8.3 Project Benefits

8.3.1 Agricultural Benefits

(1) Crop Benefits

Cropping intensity, yield increase and quality improvement are appropriate for crop benefits, details of which are provided in TABLE - 4. Cropping ratio will be increased by implementation of irrigation projects; yield increase will be realized by stable irrigation water supply and agricultural extension services; and quality improvement will be made by construction of a farm road network and utilization of paddy drying yards at Integrated Community Centers described herein fter.

At present, agricultural inputs and outputs are mainly transported manually due to the poor farm road network in the Project area, especially in paddy. In particular, the transportation of harvested rice is delayed due to lack of drying facilities and labor shortage lowering the quality of rice. It is expected that project implementation will upgrade the quality of rice at an estimated 5% increase in rice price compared to without Project.

(2) Benefits of Integrated Community Center (ICC)

Integrated community centers equipped with public wells to supply water for domestic use and farm management, and paddy drying yards used both as a meeting site and recreation ground will be constructed to upgrade the living conditions of beneficiaries (mainly farmers) in the Project area and to heighten the production base. Tangible benefits consist of a stable drinking water supply and improvement of rice quality with the drying yards.

Benefits of irrigation water supply are generally determined on the basis of the economic alternative plan with the lowest cost to Project cost or by beneficiaries' willingness to pay. The economic alternative plan selected consists of construction of six deep wells per public well. However, as the lower portion of the Project area is close to the river mouth, this plan is impractical due to sea water intrusion. Therefore, public well benefits through beneficiaries' willingness to pay were used in calculations.

CROP BENEFITS

Items	Present	Future	
		Without Project	With Project
1. Farmland (ha)	6,900	6,900	6,760
2. Cropping Area (ha)			
- Paddy	10,140(100)	10,140(100)	13,200(130)
- Sugarcane	380	380	-
- Coconut	200	200	-
- Corn	-	-	205
- Vegetables	-	-	718
- Mung beans	-	-	205
Total	10,720(100)	10,720(100)	14,328(134)
3. Cropping Intensity (%)	155	155	212
4. Crop Production (ton)			
- Paddy	22,161(100)	25,656(116)	63,460(286)
- Sugarcane	21,633	21,633	-
- Coconut	22	22	-
- Corn	-	-	718
- Vegetables	-	-	12,310
- Mung beans	-	-	205
5. Farm-gate price, Financial/Economic(₱/ton)			
- Paddy	2,650/2,835	2,650/2,835	2,780/2,985
- Sugarcane	301/473	301/473	-
- Coconut	6,000/5,040	6,000/5,040	-
- Corn	-	-	3,340/2,806
- Vegetables	-	-	2,000/1,680
- Mung beans	-	-	8,000/6,720
6. Benefits, Financial/Economic (000₱)			
a. Gross Production Value		74,617/83,108	205,298/213,689
b. Production Cost		58,042/38,065	124,060/ 85,648
c. Net Production Value		16,575/45,043	81,238/128,041
d. Total Benefits			64,663/ 82,998
e. Benefits per hectare (₱/ha)			(9,566/12,278)

Drinking water supply charge per family per month in Sara, Ajuy, Concepcion and San Dionisio is ₱5 to ₱15 with an average of ₱9 and is considered to be a good indication of beneficiaries' willingness to pay. Consumers' willingness to pay on an economic base is estimated at ₱7/family/month by applying 0.802, the conversion factor for drinking water. Benefits of ICC are summarized as follows:

- Number of Integrated Community Centers	100
- Beneficiary Households	5,000
- Willingness to Pay for Domestic Water (₱/month)	
Financial	9
Economic	7
- Benefits (₱'000)	
Financial	540
Economic	420

(3) Benefits of Farm Road Network

According to the agricultural census in 1980, 86% of farm households in the four municipalities of the Project area transport agricultural products manually, 6% with draft animals, and 5% with the aid of carts or sleds drawn by draft animals. Transportation on foot and by animal accounts for 97% mainly due to the underdeveloped farm road network. Operation and maintenance of roads for main canals and the network arrangement planned under this Project will remarkably improve the transportation of agricultural inputs and outputs.

TRANSPORTATION OF FARM PRODUCTS IN THE PROJECT AREA

	Ajuy	Concep-tion	San Dionisio	Sara	Total
1. Foot	367	18	161	1,186	1,732(86%)
2. Animal	73	5	35	2	115(6%)
3. Cart or Sled	20	9	23	60	112(5%)
4. Tricycle	4	26	2	6	38(2%)
5. Power Tiller or Tractor	0	-	0	-	0(-)
6. Motor Vehicle	7	7	0	1	15(1%)
7. Boat or Banca	-	-	-	-	-(-)
8. Others	-	-	-	-	-(-)
Total	471	65	221	1,255	2,012(100%)

Benefits of farm roads were analysed by the diff rence in proposed rice transportation cost between without project and with project conditions at the peak farming season which has the maximum opportunity labor cost in the Project area. Transporation under without project conditions is estimated at 90% by manual labor and 10% by draft animal. On the assumption that project implementation will begin as scheduled, the average scale of farm households will be able to harvest and transport agricultural products within one week by their own labor with 10% transported by manual labor and 90% by draft animal. This estimation is based on the assumption that 90% of transportation in the Project area will be by water buffalo and 10% by manpower along main roads. A summary of road benefits are estimated in TABLE - 5.

