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PROJECT EVALUATION

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PROJECT EVALUATION

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PROJECT EVALUATION

CHAPTER L-1 OBJECTIVES AND PROCEDURES

Based on the water resource assessment in the Study Area, the selected priority projects from the following three irrigation-based development plans were evaluated for the Master Plan Study:

1) Upper Slakou River Irrigation Reconstruction Plan (USP)
2) Small Reservoir Rehabilitation Plan (SRP)
3) Small Pond Development Plan (PDP)

Objectives of the master plan evaluation are clarification of economic viability using EIRR and effects on the farmers' economy applying farm budget analysis in order to assure viability of the projects selected for further detailed study, i.e. feasibility study. Viability among the above three irrigation-based development plans and their priority projects were not discussed in the evaluation analyses because there is difference in development approaches, development potential, degree of economic impact, etc.

USP was formulated as the most appropriate development project. The SRP as a whole was evaluated by selecting the highest two and single lower one priority projects in order to clarify the range of viability among the 15 SRP projects. The PDP was evaluated for three (3) types of small ponds, i.e. farmers' group operated small pond, individual farmer operated small pond, and small pond utilizing existing canal in order to develop a unit irrigated farm area (5 ha), respectively.

The feasibility study was made for the selected priority projects as follows:

1) Upper Slakou River Irrigation Reconstruction Plan (USP, 3,500 ha)
2) Small Reservoir Rehabilitation Plan at the following two sites;
    i) Kim Sei SRP (27 ha)
    ii) Ang 160 SRP (25 ha)
3) Small Pond Development Plan (PDP) in Trapeang Snao village, Nhaeng Nhang commune (5.82 ha)
4) Rural Road Improvement Program (23.62 km) comprising;
    i) Trapeang Thum Khang Cheung to Trapeang Kranhung (13.32 km),
    ii) O Saray to Slakou river (4.14 km), and
    iii) Kpob Svay road (6.16 km).

CHAPTER L-2 EVALUATION FOR MASTER PROJECTS

L-2.1 Economic Evaluation

L-2.1.1 Evaluation Procedures

All prices for Master Plan Evaluation were expressed in constant prices as of May, 2001 applying the official exchange rate of US$ 1.0 = Riel 3,835 = \ 123.32. The economic life of the project is assumed to be 50 years for USP and SRP, 30 years for PDP, beginning from the year 2002, which is assumed to be the commencement year for construction.

Economic farm gate prices of traded agricultural inputs and outputs were based on their export or import parity prices derived from the World Bank Commodity Price Forecasts as of May 2000. The long-run projected prices in 2005 at 2001 constant price were used in the analysis. The average of export and import parity prices of farm products of rice, maize, soybean, and groundnut, and import parity prices of fertilizer were calculated and applied for the economic prices as shown in Table L-1.

A standard conversion factor (SCF) of 0.94 was applied for adjustment of the trade distortion in order to reflect the opportunity cost of the items being shadow priced. Economic prices applied for preparation of crop production budgets were summarized in Table L-2.

Transfer payment such as tax, duty, subsidy, interest, etc., were excluded in estimating the economic costs and benefits. Financial construction costs were converted into economic values using the construction conversion factors (CCFs).

L-2.1.2 Economic Benefit

Irrigation and drainage benefit will be accrued from increase in cropping areas and productivity of target crops comprising paddy, maize, soybean/mung-bean, groundnut, sesame, and vegetables. The economic benefit was estimated as an increment of Net Production Value (NPV) between the future with and without project conditions. The economic crop budgets of respective crops were prepared under the without and with project conditions by applying requirements for farm inputs and total labor, unit crop yields, and their economic prices (See Table L-3 and L-4).

The irrigation and drainage benefit (increment of NPV) of the respective projects for USP, SRP and PDP was estimated as follows (See Table L-5):

Economic Irrigation and Drainage Benefit

Project	Project Area (ha)	Cropping Intensity (%)		Net Production Value (Riel Million)		
		Without Project	With Project	Without Project	With Project	Increment
1. USP	3,500	95	130	2,222.1	7,825.8	5,603.7
2. SRP						
Kim Sei	21	95	130	13.33	46.95	33.62
Ang 160	21	95	130	13.33	46.95	33.62
Trapeang Lean	10	95	130	6.35	22.36	16.01
3. PDP						
Pond (Group)	5 (57.1)	95	95.3 *	3.17	13.05	9.88
Canal Pond (G)	5 (57.1)	95	95.3 *	3.17	13.05	9.88
Pond (individual)	5 (57.1)	95	95.3 *	3.17	13.05	9.88

Note: * % to the area (57.1 ha) including rain-fed area

Annual economic benefit flow was estimated based on the progress of area developed, built-up period of increment of NPVs for three years (See Table L-6).

L-2.1.3 Negative Benefit

Existing farmlands will be acquired and used for the construction of irrigation and drainage facilities. The agricultural production foregone defined as the annual net production value without project was accounted for negative benefit in the evaluation as follows (See Table L-7):

Negative Project Benefit

Project	Farm Land (ha)	Forgone Amount (Riel Million)
1. USP	6.0	3.80
2. SRP		
Kim Sei	0.2	0.13
Ang 160	0.2	0.13
Trapeang Lean	0.1	0.06
3. PDP		
Pond (Group)	0.6	0.37
Canal Pond (G)	0	0
Pond (individual)	1.1	0.70

L-2.1.4 Economic Cost

1) Cost for Project Investment

The economic project cost was classified by (i) direct construction cost, (ii) O & M equipment cost, (iii) institutional development cost, (iv) administration cost, (v) engineering cost, and (vi) physical contingencies (See Table L-8). The economic project investment cost was estimated by applying relevant conversion factors to the components of financial foreign and local currency cost comprising equipment, materials and labor. The total economic project investment cost of the respective projects for USP, SRP and PDP was estimated as follows:

Economic Investment Cost

Project	Project Area (ha)	Investment Cost (Riel Million)	Cost per ha (Riel '000)
1. USP	3,500	50,232.1	14,352
2. SRP			
Kim Sei	21	317.4	15,114
Ang 160	21	305.9	14,567
Trapeang Lean	10	208.8	20,880
3. PDP			
Pond (Group)	5	75.5	15,100
Canal Pond (G)	5	57.1	11,420
Pond (individual)	5	90.3	18,060

2) O & M Cost

The financial O & M cost was converted to economic value by applying relevant conversion factors to the components of financial foreign and local currency costs same as the project investment costs. The O & M cost of the respective projects for USP, SRP and PDP was estimated as follows (See Table L-9):

Economic O & M Cost

Project	Project Area (ha)	O & M Cost (Riel Million)	Cost per ha (Riel '000)
1. USP	3,500	206.8	59.1
2. SRP			
Kim Sei	21	1.49	71.0
Ang 160	21	1.49	71.0
Trapeang Lean	10	0.74	74.0
3. PDP			
Pond (Group)	5	0.42	84.0
Canal Pond (G)	5	0.73	146.0
Pond (individual)	5	0.71	142.0

3) Replacement Cost

The project facilities and equipment with shorter useful life than those of respective projects need to be replaced after the assumed working life is over. The replacement cost was estimated by applying the conversion factors to the respective financial cost for replacement. The useful life and replacement cost of the respective projects for USP, SRP and PDP was estimated as follows (See Table L-10):

Economic Replacement Cost

(Riel Million)

Project	Gate (25 years)	Wooden stop log (5 years)	O & M Equipment (10 years)
1. USP	823.4	82.0	227.0
2. SRP			
Kim Sei	7.9	0.6	2.0
Ang 160	2.6	0.5	2.0
Trapeang Lean	10.5	0.4	2.0

L-2.1.5 Economic Evaluation

The economic cost and benefit stream comprising (i) the cost for project investment, O & M and replacement, and (ii) irrigation and drainage, and negative benefit was prepared for the economic life of the respective projects for USP, SRP and PDP. Economic internal rate of return (EIRR) and other indicators were calculated and summarized as follows (See Table L-11):

Economic Efficiency of the Projects

Item	USP	SRP			PDP (Per 5 ha)		
		Kim Sei	Ang 160	Trapeang Lean	Pond (Group)	Canal Pond	Pond (Individual)
EIRR (%)	10.0	9.4	9.8	6.6	10.5	14.4	7.7
NPV (Riel Million) (6.5 % discount rate)							
Benefit	59,380	417	417	199	102	107	98
Cost	40,780	302	291	197	72	59	88
B - C	18,600	115	126	2	30	48	10
B / C	1.5	1.4	1.4	1.0	1.4	1.8	1.1

L-2.2 Financial Evaluation

L-2.2.1 Farm Budget Analysis

Farm budget analysis was made by assuming the anticipated change in income and expenditure for the median size farm operation (0.8 ha in the Study Area). Other farm and non-farm income and living expenditure were assumed to be same between with and without project conditions to enable the direct impact on the farm economy of the respective projects for USP, SRP and PDP to be evaluated.

The household income was estimated to increase by 155 % for the USP and SRP area and 17 % for the PDP area. Because the livelihood of the median size farmers and below is at subsistence level, the future net reserves of those farm households under with project condition is expected to increase significantly. The median size farmers could get a 200-fold increase on the without condition for the USP and SRP area, and a 25-fold increase for the PDP area. The future livelihood situation under the without and with project conditions was summarized as follows (See. Table L-12):

Farm Budget Assessment (Median Size 0.8 ha)

(Unit: Riel '000)

Item	USP and SRP Area	PDP Area
Without Project		
Income	789.2	789.2
Expenditure	789.6	784.6
Net Reserve	4.6	4.6
With Project		
Income	2,011.6	923.1
Expenditure	1,081.6	804.4
Net Reserve	930.0	118.7
Increase (%)		
Income	155	17
Expenditure	38	3
Net Reserve	20,117	2,480

L-2.2.2 Capacity to Pay for O & M Cost

Increase in farm income shall be utilized for additional livelihood expenditure, savings, and O & M cost for the respective project facilities. The annual requirement of O & M cost of the respective projects in the case of the median size farmers (0.8 ha) was estimated and compared to the respective incremental net income. The O & M cost requirement will be below 10 % of the incremental net income for USP and SRP areas and below 20 % for PDP area as follows:

O & M Cost Requirement and Share to Net Reserve

Project	O & M Cost (Financial)		
	Per ha (Riel '000)	Per 0.8 ha (Riel '000)	Share to Incremental Net Reserve (%)
1. USP	76.7	61.4	7
2. SRP			
Kim Sei	96.0	76.8	8
Ang 160	96.0	76.8	8
Trapeang Lean	96.0	76.8	8
2. PDP		(0.07 ha)*	
Pond (Group)	152.0	10.6	9
Canal Pond (G)	268.0	18.8	16
Pond (Indivisual)	258.0	18.8	16

Note: * Irrigation area per median farmer (0.8 ha)

L-2.3 Justification of Priority Projects

Evaluation indicated that the Upper Slakou River Irrigation Reconstruction Project (USP) has sufficient economic and financial viability. It is expected to increase farm income sufficiently to finance the future O & M cost of the project facilities.

Regarding the Small Reservoir Rehabilitation Plan (SRP) comprising 15 projects, economic viability of those projects indicated EIRRs between 6.6 % and 9.8 %. The lower ranking priority project, i.e. Trapeang Lean SRP is still affordable for implementation because there are no other alternative measures at the area to increase farm income through water resources development.

Pond Development Plan (PDP) indicated a higher viability in terms of EIRR, but the magnitude of impact to the farm economy in terms of increment of net income is comparatively smaller than those of USP and SRP.

The viability of the three development approaches (USP, SRP and PDP) in the Study Area were justifiable as the master plan. Three types of development approaches as model projects were considered applicable for other areas under similar climate and topography.

L-2.4 Selection of Priority Projects for Feasibility Study

The priority projects for the feasibility study were selected for the proposed three irrigation development plans (USP, SRP and PDP) as follows:

1) Upper Slakou River Irrigation Reconstruction Plan (USP): 3,500 ha

2) Small Reservoir Rehabilitation Plan (SRP): 42 ha

Based on technical soundness, degree of beneficiary participation and availability of water source, the following two priority projects should be studied at feasibility level as model SRP:

1. Kim Sei SRP (21 ha)
2. Ang 160 SRP (21 ha)

3) Small Pond Development Plan (PDP)

There are three types of ponds in the plan, i.e. pond operated by individual farmers, ponds operated by farmers groups, and canal ponds operated by farmers groups. In order to formulate the small pond development project at feasibility level, at least one development plan for each pond type needs to be studied as a model PDP at one village. A canal pond has higher EIRR than the others, and availability of existing canal having potential water is a key factor. Based on the consideration of the following factors, one village in Nhaeng Nhang commune covering the canal No. 8 should be selected as a site for the feasibility study:

1. The area is not covered by the USP and SRP and irrigation water is short.
2. Canal No. 8 has potential for using drained water from the upstream after construction of the canal pond.
3. High demonstration effects are expected.
4. Accessibility to the markets, i.e. Tramkak and Takeo along the national road No. 3 is good and sale of vegetables to be produced by using the pond water is easy.

