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IRRIGATION PROJECTS DOCUMENT REVIEW



APPENDIX B: EAST ASIA

**WATER MANAGEMENT SYNTHESIS PROJECT
WMS REPORT 1**

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IRRIGATION PROJECTS DOCUMENT REVIEW

APPENDIX B:

EAST ASIA

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WMS Report 1

INTRODUCTION

Members of the staff of the USAID-sponsored Water Management Synthesis Project have written this project document review to serve as a resource paper indicating general directions of irrigation project investments in developing countries.

The bulk of the documents obtained were written preliminary to project execution and therefore did not attempt to evaluate either an ongoing or a completed project. It is thus clear that these papers do not purport to represent the projects' actual attainments and shortcomings. For this reason, the reviewers have not attempted to critically assess the merits of executed projects on the basis of this documentation, but rather, have summarized information contained in these documents to arrive at descriptions of individual projects as perceived during the planning stage.

Taking collectively, these summaries afford an overview of methods and strategies used by USAID and IBRD (World Bank) in facing the problems of irrigation development.

METHODOLOGY

Each of the following summaries is divided loosely into three sections. The first section is an outline giving the project's location, approximate area, expected cost and brief entries on the goals of the project and how these goals are to be achieved. Following this outline are more detailed descriptions of selected aspects of the projects. These descriptions come under the headings "Technical," "Environmental," "Social," "Institutional" and "Economic," headings which generally correspond with those used to organize World Bank appraisal reports.

USAID project papers are less standardized in format with the result that individual project papers may not specifically address certain topics, while having extensive coverage of others. Also, aspects which may sensibly be viewed as one type of factor by the authors of some project papers may legitimately be classified under another heading by other authors. These judgments are reflected in the summaries.

Environmental aspects are not consistently addressed in either USAID or IBRD papers, although in general, the later the document, the more attention is paid to environmental questions. The institutional emphasis in the documents of both organizations pertains mainly to the official channels designated for the construction and operation of projects without casting much light on how water is to be managed by the farmers themselves or on the level of rapport anticipated between irrigators and project personnel.

The third section of the summaries is composed of tables usually including an implementation schedule, a cost breakdown and estimates of present and future productivity within the project area. USAID project summaries also include a copy of the project logical framework, whenever this was available.

ACKNOWLEDGMENTS

The permission of FAO and the World Bank (IBRD) to perform this project and their assistance in bringing it to completion are gratefully acknowledged.

Recognition of this cooperation, however, in no way implies the support or endorsement of these bodies for this study.

EXPLANATION OF SYMBOLS

The documents included in this review are organized first by country, then grouped within each country by donor organization, and finally assigned a number within each group. Thus, for example, IN-A-1 stands for Indonesia-AID-1.

The full project title may be found in the index of projects. The number in parenthesis after the key word is an indication of the frequency of use of the word or words.

Donor Code

A	USAID
F	FAO
W	World Bank

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EAST ASIA

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TITLE: Sederhana (Simple) Irrigation and Land Development Project

PROJECT NO.: 497-0242

COUNTRY: Indonesia

REGION: Asia

KEYWORDS: Paddy irrigation (2); water users' association (5);
bamboo and gabion diversion dams (3).

SUMMARY: The AID loan will strengthen the various GOI agencies responsible for designing and constructing over 400 small-scale, simple irrigation projects. The projects will employ traditional technology -- gabion or bamboo diversion weirs and earthen watercourses -- in order to increase the area and intensity of rice production.

LOCATION: Throughout country (23 provinces).

CLIMATE: Ar-Aw.

CROPS: Rice.

SOILS: N/A

TARGET GROUP: Initially, the employees of the GOI implementing agencies; through them, the one hectare irrigating farmer.

BEGIN: 1975 END: FY 1977 AREA: 165,638 ha.

NUMBER OF FARMS: 165K

CONTRIBUTIONS:	U.S.	\$23.7M loan (40 year)
		50K grant
		12 technicians (8 irrigation engineers, 4 farm specialists)
		72 man-months short-term consultants
	GOI	\$31.7M
	Farmers	\$ 3.9M Farm labor

GOALS: To decrease Indonesia's dependence on food imports, particularly rice, needed to grow a growing population.

PURPOSE: (1) Institution building; (2) rice production; and (3) well-being of the rural poor.

TYPE OF PROJECT: Large-scale institution building, construction of simple subprojects.

TECHNOLOGY USED: Diversion dams (bamboo, gabions), unlined canals, 3/4 ton pickup trucks, inspection jeeps and motor bikes, surveying equipment.

DOCUMENTS REVIEWED: Project paper (150 pp).

