

CHAPTER 14 ECONOMIC ANALYSIS

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14.1 Project Costs

The financial cost of the countermeasures was estimated at US\$ 11,900,000. This financial cost was converted into an economic cost by subtracting various taxes (estimated to be 15 % of the financial cost). As a result, the economic cost was estimated at US\$ 10,120,000. The yearly financial maintenance cost was estimated to be US\$ 200,000, which was also converted into an economic cost of US\$ 170,000 in the same way as the above.

14.2 Project Benefits

In general, it is very difficult to gain a quantitative grasp of the benefits of an environmental project. However, in this project, the benefits were estimated in terms of use-value and non-use-value. Use-value benefits were estimated from the rise in the value of farm and orchard land, the increase in the number of goats raised in each household, and the savings from the cost of free drinking water supplied by OMCO to households in the area of groundwater contamination. Non-use-value benefits were estimated with the contingent valuation method by interviewing the willingness-to-pay for the existence value of this objective area, considering that this objective area, known world-wide for its unique geological and topographical features, should be abandoned with no measures taken to prevent further contamination.

14.2.1 Benefit from Increased Value of Orchard Land

In the area of groundwater contamination, drinking water is supplied to each household by OMCO at no charge, and therefore the value of housing land would not fall appreciably. However, the value of the orchard land, where mainly dates are cultivated, a very important source of nutrition for the villagers, would fall since the quality of the dates deteriorates as contamination increases. If the implementation of countermeasures can make the groundwater clean, the fall in land values will be stopped, and may even rise.

As mentioned above, the implementation of countermeasures will generate benefits in the form of rising land values. However, the degree of benefit will differ according to area. In this analysis, the area under study was categorized into two groups; Group 1 is the already contaminated area from the tailing dam to DH-4, which includes the communities of A'Sahga, Aarja, and Bayda; Group 2 includes such communities as Kheshishet Al Milh, Misial A'sidar, Sihlat and Falaj al Qabail, where it is anticipated contamination will occur in the near future if no countermeasures are taken.

The criteria used for estimating land value benefits were as follows;

- 1) The area of orchard land was measured for each site.

- 2) The present value of orchard land was estimated from interviews with officers of the Sohar Development Office, owners of real estate, villagers, etc. At present, the average value of orchard land is about 3 to 5 R.O./m² near the Gulf of Oman and about 8 to 10 R.O./m² along National Road Route No. 1. Groundwater in the former area is already contaminated by seawater from the Gulf of Oman, and so its value is falling; therefore the value of orchard land in Group 1 is also judged to be quite low, because of the groundwater contamination. Thus, the land value of Group 1 was estimated at 1 R.O./m², while the land value in Group 2 was estimated at 1.5 R.O./m² because the groundwater in this Group is not contaminated, at present.

- 3) The future values of orchard land in both Groups will vary depending on the rise in contamination should no countermeasures be taken, and on the fall in contamination should measures be taken. Therefore, future values in both scenarios are estimated as the values given in the third and fourth columns of Tables 14.1 and 14.2, respectively. The future levels of contamination or cleanliness in both Groups are shown in Figures 7.8 to 7.10. The difference in future orchard land values in both Groups can be regarded as a benefit, as indicated in dollars in the rightmost column.

14.2.2 Benefit from Increase in Number of Goats

According to interviews with villagers, until about 15 years ago each household located in the mine area kept more than 100 goats each. At present the number of goats kept by each household has dropped drastically due to insufficient clean drinking water obtained from groundwater sources. Currently, each household keeps only 20 to 30 goats. It is certain that if countermeasures make the groundwater cleaner in the future, the number of goats kept in each household will gradually rise. Therefore, the future number of goats for each above-mentioned Community Group was estimated on the basis of the following criteria:

(1) Number of Goats in Each Community, Interviewed and Estimated

It is forecast that if no measures are taken, the number of goats in Community Group 1 will drop by half in 20 years because of the rapid deterioration in water quality, but that if measures are taken the number will increase by 150 % as contamination levels fall. In Community Group 2 on the other hand, it is estimated that unless countermeasures are taken the number of goats will fall to three-quarters their present level because of the slow speed of contamination, but that if countermeasures are taken numbers will double in 20 years because of the rapid drop in salt concentrations in the groundwater. These estimates were made on the basis of contamination simulation results and an interview survey of villagers. The estimated number of goats is shown in the two and third columns of Table 14.3 and 14.4. The estimated benefit in dollar is shown as below.

Table 14.1 Benefit from Increased Value of Fruit Garden Land in Group 1

Year	Area of Planted Field (m ²)	Unit Price of Land (R.O./m ²)		Total Price of Land (R.O.)		Difference of Land Value (R.O.)	Increase of Land Value Per Year (R.O.)	Increase of Land Value Per Year (US\$)
		Without Counter-measures	With Counter-measures	Without Counter-measures	With Counter-measures			
2002	27,400	1	1	27,400	27,400	0	0	0
2003	27,400	1	1	27,400	27,400	0	0	0
2004	27,400	1	1	27,400	27,400	0	0	0
2005	27,400	1	1	27,400	27,400	0	0	0
2006	27,400	0.5	1	13,700	27,400	13,700	2,740	7,211
2007	27,400	0.5	1	13,700	27,400	13,700	2,740	7,211
2008	27,400	0.5	1	13,700	27,400	13,700	2,740	7,211
2009	27,400	0.5	1	13,700	27,400	13,700	2,740	7,211
2010	27,400	0.5	1	13,700	27,400	13,700	2,740	7,211
2011	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2012	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2013	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2014	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2015	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2016	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2017	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2018	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2019	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2020	27,400	0	1.5	0	41,100	41,100	4,110	10,816
2021	27,400	0	1.5	0	41,100	41,100	4,110	10,816

Table 14.2 Benefit from Increased Value of Fruit Garden Land in Group 2

Year	Area of Planted Field (m ²)	Unit Price of Land (R.O./m ²)		Total Price of Land (R.O.)		Difference of Land Value (R.O.)	Increase of Land Value Per Year (R.O.)	Increase of Land Value Per Year (US\$)
		Without Counter-measures	With Counter-measures	Without Counter-measures	With Counter-measures			
2002	12,400	1.5	1.5	18,600	18,600	0	0	0
2003	12,400	1.5	1.5	18,600	18,600	0	0	0
2004	12,400	1.5	1.5	18,600	18,600	0	0	0
2005	12,400	1.5	1.5	18,600	18,600	0	0	0
2006	12,400	1	1.5	12,400	18,600	6,200	1,240	3,263
2007	12,400	1	1.5	12,400	18,600	6,200	1,240	3,263
2008	12,400	1	1.5	12,400	18,600	6,200	1,240	3,263
2009	12,400	1	1.5	12,400	18,600	6,200	1,240	3,263
2010	12,400	1	1.5	12,400	18,600	6,200	1,240	3,263
2011	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2012	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2013	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2014	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2015	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2016	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2017	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2018	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2019	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2020	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789
2021	12,400	0.5	2	6,200	24,800	18,600	3,720	9,789