Together with the above priority projects for the feasibility study, implementation of the rural road improvement program is crucial to realize the benefits of development of USP. The USP area including the access road to Tumnup Lok reservoir has poor accessibility. The following three priority roads with total length of 24.5 km were selected for the feasibility study:

1. Trapeang Thum Khang Cheung to Trapeang Kranhung (13 km),
2. O Saray to Slakou river (5.5 km), and
3. Kpob Svay road (6.0 km).

The following support programs for the selected priority irrigation projects should also be studied at feasibility level in order to assure the irrigation development impact and other associated effects, specifically for the improvement of farmers' living standard:

1. Agricultural production Program,
2. Agricultural Support Program,
3. Institutional Development Program, and
4. Environmental Conservation Program.

CHAPTER L-3 EVALUATION FOR FEASIBILITY STUDY PROJECTS

L-3.1 Economic Evaluation

L-3.1.1 Evaluation Procedures

All prices for Feasibility Study Evaluation were expressed in constant prices as of October, 2001 applying the official exchange rate of US$ 1.0 = Riel 4,022.2 = ¥ 120.53. The economic life of the projects is assumed to be 50 years for USP, SRP and RIP, 30 years for PDP, beginning from the year 2002, which is assumed to be the commencement year for construction.

Economic farm gate prices of traded agricultural inputs and outputs were based on the World Bank Commodity Price Forecasts as of May 2000. The average of export and import parity prices of farm products and import parity prices of fertilizer were calculated and applied for the economic prices as shown in Table L-13.

A standard conversion factor (SCF) of 0.94 was applied for adjustment of the trade distortion in order to reflect the opportunity cost of the items being shadow priced. Economic prices applied for preparation of crop production budgets were summarized in Table L-14.

Transfer payment such as tax, duty, subsidy, interest, etc., were excluded in estimating the economic costs and benefits. Financial construction costs were converted into economic values using the construction conversion factors (CCFs).

L-3.1.2 Economic Benefit

Irrigation and drainage benefit will be accrued from increase in cropping areas and productivity of target crops comprising paddy, maize, soybean, mung-bean, groundnut, sesame, and vegetables based on the feasibility study. The economic crop budgets of respective crops were prepared under the without and with project conditions as shown in Table L-15 and L-16.

The irrigation and drainage benefit (increment of NPV) of the respective projects for USP, SRP and PDP was estimated as follows (See Table L-17):

Economic Irrigation and Drainage Benefit, Feasibility Study

Project	Project Area (ha)	Cropping Intensity (%)		Net Production Value (Riel Million)		
		Without Project	With Project	Without Project	With Project	Increment
1. USP	3,500	96	130	3,068.8	9,977.3	6,908.5
2. SRP						
Kim Sei	27	100	100	23.2	55.6	32.4
Ang 160	25	12	120	27.1	58.9	31.8
3. PDP	5.82	97	128	5.1	18.8	13.7

The transportation cost for commodities and passenger traffic and frequency of commuting using the existing road were surveyed at the influencing area of the RIP and the developed area along ADB road-1 and the district road 33 before

T.T.K. Cheung. The transportation cost of the RIP area is expected to reduce at the level of the developed area. The increase in volume of transportation will be different between with and without USP because of increase in agricultural production and farm inputs. Based on the future traffic volume and number of passenger, and the transportation cost savings, rural road improvement benefit was estimated as follows (See Table L-18):

Economic Rural Road Improvement Benefit, Feasibility Study

Year	Without USP		With USP	
	Goods (ton)	Passenger (persons)	Goods (ton)	Passenger (persons)
2005	14,130	140,560	14,130	140,560
2030	15,810	236,910	34,780	359,810
2050	17,950	359,700	40,580	546,310
Year	Transportation Cost Saving (Riel '000)			
	Financial	Economical*	Financial	Economical*
2005	618,510	439,140	618,510	439,140
2030	777,560	552,070	1,335,900	948,490
2050	980,380	696,070	1,689,570	1,199,590

Note: * Adjusted with CF of 0.71

Annual economic benefit flow for irrigation and drainage projects was estimated based on the progress of area developed, built-up period of increment of NPVs in five years for USP and SRP, three years for PDP. Road improvement benefit will accrued after the completion of construction from the present level of traffic volume and enlarged according to the increase of volume of traffic under with and without USP (See Table L-19).

L-3.1.3 Negative Benefit

Existing farmlands will be acquired and used for the construction of irrigation and drainage facilities. The agricultural production foregone defined as the annual net production value under without project was accounted for negative benefit in the evaluation as follows (See Table L-20):

Negative Project Benefit for Irrigation and Drainage Project
Feasibility Study

Project	Farm Land (ha)	Forgone Amount (Riel Million)
1. USP	60.0	52.60
2. SRP		
Kim Sei	0.2	0.18
Ang 160	0.1	0.09
3. PDP	0.4	0.39

L-3.1.4 Economic Cost

(1) Cost for Project Investment

The economic project investment cost was estimated by applying relevant conversion factors to the components of financial foreign and local currency cost comprising equipment, materials and labor same as the master plan evaluation. The

total economic project investment cost of the respective projects for USP, SRP, PDP and RIP was estimated as follows (See Table L-21):

Economic Investment Cost, Feasibility Study

Project	Project Area (ha)	Investment Cost (Riel Million)	Cost per ha (Riel '000)
1. USP	3,500	55,180.2	15,766
2. SRP			
Kim Sei	27.0	184.6	6,837
Ang 160	25.0	169.1	6,764
3. PDP	5.82	111.3	19,124
4. RIP	23.62 km	3,074.2	130,151 /km

(2) O & M Cost

The financial O & M cost was converted to economic value by applying relevant conversion factors to the components of financial foreign and local currency costs same as the project investment costs. The O & M cost of the respective projects for USP, SRP, PDP and RIP was estimated as follows (See Table L-22):

Economic O & M Cost, Feasibility Study

Project	Project Area (ha)	Annual O & M Cost (Riel Million)	Cost per ha (Riel '000)
1. USP	3,500	160.4	45.8
2. SRP			
Kim Sei	27.0	2.4	90.0
Ang 160	25.0	2.6	105.2
3. PDP	5.82	1.1	187.3
4. RIP	23.62 km	9.8	416.2 /km

(3) Replacement Cost

The project facilities and equipment with shorter useful life than those of respective projects need to be replaced after the assumed working life is over. The replacement cost was estimated by applying the conversion factors to the respective financial cost for replacement. The useful life and replacement cost of the respective projects for USP, SRP and PDP was estimated as follows (See Table L-23):

Economic Replacement Cost, Feasibility Study

(Riel Million)

Project (Useful Life)	Gate		Wooden stop log	O & M Equipment		Building
	25 years	10 years	5 years	8 years	10 years	30 years
1. USP	1,295.0	34.1	8.8	29.2	217.3	329.0
2. SRP						
Kim Sei	0.2	-	-	-	-	-
Ang 160	6.09	-	-	-	-	-

L-3.1.5 Economic Evaluation

The economic cost and benefit stream comprising (i) the cost for project investment, O & M and replacement, and (ii) irrigation and drainage, and negative

benefit was prepared for the economic life of the respective projects for USP, SRP, PDP and RIP. Economic internal rate of return (EIRR) and other indicators were calculated and summarized as follows (See Table L-24):

Economic Efficiency of the Projects, Feasibility Study

Item	USP	SRP		PDP	RID with USP
		Kim Sei	Ang 160		
EIRR (%)	10.2	13.7	14.5	8.7	18.8
NPV (Riel Million) (6.5 % discount rate)					
Benefit	73,660	410	404	105	11,551
Cost	47,535	207	196	87	2,773
B - C	26,125	203	208	18	8,778
B / C	1.5	2.0	2.1	1.2	4.2

The sensitivity of USP, SRP, PDP and RIP from adverse economic changes was tested by using three assumptions, i.e. increasing the cost by 20 %, decreasing the benefit by 20 %, and increasing the cost by 10 % and decreasing the benefit by 10 %. In general, USP and SRP are insensitive to such changes, while PDP is sensitive especially to decreasing the benefit. Decrease in the benefit of all projects will affect more to the economic viability than increase in the cost. The result of the sensitivity test was summarized as follows:

Sensitivity of the Projects, Feasibility Study

Project	Change in Variation	EIRR (%)	Sensitivity Indicator	Switching Value EIRR: 6.5 %
1. USP				
Base case		10.2	0.78	58
- Cost increased	+ 20 %	8.6	0.98	35
- Benefit reduced	- 20 %	8.2		
- Cost increased &	+ 10 %	8.4		
benefit reduced	-- 10 %			
2. SRP				
Kim Sei				
Base case		13.7	0.73	117
- Cost increased	+ 20 %	11.7	0.99	49
- Benefit reduced	- 20 %	11.0		
- Cost increased &	+ 10 %	11.3		
benefit reduced	-- 10 %			
Ang 160				
Base case		14.5		
- Cost increased	+ 20 %	12.3	0.76	131
- Benefit reduced	- 20 %	11.6	1.00	51
- Cost increased &	+ 10 %	12		
benefit reduced	-- 10 %			
3. PDP				
Base case		8.7		
- Cost increased	+ 20 %	6.8	1.09	23
- Benefit reduced	- 20 %	6.0	1.55	16
- Cost increased &	+ 10 %	6.4		
benefit reduced	-- 10 %			
4. RIP (With USP)				
Base case		18.8		
- Cost increased	+ 20 %	16.3	0.66	256
- Benefit reduced	- 20 %	15.8	0.80	71
- Cost increased &	+ 10 %	16.1		
benefit reduced	-- 10 %			

L-3.2 Financial Evaluation

L-3.2.1 Farm Budget Analysis

Farm budget analysis was made by assuming the anticipated change in income and expenditure for the respective average size of farm operation. Other farm and non-farm income and living expenditure were assumed to be the same for both with and without project conditions to enable the direct impact on the farm economy of the respective projects for USP, SRP and PDP to be evaluated.

The household income was estimated to increase by 99 % for USP, 14 to 34 % for SRP and 16 % for PDP. The future net reserve of the farm households under with project condition is expected to increase, specifically at the USP area. Because SRP and PDP can irrigate a part of agricultural land operating by the farmers, financial impact to the farm economy of those areas will be limited.

The average size farmers could get around a 7,500-fold increase on the without condition for the USP, a 220-fold increase for SRP, and a 150-fold increase for PDP. The future livelihood situation under the without and with project conditions was summarized as follows (See. Table L-25):

Farm Budget Assessment, Feasibility Study

(Unit: Riel '000)

Item	USP	SRP		PDP
		Kim Sei	Ang 160	
Average Size (ha)	0.87	1.33	1.10	1.15
Without Project				
Income	875.5	1,502.2	1,034.7	1,065.6
Expenditure	866.2	1,330.2	983.7	961.7
Net Reserve	9.3	172.0	51.0	103.9
With Project				
Income	1,746.0	2,017.7	1,184.4	1,239.2
Expenditure	1,033.9	1,459.5	1,023.2	978.3
Net Reserve	712.1	558.2	161.2	260.9
Increase (%)				
Income	99	34	14	16
Expenditure	19	10	4	2
Net Reserve	7,557	225	216	151

L-3.2.2 Capacity to Pay for O & M Cost

The annual requirement of O & M cost of the respective projects by the average scale of farm operation was estimated and compared to the respective increment of net income. The O & M cost requirement will be below 10 % of the incremental net income for USP and PDP and below 15 % for SRP as follows:

O & M Cost Requirement and Share to Net Reserve, Feasibility Study

Project	Average Size (ha/F. House)	Increment of Net Reserve (Riel '000/F. House)	O & M Cost (Riel '000/F. House)	Share to Increment of Net Reserve (%)
1. USP	0.87	702.8	48.1	7
2. SRP				
Kim Sei	1.33	386.2	47.0	12
Ang 160	1.10	110.2	13.4	12
3. PDP	1.15	157.0	12.1	8

L-3.2.3 FWUCs' Activities and Management

After completion of the project construction works, FWUCs and their Apex organization will operate the facilities comprising the irrigation facilities, the FWUCs' depots and offices, the Apex office, and the assembling market. The income for FWUCs will be the irrigation service fee (ISF), income accrued from the storage of paddy paid as ISF, market charge paid by the farmers and buyers, and trade income from sales of the members' products at the terminal markets. The expenditure comprises the personnel cost of FWUCs, the operation and maintenance cost for the facilities, and their replacement cost.