PROJECT ORIGIN AND BASE LINE DATA: Program was initiated by President Suharto. A pilot project, financed by the Bank Rakyat of Indonesia for \$200K, tested land clearing and wet rice irrigation on about 1,400 ha. The project concept has been endorsed by the BIRD, Asian Development Bank, and the Dutch development agency.

BENEFICIARY INVOLVEMENT: The farmers will help to build the tertiary canals and farm watercourses. Eventually, irrigators' associations will take over O&M of the system.

ACTUAL STARTING DATE: N/A

COMPLETION DATE: N/A

LOGICAL FRAMEWORK: Attached to reviewed documents.

PERT CHART: Not available.

TECHNICAL

The actual projects to be built will range in size from 100 to 2,500 ha (with most under 300 ha) and will utilize the simplest technologies possible. Four hundred and seven simple irrigation projects will be installed on 165K ha. Diversion dams, made of rock gabions or bamboo, will provide water directly from mountain streams to tertiary canal systems, mostly of unlined earth.

Criteria for selection of irrigation projects in Indonesia are: (1) soil; (2) available water; (3) adequate manpower; (4) proximity to market; (5) physical accessibility; (6) no land status problems; and (7) low flood risk. In addition, for the Sederhana Program, the following criteria were added: (8) simplicity of construction; (9) capability for rapid execution; (10) relatively low expense (less than \$240/ha for the first two years of the program); and (11) area less than 2,000 ha.

AID will provide pickup trucks and surveying equipment to the GOI implementing agencies (DGWRD, AAETE, RIS) for the engineering design and construction teams.

After one year, the BIMAS crop production package will be introduced to farmers to provide them with fertilizer and pesticide. Rice production will increase by 101K tons in subproject areas in IFY 1978-79.

Fifty percent of the projects will be rehabilitation or replacement of existing systems, and 50% will install irrigation in new areas (including 10% with clearing of new land).

INSTITUTIONAL

Water user associations will be established for farmers at each site. At the time that they become self-sustaining, and can levy assessments from the farmers, they will take over O&M of the projects.

The various implementing GOI agencies -- the Directorate General Water Resource Development (DGWRD), the Agency for Agriculture Education, Training and Extension (AAETE), and the Rural Irrigation Service (RIS) -- will be strengthened and enlarged, but not significantly reorganized. Training of personnel will cost \$854K. This will provide the GOI agencies with the ability to implement a program of 60K ha in IFY 1976-1977, requiring approximately 50% annual growth rate in those agencies.

SOCIAL

In areas of the outer islands where there is a shortage of labor, the GOI will provide for transmigrations of settlers and laborers.

FINANCIAL/ECONOMIC

Farmer income will increase by \$210 in subproject areas, and there will be an increase of 97K wet-season and 29K dry-season jobs in IFY 1978-79.

Yearly AID disbursements are shown in Annex B2, Table 25.

IRR = 46%.

AID funding is divided into two categories: traditional direct procurement provides for imported and major-expenditure items, and Fixed Amount Reimbursement (FAR) is used for most of the small project costs.

Project Paper - Pages 19 and 20

2. Cost Estimate.

Table 3 below presents a detailed summary of the estimated \$59.2 million total cost of the AID Sederhana Project.

TABLE 3

a. Detailed Summary of Cost Estimate (\$ Thousand).

	Foreign Exchange	Local Currency	Total	AID Financing	
				Category	Amount
I. DGWRD					
A. Long-term Consultants	1019.9	340.0	1359.9	DIR	1019.9
B. Short-term Consultants	336.4	112.1	448.5	DIR	336.4
C. Training					
1. In-country	--	293.2	293.2	FAR	246.6
2. Overseas	51.8	--	51.8	DIR	51.8
D. Gabion Wire	--	631.1	631.1	FAR	315.6
E. Light Equipment					
1. FAR	--	697.2	697.2	FAR	348.5
2. Direct Procurement	775.0	88.8	863.8	DIR	775.0
3. GOI Contribution	--	465.5	465.5	GOI	--
F. Hydrology	103.5	11.5	115.0	DIR	103.5
G. Maintenance Support Light Equipment and Hand Tools	1035.0	115.0	1150.0	DIR	1035.0
H. Survey and Design	--	912.0	912.0	FAR	456.0
I. Construction	--	32172.5	32172.5	FAR	16086.3
J. Central Administration	--	1893.5	1893.5	GOI	--
<u>Total DGWRD</u>	<u>3321.6</u>	<u>37732.4</u>	<u>41054.0</u>		<u>20674.6</u>
II. Dept. (Min.) of Agriculture:					
A. Long-term Consultants	569.3	189.8	759.1	DIR	569.3
B. Short-term Consultants	67.3	22.4	89.7	DIR	67.3
C. Training					
1. In-country	--	457.3	457.3	FAR	228.6
2. Overseas	51.8	--	51.8	DIR	51.8
D. Light Equipment					
1. FAR	--	304.3	304.3	FAR	152.2
2. Direct Procurement	772.3	81.3	803.6	DIR	722.3
3. GOI Contribution	--	305.9	305.9	GOI	--
E. Hand tools	--	256.2	256.2	FAR	208.3
F. Formation of Water User Associations & Extension	--	416.6	416.6	FAR	208.3
G. Construction of Water User Association Offices	--	456.1	456.1	FAR	228.0
H. Construction of Farm Service Ditches					
1. FAR	--	1216.1	1216.1	FAR	608.1
2. GOI Contribution	--	1520.2	1520.2	GOI	--
I. Office Facilities	--	114.7	114.7	GOI	--
J. Administration (Exploitation and Control)	--	3035.0	3035.0	GOI	--
<u>Total Dept. Agriculture</u>	<u>1410.7</u>	<u>8375.9</u>	<u>9786.6</u>		<u>2964.0</u>