Table 14.3 Benefit from Increase in Number of Goats in Group 1

Year	Number of Goats		Price of Goat (R.O.)	Price of Goats (R.O.)			Increase of Value (R.O.)	Increase of Value (US\$)
	Without Counter-measures	With Counter-measures		Without Counter-measures	With Counter-measures	Difference of Value		
2002	450	450	30	13,500	13,500	0	0	0
2003	450	450	30	13,500	13,500	0	0	0
2004	450	450	30	13,500	13,500	0	0	0
2005	450	450	30	13,500	13,500	0	0	0
2006	431	450	30	12,928	13,500	572	572	1,506
2007	413	450	30	12,380	13,500	1,120	548	1,442
2008	395	450	30	11,855	13,500	1,645	525	1,381
2009	378	450	30	11,352	13,500	2,148	503	1,323
2010	362	450	30	10,871	13,500	2,629	481	1,267
2011	347	467	30	10,410	14,007	3,597	968	2,547
2012	332	484	30	9,969	14,533	4,564	967	2,545
2013	318	503	30	9,546	15,079	5,533	968	2,548
2014	305	521	30	9,141	15,645	6,503	971	2,555
2015	292	541	30	8,754	16,232	7,478	975	2,566
2016	279	561	30	8,383	16,842	8,459	981	2,581
2017	268	582	30	8,027	17,474	9,447	988	2,599
2018	256	604	30	7,687	18,130	10,443	996	2,622
2019	245	627	30	7,361	18,811	11,450	1,007	2,649
2020	235	651	30	7,049	19,517	12,468	1,018	2,680
2021	225	675	30	6,750	20,250	13,500	1,032	2,715

Table 14.4 Benefit from Increase in Number of Goats in Group 2

Year	Number of Goats		Price of Goat (R.O.)	Price of Goats (R.O.)			Increase of Value (R.O.)	Increase of Value (US\$)
	Without Counter-measures	With Counter-measures		Without Counter-measures	With Counter-measures	Incremental Value		
2002	640	640	30	19,200	19,200	0	0	0
2003	640	640	30	19,200	19,200	0	0	0
2004	640	640	30	19,200	19,200	0	0	0
2005	640	640	30	19,200	19,200	0	0	0
2006	640	694	30	19,200	20,822	1,622	1,622	4,268
2007	640	753	30	19,200	22,581	3,381	1,759	4,629
2008	640	816	30	19,200	24,488	5,288	1,907	5,020
2009	640	885	30	19,200	26,557	7,357	2,069	5,444
2010	640	960	30	19,200	28,800	9,600	2,243	5,903
2011	640	988	30	19,200	29,641	10,441	841	2,212
2012	640	1017	30	19,200	30,506	11,306	865	2,277
2013	640	1047	30	19,200	31,396	12,196	890	2,343
2014	640	1077	30	19,200	32,312	13,112	916	2,411
2015	640	1109	30	19,200	33,255	14,055	943	2,482
2016	480	1141	30	14,400	34,226	19,826	5,771	15,186
2017	480	1174	30	14,400	35,225	20,825	999	2,629
2018	480	1208	30	14,400	36,253	21,853	1,028	2,705
2019	480	1244	30	14,400	37,311	22,911	1,058	2,784
2020	480	1280	30	14,400	38,400	24,000	1,089	2,866

14.2.3 Savings in Supply of Free Drinking Water by OMCO

OMCO has supplied free drinking water to households in communities where the groundwater has already been contaminated by the copper smelting. In Community Group 1, all households are supplied with free drinking water; in Community Group 2 only households in Misial A'sidr are supplied. These households will continue to be supplied with free drinking water by OMCO in the future, (at least for the 20 year period of the economic analysis), even if some countermeasures are implemented, because the groundwater will not become clean enough to drink. At the same time, OMCO will have to start supplying free drinking water to all households in Community Group 2 (including Misial A'sidr) if no countermeasures are to be implemented in the near future. Therefore, if some countermeasures are implemented, the latter cost will become unnecessary, and this can be counted as a cost-saving benefit. The estimated benefit is shown in the right-most column in Table 14.5. The estimate is made according to the following assumptions;

- (1) The number of households becoming newly in need of free drinking water is counted at 57

households.

- (2) The average volume of water used per household is assumed to be 96.1 m³ per year, the same as at present (data source: OMCO).
- (3) The cost to OMCO for the water supply is taken to be 2.9 R.O./m³, the same as at present (data source: OMCO).

Table 14.5 Savings in Supply of Free Drinking Water by OMCO

Year	Number of Houses	Water Consumption per Household (m ³)	Cost (Rial/m ³)	Cost of Distribution (R.O.)	Cost of Distribution (US \$)
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0
2006	0	0	0	0	0
2007	0	0	0	0	0
2008	0	0	0	0	0
2009	0	0	0	0	0
2010	0	0	0	0	0
2011	43	96.1	2.9	11,984	31,536
2012	43	96.1	2.9	11,984	31,536
2013	43	96.1	2.9	11,984	31,536
2014	43	96.1	2.9	11,984	31,536
2015	43	96.1	2.9	11,984	31,536
2016	43	96.1	2.9	11,984	31,536
2017	43	96.1	2.9	11,984	31,536
2018	43	96.1	2.9	11,984	31,536
2019	43	96.1	2.9	11,984	31,536
2020	43	96.1	2.9	11,984	31,536
2021	43	96.1	2.9	11,984	31,536

14.2.4 Willingness to Pay for Existence Value

The area in question is known not only for its promising mineral deposits but also for its unique geological and topographical features. In this sense the area has sufficient existence value in itself, so that abandonment of the area in a contaminated state must be avoided. In order that the area might not be abandoned, an attempt was made to estimate the existence value of the area as assessed by residents and/or nations (only Omani persons with job), using the contingent valuation method (CVM). The CVM is a method of estimating willingness to pay for improving environmental conditions by

countermeasures in order to avoid abandonment of the area. The necessary questionnaire survey was carried out among the citizens of both Sohar (a neighboring city) and Muscat (the capital city). Approximately 250 survey sheets were distributed at random to citizens in both Sohar and Muscat, of which 183 sheets and 191 sheets were recovered in Muscat and Sohar, respectively. After excluding invalid sheets filled in by students, housewives, unemployed persons, etc., 159 sheets from Muscat and 150 sheets from Sohar were judged to be valid sheets

(1) Theory of CVM

Questionnaire Method

CVM is a method used to estimate “willingness to pay” for the existence value, from persons selected at random. There are mainly four methods for presenting the questions; Open Ended, Bidding Game, Payment Card, and Dichotomous Choice. Here the double bound dichotomous choice method was adopted, for the following reasons;

- a. Interviewees can answer questions easily.
- b. There is relatively little bias.
- c. This method is considered best at this moment.

The double bound dichotomous choice, at first, proposes an amount of money (first bid) to the interviewee and asks whether or not he (or she) would be willing to pay this amount of money for the improvement of environmental conditions in the Sohar mine area. If the interviewee answers “Yes”, a much higher amount of money (higher bid) is proposed: if the answer is “No”, a much lower amount of money (lower bid) is proposed. Then the interviewee again answers, “Yes” or “No” with respect to the second proposed amount of money (second bid).

Parametric or Non-parametric Model

Through this process the mean of willingness to pay of interviewees can be estimated, and the estimation is made in accordance with a parametric or non-parametric model. The parametric model assumes a specific distribution function with a characteristic that the higher the willingness to pay, the smaller the number of persons who are willing to pay. The non-parametric model does not assume any distribution function. In this analysis the parametric model was adopted because the mean of willingness to pay of interviewees can be determined uniquely, that is, only one solution can be obtained.

