14.2.2 Economic Costs

This analysis considered (1) project costs, (2) replacement costs, and (3) operating and maintenance costs. These economic costs are based on the values used in the Financial Analysis adjusted to convert them into economic costs.

1) Project Costs

In determining project costs, this analysis used adjustments for two items only, where the market price mechanism does not function properly. The adjusted prices or so-called "shadow prices" used in this analysis are those employed by OECF and international lending institutions.

a. Prices of Skilled and Unskilled Labor

In this study, the opportunity cost of unskilled labor or its potential in other employment is valued at 0.38 of its estimated cost for the project.

Skilled labor, on the other hand, is valued at a factor of 0.73.

b. Foreign Exchange

In view of the comparatively free foreign exchange practices in Thailand, no shadow prices are applied in this analysis.

c. Interest and Hidden Taxes

Interest is not included since this is a financial rather than economic cost. Local hidden taxes, subsidies and duties, which we assumed to amount 20.9% of local costs, are also removed as they consist only of inter-sectorial transfers of funds from the view point of national economy. This type of reduction is also applied to raw water fees payable to RID, as nearly 20 % of the fees considered to be kind of commissions to be earned by RID, a sectorial transfer viewed from the national economy as a whole.

2) Operation and Maintenance Cost

This study considers the operation and maintenance costs pertaining to the proposed project only, excluding those of the present system. The operation and maintenance costs are so-called "annual costs" which include personnel, electricity & fuel, chemical, connection, raw water and other miscellaneous expenses.

3) Replacement Cost and Salvage Value

This analysis also considers the present value of all those facilities, equipment and other items included in the Project with a service life of less than 30 years to be replaced during the 30 years period from 1987 to 2006.

The replacement costs or costs incurred in order to replace mechanical equipment and others that have exceeded their life expectancy are considered part of the economic cost. They are however not shown in the EIRR Table as most of these mechanical equipment having a service life of 15 years will be required to be replaced after 2006, the terminal year of the Table.

The economic cost of the project is expressed as :

"Adjusted (shadow priced) project cost" + "Operating and maintenance cost" + "Replacement cost" - "Salvage Value". The percentage of salvage value is measured on the basis of the remaining service life of the facilities invested in the proposed project in the year of 2006.

14.2.3 Economic Justification

To verify a synthetic measure of the economic justification of the projects, the following two analyses are given in this study.

1) Cost Benefit Ratio

As shown Table-14.14, the ratios of present-value economic benefits to economic cost of the proposed projects for Chiangmai, combined with Mae Rim and San Kamphaeng Waterworks, calculated in the methods previously outlined are 2.60 at 1986 price and 1.73 at present value discounted at 10 % per annum. This is greater than 1 : 1, which demonstrates the economic viability of the projects. The actual benefits of the projects are considered to be greater than the Cost-Benefit ratios calculated, the reason being that non-quantifiable indirect benefits are not incorporated into this analysis.

2) Economic Internal Rate of Return

The economic internal rate of return (EIRR) of the project is the rate at which the present value of the quantifiable benefits equals the present value of the economic cost of the proposed project.

This study uses as the measure of economic benefits the total revenue of the waterworks which is considered to be the lowest economic benefits of water supply.

Table-14.15 shows economic internal rates of return (EIRR) at 16.56 %, exceeding 10% which is considered as the prevailing opportunity cost of capital in Thailand.

In view of the difficulty of quantifying the economic benefits delineated in Section 14.2.1 above, this study also tried to show as for reference the EIRR based on the Average Incremental Cost (AIC) which the World Bank and WHO recommend as a proxy for economic benefits or a long run marginal cost of water as shown in Appendix 10, Table-10.17. The EIRR based on the AIC is calculated at 10.19 %.

The above analysis demonstrates the economic feasibility of the project.