8.3.2 Hydropower Benefits

Hydropower benefits are analysed on the basis of the second lowest cost alternative plan. Two alternative power generation systems were examined; namely, the selling rate of ILECO II and diesel engines. The study has proven that the selling rate of ILECO II is less costly in terms of present worth value as shown in the following table.

Item	Selling Rate of ILECO II		Diesel Engine	
	Financial	Economic	Financial	Economic
1. Unit Rate (₱/kWh)	1.60	1.283	1.640	1.315
2. Present Worth Value (000₱)				
7%	106,054	85,049	108,764	87,227
8%	89,342	71,647	91,481	74,443

SUMMARY OF ROAD BENEFIT ESTIMATION

Items	Paddy Field to Drying Yard	Drying Yard to Existing Main Road
1. Beneficial Paddy Field (ha)	3,730	3,050
2. Transportation Volume Wtih Project (tons)	37,278	23,683
3. Transportation Distance (m)	548	800
4. Transportation Means and Speed		
a. Without Road Network		
- Manual	90% (1.0km/hr)	90% (1.0km/hr)
- Animal	10 (2.0 ")	10 (2.0 ")
b. With Road Network		
- Manual	10 (1.5 ")	10 (1.5 ")
- Animal	90 (3.0 ")	90 (3.0 ")
5. Working Days (days)		
a. Without Road Network		
- Manual	187,151	172,099
- Animal	1,625	1,579
b. With Road Network		
- Manual	23,309	22,102
- Animal	10,307	9,473
6. Total Cost, Financial/Economic(000₱)		
a. Without Road Network		
- Manual	6,738/2,762	6,196/2,547
- Animal	119/98	115/95
Sub-total	6,857/2,860	6,311/2,642
b. With Road Network		
- Manual	839/345	796/327
- Animal	752/618	692/568
Sub-total	1,591/963	1,488/895
7. Benefits, Financial/Economic(000₱)	5,266/1,897	4,823/1,747

8.3.3 Benefits of Sara Waterworks

As described in (2) Benefits of Integrated Community Center, drinking water supply benefits are measured by beneficiaries' willingness to pay. In the same way, the benefits of Sara Waterworks are analysed by the standard of ₱9/month/family as seen in the following table.

Items	Without Project	With Project
Beneficial Households	940	3,384
Willingness to Pay (000₱)		
- Financial	102	365
- Economic	79	284
Benefits (000₱)		
- Financial	-	263
- Economic	-	205

8.3.4 Socioeconomic Impact

In addition to the above-mentioned tangible benefits, the following socioeconomic impacts are expected to be realized with the Project.

a) reduced consumption of imported fuels and economic expenditure;

b) improvement of cultivation techniques and farm management;

c) introduction of fresh and inexpensive farm produce throughout the year;

d) improvement of nutrition via increased intake of vegetables grown on home plots;

e) establishment of irrigators' associations managed by farmers;

f) expansion of radius of interaction and close communication among the villagers of the area via improved farm road network;

g) enhancement of integrated community development with the construction of an Integrated Community Center resulting in the mitigation of outflow of the population;

h) improvement of public health via facilities at the Integrated Community Center;

i) dissemination of information on the importance of joint water use;

j) improved consciousness of farmers with regards to agricultural cooperatives;

k) deepening of mutual communication among beneficiaries;

l) continued employment opportunities with 962,000 man-days required for Project construction and operation and maintenance thereafter; and,

m) enhancement of self-sufficient rice production and contribution to improved foreign currencies earnings.

In short, the Project will improve the rural people's living standards through intensive water use for agriculture, hydropower and domestic needs, as well as improving interaction between villages by the farm road network. Thus, the Project will facilitate effective socioeconomic development promoting not only rural public welfare but also helping to alleviate the disparity in living standards between regions.

8.4 Economic Efficiency of the Project

8.4.1 Cost Allocation

This Project consists of three components; namely, agriculture, hydropower and Sara Waterworks. To evaluate the respective economic efficiency of each component, joint construction cost (construction cost of dam and driving channel) should be allocated to the same. Joint construction cost except specific cost of each component for the Catipayan dam and driving channel total ₱432.27 million in financial value and ₱354.77 million in economic value. In general, the separable costs-remaining benefits method is used but in this case, the remaining benefits method is employed for the following reasons:

a) The dam has a total capacity of 28,200,000t exclusively for hydropower, with only 300,000t for domestic water supply. Thus, joint construction cost is equal to alternate costs for agriculture. Construction cost will, therefore, be borne by the agricultural sector.

b) On the assumption that water volume drawn off from the channel is fixed at 50% each from agriculture and hydropower (residual water allocation after draw-off for domestic use), the result is uneconomical due to the high allotment for hydropower.

The allocation of construction cost for each component is tabulated below.

Unit: 000 P

Items	Agriculture	Hydropower	Sara Waterworks	Overall
1. Specific Cost				
- Financial	243,165	53,995	1,521	298,681
- Economic	183,545	50,801	1,405	235,751
2. Joint Cost				
- Financial	383,462 (88.71)	48,025 (11.11)	778 (0.18)	433,265 (100%)
- Economic	334,947 (94.41)	19,690 (5.55)	142 (0.04)	354,769 (100%)
3. Total				
- Financial	626,627	102,020	2,299	730,946
- Economic	518,482	70,491	1,547	590,520

As for economic analysis, the evaluation period of the Project is assumed to be 50 years in consideration of the physical life of the dam.

