per capita was illustrated in Table 411-8. The respective types of water source procurement systems in 2001 are considered to be applied to the same economic level in 2020. As a result, it is expected that the distribution of the types of water procurement methods in 2020 will change as shown in the table below.

Year	Type A	Type B	Type C	Type D	Type E
2003	35%	35%	20%	8%	2%
2020	40%	15%	15%	30%	0%

As mentioned in Section 4.11.1-(2)-3), the total water source costs are estimated as 4,930 kip per m^3 for Type A; 3,150 kip per m^3 for Type B; 1,260 kip per m^3 for Type C; 16,820 kip per m^3 for Type D; and 1,090 kip per m^3 for Type E. These costs could be eliminated once the water supply project is introduced in the service areas of the proposed project. In the target year, these types are composed as follows, as discussed

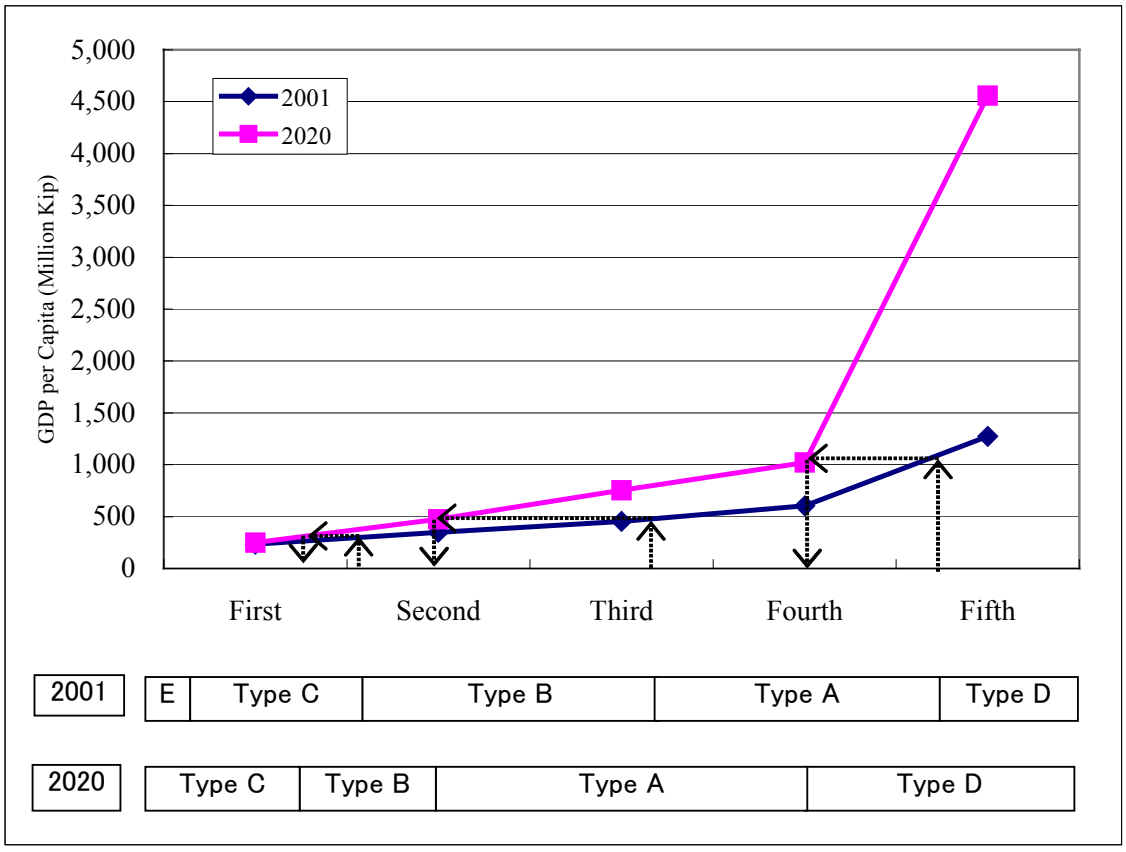
above: 40% for Type A, 15% for Type B, 15% for Type C, 30% for Type D and 0% for Type E. Finally, the weighted average water source cost was estimated as 7,681 kip per m^3. However, the water source value was estimated at market prices. In the economic evaluation, these values are converted to an economic value. Applying conversion factors of 0.90 for the market prices, the economic source water value was converted to 6,913 kip per m^3 in economic terms.

Accordingly, the benefit of domestic water in Vientiane Capital City with future growth projection was estimated as at least 6,913 kip per m^3 in economic terms, which includes not only a water source saving benefit but also a public health improvement benefit. In other words, the people in Vientiane Capital City will pay for around US$ 0.65 per m^3 on average to procure water in 2020. Once the people recognize the water resource cost and conceive the intangible benefits shown in the benefit table, the project benefit could become more than this estimated value of US$ 0.65 per m^3. In this study, it was assumed from the economic point of view that other benefits might be 10% more than the estimated value, taking intangible direct benefits into consideration. Thus, it resulted in US$ 0.71 per m^3 in 2020. Between 2003 and 2020, the unit benefit will increase in proportion to the economic growth.

Table 411-4 Change of Water Source Procurement System under Future Growth Scenario: 2001 and 2020

Quintile	GDP per Capita Projection*1 Distribution Assumed*2		Distribution of Real Consumption per Capita*3		
	2001*2	2020*4	1992-93	1997-98	Growth Rate
1. First	235	248	2,356	2,325	-0.3
2. Second	350	476	3,296	3,466	1.0
3. Third	453	756	4,125	4,486	1.7
4. Fourth	604	1,021	5,489	5,982	1.7
5. Fifth	1,274	4,560	10,228	12,623	4.3
All Quintiles	2,914	7,060	25,494	28,886	2.5

Source: Poverty in Lao PDR during the 1990's, 2002, NSC, CPC
Note: *1 Refer to Table 54-1.
*2 Assumed to be the same distribution as that in 1997/98 distribution of real consumption per capita.
*3 Quoted from the source above.
*4 Estimated applying the similar growth rates of the respective quintiles calculated in the source above.



	Type A	Type B	Type C	Type D	Type E
2001 (2003)	35%	35%	20%	8%	2%
2020	40%	15%	15%	30%	0%

In the same manner as estimated in Table 411-3, the total benefits were estimated at US$ 3.34 million in 2007 and US$ 14.3 million in 2020, as shown in Table 411-5. Hence, the benefit of non-domestic water was assumed to be the same as under the present conditions.

Table 411-5 Estimate of Economic Benefits under Future Economic Growth Conditions

Item	2007	2010	2015	2020
Benefit (US$1000/Year)				
Domestic Demand	2,556	3,592	9,426	11,933
Non-residential Demand	786	953	2,159	2,401
Total	3,342	4,544	11,583	14,334

(4) Economic Costs

The estimate of the proposed project was already described in Section 4.9. The estimate, however, was enumerated at market prices, what is called the "financial value". In an economic evaluation, the financial value has to be converted into economic value. The procedure of this conversion has been already discussed in Section 4.11.1(2). The total economic cost of the priority project was calculated at US$ 79.4 million, as shown in Table 411-6. The construction costs are annually disbursed in compliance with the construction schedule.

Table 411-6 Economic and Financial Costs of Proposed Project

(Unit: US$ 1000)

Item	Financial Cost	Economic Cost
1. Construction Cost	64,726	62,701
2. Administration Cost	4,832	4,349
3. Engineering Services	5,327	5,244
4. Physical Contingency	7,294	7,069
5. Price Contingency	4,832	0
Total	98,553	79,362

The pipeline facilities of the respective projects are considered to last 30 years. Then, the evaluation period (corresponding to the economic life) of the project is set as 30 years after the completion of the project construction. On the other hand, machinery such as circulating pumps and booster pumps are considered to last 15 years. These machines will have to be replaced during the system's life, as mentioned above. In the disbursement schedule, the replacement costs of these machines are appropriated every 15 years. Thus, these replacement costs were estimated in economic terms as follows: US$ 5.36 million in 2022 and 2037, and US$ 7.06 million in 2027 and 2042.

