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MINISTRY OF PUBLIC WORKS
REPUBLIC OF INDONESIA

JRATUNSELUNA BASIN UPDATED DEVELOPMENT PLAN

PART I

TUNTANG/JRAGUNG RIVERS BASINS
INTEGRATED DEVELOPMENT PLAN

PART II

TUNTANG AND RELATED RIVERS BASINS
DEVELOPMENT PLAN

APPENDIX E

ECONOMICS

MAY 1980

SUBMITTED BY

PRC ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO, U.S.A. SEMARANG, INDONESIA

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
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PREFACE

The Directorate General of Water Resources Development (DGWRD) of the Ministry of Public Works, Government of Indonesia (GOI) contracted PRC Engineering Consultants, Inc. (PRC/ECI) to provide consulting engineering services for preparing an integrated development plan for the Tuntang/Jragung Rivers in the Jratunseluna Basin. The study for the preparation of the plan started on May 16, 1979 and was originally scheduled to be completed on November 30, 1979.

An interim report on the study was submitted by PRC/ECI on August 15, 1979 which was discussed on September 24, 1979 in a meeting held by the DGWRD at Jakarta. In that meeting and in subsequent discussions between PRC/ECI and DGWRD, it was decided that the study on the Tuntang/Jragung Rivers should be modified by including the entire Jratunseluna Basin in certain aspects of the study. In that modified study the interrelationships of the existing, proposed and the potential development works of the Tuntang/Jragung Subbasins and those of the adjoining subbasins within the Jratunseluna Basin should be examined. Thus, the master plan for the development of the Jratunseluna Basin which was prepared earlier by NEDECO in the year 1973, would be revised and updated. The changes in criteria and constraints which have occurred and the large amount of new data which have become available since preparation of the original master plan would be incorporated in the modified study for formulating a conceptual optimized development plan. The original contract between GOI and PRC/ECI for the engineering services was, therefore, amended to include the revised scope of work for the modified study.

For the preparation of the integrated development plan for the Tuntang/Jragung Rivers, as contemplated originally, a report was prepared on Economics for supporting the proposed plan. That report is being produced as Appendix E - Part I, Economics, related to the Tuntang/Jragung Rivers Basins Integrated Development Plan.

The above mentioned modified study to update the Master Plan for the Jratunseluna Basin was started in December 1979 and completed in May 1980. The results of that study pertinent to Economics done by the consultant to support the proposed plan are reported in this document as Appendix E - Part II, Economics, related to the Tuntang and Related Rivers Basins Development Plan.

Semarang, May 1980

PRC Engineering Consultants, Inc.

PART I

TUNTANG/JRAGUNG RIVERS BASINS
INTEGRATED DEVELOPMENT PLAN

APPENDIX E

ECONOMICS

TABLE OF CONTENTS

APPENDIX E - PART I

ECONOMICS

LIST OF TABLES

APPENDIX E - PART I

ECONOMICS

LIST OF TABLES
(Cont.)

APPENDIX E - PART I

ECONOMICS

TUNTANG/JRAGUNG RIVERS BASINS

INTEGRATED DEVELOPMENT PLAN

APPENDIX E - PART I

ECONOMICS

E.1. INTRODUCTION

The agricultural economy of the services area has been studied with a view to supporting analyses of the following facets of the Tuntang/Jragung Rivers Basins Development Plan.

1. Analysis of irrigation, power and municipal and industrial water benefits.
2. Right of way compensation costs.
3. Costs of resettlement of displaced persons.

Summaries of project costs and benefits and the economic analyses are presented in the Project Planning Appendix, Appendix D-Part I.

This determination has required the review of the agricultural and economic data of all the reports of the Jratunseluna Basin.

Because of the recent completion of the Jragung Dam Project Final Design Report, April 1979 by PRC/ECI [1] heavy reliance has been placed on the basic data contained therein.

E.2. IRRIGATION BENEFITS

E.2.1. Present Situation

The irrigation benefits for the Jragung project have been updated in the Jragung Dam Project, Final Design Report [1]. These benefits have been calculated on 1985, IBRD projections at 1978 constant dollars for economic analyses. The foreign currency has been converted to Rupiah at the mid year 1979 rate of exchange of Rp. 620 = $ 1.00.

The basic assumptions in the irrigation benefit analyses have been reviewed and data compiled to test the conclusions used in the Jragung Dam Project, Final Design Report [1].

The Jratunseluna Project Office supplied average yield data for the period 1975/76 to 1977/78 for the wet season and dry season rice. The source of the data was the Agricultural Extension Service. Yields are for the BIMAS with HYV, INMAS with HYV and non intensification with local varieties. The BIMAS and INMAS programs are primarily utilized on the irrigated land and therefore are indicative of the best present accomplishments with irrigation. The average yields are as shown in Table E-1.

From these comparisons it was concluded that no significant variation between wet season rice and dry season rice exists.

The yields of the principal crops 1974-1978 for the 10 Kecamatans covering the Jragung and Tuntang service areas were tabulated to obtain an estimate of present yields. The rice yield data in the Agricultural Extension Service office were not separated for wet season and dry season nor for irrigated and non-irrigated. The 5-year average dry rough rice yield was 2,376 kilograms. The first three years of the period averaged 2,128 kg while the last two years average 2,699 kg/ha (Table E-2).

In order to appraise the dry rough yields used in the Final Design Report Jragung Dam, the other reports in the Jratunseluna Basin were compared [3, 4, 5]. Certainly the future situation without the projects are markedly influenced by the amount and timing of rainfall and irrigation service available in constructed subprojects. However, estimated future yields for various basin projects with regulated and adequate water supplies as determined by various consultants are useful for comparison (Table E-3). Palawija yields are presented in Table E-4.

E.2.2. Rice Yields With and Without the Project

The agricultural scientist was charged with the responsibility of optimizing the water resources by selecting the most suitable and profitable crops. Estimates of yields and intensity of land use were developed in Appendix B-Part I. Yields were presented as wet rough rice. Other comparative studies and rice prices have been developed on dry rough rice which is 94 percent of wet rough rice. Yields in Appendix B-Part I have therefore been adjusted to the following.

	1987	2000	2020
Without the project	3.2 t/ha	3.6 t/ha	3.9 t/ha
With the project	3.2	4.9	5.4

In the economic analyses the costs of the project are considered to be the 1979 current costs of construction. Irrigation benefits will be priced at 1985 IBRD projections at 1978 constant dollars. However benefits will accrue over the whole period of analysis and in this case over a period of 50 years. Therefore an average annual value needs to be derived. A suitable rule is to target the early part of the period of the project operation, say not less than 10 years and perhaps not more than 20 years hence. Thus with a 5-year construction period perhaps approximately 15 years after the beginning of service is a reasonable estimate. Therefore yields for the year 2000 are chosen for the economic analyses.

E.2.3. Crop Prices

Both rice and soybeans are commodities which are widely traded in international markets. From an economic stand point the two commodities are valued on the basis of their import substitution value. This is developed from international price data and converted into farmgate price (Tables E-5 and E-6). A summary of commodity prices and input prices is provided in Table E-7.

E.2.4. Crop Enterprises

In the future it is anticipated that with storage and a dependable water supply along with the necessary agricultural support services, the BIMAS/INMAS programs of HYV seeds, fertilizer, pest control and credit, that irrigated rice yields by year 2000 should average 4.9 tons/ha/crop and non irrigated rice yield will average 3.6 tons/ha/crop. For the economic analysis, the incidence of the increased income is not important because we are viewing the economics from a national public viewpoint. Therefore, enterprise budgets were prepared to analyze the increased agricultural income on a per hectare basis that can readily be extended to the whole project.

Enterprise budgets have been calculated according to cash flows. The expenses include all cash costs of seed, fertilizer, pest control, hired labor and harvest. Farm family labor and shares of harvest labor are left unseparated in the net farm income. Thus, the change in the return to labor is measured as a part of the irrigation benefits.

The Bogor Agricultural University had just completed field interviews and study of the income and expenses of farmers in 1975 on wet rice lands and on surjan lands by the total crops harvested in 12 months. Basically this accounted for all income and expenses of the mixed and multiple cropping. These data have been updated on harvested area, yields, economic prices and farm expenses for the Tuntang/Jragung study.

