CHAPTER 7

ECONOMIC AND FINANCIAL ANALYSIS

CHAPTER 7 ECONOMIC AND FINANCIAL ANALYSIS

7.1 Economic Evaluation

7.1.1 Methodology of Economic Evaluation

The economic evaluation in this report is conducted in the same manner as in the master plan. In the feasibility study, the respective experts estimated the costs with discretion, and more precisely than those in the master plan. The 1st stage project could be then be evaluated with more reliability. In spite of that, some uncertainty still exists in the estimations made. In particular, in the case of a long implementation period and the incremental growth of future water demand there are risks in terms of judgment of the project viability. In this context, a sensitivity test is introduced for assessing certain aspects of the project.

In the feasibility study, the preconditions and assumptions for an economic evaluation are the same as defined in the master plan. The costs and benefits are estimated on the basis of economic values instead of market values, which are applied for the financial analysis. The economic values are converted from financial values by applying the conversion factor. For the economic evaluation, the following criteria and assumptions are applied to calculate the economic values and evaluation indicators.

Schedule and evaluation period of the 1st stage project are set as follows. Basic conditions and assumptions are also set in the same manner as done in the master plan.

(a)	Base Year:	The year 2004
(b)	Construction Period:	Four years in real terms, from 2004 through 2007
(c)	Economic Life and Evaluation Period:	30 years after completion of the project
(d)	Timing of Benefits Accruing:	After the completion of the project. The plant inaugurates its operation from four months before the end of 2007. The matured benefit is attained in 2009. After 2009, the full capacity of the plant will be realized for the beneficiaries in the service areas.
(e)	Price Level:	Costs and benefits of the project are set in April 2003.
(f)	Prevailing Exchange Rates:	10,720 kip per US$1.00 and J¥119 per US$1.00
(g)	Opportunity Cost of Capital:	12% per annum
(h)	Conversion Factor	90% of local financial value
(i)	Economic Value of Land for Plant	No-value

7.1.2 Economic Benefits

The unit economic benefits have already been estimated in the master plan. They were calculated as follows: US$ 0.41 per m^3 for domestic water and US$ 0.21 per m^3 for non-residential water under the present socio-economic conditions. The detailed procedures were described in Section 4.11.1 in Volume II of the master plan.

The total water consumption volume during the project live of the 1st stage project is estimated already in the master plan. Actual water demand of beneficiaries is illustrated in Figure 71-1. It was calculated on the basis of average water demand of incremental beneficiaries and water supply capacities of the 1st stage project.

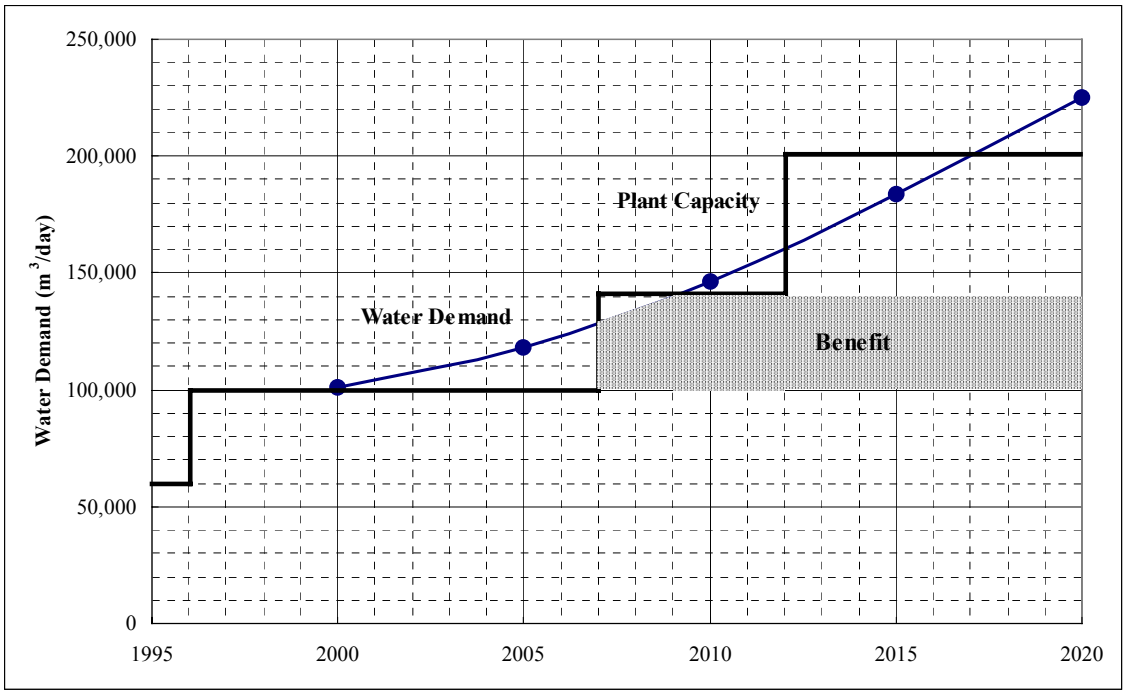

Figure 71-1 Range of Benefit of the 1st Stage Project

The total benefits are calculated as a product of unit benefits of the respective categories, and total consumption volumes of the corresponding categories. In 2007, the water will be supplied four months before the end of the year 2007, just after the inauguration of the plant. Finally, the total economic benefits were estimated at US$ 1,011 million in the first year 2007, and US$ 3.817 million in the matured year 2009.

With future increased economic growth conditions, the unit benefit was estimated at US$ 0.71 per m^3 for domestic water in 2020. Applying this unit benefit, the total economic benefits were

estimated as follows.

Item	2007	2010	2015	2020
Benefit (US$1000/Year)	*1			
Domestic Demand	852	3,592	4,221	4,961
Non-residential Demand*2	262	953	953	953
Total	1,114	4,544	5,174	5,914

Note: *1 Water sales in 2007 are for the last four months only.

7.1.3 Economic Costs

The estimate of the 1st stage project was already described in Chapter 5 in Volume III of the feasibility study. 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 an economic value. The procedure of this conversion was discussed in Section 4.11.1 in Volume II of the master plan. The total economic cost of the proposed JICA project was calculated at US$24.3 million. In addition to this work, other projects by the AFD were estimated at US$5.7 million. The total cost was aggregated to US$30.0 million.

The construction costs will be disbursed in compliance with the construction schedule over four years. The economic construction costs as a total of both the JICA projects and other projects are to be disbursed as follows: US$0.46 million in 2004, US$4.30 million in 2005, US$12.41 million in 2006 and US$12.79 million in 2007.

The O&M costs are an annual requirement during the economic life of the 1st stage project. The O&M unit cost in economic terms was estimated at US$0.24 million in 2007, US$0.77 million in 2008 and US$0.81 million in 2009. After 2009, the plant will operate at full capacity to meet the water demand, so the O&M unit costs were estimated to be US$0.81 million in economic terms.

The pipeline facilities of the respective projects are considered to have an expected lifetime of 30 years. Hence the evaluation period is determined to be 30 years. On the other hand, ancillary machinery such as submersible pumps and booster pumps are considered to last 15 years. These machines will have 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 are disbursed as follows: US$8.05 million in economic terms in 2022.

7.1.4 Economic Efficiency

A stream of economic costs and benefits was tabulated in Table 71-1. The benefits were estimated under the present socio-economic conditions. The evaluation indices were 8.1% of EIRR, minus US$5.84 million of NPV and 0.77 of B/C. Then, the 1st stage project might not be viable under present conditions from the economic point of view, because its EIRR was lower than the opportunity cost of capital, 12%.

Yet, the socio-economic conditions, particularly the people's living standard, will be improved in accordance with the economic growth in the future. In consideration of this future growth conditions, the benefit of the project could be increased in the project evaluation period. These conditions were already discussed in the master plan. The economic benefits with the future economic growth conditions are tabulated in Table 71-2. As shown in the table, the evaluation indices were 12.4% of EIRR, US$0.68 million of NPV and 1.03 of B/C. Thus, the 1st stage project could be viable from economic point of view, since its EIRR exceeded the opportunity cost of capital.

Item	EIRR (%)	NPV (US$ Million)	B/C
Under Present Conditions	8.1	-5.84	0.77
With Economic Growth Conditions	12.4	0.68	1.03

7.1.5 Sensitivity Analysis

As mentioned in Section 7.1.1, the sensitivity test is commenced in this section. A case with cost over-run and decrease of future water demand has risks in terms of judgment on project viability. It is customary, therefore, to test the results of economic analysis for sensitivity to variations in certain important inputs. The test is made for the variations in ±10% and ±5% of the cost and benefit with respect to evaluation factors of the 1st stage project. Then, there are 25 cases under these variations. EIRRs of these variations were tabulated in the table below. Figure 71-2 shows the project viable range of cost and benefit variation from the original estimate.