Cumulative Distribution Function

In the parametric model, a probability distribution function should be assumed for the Yes/No distribution for willingness to pay. Generally, logistic distribution, probit distribution, Weibull distribution, etc. are assumed to be a distribution function. In this analysis a logistic distribution was

adopted, because it is based on the random utility theory of economics, which can explain economic behavior of human beings.

Theory

The theory is developed as follows;

In the random utility theory the utility function is divided into two parts; probabilistically invariable terms and probabilistically variable terms. This random utility function assumes a linear function as follows;

$$U = V(Q,M) + \varepsilon$$

Where U : Utility function
V : Invariable term
Q : Environmental state
M : Income
 ε : Probabilistic term

To present T R.O. to the implementation of the countermeasures, the probability of a “Yes” answer is shown as follows (Q^0 : original state, Q^1 : deteriorated state);

$$\begin{aligned} \Pr [\text{Yes}] &= \Pr [U(Q^0, M-T) > U(Q^1, M)] \\ &= \Pr [U(Q^0, M-T) - U(Q^1, M) > \varepsilon^1 - \varepsilon^0] \end{aligned}$$

It is assumed that ε^1 and ε^0 are mutually independent and follow the same Gumbel distribution. Using the characteristic of Gumbel distribution, that the difference between two mutually independent probabilistic variables of Gumbel distribution ($\varepsilon^1 - \varepsilon^0$) follows a logistic distribution, then the above equation can be expressed as follows;

$$\begin{aligned} \Pr [\text{Yes}] &= 1-G [T] \\ &= [1 + e^{\{-(U(Q^0, M-T) - U(Q^1, M))\}}]^{-1} \end{aligned}$$

Since the questioning follows the double bound dichotomous choice method, a higher bid (TU) is presented to a person who answered “Yes” to the first proposed bid, while a lower bid (TL) is presented to a person who answered “No” to the first proposed amount of money. As a result, the interviewee’s answer will match one of the following four combinations; Yes - Yes, Yes - No, No - Yes, and No - No. The probability for each of these combinations is shown below;

$$\begin{aligned} \Pr [\text{Yes} - \text{Yes}] &= 1 - G(TU) = P^{YY} \\ \Pr [\text{Yes} - \text{No}] &= G(TU) - G(T) = P^{YN} \\ \Pr [\text{No} - \text{Yes}] &= G(T) - G(TL) = P^{NY} \end{aligned}$$

$$\Pr [\text{No} - \text{No}] = G (\text{TL}) = P^{\text{NN}}$$

Here, if the difference in the observable invariable utility term, $U(Q_0, M-T) - U(Q_1, M)$, is specified as a log-linear model $[a - b \cdot \log T]$, parameters a and b can be estimated using the most-likelihood method. Using the estimated parameters, the mean of willingness to pay can be obtained. The likelihood function is as follows;

$$\ln L = \sum \{DYY \ln (P^{YY}) + DYN \ln (P^{YN}) + DNY \ln (P^{NY}) + DNN \ln (P^{NN})\}$$

Here, DYY is a dummy variable, which takes the value one (1) when the interviewee answers “Yes” to the first bid and “Yes” to the second bid. DYN takes the value one (1) when the answers are “Yes” to the first bid and “No” to the second bid. DNY takes the value one (1) when the answers are “No” to the first bid and “Yes” to the second bid. DNN takes the value one (1) when the answers are “No” to the first bid and “No” to the second bid. For other answers, DYY, DYN, DNY, and DNN take the value zero (0).

(2) Results of Estimation of Willingness to Pay

Separate analyses were made for Sohar and Muscat. The estimated mean of willingness to pay was judged to be considerably reliable for the following reasons;

- a. The coefficient of “T” in the above log linear model is negative, which means that the higher the proposed bid is, the smaller the probability of a “Yes” answer.
- b. The approximate t-value is sufficiently high enough to be significant.
- c. The likelihood ratio is greater than 0.4 (generally this value is said to be statistically significant between 0.2 ~ 0.4).

The estimated mean of willingness to pay was 6.54 R.O. for Muscat city and 7.69 R.O. for Sohar city. Summarized data of the questionnaire, analytical results and survival curve (the relationship between the probability of a “Yes” answer and the size of the bid) for Muscat are shown in Table 14.6, Table 14.7, and Figure 14.1. Those for Sohar are shown in Table 15.8, Table 14.9, and Figure 14.2.

Using the estimated mean of willingness to pay, the total amounts of willingness to pay were estimated for Muscat and Sohar cities. The results are shown in Table 14.10 and Table 14.11. The present numbers of employed in Muscat and Sohar (only Oman citizens) are 117,438 persons and 45,343 persons in 2001, respectively. It was assumed that the future number of employed persons would increase at an average growth rate of 2 % (source: Sixth Five-Year Plan) during the period 2001 to 2005, after which time the growth rate would drop by half.

Table 14.6 Summary of Results of Questionnaire

Bid No.	First Bid	Higher Second Bid	Lower Second Bid	No. of Yes-Yes Answers	No. of Yes-No Answers	No. of No-Yes Answers	No. of No-No Answers
1	2	5	1	8	1	2	0
2	5	10	2	4	4	16	6
3	10	20	5	1	8	7	15
4	20	30	10	0	0	2	18
5	30	40	20	0	0	1	13
6	40	50	30	0	0	0	4
7	50	75	40	0	0	0	17
8	75	100	50	0	0	0	11
9	100	250	75	0	0	0	8
10	250	500	100	0	0	0	4

Table 14.7 Results of Analysis (Muscat)

Item	Value
Constant (t-value)	4.6287 (6.453)
Coefficient (t-value)	- 2.5894 (-6.856)
Likelihood Ratio	0.8447
Average Willingness to Pay	6.54 R.O.