Enterprise budgets were prepared for future condition (year 2000) for both irrigated and non irrigated conditions. Wet season non irrigated rice is shown on Table E-8 based on inputs levels for the expected level of production. Net farm income for non irrigated rice is estimated at $ 559/ha. Surjan budgets are based on a 12-month production cycle and it is expected that the surjan system will be the same for both the with and without project condition. The budget is shown on Table E-9 and net farm income is estimated at $ 685/ha/year. Irrigated rice budget is shown on Table E-10 with an estimated net farm income of $ 780/ha. For the palawija crops monoculture soybeans and mixed corn and soybeans were analyzed. Grown alone with a 1.0 ton yield of soybeans the estimated net return will be $ 273 per hectare per crop. When the two crops are mixed the estimated net return is $ 300/ha (Tables E-11 and E-12). It was concluded that the mixed crop would be used to represent the palawija crops in the future with the project.

E.2.5. Future Without Project Condition

The same methodology as was used in the Jragung Dam Upgraded Feasibility Study [2] is employed for the Tuntang/Jragung Study.

The cropping pattern for the future without project condition is identical with the present cropping pattern described in Appendix B-Part I and shown on Table E-13 in percentage form. Yields and farm input levels were increased for the condition expected with year 2000. The single rice crop will be produced from a combination of partial irrigation and rainfall the same as it was during the period 1976-1978. The irrigated rice crops are expected to have the same level production and costs as new areas that are to be irrigated under the with project condition.

The prorated enterprize values and net farm income on a per hectare basis is $ 1,039 and is shown on Table E-13.

The underlying assumption of prorating the present cropping pattern uniformly distributed is that the present irrigation water as available is also uniformly distributed. This analysis is not site specific and cannot be used to evaluate individual subprojects.

The intensity of cropping in the future without project condition is 1.67 including the surjan.

E.2.6. Future With Project Conditions

The cropping pattern for the with project condition was described in Appendix B-Part I and is shown on Table E-14 percentage form. All project rice land will be irrigated in the future. Multiple cropping will be extensive. The net farm income per hectare for the future with project is $ 2,154 and is shown on Table E-14.

This intensity of cropping in the future with project is 2.88 including the surjan area.

E.2.7. Summary of Irrigation Benefits

The average future net income per hectare was $ 1,039/ha and $ 2,154/ha for the without and with project conditions. The net irrigation benefits are $ 1,115/ha.

Another measure of the benefits of the project is the increased tonnage of production. This is derived in Table E-15. Rice production increases by 13.50 t/ha less 7.21 t/ha or 6.29 t/ha per year. For the total project area of 36,781 ha the annual increase of rice will be 231,352 tons. The palawija crops will decrease by 0.06 t/ha or 2,207 tons for the entire project. The Surjan crops will also decrease by 0.46 t/ha or 16,919 tons over the entire project. The net annual increase in tonnage of agricultural production attributable to the project is 212,226 tons.

TABLE E-1

WET SEASON AND DRY SEASON

DRY ROUGH RICE YIELDS

(1975/76 - 1977/78)

	Wet Season kg/ha	Dry Season kg/ha	Dry Season Increase kg/ha
Upper Portion of Service Area			
BIMAS	3,140	3,102	- 38
INMAS	2,819	2,723	- 96
Non-Intensive	1,982	2,364	382
Lower Portion of Service Area			
BIMAS	2,679	2,660	- 19
INMAS	2,249	2,285	36
Non-Intensive	1,654	1,629	- 25

TABLE E-2

CROP YIELDS FOR 10 SUBDISTRICTS 1974-1978

(kilogram/hectare)

	1974	1975	1976	1977	1978	Average
Dry rough rice	2,116	2,188	2,078	2,590	2,807	2,376
Soybeans	479	597	573	591	646	577
Maize	701	922	1,120	1,130	1,196	1,014
Sorghum	691	1,501	1,543	1,690	1,674	1,420
Sweet Potatoes, wet WT	2,728	2,979	3,964	4,053	4,236	3,592
Ground Nuts	508	456	542	766	872	629
Cassava, Wet WT	3,752	4,708	5,518	5,289	5,209	4,895
Green Pea, Dry Seeds	297	308	289	276	334	301

TABLE E-3

ESTIMATED FUTURE RICE YIELDS, DRY ROUGH RICE

	Present kg/ha	Future Without kg/ha	Future With Yield kg/ha	Future With Year
Jragung [1]				
Rainfed Wet Season	1,600	-	1,900	1985
Irrigated Wet Season	2,800	4,000	4,000	1985
Irrigated Dry Season	-	-	4,300	1985
Irrigated Wet Season	-	4,000	4,000	1988
Irrigated Dry Season	-	-	4,3	
Glapan Dam [2]				
Wet Season	2,165	2,165	2,450	1985
Dry Season	-	-	2,532	1985
Wet Season	2,772	2,772	3,850	1997
Dry Season	-	-	4,081	1997
South Grobogan Irrigation Project [3] **Serang River**				
Wet Season	2,950	3,200	3,200	1985
Dry Season	-	-	3,600	1985
Wet Season	2,950	3,250	3,800	1987
Dry Season	-	-	4,600	1987
Glapan-Sedadi Irrigation Works [4]				
Serang and Tuntang-Serang				
Wet Season	3,400	3,900	3,900	1985
Dry Season	4,000	4,500	4,500	1985
Wet Season	3,400	4,700	5,000	2000
Dry Season	4,000	5,300	5,500	2000
Pelayaran Wedung				
Wet Season	1,700	2,000	2,500	1985
Dry Season	-	-	3,400	1985
Jragung [5]	1,900	2,400	4,250	1985

1/ IBRD Appraisal Report Nov 1977 b-IND
2/ NEDECO Glapan Dam July 1975 vol. I [3]
3/ SMEC South Grobogan Irrigation Project, June 1978 [4]
4/ SMEC Downriver Works Serang River Sept. 1978 [5]
5/ ECI Jragung Dam Project, Semarang April 1979 [2]

TABLE E-4

ESTIMATED FUTURE PALAWIJA YIELDS

	Present kg/ha	Future Without kg/ha	Future With Yield kg/ha
Soybeans			
South Grobogan Project [1]	740	800	800
Jragung Project [2]	490	490	1,000
Serang and Tuntang-Serang [3]	-	-	700
Cipamingkis [4]	400	400	600
Ground Nuts			
Jragung Project [2]	540	-	-
Maize			
South Grobogan Project [1]			
Dry Season Project [1]	800	850	1,100
Labuan Season Project [1]	1,100	1,200	-
Wet Season Project [1]	1,100	1,200	1,200
Jragung Project [2]	590	590	-
Serang and Tuntang-Serang [3]	1,000	1,000	1,100
Jragung [2]	800	900	-
Tobacco			
South Grobogan Project [1]	600	600	600
Jragung [4]	200	250	-
Sorghum			
South Grobogan Project [1]	1,600	-	-
Serang and Tuntang-Serang Project [3]	2,600	2,600	2,800
Pelayaran-Wedung Project [3]	1,600	1,900	2,100
Cassava			
South Grobogan Project [1]	5,300	5,300	-
Jragung Project	4,730	4,730	-

1/ SMEC South Grobogan Irrigation Project, Technical Report June 1978 [4]
2/ ECI Jragung Project [1]
3/ SMEC Serang River Project Vol. 3 September 1978 [5]
4/ IBRD Appraisal Report No 1905b - IND.

TABLE E-5

ECONOMIC PRICE OF RICE - IMPORT SUBSTITUTION VALUE

(Rupiahs per metric ton)

	(Rp. 620/$)
International price F.O.B. Bangkok 5% broken 1/ ($ 410)	254,200
International price F.O.B. Bangkok local grade 2/ ($ 300)	186,000
Ocean freight and insurance cost	12,400
Imported price	198,400
Port handling cost	2,150
Transportation to selling center cost	1,240
Less transportation cost from mill	- 2,080
Cost ex-mill	201,710
Conversion to rough dry rice (.63)	127,080
Milling	- 830
Transportation farm gate to mill	- 1,240
Farm gate economic price	125,010
	($ 202)

1/ IBRD projections at 1978 constant dollars.

2/ 30% broken based on 10% of 5% broken kernels
60% of 25-35% broken kernels
30% of 42% broken kernels

TABLE E-6

SOYBEAN PRICE STRUCTURE, INDONESIA

(Rupiahs per metric ton)

	(Rp. 620/$)
International price, f.o.b. export point 1/ ($ 315)	195,300
Ocean freight and insurance	16,740
Imported price	212,040
Port handling charges	4,150
Transport to selling center	1,245
Less transport from mill	- 2,075
Price ex-mill	215,360
Less milling cost	- 2,490
Less transport farm to mill	- 830
Farm gate economic price	212,040
	($ 342)

1/ Soybean f.o.b. Gulf port U.S.A., 1985 IBRD projection at 1978 constant dollars.