		Benefit				
		-10%	-5%	0%	5%	10%
Cost	10%	9.5%	10.3%	11.0%	11.7%	12.4%
	5%	10.2%	10.9%	11.7%	12.4%	13.1%
	0%	10.9%	11.6%	12.4%	13.1%	13.8%
	-5%	11.6%	12.4%	13.2%	13.9%	14.7%
	-10%	12.4%	13.2%	14.0%	14.8%	15.5%

The cases, which their EIRR exceeds 12%, were positioned at the border of 12% among the 25 cases: (a) 10% decrease of cost and also 10 decrease of benefit; (b) 5% decrease of cost and also 5% decrease of benefit; (c) 5% increase of cost and 5% increase of benefit and (d) 10% increase of cost and 10% increase of benefit as well as the original case. Thus, the better cases than those above were viable from the economic viewpoint. While, all other worse cases were less than 12% of EIRR. Accordingly, the estimates of cost and benefit should be reconsidered with prudence at the implementation stage.

Table 71-1 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	
	2004	460			460			0	-460
	2005	4,296			4,296			0	-4,296
	2006	12,406			12,406			0	-12,406
	2007	12,789	241		13,029	749	262	1,011	-12,019
1	2008		774		774	2,708	924	3,632	2,858
2	2009		808		808	2,865	953	3,817	3,009
3	2010		808		808	2,865	953	3,817	3,009
4	2011		809		809	2,865	953	3,817	3,008
5	2012		779		779	2,865	953	3,817	3,039
6	2013		783		783	2,865	953	3,817	3,035
7	2014		783		783	2,865	953	3,817	3,035
8	2015		783		783	2,865	953	3,817	3,035
9	2016		783		783	2,865	953	3,817	3,035
10	2017		783		783	2,865	953	3,817	3,035
11	2018		783		783	2,865	953	3,817	3,035
12	2019		783		783	2,865	953	3,817	3,035
13	2020		783		783	2,865	953	3,817	3,035
14	2021		783		783	2,865	953	3,817	3,035
15	2022		783	8,053	8,836	2,865	953	3,817	-5,019
16	2023		783		783	2,865	953	3,817	3,035
17	2024		783		783	2,865	953	3,817	3,035
18	2025		783		783	2,865	953	3,817	3,035
19	2026		783		783	2,865	953	3,817	3,035
20	2027		783		783	2,865	953	3,817	3,035
21	2028		783		783	2,865	953	3,817	3,035
22	2029		783		783	2,865	953	3,817	3,035
23	2030		783		783	2,865	953	3,817	3,035
24	2031		783		783	2,865	953	3,817	3,035
25	2032		783		783	2,865	953	3,817	3,035
26	2033		783		783	2,865	953	3,817	3,035
27	2034		783		783	2,865	953	3,817	3,035
28	2035		783		783	2,865	953	3,817	3,035
29	2036		783		783	2,865	953	3,817	3,035
30	2037		783		783	2,865	953	3,817	3,035

EIRR: 8.1% NPV: -5,838 thousand US$ B/C: 0.77

Table 71-2 Cost and Benefit Stream of Proposed Project with Future Economic Growth Conditions

(Unit: US$1000)

Year		Cost				Benefit			Balance
		Const-ruction	O&M	Replace-ment	Total	Domestic	Non-domestic	Total	
	2004	460			460			0	-460
	2005	4,296			4,296			0	-4,296
	2006	12,406			12,406			0	-12,406
	2007	12,789	241		13,029	852	262	1,114	-11,915
1	2008		774		774	3,183	924	4,107	3,333
2	2009		808		808	3,477	953	4,430	3,622
3	2010		808		808	3,592	953	4,544	3,736
4	2011		809		809	3,710	953	4,662	3,853
5	2012		779		779	3,831	953	4,784	4,005
6	2013		783		783	3,957	953	4,910	4,127
7	2014		783		783	4,087	953	5,039	4,257
8	2015		783		783	4,221	953	5,174	4,391
9	2016		783		783	4,360	953	5,312	4,529
10	2017		783		783	4,503	953	5,455	4,673
11	2018		783		783	4,651	953	5,603	4,820
12	2019		783		783	4,803	953	5,756	4,973
13	2020		783		783	4,961	953	5,914	5,131
14	2021		783		783	4,961	953	5,914	5,131
15	2022		783	8,053	8,836	4,961	953	5,914	-2,922
16	2023		783		783	4,961	953	5,914	5,131
17	2024		783		783	4,961	953	5,914	5,131
18	2025		783		783	4,961	953	5,914	5,131
19	2026		783		783	4,961	953	5,914	5,131
20	2027		783		783	4,961	953	5,914	5,131
21	2028		783		783	4,961	953	5,914	5,131
22	2029		783		783	4,961	953	5,914	5,131
23	2030		783		783	4,961	953	5,914	5,131
24	2031		783		783	4,961	953	5,914	5,131
25	2032		783		783	4,961	953	5,914	5,131
26	2033		783		783	4,961	953	5,914	5,131
27	2034		783		783	4,961	953	5,914	5,131
28	2035		783		783	4,961	953	5,914	5,131
29	2036		783		783	4,961	953	5,914	5,131
30	2037		783		783	4,961	953	5,914	5,131

EIRR: 12.4% NPV: 677 thousand US$ B/C: 1.03

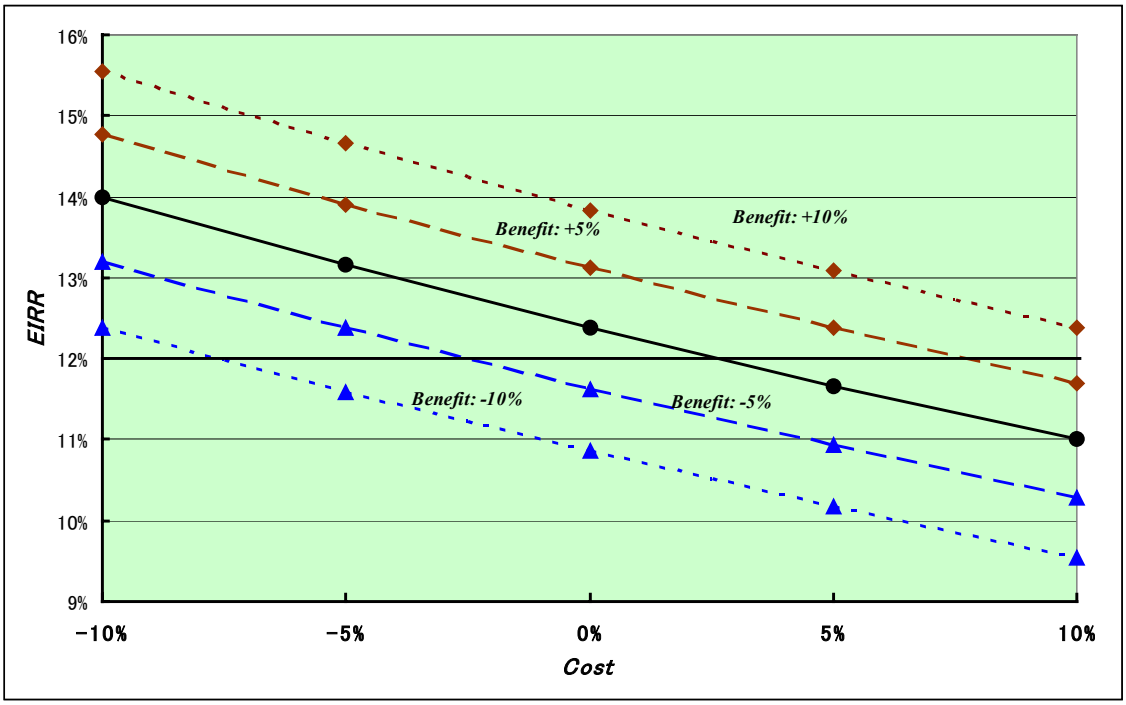

Figure 71-2 Relation between Benefit/Cost and EIRR

7.2 Financial Analysis

7.2.1 Methodology of the Financial Analysis

The methodology of the financial analysis in this report is the same as in the master plan. In the feasibility study, the preconditions and assumptions for the financial analysis are the same as defined in the master plan. The project costs are estimated in Chapter 5. These costs reflect the actual present market conditions. The revenue of water sales is calculated as a product of the volume of water sold, and the water rates set by the NPVC. Finally, the projects are examined for financial efficiency, and evaluated taking into account of the financial conditions.

The financial evaluation aims to examine the financial viability of the 1st stage project. The project is expected to earn its return by not only covering all the incurred costs, but also with the intention of making a profit. The project inputs are evaluated at actual market prices, called the "financial costs". The project outputs are also evaluated at market prices, called the "financial benefit."

