

CHAPTER 6 : PROJECT EVALUATION

CHAPTER 6 PROJECT EVALUATION

6.1 BASIC APPROACH AND EVALUATION PARAMETERS

The justification for the implementation of a project is commonly assessed by means of: 1) Economic Evaluation, 2) Financial Evaluation and 3) Socio-economic Evaluation. In the case of this Project, since the development plan has been formulated with focus on agricultural activities and the development area is vested with high public interests, the feasibility of the Project has been assessed mainly on the basis of the economic evaluation. On the other hand, in the financial evaluation, an assessment of the Project has been made with respect to the cash flow and farmer's economy. Basic approach to the Project evaluation is made referring to the standards and methods acceptable to such international agencies as IBRD, OECF and other agencies. The main parameters used in the Project evaluation are as follows:

- (1) All costs and benefits are expressed in economic prices estimated based on September 1985 market prices.
- (2) An official exchange rate of US\$ 1 = Ch\$ 178 is applied.
- (3) Prices of agricultural products are expressed in farm-gate prices. Costs for construction machinery, equipment and materials are estimated on the basis of delivery to the construction site.
- (4) All costs and benefits are discounted over a period of 30 years including 1.5 years for detailed design phase and 3.5 years for construction phase.

6.2 BENEFITS OF THE PROJECT

Benefits of the Project are computed as the difference of net returns between the "with" and "without" cases for the implementation of development plan. These benefits are divided

into quantifiable and unquantifiable categories: the former comprises crop yield improvement, transportation cost saving, flood damage saving etc. and the latter includes incremental employment opportunity, improvement of environment by means of water quality improvement, constant supply of agricultural products, etc. Quantifiable benefits are concerned in economic and financial evaluations; while unquantifiable ones are treated comprehensively within the context of socio-economic impact.

Agricultural development benefits are quantified by incremental agricultural land and crop production attributable to the consolidation of irrigation and drainage systems; in the same way, the improvement of water quality is quantified by reduction of labor cost for cleaning of canals, the rehabilitation of farm roads and bridges by transportation cost saving, and flood control by decrease of flood damages.

6.2.1 Agricultural Development Benefits

Beneficiaries of the Project can be divided into two categories in terms of their farm sizes: small-scale farmer with holdings below 12 ha and medium- and large-scale farmers with other holdings. Production of small-scale farmers with Project case is described in detail in 4.3 : Proposed Development Plan for Agriculture, which refers to the level for cropping technique and limit of capital investment. It is supposed that with the implementation of the Project, medium- and large-scale farmers will be available more financial resources and thus capital investment will be allocated to the production of export-oriented fruits, the most profitable agricultural products.

(1) Small-Scale Farmers

Benefits generated by the agricultural development are calculated in accordance with the Farm Household Economy Plan discussed in Section 4.3.2. And, such benefits as to be expected by the improvement of water quality in Blocks-1, 2 and 3 are quantified by the decrease of labor cost for

cleaning of canals (one laborer/ha/year, Ch\$ 4,800) within agricultural development benefits. The total sum of benefits is estimated at approximately Ch\$ 798 x 10⁶ per annum (Table 6-2-1).

Table 6-2-1 Net Return of Small-Sector

Block	Net Return per Farmer			Number of Farmers	Total Benefits
	① With Project	② Without Project	① - ②		
1	1,243.5	295.1	948.4	68	64,491
2	1,137.8	224.6	913.2	128	116,890
3	1,528.3	329.5	1,198.8	85	101,898
4	1,216.6	279.4	937.2	549	514,523
Total	-	-	-	830	797,802