Based on the annual O & M cost required and the prevailing ISF rates around the project area, ISF rates were set at Riel 40,600 /ha (equivalent to the value of 140 kg of paddy) for wet season paddy and diversified crops, and at Riel 76,500 /ha (264 kg of paddy) for dry season diversified crops. Cash flow for irrigation O & M activities was prepared as shown in Table L-26. The annual O & M cost for the irrigation facilities could be made by the 80 % of ISF collection, while the replacement cost for irrigation facilities, the offices and equipment needs to be subsidized by the government from the 6th-year of the operation. If the cost for the replacement is paid by the beneficiaries, the ISF rates will be set as follows:

ISF Requirement for Replacement, Feasibility Study

Item	Original Rate		Replacement by ISF Saving			
	80 % ISF Collection		100 % ISF Collection		80 % ISF Collection	
	Paddy (kg/ha)	Amount (Riel/ha)	Paddy (kg/ha)	Amount (Riel/ha)	Paddy (kg/ha)	Amount (Riel/ha)
Wet season						
Paddy	140	40,600	174	50,482	218	63,103
Div. Crops	140	40,600	174	50,482	218	63,103
Dry season						
Div. Crops	264	76,500	328	95,120	410	118,900

Taking the achievable ISF collection efficiency of 80 % into consideration, the ISF rates at 218 kg of paddy/ha and 410 kg of paddy equivalent/ha for wet and dry season crops, respectively are considered as unrealistic for the USP management. Total ISF payment for 0.87 ha of average operation size will be around Riel 79,000 /year that accounts for 11 % of the increment of net income under with project condition.

Annual ISF Payment for 0.87 ha Operation, Feasibility Study

Crops	Cropping Area		ISF (Riel '000/operation area)	
	Area (ha)	C. Intensity (%)	Per ha	Ave. Size (0.87 ha)
Paddy	3,500	1.000	63,103	54,900
Wet S. Diver. crops	500	0.143	9,015	7,843
Dry S. Diver. crops	550	0.157	18,684	16,255
(Physical Area	3,500	ha)		
Total	4,550	1.300		78,998
			Incre. Net Income (0.87 ha)	702,800
			Share to ISF (%)	11.2 %

To supplement the deficit for cost of replacement, USP requires FWUCs' marketing services for the farmer beneficiaries. The cash flow for marketing services was independently prepared taking revenue from market charge and trade income, and all O & M expenditure for the activities as shown in Table L-26. The marketing services are financially sustainable at around 30 % of gross revenue reduction. The net income from the marketing services will be saved for the fund of the replacement of irrigation facilities and FWUCs could be financially sustained. Under the 80 % of ISF collection efficiency at 140 kg and 264 kg of paddy for wet and dry season crops, respectively, around 15 % of gross revenue reduction in the marketing services will be breakeven for the entire management of FWUCs.

L-3.3 Indirect Benefits and Socio-Economic Impacts

L-3.3.1 Self-sufficiency of Rice in the Project Area

The annual increment of rice production by the USP, two SRPs and PDP projects will be around 6,100 ton of paddy and 4,000 ton of rice under with project condition. This increment of rice production will be additional supply for the deficit of local rice demand.

L-3.3.2 Vegetable Production and Foreign Currency Savings

Vegetable production in the project area is made mainly for home and local consumption at present. After implementation of the projects, annual increment of vegetable production will be around 3,500 ton that is equivalent to Riel 2.4 billion (US$ 0.6 million) at the farm gate value. Future vegetable production by the projects will substitute vegetable importation from the neighboring countries and save this amount.

L-3.3.3 Improvement of Rural Accessibility

The USP will provide 44.7 km of farm road along the secondary canals. These road will effect to the local economy through not only directly by reducing the transportation cost, but also by saving time for transportation and minimizing post harvest losses, etc.

L-3.3.4 Increase in Employment Opportunity

The projects will generate additional employment of around 134 thousand person-days annually for the farming activities. In addition, construction labor for USP will be around 303.8 thousand person-days in total. During the construction period from 2003 to 2005, around 580 persons per month will be deployed on average in the actual construction period of 21 months. These additional employment generations will effect to reduce the present unemployment especially in the lean production season. The labor for the project construction will be employed mainly from the beneficiaries of the projects.

L-3.3.5 Promoting Rural Industry

The agro-industry and agri-related service sectors will be activated by value adding

to the crop products and enlarging trade of farm inputs. Project effects on the local economy including the industry and services are considered significant.

CHAPTER L-4 RECOMMENDATIONS

L-4.1 Justification of Feasibility Study Projects

(1) Master Plan and Feasibility Studies

The Maser Plan Study on the Rehabilitation and Reconstruction of Agricultural Production System in the Slakou River Basin aimed at formulation and selection of appropriate irrigation-based development plans in the area that will be model plans for other similar areas in Cambodia. The Master Plan Study identified the following three irrigation-based development plans and verified their economic viability using EIRR and effects on the farmers' economy applying farm budget analysis and assessment of capacity to pay O & M cost:

1) Upper Slakou River Irrigation Reconstruction Plan (USP)
2) Small Reservoir Rehabilitation Plan (SRP)
3) Small Pond Development Plan (PDP)

USP was formulated as the most appropriate development project. The SRP as a whole was evaluated by selecting the highest two and single lower one priority projects in order to clarify the range of viability among the 15 SRP projects. The PDP was evaluated for three (3) types of small ponds, i.e. farmers' group operated small pond, individual farmer operated small pond, and small pond utilizing existing canal in order to develop a unit irrigated farm area (5 ha), respectively.

Based on the above Master Plan Evaluation, the following priority projects were selected and studied at the feasibility level:

1) Upper Slakou River Irrigation Reconstruction Plan (USP, 3,500 ha)
2) Small Reservoir Rehabilitation Plan at the following two sites;
   - Kim Sei SRP (27 ha)
   - Ang 160 SRP (25 ha)
3) Small Pond Development Plan (PDP) in Trapeang Snao village, Nhaeng Nhang commune (5.82 ha)
4) Rural Road Improvement Program (23.62 km) comprising;
   - Trapeang Thum Khang Cheung to Trapeang Kranhung (13.32 km),
   - O Saray to Slakou river (4.14 km), and
   - Kpob Svay road (6.16 km).

(2) Economic Viability of Priority Projects

The Upper Slakou River Irrigation Reconstruction Project (USP) covering the irrigation area of 3,500 ha has sufficient economic and financial viability. The magnitude of project impact to the local economy by additional income and employment generation, creating rice self-sufficiency in the area, and promoting rural industry is considered significant.

The two priority SRPs, i.e. Kim Sei and Ang 160, indicated high economic efficiency. While impact to the farmer beneficiaries will be limited because SRPs

can irrigate a part of agricultural land, i.e. 27 ha for Kim Sei and 25 ha for Ang 160, operating by the farmers (37 and 130 farmers respectively).

The PDP indicated affordable economic efficiency, but magnitude of impact to the farm economy in terms of increment of net income was smaller than those of USP and SRP.

RIP has sufficient economic viability. Economic impact to the upper area of USP (1,477 ha of agricultural land) and outside influencing area (4,004 ha) covering the total households of around 4,400 in 2001 will be significant. The access road to Tumnup Lok reservoir of USP, one of the RIP routes, is very poor at present and needs to be rehabilitated for the effective implementation of USP. The development of the outside influencing area will be also accelerated by RIP.

Economic Efficiency of the Projects, Feasibility Study

Item	USP	SRP		PDP	RID with USP
		Kim Sei	Ang 160		
EIRR (%)	10.2	13.7	14.5	8.7	18.8
NPV (Riel Million) (6.5 % discount rate)					
Benefit	73,660	410	404	105	11,551
Cost	47,535	207	196	87	2,773
B - C	26,125	203	208	18	8,778
B / C	1.5	2.0	2.1	1.2	4.2

L-4.2 Requirements for Project Sustainability

The project risk for USP will be financial background for O & M of the project facilities as well as assurance of ISF collection. If the beneficiaries pay the cost for the replacement, the ISF rates will be set as follows:

- 218 kg of paddy/ha and 410 kg of paddy equivalent/ha for wet and dry season crops, respectively, and
- Total ISF payment for 0.87 ha of average operation size will be around Riel 79,000 /year that accounts for 11 % of the increment of net income under with project condition.

In order to minimize the beneficiaries' load to pay a high rate of Irrigation Service Fee (ISF), FWUCs need to operate marketing assistance services to ensure markets of products and generate internal revenues through storage and sales of paddy collected as ISF, and assembling and marketing assistance. The net income from the marketing services will be saved for the fund of the replacement of irrigation facilities and FWUCs could be financially sustained.

In addition to the project investment for direct construction cost, institutional development for FWUCs and capacity building of the staff of FWUCs as well as the project office staff will be crucial. Participatory development for the secondary and tertiary canal systems with farmer beneficiaries will be a key factor for assurance of project ownership generation among the beneficiaries and sustainable O & M participation. The technical assistance for organizing and developing

FWUCs by deploying the consultants for these realization will be required and a part of USP investment.

Technical issues for O & M of SRP and PDP are limited except introducing new crops such as vegetables with farm guidance extension. Sustainability of SRP and PDP will be fully depending on the beneficiaries' participation and implementation of their obligation such as payment of ISF and/or other charges. Coverage of O & M activities for SRP will be a command area of tertiary canal at USP. PDP will be a village based development program depending on the participation and consensus creation among the villagers.

Similar to the USP, SRP and PDP beneficiaries need to implement the irrigation and other related activities by themselves after the initial investment and support. SRP beneficiaries need to pay the cost for annual O & M activities and to save a fund required for replacement of the irrigation facilities in the future. PDP beneficiaries will obligate to pay a certain amount for creation of revolving fund that will be utilized for similar activities in other villages.

L-4.3 Implementation Arrangement for USP

Sustainability of the irrigation system will fully depend on the beneficiaries' self-reliance organization and their activities. Under the economic situation in Cambodia, continuos financial support will not be made for the rehabilitated and newly developed systems. Equity to other areas not yet reaching assistance and investment need to be considered. Project office to be organized for USP will act as facilitator and supporter to organize beneficiaries to FWUCs, implement facility design and supervision of construction work by applying the participatory manners, and transfer the technologies for O & M, farming and marketing. The term of the project office will be limited at the initial four years until completion of the construction work. The Technical Supervision and Assistance Unit under the coordination with FWUCs' Apex will assist the succeeding four years. These organizational arrangement aims at more attention to realization of beneficiaries' self-reliance O & M organization and activities, not continuos support by the government.

Under the above implementation arrangement and development concept as a model development in Cambodia, the institutional development support focusing on the following activities needs to be implemented by the donor agencies with technical assistance, transfer of technologies, and provision of program fund to be required:

- Participatory agricultural land registration and mapping for preparation of water users' list by tertiary canal,
- Participatory tertiary canal alignment and layout of the facilities and coordination for agricultural land sharing and compensation among the tertiary canal users,
- FWUCs' registration assistance,
- Transfer of technologies on O & M of irrigation and marketing facilities,

management and accounting of FWUCs and Apex, farming and marketing assistance, and

- Transfer of technologies for the staff of the project office through the above assistance activities mainly by means of on-the job training.

Without the above institutional development arrangement, USP will not be a self-reliance system as a model project in Cambodia.

L-4.4 Implementation of SRP with Institutional Support

The technical and economical feasibility of Kim Sei and Ang 160 SRPs was verified and there are farmers' communities at the project areas. Early implementation for two SRPs was recommended. In order to ensure the SRP sustainability and prevent same mistakes as the previous investment, institutional assistance to the beneficiaries' communities needs to be made parallel with the construction investment.

L-4.5 Institutional Arrangement for PDP Formation

PDP's key issue for the implementation was identified at the system for replication of capital investment to the other villagers. Institutional arrangement for revolving the fund collected from the individual and group beneficiaries needs to be prepared by the concerned agencies lead by MOWRAM. Awareness of the government investment not only for the PDP beneficiaries but also for other villagers through revolving the fund paid by the beneficiaries needs to be created before the PDP implementation.