8.4.2 Quantifiable Benefits

Quantifiable benefits include crops, integrated community center, farm roads, hydropower and waterworks. Target year is assumed to be 1997, 12 years after commencement of the Project in 1986. The breakdown of each component as of 1997 is as follows:

Unit: 000P

	Agriculture						Sara
	Crops	ICC	Farm Road Network	Total	Hydro-power	Water-works	Overall
Financial	64,663 (74.1)	540 (0.6)	10,089 (11.6)	75,292 (86.3)	11,739 (13.4)	263 (0.3)	87,294 (100%)
Economic	82,998 (85.9)	420 (0.4)	3,644 (3.8)	87,062 (90.1)	9,414 (9.7)	205 (0.2)	96,681 (100%)

8.4.3 Financial and Economic Indicators of the Project

The comparison between project cost and benefits is shown in TABLE - 6. On the basis of project evaluation of private economy and national economy, several conclusions were made as given below.

(1) Agriculture

1) Analysis of Farm Household Income

Farm households in the Project area depend mainly on paddy monoculture with an average area of 2.4ha. The income of a farm household is assumed to be ₱10,554/year without project. Upon implementation of the Project, however, income will become ₱28,624/year, with a disposable income of ₱1,804/year due to the enhancement and upgrading of cropping ratio, and increases in yield and quality (TABLE - 7).

If construction cost and operation and maintenance costs of terminal facilities are all borne by beneficiaries, project cost is calculated to be ₱249/ha per year (₱185 as yearly repayment for facilities and ₱64 as operation and maintenance cost). This equals 2.6% of the total ₱9,564 which is equivalent to the amount of incremental net production value of crops her ha.

CONSTRUCTION AND O & M COSTS FOR ON-FARM FACILITIES

Item	Unit	Cost
1. Construction Cost of On-Farm Works		
a. Direct Cost	(000₱)	8,138
b. Contigency	(")	1,222
c. Total Cost	(")	9,360
d. Cost per Hectare	(₱/ha)	1,385
e. Annual Loan Repayment 1/	(")	185
2. Annual O & M Cost of On-Farm Level		
a. Total Cost 2/	(000₱)	430
b. Cost per Hectare	(₱/ha)	64
3. Total annual cost	(₱/ha)	249

Note: 1/ ..... Supposed 12% of interest and 20 years of repayment period.

2/ ..... Salary for gate keeper and ditch tender only.

COMPARISON OF PROJECT COST AND BENEFITS

Items	Agricul-ture	Hydro-power	Sara Water-works	Overall
A. Financial Indicator				
1. Construction Cost (000₱)	626,627	102,020	2,299	730,946
10% Discount Rate	422,890	65,033	1,417	489,340
2. Benefit (000₱)				
- Annual Benefit	75,292	11,739	263	87,294
- Present Worth Value (10% Discount Rate)	403,343	65,265	1,462	470,070
3. Benefit Cost Ratio				
- 6% Discount Rate	1.56	1.58	1.67	1.57
- 8% - do -	1.20	1.24	1.29	1.21
- 10% - do -	0.95	1.00	1.03	0.96
4. Internal Rate of Return (%)	9.6	10.0	10.3	9.7
B. Economic Indicator				
1. Construction Cost (000₱)	518,482	70,491	1,547	590,520
10% Discount Rate	350,645	44,718	934	396,297
2. Benefit (000₱)				
- Annual Benefit	87,062	9,414	205	96,681
- Present Worth Value (10% Discount Rate)	481,221	52,338	1,140	534,699
3. Benefit Cost Ratio				
- 10% Discount Rate	1.37	1.17	1.22	1.35
- 12% - do -	1.13	0.98	1.01	1.11
- 14% - do -	0.94	0.83	0.85	0.93
4. Internal Rate of Return (%)				
- Proto-type (Sensitivity Test)	13.3	11.7	12.1	13.2
a. Fluctuation of Crop Target Yield				
a-1 10% increase	15.0	-	-	14.7
a-2 10% decrease	11.6	-	-	11.6
b. Two Years Delay in Project Implementation	-	-	-	11.9
c. Increase of Construction Cost				
c-1 10% increase	12.3	10.7	11.1	12.1
c-2 20% increase	11.4	9.8	10.2	11.2
d. Combination of a-2 & c-1	10.6	-	-	10.6
e. Combination of a-2 & c-2	9.8	-	-	9.8

FARM BUDGETS

Items	1.5ha Farm W.O.P.	1.5ha Farm W.P.	2.4ha Farm (Average Size) W.O.P.	2.4ha Farm (Average Size) W.P.	3.5ha Farm W.O.P.	3.5ha Farm W.P.
(Farm Land, unit: ha)						
(1) Operated Area - Paddy Field	--- 1.5 ---		--- 2.4 ---		--- 3.5 ---	
(2) Planted Area of Paddy						
a. 1st Crop, Irrigated, DS 1/	0.42	0.90	0.67	1.44	0.98	2
b. - do - TR 2/	0.03	0.60	0.05	0.96	0.07	1
c. 1st Crop, Rainfed, DS	1.00	-	1.59	-	2.31	-
d. - do - TR	0.08	-	0.12	-	0.18	-
e. 2nd & 3rd Crop, Irrigated, DS	0.34	0.97	0.54	1.55	0.80	2
f. - do - TR	0.02	0.65	0.04	1.03	0.06	1
g. 2nd Crop, Rainfed, DS	0.51	-	0.82	-	1.20	-
h. - do - TR	0.04	-	0.06	-	0.09	-
Sub-total	2.44	3.12	3.89	4.95	5.69	1
(3) Gross Production Value of Paddy	15,100	41,700	24,074	66,553	35,210	97
(4) Production Cost	11,943	27,222	19,042	43,451	27,854	63
(5) Net Production Value of Paddy	3,157	14,478	5,032	23,102	7,356	33
(6) Net Production Value of Livestock 3/	541	541	541	541	541	
(7) Total of Agricultual Income	3,698	15,019	5,573	23,643	7,897	54
(8) Non-farm Income 3/	4,981	4,981	4,981	4,981	4,981	4
(9) Total of Farm Income	8,679	20,000	10,554	28,624	12,878	59
(10) Household Expenditure						
- Food expenditure for own farm 4/	2,960	3,100	2,960	3,100	2,960	3
- Other expenditure	5,100	15,640	6,810	23,720	8,930	33
- Sub-total	8,060	18,740	9,770 3/	26,820	11,890	36
(11) Disposable Income	619	1,260	784	1,804	988	2