TABLE E-7

COMMODITY AND INPUT PRICES [1]

(Rp. 620/$)

	Per Ton [2] $	Per Ton Rp.
Commodity Prices		
Rice farm gate [3] (Bangkok)	202	125,010
Soybeans (Rotterdam adj. to Gulf)	342	212,040
Corn (No. 2 Gulf)	131	81,220
Tobacco (India)	1,538	953,560
Input Prices		
Urea (Europe)	269	166,780
T.S.P. (Gulf)	237	146,940
Seeds		
Rice, local variety	288	178,560
Rice, HYV	577	357,740
Red pepper	337	208,940
Tobacco	415	257,300
Soybeans	379	234,980
Corn	125	77,500
Zinc Phosphate Rodenticide	5,192	3,219,000
Agrochemicals/liter	7.88	4,885

1/ IBRD forecasts for world market conditions and adjusted to farmgate equivalent value in Indonesia.

2/ 1978 Dollars, 1985 Projection

3/ Forecast of $ 410 per ton adjusted for local quality to $ 300 per ton, f.o.b. Bangkok.

TABLE E-8

NET FARM INCOME PER HECTARE ON NON-IRRIGATED RICE LANDS

FUTURE WITHOUT PROJECT WET SEASON

Per Crop

Rp. 620/US$ 1.00

Item	Unit	Price	Total
Receipts:			
Rice (paddy)	3.6 t	Rp. 125,010	Rp. 450,036
Cash Expenses:			
Custom plowing	25 day	1,000	25,000
Urea	200 kg	167	33,400
T.S.P.	75 kg	147	11,025
Insecticide	2 ltr	4,950	9,900
Rodenticide	0.1 kg	3,201	320
Seed	25 kg	240	6,000
Spraying rental			1,500
Harvest Cost	3 % 1/		13,501
Operating Capital (1% for 3 months) 2/	Rp. 87,145	.03	2,614
Total Expense			Rp. 103,260
Net Farm Income			Rp. 346,776 ($ 559)

1/ 3% of gross income

2/ Pre-harvest cost items

TABLE E-9

NET FARM INCOME PER HECTARE - SURJAN LANDS

FUTURE WITH AND WITHOUT THE PROJECT

Rp. 620/US $ 1.00

Crop	Hectares	Yield t/ha	Price Rp/t	Value Rp.	Expense Rp.	Income Rp.
Paddy	.333	3.600	125,010	149,862	34,386	115,476
Green beans	.290	.167	147,286	7,133	2,328	4,805
Maize	.339	.631	81,220	17,374	3,140	14,234
Red beans	.018	.320	125,119	721	76	645
Cucumbers	.010	.280		221	22	199
Tobacco	.667	.600	953,560	381,615	108,283	273,332
Peanuts	.054	.710		2,121	797	1,324
Soybeans	.110	.910	212,040	21,225	10,986	10,239
Eggplant	.030	.377		1,999	586	1,413
Cassava	.030	.375		1,433	522	911
Red Pepper	.030	.390		1,896	78	1,818
Sorghum	.010	.250		150	36	114
Pumpkin	.006			248	10	238
String bean	.006			135	20	115
Squash	.006			135	20	115
Total	1.939			586,268	161,290	424,978 ($ 685)

Note:

Budget from Socio-Agronomic Survey of Jragung Project area by the Agricultural Institute at Bogor, 1975.
Receipts and expenditures are repriced at Rp. 620/ US $ 1.00
Price received for rice, corn, tobacco and soybeans are IBRD 1985 projections at 1978 constant dollars adjusted to market grades and farm gate price. Expenses for commercial fertilizers and chemical pesticides likewise are adjusted. Tobacco production costs reflect the expenses required for drying and sorting to the grade of product represent by the market price used. Area for tobacco increase to cover entire dry season period June-October due to rapid change in cropping pattern during period 1975-1979.

TABLE E-10

NET FARM INCOME PER HECTARE IRRIGATED RICE LANDS

FUTURE WITH THE PROJECT WET SEASON-DRY SEASON

Per Crop

Rp. 620/US $ 1.00

Item	Unit	Price	Total
Receipts:			
Rice (paddy)	4.9	Rp. 125,010	Rp. 612,549
Cash Expenses:			
Custom plowing	25 day	1,000	25,000
Urea	300 kg	167	50,100
T.S.P.	100 kg	147	14,700
Insecticide	2 ltr	4,950	9,900
Rodenticide	0.1 kg	3,201	320
Seed	25 kg	240	6,000
Spray rental			1,500
Harvest Cost	3% 1/		18,376
Operating Capital (1% for 9 months) 2/	Rp.107,520	.03	3,226
Total Expense			Rp. 129,122
Net Farm Income			Rp. 483,427 ($ 780)

1/ Gross Income

2/ Pre-harvest cost items

TABLE E-11

NET FARM INCOME PER HECTARE -
IRRIGATED SOYBEANS MONOCULTURE

FUTURE WITH THE PROJECT

PER CROP

Rp 620/US$ 1.00

Items	Unit	Price	Total
Receipts:			
Soybeans	1.0 t	Rp. 212,040	Rp. 212,040
Cash Expenses			
Custom Plowing	10 day	1,000	10,000
T.S.P.	40 kg	147	5,880
Insecticide	2 ltr	4,950	9,900
Spray Rental	4 x	500	2,000
Seed	35 kg	235	8,225
Harvest Cost	3%		6,361
Capital to Harvest	36.005	.02	720
Total expense			Rp. 43,086
Net Farm Income			Rp. 168,954 ($ 273)

TABLE E-12

NET FARM INCOME PER HECTARE PALAWIJA CROP IRRIGATED

MIXED CROP CORN AND SOYBEAN

FUTURE WITH THE PROJECT

	Unit	Price	Total
Receipts			
Corn	1.2 t 1/	Rp. 81,220	Rp. 97,464
Soybean	.8 t 1/	212,000	169,632
Total			267,096
Cash Expenses			
Custom Plowing	10 day	1,000	10,000
Urea	100 kg	167	16,700
T.S.P.	70 kg	147	10,290
Corn Seed	15 kg	78	1,170
Soybean Seed	35 kg	235	8,225
Diazanon	2.1	3,200	6,400
DDT	2.1	4,950	9,900
Bags	20	300	6,000
Spray rental	4 x	500	2,000
Capital to harvest	Rp. 70,685	.03	2,120
Harvesting	%	.03	8,004
Total Expense			Rp. 80,809
Net Farm Income			Rp.186,287 ($ 300)

1/ Estimated at 80% of monoculture.

TABLE E-13

NET FARM INCOME PER HECTARE

FUTURE WITHOUT PROJECT

Crop	Distribution % 1/	Net Value of Crop	Net Income	Intensity
Surjan	14.82	Rp. 424,978	Rp. 62,982	0.29
1-rice crop	46.36	346,776	160,765	0.46
2-rice crop	20.14	483,427	194,724	0.40
3-rice crop	12.88	483,427	186,796	0.39
1-rice crop + Palawija	4.52	346,776 186,287	15,674 8,420	0.09
2-rice crop + Palawija	1.28	483,427 186,287	12,376 2,384	0.03 0.01
	100		Rp. 644,121 ($ 1,039)	1.67

1/ Year 2000 has same cropping pattern as present.

TABLE E-14

NET FARM INCOME PER HECTARE

FUTURE WITH PROJECT

Crop	Distribution % 1/	Net Value of Crop	Net Income	Intensity
Surjan	5	Rp. 424,978	Rp. 21,249	0.10
1-rice crop	-		-	
2½-rice crop	14	483,427	169,199	0.35
3-rice crop	71	483,427	1,029,700	2.13
1-rice crop + Palawija	-		-	
2-rice crop + Palawija	10	483,427 186,287	96,685 18,629	0.2 0.1
	100		Rp.1,335,462	2.88
			(2,154)	

1/ Year 2000.