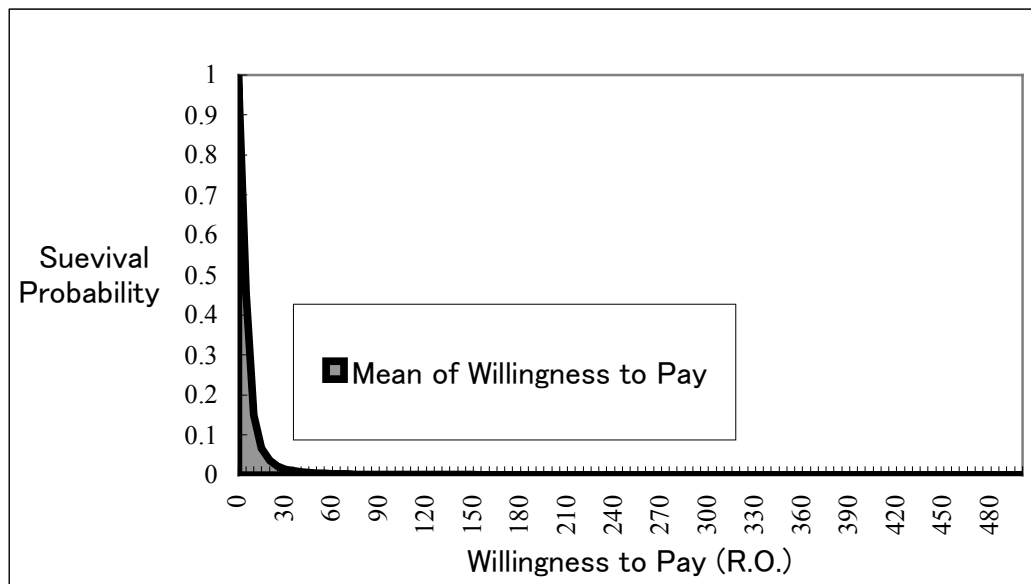


Figure 14.1 Survival Curve in Muscat

Table 14.8 Summary of Results of Questionnaire

Bid No.	First Bid	Higher Second Bid	Lower Second Bid	No. of Yes-Yes Answers	No. of Yes-No Answers	No. of No-Yes Answers	No. of No-No Answers
1	2	5	1	10	3	2	0
2	5	10	2	3	6	5	1
3	10	20	5	1	3	7	10
4	20	30	10	0	2	7	14
5	30	40	20	0	0	1	15
6	40	50	30	0	0	0	23
7	50	75	40	0	0	0	17
8	75	100	50	0	0	0	14
9	100	250	75	0	0	0	9
10	250	500	100	0	0	0	5

Table 14.9 Results of Analysis (Sohar)

Item	Value
Constant (t-value)	3.4415 (5.8247)
Coefficient (t-value)	- 2.2471 (- 6.959)
Likelihood Ratio	0.868
Average Willingness to Pay	7.69 R.O.

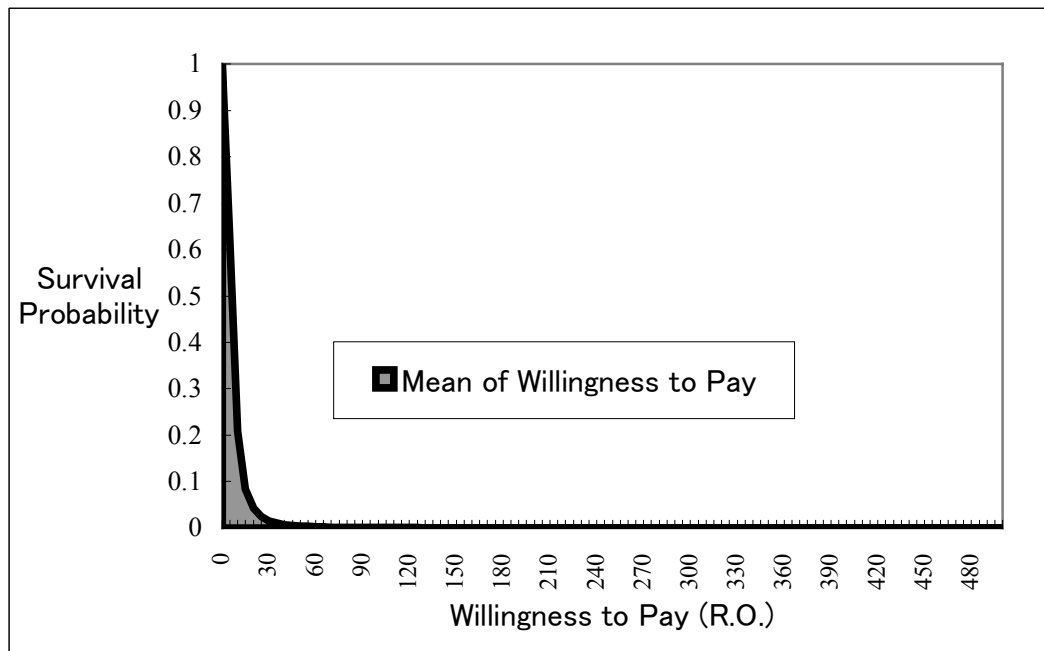


Figure 14.2 Survival Curve in Sohar

Table 14.10 Willingness to Pay for Muscat City

Year	Growth Rate of Workers (%/Year)	Number of Workers	Willingness to pay per worker	Total Willingness to pay (R.O.)	Total Willingness to pay (US\$)
2001	2.291	117,438			
2002	2.291	120,129	6.54	785,642	2,067,479
2003	2.291	122,881	6.54	803,641	2,114,845
2004	2.291	125,696	6.54	822,053	2,163,296
2005	2.291	128,576	6.54	840,886	2,212,857
2006	1.1455	130,049	6.54	850,518	2,238,206
2007	1.1455	131,538	6.54	860,261	2,263,844
2008	1.1455	133,045	6.54	870,115	2,289,777
2009	1.1455	134,569	6.54	880,082	2,316,006
2010	1.1455	136,111	6.54	890,164	2,342,536
2011	1.1455	137,670	6.54	900,360	2,369,370
2012	1.1455	139,247	6.54	910,674	2,396,511
2013	1.1455	140,842	6.54	921,106	2,423,963
2014	1.1455	142,455	6.54	931,657	2,451,729
2015	1.1455	144,087	6.54	942,329	2,479,814
2016	1.1455	145,738	6.54	953,124	2,508,220
2017	1.1455	147,407	6.54	964,042	2,536,952
2018	1.1455	149,096	6.54	975,085	2,566,013
2019	1.1455	150,803	6.54	986,254	2,595,406
2020	1.1455	152,531	6.54	997,552	2,625,137
2021	1.1455	154,278	6.54	1,008,979	2,655,208

Table 14.11 Willingness to Pay for Sohar City

Year	Growth Rate of Workers (%/Year)	Number of Workers	Willingness-to pay per worker	Total Willingness to pay (RO.)	Total Willingness to pay (US\$)
2001	2.291	45,343			
2002	2.291	46,381	7.69	356,672	938,612
2003	2.291	47,444	7.69	364,844	960,115
2004	2.291	48,531	7.69	373,202	982,111
2005	2.291	49,643	7.69	381,752	1,004,612
2006	1.1455	50,211	7.69	386,125	1,016,119
2007	1.1455	50,787	7.69	390,548	1,027,759
2008	1.1455	51,368	7.69	395,022	1,039,532
2009	1.1455	51,957	7.69	399,547	1,051,440
2010	1.1455	52,552	7.69	404,124	1,063,484
2011	1.1455	53,154	7.69	408,753	1,075,666
2012	1.1455	53,763	7.69	413,435	1,087,988
2013	1.1455	54,379	7.69	418,171	1,100,451
2014	1.1455	55,002	7.69	422,962	1,113,057
2015	1.1455	55,632	7.69	427,807	1,125,807
2016	1.1455	56,269	7.69	432,707	1,138,703
2017	1.1455	56,913	7.69	437,664	1,151,747
2018	1.1455	57,565	7.69	442,677	1,164,940
2019	1.1455	58,225	7.69	447,748	1,178,284
2020	1.1455	58,892	7.69	452,877	1,191,782
2021	1.1455	59,566	7.69	458,065	1,205,433

14.3 Economic Evaluation

The economic evaluation of countermeasures is summarized in Table 14.12. Three economic indicators, namely, Internal Rate of Return, Net Present Value and Cost Benefit Ratio, were calculated using the yearly cost and benefit. However, benefit estimates include the benefit from the capping works of the tailing dam by OMCO and the benefit from cleaning the underground water by this project, therefore, it is assumed that 90 % of the total benefit estimated in the above is generated from this project by comparing the effects of both projects.