After the evaluation period of 30 years, the replaced machines will still be able to work well, because they are in their durable period after the replacement. In the evaluation procedure, however, these residual values were neglected because they were quite small at the end of evaluation period.

The operation and maintenance (O&M) costs are an annual requirement during the economic life of the

proposed project. The O&M unit cost was estimated at US$2.05 million at market prices after the completion of the project. This was converted to US$ 1.38 million in economic terms.

(5) Economic Efficiency

Economic costs and benefits during the economic evaluation period are shown in Table 411-7. The table shows an economic and cost stream under the present socio-economic conditions. The evaluation indices were 8.5% of EIRR, minus US$ 10.9 million of NPV and 0.77 of B/C. From this it seems that the priority project might not be viable under present conditions from the economic point of view, because the EIRR was lower than the opportunity cost of capital, 12%.

Yet, the socio-economic conditions, particularly the people's living standards, will be improved in accordance with the economic growth in the future. In consideration of these future growth conditions, the benefit of the project could increase in the project evaluation period. The economic benefits and costs under the future growth conditions are tabulated in Table 411-8. As shown in the table, the evaluation indices were 12.8% of EIRR, US$2.96 million of NPV and 1.06 of B/C. Thus, the priority project could in fact be viable from an economic point of view, since the EIRR exceeds the opportunity cost of capital.

Item	EIRR (%)	NPV (US$ Million)	B/C
Under Present Conditions	8.5	-10.9	0.77
With Economic Growth Conditions	12.8	3.0	1.06

4.11.2 Financial Analysis

(1) Overview of Financial Overview

The financial analysis is carried out on the basis of the market values of the project costs and incomes from the water supply services of the proposed projects. The project costs are estimated in Section 4.9 in this Main Report. These costs reflect the actual present market conditions. The revenue of water sales is calculated as a product of a volume of water sold and water rates laid down by the NPVC, Vientiane Capital City. Finally, the projects are examined for their financial efficiency and evaluated taking into account the financial situation.

In the master plan stage, the financial viability of the proposed project is examined by means of an evaluation indicator of "financial internal rate of return (FIRR)". If the FIRR were not good to be implemented from the financial point of view, the financial constraints would be analyzed and identified, and some countermeasures would be proposed in this section.

Table 411-7 Cost and Benefit Stream of Proposed Project under Present Conditions

(Unit: US$1000)

Year		Cost				Benefit			Balance
		Const-ruction	O&M	Replace-ment	Total	Domestic	Non-domestic	Total	
-11	2004	761			761	0	0	0	-761
-10	2005	3,570			3,570	0	0	0	-3,570
-9	2006	14,233			14,233	0	0	0	-14,233
-8	2007	11,412	584		11,996	2,247	786	3,032	-8,963
-7	2008	1,180	610		1,791	2,708	924	3,632	1,842
-6	2009	1,151	635		1,786	2,865	953	3,817	2,032
-5	2010	9,779	636		10,415	2,865	953	3,817	-6,598
-4	2011	22,282	642		22,924	2,865	953	3,817	-19,107
-3	2012	13,635	1,271		14,905	4,781	1,574	6,355	-8,550
-2	2013	464	1,276		1,740	5,268	1,748	7,017	5,277
-1	2014	454	1,326		1,780	5,805	1,942	7,747	5,967
0	2015	442	1,378		1,820	6,397	2,157	8,554	6,734
1	2016		1,378		1,378	6,831	2,341	9,173	7,795
2	2017		1,378		1,378	6,891	2,401	9,292	7,914
3	2018		1,378		1,378	6,891	2,401	9,292	7,914
4	2019		1,378		1,378	6,891	2,401	9,292	7,914
5	2020		1,378		1,378	6,891	2,401	9,292	7,914
6	2021		1,378		1,378	6,891	2,401	9,292	7,914
7	2022		1,378	5,362	6,740	6,891	2,401	9,292	2,552
8	2023		1,378		1,378	6,891	2,401	9,292	7,914
9	2024		1,378		1,378	6,891	2,401	9,292	7,914
10	2025		1,378		1,378	6,891	2,401	9,292	7,914
11	2026		1,378		1,378	6,891	2,401	9,292	7,914
12	2027		1,378	7,055	8,433	6,891	2,401	9,292	859
13	2028		1,378		1,378	6,891	2,401	9,292	7,914
14	2029		1,378		1,378	6,891	2,401	9,292	7,914
15	2030		1,378		1,378	6,891	2,401	9,292	7,914
16	2031		1,378		1,378	6,891	2,401	9,292	7,914
17	2032		1,378		1,378	6,891	2,401	9,292	7,914
18	2033		1,378		1,378	6,891	2,401	9,292	7,914
19	2034		1,378		1,378	6,891	2,401	9,292	7,914
20	2035		1,378		1,378	6,891	2,401	9,292	7,914
21	2036		1,378		1,378	6,891	2,401	9,292	7,914
22	2037		1,378	5,362	6,740	6,891	2,401	9,292	2,552
23	2038		1,378		1,378	6,891	2,401	9,292	7,914
24	2039		1,378		1,378	6,891	2,401	9,292	7,914
25	2040		1,378		1,378	6,891	2,401	9,292	7,914
26	2041		1,378		1,378	6,891	2,401	9,292	7,914
27	2042		1,378	7,055	8,433	6,891	2,401	9,292	859
28	2043		1,378		1,378	6,891	2,401	9,292	7,914
29	2044		1,378		1,378	6,891	2,401	9,292	7,914
30	2045		1,378		1,378	6,891	2,401	9,292	7,914

EIRR: 8.5% NPV: -10,871 thousand US$ B/C: 0.77

Table 411-8 Cost and Benefit Stream of Proposed Project under Future Growth Conditions

(Unit: US$1000)

Year		Cost				Benefit			Balance
		Const-ruction	O&M	Replace-ment	Total	Domestic	Non-domestic	Total	
-11	2004	761			761	0	0	0	-761
-10	2005	3,570			3,570	0	0	0	-3,570
-9	2006	14,233			14,233	0	0	0	-14,233
-8	2007	11,412	584		11,996	2,556	786	3,342	-8,653
-7	2008	1,180	610		1,791	3,183	924	4,107	2,316
-6	2009	1,151	635		1,786	3,477	953	4,430	2,644
-5	2010	9,779	636		10,415	3,592	953	4,544	-5,871
-4	2011	22,282	642		22,924	3,710	953	4,662	-18,262
-3	2012	13,635	1,271		14,905	6,394	1,574	7,968	-6,937
-2	2013	464	1,276		1,740	7,277	1,748	9,025	7,285
-1	2014	454	1,326		1,780	8,282	1,942	10,224	8,444
0	2015	442	1,378		1,820	9,426	2,157	11,583	9,763
1	2016		1,378		1,378	10,396	2,341	12,737	11,359
2	2017		1,378		1,378	10,831	2,401	13,232	11,854
3	2018		1,378		1,378	11,186	2,401	13,587	12,209
4	2019		1,378		1,378	11,553	2,401	13,955	12,577
5	2020		1,378		1,378	11,933	2,401	14,334	12,956
6	2021		1,378		1,378	11,933	2,401	14,334	12,956
7	2022		1,378	5,362	6,740	11,933	2,401	14,334	7,594
8	2023		1,378		1,378	11,933	2,401	14,334	12,956
9	2024		1,378		1,378	11,933	2,401	14,334	12,956
10	2025		1,378		1,378	11,933	2,401	14,334	12,956
11	2026		1,378		1,378	11,933	2,401	14,334	12,956
12	2027		1,378	7,055	8,433	11,933	2,401	14,334	5,901
13	2028		1,378		1,378	11,933	2,401	14,334	12,956
14	2029		1,378		1,378	11,933	2,401	14,334	12,956
15	2030		1,378		1,378	11,933	2,401	14,334	12,956
16	2031		1,378		1,378	11,933	2,401	14,334	12,956
17	2032		1,378		1,378	11,933	2,401	14,334	12,956
18	2033		1,378		1,378	11,933	2,401	14,334	12,956
19	2034		1,378		1,378	11,933	2,401	14,334	12,956
20	2035		1,378		1,378	11,933	2,401	14,334	12,956
21	2036		1,378		1,378	11,933	2,401	14,334	12,956
22	2037		1,378	5,362	6,740	11,933	2,401	14,334	7,594
23	2038		1,378		1,378	11,933	2,401	14,334	12,956
24	2039		1,378		1,378	11,933	2,401	14,334	12,956
25	2040		1,378		1,378	11,933	2,401	14,334	12,956
26	2041		1,378		1,378	11,933	2,401	14,334	12,956
27	2042		1,378	7,055	8,433	11,933	2,401	14,334	5,901
28	2043		1,378		1,378	11,933	2,401	14,334	12,956
29	2044		1,378		1,378	11,933	2,401	14,334	12,956
30	2045		1,378		1,378	11,933	2,401	14,334	12,956