Note: 1/ ..... Direct Seeding
2/ ..... Transplant
3/ ..... Based on Farm Survey
4/ ..... Base of calculation is as follows:
- Annual consumption of paddy per capita = 186kg
- Family size = 6 persons
- Paddy price Without Project = 2.65₱/kg
- Paddy price With Project = 2.78₱/kg

2) Internal Rate of Return (IRR)

Based on comparison between the allocated project cost and the total benefits of crops, integrated community centers and farm roads, IRR totals 9.6% on a financial base and 13.3% on an economic base. The FIRR is lower than the economic value. However, agriculture is one of main industries in the Philippines and the EIRR exceeds 10%. Under these circumstances, the above figure is considered reasonable.

(2) Hydropower

The FIRR and EIRR for hydropower are 10.0% and 11.7%, respectively. Judging from the fact that the opportunity cost of capital in the Philippines is 15%, the economic value of the Project is not high. However, these percentages are judged to be substantial in consideration of the effective availability of resources.

(3) Sara Waterworks

The FIRR and EIRR are 10.3% and 12.1%, respectively for Sara Waterworks. The IRR is lower than the opportunity cost of capital, which is equal to hydropower. Nevertheless, waterworks are significant and useful for securing a living base for beneficiaries. Consequently, the implementation of the Project will play an important role in correcting the differences in living standards among the regions in the Philippines.

(4) Overall

The overall FIRR and EIRR are 9.7% and 13.2%, respectively. The project cost and benefits of the agricultural sector occupy 88% and 90%, respectively. Accordingly, the overall IRR of the Projeect is greatly affected by the economic effectiveness of agriculture.

CHAPTER IX

STAGE DEVELOPMENT APPROACH

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STAGE DEVELOPMENT APPROACH

9.1 General

The objective of the present Project is promotion of agricultural development through improvement of irrigation systems which is essential for increased agricultural productivity. The main Project component is accordingly irrigation development. In order to achieve development objectives and increase effectiveness, the plan will also include secondary components wherever functionally related to irrigation development, including road network development, hydropower development, and domestic water supply, in order to effectively utilize water resources and Project facilities.

The Project will contribute to achievement of the various objectives of the Five Year Economic Development Plan. Technical as well as economic feasibility of the Project was proved in this report. In addition, intangible benefits, i.e. improvement of living environment, socioeconomic conditions, etc. are found to be substantial and hence early implementation of the Project is desirable.

Staged implementation of the Project was accordingly evaluated as an alternative plan for realistic implementation of the original plan which requires a comparatively large-scale initial investment. In formulation of a staged development plan attention was paid to the conformity of each stage with the overall development plan and to the realization of immediate benefit with minimal initial investment. In addition, timely implementation of other components such as hydropower generation and the domestic water supply plan was optimized.

9.2 Staging of the Project

Water resources development of the proposed scheme (original plan) can be broadly divided into three categories i.e. Asue Basin development, trans-diversion from the Catipayan River and construction of the proposed Catipayan dam.

As the proposed schemes show, through construction of the dam on the Catipayan River, a 6760ha area including the enriched benefit area, becomes irrigable mainly for 200% paddy cultivation. The Project proposes the construction of three diversion dams on the Asue and Gubaton rivers to effectively utilize water resources in the Asue Basin. Appropriate staging of the Project was examined premising the construction of these diversion dams and utilization of the existing Serruco diversion dam.

After examination of irrigable area under stage development for Case A, using the water resources of the Asue Basin, and Case B, using Catipayan River natural flow in addition to the Asue Basin without the dam, an average irrigable area of 2,200ha in Case A and 3,390ha in Case B were obtained. Furthermore, the irrigable area by the Asue diversion dam in Case A is relatively small at 840ha. On the other hand, the same in Case B is 2,250ha which is almost equivalent to the command area of the Asue main canal. As for benefit/cost ratio, a slightly high ratio of 1.68 for Case A against 1.57 for Case B was obtained.

After judging these conditions, implementation stages were determined as outlined below.

Stage I: An irrigation area of 4,130ha will be developed including three diversion dams i.e. Asue, Bakabak and Gubaton, irrigation canals and on-farm development. The area of 4,130ha excludes the command area of the Eastern main canal and the trans-diversion canal. This stage includes the construction of a temporary trans-diversion canal/tunnel and temporary diversion works on the Catipayan River. A road network and an Integrated Community Center will also be included in this stage for the said area.

Stage II: Irrigation for the area under the proposed Eastern main canal will be developed in this stage. The proposed Catipayan dam coupled with hydropower and domestic water supply works will also be implemented. The trans-diversion canal will be enlarged in the final plan.