Table-14.14 ECONOMIC BENEFITS VS COSTS (INCREMENTAL)

[CHIANGMAI WATERWORKS] x 1,000 BAHT

YEAR	AT 1986 PRICE		DISCOUNTED AT 10% PER ANNUM	
	BENEFITS	COSTS	BENEFITS	COSTS
1987	0	3,504	0	3,185
1988	0	18,820	0	15,554
1989	15,789	19,852	11,862	14,915
1990	20,962	84,660	14,317	57,824
1991	26,636	123,117	16,539	76,446
1992	32,617	12,118	18,412	6,840
1993	38,044	10,851	19,523	5,568
1994	43,749	12,297	20,409	5,737
1995	48,583	13,406	20,604	5,686
1996	52,825	14,382	20,366	5,545
1997	57,682	15,716	20,217	5,508
1998	62,486	17,054	19,910	5,434
1999	66,505	18,145	19,264	5,256
2000	71,031	19,171	18,705	5,048
2001	71,031	19,171	17,004	4,589
2002	71,031	19,171	15,458	4,172
2003	71,031	19,171	14,053	3,793
2004	71,031	19,171	12,776	3,448
2005	71,031	19,171	11,614	3,135
2006	71,031	19,171	10,558	2,850
Salvage		-127,943		-66,836
TOTAL	963,096	370,174	301,592	173,696

BENEFITS/COSTS = 2.60174 BENEFITS/COSTS =1.73632

Table-14.15 ECONOMIC INTERNAL RATE OF RETURN (EIRR)

[CHIANGMAI WATERWORKS] x 1,000 BAHT

YEAR	TOTAL ECONOMIC BENEFITS * AT 1986 PRICE	TOTAL CAPITAL INVESTMENT AT 1986 PRICE	OPERATING COSTS & H.R.O.** AT 1986 PRICE	NET BENEFITS AT 1986 PRICE	CONVERTED ECONOMIC VALUE: TOTAL ECONOMIC BENEFITS	CONVERTED ECONOMIC VALUE: TOTAL CAPITAL INVESTMENT	CONVERTED ECONOMIC VALUE: OPERATING COSTS & H.R.O.*	CONVERTED ECONOMIC VALUE: NET BENEFITS	NET BENEFITS: DISCOUNTED AT 16%	NET BENEFITS: DISCOUNTED AT 17%
1987	0	3,912	0	-3,912	0	3,504	0	-3,504	-3,020	-2,994
1988	0	21,279	0	-21,279	0	18,820	0	-18,820	-13,986	-13,748
1989	15,789	17,453	6,049	-7,713	15,789	15,012	4,839	-4,063	-2,603	-2,537
1990	20,962	91,816	8,450	-79,304	20,962	77,899	6,760	-63,697	-35,180	-33,992
1991	26,636	135,174	10,690	-119,228	26,636	114,565	8,552	-96,481	-45,936	-44,006
1992	32,617		15,147	17,470	32,617		12,118	20,499	8,414	7,991
1993	38,044		13,563	24,481	38,044		10,851	27,194	9,622	9,061
1994	43,749		15,372	28,377	43,749		12,297	31,452	9,594	8,957
1995	48,583		16,758	31,825	48,583		13,406	35,177	9,250	8,562
1996	52,825		17,977	34,848	52,825		14,382	38,443	8,714	7,998
1997	57,682		19,645	38,037	57,682		15,716	41,966	8,201	7,462
1998	62,486		21,318	41,168	62,486		17,054	45,432	7,654	6,904
1999	66,505		22,681	43,823	66,505		18,145	48,360	7,023	6,282
2000	71,031		23,964	47,068	71,031		19,171	51,860	6,493	5,757
2001	71,031		23,964	47,068	71,031		19,171	51,860	5,597	4,921
2002	71,031		23,964	47,068	71,031		19,171	51,860	4,825	4,206
2003	71,031		23,964	47,068	71,031		19,171	51,860	4,180	3,595
2004	71,031		23,964	47,068	71,031		19,171	51,860	3,586	3,072
2005	71,031		23,964	47,068	71,031		19,171	51,860	3,091	2,626
2006	71,031		23,964	47,068	71,031		19,171	51,860	2,665	2,244
Salvage		-127,943		127,943		-108,954		108,954	5,599	4,715
TOTAL				486,010				573,932	3,761	-2,923

Note : * Average Water Tariff in 1986 used as benefits. (6.90 Baht)
** Share Allocation of Head and Regional Office Overhead Expenses.