TABLE E-15

ESTIMATED INCREASED TONNAGE OF CROPS PRODUCED WITH PROJECT

Cropping Pattern	Crop Production w/o Project			Crop Production with Project		
	Intensity	Yield (t/ha)	Production (t/ha)	Intensity	Yield (t/ha)	Production (t/ha)
Surjan	29			0.10		
Maize		0.63	0.18		0.63	0.06
Soybean		0.91	0.26		0.91	0.09
Tobacco		0.60	0.17		0.60	0.06
Paddy		3.60	1.04		3.60	0.36
Vegetables		0.36	0.10		0.36	0.04
1-Rice Crop	0.46	3.6	1.66			
2-Rice Crop	0.40	4.9	1.96			
2½-Rice Crop				0.35	4.9	1.72
3-Rice Crop	0.39	4.9	1.91	2.13	4.9	10.44
1-Rice Crop + Palawija	0.09					
Paddy		4.9	0.44			
Maize		1.2	0.11			
Soybean		0.8	0.07			
2-Rice Crop + Palawija	0.04			0.30		
Paddy		4.9	0.20		4.9	0.98
Maize		1.2	0.05		1.2	0.12
Soybean		0.8	0.03		0.8	0.08
	1.67		8.18	2.88		13.95

E.3. HYDROPOWER BENEFIT

The conventional procedure of utilizing the most likely alternative capable of producing a comparable type and quality of power is proposed. Methodology used on the Karangsambung Wadaslintang Multipurpose Project has been revised for the updated Jragung Dam Study. An oil fired steam plant has been considered as the alternative.

The investment in an oil fired steam plant has been estimated to be $ 750/KW. The OPEC official price of crude oil in June 1979 was $ 14.55 per barrel but most Cartel members were charging a premium of about $ 2.50 making the cost about $ 17 per barrel. The July 1979 price is expected to be $ 20 per barrel which has been analyzed in Table E-16.

It seems a certainity that the present OPEC price will be increased still further. Although there is no means of predicting how much the increase will be, a price of $ 25 per barrel is only a 25% increase and $ 30 only a 50% increase. Either of these figures is probably conserservative in view of the 1,100 percent recent increase over the $ 1.80 per barrel in 1973. (Tables E-17 and E-18).

To the extent that the capacity value is utilized and firm power is produced these should be valued at $ 120/kw of capacity and 33.2 mills/kwh of energy. All secondary energy is valued at 27.6 mills/kwh.

TABLE E-16

JRAGUNG DAM AND TUNTANG DAM

COMPUTATION OF THE UNIT VALUE OF POWER

FUEL COST $ 20.00/bbl

Item		Capacity ($ per kw)	Energy: Firm ($ per kw)	Energy: Secondary ($ per kw)
Oil-Fired Steam Plant Investment		750.00		
Capacity Cost:				
Cost of Money	12.00 %	90.00		
Depreciation	0.61 %	4.58		
Replacement	0.20 %	1.50		
Fixed O & M	1.85 %	13.88		
Total	14.66 %	109.96		
Energy Cost:				
Fuel Cost 1/ = $ 20.00/bbl x 9,000 BTU/kwh / (147,080 BTU/gal x 42 gal/bbl)			$ .0291	$ .0291
Variable O & M			$ .0058	
Dependable Energy			$ .0349	
Adjustments 2/				
Capacity Cost with + 15% Hydro Advantage		126.45		
Capacity Cost with - 5% Transmission Differential		120.13		
Energy Cost with - 5% Transmission Differential			$ 0.0332	$ 0.0276
UNIT VALUE OF POWER		$ 120.13	33.2 mills	27.6 mills

1/ 1979 price of crude of $ 20.00 bbl.

2/ An advantage is assigned to hydro over thermal power by reason of environmental factors and energy conservation. The transmission loss is to account for load center distance between Project site and hypothetical thermal alternative site.

TABLE E-17

JRAGUNG DAM AND TUNTANG DAM

COMPUTATION OF THE UNIT VALUE OF POWER

ALTERNATIVE I FUEL COST $ 25.00/bbl

Item		Capacity ($ per kw)	Energy Firm ($ per kw)	Energy Secondary ($ per kw)
Oil-Fired Steam Plant Investment		750.00		
Capacity Cost:				
Cost of Money	12.00 %	90.00		
Depreciation	0.61 %	4.58		
Replacement	0.20 %	1.50		
Fixed O & M	1.85 %	13.88		
Total	14.66 %	109.96		
Energy Cost:				
Fuel 1/ = 25.00 $/bbl x $\frac{9{,}000 \text{ BTU/kwh}}{147{,}080 \text{ BTU/gal} \times 42 \text{ gal/bbl}}$			$ 0.0364	$ 0.0346
Variable O & M			$ 0.0073	
Dependable Energy			$ 0.0437	
Adjustments 2/				
Capacity Cost with + 15% Hydro Advantage		126.45		
Capacity Cost with - 5% Transmission Differential		120.13		
Energy Cost with - 5% Transmission Differential			$ 0.0415	$ 0.329
UNIT VALUE OF POWER		$ 120.13	41.5 mills	32.9 mills

1/ Assumed future price of crude oil is $ 25.00

2/ An advantage is assigned to hydro over thermal power by reason of environmental factors and energy conservation. The transmission loss is to account for load center distance between Project site and hypothetical thermal alternative site.

TABLE E-18

JRAGUNG DAM AND TUNTANG DAM

COMPUTATION OF THE UNIT VALUE OF POWER

ALTERNATIVE II FUEL COST $ 30.00/bbl

Item		Capacity ($ per kw)	Energy Firm ($ per kw)	Energy Secondary ($ per kw)
Oil-Fired Steam Plant Investment		750.00		
Capacity Cost:				
Cost of Money	12.00 %	90.00		
Depreciation	0.61 %	4.58		
Replacement	0.20 %	1.50		
Fixed O & M	1.85 %	13.88		
Total	14.66 %	109.96		
Energy Cost:				
Fuel Cost 1/ = 30.00 $/bbl x 9,000 BTU/kwh / 147,080 BTU/gal x 42 gal/bbl			$ 0.0437	$ 0.047
Variable O & M			$ 0.0087	
Dependable Energy			$ 0.0524	
Adjustments 2/				
Capacity Cost with + 15% Hydro Advantage		126.45		
Capacity Cost with - 5% Transmission Differential		120.13		
Energy Cost with - 5% Transmission Differential			$ 0.0498	$ 0.0415
UNIT VALUE OF POWER		$ 120.13	49.8 mills	41.5 mills

1/ Assumed future price of crude oil is $ 30.00/bbl

2/ An advantage is assigned to hydro over thermal power by reason of environmental factors and energy conservation. The transmission loss is to account for load center distance between Project site and hypothetical thermal alternative site.

E.4. MUNICIPAL AND INDUSTRIAL WATER SUPPLY BENEFITS

The conclusion derived in the upgraded feasibility study that the Jragung Dam location was the most likely alternative for supplying M & I water to the city of Semarang has been maintained in the Tuntang/ Jragung Project. The construction of a single-purpose dam at the same location to supply the daily requirements of 2,000 l/s of M & I water from one source is estimated to cost $ 33,000,000. This facility would produce an alternative single-purpose raw water supply. The annual equivalent value of this alternative is $ 4,962,000. This is the annual M & I benefit accruable from the Project at the rate of $ 78.67 per thousand cubic meter of raw water.

In evaluating the M & I benefits, the water requirements setforth in Special Report I - Municipal and Industrial Water Supply [6] have been applied. In accordance with these criteria, the projected demands of M & I water from the city of Semarang are tabulated below:

	1980	1985	1990	1995	2000
Total M & I Water Demand (l/s)	1,215	1,720	2,660	3,870	5,650

E.5. FLOOD CONTROL BENEFITS

E.5.1. Jragung River

The historical flood frequencies depths and duration and time of occurence have not been documented. In the Jragung Dam Updated Feasibility Study it was estimated that 1,800 ha below the dam would benefit by the routing effect of the reservoir and the attenuation of peak floods from above the dam. Damage was estimated to be $ 95 per ha for areas flooded less than 3 days and $. 247/ha per year for areas flooded more than 3 days. This plus the reduction in maintenance costs were estimated to be $ 299,000. Relating this to 1,800 ha benefited amounts to $ 166/ha/year.

E.5.2. Tuntang River

Special Report III [7] summarizes the flood problems in terms of stream flooding and rainfall combined. Time of study was much too short to determine the damages on frequency basis as with present without project condition. It was recommended that a plan be adopted that will provide a reasonably high degree of flood protection. Presumably this would be primarily dikes and channel improvements. However, the actual flood control measures will depend upon the locations and capacities of storage reservoirs built on the system.

It was concluded that the Jragung and Gunung Wulan reservoirs would provide flood benefits to areas presently being inundated from the upstream catchment area. The degree and difference between reservoir alternatives could not be evaluated thus benefits from flood control are not included in the economic analyses.