The road network and Integrated Community Center will be implemented along with irrigation development in consideration of the advantageousness of simultaneous construction. On the other hand, the hydropower plant and domestic water supply will be constructed at the same time as the Catipayan dam.

9.3 Facilities Planning

In the case of first stage development, required maximum diversion capacity to the Asue Basin was calculated at 1.5m3/sec from the water balance study. Required facilities for trans-diversion under Stage I are the intake at the Catipayan River, trans-diversion canal and tunnel.

A trans-diversion canal on the left bank of the Catipayan River will convey irrigation water to the Asue Basin. In Stage I, an open canal at the proposed Catipayan dam presents no constraints; however, for dam construction in Stage II, the open canal will hinder dam embankment. In considerion of dam construction, the construction of a new tunnel was adopted for the Catipayan River diversion around the proposed dam after comparative study.

9.4 Implementation and Disbursement Schedule

The implementation p riod for staged development includes one 5-year period for each stage, resulting in a total period of 10 years as presented in FIG. - 14. Total financial cost including physical and price contingencies for each stage and for overall implementation are as presented in the following table.

FINANCIAL COST

Unit: ₱ 10^6

	Stage I	Stage II	Overall
F.C.	173.281	560.189	733.469
L.C.	262.055	778.729	1,040.783
Total	435.336	1,338.917	1,774.253

IMPLEMENTATION SCHEDULE FOR STAGE DEVELOPMENT

Item	STAGE I					STAGE II				
	Pre-Project Stage		Construction Stage			Construction Stage				
	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
1) Dam										
Diversion Tunnel										
Cofferdam										
Excavation										
Embankment										
Spillway										
Trans-diversion Canal										
Tunnel										
2) Hydropower Station										
3) Domestic Water Supply										
4) Irrigation and Drainage										
Diversion Dam			Bakabak D.D	Gubaton D.D	Asue D.D					
Irrigation Canal	Detail Design	Preparation Works								
Main Canal			5,780 m	8,430 m	8,380 m				6,160 m	1,120 m
Lateral Canal			7,430 m	10,820 m	14,640 m				11,870 m	20,110 m
Drainage										
New Drainage Canal			6,400 m	5,300 m	2,500 m				2,100 m	5,200 m
Excavation of Creeks					1,500 m				4,500 m	
Drainage Structure					2 nos.				4 nos.	
Rehabil. for Up. of Asue R.					650 m					
Removal of Ex. Wiers										
On-Farm Development			1,360 ha	1,367 ha	1,403 ha				1,341 ha	1,289 ha
Facilities at H.P. Station										
5) Road (Excluding of Service Road)										
New Road			6,750 m	1,350 m	900 m				2,400 m	3,900 m
Rehabil. for Ex. Road			3,700 m	800 m	1,400 m				100 m	
Related Structures			11 nos.	1 nos.	2 nos.				2 nos.	3 nos.
Enlargement of S. Road			2,160 m	1,910 m	5,620 ha				2,910 m	
Along the Serruco CIS Canal			16,110 m							
6) Integrated Community Center			20 nos.	20 nos.	20 nos.				20 nos.	20 nos.
7) Dry Yard			31 nos.	30 nos.	30 nos.				30 nos.	30 nos.

9.5 Evaluation

Evaluation was made on the basis of the economic internal rate of return (EIRR) and investment scale for each stage and for overall implementation as tabulated below.

ECONOMIC INTERNAL RATE OF RETURN

	Stage I	Stage II	Overall
EIRR	15.5%	11.8%	13.1%

As shown in the above table, overall EIRR is 13.1% which is 0.1% smaller than that of the original plan. However, Stage I has a high EIRR of 15.5%.

Comparison of financial cost was also conducted as shown in the table below.

FINANCIAL COST COMPARISON

Unit: ₱ 10^6

	Stage I	Stage II	Overall	Original Plan
Financial Cost	213.4	424.3	637.7	635.6
Physical Contingency	32.0	63.7	95.7	95.3
Price Contingency	190.0	850.9	1,040.9	652.5
Total Financial Cost	435.4	1,338.9	1,774.3	1,383.5

Although the total financial cost of the stage develoment plan is rather large compared to the original plan because of the high price contingency, the cost required for Stage I is ₱435 million. In view of the high Economic Internal Rate of Return for Stage I development, this approach seems most advantageous in reducing initial investment.

CHAPTER X

ENVIRONMENTAL IMPACT

CHAPTER X

ENVIRONMENTAL IMPACT

10.1 Outline

The National Environmental Protection Council (NEPC) issued the Philippines Environmental Impact Statement System (PEISS) which defines the environment as comprising all natural, ecological, aesthetic, cultural, institutional, economical, and historical facets of life. NEPC studies the environmental impact of a project including discussions on the direct and indirect consequences of large-scale projects upon human welfare and ecological and environmental integrity.

The Project proposes construction of the Catipayan dam reservoir, hydropower plant, trans-diversion canal, road network and other works and also recommends intensive agricultural methods. The Catipayan dam reservoir capacity is 28 million tons which is more than the standard of 20 million tons. Therefore an environmental impact study was necessary. The proposed Project activities extend over a wide area in and around the Project area and affect various environmental elements. Although it is impossible to study the impact on all elements, the environmental impacts of Catipayan dam reservoir construction on the surrounding area and of agro-chemicals on fish ponds downstream of the irrigation service area were studied and the results discussed with NIA and the JICA Advisory Mission.