EIRR: 12.8% NPV: 2,955 thousand US$ B/C: 1.06

The analysis above is conducted mainly in consideration of the supply. The project management is also evaluated from the viewpoint of the demand. Affordability-to-pay as well as willingness-to-pay of water consumers for the proposed projects is an important constraint for the project to be accepted by the consumers. Through these analyses, this financial study proposes financial solutions and recommendations in the sectoral conclusion of the master plan study. On the basis of these solutions and recommendations, finally, a financial simulation for the most appropriate system is conducted to identify management issues in the future.

(2) Revenue from Water Supply Services

The revenue of the proposed project accrues from expenses of the water consumers. The consumers pay for water charges in accordance with the water volume consumed. The NPVC set a new water tariff for water consumption in their service areas in December 2001. An average water price was estimated at 385 kip/m^3 (equivalent to US$0.0358/$m^3$) for domestic users (category 1) and 770 kip/m^3 (equivalent to US$0.0718/$m^3$) for non-domestic users (category 1 to 4).

The revenue from water supply services is calculated as a product of water volume consumed and unit rates set by the water tariff. As discussed in the previous section, the average unit volume of water consumed in 2007 was projected and the consumption volumes were already calculated in forms of monthly and annual figures. The details of water demand are explained in Section 4.4 in this Report. The unit revenue is calculated as a product of unit rate (kip/m^3) and the average volume of water consumed by consumer types. Table 411-9 shows the annual average unit revenue of the respective consumers in the beginning year of the project in 2007.

Table 411-9 Average Water Consumption and Water Charge from Project Proposed

Type of Consumer	Unit	Domestic User	Non-domestic	Total
Average Unit Price (as of May 2003)	Kip/m^3	385	770	540
1. Annual Consumption in 2007				
Consumption Volume	1000 m^3	5,479	3,742	9,221
Monthly Charge	US$ Million	196	269	465
2. Annual Consumption in 2020				
Consumption Volume	m^3	16,807	11,434	28,241
Annual Charge	US$ Million	602	821	1,423

As mentioned before, the total revenue of the proposed project is estimated as a product of unit rate of the water tariff and total volume of the water supply scheme. The unit rate is assumed to be constant during the evaluation period, which was set as of May 2003. The total annual revenue from water supply services is summarized in Table 411-10.

In addition to water sales, the NPVC can receive connection charges from new consumers. The number of the new consumers is estimated at 38,700 between 2002 and 2020. The NPVC, therefore, will collect the

connection charge of US$ 4,000 in total at 2003 constant prices. The annual distribution of this revenue is summarised in Table 411-10.

Table 411-10 New Connections and Connection Fee from Proposed Project

Item	Unit	New Connection Fee
Average Unit Price (as of May 2003)	1000 Kip/Unit	1,128
1. New Connection in 2007		
Number of Connections	Unit	5,118
Monthly Charge	US$ Million	131
2. New Connection in 2020		
Number of Connections	Unit	17,901
Annual Charge	US$ Million	406

Furthermore, the NPVC collects a meter rental charge from water consumers. Water meter rental rates were tabulated in Table 36-12, which is effective as of May 2003. The average rate was calculated at 2,280 kip/unit (equivalent to US$2.56/unit) in 2002. Applying this average rate in the project, the expected income from meter rental was estimated as shown in the table below. The annual increment of the meter rental charges is summarised in Table 411-11.

Table 411-11 Water Meter Rental Fee from Proposed Project

Item	Unit	New Connection Fee
Average Unit Price (as of May 2003)	1000 Kip/Unit/Year	27.8
1. New Connection in 2007		
Number of Connections	Unit	1,248
Monthly Charge	US$ Million	3
2. New Connection in 2020		
Number of Connections	Unit	38,747
Annual Charge	US$ Million	99

(3) Costs for Water Production

The financial construction cost of the proposed project consists of the following major items:

(a) Main construction cost

(b) Engineering service cost

(c) Physical contingency cost

(d) Price contingency cost

(e) Government administration cost

The work types of the main construction cost comprise (i) treatment plants facilities, (ii) supplementary facilities, (iii) water pipe lines and (iii) circulation pumps. The supplementary facilities include treatment plant house, clear water reservoirs, pumps and other machinery. Details of the cost estimate were described in Section 4.5 in this report. The investment costs of the proposed project were summarized as shown in Table 411-12. The construction costs are disbursed in compliance with the construction schedule of the respective stages.

Table 411-12 Investment Costs of Proposed Project

Description	Investment Costs (US$ 1000)
1. Construction Cost	64,726
2. Administration Cost	4,832
3. Engineering Services	5,327
4. Physical Contingency	7,294
5. Price Contingency	4,832
Total	98,553

Note: The costs above exclude all costs taking part in the whole NPVC management such as "UFW Reduction" and "Human Resource Development". These costs are included in the financial analysis of the entire waterworks including both existing services and new services.

In addition to the investment costs above, a connection system such as connection service pipes and a water meter is installed for each consumer. The installation costs of these connection systems are fully collected from the individual consumers as connection charges. These costs are invested in conformity with the increase of new consumers year by year.

As mentioned in the analysis of the economic cost, replacement costs are required for the evaluation period of the project proposed. The machinery in the plants has to be replaced during the system's life. In the disbursement schedule, the replacement costs of these machines are appropriated every 15 years. Thus, these replacement costs were estimated in market values as follows: US$ 5.44 million in 2022 and 2037, and US$ 7.16 million in 2027 and 2042.

An O&M cost is an annual requirement during the economic life of the proposed project. The O&M cost was estimated at US$ 792,000 in the initial year of the project, 2007, and US$ 2,054,000 at the target year 2015, at 2003 price levels.

(4) Financial Analysis

Financial expenditure and revenue during the evaluation period are shown as an annual stream in Table 411-13. The table also shows the evaluation indices. The indices were 0.12 of B/C and minus US$ 52.7 million of NPV. FIRR was not calculated because the revenue was small compared with expenditure. From the financial point of view, accordingly, the proposed project is not said to be viable.

Table 411-13 Cost and Benefit Stream of Proposed Project Applying Present Tariff

(Unit: US$1000)