E.6. RESERVOIR LAND COST

E.6.1. Transmigration and Resettlement Method

One way to estimate the economic cost of acquiring land for new reservoirs is to determine the cost of moving the displaced families to other locations where unused land is available and can be cultivated to replace lost production. The Ministry of Public Works, in cooperation with the Department of Transmigration, has considered relocating families displaced by reservoir projects in Java. Procedures for estimating transmigration and resettlement costs are contained in The Economic Costs of Displacement in Water Resources Development Projects, Directorate of Planning and Programming, Directorate General of Water Resources Development, Ministry of Public Works and Electric Power, February 1975 (Planning Guide No. 5) [8]. The Agricultural College at Padjadjaran University, Bandung, in cooperation with the Serang Development Project, studied the cost of resettling families displaced by Kedungombo Dam and Reservoir. Data for the study were obtained from the Ditjen of Transmigration in Jakarta and the Transmigration Service in Central Java. The basic cost to resettle one family, updated to 1979 prices, amounted to Rp 3,248,000 ($ 5,238). This cost, with adjustments, was used for estimating land costs for Gunung Wulan Reservoir where 2,829 families would be displaced (Table E-21).

The cost of relocating displaced families includes (1) assembly, processing and transportation; (2) new housing and infrastructure; and (3) land development, including irrigation if needed. Two additions to the basic cost are (1) a rice allowance for one year; and (2) compensation for the loss sustained if dwellings and trees at the new site are inferior to the forfeited houses and trees.

Resettlement of families displaced by reservoirs is one part of a broader and continuing national program to develop new land on

islands other than Java, and to resettle Javanese families on such land. National economic development benefits and improvements in social well-being accrue from investments in transmigration and resettlement. Therefore, the total financial costs connected with resettlement of families displaced by a reservoir should not be charged against the reservoir in evaluating its economic feasibility. For this study, the cost of assembling displaced families and providing them with transportation and a year's supply of rice are financial costs that are also economic costs. Other outlays to develop a new village and prepare land for cultivation are financial costs of the new settlement, but not economic costs charged against the reservoir. However, one economic cost - five years of foregone production on reservoir land - is taken into account in evaluating a reservoir's feasibility, although this is not an actual financial cost of resettlment. After 5 years, production at the resettlement should replace production foregone at the reservoir site. Derivation of adjustments for the difference in quality of housing and trees and the value of five years of foregone production are shown in Tables E-19 and E-20. Both adjustments are explained in the following section.

E.6.1.a. Adjustments to Transmigration and Resettlement Costs

There will be a loss in production of agricultural crops, after evacuation of land for a reservoir site, until new land is brought into production. The loss is estimated to occur over a period of 5 years, with each year's loss discounted to its present worth at 10 percent. Based on the Glapan Dam studies [3] of NEDECO, foregone production during 5 years is estimated to be $ 143 per family (Table E-19). The estimated difference in value of homes and homesite trees is based on the Glapan Dam studies and the previously cited Kedungombo Dam study at Padjadjaran University. The difference in value occurs because farmers displaced by a reservoir are in a better economic situation than landless transmigrants. Appropriate compensa-

tion for this difference would be $ 304 per family at Gunung Wulan Reservoir.

E.6.2. Alternative Method

Another way to estimate the economic cost of land for a new reservoir is to determine the present worth of net earnings from the crops that would be produced on the land in future years if the reservoir is not built. Such earnings should be estimated on the basis of cropping patterns and average yields in the reservoir area, taking into account the effect on future earnings of any growth in yields that is considered likely. When the economic cost of land for a reservoir is estimated in this way, the cost of transmigration and resettlement of displaced families should not also be charge against the reservoir for determining its economic feasibility. This would be double counting of the same economic cost.

E.6.3. Gunung Wulan Land Cost

The economic cost of land for Gunung Wulan reservoir was originally considered to be covered by the economic costs of transmigration and resettlement, with appropriate adjustments, amounting to $ 1,296 (Rp 803,520) per family (Table E-21). Subsequently, the policy question arose of whether the Indonesian Government wished to have the economic cost of land based solely on transmigration and resettlement costs, or whether the costs should be determined by an alternative method. Clearly, inclusion of both costs would be duplication. An inventory is not available of the lands, buildings and other improvements in the Gunung Wulan reservoir area. However, the Kedungombo study indicated that land, houses, and other improvements in that reservoir area had a value of $ 2,749 (Rp 1,732,280) per family. Using this figure (rounded to $ 2,800 per family) for the Gunung Wulan Reservoir, where 2,829 families would be displaced

by 340 x 10^6 m^3 of storage, the cost of land for the project was estimated to be $ 7,921,000. This figure does not include compensation for commercial forest land, since it may be assumed that stands of commercial timber would be harvested before the reservoir is filled. Mature trees would have a high value, while the value of noncommercial trees to be used for fuel would equal the cost of clearing.

TABLE E-19

ESTIMATED CROP VALUES FOREGONE BASED ON GLAPAN DAM

	Per ha Present Worth 10% - 30 year	Annual Amount 1975	1979 1.855 Inflation Index
Rice Fields	Rp. 400,000 1/	Rp. 42,431	Rp. 78,709
Dry Fields	250,000	26,520	49,195
Homeyards	125,000	13,240	24,597

	Rice	Dry Fields	Homeyard Trees	Total
Annual Net Return/ha	Rp. 78,709	Rp. 49,195	Rp. 24,597	
Present worth 5 years/ha	298,000	186,000	93,000	
Land in reservoir ha	318	937	599	
Total foregone	Rp. 94,764,000	Rp. 174,282,000	Rp. 55,707,000	
	$ 153,000	$ 281,000	$ 90,000	$ 524,000
Values per family 3673				$ 143

1/ NEDECO Glapan Dam July 1975 [3]. Appendix VIII-15 converted to amount by 9.427 present worth of an annuity.

TABLE E-20

ESTIMATED DIFFERENCE IN VALUE
OF HOMES AND HOMEYARD TREES
EXAPPROPRIATED AND THOSE PROVIDED

Present Situation [1/]	
Average value of homes	$ 1,204
Average value of homeyard trees	160
	$ 1,364
Future Situation at Transmigration Site [2/]	
Average value of homes	$ 1,010
Value of seedlings provided	50
Total	$ 1,060
Difference due to transmigrant	$ 304
Total transmigrants 2,829 families	$ 806,000

1/ Based on Glapan Dam Estimates

2/ Based on unit values in Estimation of Compensation and Expenses For Moving The Inhabitants From The Kedungombo Dam Area Agricultural Faculty of Padjadjaran University at Bandung.

TABLE E-21

RESERVOIR RIGHT OF WAY COSTS GUNUNG WULAN DAM 1979

BASED ON TRANSMIGRATION COSTS

	Financial Costs	Economic Costs
Costs per Family [1]		
Planning and Surveys	$ 155	
Mobilization-Transport	738	$ 738
Preparing dwelling site	2,742	
Cultivation & Development of village	1,187	
Exercise and upgrading	36	
Administration	350	
	$ 5,238	
Rice allowance 100 kg x 5.5 x Rp. 125	$ 111	111
Total	$ 5,349	$ 849
Gunung Wulan Reservoir 2,829 Families [2]		
Transmigration Costs	$ 15,132,000	$ 2,402,000
Production foregone 5 years $ 143 [3]	0	405,000
Difference in value of home and yard family $ 304 [4]	860,000	860,000
Total	$ 15,992,000	$ 3,667,000
Total Cost per Family	$ 5,653	$ 1,296

1/ Agricultural Faculty Padjadjaran University Bandung Draft Report Table 3

2/ Number of families 1979 supplied by Jratunseluna Project Office 9-10-79

3/ Table E-19

4/ Table E-20

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PART II

TUNTANG AND RELATED RIVERS BASINS
DEVELOPMENT PLAN

APPENDIX E

ECONOMICS

TABLE OF CONTENTS

APPENDIX E - PART II

ECONOMICS

LIST OF TABLES

APPENDIX E - PART II

ECONOMICS

LIST OF FIGURES

APPENDIX E - PART II

ECONOMICS

TUNTANG AND RELATED RIVERS BASINS
DEVELOPMENT PLAN

APPENDIX E - PART II

ECONOMICS

E.1. INTRODUCTION

In Part II of this study, irrigation benefits per hectare of irrigable land were determined for each of the service areas of the Western and Eastern Subbasins, based on studies by PRC/ECI and other consultants of agricultural conditions in each area. Flood control benefits that would accrue from projects in the Western Subbasins were determined, based on data indicating damages sustained and areas flooded in these basins during the past 15 years. Hydropower benefits were adjusted to reflect crude oil valued at $ 30/barrel, and the costs of M & I water from several alternative sources were computed.