As the proposed Project activities extend over a wide area, integrated environmental assessment following PEISS should be undertaken for project implementation.

10.2 Environmental Impact of Catipayan Dam Reservoir

10.2.1 National Conditions

(1) Land

Area below EL.124.0m, about 2,100ha, will be submerged by the reservoir. The reservoir site is in a V-shaped valley along the river course, both sides of which are steeply sloped. Arable land in the submerged area consists of 4ha of paddy and 11ha of shifting

cultivation. The remaining area is open grassland with scattered bush, and land utility is low.

Both side slopes above the submerged area may suffer from erosion due to fluctuation of water level, especially during flood. Based on the watershed management plan, afforestation should be urgently promoted for soil conservation in the area.

(2) Water

There is no large intake of river flow either above or below the dam site and only a few residents in the limited area downstream are using water for domestic and other purposes. The river density downstream from the dam site is high and many rivers are utilized as domestic and irrigation water sources.

Dam and reservoir construction will decrease the river water level and flow volume downstream. Considering present conditions, however, this will affect only a limited area of 1.5 to 2.0km in which few residents are found. Moreover, desirable effects are expected to outnumber the disadvantages, provided that intake of irrigation water in drought years is not obstructed and that trans-diversion from the dam reservoir is used in a limited area to prevent pollution of water quality.

The reservoir will stabilize water supply to residents upstream in drought years. The spillway of the dam is designed as an over-flow type, which eliminates the risk of rapid increase of water level through discharge to residents downstream. Moreover, discharge of sediments and scouring by the same during floods is prevented. The reservoir does not have flood control capacity. However, at design full water level, with 2,100ha submerged, storage capacity is high and the reservoir will reduce flood peak downstream.

(3) Watershed Management

In the Catipayan dam reservoir watershed, 5% of the total area is secondary forest and 84% is open grassland and scattered bush. Consequently, topographic conditions and shifting cultivation adversely affect watershed management.

In consideration of the above conditions, afforestation and agro-forest establishment plans are an effective measure not only to establish watershed management but also to protect and improve the natural and socioeconomic environment of local residents. Implementation of the watershed management plan is therefore urgently recommended.

(4) Wildlife and Fish Species

There are few riverine fish species in the Catipayan River and no species which migrate to the sea requiring protection. Data on fish or wildlife in the watershed area and the Catipayan River were unavailable.

10.2.2 Socioeconomic Impact

(1) Transportation

The present road density of the proposed watershed is high; however, there are only three roads which are passable by small vehicles. The remaining roads are footpaths following natural topographic contours, while rivers are generally forded on foot except where a few log bridges exist.

The predominant means of transportation are walking and carabao. Waterborne traffic is non-existant due to topographical and hydrographical conditions of the river. With construction of the dam, fording of rivers on foot will become impossible; however, the dam crest can be utilized as a pedestrian path, thereby promoting traffic in and around the watershed.

Maintenance roads for the dam and trans-diversion canal will stimulate local economic activity while waterborne traffic in the reservoir is expected to develop as a new means of transportation contributing to socioeconomic activities. Two bridges in the proposed dam reservoir area will be submerged and replacement of the same is very costly. As bridge construction should be planned on the basis of the watershed management plan for the Project, bridges which will be submerged in the reservoir will not be replaced. However, river and reservoir crossings should be established as part of the road network.

(2) Resettlement

The shore of the reservoir is along the steep slope of the V-shaped valley which has little agricultural use. Households and population in the watershed area total 240 and 1,700, respectively. Most residents practise shifting cultivation for their livelihood.

About 84% of the total watershed area is open grassland with scattered bush and the proposed dam reservoir area covers about 2,100ha. Coastal areas are private land while arable land in the reservoir amounts to 15ha consisting of 4ha of paddy field and 11ha of shifting cultivation area.

Resettlement of two farm households in the proposed reservoir area is required. According to the results of the field survey, both households will accept resettlement on the condition of proper compensation. Both are share tenants of shifting cultivation lands which are located above the full water level of the reservoir; therefore resettlement nearby is possible.

10.3 Irrigation and Drainage Impact on Fish Ponds

The lower areas of the river basin adjoin a large extent of fish ponds, totalling 1,400ha. These fish ponds utilize river water from the Asue, Gubaton and other rivers which flow into Ajuy Bay and from the Hasohoy, Tabagay and other rivers which flow into Bagacay Bay.

Major fish species include milk fish, tilapia, catfish, prawn and shrimp. Water for fish ponds is brackish and fresh water is used for dilution. The effect of irrigation and drainage development under the Project on freshwater used for dilution is therefore an important concern.

The service area located upstream of the fish ponds will be irrigated with water diverted from the Catipayan water reservoir. Drainage volume will increase, especially in dry season, as river flow volume will increase. Consequently available water for fish ponds will increase and be stabilized. This increase and stability of water supply could contribute to the extension of fish culture into the dry season.

To achieve the target yield of crops, increased application of agro-chemicals and fertilizer is proposed. Contamination of river flow

was estimated on the assumption that 25% of total applied agro-chemicals are drained into the rivers, as presented in the following table.

	Weedicide	Pesticide	N	P	K
Actual Density (ppm)	0.0006	0.0007	0.0473	0.0258	0.0258

Since all these values are lower than the acceptible water pollution load for fish ponds designated by NEPC, the effect of agro-chemicals on fish culture is considered negligible.