	<u>Foreign Exchange</u>	<u>Local Currency</u>	<u>Total</u>	<u>AID Financing</u>	
				<u>Category</u>	<u>Amount</u>
III. Ministry of Interior					
A. Land Certificates	--	1216.1	1216.1	GOI	--
IV. Bank Rakyat Indonesia (BRI)					
A. Credit for Land Clearing, Leveling and Paddy Shaping	--	3313.5	3313.5	GOI	--
V. Farmers					
A. Land Clearing, Leveling and Paddy Shaping	--	2208.4	2208.4	FRM	--
B. Labor for Construction of Tertiary Canals and Farm Service Ditches	--	1641.9	1641.9	FRM	--
<u>Total Farmers</u>	--	<u>3850.3</u>	<u>3850.3</u>		--
<u>Grand Total</u>	<u>4732.3</u>	<u>54488.2</u>	<u>59220.5</u>		<u>23638.6</u>

b. Summary of Cost Estimate by Source of Financing (\$ thousand).

	<u>AID</u>	<u>GOI</u>	<u>Farmers</u>	<u>Total</u>
DGWRD	10674.0	20379.4	--	41054.0
Dept. (Min.) of Agriculture	2964.0	6822.6	--	9786.6
Ministry of Interior	--	1216.1	--	1216.1
Bank of Rakyat Indonesia (BRI)	--	3313.5	--	3313.5
Farmers	--	--	3850.3	3850.3
<u>Grand Total</u>	<u>23638.6</u>	<u>31731.6</u>	<u>3850.3</u>	<u>59220.5</u>

Notes:

- Estimates include provision for contingency (15%) and price escalation (20% per year) where appropriate.
- AID financing category legend:
 - FAR - Fixed Amount Reimbursement.
 - DIR - Traditional Direct Procurement
 - GOI - Government of Indonesia Contribution
 - FRM - Farmer Contribution.
- See Annex B.2. Tables 21 to 24 for detailed cost estimate and breakdowns.

TITLE: Luwu Agricultural Development

PROJECT NO.: 497-0244

COUNTRY: Indonesia

REGION: Asia

KEYWORDS: Transmigration (5); surface irrigation (5).

SUMMARY: The Luwu Agricultural Development Project includes five separate activities; (1) upgrading the 176 km of road; (2) rehabilitation and construction of irrigation systems on 10,760 ha; (3) establishment of four pilot farm service centers; (4) creation of project organization; and (5) resettlement to transfer 3,550 families to newly irrigated areas.

LOCATION: Luwu

CLIMATE: Ar

CROPS: Rice.

SOILS: N/A

TARGET GROUP: Small farmers and landless laborers.

BEGIN: FY 1976 END: FY 1979 AREA: 10,760 ha irrigated.

NUMBER OF FARMS: 1.7 ha average farm size, 3,550 families relocated.

CONTRIBUTION:	USAID	\$15.0M
	GOIL	27.9M
	TOTAL	<u>\$42.9M</u>

GOALS: Improve the well-being of small farmers by raising productivity sufficiently to increase both per capita consumption and the movement of marketable surpluses to food deficit areas.

PURPOSE: To increase agricultural productivity and increase income and employment for the rural poor.

TYPE OF PROJECT: Full-scale construction and rehabilitation of irrigation systems.

TECHNOLOGY USED: Bulldozers, graders, trucks, etc.