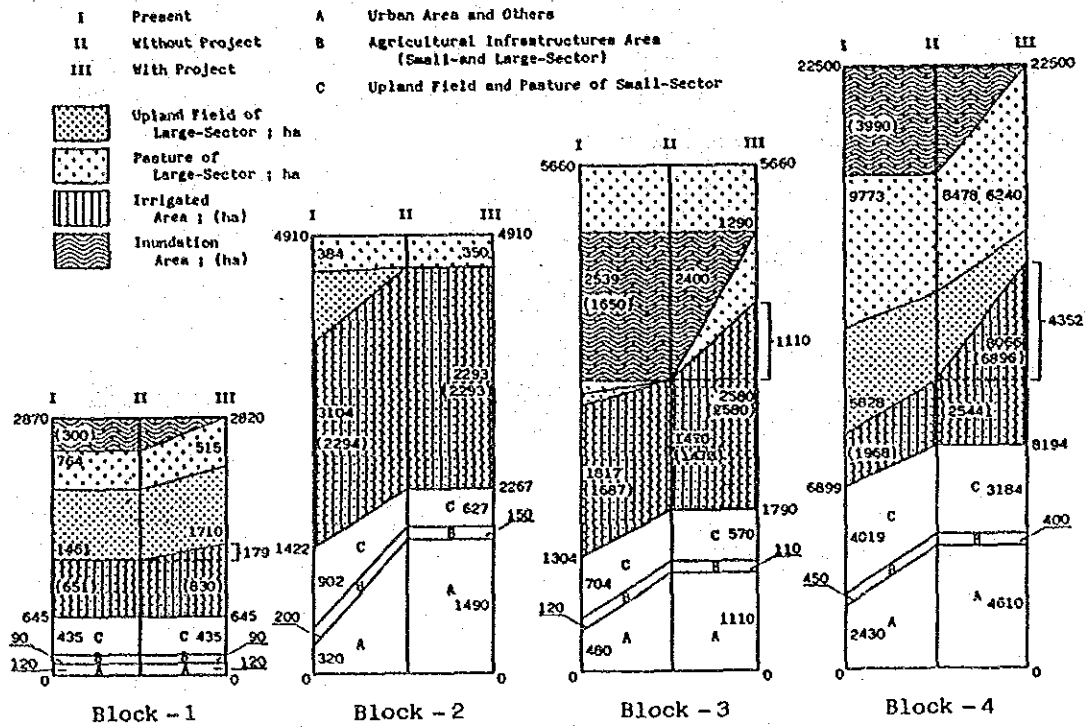
Source: Table 4-3-9

(2) Medium- and Large-scale Farmers

The evaluation of landuse from without Project to with Project cases are given in Fig 6-2-1 and Table 6-2-2. It is presumed that the expanded irrigation farmland with the implementation of the Project (5,641 ha) will be covered by the plantation of export-oriented fruits (Table 6-2-2). In this regard, table grape, peach and nectarin have been selected as proposed crops to be introduced in the said expanded farmland and plantations for respective fruits will cover 3,141 ha, 1,500 ha, and 1,000 ha.

On the other hand, the existing plantation of these three fruits as of 1984 were around 21,400 ha, 6,000 ha and 6,800 ha (Indicadores de Comercio Exterior, BCC, 1984); growth projection in the latest development plan is 1,500 ha/year for table grapes and 1,000 ha for all the other fruits (Programa Trienal 1985-1987, MA, 1985).

LEGEND



Source : Table 4-2-1, A-16-1 to A-16-3

Fig 6-2-1 Landuse With and Without Project Situation of Large-Sector

Table 6-2-2 Increased Irrigated Area of Large-Sector

Item	(Unit: ha)				
	Block-1	Block-2	Block-3	Block-4	Total
Present	651	2,294	1,687	1,968	6,600
Without Project	651	2,293	1,470	2,544	6,958
With Project	830	2,293	2,580	6,896	12,599
Increased Area	179	0	1,110	4,352	5,641
(by irrigation)	179	0	801	4,352	5,332
(by flood control)	0	0	309	0	309

Source: Table A-16-4

Consequently, the plantation phasing of new crops in three years is proposed so as to avoid competition with producers in other regions (Table A-16-6); wheat will be planted temporarily where the plantation of new three crops will be postponed. Furthermore, all the existing irrigable ordinary fields of about 7,000 ha in the Project Area will, logically speaking, have been changed into vineyards or orchards by the time the newly irrigable or reclaimed land can be cultivated in 1992.

Nevertheless, these benefits have not been taken into account in the Project, because they are generated in both with and without Project cases.

Procedures for the quantification of agricultural development benefits are described in sections for economic and financial evaluations. Cleaning labour of canals is saved in the existing upland fields like the case of small-scale farmers due to the improvement of water quality in Blocks-1, 2 and 3 (4,414 ha). The amount of benefits generated by this saving is equivalent to Ch\$ 21 x 10⁶ per annum (Table 6-2-3).

Table 6-2-3 Benefits of Water Quality Improvement

Block	Existing Upland Field (ha)	Benefits (10 ³ Ch\$)
1	651	3,125
2	2,293	11,006
3	1,470	7,056
4	4,414	21,187

Source: Table 6-2-2

6.2.2 Farm Road and Bridge Rehabilitation Benefits

The rehabilitation of farm roads and bridges will make it possible to access heavy vehicles for forwarding agro-products; transportation of exporting fruits to Valparaiso Port will be made by 14 ton-trailer in place of present 7 ton-truck and, consequently, the transportation cost will be saved by Ch\$ 500/ton (Ch\$2,000 minus Ch\$ 1,500). Benefits attributable to the rehabilitation of farm roads and bridges are set forth to be equivalent to 40% of the saved transportation cost. Meanwhile, savings of transportation cost corresponding to basic grains, vegetables and fruits for domestic market (Santiago) are calculated at Ch\$ 60/ton. Benefits by transportation cost saving are also generated with regard to the transportation of purchased inputs. The total annual benefits are estimated to be Ch\$ 50 x 10⁶ (Appendix Table A-16-7).

6.2.3 Flood Control Benefits

Benefits expected by the flood control in urban area of Santiago are expressed as the savings of flood damages. Nevertheless, these benefits are omitted from the Project benefits and their relation with the Project implementation is considered in the sensitivity analysis due to the following justifications:

- Santiago urban area is indirect beneficial area of the Project.
- Agricultural development constitutes the principal objective of the Project as the greater part of investment is allocated to it.
- No detailed quantifiable information which can verify the relation between flood loss in Santiago urban area and flooding return period is available.