For calculating values of net present value and cost benefit ratio, the social discount rate of 10 % was adopted here, in view of the fact that the social discount rates in past projects implemented in Oman have been between 5 % and 10 %, and the general discount rate adopted by the World Bank is 12 %. The calculated values of economic indicators are shown in Table 14.13.

Table 14.12 Values of Economic Indicators

(1) Countermeasures-A

Indicators	Value
Internal Rate of Return	14.0 %
Net Present Value	US \$ 4,030,820
Cost Benefit Ratio	3.19

(2) Countermeasures-B

Indicators	Value
Internal Rate of Return	29.2 %
Net Present Value	US \$ 10,558,666
Cost Benefit Ratio	6.68

(3) Countermeasures-C

Indicators	Value
Internal Rate of Return	55.2 %
Net Present Value	US \$ 13,104,121
Cost Benefit Ratio	10.89

As a result, the recommended countermeasures can be judged to be sufficiently feasible for the following reasons;

- a. IRR are indicated at more than 14.0 %.
- b. The present net values are considerably large.
- c. The cost benefit ratio are indicated to be greater than 3.19.

In order to check the sensitivity of the value of IRR by the changes of benefit and cost, the sensitivity analysis was performed. In this analysis, the following changes are examined; the case of 5 %, 10 %, and 15 % decrease of the mean of willingness to pay, considering the difficulty of acceptance of the estimated mean of willingness to pay, and the case of 5 %, 10 %, and 15 % of cost increase. As the result is shown in T 14.13 (1) ~ (3).

Table 14.14, even the worst case IRR (25 % decrease of the mean of willingness to pay and 15 % increase of project cost) was shown 8.2 %, therefore, it can be said that the IRR of this project is considerably robust for the uncertain changes of the mean of willingness to pay and project cost.

In addition to the above-mentioned quantitative benefits, it is expected that the following benefits will be obtained after the countermeasures have been implemented;

- 1) If no countermeasures are taken within the next 20 years, the salty groundwater will reach as far as Falaj al Quaba'l and Majis (densely populated areas). As a result, the groundwater in this area will have a much higher level of salt contamination, which will make infertile the existing fruit garden land of about 16 km².

Table 14.13 Cost and Benefit

(1) Countermeasures-A

(Unit: US\$)

Year	Construction & Maintenance	Rise in Fruit Garden Land		Increase in Number of Goats		Saving of Free Water Supply Cost	Willingness to Pay		Total Benefit	Benefit - Cost
		Group 1	Group 2	Group 1	Group 2		Muscat	Sohar		
2002	11,900,000	0	0	0	0	0	0	0	0	-11,900,000
2003	170,000	0	0	0	0	0	951,680	432,052	1,383,732	1,213,732
2004	170,000	0	0	0	0	0	973,483	441,950	1,415,433	1,245,433
2005	170,000	0	0	0	0	0	995,786	452,075	1,447,861	1,277,861
2006	170,000	6,489	2,937	1,356	3,841	0	1,007,193	457,254	1,479,069	1,309,069
2007	170,000	6,489	2,937	1,298	4,166	0	1,018,730	462,492	1,496,112	1,328,112
2008	170,000	6,489	2,937	1,243	4,518	0	1,030,399	467,789	1,513,376	1,343,376
2009	170,000	6,489	2,937	1,190	4,899	0	1,042,203	473,148	1,530,867	1,360,867
2010	170,000	6,489	2,937	1,140	5,313	0	1,054,141	478,568	1,548,588	1,378,588
2011	170,000	9,734	8,811	2,292	1,807	10,785	2,132,433	968,100	3,133,962	2,963,962
2012	170,000	9,734	8,811	2,291	1,855	10,785	2,156,860	979,189	3,169,525	2,999,525
2013	170,000	9,734	8,811	2,293	1,904	10,785	2,181,567	990,406	3,205,500	3,035,500
2014	170,000	9,734	8,811	2,299	1,955	10,785	2,206,556	1,001,751	3,241,892	3,071,892
2015	170,000	9,734	8,811	2,309	2,007	10,785	2,231,832	1,013,226	3,278,705	3,108,705
2016	170,000	9,734	8,811	2,323	13,428	10,785	2,257,398	1,024,833	3,327,312	3,157,312
2017	170,000	9,734	8,811	2,339	2,115	10,785	2,283,257	1,036,572	3,353,613	3,183,613
2018	170,000	9,734	8,811	2,360	2,171	10,785	2,309,411	1,048,446	3,391,718	3,161,718
2019	170,000	9,734	8,811	2,384	2,228	10,785	2,335,866	1,060,456	3,430,264	3,260,264
2020	170,000	9,734	8,811	2,412	2,287	10,785	2,362,623	1,072,603	3,469,256	3,299,256
2021	170,000	9,734	8,811	2,443	2,348	10,785	2,389,687	1,084,890	3,508,698	3,338,698

Table 14.13 Cost and Benefit

(Unit: US\$)

(3) Countermeasures-C

Year	Construction & Maintenance	Rise in Fruit Garden Land		Increase in Number of Goats		Saving of Free Water Supply Cost	Willingness to Pay		Total Benefit	Benefit - Cost
		Group 1	Group 2	Group 1	Group 2		Muscat	Sohar		
2002	2,500,000	0	0	0	0	0	0	0	0	-2,500,000
2003	102,000	0	0	0	0	0	951,680	432,052	1,383,732	1,281,732
2004	102,000	0	0	0	0	0	973,483	441,950	1,415,433	1,313,433
2005	102,000	0	0	0	0	0	995,786	452,075	1,447,861	1,345,861
2006	102,000	6,489	2,937	1,356	3,841	0	1,007,193	457,254	1,479,069	1,377,069
2007	102,000	6,489	2,937	1,298	4,166	0	1,018,730	462,492	1,496,112	1,394,112
2008	102,000	6,489	2,937	1,243	4,518	0	1,030,399	467,789	1,513,376	1,411,376
2009	102,000	6,489	2,937	1,190	4,899	0	1,042,203	473,148	1,530,867	1,428,867
2010	102,000	6,489	2,937	1,140	5,313	0	1,054,141	478,568	1,548,588	1,446,588
2011	102,000	9,734	8,811	2,292	1,807	10,785	2,132,433	968,100	3,133,962	3,031,962
2012	102,000	9,734	8,811	2,291	1,855	10,785	2,156,860	979,189	3,169,525	3,067,525
2013	102,000	9,734	8,811	2,293	1,904	10,785	2,181,567	990,406	3,205,500	3,103,500
2014	102,000	9,734	8,811	2,299	1,955	10,785	2,206,556	1,001,751	3,241,892	3,139,892
2015	102,000	9,734	8,811	2,309	2,007	10,785	2,231,832	1,013,226	3,278,705	3,176,705
2016	102,000	9,734	8,811	2,323	13,428	10,785	2,257,398	1,024,833	3,327,312	3,225,312
2017	102,000	9,734	8,811	2,339	2,115	10,785	2,283,257	1,036,572	3,353,613	3,251,613
2018	102,000	9,734	8,811	2,360	2,171	10,785	2,309,411	1,048,446	3,391,718	3,289,718
2019	102,000	9,734	8,811	2,384	2,228	10,785	2,335,866	1,060,456	3,430,264	3,328,264
2020	102,000	9,734	8,811	2,412	2,287	10,785	2,362,623	1,072,603	3,469,256	3,367,256
2021	102,000	9,734	8,811	2,443	2,348	10,785	2,389,687	1,084,890	3,508,698	3,406,698