In the feasibility study, and in this report, the financial viability of the 1st stage project is examined by means of an evaluation index of the financial internal rate of return (FIRR). If the FIRR is not

sufficient to implement under the preconditions and assumptions from the financial point of view, the financial constraints would be analyzed and identified, and some countermeasures would be proposed at this stage. In addition, the following financial indices were adopted: the net present value (NPV), the benefit-cost ratio (B/C), as well as the FIRR.

The analysis above is conducted mainly concerning the supply side of the project. The project management is also evaluated from the viewpoint of the demand side. Consumers' affordability-to-pay, as well as their willingness-to-pay for water, for the 1st stage projects is an important constraint for the project to be accepted. Through these analyses, this financial study proposes financial solutions and recommendations in the conclusion of the feasibility study. On the basis of these solutions and recommendations, a financial simulation for the most appropriate system is discussed to identify management issues in the future.

The 1st stage project in this feasibility study is an urgent scheme, and was formulated as the first stage of the water supply system formulated in the master plan. The financial analysis aims at working out a successful financial plan for the 1st stage project. The fundamentals of the analysis are based on the following preconditions and assumptions.

1) The tariff structure approved in Prime Ministerial Decision (37/PM) was expected to fully recover costs of water production by the new plant system.
2) The 1st stage project in this feasibility study is expected to have long-term financial sustainability.
3) Establishment of a new organization for operation and maintenance will ensure the long-term financial viability of the managing entity by means of ensuring full cost recovery.
4) The management of the system will improve its performance efficiency through the reduction of water losses, better commercial practices and good working incentives.

7.2.2 Revenue from Water Supply Services

The revenue of the 1st stage project accrues from payments by water consumers for services provided by the NPVC. The consumers pay for water charges in accordance with the volume of water consumed. The NPVC imposed a new water tariff effective in December 2001 for water consumption in their service areas. The 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 (non-domestic) to 4).

The revenue from water supply services is calculated as a product of water volume consumed and the unit rates defined by the water tariff. As discussed in the previous section, the average unit volume of water consumption in the 2007 was calculated and consumption volumes were already tabulated in forms of monthly and annual figures. The details of water demand are explained in Section 4.4 in Volume II. The annual revenue was estimated at US$155 thousand for four months' operation in the initial year of the project in 2007, and US$576 thousand in the matured demand year of the project in 2009.

In addition to water sales, the NPVC receives fees for connection charges from new consumers. The number of the new consumers is projected to increase 1,248 in 2007, 1,322 in 2008 and 1,401 in 2009. The NPVC, therefore, will collect connection charges of US$131,000, US$139,000 and US$147,000, respectively.

Furthermore, the NPVC collects meter rental charges from water consumers. The average rate was calculated at 2,280 kip/unit (equivalent to US$2.56/unit) in 2003. Applying this average rate to the proposed project, the expected income from meter rental was estimated at US$10,000 in 2009.

7.2.3 Cost for Water Production

The components of the main construction costs comprise (i) treatment plant facilities, (ii) supplementary facilities, (iii) water pipe lines and (iv) circulation pumps. The supplementary facilities include a treatment plant house, clear water reservoirs, pumps and other machinery. Other costs are estimated proportional to the main construction costs. Details of the cost estimates were described in Chapter 5. The financial costs of the 1st stage project were aggregated as US$34.1 million, comprising US$27.7 million of JICA portion and US$6.4 of other projects. The costs above exclude all costs taking part in the whole NPVC management such as "Human Resource Development". "UFW Reduction" costs are set as an O&M cost in proportion to the new water capacity to the total supply capacity. The construction costs are disbursed in compliance with the construction schedule of the respective stages.

In addition to the investment costs above, a connection system including connection service pipes and water meters are 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 every year.

The O&M cost is an annual requirement during the economic life of the 1st stage project. The O&M cost was estimated at US$262,000 in the initial year of the project, 2007, and US$ 880,000 in the matured year of the project, 2009, at 2003 price levels.

As mentioned in the discussion of economic costs, replacement costs are required during the evaluation period of the 1st stage project. Some machinery utilised in the plants needs to be replaced during the system's life. In the disbursement schedule, the replacement costs of these machines are appropriated for every 15 years. Thus, these replacement costs were estimated at a market value of US$8.09 million in 2022.

7.2.4 Financial Feasibility

Financial costs and revenues earned during the evaluation period are shown as an annual stream in Table 72-1. The table also shows the evaluation indices. The indices were 0.12 of B/C and minus US$25.6 million of the NPV. The FIRR was not calculated because the revenue was too small compared with the costs. From the financial point of view, accordingly, the 1st stage project is not said to be viable.

The reason why the 1st stage project is not financially viable is that the revenue is small compared with the investment and O&M costs. Based on this result of the financial costs and revenue, the relationship between water tariffs and financial costs were analysed and delineated in a graph as shown in Figure 72-1. In this figure, it was assumed that the charges for new connection installations and water meter rentals are kept at the same level as the present rates. The average rates for these services were US$105/unit for a new connection, and rental of US$2.56 per unit per year as of May 2003.

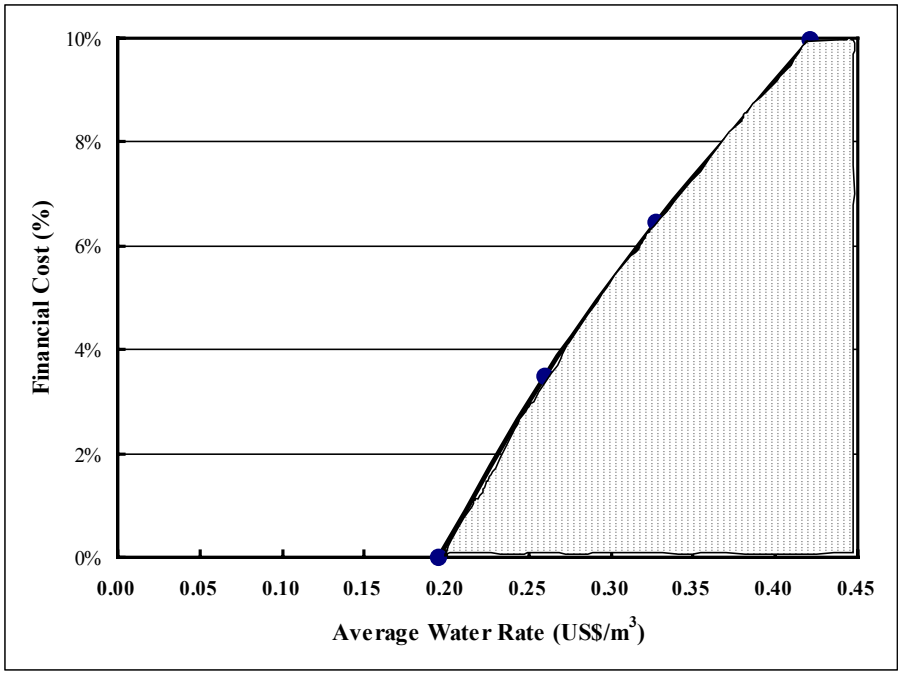

Figure 72-1 Relationship between Average Water Rates and Financial Costs

Table 72-1 Cost and Benefit Stream of 1st Stage Project Applying Present Tariff

(Unit: US$1000)

	Year	Cost				Revenue				Balance
		Construction	O&M	Replacement	Total	Water Charge	Connection	Meter Rental	Total	
	2004	496			496	0	0	0	0	-496
	2005	4,749			4,749	0	0	0	0	-4,749
	2006	14,055			14,055	0	0	0	0	-14,055
	2007	14,834	262		15,096	155	131	3	289	-14,806
1	2008		842		842	552	139	7	698	-144
2	2009		880		880	576	147	10	733	-147
3	2010		880		880	576	0	10	586	-294
4	2011		882		882	576	0	10	586	-296
5	2012		849		849	576	0	10	586	-263
6	2013		853		853	576	0	10	586	-267
7	2014		853		853	576	0	10	586	-267
8	2015		853		853	576	0	10	586	-267
9	2016		853		853	576	0	10	586	-267
10	2017		853		853	576	0	10	586	-267
11	2018		853		853	576	0	10	586	-267
12	2019		853		853	576	0	10	586	-267
13	2020		853		853	576	0	10	586	-267
14	2021		853		853	576	0	10	586	-267
15	2022		853	8,094	8,947	576	0	10	586	-8,361
16	2023		853		853	576	0	10	586	-267
17	2024		853		853	576	0	10	586	-267
18	2025		853		853	576	0	10	586	-267
19	2026		853		853	576	0	10	586	-267
20	2027		853		853	576	0	10	586	-267
21	2028		853		853	576	0	10	586	-267
22	2029		853		853	576	0	10	586	-267
23	2030		853		853	576	0	10	586	-267
24	2031		853		853	576	0	10	586	-267
25	2032		853		853	576	0	10	586	-267
26	2033		853		853	576	0	10	586	-267
27	2034		853		853	576	0	10	586	-267
28	2035		853		853	576	0	10	586	-267
29	2036		853		853	576	0	10	586	-267
30	2037		853		853	576	0	10	586	-267

FIRR: -- NPV: -25,842 thousand US$ B/C: 0.11

In the figure, the area shaded indicates the effective combination of financial sources and the water charge. According to the figure, the following financial scenarios were analysed for making the 1st stage project viable from the financial point of view. These scenarios, or cases, are summarised in Table 72-2. Taking into account the following discussion, case 2 is one of the special cases in the areas shaded in Figure 72-1, and is considered as the most likely case, from the viewpoint of past financial performance.