In the present Study, so advised by the ODEPLAN, flood damages have been estimated referring to "Plan Maestro, Alcantarillado del Gran Santiago, 1984", EMOS. Flood loss is composed of 1)

damages of houses and public utilities, 2) stagnation of productive activities due to damages in transportation system and 3) increase in consumption of fuels. The flood loss of 1991 is estimated at approximately Ch\$ 250 x 10⁶ (Appendix Table A-16-8).

6.3 ECONOMIC EVALUATION

The objective of economic evaluation is to assess the economic impact of the Project implementation from the viewpoint of national economy. For this purpose, all benefits and costs are converted into economic prices. Economic prices correspond to shadow prices which are calculated deducting transfers aside from real resources used in the Project from market prices and multiplying conversion factors. Coefficients are established by the ODEPLAN: they vary year by year from 1985 to 1988 and from 1988, and from 1988 they will be constant (Table 6-3-1).

Table 6-3-1 Coefficients for Economic Price

Item	1985	1986	1987	1988 and after
Shadow Price	1.16	1.14	1.13	1.13
Shadow Wage (un-skilled)	0.45	0.46	0.48	0.50
(semi-skilled)	0.47	0.48	0.50	0.52
Social Discount Rate	0.17	0.14	0.12	0.10

Note: The average exchange rate of reference (tipo de cambio de referencia) as of September 1985 started with a rate of Ch\$177.79/US\$ on the first and ended with 179 on the thirtieth (Citicorp. Chile S.A.); therefore, a rate of Ch\$178/US\$ is used as the exchange rate in this report.

The local currency is over-evaluated, so shadow exchange rate against US\$ is established in the range of 1.16 - 1.13 times as low as official exchange rate. As to labor wage, skilled laborers are less available, thus labor opportunity cost is nearly as same as market price. On the other hand, semi-skilled and unskilled laborers are in the state of oversupply, which is associated with the low labor opportunity cost; coefficients for shadow labor price varies between 0.45 and 0.52.

Economic evaluation may be done using mutually related three main decision rules: economic internal rate of return (EIRR), economic net present value (ENPV) and benefit-cost ratio (B/C). The net flows of costs and benefits for each year of the project's life are discounted with ordinary capital opportunity cost.

The ENPV is the difference between the discounted streams of benefits and costs, and the B/C is the ratio between discounted total benefits and costs. And, the EIRR can be defined as the discount rate at which the ENPV of a project is zero.

The criteria for judging the economic feasibility of a project are that the ENPV is positive, or the B/C is more than 1.00, or the EIRR exceeds the capital opportunity cost.

6.3.1 Prices Conversion

(1) Benefits

The following transfers are omitted in estimating benefits of the Project.

- Interest for agricultural credit (direct production cost)
- Tax on value added for inputs (IVA 20%)
(direct production cost)
- Depreciation cost for machinery (50%)
(indirect production cost)
- Taxes (indirect production cost)

Shadow prices are applied with respect to wheat and maize in such manner as their farm-gate prices are converted into international prices (Appendix Table A-16-9):

- Wheat : Ch\$ 38.4/kg
- Maize: Ch\$ 31.2/kg

(2) Costs

The following costs are excluded from the computation of costs.

- Land acquisition cost
- Importation tax (30%) and sales tax (3%) on imported equipment and materials for construction works and replacement
- Tax on value added for locally procured construction equipment and materials and transportation (IVA 20%)
- Depreciation cost on materials for O/M
- Tax on value added for O/M costs except for wages (IVA 20%)

Coefficients applied are as follows:

- Labor wages: Unskilled Laborer 0.50
Semi-skilled Laborer 0.52
- Exchange rate between US\$ and Ch\$ on imported equipment materials and consulting services: 1.13

6.3.2 Economic Internal Rate of Return (EIRR), Economic Net Present Value (ENPV) and Benefit-Cost Ratio (B/C)

Some irrigation and water treatment facilities will be consumed before the termination of the Project life. Hence, the replacement of these facilities (every 10 years or 20 years) is required. Furthermore, residual values will be only generated in the final year of the Project life.

Table 6-3-2 shows the cash flow of discounted benefits, costs, and O/M and replacement costs of the Project.

Table 6-3-2 Flow of Economic Cost and Benefit

(Unit : 10³ Ch\$)