Benefits in Part II are expressed in 1979 prices.

E.2. IRRIGATION BENEFITS

E.2.1. Prices, Crop Patterns, and Yields

The irrigation benefits that would accrue from the development plans and individual components evaluated in Part II of this study were measured by the difference in net agricultural earnings on irrigable crop lands with and without development. Most of the basic economic data that were used in Part I were also used in Part II. However, the value of crops, farm budgets, and net farm earning per hectare were updated to 1979 prices.

The key factor affecting the value of additional agricultural output obtained by introducing irrigation or improving existing irrigation is the price of agricultural commodities, primarily rice. As the market prices of agricultural commodities are subject to continual fluctuations, use of the actual market prices that prevailed on some given date would give an unreliable estimate of economic feasibility. Therefore, commodity prices used for evaluating irrigation benefits were the prices projected by the International Bank for Reconstruction and Development (IBRD). The prices reflect only long-term trends and not short-term fluctuations. Since no benefits could accrue until 1985, at the earliest, the IBRD projected price of rice in world trade in 1985 was used as a starting point. It refers to rice of a specified quality, FOB Bangkok, expressed in 1978 constant dollars. Several adjustments to this price were made in order to take into account the international rate of inflation from 1978 to 1979, the difference in quality between Bangkok rice and local rice, and the costs that would be incurred to ship rice from Bangkok. The result is designated as the "farm gate economic price" of rice in the Jratunseluna Basin, and amounted to $ 215/metric ton. Yields and cropping patterns used for evaluating irrigation benefits in all the Western Subbasins and some of the Eastern Subbasins were

based on the PRC/ECI studies of existing and projected agricultural conditions, as reported in Appendix B. In the Eastern Subbasins yields and cropping patterns for evaluating irrigation benefits in the Upper and Lower Sedadi Service Areas were based on agricultural data developed by Snowy Mountains Engineering Corporation (SMEC) and published in "Downriver Works Definite Scheme Report", Volume 3, dated September 1978.

E.2.2. Agricultural Conditions Without Projects

Three principal types of agricultural conditions presently prevail in areas to be served by the projects: rainfed agriculture, wet season irrigation, and wet season irrigation plus some dry season irrigation.

E.2.2.a. Irrigable Lands Without Any Irrigation

About 14,000 ha of farm land on the right and left banks of Lusi River could potentially be supplied with water for perennial irrigation. Under present conditions, only one crop of rice is produced each year, half of it low-yield varieties. Some maize and soybeans are also grown. The PRC/ECI study of nonirrigated crop production in the Lusi River Basin, and a forecast of what may be expected with irrigation, is provided in Appendix B - Part II. South Grobogan is an irrigable area of 7,300 ha. Present agricultural conditions are similar to those in the adjacent Lusi River right and left bank areas.

E.2.2.b. Areas Irrigated Only in Wet Season

About 35,000 ha in the Tuntang/Jragung Basins need additional water for perennial irrigation. A large part of this area (approximately 29,000 ha) now has enough water for wet season irri-

gation plus a limited amount of dry season irrigation. The total area of 35,000 ha was treated as a single service area for evaluating project benefits in Part I of this study. However, separate analyses of the two areas are provided in Part II.

The Dolok and Penggaron Basins have 6,500 ha of crop land which is irrigated in the wet season only, as water is not available in the dry season. The Lower Sedadi irrigable area has about 17,400 ha of cropland which is irrigated only in the wet season and in the Juana Valley about 15,000 ha have irrigation only in the wet season.

E.2.2.c. Areas Irrigated in Wet Season and Partially Irrigated in Dry Season

Farmers in the Upper Sedadi area of 11,800 ha have water to irrigate during the wet season plus some water for the dry season. However, the quantity available in the dry season is inadequate. Yields are smaller than could be obtained with more water. As noted above, about 6,000 ha in the Tuntang-Jragung Basins now have water for some dry season irrigation.

E.2.3. Agricultural Conditions With Projects

The projects evaluated in this report would make available an adequate supply of water for perennial irrigation. Farmers would be able to raize more crops during a year, obtain higher yields from each crop, and change cropping patterns. Substantial increases would occur in the physical quantity of crops produced and net farm income.

E.2.3.a. Service Areas Where Irrigation will be Introduced

The area described in E.2.2.a. now have the greatest scarcity of water and thus the lowest level of present agricultural output.

Table E-1 shows crops, yields, and net farm income in the Lusi River irrigable area, one of the two areas presently without irrigation. The benefit of perennial irrigation per hectare of cropland amounts to $ 1,589. This same gain in net farm income is also expected in South Grobogan.

E.2.3.b. Service Areas Where Dry Season Irrigation will be Introduced

The areas described in E.2.2.b. now have water for wet season irrigation. Dry season irrigation could be added with water provided by the projects under consideration.

Table E-2 shows crops, yields, and net farm income per hectare in the portion of the Western Subbasins where water is not presently available for dry season irrigation. Net farm income per hectare would increase in the amount of $ 1,406 under with project conditions.

Table E-3 shows agricultural conditions with and without the projects for the Lower Sedadi Service Area. Net farm income per hectare in this area would increase in the amount of $ 1,013 with enough water for perennial irrigation.

Table E-4 shows agricultural conditions with and without the projects in the Juana River Basin service area. Net farm income would increase $ 1,163.

E.2.3.c. Service Areas Where Dry Season Irrigation will be Increased

The areas described in E.2.2.c. now have water for wet season irrigation and some dry season irrigation, but the quantity of water available in the dry season is inadequate.

Table E-5 shows agricultural conditions in the Upper Sedadi service area, with and without the projects. Net farm income would increase in the amount of $ 670/ha with the projects.

Table E-6 shows agricultural conditions in the portion of the Western Subbasins where there is now some dry season irrigation, with and without the projects. Net farm income would increase in the amount of $ 1,157/ha with the projects.

TABLE E-1

LUSI RIVER BASIN

NET FARM INCOME PER HECTARE
(1979 Prices)

Crop	Distribution 1/ (%)	Yield t/ha	Gross Value of Crop per ha. (Rp)	Net Value of Crop per ha 2/ (Rp)	No. of Crops/Year	Net Income (Rp)
WITHOUT PROJECT CONDITIONS						
Surjan Crops	2.0		624,375	452,602		9,052
1 Rice Crop:	17.0	3.1	412,703	302,718	1	51,462
2 Rice Crops (HYV)	1.0	3.1	412,703	275,085	2	5,501
1 Rice Crop:	80.0					
HYV	(50)	3.1	412,703	302,718	1	183,597
LV	(50)	2.0	266,260	156,275	1	
+ Palawija						
Maize		1.3	112,450	228,664	1	182,931
Soybeans		0.9	203,242		TOTAL:	432,543
WITH PROJECT CONDITIONS						
Surjan Crops	2.0		624,375	452,602		9,052
2½ Rice Crops (HYV)	14.0	4.9	652,337	514,719	2.5	180,151
3 Rice Crops (HYV)	71.0	4.9	652,337	514,719	3	1,096,351
2 Rice Crops	13.0					
HYV	(50)	4.9	652,337	514,719	2	90,560
LV	(50)	2.4	319,512	181,994	2	
+ Palawija						
Maize		1.6	138,400	322,361	1	41,906
Soybeans		1.2	270,990		TOTAL:	1,418,020
					BENEFIT:	985,477 ($1,589)

Notes: 1/ Yields and crop distribution for without project conditions based on PRC/ECI study of existing agricultural conditions, Appendix B - Part II. Crop distribution with project based on yields equal to with project yields in Tuntang/Jragung Basins. Yields of wet rough rice adjusted to dry rough rice.

2/ Gross value less cash expenses in farm budgets.