Though the amount of weedicide and pesticide is slight, possible threat to people as well as fish should be duly considered. Therefore, long-term observation should be conducted on the effect of agrochemicals on fish culture and appropriate amounts of agrochemicals should be recommended on the basis of observation results. Moreover, careful instruction on selection of agro-chemicals, application, storage methods and disposal of empty bottles should be provided.

CHAPTER XI

WATERSHED MANAGEMENT PLAN

CHAPTER XI

WATERSHED MANAGEMENT PLAN

11.1 Outline

The total area of watershed management for the Catipayan dam site and its reservoir is approximately 4,420ha. Out of that, approximately 84% of the total area is covered by open grassland with scattered trees and savanna forest. Second forest area covers only 4.5% of the total area while 11.5% of the same is used for human activities such as villages, arable land and roads.

Rainfall intensity in the area is generally low and the soils are mostly of the fine loamy to clayey type, indicating a fairly low to moderate erodibility hazard. Moreover, the severity of the erosion problem is in great part due to physical factors. The terrain is undulating, rough and broken and the slopes are generally steep to very steep.

Human activity has also been a major contributing factor to soil loss through erosion. Clearing and cultivation of open grassland is fast progressing without regard for topography. Other contributory factors are the present natural vegetation, and undesirable land management practices, such as burning, clearing and cultivation.

Considering the present situation, reforestation should be given priority in watershed management of the Catipayan dam and reservoir. The main goal of watershed management is not to extend agricultural land but to ensure long-term and effective utilization of the Capitayan dam. Therefore, control of siltation and soil erosion are the optimum solution.

Tree planting is an effective countermeasure to siltation and soil erosion which reduce the useful life of the Catipayan reservoir. Although a watershed management development plan is not included in the Project, such a plan is urgently required and should be formulated as soon as possible to promote socioeconomic development, raise the standard of living, and increase employment opportunities in the area.

11.2 Plantation Plan

11.2.1 Land Use Plan

On the basis of present land use, land classification and topographic conditions, the watershed area was roughly categorized into the following 4 areas and proposed land uses.

Proposed Land Use	Features	Area
Forest Area (I)	Reservoir basin, very steep slopes EL. 124 - 150 or 175m	570ha
Forest Area (II)	Mountain with long continuous very steep slopes EL. 300 - 700m	1,325ha
Agro-forest Area	High to medium hills slope 15° - 40° EL. 200 - 300m	1,170ha
Arable Land, Range and Residential Area	Undulating low hills short slopes and isolated terraces slope 0 - 15° EL. 150 - 200m	1,105ha