Year		Cost				Benefit				Balance
		Construction	O&M	Replacement	Total	Water Charge	Connection	Meter Rental	Total	
-11	2004	810			810	0	0	0	0	-810
-10	2005	3,927			3,927	0	0	0	0	-3,927
-9	2006	16,103			16,103	0	0	0	0	-16,103
-8	2007	13,288	792		14,080	465	131	3	599	-13,480
-7	2008	1,430	828		2,258	552	139	7	698	-1,560
-6	2009	1,433	863		2,296	576	147	10	733	-1,562
-5	2010	12,351	872		13,223	576	156	14	746	-12,477
-4	2011	28,916	887		29,803	576	132	17	725	-29,077
-3	2012	18,201	1,877		20,078	956	347	26	1,328	-18,750
-2	2013	688	1,902		2,590	1,058	363	34	1,455	-1,135
-1	2014	699	1,977		2,676	1,171	380	44	1,594	-1,082
0	2015	707	2,054		2,761	1,296	398	53	1,747	-1,014
1	2016		2,054		2,054	1,397	348	62	1,807	-247
2	2017		2,054		2,054	1,423	362	71	1,855	-199
3	2018		2,054		2,054	1,423	376	80	1,878	-176
4	2019		2,054		2,054	1,423	391	89	1,903	-151
5	2020		2,054		2,054	1,423	406	99	1,928	-126
6	2021		2,054		2,054	1,423	0	99	1,522	-532
7	2022		2,054	5,444	7,498	1,423	0	99	1,522	-5,976
8	2023		2,054		2,054	1,423	0	99	1,522	-532
9	2024		2,054		2,054	1,423	0	99	1,522	-532
10	2025		2,054		2,054	1,423	0	99	1,522	-532
11	2026		2,054		2,054	1,423	0	99	1,522	-532
12	2027		2,054	7,162	9,216	1,423	0	99	1,522	-7,695
13	2028		2,054		2,054	1,423	0	99	1,522	-532
14	2029		2,054		2,054	1,423	0	99	1,522	-532
15	2030		2,054		2,054	1,423	0	99	1,522	-532
16	2031		2,054		2,054	1,423	0	99	1,522	-532
17	2032		2,054		2,054	1,423	0	99	1,522	-532
18	2033		2,054		2,054	1,423	0	99	1,522	-532
19	2034		2,054		2,054	1,423	0	99	1,522	-532
20	2035		2,054		2,054	1,423	0	99	1,522	-532
21	2036		2,054		2,054	1,423	0	99	1,522	-532
22	2037		2,054	5,444	7,498	1,423	0	99	1,522	-5,976
23	2038		2,054		2,054	1,423	0	99	1,522	-532
24	2039		2,054		2,054	1,423	0	99	1,522	-532
25	2040		2,054		2,054	1,423	0	99	1,522	-532
26	2041		2,054		2,054	1,423	0	99	1,522	-532
27	2042		2,054	7,162	9,216	1,423	0	99	1,522	-7,695
28	2043		2,054		2,054	1,423	0	99	1,522	-532
29	2044		2,054		2,054	1,423	0	99	1,522	-532
30	2045		2,054		2,054	1,423	0	99	1,522	-532

FIRR: -- NPV: -52,732 thousand US$ B/C: 0.12

The reason why the proposed project is not financially viable that the revenue is small compared with the investment and O&M costs. Based on this result of financial expenditure and revenue, hence, the relationship between the water tariff and the financial cost is delineated as shown in Figure 411-6. In this figure, the following assumptions are set forth as a premise. Namely, the charges for new connection installations and water meter rentals are kept at the same level as the present rates. Their average rates were US$105/unit for new connections and US$2.56/unit/year for rentals, as of May 2003.

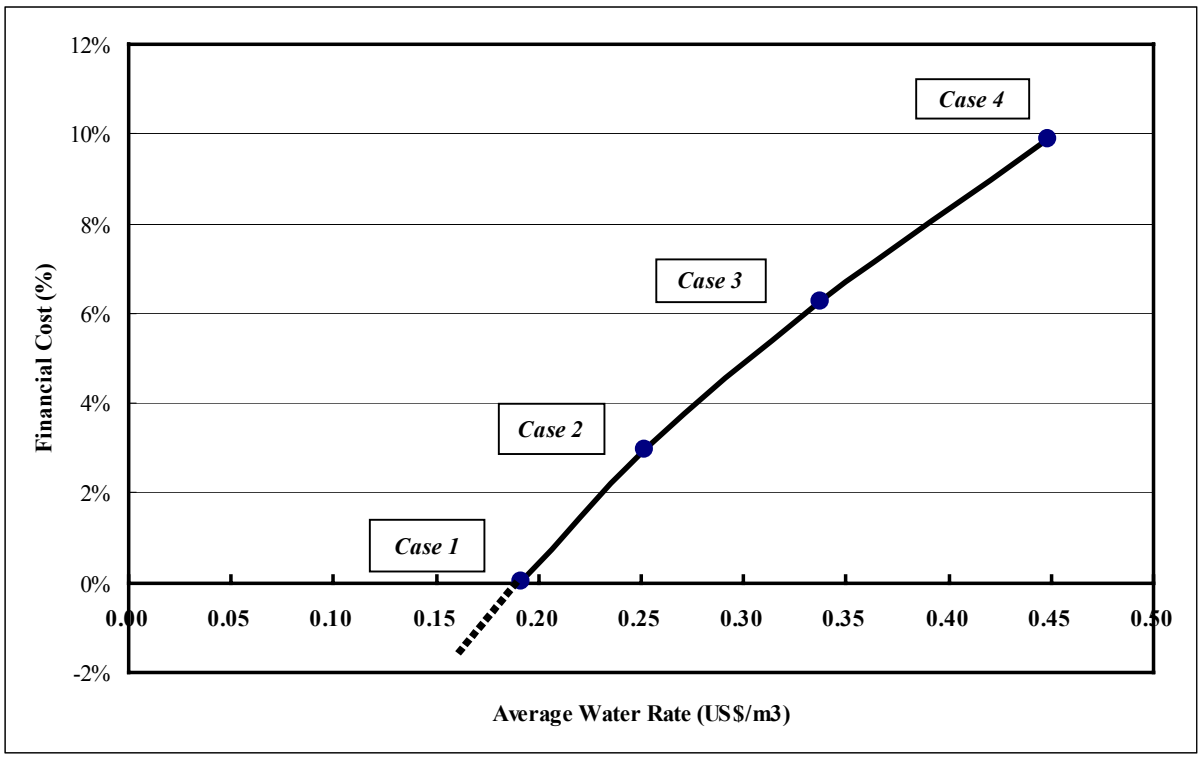


Figure 411-6 Relation between Average Water Rates and Financial Costs

According to the figure above, the following relationships are analysed for making the proposed project viable from financial point of view. The cases are shown in Table 411-14.

Table 411-14 Relationship between Financial Cost and the Average Water Rate

Case	Financial Cost		Average Water Rate	
	Interest Rate (%)	Remark	Water Cost (US$/m^3)	Ratio to Present Rate
Case 1	0.0%	Complete Grant	0.19	3.8 times
Case 2	3.0%	Chinaimo Expansion	0.25	5.0 times
Case 3	6.3%	International Loan	0.34	6.8 times
Case 4	9.9%	Private Bank Loan	0.45	9.0 times

If the initial investment costs were granted completely, an average water cost could be around US$0.19/m^3 (equivalent to 2,010 kip/m^3) or 3.8 times of the present average water rate, as shown in the table above.

In case 2, if the financial cost was set at a lower interest case of 3.0%, the average water rate could be around US$0.25/$m^3$ (equivalent to 2,700 kip/m^3) or 5.0 times of the present average water rate, as shown in Table 411-4.

In case 3, if the financial cost was set at a standard public interest rate of 6.3% like loans from any international financial organizations such as World Bank or ADB, the average water rate could be around US$0.34/$m^3$ (equivalent to 3,640 kip/m^3) or 6.8 times of the present average water rate, as shown in Table 411-4.

In case 4, if the financial cost was set at an interest rate of 9.9% from a private bank which is applied in the NPVC, the average water rate could be around US$0.45/$m^3$ (equivalent to 4,820 kip/m^3) or 9.0 times of the present average water rate, as shown in Table 411-4.

(5) Issues of Affordable Water for Domestic Consumers

According to the LECS2, average household expenditure in urban areas of Vientiane Capital City was estimated at 284,600 kip/month in the survey year 1997/98. The expense for water was 2,860 kip/month on average, accounting for 1.0% of household expenditure. In 2003, the total household expenditure was projected as being 1,679,000 kip/month, applying the inflation rate of 5.9 calculated through price indices between 166 of March 1998 and 980 of February 2003. In the same manner, expense for water was converted to 16,900 kip/month, also accounting for 1.0% of the total expenditure.

In the household survey conducted by the JICA study team in March 2003, the average expenditure for the public water supply was estimated at around 26,000 kip/month on average. In the same survey, a family income was estimated at 1,600,000 kip/month, on average. Then, the water expense accounted for 1.6% of the family income. Around 70% of the interviewees answered that the current amount of water charge was fair. Around 20% responded the water charge was expensive. On the other hand, around 10% answered that the water charge was cheap.