Table 72-2 Relation between Financial Cost and 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	0.20	4.0 times
Case 2	3.5%	Chinaimo Expansion	0.26	5.2 times
Case 3	6.5%	International Loan	0.33	6.6 times
Case 4	10.0%	Private Bank Loan	0.42	8.4 times

If the initial investment costs were granted completely, the average water cost could be around US$0.20/m^3 (equivalent to 2,140 kip/m^3) or 4.0 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 rate of 3.5%, the average water rate could be around US$0.26/m^3 (equivalent to 2,790 kip/m^3) or 5.2 times of the present average water rate. This rate was already applied in Chinaimo Expansion Project.

In case 3, if the financial cost was set at a standard public interest rate of 6.5%, like loans from international financial organizations such as the World Bank and the ADB, the average water rate could be around US$0.32/m^3 (equivalent to 3,430 kip/m^3) or 6.6 times of the present average water rate.

In case 4, if the financial cost was set up at an interest rate of 10.0% from a private bank, the average water rate could be around US$0.42/m^{3,} (equivalent to 4,500 kip/m^3) or 8.4 times of the present average water rate.

7.2.5 Sensitivity Analysis

In the same manner as conducted in the economic evaluation, a sensitivity analysis for the financial evaluation is applied to these data in this section. The test is made for the variations of ±10% and ±5% of the costs for the four revenue scenarios discussed in the previous sections. There are 20

cases using these variations. Figure 72-2 shows the range of FIRRs in accordance with the variations of costs and revenues.

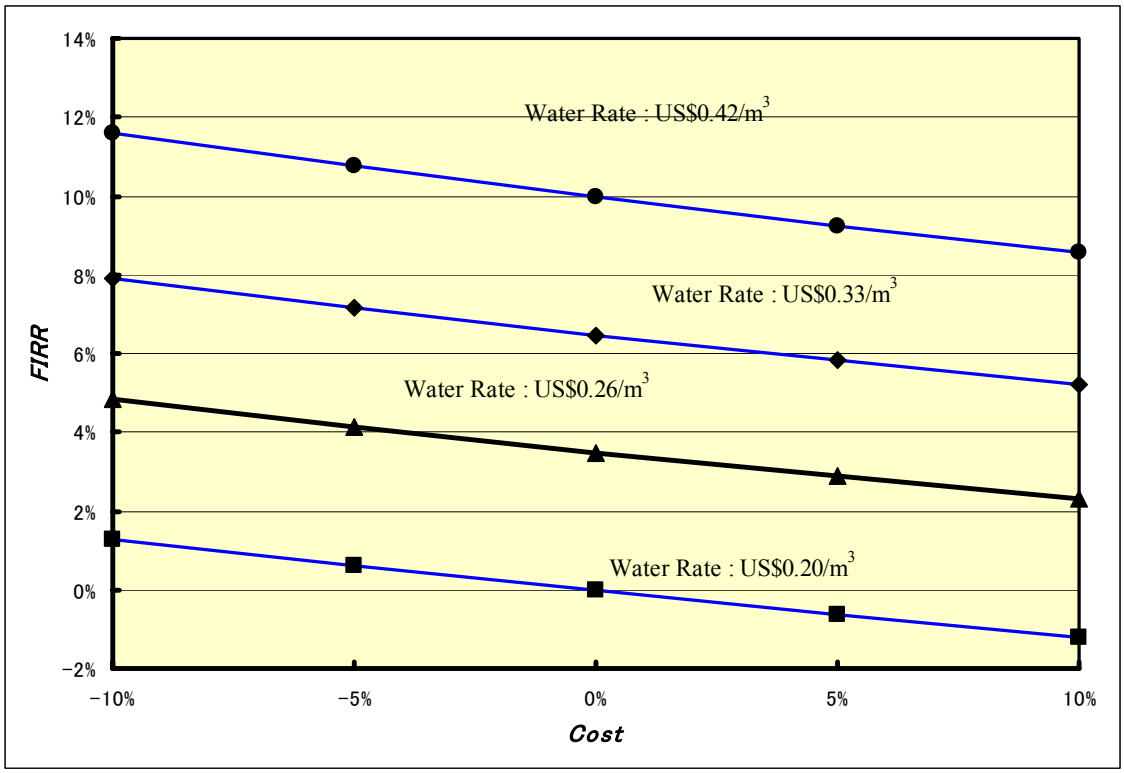

Figure 72-2 Relationship between Cost/Revenue and FIRR

The FIRR indicates that there is a marginal efficiency of investment for the 1st stage project. In the case of water rate set at US$0.26/m^3, the FIRR of the original cost estimate was 3.5%. Then, the project could be expected to have 3.5% of marginal efficiency for investment if it were managed in the most efficient conditions. In other words, the project could be viable from the financial point of view, if an interest rate of less than 3.5% were procured for the execution of the project with favourable management conditions. However, if the costs increased to 10% more than the original estimate, FIRR (marginal efficiency for investment) might go down to 2.2% as shown in the figure. Thus, investment costs directly influence the financial costs, so costs must be carefully reviewed with prudence in the design stage.

7.2.6 Affordability of Domestic Consumers

In accordance with the discussion in the master plan, affordability and willingness-to-pay to household income (or expenditure) of domestic users can be summarized as shown in Table 72-3.

Table 72-3 Affordability of Domestic Water Consumers

Survey/Report		Ratio of Water Charge to Household Income (Expenditure)
LECS2, 1997/98, NSC		1.0%
Household Survey by JICA In March 2003	Household Served by NPVC	1.6%
	Household Not-served by NPVC	1.4%
Prime Ministerial Decision (No.37/PM)	Lower Block Tariff	3%
	Higher Block Tariff	5%
World Bank Report, 1985		3 ~ 5%

In the Prime Ministerial Decision (No.37/PM), the affordability level of domestic water was set as 3% to 5% of household income. Recently, WASA established the "Tariff Policy 2003" in May 2003. The Tariff Policy suggests that the maximum price households are prepared to pay for water and sanitation facilities are in the order of 3-5% of the disposable household income, subject to revision in the light of new information. In addition, the average tariff should not exceed a level where the average household consumption results in a household water bill that exceeds 3% of the household's disposable income. For the poorest sector, (the lowest 10% up the community's income earners), the water tariff should not result in a water bill that exceeds 5% of that household's disposable income.

The average family income was 1.6 million kip/month (equivalent to US$150) as of 2003, as discussed in the master plan. Therefore the water charge should be less than 48,000 kip per month for a level of 3% of disposable income, and 80,000 kip per month at 5% of disposable income. In the poorest households, which are assumed to be in the first quintile among the quintile shares based on "Poverty Survey, 2002, NSC", the household income was estimated at around 0.64 million kip/month, on average. In compliance with the water policy, the water charge for the poor should therefore be less than 19,200 at 3%. In this current study, these water charges are set as the upper level of affordability. As a matter of course, the limits of charges at this level are considered to rise as incomes increase in proportion to the future economic growth.

7.2.7 Tariff Design based on the Average Water Rate

Firstly, the average water rate is verified, taking into account the cost recovery policy. In general, the water rate is set by means of applying the Long-Run Average Cost (LRAC). From the past experience of the NPVC, the financial opportunity cost of capital was considered to be 3.5%, as the lowest financial cost. As a result, the LRAC was calculated at US$0.26/$m^3$. Thus, the average

water rate of US$0.26/m^3 was considered as the most applicable for the 1st stage project from the viewpoint of both affordability for water consumers, and the financial availability of the NPVC.

In Section 4.3, the discussion of "Water Demand Management" considered that water pricing might be one of the most effective measures for water demand management, with the introduction of a progressive block tariff system. Hence, the new water tariff system is designed taking the following cross-subsidisation policies into consideration.

1) The water tariff for non-domestic water consumers is to be set at twice the level of the domestic consumers, based on the present structure.
2) For the poor sector (nearly 20% of the population of Vientiane), the water tariff is 3% of the household disposable income (around 640,000 kip as of 2003).
3) For the average household consumers, the water tariff is 3.5% of the household disposable income (around 1.6 million as of 2003), as discussed in the previous section.