TABLE E-2

WESTERN SUBBASINS 1/

NET FARM INCOME PER HECTARE

(1979 Prices)

Crop	Distribution (%)	Yield t/ha	Gross Value of Crop per ha. (Rp)	Net Value of Crop per ha 2/ (Rp)	No. of Crops/year	Net Income (Rp)
WITHOUT PROJECT CONDITIONS						
Surjan Crops	14.82	-	624,375	452,987	-	67,133
1 Rice Crop	85.18	3.6	479,268	369,283	1	314,555
+ Palawija						
Maize		1.2	103,800	197,430	1	168,172
Soybeans		0.8	180,660			
					TOTAL:	549,960
WITH PROJECT CONDITIONS						
Surjan Crops	5.0	-	624,375	452,987		22,649
2½ Rice Crops	14.0	4.9	652,337	514,719	2.5	180,152
3 Rice Crops	71.0	4.9	652,337	514,719	3	1,096,351
2 Rice Crops	10.0	4.9	652,337	514,719	2	102,944
+ Palawija						
Maize		1.2	103,800	197,430	1	19,743
Soybeans		.08	180,660			
					TOTAL:	1,421,839
					BENEFIT:	871,979 ($ 1,406)

1/ This table shows "without" condition where water is available for wet season irrigation only.

2/ Gross value less cash expenses in form budgets.

TABLE E-3

LOWER SEDADI AREA

NET FARM INCOME PER HECTARE
(1979 Prices)

Crop	Distribution (%)	Yield t/ha	Gross Value of Crop per ha. (Rp)	Net Value of Crop per ha.2/ (Rp)	Net Income (Rp)
WITHOUT PROJECT CONDITIONS 1/					
1 Rice Crop	100.0				
(HYV)	(33.0)	3.6	479,268	369,283	121,863
(LV-A)	(34.0)	2.2	292,886	182,901	62,186
(LV)	(33.0)	1.5	199,695	89,710	29,604
Sorghum	25.0	2.3	86,265	47,925	11,981
				TOTAL:	225,634
WITH PROJECT CONDITIONS 1/					
1 Rice Crop (Wet Season)	100.0				
(HYV)	(80.0)	4.1	545,833	408,215	326,572
(LV-A)	(10.0)	2.4	319,512	181,894	18,189
(LV)	(10.0)	1.6	213,008	75,390	7,539
1 Rice Crop (Dry Season)					
(HYV)	100.0	4.8	639,024	501,406	501,406
				TOTAL:	853,706
				BENEFIT:	628,072 ($ 1,013)

1/ Yields & crop distribution, with and without projects, based on SMEC "Down River Works Definite Scheme Report", September 1978.

2/ Gross Value less cash expenses in form budget.

TABLE E-4

JUANA RIVER BASIN

NET FARM INCOME PER HA.

(1979 Prices)

Crop	Distribution 1/ (%)	Yield t/ha	Gross Value of Crop per ha. (Rp)	Net Value of Crop per ha.2/ (Rp)	No. of Crops/year	Net Income (Rp)
WITHOUT PROJECT CONDITIONS						
Cassava	9.0	9.0	287,550	184,032	1	16,563
Maize	2.0	1.2	103,800	174,848	1	3,497
Soybeans		0.7	158,077			
1 Rice Crop	31.0					
HYV	(10)	3.3	439,329	329,344	1	53,810
LV	(90)	2.0	266,260	156,275		
2 Rice Crops (HYV)	19.0	3.1	412,703	275,085	2	104,532
3 Rice Crops (HYV)	9.0	3.4	452,642	315,024	3	85,056
1 Rice Crop	30.0					
HYV	(50)	3.1	412,703	302,718	1	68,849
LV	(50)	2.0	266,260	156,275		
+ Palawija						
Maize		1.1	95,150	188,781	1	56,634
Soybeans		0.8	180,660		TOTAL:	388,941
WITH PROJECT CONDITIONS						
Cassava	5.0	11.0	351,450	225,993	1	11,300
2½ Rice Crops (HYV)	14.0	4.2	559,146	421,528	2.5	147,535
3 Rice Crops (HYV)	71.0	4.0	532,520	394,902	3	841,141
2 Rice Crops	10.0					
HYV	(90)	4.2	559,146	421,528	2	79,513
LV	(10)	2.4	319,512	181,894		
+ Palawija						
Maize		1.7	147,050	308,428	1	30,843
Soybeans		1.1	248,407		TOTAL:	1,110,332
					BENEFIT:	721,391 ($1,163)

1/ Crops, yields, and crop distribution based on PRC/ECI study of agricultural conditions in Juana River Basin, Appendix B - Part II. Wet rough rice yields adjusted to dry rough yields.

2/ Gross value less cash expenses in farm budget.

TABLE D-5

UPPER SEDADI SERVICE AREA

NET FARM INCOME PER HECTARE 1/

(1979 Prices)

Crop	Distribution	Yield t/ha	Gross Value of Crop per ha. (Rp)	Net Value of Crop per ha 2/ (Rp)	No. of Crops/Year	Net Income (Rp)
WITHOUT PROJECT CONDITIONS						
1 Rice Crop (Wet Season)	100	4.7	625,711	515,762	1	515,762
1 Rice Crop (Dry Season)	25	5.3	705,589	567,971	1	141,992
Palawija						
Maize	30	1.1	103,799	242,595	1	72,778
Soybeans		1.0	225,825			
					TOTAL:	730,532
WITH PROJECT CONDITIONS						
1 Rice Crop (Wet Season)	100	5.0	665,650	528,032	1	528,032
1 Rice Crop (Dry Season)	100	5.5	732,215	594,597	1	594,597
Soybeans	13	1.0	225,825	179,938	1	23,392
					TOTAL :	1,146,021
					BENEFIT:	415,489 ($ 670)

1/ Crops, yields, crop distribution based on SMEC projections for year 2000, with & without projects, in "Define Scheme Report Down River Works" dated September 1978.

2/ Gross value less cash expenses in farm budget.

TABLE E-6

WESTERN SUBBASINS

NET FARM INCOME PER HECTARE
(1979 Prices)

Crop	Distribution (%)	Yield 1/ t/ha	Gross Value of Crop per ha. (Rp)	Net Value of Crop per ha 2/ (Rp)	No. of Crops/Year	Net Income (Rp)
WITHOUT PROJECT CONDITIONS						
Surjan Crops	14.8	-	624,375	456,602	-	67,577
1 Rice Crop	46.4	3.6	479,269	369,283	1	171,347
2 Rice Crops	20.1	4.9	674,328	536,710	2	215,757
3 Rice Crops	12.9	4.9	674,328	536,710	3	207,707
1 Rice Crop + Palawija	4.5	3.6	479,269	369,283	1	16,618
Maize		1.2	103,800	197,431	1	8,884
Soybeans		0.8	180,660			
2 Rice Crops + Palawija	1.3	4.9	674,328	536,710	2	13,954
Maize		1.2	103,800	197,431	1	2,566
Soybeans		0.8	180,660			
					TOTAL:	704,410
WITH PROJECT CONDITIONS						
Surjan Crops	5.0		624,375	456,602	1	22,830
2½ Rice Crops	14.0	4.9	652,337	514,719	2.5	180,152
3 Rice Crops	71.0	4.9	652,337	514,719	3	1,096,351
2 Rice Crops + Palawija	10.0	4.9	652,337	514,719	2	102,943
Maize		1.2	103,800	197,431	1	19,743
Soybeans		0.8	180,660			
					TOTAL:	1,422,019
					BENEFIT:	717,699 ($1,157)

1/ Yields and crop distribution, with and without projects, based on PRC/ECI study of agricultural conditions in the portion of the Tuntang/Jragung Basins where water is available for wet season irrigation plus some dry season irrigation.

2/ Gross value less cash ecpenses in form budgets.

E.3. FLOOD CONTROL BENEFITS

E.3.1. Dolok and Penggaron Basins

An assessment of floods and their effects on the coastal plain between the city of Semarang and the Tuntang River is one part of a study currently in progress for DGWRD by Netherlands Engineering Consultants (NEDECO). Basing an estimate partly on NEDECO's findings and partly on other flood damage studies, the Jratunseluna Project office estimates that the average annual area flooded on the floodplains of the Dolok and Penggaron Rivers is approximately 4,500 ha (69 percent of the total areas).[1/] Irrigable lands in the lower basins of the two rivers have areas of 1,950 ha and 4,590 ha, respectively. Based on this relationship, the average annual area flooded in the Dolok River Basin is approximately 1,350 ha and in the Penggaron River Basin approximately 3,150 ha. In each basin about 2/3 of the area is cropland.[2/] The remaining 1/3 of the land is used for residential dwellings, public buildings, roads, and other uses. In the Dolok River Basin, therefore, an average of 900 ha of cropland is affected by annual flooding, and 2,100 ha of cropland in the Penggaron River Basin. The flatest land may remain under water for at least 3 days; elsewhere flood waters normally receed in less than 3 days. It is assumed that half the cropland subject to flooding will be under water at least 3 days and the other half less than 3 days.