EIRR = 16+(17-16)x3,761/(3,761+2,923)
= 16.56%

14.2.4 Summary of Sensitivity Study Results

The results of sensitivity studies are summarized ,for your references, as follows:

1) Main Report (share allocation: PWA formula)

a. Economic Benefit vs Cost (see Table-14.14)

i) at 1986 price	2.60 : 1
ii) discounted at 10 % p.a.	1.74 : 1

b. Average incremental cost (see Table-10.13 of App.10) 5.78 Baht

c. Economic internal rate of return

i) prevailing tariff as unit of benefit (Table-14.15)	16.6 %
ii) AIC as unit of benefit (Table-10.17 of App.10)	10.2 %

2) Sensitivity Study (share allocation: new formula)

a. Economic Benefit vs Costs (see Table-10.15 of APP.10)

i) at 1986 price	2.57 : 1
ii) discounted at 10 % p.a.	1.72 : 1

b. Average incremental cost (see Table-10.14 of App.10) 5.82 Baht

c. Economic internal rate of return

i) prevailing tariff used as unit of benefit (see Table-10.16 of App.10)	16.4 %
ii) AIC used as unit of benefit (see Table-10.18 of App.10)	10.2 %

14.3 Considerations on Water Tariffs

14.3.1 General

As discussed below, this chapter makes the following suggestions for successful implementation of the project as well as effective post-implementation operation and maintenance of the improved water supply system proposed in this feasibility study.

1) periodical upward revisions, every three-year revisions for example, to cover price escalations.

2) consideration for lower tariff burdens for users of lower income brackets.

3) study of an appropriate level of connection fees and such other factors as cost of drilling a new well in connection with the willingness of potential new consumers in the project area.

4) consideration for alleviating the burden of share of PWA Head and Regional Office overhead expenses allocable to small-sized water-works.

14.3.2 Present Level of Water Tariffs

1) The average water tariff level

The average water tariff charged both to domestic and other large scale consumers in Chiangmai inclusive of Mae Rim and San Kamphaeng Districts for the six months starting October 1985, the first month after the recent across-the-board water tariff revision which took place from November 1984, was 7.11 Baht/m3.

Thanks to the recent tariff revision, Chiangmai Waterworks combined with Mae Rim and San Kamphaeng Waterworks is predicted to produce annual net surpluses up to the target year of the current feasibility study, 2000, even if the prevailing water tariff level is kept unchanged as forecast in Appendix 10, Table-10.3.

As shown in Table-14.3, the water tariff level will be 55.6 % higher than the projected unit cost of water in 1987, and will exceed unit cost of water by 76.8 % in 2000.

2) Ability and Willingness to Pay

As shown in Tables-14.16, -14.18 and -14.20, the average household income per month of all households who replied to the questionnaire survey conducted in January 1986 is estimated at 6,676 Baht in Chiangmai, 2,526 Baht in Mae Rim and 3,419 Baht in San Kamphaeng. If the criteria of 3 % of average household income which OECF and other international lending institutions recommend as the maximum payable limit of water tariffs is applied, the limit of ability to pay by dwellers is, as shown in Tables-14.17, -14.19 and -14.21 estimated at the 8.6 Baht/m3 in Chiangmai, 7.0 Baht in Mae Rim and 9.6 Baht in San Kamphaeng. All these maximum payable amounts are found higher almost equal to or higher than the prevailing average water tariff level. It is also to be noted that considerable part of water consumption particularly in Chiangmai is shared by hotels, industrial firms and other large consumers and therefore the prevailing water tariffs applicable to domestic households are lower than the average tariff level.

The expressed average willingness-to-pay amount of those households willing to connect is calculated, as shown in Tables-14.16 -14.18 and -14.20, at 5.2 Baht/m3 in Chiangmai, 8.0 Baht in Mae Rim and 6.0 Baht in San Kamphaeng. This survey result may partly indicate kind of reactions of consumers against the recent water tariff revision by PWA and may partly be attributed to the fact that the majority of repliers consisted of domestic households belonging to lower income brackets. It is also recognized that the willing-to-pay amount stated in a questionnaire survey always reflects the psychology of purchasers to pay as little as possible.

The prevailing water tariff level is thus found high enough to cover operation and maintenance expenses of the waterworks and also from the view point of the ability to pay of the dwellers in Chiangmai, Mae Rim and San Kamphaeng.