The average water rate for domestic users was calculated at US$0.17/m^3 or 1,806 kip/m^3, as shown in Table 72-4. Incidentally, the NPVC applies a new tariff for amendment to the government; an average water rate of which is set as 750 kip/m^3. The results of the new tariff design are outlined in Table 72-4. The water tariff for domestic users is illustrated in Figure 72-3.

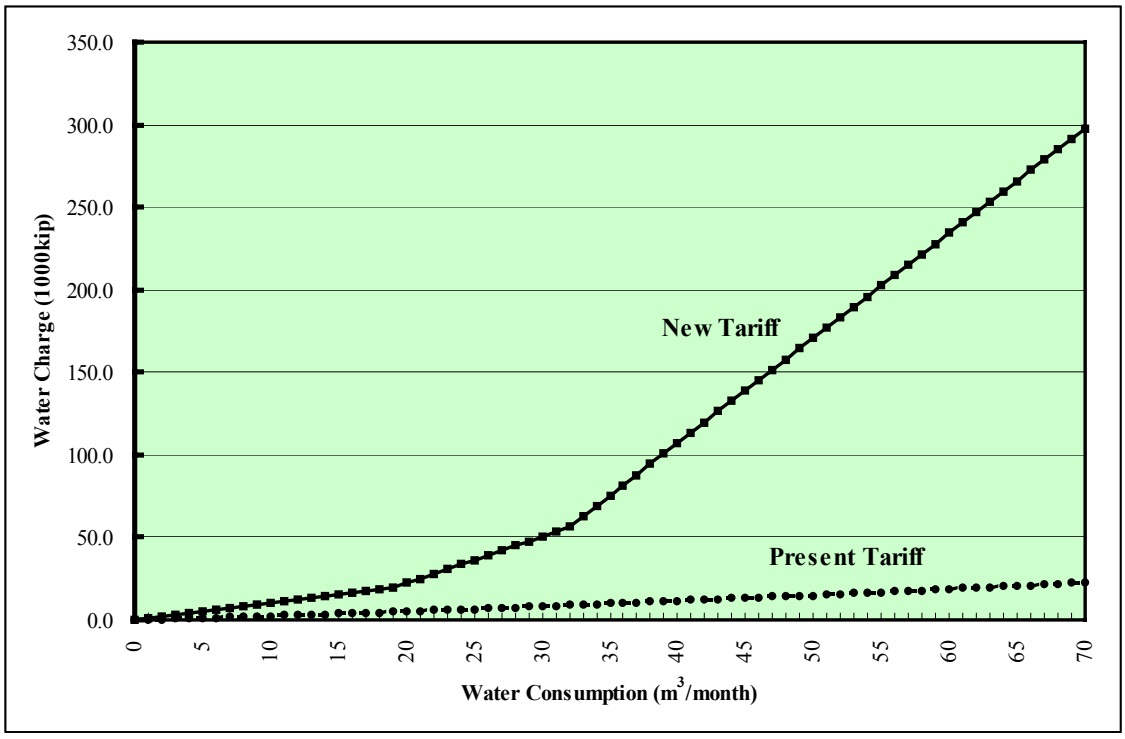

Figure 72-3 Tariff Structure based on Average Water Rate

For the poor, the water charge was calculated at an average of 19,200 kip per household, accounting for 3% of their household income. The water rate for this group was set as 1,016 kip/m^3, as shown in the table, which is 4.0 times higher than that of the present rate. For the average household, the water charge was calculated at 56,000 kip on average, accounting for 3.5% of their household income. The water rate for this group was set as 1,743 kip/m^3 as shown in the table, which is 6.2 times that of the present rate. For the higher income people, the water charge was calculated at 224,000 kip on average, accounting for 6.4% of their household income. The water rate for this group was set as 3,831 kip/m^3 as shown in the table, which is 12.3 times the present rate.

Table 72-4 Comparison of New Tariff Structure to Present Tariff

Item	Unit	Domestic User					Non-domestic User
		Income Group			Total/ Average	Average in 2002	
		Low	Middle	High			
(1) Composition		20%	70%	10%	100%		
(2) Unit Consumption	liter/Capita/day	100	170	310	170		
(3) Monthly Consumption	m^3/month	19	32	59	32		
(4) Monthly Income	1000Kip	640	1,600	3,500	1,600		
(5) Ratio of Water Charge		3.0%	3.5%	6.4%			
(6) Monthly Charge	Kip/month	19,200	56,000	224,000			
(7) Average Unit Rate	Kip/m^3	1,016	1,743	3,831	**1,806**		3,616
(8) Present Unit Rate	Kip/m^3	251	280	311	277	385	770
(9) Times of New Rate to Present Rate		4.0	6.2	12.3	6.5		4.7

The present water tariff as of 2003 and the new tariff mentioned above were compared with the present tariffs of major cities in South-east Asian Countries. Figure 72-4 shows the water tariffs of these cities with those in Vientiane. The present tariff in Vientiane is the second lowest after Yangon City among these cities, as shown in the figure. The new tariff of low-quantity water consumers of less than 32m^3/month was ranked at the fourth from the bottom of Yangon. The tariff of more than 38m^3/month became to the top ranked tariff, as shown in the figure. As analyzed in the following section, however, the new tariff will be introduced around 15 years later after the inauguration. It might not be so expensive among the tariffs in the major cities, once economic growth and price escalation in these cities were taken into consideration in the future.

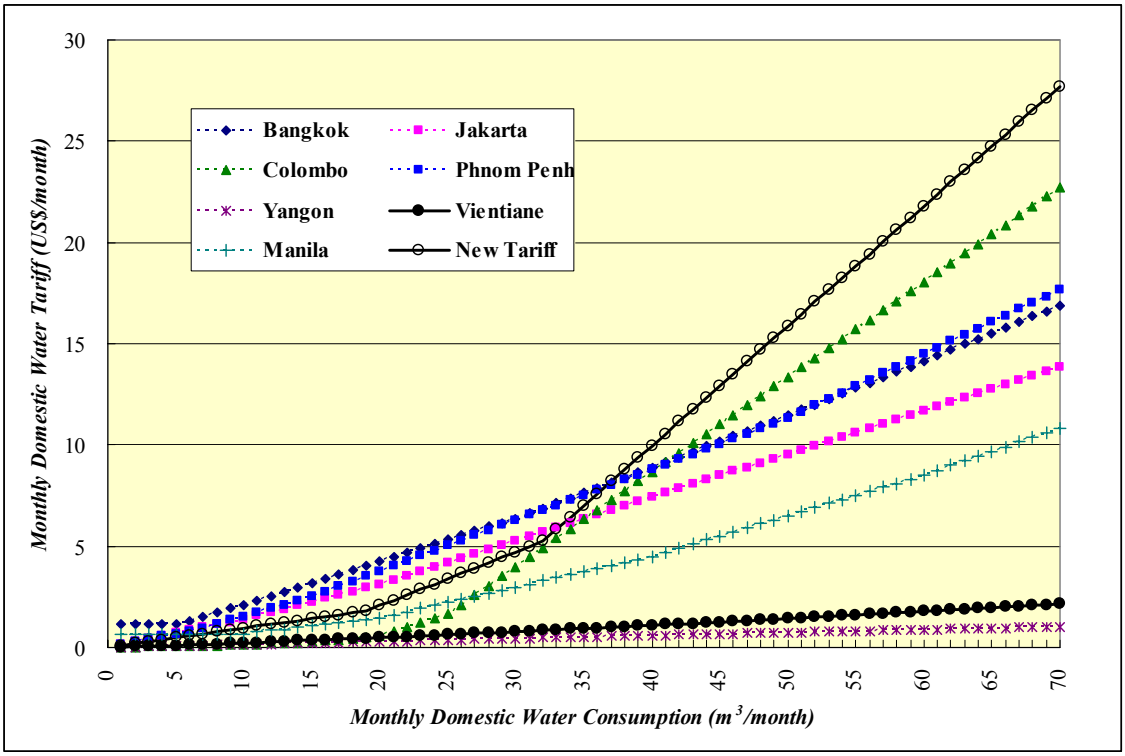

Figure 72-4 Comparison of Existing and New Tariffs in Vientiane Capital City with Existing Water Tariffs in Major Asian Cities

7.2.8 Cash Flow Analysis

In this section, the 1st stage project is analysed from the viewpoint of the following two aspects: (1) the approach to cost recovery management, and (2) the approach to sustainable management.

(1) Approach to Cost Recovery Management

To recover the total input for the 1st stage project, the project entity is expected to manage its revenues and costs through the project life. This subject is dealt with in a cash flow analysis in the following discussion. Firstly, the water tariff based on the LRAC is introduced in the middle of the target year. Then, the initial tariff is raised over an extended period of time to the LRAC. Finally, the management strives to recover the total cost by the end of the project life.

The following conditions and assumptions are made for the projected cash flow.