Table 14.13 Cost and Benefit

(Unit: US\$)

(2) Countermeasures-B

Year	Construction & Maintenance	Rise in Fruit Garden Land		Increase in Number of Goats		Saving of Free Water Supply Cost	Willingness to Pay		Total Benefit	Benefit - Cost
		Group 1	Group 2	Group 1	Group 2		Muscat	Sohar		
2002	5,300,000	0	0	0	0	0	0	0	0	-5,300,000
2003	102,000	0	0	0	0	0	951,680	432,052	1,383,732	1,281,732
2004	102,000	0	0	0	0	0	973,483	441,950	1,415,433	1,313,433
2005	102,000	0	0	0	0	0	995,786	452,075	1,447,861	1,345,861
2006	102,000	6,489	2,937	1,356	3,841	0	1,007,193	457,254	1,479,069	1,377,069
2007	102,000	6,489	2,937	1,298	4,166	0	1,018,730	462,492	1,496,112	1,394,112
2008	102,000	6,489	2,937	1,243	4,518	0	1,030,399	467,789	1,513,376	1,411,376
2009	102,000	6,489	2,937	1,190	4,899	0	1,042,203	473,148	1,530,867	1,428,867
2010	102,000	6,489	2,937	1,140	5,313	0	1,054,141	478,568	1,548,588	1,446,588
2011	102,000	9,734	8,811	2,292	1,807	10,785	2,132,433	968,100	3,133,962	3,031,962
2012	102,000	9,734	8,811	2,291	1,855	10,785	2,156,860	979,189	3,169,525	3,067,525
2013	102,000	9,734	8,811	2,293	1,904	10,785	2,181,567	990,406	3,205,500	3,103,500
2014	102,000	9,734	8,811	2,299	1,955	10,785	2,206,556	1,001,751	3,241,892	3,139,892
2015	102,000	9,734	8,811	2,309	2,007	10,785	2,231,832	1,013,226	3,278,705	3,176,705
2016	102,000	9,734	8,811	2,323	13,428	10,785	2,257,398	1,024,833	3,327,312	3,225,312
2017	102,000	9,734	8,811	2,339	2,115	10,785	2,283,257	1,036,572	3,353,613	3,251,613
2018	102,000	9,734	8,811	2,360	2,171	10,785	2,309,411	1,048,446	3,391,718	3,289,718
2019	102,000	9,734	8,811	2,384	2,228	10,785	2,335,866	1,060,456	3,430,264	3,328,264
2020	102,000	9,734	8,811	2,412	2,287	10,785	2,362,623	1,072,603	3,469,256	3,367,256
2021	102,000	9,734	8,811	2,443	2,348	10,785	2,389,687	1,084,890	3,508,698	3,406,698

Table 14.14 Results of Sensitivity Analysis

Countermeasures-A

Mean of Willingness to pay (WTP) and Cost	Cost is not changed.	5 % of Cost Increase	10 % of Cost Increase	15 % of Cost Increase
WTP is not changed.	14.0	13.1	12.6	12.0
5 % of WTP decrease	13.3	12.6	11.9	11.3
10 % of WTP decrease	12.5	11.8	11.1	10.6
15 % of WTP decrease	11.7	11.0	10.4	9.8
20 % of WTP decrease	10.9	10.2	9.6	9.0
25 % of WTP decrease	10.0	9.4	8.8	8.2

- 2) In the objective area there is the “Al Ons Nature Reserve”, where various kind trees are planted. At this moment the underground water is used for sprinkling tress, however, if the underground water will be contaminated further without the countermeasures, these trees will be surely died.
- 3) If countermeasures to remedy not only groundwater pollution but also air pollution, a large honeybee population will return to the mine area, providing a supply of delicious honey to the villagers.
- 4) Promoting the fact that there is no pollution around the mine area might attract many more tourists in the future.

CHAPTER 15 COUNTERMEASURE PROJECT IMPLEMENTATION

CHAPTER 15 COUNTERMEASURE PROJECT IMPLEMENTATION

15. 1 Procurement of Project Fund

15. 1. 1 Burden of Project Cost

In the case of the alternative-A, US\$ 11.900,000 is required for the construction cost and US\$ 200,000 for the maintenance cost per year for implementing the countermeasure projects. In the case of the alternative-C, the construction cost is US\$ 2.500,000 and the maintenance cost per year is US\$ 120,000. It is desired that the operating entity, that is, OMCO bear both construction cost and maintenance cost on the basis of “polluter-pays principle”. However, considering the present financial difficulties of OMCO, it is almost impossible for OMCO to procure such a large amount of construction financing by itself. In addition, considering that OMCO has been undertaking, as a state-run enterprise, the copper refinery under the state policy, it would be unfair to place all of burden to only OMCO. Therefore, the government should burden for this project, which contributes to the improvement of regional environment.

In specialty since the construction cost is necessary for a large amount of money, the government is requested for giving its help to OMCO as much as possible by granting subsidy, borrowing soft loans, etc. However, OMCO is desired to expend the yearly maintenance cost basically since the amount is not so large and its expenditure continues for a long time. In case that it is impossible by all means for OMCO to burden the yearly maintenance cost, OMCO would ask subsidy to the government through the Ministry of Commerce and Industry

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Therefore, the government should burden for this project, which contributes to the improvement of regional environment. In specialty since the construction cost is necessary for a large amount of money, the government is requested for giving its help to OMCO as much as possible by granting subsidy, borrowing soft loans, etc. However, OMCO is desired to expend the yearly maintenance cost basically since the amount is not so large and its expenditure continues for a long time. In case that it is impossible by all means for OMCO to burden the yearly maintenance cost, OMCO would ask

subsidy to the government through the Ministry of Commerce and Industry.

15. 1. 2 Procurement of Construction Cost

Since OMCO cannot procure the construction cost by it, the financial sources should be sought. Generally, the followings are considered to be financial sources:

- a. Subsidy from the government
- b. Loans from domestic banks
- c. Grants or loans from foreign governments or international financial institutions

It is desirable that the government should pay construction cost. However, considering the severe financial situation of the government caused by recent stagnant export of oil and gas, the government itself cannot prepare all of the construction cost. However, since the export of oil and gas is taking a turn for the better at this moment, the assignment of the government subsidy is desired to examine. Other than subsidy, loans should be borrowed. In this case it is very important to examine the loan conditions such as the interest rate, repayment period, grace period, etc. In the below, the amortization of capital and interest is examined under the conditions listed in Table-15.1.

Table-15.1 Loan Conditions

Fund Sources	Project Type	Interest Rate	Repayment Year	Grace Period
Domestic Bank	General	8.0 %	5 year	0 year
International Bank	Standard	12.0 %	20 year	5 year
International Financial Institutions	Standard	3.0 %	25 year	7 year
International Financial Institutions	Environmental	2.5 %	25 year	7 year

15. 1. 3 Repayment Schedule

Table 15.2 summarized the repayment schedule on the condition of loan share of 100 %, 50 %, and 30 % to the total construction cost. In case of loan from domestic banks, yearly repayment becomes considerably high, even if borrowed money is not so large, because the repayment period is short (under 30 % borrowing, yearly repayment reaches to US\$ 790,000 at minimum). Therefore, it is necessary to negotiate on loan conditions for borrowing from domestic banks. It goes without saying that soft loans through the bilateral relationship are favorable. However, it is very difficult for a high-income country like Oman to borrow soft loans, therefore, to ask assistance to the international funding institutions like World Bank might be a better solution. In this case, repayment of capital

and interest is sufficiently possible by assigning only 0.01 % of GDP to the projects (the Oman's GDP is 15.6 billion dollars in 1999). Table 15.3~15.6 shows the summary of repayment schedule.