No.	Year	Project Benefit	Project Replacement Cost	Cost & Cost	O/M Cost	Total Cost	Benefit - Cost		Present Value (10%, 1987:12%)	
							Benefit	Cost	Benefit	Cost
1	1987	0	604940			604940	-604940	0	540125	
2	1988	0	782715			782715	-782715	0	646872	
3	1989	0	4478663			4478663	-4478663	0	3364886	
4	1990	0	5090022			5090022	-5090022	0	3476554	
5	1991	0	5040261			5040261	-5040261	0	3129606	
6	1992	1187173			52700	52700	1134473	670128	29747	
7	1993	749498			52700	52700	696799	384611	27043	
8	1994	442888			52700	52700	390188	206610	24585	
9	1995	1089394			52700	52700	1036695	462009	22350	
10	1996	2365089			52700	52700	2312389	911844	20318	
11	1997	3525851			52700	52700	3473152	1235789	18471	
12	1998	4742915			52700	52700	4690216	1511239	16792	
13	1999	5156394			52700	52700	5103695	1493624	15265	
14	2000	5598423			52700	52700	5545724	1474240	13877	
15	2001	6070552	371436		52700	424136	5646417	1453242	101535	
16	2002	6314690			52700	52700	6261990	1374260	11469	
17	2003	6361104			52700	52700	6308404	1258510	10426	
18	2004	6200966			52700	52700	6148267	1115298	9478	
19	2005	6070929			52700	52700	6018229	992645	8617	
20	2006	5904551			52700	52700	5851852	877674	7833	
21	2007	5697766			52700	52700	5645067	769942	7121	
22	2008	5433268			52700	52700	5380568	667455	6474	
23	2009	5123572			52700	52700	5070872	572191	5885	
24	2010	4745833			52700	52700	4693133	481824	5350	
25	2011	4307278	846671		52700	899370	3407908	397545	83008	
26	2012	3877257			52700	52700	3824557	325323	4422	
27	2013	3498967			52700	52700	3446267	266893	4020	
28	2014	3178542			52700	52700	3125843	220411	3654	
29	2015	2911807			52700	52700	2859107	183559	3322	
30	2016	2678157	-542144		52700	-489445	3167601	153481	-28049	
						Total	19460349	11591057		

EIRR= .1509742
 ENPV(10%)= 7869292 x 10³ Ch\$
 (1987:12%)
 B/C(10%)= 1.678911
 (1987:12%)

Source : Table A-16-13 to A-16-21

Note : Replacement Cost = Financial Price x Shadow Price(1.13) -
 Import Duty(0.3) - Sale Tax(0.03)
 -542144 = Residue Value
 O/M Cost = Financial Price (88,747 - Depreciation of O/M
 Equipment) - IVA(0.2)

The EIRR for the total Project is calculated as 15.1% and the
 ENPV at social discount rate of 12% in 1987 and 10% for
 succeeding years for the total Project is calculated as Ch\$ 7.87
 x 10⁹ in 1985 price. The B/C at the same discount rate is
 1.68.

It is suggested that proposed capital investment to the Project is worthwhile in the context of national economy, as the figure of the EIRR is above the opportunity cost of capital usually found in agricultural sector, the ENPV is positive and the B/C is above 1.00.

The relation between blocks and countermeasures is presented with EIRR, ENPV, and B/C in Table 6-3-3.

Table 6-3-3 Economic Relation Between Blocks and Countermeasures

Block	Countermeasures	EIRR (%)	ENPV (10 ⁹ Ch\$)	B/C
1	Irrigation	22.7	0.62	3.11
	Water Quality	-	-0.22	0.11
	Flood Control	-	-0.02	0.00
2	Transportation	17.8	0.09	1.84
	Water Quality	13.7	0.20	1.31
	Transportation	36.8	0.03	4.95
3 & 4	Irrigation and Water Quality	21.5	11.01	3.00
	Flood Control	-	-3.68	0.16
	Transportation	4.8	-0.16	0.59
Total		15.1	7.87	1.68

Source : Table A-16-13 to A-16-21

The above evaluation will serve as criterion for judging the priority of each countermeasure, though unquantifiable benefits are not taken into account.

6.3.3 Sensitivity Analysis

In the sensitivity analysis, variations in the main cost and benefit parameters are tested. The following three general tests were carried out (Table 6-3-4):

- (i) Costs increased by 10%
- (ii) Benefits reduced by 10%
- (iii) Delay in construction by 1 year

Table 6-3-4 Sensitivity Analysis

Item	EIRR (%)	ENPV (10^9 Ch\$)	B/C
Base	15.1	7.87	1.68
Cost Up (10%)	14.1	6.71	1.53
Benefit Down (10%)	14.0	5.92	1.51
Delay (1 year)	14.2	6.39	1.57