In the survey, consumers who do not consume piped water were questioned on their willingness-to-pay for water. The willingness-to-pay was estimated at around 14,000 kip/month on average. Their family income was estimated at 1,000,000 kip/month on average. Then, the willingness-to-pay accounted for 1.4% of the average family income.

Accordingly, the water charge for consumers of the water supply system in Vientiane Capital City is said to range from 1.0% to 1.6% of the total household income, referring to the discussion above. Thus, the people in these areas would be satisfied with the water charge of around 1.5% of the household income. Supposing that an average family income was 1,600,000 kip/month in 2003, a water charge of 24,000 kip/month would be acceptable to the family.

In Prime Ministerial Decision (37/PM), it was decreed that the domestic water charge for low-income people should be set at to no more than 3% of household income. In situation where a water supply company sets a higher water rate in its service areas, the charge of domestic water should not be more than 5% of household income, taking into consideration internal subsidisation among categories in the areas. It must be effective for water resources conservation.

It should be remembered that the World Bank report "Investing in Development, 1985" insisted that the price of the minimum block of water is commonly set at 3 to 5 percent of household income, which experience suggests is affordable. These levels are widely acknowledged among the agencies concerned. Once this ratio was applied to the people in urban areas in Vientiane Capital City, the affordability of water could be estimated at 48,000 to 80,000 kip/month for their average monthly income of 1,600,000 kip.

As discussed in the previous section, the water cost of the project proposed was estimated as being in the range of US$0.19/$m^3$ (equivalent to 2,010 kip/m^3) for Case 1 and US$0.45/$m^3$ (4,820 kip/m^3) for Case 4, as shown in Table 411-14. If these water costs applied simply to water charges for families in service areas of the NPVC, their water charge would be calculated as shown in Table 411-15.

Table 411-15 Affordability of Water Charge Corresponding to Case 1 to 4 of Financial Cost

Case	Water Unit Cost		Water Charge	Percentage of Water Charge to Income	Affordability*1
	(US$/$m^3$)	(Kip/m^3)	(Kip/month)	(%)	
Case 1	0.19	2,010	64,000	4.0	○
Case 2	0.25	2,680	86,000	5.4	△
Case 3	0.34	3,640	117,000	7.3	△
Case 4	0.45	4,820	154,900	9.7	×

Note: *1 Signs mean: ○ - fair, △ – hard, and × - impossible

As shown in the table above, the percentage of the water charge to average income in Case 1 was 4.0%, which is within the affordable block of 3% to 5%, so it can be considered that Case 1 is fair for the people. In Case 2, however, the percentage was 5.4% which is over the WB prescribed level, so it would not be affordable unless the water tariff for domestic users is arranged for them to accept taking their affordability into account. In Case 3, it would be much more difficult than that of Case 2, because of the high percentage of 7.3%. In Case 4, it would be almost impossible to apply the water cost to the water consumers in the service areas of the NPVC because of the high cost. The water tariff system for the new project proposed is discussed in the feasibility study stage in a more precise analysis.

Incidentally, the water tariff of the NPVC has been revised six times since 1994. In January 1994, the average water rate was revised at 74 kip/m^3. As of 2003, the average water rate was 550 kip/m^3 or around

7.4 times more than that of 1994. On the other hand, the consumer price index (CPI) in January 1994 was 72 (base: 1995=100) and rose to 980 in February 2003. Therefore the inflation rate during the period was around 13.3 times. The inflation rate of 13.3 times was higher than the increased average water rate which was of 7.4 times, as mentioned in Section 3.6.5(2). Therefore, it is considered that the water rate is undesirably slower than the inflation speed. The water consumers have felt happy about water comparatively declining in price. They have enjoyed their lives with the low-priced water.

Furthermore, the water rate for domestic water consumers is known to be cheaper than those of other provinces. The monthly charge of an average household consuming 30 m^3/month in Vientiane Capital City was calculated at only 8,110 kip/month, which is the lowest among the 18 provinces, as discussed in Section 3.6.5(3). The average water charge in the 18 provinces was calculated at 29,700 kip/month. The charges in Vientiane Capital City accounted for only 27% of the national average.

In order that the people in the service areas receive the new project, they have to accept a price rise for water in the future. According to the household survey, around 70% of the interviewees answered that the current amount of water charge was fair. Furthermore, if the NPVC improves the service levels such as water quality and the elimination of water supply stoppages, they would accept an increase in water charges. Their affordability-to-pay is considered to be higher than the present price level, so the price increase of water could be negotiable. Thus, the NPVC has to manage a campaign to educate the water consumers on the need for rational water costs and to set up a reasonable water tariff through a consultation with the consumers.

It is said that the installation charges are a heavy burden for new connections to the water supply services. As shown in Table 411-10, a new water consumer has to pay on average, US$ 105 for connection installations at the time of application, although the installation charge for a domestic consumer is smaller than the average cost applied to other consumers. In particular, the connection charge seems to be a serious for new connections for low-income earners. Thus, it would be recommended that a system of lending and/or subsiding for new connection fees is established with some regulations such as a loan program in accordance with household income. The system could make lower-income families access the water supply system more easily than present.

4.11.3 Financial Simulation

(1) Financial Plan

In the financial simulation analysis, the revenues from the water supply services and the expenditures for operation and maintenance as well as capital investment are estimated on the basis of the proposed water supply system. Besides these data, the following conditions and assumptions are made for the financial simulation.

1) Projection period: 17 years, from 2004 as the start year of consulting services and then construction works of the proposed project through to 2020.

2) Prices and cost escalation: Projections of both revenues and expenditures were made without escalation to simplify and to make the simulation clearly understandable.

3) Currency and exchange rate: Capital costs, revenues and expenditures are evaluated in US dollars. Exchange rates of 10,720 kip to US$ 1.00 and ¥119 per US$1.00 are applied in the master plan study

4) Finances for Implementation: Finances for the financial plans are set as shown in Table 411-16.

Table 411-16 Finances of Financial Plan 1 and 2

	Financial Source	Amount (US$ Million)	
		Financial Plan 1	Financial Plan 2
1.	Loan*1 (International Agency)	45	0
2.	Loan*2 (International Agency)	0	85
3.	Grant (Foreign Country)	50	0
4.	Local Government (Capital Infusion)	3	13
	Average Financial Cost	3%/annum	3%/annum

Note: *1 Terms of loan by international agency are as follows: 6.5% of annual interest rate, and 20 years of repayment period with 5 years of grace period.
*2 Terms of loan by international agency are as follows: 3.5% of annual interest rate, and 20 years of repayment period with 5 years of grace period.
*3 Financial shortages during the simulation period are assumed to be financed by the government as done for the present waterworks so far.

5) Taxes: Profit tax or Minimum tax will be levied. In addition, Turnover tax is levied just after the inauguration of the project.

6) Water tariff structure: The present water tariff is constituted of two parts in this study: water charges by type of water consumer, i.e., Category 1, or domestic consumers such as residential users and Category 1 to 4, or non-domestic consumers. In addition, installation charges for new consumers and meter rental for every consumer are charged to consumers connected to the water supply system. The water charge is set as follows:

	Average Water Rate		US$0.25/$m^3$
(i)	Category 1	Domestic Use	US$0.18/$m^3$ *1
(ii)	Category 1 to 4	Non-domestic Use	US$0.36/$m^3$ *1

Note: *1 In case that the present structure is applied.

(i)	Installation Charge	Average rate of all categories	US$105/Unit
(ii)	Meter Rental Charge	Average rate of all categories	US$2.56/Unit/year

7) Water sales: The total amount of water sales is estimated as a product of the water consumption volume and unit charge by type of consumers.

8) Revenues: The revenues of the water supply entity accrue from water sales, water meter rental and installation charges. These revenue sources have already been discussed above. Regarding administration charges and deficits at the beginning stage of the water supply works, these expenses and losses are assumed to be filled by the government short-term support with no interest, as done with the NPVC at present. In addition to these revenues, the entity could derive other earnings from interest on short-term deposits, if it gains a net profit through its management. Interest rate is set as 1.1%/annum on average, which is a quarter of a daily saving deposit rate because of non-constant saving deposit.