DOCUMENTS REVIEWED: Project Paper (about 190 pp).

PROJECT ORIGIN AND BASE LINE DATA: AID interest in the area began in 1973, and feasibility studies have continued since then. GOI transmigration projects have a long history.

BENEFICIARY INVOLVEMENT: Low.

ACTUAL STARTING DATE: N/A

COMPLETION DATE: N/A

LOGICAL FRAMEWORK: Consists of 4 pages and is attached to reviewed documents.

PERT CHART: Consists of 4 pages and is attached to reviewed documents.

GENERAL DESCRIPTION

The Luwu Project is an integrated approach to agricultural development that comprises activities relating to irrigation, agricultural support packages, improvements to local government institutions, and rebuilding of local roads to provide extensions to area markets for agricultural products, and a transmigration program to introduce new families from more populated islands in Indonesia.

TECHNICAL

1. The Palopo-Malili Road. This subproject will consist of the construction of 176 kilometers of road, 79 bridges and 4,224 linear meters of culvert drainage structures along an existing alignment between the towns of Palopo and Malili. The road will be a single lane asphalt surface travelway with crushed stone shoulders. Cost is \$25 million.
2. Luwu Irrigation Project. The Bone-Bone Irrigation System encompasses 5,000 hectares of land, of which 1,300 is presently irrigated and 1,900 is potentially irrigable. Betterment consists of protecting canals and structures from erosion, providing additional control structures, and a complete tertiary and quaternary system of irrigation canals with adequate access roads and bridges. Rehabilitation will include repairs to the diversion dam, repair of turnouts, and canal lining when necessary.
3. Kalaena Irrigation System. Of 12.5K ha potentially irrigable, 7.56K will be developed. As for Bone-Bone, the diversion structure will be repaired, the main (12 mcs) and secondary canals will be renovated, gates and turnouts added, cross-slope drainageways improved, and an inspection road put in place. Design will be under the control of two Dutch irrigation engineers, one topographer, and one hydrologist, provided by the Dutch government. Main and secondary works will be constructed by private contractor, and tertiary and quaternary canals will be built by the farmers themselves. In the latter case, the Department of Public Works will own four D-50 bulldozers and seven backhoes to dig up the canals, while the farmers will shape their own ditches. Total cost of the irrigation subproject is \$6.5 million.

Prior to resettlement, 7,420 hectares of land within the irrigated areas will be cleared of trees and brush. This will be done by local contractors, entirely by hand, at a cost of \$1.7 million, or \$133/hectare.

Operation and maintenance of main and secondary systems is the responsibility of the Public Works Department in the province. This will be partly paid out of a water user charge of two percent of the crop (20 kilograms per ton). Farmers will maintain tertiary systems with some assistance from the Governor; this is estimated to cost 30 kilograms of rice per hectare. An O&M expert will provide two years of technical assistance beginning in the project's third year to all the relevant agencies.

3. Farm Service Centers. Four centers will be built in the project area with two components in each center:

(a) The Rural Extension Center will disseminate agricultural information, conduct field trials, hold training sessions, and develop farmer groups. The centers will be adapted to local problems and needs (such as state crops, fisheries, food crops and animal husbandry). They will be staffed by five technicians, three farm workers, and 10 to 15 field extension workers.

(b) Adjacent to each center will be a Farmer Association Complex emphasizing agri-business practices. Space will be available for seed multiplication, commercial growing of crops, grain storage and rice mill, and offices for credit union, water user association, etc. They will be operated by farmer associations with advice from farm center personnel. Total four year cost of the centers is \$2.56 million.

4. Transmigration Program. There will be land available on two irrigation projects for 3,300 additional families, and it is expected they will be settled in the next four years. The government provides each family with two hectares (one of which is already cleared), farming tools, and food and clothing for one-and-one-half years. Some public infrastructure, such as roads, schools and health facilities, is included. After a few years, when they have demonstrated good faith, settlers are given title to the land. These families will be among 20,000 to be settled in the Luwu area in the next five years. Two hundred and five thousand dollars will provide for three years of technical advice on planning and implementing transmigration programs.

INSTITUTIONAL

Four separate organizations within the GOI are involved in this project: Dian-Marga (roads), the Director General for Water Resources Development (irrigation), the Ministry of Agriculture (farm service centers), and the Director General for Transmigration (resettlement). In order to provide greater coordination within

the project area, a Project Office will be formed within the Ministry of Manpower, Transmigration, and Cooperatives to direct and coordinate activities. It would include an engineering division responsible for construction and infrastructure, and a development division promoting agricultural, economic, and social development. This office will maintain control over the project by reviewing the budgets of all technical departments before submission to the national planning board, and approval of the project manager will be required before disbursement of loan funds or reimbursements by AID. This Project Office will be disbanded after five years. \$122,000 is budgeted for short-term training of key members of the project organization and other concerned local government officials, with emphasis on integrated development planning and management.