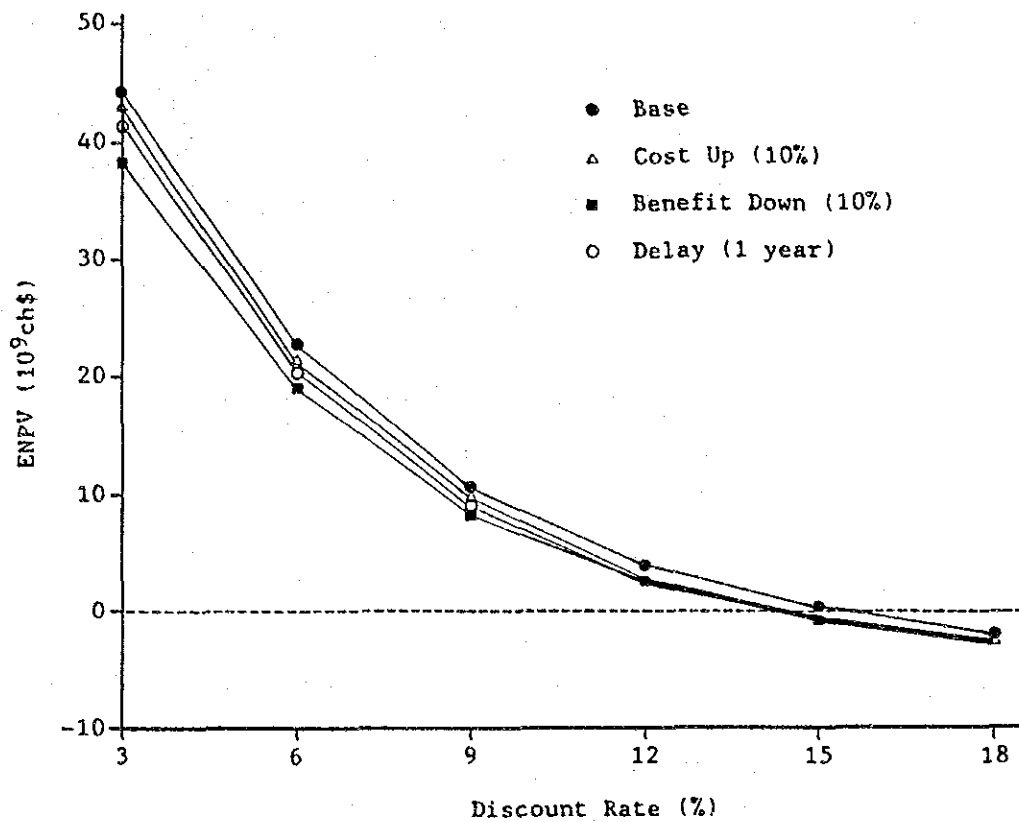
Source : Table 6-3-2

Each parameter comprises the following factors:

- Increase of costs: costs for equipment, materials and wages
- Reduction of benefits: decrease in farm-gate prices of products and productivity, and increase in production costs
- Delay of construction: delay in generating benefits

The above analysis implies that the economic feasibility of the Project is more sensitive to the reduction of benefits than to increase of costs or delay of construction works (Fig 6-3-1).

If flood control benefits are included in the total Project benefits, the EIRR will become 16.1%, the ENPV Ch\$ 9.60×10^9 and the B/C 1.83 (Appendix Table A-16-23).



(Unit : 10⁹ Ch\$)

Discount Rate (%)	3	6	9	12	15	18
Base	44.2	22.4	10.5	3.9	0.1	-2.0
Cost Up (10%)	42.6	21.0	9.3	2.8	-0.9	-2.9
Benefit Down (10%)	38.2	18.8	8.3	2.4	-0.9	-2.7
Delay (1 year)	41.6	20.3	8.9	2.7	-0.7	-2.6

Source : Table 6-3-2

Fig 6-3-1 Discount Rate Diagram

6.4 FINANCIAL EVALUATION

The financial evaluation is realized so as to assess the financial soundness of a project from the viewpoint of an execution agency and beneficiaries of a project; parameters to be used for this task are financial revenue and financial costs which are calculated using financial prices (current market prices). Financial costs do not comprise interests for agricultural credits nor depreciation costs (50% of administration costs and material costs in O/M costs).

6.4.1 Financial Internal Rate of Return (FIRR), Financial Net Present Value (FNPV) and Benefit-Cost Ratio (B/C)

Table 6-4-1 shows the cash flow of benefits, costs and O/M and replacement costs of the Project, which are converted to the financial prices.

Financial Internal Rate of Return (FIRR) is estimated to be 12.0% and Financial Net Present Value (FNPV) at a social discount rate of 12% in 1987 and 10% for succeeding years to be Ch\$ 3.33×10^9 in 1985 price over a project life of 30 years. The B/C at the same discount rate is 1.24.

It is suggested that the financial situation of the Project is sound, as the figure of the FIRR is above the opportunity cost of capital usually found in agricultural sector, the FNPV is positive and the B/C is above 1.00.

Table 6-4-1 Flow of Financial Cost and Benefit

(Unit : 10³ Ch\$)