9) Depreciation: Fixed assets such as the water supply plants and the distribution piping network are depreciated using a straight-line method over the 30 years after they have been inaugurated into service. The engineering services are depreciated also using the straight-line method over 30 years, because it is regarded as a part of construction. Some machinery such as pumps and power generator are depreciated also using the straight-line depreciation method over 15 years.

10) Assumptions about accounting and tax: Grants from foreign countries are internalized as a part of the equity of the waterworks entity. The facilities established on the basis of the grants are treated as depreciable assets in the accounting system without a reduction entry of these facilities.

In this report, the results of the financial simulation with regard to the financial plan 1 are shown in Tables 411-17 to 411-19. These simulations are based on the given conditions and assumptions mentioned above.

(2) Financial Simulation

This section presents a financial simulation of waterworks for the proposed project. The financial simulation is based on information regarding “existing financial system of the water supply business” and “financial conditions for the water sector”. An integrated financial simulation model is applied for this analysis. This analysis gives financial problems of the proposed project and fund requirements for the waterworks entity.

Figure 411-7 gives an image of the income statement trend in the financial simulation. The figure shows the following information: (a) revenue from water sales and other incomes; (b) expenditure for operation and maintenance; (c) the net operating profit, i.e., the difference between revenue and expenditure; (d) the annual net profit, i.e., the profit resulting from deducting the interest of the loan from the net operating profit; and (e) the accumulation of profit and loss.

The Figure 411-7 indicates that the net loss will continue until 2014, and will move toward surplus after 2015. The accumulation of losses continues until 2025 and turns to the black after 2026. As seen in this

figure, the profit and loss of the enterprise are very serious for around 10 years from the beginning. Thus, the financial simulation tables presented in this study show the beginning 17 years, i.e., from 2004 to the target year 2020.

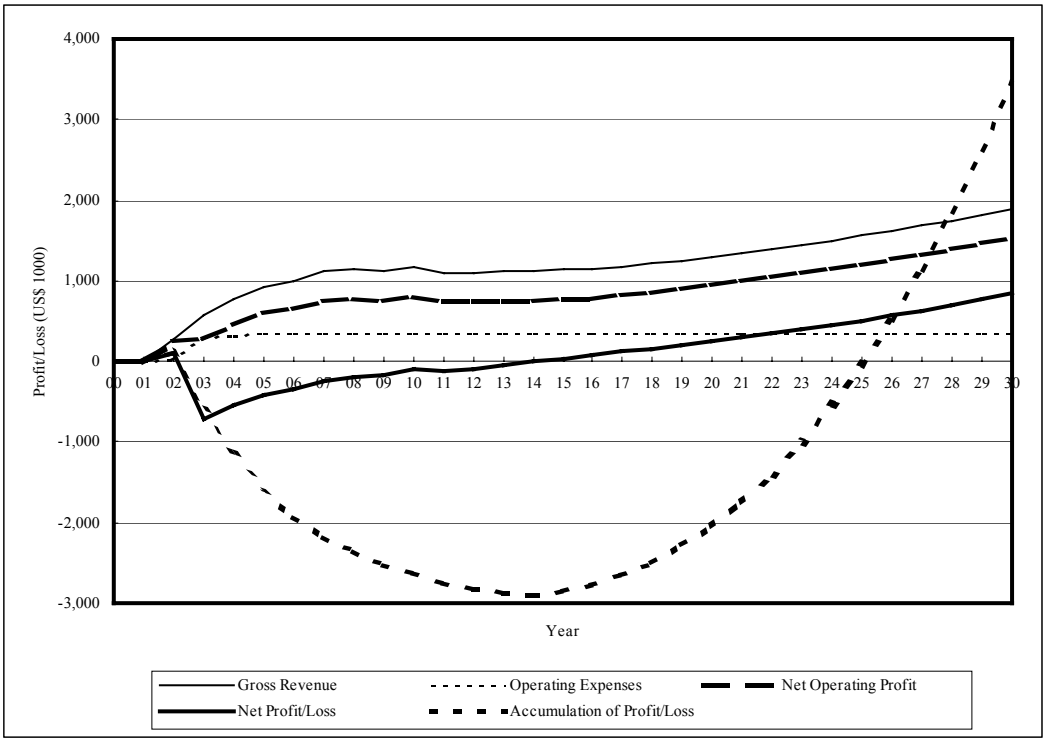


Figure 411-7 Image of Financial Simulation

(3) Management Issues and Recommendations

In the financial plan 1, the waterworks will incur a net loss at the beginning, although the operating results record net gains just after the inauguration of the project, as shown in Table 411-17. In the target year 2020, the total revenue is expected to be US$11.6 million, which is comprised of US$7.5 for water sales, US$0.5 million for meter rental and US$2.1 for installation charges. On the other hand, the operating expenses amount to US$6.5 million in the same year. Then the net operating profit becomes US$5.1 million. However, the non-operating revenue and expenses including the interest from loans are estimated at US$2.0 million, so the income before tax results in US$3.4 million. Since the profit tax is calculated at US$1.2 million, the net profit after tax is estimated at US$2.2 million in 2020. The accumulated profit aggregated to US$9.8 million by the target year 2020.

During the construction period, the waterworks will face a cash flow deficit from 2004 to 2006. Just after the inauguration of the water supply system, however, the waterworks will get sufficient revenue, so the net income will turn to black, as shown in the table. This is primarily because the water consumers are already living in water service areas. Once the waterworks expand their system, the immediate demand for water will increase significantly. This situation is favourable for the waterworks' management.

Table 411-17 Profit and Loss Table of Financial Plan 1: 2005-2020

(Unit: US$1000)

Item	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
I. Operating Revenue	0	0	0	3,618	4,214	4,427	4,503	4,379	8,016	8,785	9,627	10,549	10,909	11,200	11,341	11,488	11,641
1. Water Sales	-	-	-	2,440	2,900	3,023	3,023	3,023	5,017	5,553	6,147	6,804	7,334	7,469	7,469	7,469	7,469
(1) Domestic	-	-	-	1,030	1,242	1,313	1,313	1,313	2,192	2,415	2,661	2,933	3,132	3,159	3,159	3,159	3,159
(2) Non-domestic	-	-	-	1,410	1,658	1,710	1,710	1,710	2,826	3,138	3,486	3,871	4,203	4,310	4,310	4,310	4,310
2. New Connection	-	-	-	689	730	774	820	695	1,819	1,905	1,995	2,089	1,828	1,900	1,975	2,053	2,134
3. Meter Rental	-	-	-	17	34	53	73	90	134	181	229	280	324	370	418	468	520
4. Other Incomes	-	-	-	472	550	577	587	571	1,046	1,146	1,256	1,376	1,423	1,461	1,479	1,498	1,518
II. Operating Costs	0	0	0	2,564	2,629	2,674	2,686	2,695	6,342	6,403	6,543	6,999	7,061	6,489	6,495	6,502	6,510
1. Compensation	-	-	-	21	22	23	24	25	82	85	87	90	90	90	90	90	90
2. Electricity	-	-	-	437	455	472	469	469	888	870	904	939	939	939	939	939	939
3. Chemicals	-	-	-	99	104	108	107	107	160	168	174	181	181	181	181	181	181
5. Depreciation	-	-	-	1,600	1,600	1,600	1,600	1,600	4,083	4,083	4,108	4,133	4,156	3,552	3,552	3,552	3,552
6. Administration	-	-	-	81	86	91	96	101	264	276	289	611	632	650	650	650	650
7. Miscellaneous	-	-	-	154	162	169	177	185	483	503	523	543	543	543	543	543	543
8. Turnover Tax	-	-	-	172	201	211	214	209	382	418	458	502	519	533	540	547	554
9. Bad Debt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
III. Net Operating Income	0	0	0	1,055	1,585	1,754	1,817	1,684	1,675	2,382	3,083	3,550	3,848	4,711	4,846	4,986	5,132
IV. Non-operating Revenue & Costs	0	-23	-150	-693	-1,127	-1,158	-1,189	-1,586	-2,545	-3,066	-2,977	-2,881	-2,781	-2,673	-2,442	-2,210	-1,975
1. Non-operating Revenues	0	4	9	8	22	39	56	75	91	107	120	139	162	194	208	224	242
(1) Non-operating Revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(2) Interest Receives	0	4	9	8	22	39	56	75	91	107	120	139	162	194	208	224	242
2. Interest Charges	0	27	159	701	1,149	1,197	1,245	1,661	2,636	3,173	3,097	3,020	2,944	2,867	2,650	2,434	2,217
V. Net Income before Tax	0	-23	-150	362	458	596	628	98	-870	-684	106	669	1,067	2,039	2,404	2,776	3,157
VI. Profit Tax	0	0	0	127	160	209	220	44	80	88	96	234	373	714	841	972	1,105
VII. Net Income after Tax	0	-23	-150	235	298	387	408	54	-950	-772	10	435	693	1,325	1,562	1,805	2,052