Tables

Table L-1 Economic Price Estimate for Traded Goods, MP Study (1/5)

Item	Import Parity Price Operation	Unit	Price	Export Parity Price Operation	Unit	Price
I. Rice/Paddy						
1. Projected 2005 World Price (in 1990 price) /a		US$/ton	263.6		US$/ton	263.6
2. Projected 2005 World Price (in 2001 price) /a		US$/ton	286.8		US$/ton	286.8
3. Quality Adjustment	x	%	90	x	%	90
4. CIF/FOB Price at Kompong Som Port /b	=	US$/ton	258.1	=	US$/ton	258.1
5. Port Charge, Handling and Warehousing	+	US$/ton	12.4	-	US$/ton	12.4
6. Price at Kompong Som Port	=	US$/ton	270.5	=	Riel/kg	245.7
Equivalent in Riel / kg /c	=	Riel/kg	1,037	=	Riel/kg	942
7. Transportation Cost /d (Kampong Som-Phnom Penh)	+	Riel/kg	22			
(Takeo-Kampong Som)				-	Riel/kg	16
(Takeo-Phnom Penh)	-	Riel/kg	7			
8. Ex-Mill /Wholesale Price in Takeo	=	Riel/kg	1,052	=	Riel/kg	926
9. Milling Cost and Margin /d	-	Riel/kg	22	-	Riel/kg	22
10. Processing Ratio	x	%	66	x	%	66
11. By-Products through Processing /e	+	Riel/kg	51	+	Riel/kg	51
12. Millgate Paddy Price	=	Riel/kg	731	=	Riel/kg	648
13. Transport/Handling from Farmgate /d	-	Riel/kg	14	-	Riel/kg	14
14. Farmgate Price	=	Riel/kg	717	=	Riel/kg	634
	50%			50%		
17. Weighted average economic farm gate price		Riel/kg	676			
II. Maize						
1. Projected 2005 World Price (in 1990 price) /a		US$/ton	104.6		US$/ton	104.6
2. Projected 2005 World Price (in 2001 price) /a		US$/ton	113.8		US$/ton	113.8
3. International Shipping and Handling	+	US$/ton	40.0			
4. CIF/FOB Price at Kompong Som Port	=	US$/ton	153.8	=	US$/ton	113.8
5. Port Charge, Handling and Warehousing	+	US$/ton	12.4	-	US$/ton	12.4
6. Price at Kompong Som Port	=	US$/ton	166.2	=	Riel/kg	101.4
Equivalent in Riel / kg /c	=	Riel/kg	637	=	Riel/kg	389
7. Transportation Cost /d (Kampong Som-Phnom Penh)	+	Riel/kg	22			
(Takeo-Kampong Som)				-	Riel/kg	16
(Takeo-Phnom Penh)	-	Riel/kg	7			
8. Price in Takeo	=	Riel/kg	652	=	Riel/kg	373
9. Transport/Handling from Farmgate /d	-	Riel/kg	14	-	Riel/kg	14
10. Farmgate Price	=	Riel/kg	638	=	Riel/kg	359
	50%			50%		
17. Weighted average economic farm gate price		Riel/kg	500			

Note : /a ; Based on the World Bank, Global Commodity Markets, May 2000
The projected prices in 1990 constant US$ were adjusted by the factor of 1.088 (MUV)
to allow for price escalation between 1990 and 2001.
Paddy : Thai, milled, 5% broken, FOB Bangkok
Maize : US No.2, Yellow, FOB Gulf Ports
/b ; Assumed at the same price at Bangkok port in Thailand
/c ; Exchange rate : US$ = Riel 3,835
/d ; Adjusted with SCF of 0.94
/e ; Rice bran : Riel 300 /kg of rice bran, 18% of paddy weight

Table L-1 Economic Price Estimate for Traded Goods, MP Study (2/5)

Item	Import Parity Price Operation	Unit	Price	Export Parity Price Operation	Unit	Price
III. Soybean						
1. Projected 2005 World Price (in 1990 price) /a		US$/ton	209.2		US$/ton	209.2
2. Projected 2005 World Price (in 2001 price) /a		US$/ton	227.6		US$/ton	227.6
3. International Shipping and Handling	+	US$/ton	35.0			
4. CIF/FOB Price at Kompong Som Port	=	US$/ton	262.6	=	US$/ton	227.6
5. Port Charge, Handling and Warehousing	+	US$/ton	12.4	-	US$/ton	12.4
6. Price at Kompong Som Port	=	US$/ton	275.0	=	Riel/kg	215.2
Equivalent in Riel / kg /b	=	Riel/kg	1,055	=	Riel/kg	825
7. Transportation Cost /c (Kampong Som-Phnom Penh)	+	Riel/kg	22			
(Takeo-Kampong Som)				-	Riel/kg	16
(Takeo-Phnom Penh)	-	Riel/kg	7			
8. Trade Price in Takeo	=	Riel/kg	1,070	=	Riel/kg	809
9. Transport/Handling from Farmgate /c	-	Riel/kg	14	-	Riel/kg	14
10. Farmgate Price	=	Riel/kg	1,056	=	Riel/kg	795
	50%			50%		
11. Weighted average economic farm gate price		Riel/kg	926			
IV. Groundnut						
1. Projected 2005 World Price (in 1990 price) /a		US$/ton	686.1		US$/ton	686.1
2. Projected 2005 World Price (in 2001 price) /a		US$/ton	746.5		US$/ton	746.5
3. Conversion to Shelled Groundnuts (50%)		US$/ton	373.3		US$/ton	373.3
4. International Shipping and Handling	+	US$/ton	35.0			
5. CIF/FOB Price at Kompong Som Port	=	US$/ton	408.3	=	US$/ton	373.3
6. Port Charge, Handling and Warehousing	+	US$/ton	12.4	-	US$/ton	12.4
7. Price at Kompong Som Port	=	US$/ton	420.7	=	Riel/kg	360.9
Equivalent in Riel / kg /b	=	Riel/kg	1,613	=	Riel/kg	1,384
8. Transportation Cost /c (Kampong Som-Phnom Penh)	+	Riel/kg	22			
(Takeo-Kampong Som)				-	Riel/kg	16
(Takeo-Phnom Penh)	-	Riel/kg	7			
9. Trade Price in Takeo	=	Riel/kg	1,628	=	Riel/kg	1,368
10. Transport/Handling from Farmgate /c	-	Riel/kg	14	-	Riel/kg	14
11. Farmgate Price - Without Shell	=	Riel/kg	1,614	=	Riel/kg	1,354
- With Shell (80%)	=	Riel/kg	1,291	=	Riel/kg	1,083
	50%			50%		
12. Weighted average economic farm gate price		Riel/kg	1,187			

Note : /a ; Based on the World Bank, Global Commodity Markets, May 2000

* The projected prices in 1990 constant US$ were adjusted by the factor of 1.088 (MUV) to allow for price escalation between 1990 and 2001.

Soybeans, Groundnut oil : CIF Rotterdam

/b ; Exchange rate : US$ = Riel 3,835

/c ; Adjusted with SCF of 0.94

Table L-1 Economic Price Estimate for Traded Goods, MP Study (3/5)

Item	Import Parity Price Operation	Unit	Price
V. Fertilizer			
(1) Urea			
1. Projected 2005 World Price (in 1990 price) /a		US$/ton	100.4
2. Projected 2005 World Price (in 2001 price) /a		US$/ton	109.2
3. International Shipping and Handling	+	US$/ton	40.0
4. CIF Price at Kompong Som Port	=	US$/ton	149.2
5. Port Charge, Handling and Warehousing	+	US$/ton	17.4
6. Price at Kompong Som Port	=	US$/ton	166.6
Equivalent in Riel / kg /b	=	Riel/kg	639
7. Transportation Cost /c (Kampong Som-Takeo)	+	Riel/kg	16
8. Trade Price in Takeo	=	Riel/kg	655
9. Transport/Handling to Farmgate /c	+	Riel/kg	14
10. Farmgate Price	=	Riel/kg	669
Price of Nutrient (N) /e		Riel/kg	1,454
(2) DAP (Diammonium Phosphate)			
1. Projected 2005 World Price (in 1990 price) /a		US$/ton	163.2
2. Projected 2005 World Price (in 2001 price) /a		US$/ton	177.6
3. International Shipping and Handling	+	US$/ton	45.0
4. CIF Price at Kompong Som Port	=	US$/ton	222.6
5. Port Charge, Handling, Warehousing and Bagging	+	US$/ton	17.4
6. Price at Kompong Som Port	=	US$/ton	240.0
Equivalent in Riel / kg /b	=	Riel/kg	920
7. Transportation Cost /c (Kampong Som-Takeo)	+	Riel/kg	16
8. Trade Price in Takeo	=	Riel/kg	936
9. Transport/Handling to Farmgate /c	+	Riel/kg	14
10. Farmgate Price	=	Riel/kg	950
Price of Nutrient (P) /e		Riel/kg	2,065
Price of Nutrient (N) /e		Riel/kg	5,278
(3) Potassium Chloride (KCL) /d			
1. Projected 2005 World Price (in 1990 price) /a		US$/ton	104.6
2. Projected 2005 World Price (in 2001 price) /a		US$/ton	113.8
3. International Shipping and Handling	+	US$/ton	40.0
4. CIF Price at Kompong Som Port	=	US$/ton	153.8
5. Port Charge, Handling, Warehousing and Bagging	+	US$/ton	17.4
6. Price at Kompong Som Port	=	US$/ton	171.2
Equivalent in Riel / kg /b	=	Riel/kg	657
7. Transportation Cost /c (Kampong Som-Takeo)	+	Riel/kg	16
8. Trade Price in Takeo	=	Riel/kg	673
9. Transport/Handling to Farmgate /c	+	Riel/kg	14
10. Farmgate Price	=	Riel/kg	687
Price of Nutrient (K) /e		Riel/kg	1,145

Note : /a ; Based on the World Bank, Global Commodity Markets, May 2000

* The projected prices in 1990 constant US$ were adjusted by the factor of 1.088 (MUV) to allow for price escalation between 1990 and 2001.

Urea : Bagged, FOB Black Sea

DAP : Bulk, FOB US Gulf

KCL : Bulk, FOB Black Sea

/b ; Exchange rate : US$ = Riel 3,835

/c ; Adjusted with SCF of 0.94

/d ; Potassium Chloride (Muriate of Potash)

/e ; Nutrient content is 46%, 46%(18-46-0), and 60%, respectively for Urea, DAP and KCL.

Table L-1 Economic Price Estimate for Traded Goods, MP Study (4/5)

VI. Estimation of Standard Conversion factors

Year	Total Import Value to Cambodia (CIF)	Total Export Value from Cambodia (FOB)	Import Subsidy /a	Import Tax /b	Export Subsidy /c	Export Tax	Standard Conversion Factor
	(Unit ; US$ Million)						
	I	E	Is	It	Es	Et	SCF
1993	478.2	353	0	57.0		0	0.936
1994	841.8	490	0	109.3		0	0.924
1995	1,308.9	854	0	130.0		0	0.943
1996	1,181.1	644	0	130.3		0	0.933
1997	1,199.1	862	0	116.1	24.7	0	0.936
1998	1,156.9	913	0	99.7	22.4	0	0.944
1999	1,290.9	973	0	113.6	36.1	0	0.938
2000							
Average Standard Conversion Factor (SCF)							
1993-1999							0.936
1993-1997							0.935
1995-1999							**0.939**

Note : SCF = (I+E) / [(I-Is+It)+(E+Es-Et)]

/a ; Import subsidy is accounted at the import tax exemption.

/b ; Custom duties are accounted.

/c ; Domestic subsidies (public enterprises and social sector) are considered as direct and indirect export subsidy.