No.	Year	Project Benefit	Project Replacement Cost	Cost & O/M Cost	Total Cost	Benefit - Cost	Present Value (10%,1987:12%)		
							Benefit	Cost	
1	1987	0	552090		552090	-552090	0	492938	
2	1988	0	917661		917661	-917661	0	758398	
3	1989	0	5410706		5410706	-5410706	0	4065144	
4	1990	0	6163794		6163794	-6163794	0	4209954	
5	1991	0	6061380		6061380	-6061380	0	3763640	
6	1992	574298		60477	60477	513821	324176	34138	
7	1993	235841		60477	60477	175364	121024	31034	
8	1994	12400		60477	60477	-48077	5785	28213	
9	1995	727634		60477	60477	667157	308588	25648	
10	1996	1996760		60477	60477	1936283	769837	23317	
11	1997	3154028		60477	60477	3093551	1105467	21197	
12	1998	4367597		60477	60477	4307120	1391651	19270	
13	1999	4781076		60477	60477	4720599	1384907	17518	
14	2000	5223105		60477	60477	5162628	1375407	15925	
15	2001	5695234	437177	60477	497654	5197580	1363394	119134	
16	2002	5939371		60477	60477	5878894	1292580	13162	
17	2003	5985785		60477	60477	5925308	1184256	11965	
18	2004	5825647		60477	60477	5765170	1047794	10877	
19	2005	5695610		60477	60477	5635133	931278	9888	
20	2006	5529232		60477	60477	5468755	821885	8990	
21	2007	5318348		60477	60477	5257871	718671	8172	
22	2008	5054180		60477	60477	4993703	620886	7429	
23	2009	4744857		60477	60477	4684380	529897	6754	
24	2010	4367656		60477	60477	4307179	443429	6140	
25	2011	3929681	996524	60477	1057001	2872680	362694	97557	
26	2012	3500156		60477	60477	3439679	293682	5074	
27	2013	3122280		60477	60477	3061803	238160	4613	
28	2014	2802270		60477	60477	2741793	194319	4194	
29	2015	2535742		60477	60477	2475265	159852	3812	
30	2016	2302299	-638099	60477	-577622	2679920	131941	-33103	
							Total	17121559	13790992

FIRR=0.1196564
 FNPV(10%)= 3330567 x 10³ Ch\$
 (12% in 1987)
 B/C(10%)= 1.241503
 (12% in 1987)

Source : Table A-16-25 to A-16-32

Note : Replacement Cost -638099 = Residue Value

6.4.2 Investment and Repayment

The foreign currency portion of the Project cost is expected to be loaned by international banking institutions; while an adequate measure should be taken to budget the local currency portion.

Table 6-4-2 explains the flow disbursement and repayment of the Project cost. The foreign currency portion will be loaned under the conditions of:

Annual interest rate: 3%
Grace period : 10 years
Loan period : 30 years

6.4.3 Farm Economy

Comparison between farm economy in with and without project cases in the small-scale farm sector is carried out by block in Section 4.3.2. The result shows that the farmer's economic surplus will reach Ch\$ 950 - 1,250 x 10³, 5.6 - 6.5 times more than without case, which will help the improvement of small-scale farmer's life considerably. Whereas, annual operation and maintenance costs including depreciation cost of equipment is estimated as Ch\$ 5,118/ha. Though the amount ought to be paid by the concerned municipalities which will get indirect benefits from the Project, the farmers can afford to share the cost.

Table 6-4-2 Flow of Disbursement and Repayment

(Unit : 10⁶ Ch\$)

No.	Year	1 Foreign Loan	2 Govern. Finance	3 Total Inflow	4 O/M Cost	5 Accumula. F. Loan	6 Amort. 20 y.	7 Inter. 3 %	2+4+6+7 Total
1	1987	414.5	173.3	587.8		414.5	12.4	185.7	
2	1988	644.6	393.5	1,038.1		1,059.1	31.8	425.3	
3	1989	3,916.3	2,478.1	6,394.4		4,975.4	149.3	2,627.4	
4	1990	4,641.4	2,943.5	7,584.9		9,616.8	288.5	3,232.0	
5	1991	4,780.3	2,949.7	7,730.0		14,397.1	431.9	3,381.6	
6	1992				107.2	14,397.1	431.9	539.1	
7	1993				107.2	14,397.1	431.9	539.1	
8	1994				107.2	14,397.1	431.9	539.1	
9	1995				107.2	14,397.1	431.9	539.1	
10	1996				107.2	14,397.1	431.9	539.1	
11	1997				107.2	14,397.1	719.9	1,259.0	
12	1998				107.2	13,677.2	719.9	410.3	1,237.4
13	1999				107.2	12,957.4	719.9	388.7	1,215.8
14	2000				107.2	12,237.5	719.9	367.1	1,194.2
15	2001		475.2	475.2	107.2	11,517.7	719.9	345.5	1,647.8
16	2002				107.2	10,797.8	719.9	323.9	1,151.0
17	2003				107.2	10,078.0	719.9	302.3	1,129.4
18	2004				107.2	9,358.1	719.9	280.7	1,107.8
19	2005				107.2	8,638.3	719.9	259.1	1,086.2
20	2006				107.2	7,918.4	719.9	237.6	1,064.6
21	2007				107.2	7,198.6	719.9	216.0	1,043.0
22	2008				107.2	6,478.7	719.9	194.4	1,021.4
23	2009				107.2	5,758.8	719.8	172.8	999.8
24	2010				107.2	5,039.0	719.9	151.2	978.3
25	2011		1,083.2	1,083.2	107.2	4,319.1	719.9	129.6	2,039.9
26	2012				107.2	3,599.3	719.9	108.0	935.1
27	2013				107.2	2,879.4	719.9	86.4	913.5
28	2014				107.2	2,159.6	719.9	64.8	891.9
29	2015				107.2	1,439.7	719.9	43.2	870.3
30	2016				107.2	719.9	719.9	21.6	848.7

Source : Table 6-4-1, A-16-34

Note : Current price upto 1991 and 1991 price beyond 1992.