PRC/ECI evaluated the effect of duration of flooding on crop damage and found that inundation of a hectare of rice for at least 3 days would reduce a farmer's net income by $ 297. Inundation less

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1/ The flood of January 1980 (a 5-year to 10-year event) inundated 80 percent of the total area, and some of the area was inundated again in February 1980.

2/ Inventarisasi Data Pokok Statistik Pertanian, Extension Service, Central Java, Statistical Service - Planning & Evaluation, 1975.

than 3 days would reduce net income by $ 115. Property damage is less sensitive to duration of flooding.

Data about crop damage and property damage in 13 kecamatans were collected by the Jratunseluna Project office following the floods of January 22 and February 8, 1980. The data (see Table E-7) are a partial tabulation of the cumulative damages caused by these two floods. In some kecamatans, the fact that certain types of damages had been sustained was noted, but the amount of the damages was not known. In a few kecamatans damage data were fairly complete and indicated that crop damage is about 65 percent of total damages. PRC/ECI used this relationship in estimating total damages to crops and other property.

Table E-8 shows PRC/ECI estimates of average annual flood damage in the Dolok and Penggaron Basins.

E.3.2. Tuntang-Jragung Basins

An average of 1,800 ha in the Jragung River Basin is affected by annual flooding (15 percent of the service area) and approximately 4,500 ha in the Tuntang River Basin (19 percent of the service area). The same method and assumptions described above in E.3.1. were used to estimate average annual flood damages, which are shown in Table E-9.

TABLE E-7

JRATUNSELUNA PROJECT FLOOD DAMAGE SURVEY FLOODS OF JANUARY & FEBRUARY 1980

DAMAGES IN 13 KECAMATANS

Kecamatan & Kabupaten (River Basin)	Rice Fields (ha. and/or Damage)	Dry Fields (ha. and/or Damage)	Home Yards (ha. and/or Damage)	Houses Damaged (Yes/No & Number)	Govern-ment Land (ha. and/or Damage)	Road Damaged	Bridge Damaged or Destroyed	Irrigation Structures Damaged	Fishponds	Schools & Government Building	Livestock	Other Property Damage
Karangawen, Demak (Jragung River)	410 ha ←	380 ha Rp 19,914,500	231 ha →	Yes/302								
Wonosalam, Demak (Tuntang River)	429 ha Rp 3,213,000	97 ha Rp 297,000	100 ha	Yes/208								
Gajah, Demak (Serang River)			90 ha		100 ha			Yes				
Demak, Demak (Tuntang River)						400 m Rp 500,000						
Wedung, Demak (Serang River)				Yes/3,016 Rp 7,167,500			3 Bridges Rp110,000000	Yes			Rp 2,692,000	Pp1,359,000
Gubug, Purwodadi (Tuntang River	467 ha Rp 21,483,000	10 ha Rp 285,000										
Tegowanu, Purwodadi (Jragung River)	1,825 ha Rp440,050,000	722 ha Rp52,555,000		Yes/3,588							Rp3,144,000	Yes
Godong, Purwodadi (Serang River)	3,026 ha			Yes/			4 Bridges					
Penawangan, Purwodadi (Serang/Lusi River)	66,151 ha ← Rp 14,240,000	384 ha →		Yes/1,563		165 km	11 Bridges					
Sayung, Demak (Tuntang River)	25,680 ha ←	339 ha Rp19,335,000	257 ha →				Rp 400,000		Rp21,500,000			
Karangtengah, Demak ((Tuntang River)	4,833 ha			Yes/8,060					269 ha	25 Schools 17 Bldg's		
Dempet, Demak (Tuntang River)	367 ha Rp3,670,000	43 ha Rp 435,000	135 ha Rp 1,350,000									
Mranggen, Demak (Dolok River)	19 ha Rp2,987,500	133 ha Rp10,955,000		Yes Rp 20,000				Yes Rp7,530,000				
Total Cropland Flooded, including Government Land	← 83,383 ha →											

TABLE E-8

AVERAGE ANNUAL FLOOD DAMAGES

DOLOK AND PENGGARON BASINS

(1979 Prices)

Average Annual Flooding	Dolok River Basin		Penggaron River Basin	
	Area (ha)	Damage ($)	Area (ha)	Damage ($)
Cropland, 3 days or more	450	133,650	1,050	311,850
Cropland, 2 days or less	450	51,750	1,050	120,750
Other Land	450	99,830	1,050	232,938
TOTAL:	1,350	285,230	3,150	665,538
		($ 211/ha)		($ 211/ha)

TABLE E-9

AVERAGE ANNUAL FLOOD DAMAGES

TUNTANG-JRAGUNG BASINS

(1979 Prices)

Average Annual Flooding	Jragung River Basin		Tuntang River Basin	
	Area (ha)	Damage ($)	Area (ha)	Damage ($)
Cropland, 3 days or more	600	178,200	1,500	445,500
Cropland, 2 days or less	600	69,000	1,500	172,500
Other land	600	133,110	1,500	332,770
TOTAL:	1,800	380,310	4,500	950,770
		($ 211/ha)		($ 211/ha)

E.4. HYDROPOWER BENEFITS

The value of secondary (interruptible) power that would be generated by some of the proposed projects (a positive power benefit), and the value of firm power that would be foregone by constructing some proposed projects (a negative benefit), is evaluated in terms of the value of power from the most likely alternative source. In the case of all hydropower facilities to be installed in the proposed projects, the most likely alternative is an oil-fired steam generating plant. In accordance with standard practice, power from the alternative plant is evaluated in terms of a capacity factor, which is an estimate of the annualized cost per kilowatt, including O & M, of installing generating capacity; and an energy factor, which is the variable cost per kilowatt hour to generate electricity at the alternative plant. The capacity value is $ 120.13/Kw. The energy factor is based on oil costing $ 30/barrel (an increase of $ 10/barrel over the oil price used in Part I of this study). Table E-18 in Appendix B - Part I shows the derivation of the value of the capacity factor ($ 120.13/KW) and the energy factors based on $ 30/barrel oil ($ 0.0498 for firm power and $ 0.0415 for secondary power).

E.5. MUNICIPAL AND INDUSTRIAL WATER

More municipal and industrial water for Semarang is an important aspect of the development program in the Western Subbasins. M & I water at reservoir sites is valued in terms of the cost of water at a single-purpose water supply reservoir at the same site as the proposed multi-purpose Jragung Dam. Such a single-purpose water supply project to supply 2,000 l/s would have an estimated cost of $ 33 million. If this investment is amortized at 15 percent over 50 years, the equivalent annual cost would be $ 4.96 million, and the cost per 1,000 m^3/year of untreated water at the reservoir would be $ 79. As shown in Table E-10, untreated water in reservoirs on the Penggaron and Dolok Rivers would cost about the same amount per 1,000 m^3/year. Costs for treatment of the water and transmission by means of pumping to Semarang would vary according to the distance of a reservoir from the city. In the case of Jragung Reservoir as a source, the cost of constructing treatment and transmission facilities, including a pumping plant, was indicated in the Tuntang-Jragung Rivers Basins Special Report I, Municipal and Industrial Water Supply, as $ 62 million. Adjusted to reflect a $ 30/barrel value of crude oil to generate energy for pumping the water, this figure becomes $ 64 million, so the cost of treating and conveying water to Semarang from Jragung would be $ 153/m^3 per year.

The economic cost of conveying 2,000 l/s of water to Semarang from Muncul Springs, including the value of foregone power generation, was given in the PRC/ECI Special Report on M & I water as $ 48.6 million. If the value of the foregone power is adjusted to reflect a price of $ 30/barrel for crude oil, the economic cost becomes $ 55 million, and the annual cost of water at Semarang from Muncul Springs would be approximately $ 131 per 1,000 m^3 per year.

TABLE E-10

MUNICIPAL AND INDUSTRIAL WATER

COMPARATIVE COSTS

(1979 Prices)

Alternative Source	Liters per Second	1,000 Cubic Meter/Year	Untreated Water at Site		
			Construction Cost	Equivalent Annual Cost	Cost per 10^6 m^3
Jragung Reservoir	2,000	63,072	$ 33 x 10^6	$ 4,962,000	$ 79
Penggaron Reservoir	1,500	47,304	25 x 10^6	3,754,000	79
Dolok Reservoir	1,000	31,536	15 x 10^6	2,252,000	71

PRC ENGINEERING CONSULTANTS, INC.

FIGURE II-1