Sources : Ministry of Economy and Finance, Cambodia Statistical Yearbook 2000

Table L-1 Economic Price Estimate for Traded Goods, MP Study (5/5)

VII. Estimate of Shadow Wage Factor in the Study Area

Item	Operation		Unit	1998	2001	2010
1. Total Population in the Study Area			Person	165,580	177,690	214,430
(Population growth rate)			(%)		(2.38)	(2.11)
2. Labor Force Population			Person			
Total /b	(42.9%)			71,000	76,200	92,000
For agriculture				64,800	69,600	69,000
				(91.3%)	(91.3%)	(75.0%)
3. Annual Available Person-Day	242 (P.day/person/year)		P.day/year	15,681,600	16,843,200	16,698,000
4. Net Annual Available Person-Day for Agriculture	(50%)		P.day/year	7,840,800	8,421,600	8,349,000
5. Agricultural Labor Input /b		Distribution	P.day/year			
5.1 Present/Without Project Condition	(44,240ha)					
1) Wet season paddy (rainfed)	(39,560ha)	89.43%			3,164,800	3,164,800
2) Diversified crop (rainfed)						
Maize	(380ha)	0.86%			26,600	26,600
Groundnut	(130ha)	0.29%			7,800	7,800
Soybean	(130ha)	0.29%			6,500	6,500
Sesame	(0ha)	0.00%			0	0
Vegetables	(630ha)	1.43%			56,700	56,700
(1 + 2)	(40,830ha)	92.29%			3,262,400	3,262,400
3) Other farm works	(30% of cropping)				978,700	978,700
Total (1, 2,& 3)					4,241,100	4,241,100
5.2 Future/With Project Condition	(43,000ha)					
A. Upper Slakou & Small Reservoirs Are	(3,780ha)					
1) Wet season paddy (irrigated)	(3,780 ha)	100.00%				340,200
2) Diversified crop (irrigated)						
Maize	(110 ha)	2.86%				8,800
Groundnut	(190 ha)	5.00%				12,350
Soybean	(380 ha)	10.00%				20,900
Sesame	(190 ha)	5.00%				9,500
Vegetables	(540 ha)	14.29%				64,800
(1 + 2)	(5,190ha)	137.14%				456,550
3) Other farm works	(30% of cropping)					137,000
Total (1, 2,& 3)						593,550
B. Rainfed with Ponds Area	(39,220ha)					
1) Wet season paddy (irrigated)	(35,110 ha)	89.51%				2,808,800
2) Diversified crop (irrigated)						
Maize	(300 ha)	0.77%				21,000
Groundnut	(380 ha)	0.98%				29,260
Soybean	(760 ha)	1.95%				49,400
Sesame	(380 ha)	0.98%				22,800
Vegetables	(1,530 ha)	3.91%				201,960
(1 + 2)	(38,460ha)	98.11%				3,133,220
3) Other farm works	(30% of cropping)					940,000
Total (1, 2,& 3)						4,073,220
Total (A + B)						4,666,770
6. Shadow Wage Factors						
Without Project Condition					0.50	0.51
With Project Condition					0.55	0.56
7. Shadow Wage Rate						
(Standard conversion factor :	0.94)					
Without Project Condition					0.47	0.48
With Project Condition					0.52	**0.53**

Note : /a ; Population growth rate (Takeo province)

	1981-1998	1981-1994	1994 - 1998	1998-2001 (Estimated)	2001-2010 (Estimated)
%/year	2.38	2.11	3.25	2.38	2.11

/b ; Percentage of economically active population aged 7 and over (rural in Takeo) 56.8 % (1)
Percentage of population aged 7 and over (rural in Takeo) ; 75.5 % (2)
Labor force population ratio ; (1 x 2) 42.9 %

/c ; Labor requirement per ha

Crops	Person-day/ha Present	With Project US & SR	With Project Pond
Paddy			
Rainfed	80	-	80
Irrigated/with project	-	90	-
Maize	70	80	70
Groundnuts	60	65	77
Soybeans	50	55	65
Sesame	45	50	60
Vegetables	90	120	132

Table L-2 Summary of Financial and Economic Prices Applied, MP Study

Particulars	Unit	Financial Price Applied /a	Conversion	Economic Price Applied
1. **Farm Products**				
Dry Paddy	(Riel/kg)			
- High yielding varieties (May 2001)		330	b	676
- High yielding varieties (Oct. 2001)		300	b	676
- Improved local varieties		370	b	676
Maize/Corn	(Riel/kg)	600	b	500
Soybean	(Riel/kg)	1,200	b	926
Mungbean*	(Riel/kg)	1,400	c	1,316
Groundnut	(Riel/kg)	1,300	b	1,187
Sesame	(Riel/kg)	1,800	c	1,692
Tomato	(Riel/kg)	600	c	564
Cucumber	(Riel/kg)	400	c	376
String Bean	(Riel/kg)	800	c	752
Vegetable average*	(Riel/kg)	660	c	620
2. **By-Products**				
Rice bran	(Riel/kg)	300	c	282
Broken rice	(Riel/kg)	350	c	329
Rice straw	(Riel/kg)	16	c	15
Corn stalk	(Riel/kg)	16	c	15
3. **Seeds**				
Paddy	(Riel/kg)	400	c	376
Maize	(Riel/kg)	2,000	c	1,880
Soybean	(Riel/kg)	1,800	c	1,692
Mungbean*	(Riel/kg)	2,200	c	2,068
Groundnut	(Riel/kg)	4,500	c	4,230
Sesame	(Riel/kg)	2,500	c	2,350
Tomato	(Riel/kg)	26,000	c	24,440
Cucumber	(Riel/kg)	35,000	c	32,900
String Bean	(Riel/kg)	4,000	c	3,760
Vegetable average*	(Riel/kg)	8,800	c	8,272
4. **Fertilizer**				
Urea	(Riel/kg)	800	b	669
DAP	(Riel/kg)	1,000	b	950
KCL	(Riel/kg)	800	b	687
Farm manure	(Riel/ton)	25,000	d	12,000
5. **Chemical**				
6. **Tool and Equipment**	10% of the cost for inputs and draft animals			
7. **Labor, Animal Power and Machinery**				
Labor	(Riel/Person-day)	3,000	d	1,440
Animal	(Riel/Animal-day)	7,000	d	3,360
8. **Transportation**				
Farmgate to Takeo	(Riel/kg)	5	c	5

Remarks:

/a ; As of May 2001 prices for the Mater Plan and Oct. 2001 for the Feasibility Study

/b ; Economic price estimate based on the WB Commodity Markets (Ref. Table 6.11.1)

/c ; Financial prices are converted to economic value multiplying by SCF of 0.94

/d ; Multiplied by shadow wage rate of 0.48

Based on the shadow wage rate factor (0.51) multiplied by SCF 0.94

* ; Applied for the Feasibility Study

Table L-3 Economic Crop Budget, Present/Without Project Condition, MP Study

Name of crops		Unit	Paddy (Impr. Local V.) Q'ty	Price (Riel)	Value (1000Riel)	Paddy (H.Y.V) Q'ty	Price (Riel)	Value (1000Riel)	Maize Q'ty	Price (Riel)	Value (1000Riel)
1. Gross Income		**Riel**			**899**			**899**			**466**
Main products		kg	1,300	676	879	1,300	676	879	900	500	450
By-product		kg	1,300 (straw)	15	20	1,300 (straw)	15	20	1,080 (corn stalk)	15	16
2. Production Cost		**Riel**			**237**			**230**			**185**
2.1 Inputs		**Riel**			**83**			**77**			**56**
Seed		kg	65	376	24	50	376	19	20	1,880	38
Farm manure (wet)		ton	1	12,000	12	1	12,000	12	0	12,000	0
Fertilizer	Urea	kg	30	669	20	30	669	20	20	669	13
	DAP	kg	20	950	19	20	950	19	0	950	0
	KCL	kg	0	687	0	0	687	0	0	687	0
Agro-chemicals		liter	0		0	0		0	0		0
Others (10% of the above)					8			7			5
2.2 Labor		**P-d**	**80**		**116**	**80**		**116**	**70**		**101**
Hired labor		P-d	8	1,440	12	8	1,440	12	0	1,440	0
Family labor		P-d	72	1,440	104	72	1,440	104	70	1,440	101
2.3 Draft animal		**Riel**			**27**			**27**			**20**
Land preparation		Ani-d	6.0		20	6		20			13
Plowing		Ani-d	5.0	3,360	17	5.0	3,360	17	4.0	3,360	13
Paddling		Ani-d	1.0	3,360	3	1.0	3,360	3	0.0	3,360	0
Transportation		Ani-d	2.0	3,360	7	2.0	3,360	7	2.0	3,360	7
2.4 Tool/Equipment		**Riel**			**11**			**10**			**8**
3. Net Return		**Riel**			**662**			**669**			**281**
(N.Return/P. Cost Ratio)					**2.79**			**2.91**			**1.52**

Name of crops		Unit	Soybean Q'ty	Price (Riel)	Value (1000Riel)	Groundnut Q'ty	Price (Riel)	Value (1000Riel)	Sesame Q'ty	Price (Riel)	Value (1000Riel)
1. Gross Income		**Riel**			**471**			**541**			**513**
Main products		kg	500	926	463	450	1,187	534	300	1,692	508
By-product		kg	500 (stem and waste bean)	15	8	450 (stem and waste nuts)	15	7	300 stems	15	5
2. Production Cost		**Riel**			**270**			**274**			**117**
2.1 Inputs		**Riel**			**162**			**153**			**29**
Seed		kg	80	1,692	135	30	4,230	127	8	2,350	19
Farm manure (wet)		ton	0	12,000	0	0	12,000	0	0	12,000	0
Fertilizer	Urea	kg	10	669	7	10	669	7	10	669	7
	DAP	kg	5	950	5	5	950	5	0	950	0
	KCL	kg	0	687	0	0	687	0	0	687	0
Agro-chemicals		liter	0		0	0		0			0
Others (10% of the above)					15			14			3
2.2 Labor		**P-d**	**50**		**72**	**60**		**86**	**45**		**65**
Hired labor		P-d	0	1,440	0	0	1,440	0	0	1,440	0
Family labor		P-d	50	1,440	72	60	1,440	86	45	1,440	65
2.3 Draft animal		**Riel**			**18**			**18**			**18**
Land preparation		Ani-d			13			13			13
Plowing		Ani-d	4.0	3,360	13	4.0	3,360	13	4.0	3,360	13
Paddling		Ani-d	0.0	3,360	0	0.0	3,360	0		3,360	0
Transportation		Ani-d	1.5	3,360	5	1.5	3,360	5	1.5	3,360	5
2.4 Tool/Equipment		**Riel**			**18**			**17**			**5**
3. Net Return		**Riel**			**201**			**267**			**396**
(N.Return/P. Cost Ratio)					**0.74**			**0.97**			**3.38**

Name of crops		Unit	Cucumber * Q'ty	Price (Riel)	Value (1000Riel)	String-bean * Q'ty	Price (Riel)	Value (1000Riel)	Tomato * Q'ty	Price (Riel)	Value (1000Riel)
1. Gross Income		**Riel**			**1,510**			**2,261**			**1,697**
Main products		kg	4,000	376	1,504	3,000	752	2,256	3,000	564	1,692
By-product		kg	400 waste fruits	15	6	300 stems, waste beans	15	5	300 waste fruits	15	5
2. Production Cost		**Riel**			**357**			**373**			**246**
2.1 Inputs		**Riel**			**186**			**201**			**85**
Seed		kg	3.0	32,900	99	30	3,760	113	0.3	24,440	7
Farm manure (wet)		ton	2	12,000	24	2	12,000	24	2	12,000	24
Fertilizer	Urea	kg	40	669	27	40	669	27	40	669	27
	DAP	kg	20	950	19	20	950	19	20	950	19
	KCL	kg	0	687	0	0	687	0	0	687	0
Agro-chemicals		liter			0			0			0
Others (10% of the above)					17			18			8
2.2 Labor		**P-d**	**90**		**130**	**90**		**130**	**90**		**130**
Hired labor		P-d	0	1,440	0	0	1,440	0	0	1,440	0
Family labor		P-d	90	1,440	130	90	1,440	130	90	1,440	130
2.3 Draft animal		**Riel**			**20**			**20**			**20**
Land preparation		Ani-d			13			13			13
Plowing		Ani-d	4.0	3,360	13	4.0	3,360	13	4.0	3,360	13
Paddling		Ani-d		3,360	0	0.0	3,360	0		3,360	0
Transportation		Ani-d	2.0	3,360	7	2.0	3,360	7	2.0	3,360	7
2.4 Tool/Equipment		**Riel**			**21**			**22**			**11**
3. Net Return		**Riel**			**1,153**			**1,888**			**1,451**
(N.Return/P. Cost Ratio)					**3.23**			**5.06**			**5.90**

Note *: Cucumber, string-bean and tomato are substitutes of all suitable vegetables in the area.