Replacement Cost = Financial Price x Economic Contingency(1.087)

O/M Cost = Financial Price x Economic Contingency(1.773)

6.5 SOCIO-ECONOMIC IMPACT

Besides quantifiable direct benefits presented in the previous section, the implementation of the Project brings other secondary or indirect impacts as described herein.

(1) Development of Surrounding Areas

About 5,600 ha of irrigated agricultural land will be generated owing to the Project implementation. This will ease the acute needs of substituting fields for the fertile fields adjacent to Santiago, which have been devoured by the waves of massive urbanization, and will contribute to the development of agriculture in Great Santiago area.

(2) Balance in Agricultural Development Policies

In the agricultural development of the Project, two different development strategies are applied for two different agricultural production bases. This means that two conflicting agricultural policies; more stable life for small-scale farmers and higher efficiency and productivity in agricultural productions for medium- and large-scale farmers, should be reconciled.

(3) Improvement of Balance of Payments

The increased production of wheat and maize will save one portion of their importation. On the other hand, the increase in production of table grape and other fruits are attributable to the expansion of foreign currency holdings. Hence, saving of imports and expansion of exports will contribute to the improvement of balance of payments.

(4) Employment

The construction of Project facilities will create about $1,618 \times 10^3$ man·day of employment for unskilled labor, 201×10^3 man·day for semi-skilled labor and 69×10^3 man·day for skilled labor over 3.5 years. Increase of employment for the farm labor in the small-scale farm sector is calculated to be about 930 persons per annum (300 days/year). In the medium- and large-scale farm sector, for the newly created area of 5,641 ha, plantation of table grape, peach and nectarine will require 1,740 laborers a

year (300 days) during the plating period, 820 in the formation period and 2,400 throughout the production period.

The unemployment rate has declined since 1983 in which it recorded at 22.3%; during October - December 1985, the estimate of INE showed at 12%.

This decline of unemployment rate is significant, if the increase of labor force is taken into account. According to the two governmental strategies against unemployment - "Plan de Empleo Mínimo (PEM)" and "Programa Ocupacional para Jefes de Hogar (POJH)", the target rate of unemployment is set at 7% (uncomplete employment is regarded as employment in these plans). Furthermore, the Chilean Government is requested to maintain the unemployment rate at and around 10% during 1986-1987 within the framework of the agreement with the IMF.

The implementation of the Project will absorb surplus labor force in the Project Area and surrounding areas under influence of the Project, decrease the unemployment rate, contribute to the improvement of living standard for the employee, and create stable living conditions in the area. It is also expected that the Project will contribute to the attainment of the IMF' target unemployment rate.

(5) Water Quality Improvement

The indirect effect with the quality improvement of irrigation waters is to improve the sanitary environment in the areas. It is said that one of the causes of gastroenteritis is the raw eating vegetables cultivated using the contaminated irrigation waters without treatment.

The improvement of water quality will decrease the causes of gastroenteritis and increase the safety and added value of agricultural products. The increase of safety of products will expand the market and decrease the limitation in selecting crops.

The fame of Santiago as international city will be renewed. The necessity for sanitary survey and preventive measures against epidemics will be reduced. Furthermore, the environment in the areas along the rivers in their downstream section will be improved with the decrease of mudiness and bad smell of canals and rivers, and will provide more recreation opportunities among people living there.

(6) Flood Control

The construction of Sabo dam and improvement of San Carlos canal will stabilize the river bed and check the flow of sediments, alleviating the probable flood damages in the urban area of Santiago as well as the Project Area.

Apart from quantifiable benefits estimated in previous section, the flood alleviation will save activities to prevent flood damage and will reduce medical expenses etc.

(7) Equibration of Regional Difference

The consolidation of road network and rehabilitation of bridges will activate the commercialization among regions and then will equibrate the economic regional differences.

(8) Improvement of Living Standard

As the financial evaluation indicates, the farmer's economic surplus will be multiplied with the implementation of the Project, even if water charges are to be levied on farmers. The improvement of farmer's living standard attributable to these economic surplus is also envisaged.

(9) Economic Impact

The implementation of the Project will increase farmer's income and will greatly improve the living standard of farmers. The increase in economic surplus will associate with the raise of purchasing power of farmers and promotion of regional commercial activities. The development of related industries is also expected to be accelerated.

6.6 COMPREHENSIVE EVALUATION

The implementation of the Mapocho River Basin Agricultural Development Project envisages the increase of farmers' income attributable to the elevation of productivity and introduction of high-profit crops, and the improvement of living standard for people in and around the Project Area by means of sanitary environment improvement, creation of new job opportunity, etc. It is assessed that the Project will contribute to the stabilization of people's livelihood together with producing good result on the regional productive activities and national economy.

The economic and financial evaluations carried out with quantifiable benefits have concluded that the implementation of the Project is feasible. The same conclusion has been brought as a result of socio-economic evaluation made with unquantifiable benefits.

CHAPTER 7 : RECOMMENDATIONS

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7.1 EARLIER IMPLEMENTATION OF THE PROJECT

Based on economic and social effects of the Project not only for the project Area but also for the nation, it is recommended that the Project should be implemented immediately.