Table 15. 2 Repayment Schedule by Case

(Unit : US\$)

Fund Sources (Loan share)	Total Repayment	Largest Repayment	Minimum Repayment	Final Year of Repayment
Domestic Banks				
Loan share: 100 %	25,240,000	2,944,800	2,374,000	2007
50 %	12,917,800	1,662,000	1,187,000	2007
30 %	12,568,000	1,108,000	791,000	2007
International Bank				
Loan share: 100 %	37,349,000	2,108,000	594,000	2026
50 %	18,675,000	1,009,000	297,000	2026
30 %	16,407,000	673,000	198,000	2026
International Financial Institutions				
Loan share: 100 %	30,155,000	817,000	356,000	2033
50 %	15,077,000	408,000	178,000	2033
30 %	14,009,000	272,000	119,000	2033
International Financial Institutions				
Loan share: 100 %	29,086,000	760,000	297,000	2033
50 %	14,543,000	380,000	148,000	2033
30 %	13,653,000	253,000	99,000	2033

15. 2 Technical Support

For the implementation of the countermeasure project, it is necessary to execute making of detailed implementation plans, detailed design works and the construction management and so on. In Oman, a domestic or an international consultant company carries out such works, which are hired by the Oman government or OMCO generally. After completion of the countermeasure project, operations and management of the water treatment facilities are very important. In this report, costs of the plans are calculated as by contract biases of a domestic or an international private company.

There is a good solution to use the technology support scheme by foreign countries as the means that cuts these expenses and moreover can receive technology transfer.

Table 15.3 Loans from Domestic Banks

Year	Case 1-1: Interest rate: 8.0%, Repayment year: 5 years, Grace period: 0 year, Loan share: 100%			Case 1-2: Interest rate: 8.0%, Repayment year: 5 years, Grace period: 0 year, Loan share: 50%			Case 1-3: Interest rate: 8.0%, Repayment year: 5 years, Grace period: 0 year, Loan share: 30%		
	Construction Cost	Maintenance Cost	Amortization + Interest	Construction Cost	Maintenance Cost	Amortization + Interest	Construction Cost	Maintenance Cost	Amortization + Interest
2002	10,600,000	410,000	2,120,000	10,600,000	410,000	1,060,000	10,600,000	410,000	706,667
2003		410,000	2,120,000		410,000	1,060,000		410,000	706,667
2004		410,000	2,120,000		410,000	1,060,000		410,000	706,667
2005		410,000	2,120,000		410,000	1,060,000		410,000	706,667
2006		410,000	2,120,000		410,000	1,060,000		410,000	706,667
2007		410,000	2,120,000		410,000	1,060,000		410,000	706,667
Total			11,935,600			6,232,800			4,155,200
/ from Government			10,600,000			5,300,000			7,066,667
total + Subsidy			22,535,600			11,532,800			11,221,867

Table 15.4 Loans from World Banks, JBIC, etc.

Year	Construction Cost	Maintenance Cost	Amortization	Interest	Amortization + Interest	Year	Construction Cost	Maintenance Cost	Amortization	Interest	Amortization + Interest
2002	10,600,000					2,002	10,600,000				
2003		410,000				2,003		410,000			
2004		410,000				2,004		410,000			
2005		410,000				2,005		410,000			
2006		410,000				2,006		410,000			
2007		410,000	530,000	1,272,000	1,802,000	2,007		410,000	265,000	636,000	901,000
2008		410,000	530,000	1,144,800	1,674,800	2,008		410,000	265,000	572,400	837,400
2009		410,000	530,000	1,081,200	1,611,200	2,009		410,000	265,000	540,600	805,600
2010		410,000	530,000	1,017,600	1,547,600	2,010		410,000	265,000	508,800	773,800
2011		410,000	530,000	954,000	1,484,000	2,011		410,000	265,000	477,000	742,000
2012		410,000	530,000	890,400	1,420,400	2,012		410,000	265,000	445,200	710,200
2013		410,000	530,000	826,800	1,356,800	2,013		410,000	265,000	413,400	678,400
2014		410,000	530,000	763,200	1,293,200	2,014		410,000	265,000	381,600	646,600
2015		410,000	530,000	699,600	1,229,600	2,015		410,000	265,000	349,800	614,800
2016		410,000	530,000	636,000	1,166,000	2,016		410,000	265,000	318,000	583,000
2017		410,000	530,000	572,400	1,102,400	2,017		410,000	265,000	286,200	551,200
2018		410,000	530,000	508,800	1,038,800	2,018		410,000	265,000	254,400	519,400
2019		410,000	530,000	445,200	975,200	2,019		410,000	265,000	222,600	487,600
2020		410,000	530,000	381,600	911,600	2,020		410,000	265,000	190,800	455,800
2021		410,000	530,000	318,000	848,000	2,021		410,000	265,000	159,000	424,000
2022		410,000	530,000	254,400	784,400	2,022		410,000	265,000	127,200	392,200
2023		410,000	530,000	190,800	720,800	2,023		410,000	265,000	95,400	360,400
2024		410,000	530,000	127,200	657,200	2,024		410,000	265,000	63,600	328,600
2025		410,000	530,000	63,600	593,600	2,025		410,000	265,000	31,800	296,800
2026		410,000	530,000	0	530,000	2,026		410,000	265,000	0	265,000
Total					22,747,600						11,373,800
Subsidy from Government					10,600,000						5,300,000
Total + Subsidy					33,347,600						16,673,800

Case 2-1: Interest rate: 12.0%, Repayment year: 20 years, Grace period: 5 years, Loan share: 100%

Case 2-2: Interest rate: 12.0%, Repayment year: 20 years, Grace period: 5 years, Loan share: 50%

Case 2-3: Interest rate: 12.0%, Repayment year: 20 years, Grace period: 5 years, Loan share: 30%

Table 15.5 Loans through Bilateral Relationship (Standard Project)