Table 411-18 Cash Flow Plan of Financial Plan 1: 2005-2020

(Unit: US$1000)

Item	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
I. Procurement																	
1. Operating Revenue	-	-	-	1,055	1,585	1,754	1,817	1,684	1,675	2,382	3,083	3,550	3,848	4,711	4,846	4,986	5,132
2. Depreciation	-	-	-	1,600	1,600	1,600	1,600	1,600	4,083	4,083	4,108	4,133	4,156	3,552	3,552	3,552	3,552
3. (Less) Account Receivable*1	-	-	-	305	362	378	378	378	627	694	768	851	917	934	934	934	934
(Writeback) Account Recievable					305	362	378	378	378	627	694	768	851	917	934	934	934
Gross Internal Cash Position	-	-	-	2,349	3,128	3,338	3,417	3,284	5,508	6,398	7,117	7,600	7,938	8,247	8,398	8,538	8,684
1. Capital Infusion	523	586	332	275	34	34	255	590	371	-	-	-	-	-	-	-	-
2. Grant	370	1,827	7,514	6,200	662	664	5,764	13,501	8,498	-	-	-	-	-	-	-	-
3. Foreign Loan	411	2,030	8,349	6,889	735	738	6,404	15,001	9,442	-	-	-	-	-	-	-	-
4. Loan - Local Banks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Interest Receivable	-	4	9	8	22	39	56	75	91	107	120	139	162	194	208	224	242
Total Sources	1,305	4,447	16,204	15,722	4,581	4,813	15,896	32,451	23,911	6,505	7,237	7,739	8,100	8,441	8,606	8,762	8,926
II. Disbursement																	
1. Debt Services	0	27	159	701	1,149	1,197	1,245	1,661	3,815	4,352	4,275	4,199	4,122	6,200	5,984	5,767	5,550
(1) Principal Repayment	0	0	0	0	0	0	0	0	1,179	1,179	1,179	1,179	1,179	3,333	3,333	3,333	3,333
(2) Interest Charges	0	27	159	701	1,149	1,197	1,245	1,661	2,636	3,173	3,097	3,020	2,944	2,867	2,650	2,434	2,217
2. Investment	810	3,927	16,103	13,288	1,430	1,433	12,351	28,916	18,201	688	699	707	0	0	0	0	0
(1) New Construction	810	3,927	16,103	13,288	1,430	1,433	12,351	28,916	18,201	688	699	707	-	-	-	-	-
(2) Repairing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Inventory Stock*2	-	-	-	30	31	32	32	32	48	50	52	54	54	54	54	54	54
(Writeback) Inventory Stock					30	31	32	32	32	48	50	52	54	54	54	54	54
4. Profit Tax	0	0	0	127	160	209	220	44	80	88	96	234	373	714	841	972	1,105
Total of Disbursement	810	3,954	16,262	14,146	2,741	2,840	13,816	30,621	22,112	5,130	5,072	5,142	4,496	6,914	6,825	6,739	6,655
Net Cash Flow	495	493	-57	1,576	1,840	1,973	2,080	1,830	1,799	1,375	2,164	2,597	3,605	1,527	1,781	2,024	2,271
Opening Cash Balance	0	495	988	931	2,507	4,347	6,320	8,400	10,230	12,029	13,404	15,568	18,165	21,770	23,297	25,079	27,102
Accumulated Cash Position	495	988	931	2,507	4,347	6,320	8,400	10,230	12,029	13,404	15,568	18,165	21,770	23,297	25,079	27,102	29,373

Table 411-19 Balance Sheet of Financial Plan 1: 2005-2020

(Unit: US$1000)

Item	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
I. Assets	1,305	5,725	21,771	35,370	37,099	38,922	51,753	80,899	97,081	95,130	93,961	93,217	92,732	90,724	88,953	87,424	86,143
1. Fixed Assets	810	4,737	20,840	32,528	32,358	32,191	42,942	70,259	84,377	80,982	77,573	74,147	69,991	66,439	62,886	59,334	55,782
(1) Fixed Assets	-	-	-	34,128	34,128	34,128	34,128	34,128	96,459	97,147	97,846	98,553	98,553	98,553	98,553	98,553	98,553
(2) Accumulated Depreciation	0	0	0	1,600	3,200	4,800	6,400	7,999	12,082	16,165	20,273	24,406	28,562	32,114	35,667	39,219	42,771
(3) Works in Progress	810	4,737	20,840	-	1,430	2,863	15,214	44,130	-	-	-	-	-	-	-	-	-
2. Current Assets	495	988	931	2,842	4,741	6,730	8,810	10,640	12,705	14,149	16,389	19,070	22,741	24,285	26,067	28,090	30,361
(1) Cash	100	148	140	376	652	948	1,260	1,535	1,804	2,011	2,335	2,725	3,266	3,495	3,762	4,065	4,406
(2) Bank Deposit	395	840	791	2,131	3,695	5,372	7,140	8,696	10,225	11,393	13,233	15,441	18,505	19,803	21,317	23,037	24,967
(3) Account Receivable	-	-	-	305	362	378	378	378	627	694	768	851	917	934	934	934	934
(4) Inventory Stock	-	-	-	30	31	32	32	32	48	50	52	54	54	54	54	54	54
(6) Prepayment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
II. Equity and Liabilities	1,305	5,725	21,771	35,370	37,099	38,922	51,753	80,899	97,081	95,130	93,961	93,217	92,732	90,724	88,953	87,424	86,143
1. Short-term Liabilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(1) Account Payable	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(2) Advanced Receipt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Long-term Liabilities	411	2,441	10,790	17,680	18,415	19,153	25,557	40,558	48,821	47,643	46,464	45,285	44,107	40,773	37,440	34,107	30,773
(1) Foreign Loan	411	2,441	10,790	17,680	18,415	19,153	25,557	40,558	48,821	47,643	46,464	45,285	44,107	40,773	37,440	34,107	30,773
(3) Local Loan - Banks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(4) Creditors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(5) Interest Payable	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Equity	894	3,284	10,980	17,690	18,684	19,769	26,196	40,341	48,260	47,488	47,497	47,932	48,625	49,950	51,513	53,317	55,369
(1) Enterprise Capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(2) Government Capital	523	1,109	1,442	1,716	1,751	1,784	2,039	2,629	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
(3) Grants	370	2,197	9,711	15,912	16,573	17,237	23,001	36,502	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
(4) Profit/Loss for the Year	0	-23	-172	63	361	748	1,156	1,210	260	-512	-503	-68	625	1,950	3,513	5,317	7,369

In the financial analysis, the relationship of the water rate and the years expected to break-even under steady financial costs are indicated in Figure 411-6. Through the simulation analysis, this relationship was further depicted, as shown in Figure 411-8. For instance, if the financial cost increased 5%/year, the year to solve the accumulated deficit would be delayed to 2032, from 2007 as in the original case. In the situation where the average water rate is reduced down to US$0.225/m^3 (10% down) and the financial cost goes up to 4.5%/year (around 50% up), the year of solving the accumulated deficit will be delayed to 2040 from 2007. Therefore in making a management plan for the project, the procurement of financial sources and setting-up water rates are one of the most important issues.