1) The financial statement is based on general accounting rules as discussed in the following section. The main financial source is procured through a government loan, the terms of which are as follows: the equity covers 50% of the investment costs and the loan covers

50% of the investment costs, which has an interest rate of 6.6% per annum, and there is a 30 year repayment period, including a 10 year grace period. The rule of principal repayment and interest payment is to be compliant with the government direction.

2) The financial plan is to be conducted at constant prices without price escalation to assess the need for funds to finance the project expenditure, both during the construction process, and the period of operation.
3) The household income was assumed to increase in proportion to the GDP per capita in the future.
4) The water tariff for domestic consumers was assumed to start at the present tariff level, and increase every three years, in accordance with the household income, taking into consideration the upper tariff ceiling (5% of the household income).
5) The LRAC is realised by means of rising tariff linked with the projected GDP growth per capita, which results in mitigating the burden of water charges to domestic users.
6) Cost recovery is judged on the following criterion.
   The Loan Life Debt Service Coverage Ratio (LLCR) shows the multiple number of the present value of net profit before debt service payment, against the principal amount of loans. The LLCR describes an index for testing the solvency of the project cash flow. It makes an assessment rate of the collateral. In other words, when an LLCR=1.0, this number indicates that the project cash flow corresponds to the total amount of loans. The LLCR can be calculated by applying the following formula.

$$LLCR = \frac{\sum_t P_t / (1+r)^t}{L}$$

Where, *LLCR*: Loan life debt service coverage ratio,
P: Net cash flow before debt service payment
L: Principal amount of loans,
r: Discount rate, i.e., average interest rate of loans in this study, and
t: Period of loan life including construction period.

Table 72-5 shows the result of the cash flow statement, which has barely enough water sales to recover the full cost. As shown in the table, the LLCR was calculated at 1.085, so the project cash flow could cover the total loan amount within the project life.

Yet, there are some difficulties for the management of the project operation. To attain an average water tariff of US$0.26/m^3, the NPVC management has to wait until 2020 because the water tariff will start from the present tariff. Thus, it is projected that the NPVC management has a large

deficit for the first half of the project life. In the second half of the project, therefore, it has to cover these deficits. Finally, the debt service was covered by the end of the project life.

Regarding the water charge for domestic consumers, the ratio of the charge to household income is set to 1.1% of the household income at the beginning year. The ratio is 2.2% only even in the year 2037. This ratio could satisfy the beneficiaries of domestic users. The transition of the ratio is enumerated in Table 72-6, with the water tariff and the water charge as well as the household income during the project life. It is illustrated in Figure 72-5. The water tariff for non-domestic consumers could keep the same rate of two times higher than that of domestic consumers even in the year 2037, as shown in the right edge column of the table.

Table 72-5 Cash Flow Statement for Full Cost Recovery

(Unit: US$1000)

	Year	Financial Flow				Profit & Loss Flow							Cash Flow							Debt Service Coverage Ratio	Return on Equity (ROE)
		Equity	Capital Investment Fund	Foreign Fund Principal Payment	Foreign Fund Interest	Sales Revenue *2	Expense O&M	Expense Depre-ciation	Expense Interest	Income before Tax	Profit Tax*4	Income after Tax	Revenue	Expense O&M	Expense Tax	Balance before Debt Service	Debt Service*3 Principal	Debt Service*3 Interest	Net Cash Flow		
	2004	248	248													0			0		
	2005	2,375	2,375													0			0		
	2006	7,027	7,027													0			0		
	2007	7,417	7,417			553	262			291	102	189	553	262	102	189	0	0	189	-	1.11%
1	2008					1,332	842	1,408	0	-917	13	-930	1,332	842	13	478	0	0	478	-	2.80%
2	2009					1,400	880	1,408	0	-888	14	-902	1,400	880	14	506	0	0	506	-	2.96%
3	2010					1,511	880	1,408	0	-777	15	-792	1,511	880	15	616	0	0	616	-	3.61%
4	2011					1,511	882	1,408	0	-778	15	-793	1,511	882	15	614	0	0	614	-	3.60%
5	2012					1,511	849	1,408	0	-745	15	-760	1,511	849	15	647	0	0	647	-	3.79%
6	2013					1,990	853	1,408	0	-271	20	-291	1,990	853	20	1,116	0	0	1,116	-	6.54%
7	2014			853	1,087	1,990	853	1,408	1,087	-1,358	20	-1,378	1,990	853	20	1,116	853	1,087	-824	0.575	-4.83%
8	2015			853	1,187	1,990	853	1,408	1,187	-1,458	20	-1,478	1,990	853	20	1,116	853	1,187	-924	0.547	-5.41%
9	2016			853	1,594	2,502	853	1,408	1,594	-1,353	25	-1,378	2,502	853	25	1,624	853	1,594	-824	0.663	-4.83%
10	2017			853	2,028	2,502	853	1,408	2,028	-1,786	25	-1,811	2,502	853	25	1,624	853	2,028	-1,257	0.564	-7.37%
11	2018			853	1,971	2,502	853	1,408	1,971	-1,730	25	-1,755	2,502	853	25	1,624	853	1,971	-1,201	0.575	-7.04%
12	2019			853	1,915	3,067	853	1,408	1,915	-1,109	31	-1,140	3,067	853	31	2,182	853	1,915	-586	0.788	-3.43%
13	2020			853	1,859	3,067	853	1,408	1,859	-1,053	31	-1,084	3,067	853	31	2,182	853	1,859	-530	0.805	-3.10%
14	2021			853	1,802	3,067	853	1,408	1,802	-997	31	-1,027	3,067	853	31	2,182	853	1,802	-473	0.822	-2.77%
15	2022			853	1,746	3,711	853	1,408	1,746	-296	37	-333	3,711	853	37	2,821	853	1,746	221	1.085	1.30%
16	2023			853	1,690	3,711	853	1,408	1,690	-240	37	-277	3,711	853	37	2,821	853	1,690	278	1.109	1.63%
17	2024			853	507	3,711	853	1,408	507	943	330	613	3,711	853	330	2,528	853	507	1,167	1.858	6.84%
18	2025			853	451	4,447	853	1,408	451	1,736	607	1,128	4,447	853	607	2,986	853	451	1,682	2.290	9.86%
19	2026			853	394	4,447	853	1,408	394	1,792	627	1,165	4,447	853	627	2,967	853	394	1,719	2.378	10.07%
20	2027			853	338	4,447	853	1,408	338	1,848	647	1,201	4,447	853	647	2,947	853	338	1,756	2.474	10.29%
21	2028			853	282	5,288	853	1,408	282	2,746	961	1,785	5,288	853	961	3,474	853	282	2,339	3.061	13.70%
22	2029			853	225	5,288	853	1,408	225	2,802	981	1,821	5,288	853	981	3,454	853	225	2,375	3.202	13.92%
23	2030			853	169	5,288	853	1,408	169	2,858	1,000	1,858	5,288	853	1,000	3,434	853	169	2,412	3.359	14.13%
24	2031			853	113	6,249	853	1,408	113	3,875	1,356	2,519	6,249	853	1,356	4,039	853	113	3,073	4.181	18.01%
25	2032			853	56	6,249	853	1,408	56	3,931	1,376	2,555	6,249	853	1,376	4,019	853	56	3,110	4.418	18.22%
26	2033			853	0	6,249	853	1,408	0	3,988	1,396	2,592	6,249	853	1,396	4,000	853	0	3,146	4.687	18.43%
27	2034					7,346	853	1,408	0	5,085	1,780	3,305	7,346	853	1,780	4,713			4,713		27.61%
28	2035					7,346	853	1,408		5,085	1,780	3,305	7,346	853	1,780	4,713			4,713		27.61%
29	2036					7,346	853	1,408		5,085	1,780	3,305	7,346	853	1,780	4,713			4,713		27.61%
30	2037					8,599	853	1,408		6,338	2,218	4,120	8,599	853	2,218	5,527			5,527		32.39%
									Return on Equity (ROE):			**7.7%**				Average DSCR (Debt Service Coverage Ratio):			1.972	
	Total	17,067	17,067	17,067	19,413	120,215			Return on Investment (ROI):			**6.9%**				Loan Life Debt Service Coverage Ratio (LLCR)*1:			**1.085**	

Note: *1 Discounted at 6.6% of interest rate.
*2 Net sales revenue excluding Turnover Tax.
*3 Debt services were based on the latest principle in the Lao Government.
*4 Imposed 35% of the profit tax on net profit. In case of deficit, the minimum tax is imposed in stead of the profit tax.
*5 Ratio (%) of water charge to household income.
*6 Ratio of non-domestic water rate to domestic water rate.