Average Net Return per ha of vegetables Riel '000 **1,497**

Table L-4 Economic Crop Budget, With Project Condition, MP Study (1/2)

I. USP and SRP Area

Name of crops		Unit	Paddy (Impr. Local V.) Q'ty	Price (Riel)	Value (1000Riel)	Paddy (H.Y.V) Q'ty	Price (Riel)	Value (1000Riel)	Maize Q'ty	Price (Riel)	Value (1000Riel)
1. Gross Income		**Riel**			**1,935**			**2,273**			**1,036**
Main products		kg	2,800	676	1,893	3,300	676	2,231	2,000	500	1,000
By-product		kg	2,800 (straw)	15	42	2,800 (straw)	15	42	2,400 (corn stalk)	15	36
2. Production Cost		**Riel**			**413**			**406**			**352**
2.1 Inputs		**Riel**			**230**			**224**			**195**
Seed		kg	65	376	24	50	376	19	20	1,880	38
Farm manure (wet)		ton	3	12,000	36	3	12,000	36	0	12,000	0
Fertilizer	Urea	kg	120	669	80	120	669	80	120	669	80
	DAP	kg	50	950	48	50	950	48	40	950	38
	KCL	kg	30	687	21	30	687	21	30	687	21
Agro-chemicals		liter	0		0	0		0	0		0
Others (10% of the above)					21			20			18
2.2 Labor		**P-d**	**90**		**130**	**90**		**130**	**80**		**115**
Hired labor		P-d	9	1,440	13	9	1,440	13	4	1,440	6
Family labor		P-d	81	1,440	117	81	1,440	117	76	1,440	109
2.3 Draft animal		**Riel**			**27**			**27**			**20**
Land preparation		Ani-d	6.0		20	6.0		20	4.0		13
Plowing		Ani-d	5.0	3,360	17	5.0	3,360	17	4.0	3,360	13
Paddling		Ani-d	1.0	3,360	3	1.0	3,360	3	0.0	3,360	0
Transportation		Ani-d	2.0	3,360	7	2.0	3,360	7	2.0	3,360	7
2.4 Tool/Equipment		**Riel**			**26**			**25**			**22**
3. Net Return		**Riel**			**1,522**			**1,867**			**684**
(N.Return/P. Cost Ratio)					**3.69**			**4.60**			**1.94**

Name of crops		Unit	Soybean Q'ty	Price (Riel)	Value (1000Riel)	Groundnut Q'ty	Price (Riel)	Value (1000Riel)	Sesame Q'ty	Price (Riel)	Value (1000Riel)
1. Gross Income		**Riel**			**941**			**1,022**			**1,366**
Main products		kg	1,000	926	926	850	1,187	1,009	800	1,692	1,354
By-product		kg	1,000 (stem and waste bean)	15	15	850 (stem and waste nuts)	15	13	800 stems	15	12
2. Production Cost		**Riel**			**386**			**390**			**238**
2.1 Inputs		**Riel**			**261**			**252**			**133**
Seed		kg	80	1,692	135	30	4,230	127	8	2,350	19
Farm manure (wet)		ton	0	12,000	0	0	12,000	0	0	12,000	0
Fertilizer	Urea	kg	50	669	33	50	669	33	50	669	33
	DAP	kg	50	950	48	50	950	48	50	950	48
	KCL	kg	30	687	21	30	687	21	30	687	21
Agro-chemicals		liter	0		0	0		0			0
Others (10% of the above)					24			23			12
2.2 Labor		**P-d**	**55**		**79**	**65**		**93**	**50**		**72**
Hired labor		P-d	3	1,440	4	3	1,440	4	2	1,440	3
Family labor		P-d	52	1,440	75	62	1,440	89	48	1,440	69
2.3 Draft animal		**Riel**			**18**			**18**			**18**
Land preparation		Ani-d	4.0		13	4.0		13	4.0		13
Plowing		Ani-d	4.0	3,360	13	4.0	3,360	13	4.0	3,360	13
Paddling		Ani-d	0.0	3,360	0	0.0	3,360	0	0.0	3,360	0
Transportation		Ani-d	1.5	3,360	5	1.5	3,360	5	1.5	3,360	5
2.4 Tool/Equipment		**Riel**			**28**			**27**			**15**
3. Net Return		**Riel**			**555**			**632**			**1,128**
(N.Return/P. Cost Ratio)					**1.44**			**1.62**			**4.74**

Name of crops		Unit	Cucumber * Q'ty	Price (Riel)	Value (1000Riel)	String-bean * Q'ty	Price (Riel)	Value (1000Riel)	Tomato * Q'ty	Price (Riel)	Value (1000Riel)
1. Gross Income		**Riel**			**3,775**			**4,521**			**5,090**
Main products		kg	10,000	376	3,760	6,000	752	4,512	9,000	564	5,076
By-product		kg	1,000 waste fruits	15	15	600 stems, waste beans	15	9	900 waste fruits	15	14
2. Production Cost		**Riel**			**633**			**555**			**476**
2.1 Inputs		**Riel**			**398**			**341**			**255**
Seed		kg	3	32,900	99	30	3,760	113	0.3	24,440	7
Farm manure (wet)		ton	4	12,000	48	4	12,000	48	2	12,000	24
Fertilizer	Urea	kg	150	669	100	100	669	67	150	669	100
	DAP	kg	70	950	67	50	950	48	70	950	67
	KCL	kg	70	687	48	50	687	34	50	687	34
Agro-chemicals		liter			0			0			0
Others (10% of the above)					36			31			23
2.2 Labor		**P-d**	**120**		**173**	**110**		**158**	**120**		**173**
Hired labor		P-d	6	1,440	9	5	1,440	7	6	1,440	9
Family labor		P-d	114	1,440	164	105	1,440	151	114	1,440	164
2.3 Draft animal		**Riel**			**20**			**20**			**20**
Land preparation		Ani-d	4.0		13	4.0		13	4.0		13
Plowing		Ani-d	4.0	3,360	13	4.0	3,360	13	4.0	3,360	13
Paddling		Ani-d	0.0	3,360	0	0.0	3,360	0	0.0	3,360	0
Transportation		Ani-d	2.0	3,360	7	2.0	3,360	7	2.0	3,360	7
2.4 Tool/Equipment		**Riel**			**42**			**36**			**28**
3. Net Return		**Riel**			**3,142**			**3,966**			**4,614**
(N.Return/P. Cost Ratio)					**4.96**			**7.15**			**9.69**

Note *: Cucumber, string-bean and tomato are substitutes of all suitable vegetables in the area.

Average Net Return per ha of vegetables Riel '000 **3,907**

Table L-4 Economic Crop Budget, With Project Condition, MP Study (2/2)

I. PDP Area (Yield Rate : 80 %) (Fertilizer Rate : 60 %) (Family Labor Rate : 120 %)

Name of crops		Unit	Soybean Q'ty	Soybean Price (Riel)	Soybean Value (1000Riel)	Groundnut Q'ty	Groundnut Price (Riel)	Groundnut Value (1000Riel)	Sesame Q'ty	Sesame Price (Riel)	Sesame Value (1000Riel)
1. Gross Income		**Riel**			**753**			**817**			**1,093**
Main products		kg	800	926	741	680	1,187	807	640	1,692	1,083
By-product		kg	800	15	12	680	15	10	640	15	10
			(stem and waste bean)			(stem and waste nuts)			stems		
2. Production Cost		**Riel**			**350**			**359**			**204**
2.1 Inputs		**Riel**			**216**			**207**			**88**
Seed		kg	80	1,692	135	30	4,230	127	8	2,350	19
Farm manure (wet)		ton	0	12,000	0	0	12,000	0	0	12,000	0
Fertilizer	Urea	kg	30	669	20	30	669	20	30	669	20
	DAP	kg	30	950	29	30	950	29	30	950	29
	KCL	kg	18	687	12	18	687	12	18	687	12
Agro-chemicals		liter	0		0	0		0			0
Others (10% of the above)					20			19			8
2.2 Labor		**P-d**	**65**		**93**	**77**		**111**	**60**		**87**
Hired labor		P-d	3	1,440	4	3	1,440	4	2	1,440	3
Family labor		P-d	62	1,440	89	74	1,440	107	58	1,440	84
2.3 Draft animal		**Riel**			**18**			**18**			**18**
Land preparation		Ani-d	4.0		13	4.0		13	4.0		13
Plowing		Ani-d	4.0	3,360	13	4.0	3,360	13	4.0	3,360	13
Paddling		Ani-d	0.0	3,360	0	0.0	3,360	0	0.0	3,360	0
Transportation		Ani-d	1.5	3,360	5	1.5	3,360	5	1.5	3,360	5
2.4 Tool/Equipment		**Riel**			**23**			**23**			**11**
3. Net Return		**Riel**			**403**			**458**			**889**
(N.Return/P. Cost Ratio)					**1.15**			**1.28**			**4.36**

Name of crops		Unit	Cucumber * Q'ty	Cucumber * Price (Riel)	Cucumber * Value (1000Riel)	String-bean * Q'ty	String-bean * Price (Riel)	String-bean * Value (1000Riel)	Tomato * Q'ty	Tomato * Price (Riel)	Tomato * Value (1000Riel)
1. Gross Income		**Riel**			**3,020**			**3,617**			**4,072**
Main products		kg	8,000	376	3,008	4,800	752	3,610	7,200	564	4,061
By-product		kg	800	15	12	480	15	7	720	15	11
			waste fruits			stems, waste beans			waste fruits		
2. Production Cost		**Riel**			**562**			**514**			**412**
2.1 Inputs		**Riel**			**304**			**276**			**167**
Seed		kg	3	32,900	99	30	3,760	113	0.3	24,440	7
Farm manure (wet)		ton	4	12,000	48	4	12,000	48	2	12,000	24
Fertilizer	Urea	kg	90	669	60	60	669	40	90	669	60
	DAP	kg	42	950	40	30	950	29	42	950	40
	KCL	kg	42	687	29	30	687	21	30	687	21
Agro-chemicals		liter	0		0			0			0
Others (10% of the above)					28			25			15
2.2 Labor		**P-d**	**143**		**206**	**110**		**188**	**143**		**206**
Hired labor		P-d	6	1,440	9	5	1,440	7	6	1,440	9
Family labor		P-d	137	1,440	197	126	1,440	181	137	1,440	197
2.3 Draft animal		**Riel**			**20**			**20**			**20**
Land preparation		Ani-d	4.0		13	4.0		13	4.0		13
Plowing		Ani-d	4.0	3,360	13	4.0	3,360	13	4.0	3,360	13
Paddling		Ani-d	0.0	3,360	0	0.0	3,360	0	0.0	3,360	0
Transportation		Ani-d	2.0	3,360	7	2.0	3,360	7	2.0	3,360	7
2.4 Tool/Equipment		**Riel**			**32**			**30**			**19**
3. Net Return		**Riel**			**2,458**			**3,103**			**3,660**
(N.Return/P. Cost Ratio)					**4.37**			**6.04**			**8.88**

Note *: Cucumber, string-bean and tomato are substitutes of all suitable vegetables in the area.