Year	Case 3-1: Interest rate: 3.0%, Repayment year: 25 years, Grace period: 7 years, Loan share: 100%			Case 3-2: Interest rate: 3.0%, Repayment year: 25 years, Grace period: 7 years, Loan share: 50%			Case 3-3: Interest rate: 3.0%, Repayment year: 25 years, Grace period: 7 years, Loan share: 30%		
	Construction Cost	Maintenance Cost	Amortization + Interest	Construction Cost	Maintenance Cost	Amortization + Interest	Construction Cost	Maintenance Cost	Amortization + Interest
2002	10,600,000		318,000	10,600,000		159,000	10,600,000		106,000
2003		410,000	318,000		410,000	159,000		410,000	106,000
2004		410,000	318,000		410,000	159,000		410,000	106,000
2005		410,000	318,000		410,000	159,000		410,000	106,000
2006		410,000	318,000		410,000	159,000		410,000	106,000
2007		410,000	318,000		410,000	159,000		410,000	106,000
2008		410,000	318,000		410,000	159,000		410,000	106,000
2009		410,000	305,280		410,000	152,640		410,000	101,760
2010		410,000	292,560		410,000	146,280		410,000	97,520
2011		410,000	279,840		410,000	139,920		410,000	93,280
2012		410,000	267,120		410,000	133,560		410,000	89,040
2013		410,000	254,400		410,000	127,200		410,000	84,800
2014		410,000	241,680		410,000	120,840		410,000	80,560
2015		410,000	228,960		410,000	114,480		410,000	76,320
2016		410,000	216,240		410,000	108,120		410,000	72,080
2017		410,000	203,520		410,000	101,760		410,000	67,840
2018		410,000	190,800		410,000	95,400		410,000	63,600
2019		410,000	178,080		410,000	89,040		410,000	59,360
2020		410,000	165,360		410,000	82,680		410,000	55,120
2021		410,000	152,640		410,000	76,320		410,000	50,880
2022		410,000	139,920		410,000	69,960		410,000	46,640
2023		410,000	127,200		410,000	63,600		410,000	42,400
2024		410,000	114,480		410,000	57,240		410,000	38,160
2025		410,000	101,760		410,000	50,880		410,000	33,920
2026		410,000	89,040		410,000	44,520		410,000	29,680
2027		410,000	76,320		410,000	38,160		410,000	25,440
2028		410,000	63,600		410,000	31,800		410,000	21,200
2029		410,000	50,880		410,000	25,440		410,000	16,960
2030		410,000	38,160		410,000	19,080		410,000	12,720
2031		410,000	25,440		410,000	12,720		410,000	8,480
2032		410,000	12,720		410,000	6,360		410,000	4,240
2033		410,000	0		410,000	0		410,000	0
Total			16,324,000			8,162,000			5,441,333
Subsidy from Government			10,600,000			5,300,000			7,066,667
Total + Subsidy			26,924,000			13,462,000			12,508,000

Table 15.6 Loans through Bilateral Relationship (Environmental Project)

Case 4-1: Interest rate: 2.5%, Repayment year: 25 years, Grace period: 7 years, Loan share: 100%
 Case 4-2: Interest rate: 2.5%, Repayment year: 25 years, Grace period: 7 years, Loan share: 50%
 Case 4-3: Interest rate: 2.5%, Repayment year: 25 years, Grace period: 7 years, Loan share: 30%

Year	Construction Cost	Maintenance Cost	Amortization	Interest	Amortization + Interest	Year	Construction Cost	Maintenance Cost	Amortization	Interest	Amortization + Interest	Year	Construction Cost	Maintenance Cost	Amortization	Interest	Amortization + Interest
2002	10,600,000					2,002	10,600,000					2002	10,600,000				
2003		410,000	265,000	265,000	265,000	2,003		410,000	132,500	132,500	132,500	2003		410,000	132,500	132,500	132,500
2004		410,000	265,000	265,000	265,000	2,004		410,000	132,500	132,500	132,500	2004		410,000	132,500	132,500	132,500
2005		410,000	265,000	265,000	265,000	2,005		410,000	132,500	132,500	132,500	2005		410,000	132,500	132,500	132,500
2006		410,000	265,000	265,000	265,000	2,006		410,000	132,500	132,500	132,500	2006		410,000	132,500	132,500	132,500
2007		410,000	265,000	265,000	265,000	2,007		410,000	132,500	132,500	132,500	2007		410,000	132,500	132,500	132,500
2008		410,000	265,000	265,000	265,000	2,008		410,000	132,500	132,500	132,500	2008		410,000	132,500	132,500	132,500
2009		410,000	254,400	424,000	678,400	2,009		410,000	212,000	127,200	339,200	2009		410,000	141,333	84,800	226,133
2010		410,000	243,800	424,000	667,800	2,010		410,000	212,000	121,900	333,900	2010		410,000	141,333	81,267	222,600
2011		410,000	233,200	424,000	657,200	2,011		410,000	212,000	116,600	328,600	2011		410,000	141,333	77,733	219,067
2012		410,000	222,600	424,000	646,600	2,012		410,000	212,000	111,300	323,300	2012		410,000	141,333	74,200	215,533
2013		410,000	212,000	424,000	636,000	2,013		410,000	212,000	106,000	318,000	2013		410,000	141,333	70,667	212,000
2014		410,000	201,400	424,000	625,400	2,014		410,000	212,000	100,700	312,700	2014		410,000	141,333	67,133	208,467
2015		410,000	190,800	424,000	614,800	2,015		410,000	212,000	95,400	307,400	2015		410,000	141,333	63,600	204,933
2016		410,000	180,200	424,000	604,200	2,016		410,000	212,000	90,100	302,100	2016		410,000	141,333	60,067	201,400
2017		410,000	169,600	424,000	593,600	2,017		410,000	212,000	84,800	296,800	2017		410,000	141,333	56,533	197,867
2018		410,000	159,000	424,000	583,000	2,018		410,000	212,000	79,500	291,500	2018		410,000	141,333	53,000	194,333
2019		410,000	148,400	424,000	572,400	2,019		410,000	212,000	74,200	286,200	2019		410,000	141,333	49,467	190,800
2020		410,000	137,800	424,000	561,800	2,020		410,000	212,000	68,900	280,900	2020		410,000	141,333	45,933	187,267
2021		410,000	127,200	424,000	551,200	2,021		410,000	212,000	63,600	275,600	2021		410,000	141,333	42,400	183,733
2022		410,000	116,600	424,000	540,600	2,022		410,000	212,000	58,300	270,300	2022		410,000	141,333	38,867	180,200
2023		410,000	106,000	424,000	530,000	2,023		410,000	212,000	53,000	265,000	2023		410,000	141,333	35,333	176,667
2024		410,000	95,400	424,000	519,400	2,024		410,000	212,000	47,700	259,700	2024		410,000	141,333	31,800	173,133
2025		410,000	84,800	424,000	508,800	2,025		410,000	212,000	42,400	254,400	2025		410,000	141,333	28,267	169,600
2026		410,000	74,200	424,000	498,200	2,026		410,000	212,000	37,100	249,100	2026		410,000	141,333	24,733	166,067
2027		410,000	63,600	424,000	487,600	2,027		410,000	212,000	31,800	243,800	2027		410,000	141,333	21,200	162,533
2028		410,000	53,000	424,000	477,000	2,028		410,000	212,000	26,500	238,500	2028		410,000	141,333	17,667	159,000
2029		410,000	42,400	424,000	466,400	2,029		410,000	212,000	21,200	233,200	2029		410,000	141,333	14,133	155,467
2030		410,000	31,800	424,000	455,800	2,030		410,000	212,000	15,900	227,900	2030		410,000	141,333	10,600	151,933
2031		410,000	21,200	424,000	445,200	2,031		410,000	212,000	10,600	222,600	2031		410,000	141,333	7,067	148,400
2032		410,000	10,600	424,000	434,600	2,032		410,000	212,000	5,300	217,300	2032		410,000	141,333	3,533	144,867
2033		410,000	0	424,000	424,000	2,033		410,000	212,000	0	212,000	2033		410,000	141,333	0	141,333
Total					15,370,000						7,685,000						5,123,333
Subsidy from Government					10,600,000						5,300,000						7,066,667
Total + Subsidy					25,970,000						12,985,000						12,190,000