Table 72-6 Average Water Rate, Monthly Water Charge and Ratio of Water Charge to Monthly Income: 2007-2037

Year	Average Water Rate*1 (US$/m3)	Domestic Consumer				Average Water Rate of Non-domestic Consumer*2 (US$/m3)
		Average Wate Rate*2 (US$/m3)	Monthly Water Charge*3 (US$/month)	Average Monthly Income*4	Ratio of Water Charge to Income (%)	
2003	0.05	0.03	-	149	-	0.06
2004	0.07	0.04	-	156	-	0.09
2005	0.07	0.04	-	164	-	0.09
2006	0.07	0.04	-	172	-	0.09
2007	0.10	0.06	2.0	180	1.1	0.12
2008	0.10	0.06	2.0	188	1.1	0.12
2009	0.10	0.06	2.0	197	1.0	0.12
2010	0.13	0.08	2.7	206	1.3	0.17
2011	0.13	0.08	2.7	217	1.2	0.17
2012	0.13	0.08	2.7	228	1.2	0.17
2013	0.17	0.11	3.5	239	1.5	0.22
2014	0.17	0.11	3.5	251	1.4	0.22
2015	0.17	0.11	3.5	264	1.3	0.22
2016	0.22	0.14	4.4	276	1.6	0.28
2017	0.22	0.14	4.4	289	1.5	0.28
2018	0.22	0.14	4.4	302	1.5	0.28
2019	0.26	0.17	5.4	315	1.7	0.34
2020	0.26	0.17	5.4	330	1.6	0.34
2021	0.26	0.17	5.4	345	1.6	0.34
2022	0.32	0.20	6.6	360	1.8	0.41
2023	0.32	0.20	6.6	377	1.7	0.41
2024	0.32	0.20	6.6	394	1.7	0.41
2025	0.38	0.25	7.9	412	1.9	0.49
2026	0.38	0.25	7.9	430	1.8	0.49
2027	0.38	0.25	7.9	450	1.7	0.49
2028	0.45	0.29	9.3	470	2.0	0.58
2029	0.45	0.29	9.3	491	1.9	0.58
2030	0.45	0.29	9.3	514	1.8	0.58
2031	0.54	0.34	11.0	537	2.1	0.69
2032	0.54	0.34	11.0	561	2.0	0.69
2033	0.54	0.34	11.0	587	1.9	0.69
2034	0.63	0.41	13.0	613	2.1	0.81
2035	0.63	0.41	13.0	641	2.0	0.81
2036	0.63	0.41	13.0	670	1.9	0.81
2037	0.74	0.47	15.2	701	2.2	0.95

Note: *1 Average monthly water was set to increase at the rate of 3.5 times higher than the growth of GRDP per capita.
*2 Ratio of non-domestic rate to domestic rate was set as 2:1.
*3 Average monthly water consumption was set at 32.0 m3.
*4 Household income was assumed to cincrease in proportion to GRDP per capita.

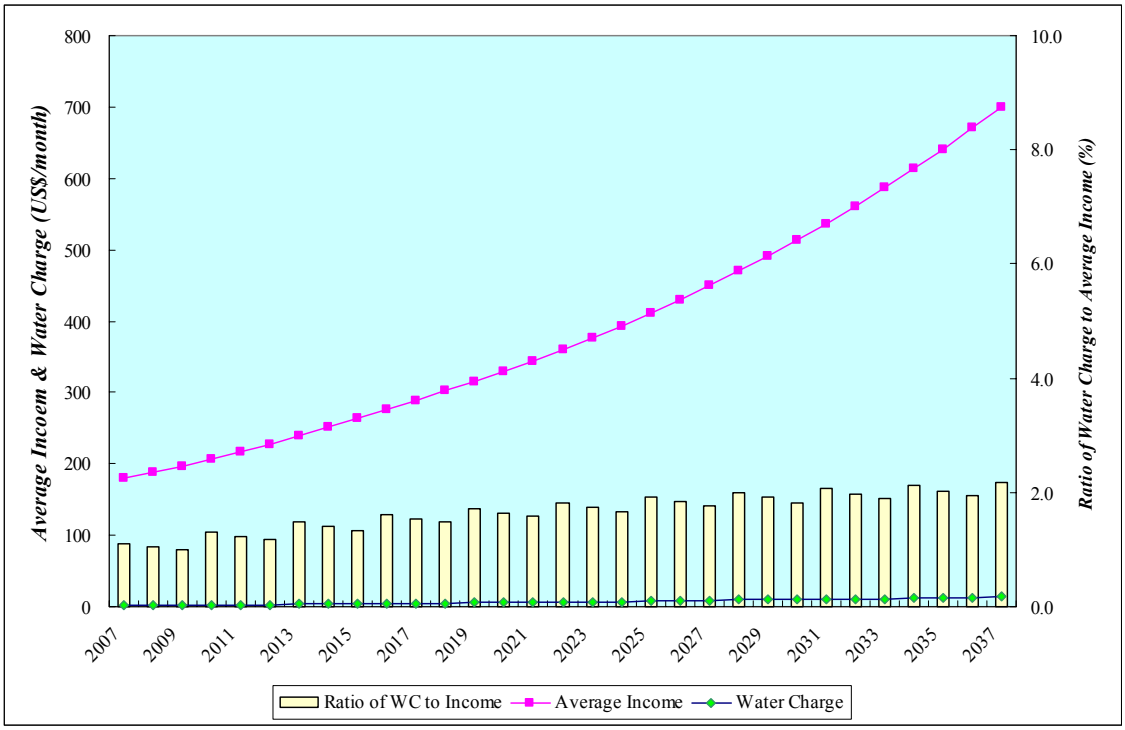

Figure 72-5 Average Household Income and Average Water Charge in Case of Full Cost Recovery Management

(2) Approach to Sustainable Management

This section provides the issues that the management of the project entity needs to achieve to attain commercial financial viability for the long term tariff benefit. This subject also deals with the cash flow analysis. The viability of the project is verified through the return on equity (ROE) and the return on investment (ROI), as well as the LLCR. The conditions and assumptions are the same as mentioned in the previous section.

Hence, ROE_t is the average return of capital input in a certain (t) year, i.e., an index of the yield on the invested capital. It is an essential factor for the investor in deciding for any investment in a project. If the net profit after tax is put on dividends to share holders, an inverse number of the average ROE can indicate an equity payback period. In the private capital market in general, an investor expects to recover the investment within five years. If this judgement is applied to the ROE, it would be expected that the index would be 20%. In the case of special characteristics like investment in real estate and infrastructure, an investor may approve a recoverable period of 10 years. In this case, the ROE would be 10%. Thus, the ROE is expected to be in a range of between 10% and 20%.

The return on investment, the ROI, is an average return of all funds input, i.e., an index of yield on

the project itself. Thus, interest payments are added to the ROE. It indicates the degree of safety for interest payments, as well as the profitability of the project. The ROI can also test the investment payback period of the whole investment including loans. In general, an investor expects to recover both equity and loans as mentioned in the discussion of the ROE. The ROI is also expected to be range between 10% and 20%.

In this financial procurement, the sustainability of project is verified by means of ROE, ROI and LLCR. The ROE and the ROI were calculated at 13.7% and 10.5%, respectively. The LLCR was calculated at 1.561. Therefore, the project cash flow could express the sustainable condition for the management of the project.

Yet, it would be difficult for the project entity to manage the operation of the project in the way shown in the statement. The accumulation of the annual incomes from the sales revenue during the project life was US$163 million, which was almost 37% more than that in the previous result. Furthermore, the average water rate was calculated at US$0.37/$m^3$ at 2003 economic conditions, which was also 42% higher than the previous management case and 7.4 times more than the average water rate in 2003. Although the water charge of domestic consumers could be kept to nearly 3.0% on average, it would be a question whether or not the beneficiaries might satisfy such high water tariff in the future. The consensus of not only domestic consumers but other stakeholders would be essential for the tariff structure.

7.3 Financial Simulation

The object of the financial simulation is set as the NPVC management during the 1st stage project. The 1st stage project is set to be implemented from 2004, as mentioned in Section 7.2. The water supply services from that project are set to start from September 2007. The simulation terminates at the end of 2037, i.e., the simulation is for the economic life of the 1st stage project.

7.3.1 Financial Plan and Assumptions

In the financial simulation analysis, the revenues from the water supply services, and the expenditures for the operation and maintenance, as well as capital investment, are estimated on the basis of a full cost recovery management, as mentioned in the previous chapter. Apart from this data, the following conditions and assumptions are made for the financial simulation.

1) Projection period: four years of construction period, from 2004 as the initial year of consulting services, and then construction works of the 1st stage project until 2007, and 30 years after the completion through to 2037.
2) Prices and cost escalation: Projections of both revenues and expenditures were made without escalation to simplify the calculations, and to make the simulation clearly understandable without being misleading.
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 capital investment: The finances of the initial investment for the 1st stage project are set as shown in the table below.