Average Net Return per ha of vegetables Riel '000 **3,074** (79% of USP)

Table L-5 Economic Irrigation and Drainage Benefit, MP Study (1/2)

I. USP Area

(1) Present/Without Project Condition

Crops	Planted Area (ha)	Net Production Value Per ha (Riel '000)	Total (Riel 'Million)
Paddy	3,220		2,134.1
Impro.Local V.	2,860	662	1,893.3
H.Y.V	360	669	240.8
Diversified Crops	100		88.0
Maize	30	281	8.4
Soybean	10	201	2.0
Groundnut	10	267	2.7
Sesame	0	396	0
Vegetables	50	1,497	74.9
Total	3,320		2,222.1
Total Physical Area	3,500	C. Intensity	95%
NPV per ha		Riel '000	US$
		634.9	165.6

Note : Riel 3,835 /US$

(2) With Project Condition

Crops	Planted Area (ha)	Net Production Value Per ha (Riel '000)	Total (Riel 'Million)
Paddy	3,500		5,706.5
Impro.Local V.	2,400	1,522	3,652.8
H.Y.V	1,100	1,867	2,053.7
Diversified Crops	1,050		2,119.3
Maize	80	684	54.7
Soybean	280	555	155.4
Groundnut	130	632	82.2
Sesame	130	1,128	147
Vegetables	430	3,907	1,680.0
Total	4,550		7,825.8
Total Physical Area	3,500	C. Intensity	130%
NPV per ha		Riel '000	US$
		2,235.9	583.0

(3) Increment (With - Without)

Crops	Planted Area (ha)	Net Production Value Per ha (Riel '000)	Total (Riel 'Million)
Paddy	280		3,572.4
Impro.Local V.	(460)	860	1,759.5
H.Y.V	740	1,198	1,812.9
Diversified Crops	950		2,031.3
Maize	50	403	46.3
Soybean	270	354	153.4
Groundnut	120	365	79.5
Sesame	130	732	147.0
Vegetables	380	2,410	1,605.1
Total	1,230		5,603.7
Total Physical Area	3,500	C. Intensity	35%
NPV per ha		Riel '000	US$
		1,601.0	417.4

Table L-5 Economic Irrigation and Drainage Benefit, MP Study (2/2)

II. SRP Area

NPV Increment (Same as USP Area)		
NPV Increment per ha =	Riel '000	1,601.0
	US$	417.4

III. PDP Area

(1) Present/Without Project Condition (Same as USP Area)

NPV per ha	=	Riel '000	634.9
		US$	165.6

(2) With Project Condition / Including Rainfed Area

Crops	Planted Area (ha)	Net Production Value Per ha (Riel '000)	Total (Riel 'Million)
Paddy	86.7		57.5
Impro. Local V.	73.0	662	48.3
H.Y.V	13.7	669	9.2
Diversified Crops	8.6		14.5
Maize (rainfed)	0.8	281	0.2
Soybean (irrigated)	1.0	403	0.4
Groundnut (irrigated)	1.9	458	0.9
Sesame (irrigated)	1.0	889	1.0
Vegetables (irrigated)	3.9	3,074	12.0
Total	95.3		72.0
Total Physical Area	100.0	C. Intensity	95.3%
NPV per ha		Riel '000	US$
		720.0	187.7

(3) With Project Condition / Irrigated Area Only (5 ha)

Crops	Planted Area (ha)	Net Production Value Per ha (Riel '000)	Total (Riel '000)
Paddy	0		0
Impro. Local V.	0	662	0
H.Y.V	0	669	0
Diversified Crops	7.2		13,053
Maize (rainfed)	0	281	0
Soybean (irrigated)	0.9	403	363
Groundnut (irrigated)	1.8	458	824
Sesame (irrigated)	0.9	889	800
Vegetables (irrigated)	3.6	3,074	11,066
Total	7.2		13,053
Total Physical Area	5.0	C. Intensity	144.0%
NPV per ha		Riel '000	US$
		2,610.6	680.7

(4) Increment (With - Without) / Irrigated Area Only (5 ha)

NPV per ha	=	Riel '000	1,975.7
		US$	515.1

Table L-6 Annual Incremental Economic Benefit Flow, MP Study

I. USP Area

Year in Order	Year	Area under Irrigation (ha)	Build-Up Ratio (%)	Benefit Build-Up (Riel Million) Year 2004 Area	Year 2005 Area	Year 2006 Area	Year 2006 Area	Total
1	2002		60					0
2	2003		85					0
3	2004	200	100	192.1				192.1
4	2005	350		272.2	336.2			608.4
5	2006	650		320.2	476.3	624.4		1,420.9
6	2007	2,300		320.2	560.4	884.6	2,209.4	3,974.6
7	2008			320.2	560.4	1,040.7	3,130.0	5,051.3
8	2009			320.2	560.4	1,040.7	3,682.4	5,603.7
9	2010			320.2	560.4	1,040.7	3,682.4	5,603.7
10	2011			320.2	560.4	1,040.7	3,682.4	5,603.7
11	2012			320.2	560.4	1,040.7	3,682.4	5,603.7
12	2013			320.2	560.4	1,040.7	3,682.4	5,603.7

Note : Incremental net production value (Rp.'000/ha) 1,601.0

II. SRP Area

Year in Order	Year	Area under Irrigation (ha) Kim Sei / Ang 160	Trapean Lean	Build-Up Ratio (%)	Benefit Build-Up (Riel '000) Kim Sei / Ang 160	Trapean Lean
1	2002			60		
2	2003			85		
3	2004	21	10	100	20,170	9,610
4	2005				28,580	13,610
5	2006				33,620	16,010
6	2007				33,620	16,010
7	2008				33,620	16,010
8	2009				33,620	16,010
9	2010				33,620	16,010
10	2011				33,620	16,010

Note : Incremental net production value (Rp.'000/ha) 1,601.0

III. PDP Area

Year in Order	Year	Area under Irrigation (ha) Pond (Group)	Canal Pond (Group)	Pond (Individual)	Build-Up Ratio (%)	Benefit Build-Up (Riel '000) Pond (Group)	Canal Pond (Group)	Pond (Individual)
1	2002				60			
2	2003				85			
3	2004	5	5	5	100	5,930	5,930	5,930
4	2005					8,400	8,400	8,400
5	2006					9,880	9,880	9,880
6	2007					9,880	9,880	9,880
7	2008					9,880	9,880	9,880
8	2009					9,880	9,880	9,880
9	2010					9,880	9,880	9,880
10	2011					9,880	9,880	9,880

Note : Incremental net production value (Rp.'000/ha) 1,975.7

Table L-7 Negative Project Benefit, MP Study
(Production Foregone)

Item	NPV Without P. Condition (Riel 000/ha)	Farm Land (ha)	Foregone Amount
	634.9		
1. USP Area			(Riel Million)
Construction of canals		6.0	3.8
2. SRP Area			(Riel '000)
Kim Sei / Ang 160		0.2	130
Trapeang Lean		0.1	60
3. PDP Site (For 5 ha of irrigation development)			(Riel '000)
Pond (Group)		0.59 /1	370
Canal Pond (Group)		0	0
Pond (Individual)		1.1 /1	700

Note : /1 Assumed at 50% of pond area

Table L-8 Economic Investment Cost, MP Study (1/2)

I. USP Area

(Unit : Riel Million)

Description	Financial Cost			Conversion	Economic Cost									
	F/C	L/C	Total	Factors	Total	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Preparatory Works	1,702.9	722.8	2,425.7	0.77	1,865.4		746.2	373.0	746.2					
2. Direct Cost														
1) Tumnup Lok Reservoir	7,810.6	2,630.5	10,441.1	0.79	8,223.7				434.8	7,788.9				
2) Diversion Canal	5,047.2	1,906.6	6,953.8	0.76	5,303.1				265.2	5,037.9				
3) Kpob Trobek Reservoir	7,292.6	2,815.1	10,107.7	0.78	7,901.1			7,901.1						
4) Irrigation Canal System	13,027.8	4,627.3	17,655.1	0.77	13,520.0			811.2	1,312.8	6,837.6	4,558.4			
5) Tertiary Development	880.2	2,475.8	3,356.0	0.70	2,359.8			168.5	202.2	1,011.4	977.7			
3. O&M Equipment	306.8	0.0	306.8	0.74	227.0			227.0						
4. Institutional Development Cost	288.4	535.4	823.8	0.83	683.4	68.4	68.4	102.5	136.6	157.1	82.0	34.2	20.5	13.7
5. Cost for Relocation	1.4	44.6	46.0	0.78	36.0				36.0					
6. Administration Cost	318.3	2,002.2	2,320.5	0.84	1,939.2	310.3	310.3	155.1	232.7	271.5	194.0	155.1	155.1	155.1
7. Engineering Services	3,428.9	452.2	3,881.1	0.93	3,606.8	288.6	360.7	901.7	793.5	721.3	360.7	180.3		
Total (1 to 7)	40,105.1	18,212.5	58,317.6	0.78	45,665.5	667.3	1,485.6	10,640.1	4,160.0	21,825.7	6,172.8	369.6	175.6	168.8
8. Physical Contingenc(10% of 1 to 7)	4,010.5	1,821.3	5,831.8		4,566.6	66.7	148.6	1,064.0	416.0	2,182.6	617.3	37.0	17.6	16.8
Grand Total	44,115.6	20,033.8	64,149.4		50,232.1	734.0	1,634.2	11,704.1	4,576.0	24,008.3	6,790.1	406.6	193.2	185.6

II. SRP Area

(1) Kim Sei SRP

(Unit : Riel '000)

Description	Financial Cost			Conversion	Economic Cost									
	F/C	L/C	Total	Factors	Total	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Preparatory Works	8,670	6,000	14,670	0.79	11,590		11,590							
2. Direct Cost														
1) Rehabilitation Works	168,370	106,020	274,390	0.79	217,560		217,560							
2) Tertiary Canal System	5,030	14,140	19,170	0.75	14,310		14,310							
3. O&M Equipment	2,740	0	2,740	0.74	2,030		2,030							
4. Insititutional Development Cost	1,650	3,060	4,710	0.83	3,910		1,170	1,170	980	590				
5. Administration Cost	2,820	17,900	20,720	0.83	17,300	1,440	3,610	5,760	3,610	2,880				
6. Engineering Services	20,740	2,740	23,480	0.93	21,860	7,640	5,470	7,650	1,100					
Total (1 to 6)	210,020	149,860	359,880		288,560	9,080	255,740	14,580	5,690	3,470				
7. Physical Contingenc(10% of 1 to 6)	21,000	14,990	35,990		28,860	910	25,570	1,460	570	350				
Grand Total	231,020	164,850	395,870		317,420	9,990	281,310	16,040	6,260	3,820				

(2) Ang 160

(Unit : Riel '000)

Description	Financial Cost			Conversion	Economic Cost									
	F/C	L/C	Total	Factors	Total	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Preparatory Works	4,760	9,250	14,010	0.80	11,150		11,150							
2. Direct Cost														
1) Rehabilitation Works	90,130	170,760	260,890	0.80	208,590		208,590							
2) Tertiary Canal System	5,030	14,140	19,170	0.75	14,310		14,310							
3. O&M Equipment	2,740	0	2,740	0.74	2,030		2,030							
4. Insititutional Development Cost	1,650	3,060	4,710	0.83	3,910		1,170	1,170	980	590				
5. Administration Cost	2,820	17,900	20,720	0.83	17,300	1,440	3,610	5,760	3,610	2,880				
6. Engineering Services	19,780	2,620	22,400	0.93	20,820	7,290	5,210	7,290	1,030					
Total (1 to 6)	126,910	217,730	344,640		278,110	8,730	246,070	14,220	5,620	3,470				
7. Physical Contingenc(10% of 1 to 6)	12,690	21,770	34,460		27,810	870	24,610	1,420	560	350				
Grand Total	139,600	239,500	379,100		305,920	9,600	270,680	15,640	6,180	3,820				

(3) Trapeang Lean

(Unit : Riel '000)

Description	Financial Cost			Conversion	Economic Cost									
	F/C	L/C	Total	Factors	Total	2006	2007	2008	2009	2010	2011	2012	2013	2014
1. Preparatory Works	6,600	2,760	9,360	0.79	7,360		7,360							
2. Direct Cost														
1) Rehabilitation Works	129,440	48,110	177,550	0.79	140,410		140,410							
2) Tertiary Canal System	2,520	7,080	9,600	0.70	6,760		6,760							
3. O&M Equipment	2,740	0	2,740	0.74	2,030		2,030							
4. Insititutional Development Cost	820	1,540	2,360	0.83	1,970		880	590	390	110				
5. Administration Cost	2,820	17,900	20,720	0.83	17,300	1,440	3,610	5,760	3,610	2,880				
6. Engineering Services	13,220	1,750	14,970	0.93	13,950	4,510	3,000	4,520	1,920					
Total (1 to 6)	158,160	79,140	237,300		189,780	5,950	164,050	10,870	5,920	2,990				
7. Physical Contingenc(10% of 1 to 6)	15,820	7,910	23,730		18,980	600	16,410	1,090	590	290				
Grand Total	173,980	87,050	261,030		208,760	6,550	180,460	11,960	6,510	3,280				

Table L-8 Economic Investment Cost, MP Study (2/2)

III. PDP Area

(1) Pond (Group Management)

(Unit : Riel '000)

Description	Financial Cost			Conversion	Economic Cost				
	F/C	L/C	Total	Factors	Total	2002	2003	2004	2005
1. Direct Cost	0	107,140	107,140	0.55	59,120		59,120		
2. Insititutional Development Cost	420	770	1,190	0.82	980	390	390	200	
3. Administration Cost	100	610	710	0.85	600	240	240	120	
4. Engineering Services	7,570	1,010	8,580	0.93	7,970	3,190	4,780		
Total (1 to 4)	8,090	109,530	117,620		68,670	3,820	64,530	320	0
5. Physical Contingencies (10% of 1 to 4)	810	10,950	11,760		6,870	380	6,450	40	0
Grand Total	8,900	120,480	129,380		75,540	4,200	70,980	360	0