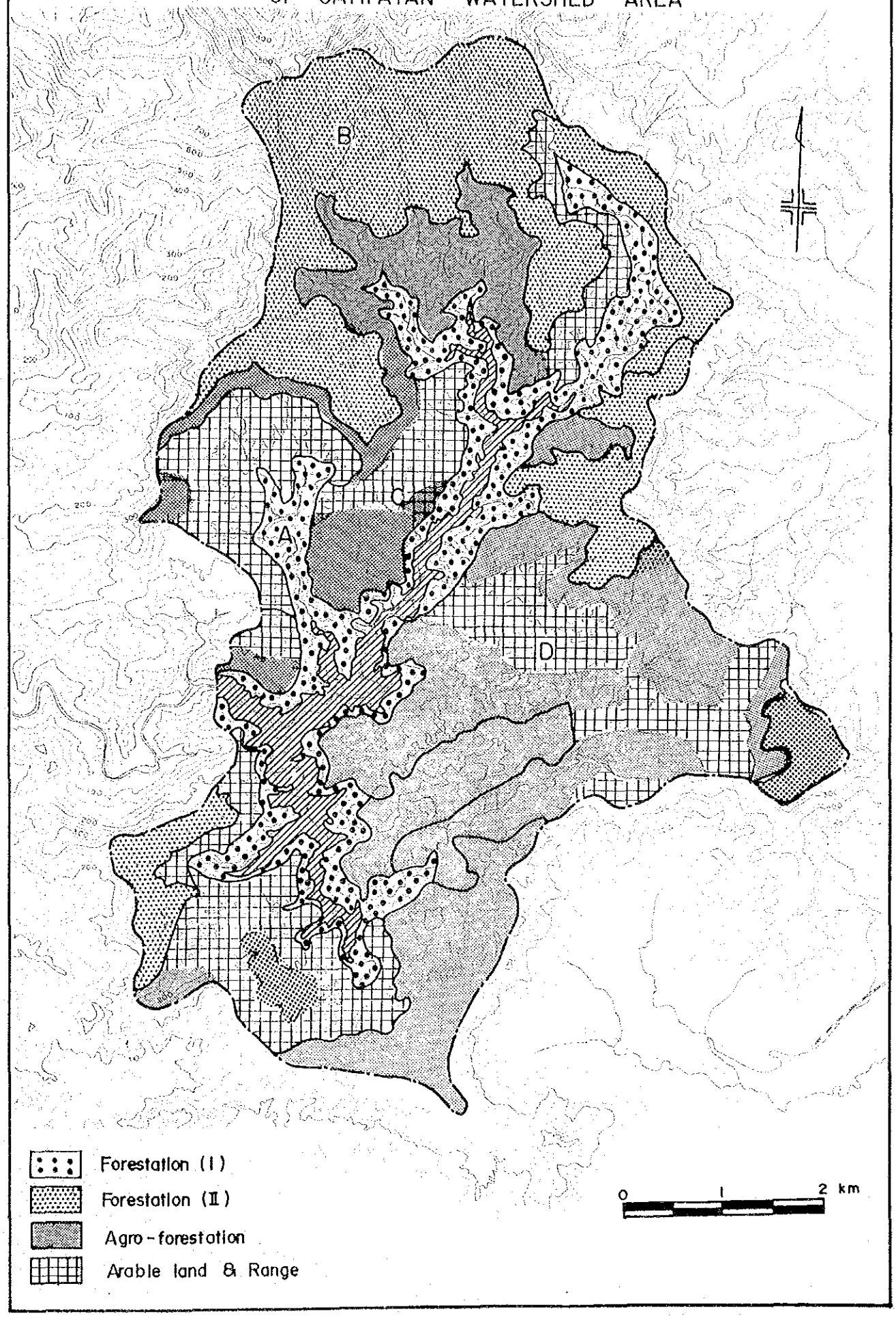
11.2.2 Selection of Tree Species

On the basis of the collected data and the field survey, proposed tree species which were selected as most suitable for watershed management are as tabulated below (FIG. - 15).

Area	Tree Species
Forest Area (I)	Ipil ipil
Forest Area (II)	Narra
Agro-forest Area	
- tree rows	Ipil ipil
- fruits	Mango
Arable Land, Residential Area	Ipil ipil

FIG. - 15

PROPOSED LAND USE AND REFORESTATION PLAN OF CATIPAYAN WATERSHED AREA



11.2.3 Plantation Plan

Each area under the plantation plan was estimated as follows:

Forest Area (I): Ipil ipil to be planted at the rate of 6,000 trees/ha for 400ha, 70% of total plan area.

Forest Area (II): Narra to be planted at the rate of 2,750 plants/ha for 905ha, excluding about 200ha of existing secondary forest.

Agro-forest Area: Two kinds of tree plantation to be planted; mango tree plantations on the slopes and Ipil ipil planted along the contour lines, with tree row intervals of 7m in the 15 -30° slope gradient and 4m in the 30 - 40° slope gradient, respectively. Mango plantations should be planted at the rate of 120 trees/ha.

Arable Land, Range and Residential Area : Ipil ipil to be planted along the contour lines to prevent soil erosion in the area. The interval of the tree belt sould be 2m.

Cost Estimation

The planting cost estimation for each tree plantation was made based on data collected from BFA. Cost estimate includes the cost of seedbed preparation, seeding and seed cultivation, land preparation, planting, fertilization, and cultivation but excludes maintenance and operation of post-harvesting facilities and construction cost of roads.

Cost estimations for each kind of tree are summarized in the following table.

Plantation Species	₱/ha	Area (ha)	Cost (₱)
Ipilipil	5,911.0	864.2	5,108,286.0
Narra	8,233.4	1,125.0	9,262,575.0
Mango	3,235.4	750.0	2,426,550.0
Total Direct Cost			16,797,411.0
Physical Contingency (15% of Direct Cost)			2,519,611.6
Administration Cost (15% of Direct Cost)			2,519,611.6
Total Cost			₱ 21,836.634.0 ($ 1,213,416)

11.3 Hill Area Development

11.3.1 Outline

The Project area is surrounded on three sides by hills, the east side of which is an independent mountain range traversed by a large, undeveloped river. The eastern area ranges in elevation from 50-300m with a generally steep slope. The side facing the Asue Area is occupied by paddy and farmers' residences while the opposite side is utilized as coconut plantation.

The hilly and mountainous areas in the north and west form the watershed of the major rivers in the Project area; namely, the Asue, Serruco, Lanjagan and Tabagay rivers. Vegetation is very poor, consisting mainly of grassland, due to shifting cultivation. Water culture capacity is consequently low and erosion is serious.

Vegetation in V-shaped valleys is generally rich and secondary is forest developed. The hilly area facing the Project area is utilized for residential area, coconut, banana and bamboo. The inland area, on the other hand, is undulating open land and consists of two mountain chains with EL.100-200m.

11.3.2 Development Potential

Possible approaches to development of the hill area include agricultural development and watershed management. During Field Work Study, both were studied to determine the most appropriate approach. As the east side is already well developed, development was considered only for the north and west areas which form the Catipayan watershed.

On the basis of the study results including topographical and soil conditions, present land use, vegetation, etc., the possibility for agricultural development in the said area is very low. Therefore, it was concluded that the optimum approach to hill area development is watershed management in the form of reforestation and soil conservation.

Reforestation is directed towards effective land utilization, raising the living-standards of local residents, and diversification of the farm economy. Diversification should include not only traditional tree crops but also tropical industrial tree crops utilizing topographical and ecological conditions. Terracing in existing shifting cultivation area is not impossible; however, excessive development promotes soil erosion and may increase sedimentation and flood damage.

11.3.3 Watershed Management and Agro-forest Plan

Afforestation in the watershed of the rivers in the Project area is important and effective to stabilize runoff, to control floods and to reduce sedimentation. On the other hand, the hill area is a useful land resource for diversification and improvement of the farm economy of the surrounding residents. Proposed afforestation should therefore satisfy both of the above requirements.

Agro-forest is the main target of proposed afforestation, while the plateau and less undulating area should be planned for livestock development. In this regard, a land utilization and agro-forest plan was studied; however, due to lack of sufficient topographical maps, a detailed plan could not be formulated. The potential afforestated area is estimated at about 5,000ha most of which has a slope of less than 30°. The simultaneous development of this area with Catipayan River watershed development is a highly effective approach and feasibility study and planning for the same is recommended.