7.2 ESTABLISHMENT OF EXECUTING AGENCY

Since the Project crosses many department lines, the establishment of a new executing agency for the Project integrated with MOP and other related organizations is recommended.

7.3 CONSTRUCTION

- (1) Before the commencement of the construction works of the Project, it would be prudent to negotiate with land owners for acquisition of the right-of-way necessary for the construction of the proposed facilities.
- (2) In consideration of difficulty to completely stop the supply of irrigation water even in the winter season, the improvement works of the existing San Carlos and Carmen canals may be made in the following manner:
 - a. Improvement of San Carlos Canal
 - . Construction period: April to September
 - . Flow volume : To be limited to irrigation water required during the construction period (=30% of max. water requirement).
 - . Power generation : To be operated with the limited irrigation water during the construction period.

- . Construction works : Half-cofferdam method
- b. Improvement of Carmen Canal
 - . Construction period: April to September
 - . Flow volume: Same as for paragraph "a".
 - . Construction works: Bypass method

However, it is strongly recommended that the irrigation waters be completely stopped during construction period (April to September) in order to complete these improvement works earlier, more safely and more economically than the works with proposed method.

- (3) Geological/Soil Mechanical and topographic surveys should be made before designing of the major structures.

7.4 Transfer of Water Rights

- (1) The surplus irrigation water secured from the Punta canal should be transferred to the Carmen canal by transferring the water rights of the Punta canal to that of the Carmen canal. This will be indispensable for the success of the Project.
- (2) At present, some water right holders do not use their legally secured waters. For the effective use of limited water resources, the change or modification of the existing water rights is strongly recommended.

7.5 Project Management and Operation & Maintenance

- (1) The success of the Project will largely depend on the management and operation & maintenance of the Project facilities. In this sense, MOP should play a leading role for the establishment of a management office in coordination with other related public institutions.
- (2) Main and secondary irrigation/drainage canals should be maintained by the management office. It is recommended, however, that the tertiary ones are maintained by the farmers benefited with their full responsibility.

7.6 LANDUSE

The economic situation of agriculture in the areas around the big cities which are expanding rapidly is weak compared with that of the second or third industries. The farmers holding agricultural lands around the big cities are always allured into selling their lands to the owners of other industries. Therefore, for the success of the Project around the big city of Santiago, the city planning that clarifies the boundary of agricultural and urban areas is indispensable.

7.7 AGRICULTURE

The highly developed technological basis is required for the improvement of agricultural productivity and the introduction of high-profitable crops, especially in the case of small-scale farmers. It is, therefore, recommended that the technology of the farmers be improved through the technology transfer plan of the INDAP and with the effective utilization of the technical assistance service companies of private sector. On the other hand, the Government or the Project Executing Agency should arrange that the farmers can get the sufficient agricultural credits.

7.8 LIVESTOCK

Livestock production especially pork production which is not included in the Project should be introduced for further improvement of the life of farmers.

7.9 CONSERVATION OF UPPER BASIN

- (1) To minimize the sediment in the Mapocho river, the surplus excavated earth from the road construction along the river should be transported to a disposal area without dumping it into the river stream.

- (2) To promote the conservation of the hillsides by planting trees, more effective utilization of the Yerba Loca Plant Research Center should be considered.
- (3) Riverbed stabilizing measures such as construction of groynes and small dams and improvement river bank should be taken without delay through continuous and systematic survey/observation of the river channel.
- (4) The upstream conservation area should be protected from urbanization in order to maintain balanced living environment between development and conservation of the limited living area.

7.10 FLOOD CONTROL MEASURES

- (1) Bridge girders should be raised or some other countermeasures should be taken wherever the girders will prevent the smooth flow of flood (about 7 problem bridges were observed).
- (2) Riverbank improvement works against floods should be conducted from the downstream section on the basis of the design flood discharge for the objective probability year. The design flood discharge should be estimated based on the rainfall records, not on the discharge records because the river discharge will increase with the improvement of river channel.

7.11 WATER QUALITY

- (1) Water quality of the Mapocho river should be continuously examined preferably with monitoring system whether it is contaminated with copper and other heavy metals or not in order to maintain sufficient soil quality of farmland usable for agriculture, considering present high contents of copper in its upstream section.

- (2) The Chilean standard limit of BOD and N for irrigation waters should be established immediately.

7.12 LAWS AND REGULATIONS FOR RIVER CONTROL

In order to control the river channels systematically, laws and regulations for the development and utilization of rivers should be established through the careful study of related laws and regulations of other countries.

7.13 FUTURE DEVELOPMENT SCHEME

- (1) The study on Mapocho high dam other than Sabo dam should be continued with detailed geological and topographic surveys in consideration of its effects on an advanced irrigation agriculture and flood control against floods of longer return period.
- (2) Improvement of problem soils should be considered in case field tests for soils and crops indicate that improvement works are feasible.
- (3) Centralized control system of irrigation water might be considered if the farmers in a block agree to such control in agricultural production, after the agriculture in the Project Area reaches the level objected in the Project.

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