(2) Canal Pond (Group Management)

(Unit : Riel '000)

Description	Financial Cost			Conversion	Economic Cost				
	F/C	L/C	Total	Factors	Total	2002	2003	2004	2005
1. Direct Cost	0	80,360	80,360	0.55	44,340		44,340		
2. Insititutional Development Cost	420	770	1,190	0.82	980	390	390	200	
3. Administration Cost	100	610	710	0.85	600	240	240	120	
4. Engineering Services	5,670	750	6,420	0.93	5,970	2,390	3,580		
Total (1 to 4)	6,190	82,490	88,680		51,890	3,020	48,550	320	0
5. Physical Contingencies (10% of 1 to 4)	620	8,250	8,870		5,190	300	4,860	30	0
Grand Total	6,810	90,740	97,550		57,080	3,320	53,410	350	0

(3) Pond (Individual Management)

(Unit : Riel '000)

Description	Financial Cost			Conversion	Economic Cost				
	F/C	L/C	Total	Factors	Total	2002	2003	2004	2005
1. Direct Cost	0	128,570	128,570	0.55	70,940		70,940		
2. Insititutional Development Cost	420	770	1,190	0.82	980	390	390	200	
3. Administration Cost	100	610	710	0.85	600	240	240	120	
4. Engineering Services	9,080	1,200	10,280	0.93	9,560	3,820	5,740		
Total (1 to 4)	9,600	131,150	140,750		82,080	4,450	77,310	320	0
5. Physical Contingencies (10% of 1 to 4)	960	13,120	14,080		8,210	450	7,730	30	0
Grand Total	10,560	144,270	154,830		90,290	4,900	85,040	350	0

Table L-9 Economic Annual O&M Cost, MP Study (1/3)

I. USP Area

(1) Economic Annual O&M Cost at Full Stage

Item	Financial Cost (Riel Million)	Conversion Factor	Economic Cost (Riel Million)
1. Materials	20.9	0.84	17.6
2. Equipment	17.6	0.75	13.2
3. Labor	60.8	0.53	32.2
4. O&M Staff	169.2	0.85	143.8
Total (3,500 ha)	268.5		206.8
Per ha (Riel)			59,086

(2) Annual Disbursement of Economic O&M Cost

Year in Order	Year	Area under Irrigation (ha)	Annual O&M Cost (Riel Million)
1	2002		
2	2003		
3	2004	200	11.8
4	2005	550	32.5
5	2006	1,200	70.9
6	2007	3,500	206.8
7	2008	3,500	206.8
8	2009	3,500	206.8
9	2010	3,500	206.8
10	2011	3,500	206.8
11	2012	3,500	206.8
12	2013	3,500	206.8
13	2014	3,500	206.8
14	2015	3,500	206.8
15	2016	3,500	206.8

Table L-9 Economic Annual O&M Cost. MP Study (2/3)

II. SRP Area

(1) Economic Annual O&M Cost at Full Stage

Item	Financial Cost (Riel '000)	Conversion Factor	Economic Cost (Riel '000)
1. Kim Sei System / Ang 160 System			
1. Materials	150	0.84	130
2. Equipment	130	0.75	100
3. Labor	430	0.53	230
4. O&M Staff	1,210	0.85	1,030
Total (21 ha)	1,920		1,490
Per ha (Riel)			70,952
2. Traneang Lean System			
1. Materials	80	0.84	70
2. Equipment	70	0.75	50
3. Labor	210	0.53	110
4. O&M Staff	600	0.85	510
Total (10 ha)	960		740
Per ha (Riel)			74,000

(2) Annual Disbursement of Economic O&M Cost

Kim Sei / Ang 160			Trapeang Lean		
Year	Area (ha)	O&M Cost (Riel'000)	Year	Area (ha)	O&M Cost (Riel'000)
2002			2006		
2003			2007		
2004	21	1,490	2008	10	740
2005	21	1,490	2009	10	740
2006	21	1,490	2010	10	740
2007	21	1,490	2011	10	740
2008	21	1,490	2012	10	740
2009	21	1,490	2013	10	740
2010	21	1,490	2014	10	740
2011	21	1,490	2015	10	740
2012	21	1,490	2016	10	740
2013	21	1,490	2017	10	740
2014	21	1,490	2018	10	740
2015	21	1,490	2019	10	740
2016	21	1,490	2020	10	740

Table L-9 Economic Annual O&M Cost, MP Study (3/3)

III. PDP Area

(1) Economic Annual O&M Cost at Full Stage

Item	Financial Cost (Riel '000)	Conversion Factor	Economic Cost (Riel '000)
1. Pond (Group)			
1. Materials	0	0.84	0
2. Equipment	60	0.75	50
3. Labor	700	0.53	370
Total (5 ha)	760		420
Per ha (Riel)			84,000
2. Canal Pond (Group)			
1. Materials	0	0.84	0
2. Equipment	110	0.75	80
3. Labor	1,230	0.53	650
Total (5 ha)	1,340		730
Per ha (Riel)			146,000
3. Pond (Individual)			
1. Materials	0	0.84	0
2. Equipment	110	0.75	80
3. Labor	1180	0.53	630
Total (5 ha)	1,290		710
Per ha (Riel)			142,000

(2) Annual Disbursement of Economic O&M Cost

Year in Order	Year	Pond (Group) (Riel '000)	Canal Pond (Group) (Riel '000)	Pond (Individual) (Riel '000)
1	2002			
2	2003			
3	2004	420	730	710
4	2005	420	730	710
5	2006	420	730	710
6	2007	420	730	710
7	2008	420	730	710
8	2009	420	730	710
9	2010	420	730	710

Table L-10 Economic Replacement Cost, MP Study (1/3)

I. USP Area

(1) Economic Replacement Cost by Item

Item	Useful Life (year)	Financial Cost (Riel Million)	Conversion Factor	Economic Cost (Riel Million)
1. Project Facilities				
1) Tumnup Lok Reservoir				
- Gate	25	44.6	0.79	35.2
- Wooden stop log	5	2.3	0.79	1.8
2) Diversio Canal				
- Wooden stop log	5	0.9	0.76	0.7
3) Kpob Trebek Reservoir				
- Gate	25	65.2	0.78	50.9
- Wooden stop log	5	2.3	0.78	1.8
4) Irrigation Canal System				
- Gate	25	957.5	0.77	737.3
- Wooden stop log	5	17.3	0.77	13.3
5) Tertiary development				
- Wooden stop log	5	92.0	0.70	64.4
2. O&M Equipment	10	306.8	0.74	227.0

(2) Annual Replacement Cost

(Unit : Riel Million)

Year in Order	Year	With 5 Years'	With 10 Years'	With 25 Years'	Total	Year in Order	Year	With 5 Years'	With 10 Years'	With 25 Years'	Total
1	2002					26	2027	32.2			32.2
2	2003					27	2028				
3	2004					28	2029	7.3		103.5	110.8
4	2005					29	2030	6.7		63.2	69.9
5	2006					30	2031	35.8		351.2	387.0
6	2007					31	2032	32.2		305.5	337.7
7	2008					32	2033				
8	2009	7.3			7.3	33	2034	7.3	227.0		234.3
9	2010	6.7			6.7	34	2035	6.7			6.7
10	2011	35.8			35.8	35	2036	35.8			35.8
11	2012	32.2			32.2	36	2037	32.2			32.2
12	2013					37	2038				
13	2014	7.3	227.0		234.3	38	2039	7.3			7.3
14	2015	6.7			6.7	39	2040	6.7			6.7
15	2016	35.8			35.8	40	2041	35.8			35.8
16	2017	32.2			32.2	41	2042	32.2			32.2
17	2018					42	2043				
18	2019	7.3			7.3	43	2044	7.3	227.0		234.3
19	2020	6.7			6.7	44	2045	6.7			6.7
20	2021	35.8			35.8	45	2046	35.8			35.8
21	2022	32.2			32.2	46	2047	32.2			32.2
22	2023					47	2048				
23	2024	7.3	227.0		234.3	48	2049	7.3			7.3
24	2025	6.7			6.7	49	2050	6.7			6.7
25	2026	35.8			35.8	50	2051	35.8			35.8

Table L-10 Economic Replacement Cost, MP Study (2/3)

II. SRP Area

(1) Economic Replacement Cost by Item

Item	Useful Life (year)	Financial Cost (Riel '000)	Conversion Factor	Economic Cost (Riel '000)
1. Kim Sei System				
1) Project Facilities				
- Gate	25	9,980	0.79	7,880
- Wooden stop log	5	700	0.79	550
2) O&M Equipment	10	2,740	0.74	2,030
2. Ang 160 System				
1) Project Facilities				
- Gate	25	3,330	0.79	2,630
- Wooden stop log	5	610	0.79	480
2) O&M Equipment	10	2,740	0.74	2,030
3. Trapeang Lean System				
1) Project Facilities				
- Gate	25	13,310	0.79	10,510
- Wooden stop log	5	490	0.79	390
2) O&M Equipment	10	2,740	0.74	2,030

(2) Annual Replacement Cost

1. Kim Sei System (Unit : Riel '000)

Year in Order	Year	With 5 Years'	With 10 Years'	With 25 Years'	Total	Year in Order	Year	With 5 Years'	With 10 Years'	With 25 Years'	Total
1	2002					26	2027				
2	2003					27	2028				
3	2004					28	2029	550		7,880	8,430
4	2005					29	2030				
5	2006					30	2031				
6	2007					31	2032				
7	2008					32	2033				
8	2009	550			550	33	2034	550	2,030		2,580
9	2010					34	2035				
10	2011					35	2036				
11	2012					36	2037				
12	2013					37	2038				
13	2014	550	2,030		2,580	38	2039	550			550
14	2015					39	2040				
15	2016					40	2041				
16	2017					41	2042				
17	2018					42	2043				
18	2019	550			550	43	2044	550	2,030		2,580
19	2020					44	2045				
20	2021					45	2046				
21	2022					46	2047				
22	2023					47	2048				
23	2024	550	2,030		2,580	48	2049	550			550
24	2025					49	2050				
25	2026					50	2051				

Table L-10 Economic Replacement Cost, MP Study (3/3)

II. SRP Area

(2) Annual Replacement Cost

2. Ang 160 System (Unit : Riel '000)

Year in Order	Year	With 5 Years'	With 10 Years'	With 25 Years'	Total	Year in Order	Year	With 5 Years'	With 10 Years'	With 25 Years'	Total
1	2002					26	2027				
2	2003					27	2028				
3	2004					28	2029	480		2,630	3,110
4	2005					29	2030				
5	2006					30	2031				
6	2007					31	2032				
7	2008					32	2033				
8	2009	480			480	33	2034	480	2,030		2,510
9	2010					34	2035				
10	2011					35	2036				
11	2012					36	2037				
12	2013					37	2038				
13	2014	480	2,030		2,510	38	2039	480			480
14	2015					39	2040				
15	2016					40	2041				
16	2017					41	2042				
17	2018					42	2043				
18	2019	480			480	43	2044	480	2,030		2,510
19	2020					44	2045				
20	2021					45	2046				
21	2022					46	2047				
22	2023					47	2048				
23	2024	480	2,030		2,510	48	2049	480			480
24	2025					49	2050				
25	2026					50	2051				

3. Trapeang Lean System (Unit : Riel '000)

Year in Order	Year	With 5 Years'	With 10 Years'	With 25 Years'	Total	Year in Order	Year	With 5 Years'	With 10 Years'	With 25 Years'	Total
1	2006					26	2031				
2	2007					27	2032				
3	2008					28	2033	390		10,510	10,900
4	2009					29	2034				
5	2010					30	2035				
6	2011					31	2036				
7	2012					32	2037				
8	2013	390			390	33	2038	390	2,030		2,420
9	2014					34	2039				
10	2015					35	2040				
11	2016					36	2041				
12	2017					37	2042				
13	2018	390	2,030		2,420	38	2043	390			390
14	2019					39	2044				
15	2020					40	2045				
16	2021					41	2046				
17	2022					42	2047				
18	2023	390			390	43	2048	390	2,030		2,420
19	2024					44	2049				
20	2025					45	2050				
21	2026					46	2051				
22	2027					47	2052				
23	2028	390	2,030		2,420	48	2053	390			390
24	2029					49	2054				
25	2030					50	2055				