Table-14.16 MAXIMUM PAYABLE PRICE FOR WATER IN CHIANGMAI

The assumed maximum domestic payable price for water to be used for financial and economic analysis was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		145
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		5.35
(3) AVERAGE HOUSEHOLD INCOME PER MONTH		6,676
(A) LESS THAN 2,000 Baht	8.5%	
(B) 2,000 - 3,000 Baht	17.5%	
(C) 3,000 - 4,500 Baht	20.9%	
(D) 4,500 - 6,000 Baht	19.6%	
(E) 6,000 - 7,500 Baht	12.5%	
(F) 7,500 - 10,000 Baht	10.1%	
(G) 10,000 - 15,000 Baht	6.4%	
(H) 15,000 - 50,000 Baht	3.7%	
(I) OVER 50,000 Baht	0.8%	

(4) MAXIMUM PAYABLE PRICE FOR WATER PER M3
((3)x0.03)/((1)x(2)x30/1000)= 8.6 Baht/m3

Note: 3% of monthly Household income assumed to be the maximum payable amount for water charges. (according to the World Bank guideline.)

SOURCE : QUESTIONNAIRE SURVEY, JANUARY 1986

Table-14.17 WILLING-TO-PAY PRICE FOR WATER IN CHIANGMAI

The assumed willing-to-pay value of water to be used as a basis of measuring the economic value of water volume benefits was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		145
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		5.35
(3) AVERAGE WILLING-TO-PAY AMOUNT PER MONTH		120.4
(A) Up to 50 Baht	45.6%	
(B) Up to 100 Baht	36.1%	
(C) Up to 200 Baht	12.0%	
(D) Up to 500 Baht	1.2%	
(E) Up to 1,000 Baht	1.2%	

(4) WILLING-TO -PAY PRICE PER M3
(3)/((1)x(2)x30/1000) = 5.2 Baht/m3

Table-14.18 MAXIMUM PAYABLE PRICE FOR WATER
IN
MAE RIM

The assumed maximum domestic payable price for water to be used for financial and economic analysis was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		81
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		4.47
(3) AVERAGE HOUSEHOLD INCOME PER MONTH		2,526
(A) LESS THAN 2,000 Baht	46.3%	
(B) 2,000 - 3,000 Baht	29.5%	
(C) 3,000 - 4,500 Baht	16.8%	
(D) 4,500 - 6,000 Baht	6.3%	
(E) 6,000 - 7,500 Baht	0.0%	
(F) 7,500 - 10,000 Baht	0.0%	
(G) 10,000 - 15,000 Baht	1.1%	
(H) 15,000 - 50,000 Baht	0.0%	
(I) OVER 50,000 Baht	0.0%	

(4) MAXIMUM PAYABLE PRICE FOR WATER PER M3
((3)x0.03)/((1)x(2)x30/1000) = 7.0 Baht/m3

Note: 5% of monthly Household income assumed to be the maximum payable amount for water charges. (according to the World Bank guideline.)

SOURCE : QUESTIONNAIRE SURVEY, JANUARY 1986

Table-14.19 WILLING-TO-PAY PRICE FOR WATER
IN
MAE RIM

The assumed willing-to-pay value of water to be used as a basis of measuring the economic value of water volume benefits was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		81
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		4.47
(3) AVERAGE WILLING-TO-PAY AMOUNT PER MONTH		87
(A) Up to 50 Baht	44.4%	
(B) Up to 100 Baht	46.7%	
(C) Up to 200 Baht	8.9%	
(D) Up to 500 Baht	0.0%	
(E) Up to 1,000 Baht	0.0%	

(4) WILLING-TO -PAY PRICE PER M3
(3)/((1)x(2)x30/1000) = 8.0 Baht/m3

Table-14.20 MAXIMUM PAYABLE PRICE FOR WATER
IN
SAN KAMPHAENG

The assumed maximum domestic payable price for water to be used for financial and economic analysis was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		81
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		4.41
(3) AVERAGE HOUSEHOLD INCOME PER MONTH		3,419
(A) LESS THAN 2,000 Baht	48.1%	
(B) 2,000 - 3,000 Baht	21.3%	
(C) 3,000 - 4,500 Baht	18.5%	
(D) 4,500 - 6,000 Baht	5.6%	
(E) 6,000 - 7,500 Baht	1.9%	
(F) 7,500 - 10,000 Baht	2.8%	
(G) 10,000 - 15,000 Baht	0.9%	
(H) 15,000 - 50,000 Baht	0.0%	
(I) OVER 50,000 Baht	0.9%	