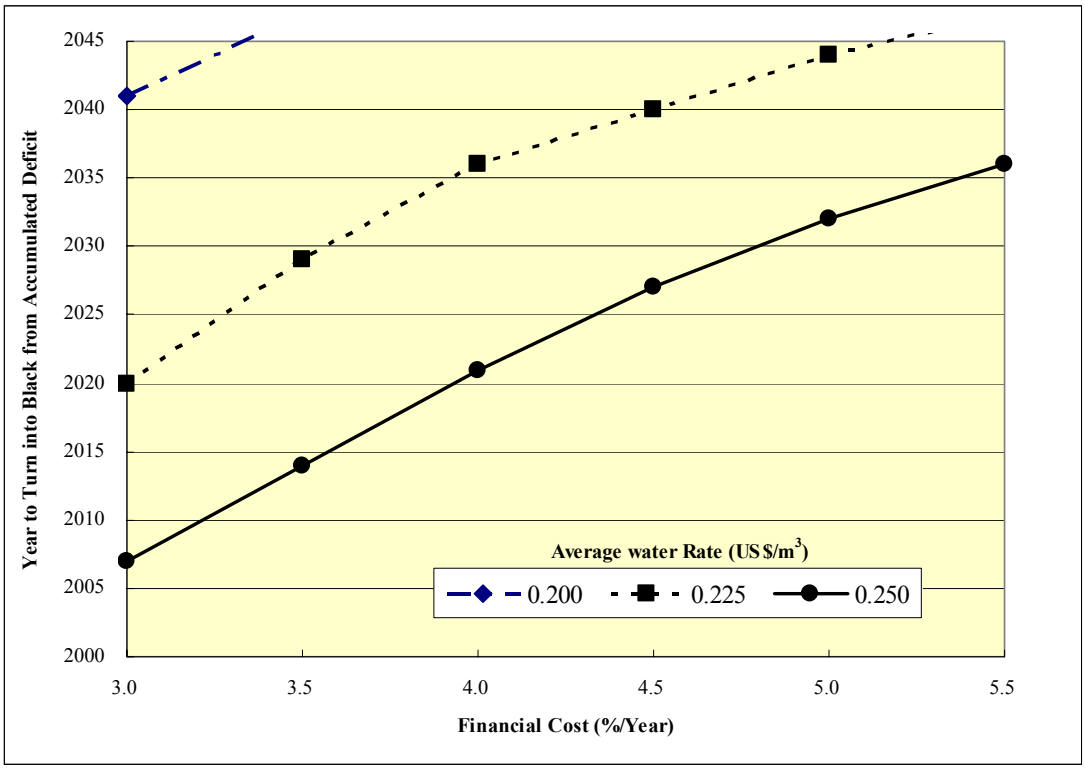


Figure 411-8 Relation between Water Rates and Years of Solving Accumulated Deficit

4.11.4 Socio-Economic Impacts

(1) Impact on the Regional Economy

It is obvious that commencement of construction works such as water supply project induces activation in the regional economy in sectors related to construction works, as well as the construction sector itself. In general, one unit of construction work could induce 1.50 to 2.00

units of economic effects in the national and regional economy. In other words, construction work would bring about a 50% to 100% ripple effect on related works in various economic sectors in monetary terms, in addition to the said construction work. This effect could stimulate the regional economy in Vientiane Capital City and the surrounding provinces.

According to the 1995 census, 7% of the labour force in Vientiane Capital City is not employed. The investment of the proposed project would activate the regional economy and at the same time create opportunities for temporary jobs during the construction period. Accordingly, it would be clear that the investment proposes new labour opportunities for unemployed and underemployed people in the province.

(2) Impact on Public Finance

The total investment cost was estimated at around US$ 100 million or 1.07 trillion kip in total. The total amount will be disbursed over a period of 12 years, accounting for 25% of the total expenditure of the central government in the fiscal year 2002/23. It also accounts for 42% of the capital expenditure of the government. Although this amount is not disbursed within a year, it is still a heavy burden for the government. The capital expenditure of the central government generally has relied on foreign project assistance so far. For implementation of this proposed project, there would be no other way that the capital cost could be raised without depending on foreign financial assistance. Without the support of the government finance, the project could not be implemented in reality. In this context, the project has a large influence on the public finance sector.

Considering this, the water supply business has to be managed as an independent autonomous entity after the project is implemented. To put this policy into practice, the following basic management principles should be carried out in the management of the water supply business.

1) As a minimum, the revenue from water sales should cover the full costs of water production, as proclaimed in "Prime Ministerial Decision on Management and Development of Water Supply Sector (37/PM)".
2) Working funds are procured by the water supply entity not through public finance but through private self-financed options.
3) Taking into consideration of re-investment and replacement in the near future, the surplus has to be reserved as much as possible in retained earnings as a part of equity in the water supply management.

(3) Impact on Household Economy

According to the "Household Survey 1997/98", the water charge for the average family accounted for 1.0% of the total household expenditure in the urban areas of Vientiane Capital City. The average annual amount of the water charge was estimated at around 16,700 kip, at 2003 current prices. On the other hand, the average annual total expenditure was estimated at 1,679,000 kip. Although the total income was not reported in the survey, it could be assumed that it is almost the same amount as the expenditure.

As of May 2003, the water rate of for domestic use is 384 kip/m^3, on average. Annual consumption of domestic water is estimated at 390 m^3 per household, so the annual charge is calculated at 149,800 kip per household. As the annual family income in 2003 is estimated at 20.1 million kip, a water charge of a household is estimated to account for only 0.7% of an average household income. This rate is lower than that of 1.0% in the survey above. The rate applies to 70% of the surveyed household with a result of 1.0%.

Yet, the domestic water charge for low-income people should be limited to at most, 3% of household income in section 4.6 in article 4 in Prime Ministerial Decision (37/PM). Furthermore, the World Bank report of "Investing in Development, 1985", prescribed that the price of a minimum block of water is commonly set at 3 to 5 percent of household income, which experience suggests is affordable. As shown in Table 411-15, the lowest rate of 4.0% in Case 1 seems to be within the prescribed range of the World Bank, although it is on the high side. Although the new tariff might appear to be expensive for the domestic consumers in the water supply service areas at present, the statistics detailed above show that this is not true.

As discussed in the "Financial Analysis", the rate for domestic water might be increased to five times more than the present value, if the capital investment is financed in the same manner as the case of the Chinaimo Expansion Project. That project was financed as follows: a half of the total costs were financed as equity by the government and the other half was financed as a loan with 6.5% interest rate and 25 years repayment period including a 5 year grace period. In this case, the water charge of a household is estimated to account for 5.4% of the total household expenditure, on average. Since this water charge exceeds the affordable level described in the World Bank experience's viewpoint, it might be too large an increase for every family to afford at once. Thus, the NPVC has to disclose its technical and financial information and bring about a better understanding between water consumers and the NPVC. Through a good mutual understanding therefore, the NPVC has to create a climate of economic and political stability conducive to building a proper relationship with water consumers.

(4) Understanding of Rational Utilisation and Reasonable Price

In Vientiane Capital City, people have been in close communion with ample and cheap city water. They have enjoyed their lives with plenty of pure water, although the people without water supply services still .suffer hardships of water shortage. This disparity regarding the availability of water services should be improved as soon as possible. In the meantime people with water supply services enjoy a mass consumption of water through the mass production of water by the NPVC waterworks.

After introduction of the project proposed in this study, water produced with the new system can not be produced in as cheap a manner as is done at present. With the progress of economic growth, the people in Vientiane will express their wishes for potable water in a steady manner. Fortunately, they understand the need to share the reasonable costs for potable water. At the same time, they must understand the need for the rational utilisation of potable water in their lives, instead of the mass consumption of water as is occurring now. To achieve a balance between the reasonable prices of water against the rational utilisation of water consumers, the NPVC strives to attain a balanced water production based on a mutual understanding between the NPVC and their consumers. This mutual understanding makes for an equitable society and the effective and steady management of the NPVC for the near future.