	Financial Source	Amount (US$ Million)
1.	Equity (Government	50
2.	Loan (International Agency)	0
3.	Grant (Foreign Country)	50
	Average Financial Cost	3.3%/annum

Note: *1 Terms of loan by international agency are as follows: 6.6% annual interest rate, and a 30 year repayment period, with a 10 years grace period.
*2 Financial shortages during the simulation period are assumed to be financed by the government, as done for the present waterworks so far.

5) Finances for replacement investment: The finances for the replacement of machinery and equipment are set as shown the table below.

Financial Source	Amount (US$ Million)	
	Existing Plants	1st Stage Project
Loan (International Agency)	10.8	8.1

Note: *1 Terms of loan by international agency are as follows: 6.6% annual interest rate, and a 20 year repayment period, with a 5 years grace period.

6) Taxes: A profit tax or minimum tax will be levied. In addition, a turnover tax will levied just after inauguration, the rates of which are 5% on water sales, and 10% for installation charges and meter rental charges.
7) Water tariff structure: In this study the present water tariff is constituted of two parts: water charges by type of water consumer, the two groups being domestic consumers and non-domestic consumers. The unit tariff rate was set to rise every three years in accordance with the projected economic growth (GDP per capita) in Lao PDR. In addition, installation charges for new consumers, and meter rentals for every consumer are to be charged to consumers connected to the water supply system.
8) Revenues: The revenues of the water supply entity accrue from water sales, water meter rental and installation charges. These revenue sources are already discussed above. If the management had the deficit at the beginning stage of the water supply works, it is assumed that these expenses and losses will be filled by the government as short-term support with no interest, as is done with the NPVC at present. In addition to these revenues the entity

could obtain other earnings from interest on short-term deposits, if it gains a net profit through its management. Interest rates for short term deposits are 1.1%/annum on average, which is a quarter of the daily saving deposit rate. This low interest rate is because of the nature of the non-constant saving deposits.

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

The NPVC has taken over the water supply management from the Nam Papa Lao (NPL), and at the same time inherited some financial problems from the NPL. These problems and present financial are issues which can be improved as follows.

1) A turnover of the accounts receivable in 2002 was 3.7. This means that it takes 100 days to collect bills, on average. In the simulation, the turnover is revised to around 8.0 by the year 2010, which means that it will then take around one and a half months to collect bills.
2) Account receivable from rural waterworks is to be collected completely by the year 2010.
3) Inventory stock should be set as follows:
   (a) In terms of chemical materials, 30% of the annual amount is stocked as inventory stock after 2004.
   (b) Stocks of construction materials such as pipes and other commodities are reduced to 30% of the annual amount after 2004. They are to be incorporated in construction works, but these works will be recorded as operating expenses because of an individual work is small.
4) Products in progress are to be gradually reduced to zero by the year 2010.
5) Interest payable is to be paid completely by the year 2010.
6) Short-term borrowings such as (a) overseas accounts payable, (b) local accounts payable, (c) accounts payable of reparation, and (d) advanced receipts, are to be paid back completely by the year 2010.

Figure 73-1 illustrates the results of the income statement in the simulation. The figure includes the following line items: (a) operating revenue, (b) operating cost, (c) net operating income, (d) net income before tax, and (e) net income after tax.

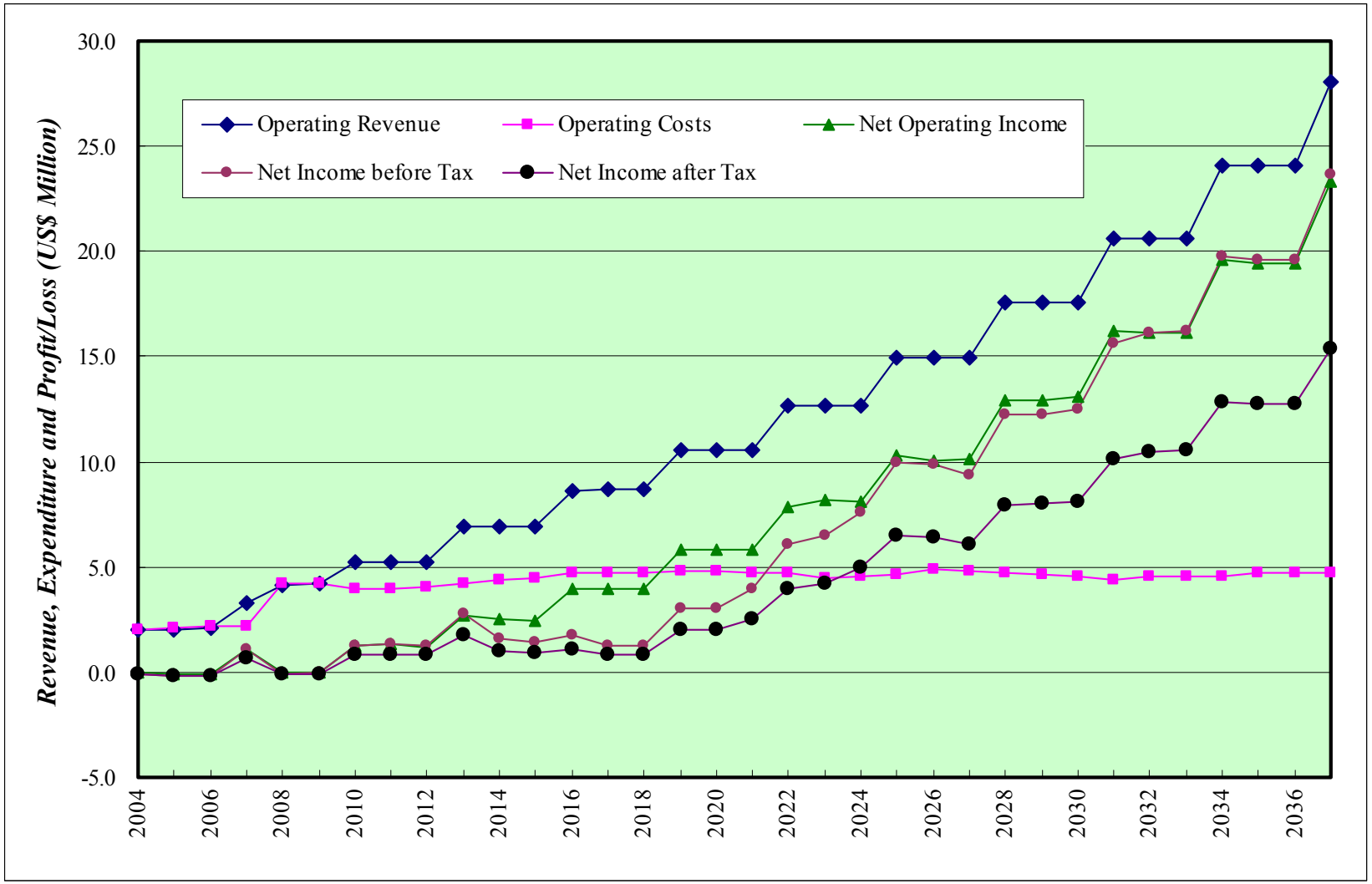

Figure 73-1 Profit and Loss Based on Financial Simulation of NPVC with 1st Stage Project

7.3.2 Financial Issues and Recommendations

The unit rate of water sales revenue of the simulation was set on the basis of full cost recovery principle for the 1st stage project. The average rate is nearly five times more than the present tariff rate. Although the water charge to domestic consumers was verified as less than the affordable level, the consumers familiar with the present water supply conditions might consider that the water charge in the future is too expensive.

According to the balance sheet in the simulation, the accumulation of net profit was estimated at US$156 million in 2037, which could be preserved as retained earnings. This was because the revenue from water sales was enough to cover the management costs of the NPVC with the 1st stage of the project. As enumerated in the cash flow statement, the replacement investment for machinery and equipment in the existing plants, between 2011 and 2015, and the expansion of the plants between 2022 and 2026, were procured through foreign funds with terms mentioned in the previous section. Within this simulation period however, the existing plants such as Kaolieo and Chinaimo might be rebuilt due to their physical lives. These reinvestment costs were not considered in the simulation. At the end of the simulation period furthermore, the 1st stage project plant might be rebuilt due to its physical life. As a matter of course, the retained earnings of US$156 million in 2037 will not be enough to cover the reinvestment costs of these all water supply systems. Thus, the financial requirement schedule for reinvestment should be planned to attain the sustainable management through applying this kind of simulation model.

It is said that there are two standards in the decision making process of deciding water tariffs: (1) costs and (2) the affordability or willingness-to-pay of the beneficiaries. The water tariff is a matter of controversial issue among the stakeholders, and thus can not be decided in a simple way. Therefore it should be decided through the consensus of the stakeholders. From the financial point of view, the water tariff in this simulation was set on the basis of a full cost recovery principle, taking the affordability of domestic consumers into consideration. This is one of the best solutions for the stable and sound management of the NPVC. The management of the NPVC has to establish a rational logic for tariff design, and create a climate of financial stability conductive to sustainable conditions for the water supply business.