(4) MAXIMUM PAYABLE PRICE FOR WATER PER M3
((3)x0.03)/((1)x(2)x30/1000) = 9.6 Baht/m3

Note: 3% of monthly Household income assumed to be the maximum payable amount for water charges. (according to the World Bank guideline.)

SOURCE : QUESTIONNAIRE SURVEY, JANUARY 1986

Table-14.21 WILLING-TO-PAY PRICE FOR WATER
IN
SAN KAMPHAENG

The assumed willing-to-pay value of water to be used as a basis of measuring the economic value of water volume benefits was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		81
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		4.41
(3) AVERAGE WILLING-TO-PAY AMOUNT PER MONTH		64
(A) Up to 50 Baht	75.6%	
(B) Up to 100 Baht	22.2%	
(C) Up to 200 Baht	2.2%	
(D) Up to 500 Baht	0.0%	
(E) Up to 1,000 Baht	0.0%	

(4) WILLING-TO -PAY PRICE PER M3
(3)/((1)x(2)x30/1000) = 6.0 Baht/m3

Of the total repliers, on the other hand, the shares of those households belonging to the income brackets less than 2,000 Baht/month whose average income is assumed at around 1,300 Baht/month are, as shown in Tables-10.17, -10.19 and -10.21, 8.5 % in Chiangmai, 46.3 % in Mae Rim and 48.1 % in San Kamphaeng.

These households consist of 5.4 members in Chiangmai, 4.5 in Mae Rim and 4.4 in San Kamphaeng, according to the questionnaire survey, and consume water at the rate of 145 lpcd in Chiangmai and 80 lpcd in Mae Rim and San Kamphaeng, with their maximum payable water rates estimated at around 1.7 Baht/m3 in Chiangmai and 3.6 Baht/m3 in Mae Rim and San Kamphaeng, both of which are lower than the prevailing PWA water rate (4.5 Baht/m3) applicable to the corresponding water consumption by these low income consumers. This suggests a need of special consideration for lower water rates applicable to those households of low income brackets.

It was also found out during the course of questionnaire survey the prevailing high connection charges were serving to dampen the willingness of potential new consumers to connect. This was found true particularly when connection charges exceeded the cost of well drilling where water of comparatively good quality was available.

14.3.3 Future Water Tariff Considerations

As forecast in Section 14.1.4, the annual rate revenue-expenditure balance will produce surpluses up to 2000. It is however projected, as shown in Appendix 10, Table-10.3 that if the water tariff level is kept unchanged, annual net surpluses of Chiangmai Waterworks combined with Mae Rim and San Kamphaeng Waterworks will incline to reduce yearly, i.e., with the surplus of 32,002 thousand Baht for fiscal 1989 decreasing to 15,620 thousand Baht for 2000. This suggests an advisability of raising the water tariffs to cover price escalations. Ideally speaking such revisions should be made as frequently as possible. In view of the past performance and the political and social climate of Thailand, this study recommends periodical revisions of water tariffs with three- to four-year intervals.

Constant regard is required to be paid to the relation between unit cost of water and the prevailing water tariff level. In this connection such

accounting items as the share of PWA Head Office and Regional Office overhead expenses, debt service expenses and allocation of depreciation cost, as referred to in Section 14.1.4, are important factors in determining unit cost of water. Complaints are heard about the formula being used in allocating the share of PWA Head Office and Regional Office overhead expenses, which imposes unfairly heavy burdens on small sized waterworks, the reason being that per waterworks portions both of Head and Regional Office expenses (one third of their expenses) are allocated to each waterworks regardless of the production scales and earning positions of waterworks as discussed in 14.1.14, 2), 2.2. It is therefore suggested that consideration be paid to the alleviation of such burdens on small sized waterworks. In this connection, a tentative formula is suggested in Appendix 10, Table-10.4 as a hint to such consideration.

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