SOCIAL

Development of agriculture toward a full-time employment will reduce farmers' dependence on non-farm, off-season employment. In the past, settlers have integrated well with existing indigenous populations.

FINANCIAL/ECONOMIC

A summary of annual costs is given on page M-2 (attached). The IRR for the project is 19%; individually, this can be broken down to 31% for Bone-Bone irrigation, 28% for Kalaena irrigation, and 17% for the trunk road.

Farm family income will increase from \$206 to \$340 per year on irrigated areas assuming a change in cropping intensity from 50% to 170%.

Disbursement will be by: (1) direct procurement of manufactured items (steel construction equipment); and by (2) fixed amount reimbursement, FAR, of local construction, in-country training, and the evaluation program.

The appendices to this report contain fairly detailed economic and financial evaluations for the subprojects, as well as equivalent requirements for each subproject.

Project Paper - Page M-2

Luwu Agricultural Development Project Disbursement Schedule
(in thousands of U.S. dollars)

<u>Activity</u>	<u>FY 1976</u>	<u>FY 1977</u>	<u>FY 1978</u>	<u>FY 1979</u>	<u>Totals</u>
<u>1. Betterment Palopo-Malili Road</u>					
a. Purchase Steel	1,500	--	--	--	1,500
b. Local Cost Construction	7,060	9,414	7,060	--	23,534
c. Totals	8,560	9,414	7,060	--	25,034
d. AID Contribution	3,520	2,700	2,023	--	8,243
<u>2. Luwu Irrigation Program</u>					
a. Rehab/Exrension Thru Secondary Canals	1,512	2,710	2,276	--	6,498
b. Tertiary/Quaternary Canal					
1. Equipment	701	--	--	--	701
2. Local cost construction	--	474	854	646	1,974
c. Construction Advisor	65	68	72	--	205
d. Land Clearing	51	451	571	631	1,704
e. Operations and Maintenance					
1. Advisor	--	--	72	75	147
2. Equipment	288	--	--	--	288
f. Totals	2,617	3,703	3,845	1,352	11,517
g. AID Contribution	1,522	1,260	1,390	610	4,782
<u>3. Farm Service Centers</u>					
a. Construction	109	542	641	265	1,557
b. Training	41	30	--	--	71
c. Direct Procurement	6	152	110	32	300
d. Operational Expenses	49	171	197	217	634
e. Totals	205	895	948	514	2,562
f. AID Contribution	102	453	431	163	1,149
<u>4. Transmigration</u>					
a. Movement of 3550 families	430	640	850	210	2,130
b. Foreign Advisor	65	68	72	--	205
c. Health Program	40	31	25	--	100
d. Total	535	743	947	-210	2,435
e. AID Contribution	93	91	85	--	269
<u>5. Project Organization</u>					
a. Capital/Operating Costs	180	181	181	181	723
b. Foreign Advisory Services	65	136	144	--	345
c. Training	80	42	--	--	122
d. Evaluation	40	35	35	40	150
e. Total	365	394	360	221	1,340
f. AID Contribution	173	189	155	40	557
<u>6. Total LADP Costs</u>	<u>12,282</u>	<u>15,149</u>	<u>13,160</u>	<u>2,297</u>	<u>42,888</u>
<u>AID CONTRIBUTION</u>	<u>5,410</u>	<u>4,693</u>	<u>4,084</u>	<u>813</u>	<u>15,000</u>

TITLE: Citanduy River Basin Development

PROJECT NO.: 497-0245

COUNTRY: Indonesia

REGION: Asia

KEYWORDS: Flood control (5); surface irrigation (3).

SUMMARY: The project will (a) construct 182 km of flood control levees in the Citanduy Basin, affecting 620K people; rehabilitate seven irrigation systems (12,500 ha); construct one new irrigation system (600 ha); and provide technical training, water user associations, and feasibility studies for additional Basin development.

LOCATION: Lower Citanduy Basin.

CLIMATE: Ar.

CROPS: Rice.

SOILS: N/A

TARGET GROUP: Small landowners, average farm size is one-half hectare, and maximum legal size is five hectares.

BEGIN: 1975 END: 1981 AREA: 12,447 ha rehabilitated
600 ha new irrigation

NUMBER OF FARMS: 37,000

CONTRIBUTION:	USAID	\$12.500M
	GOI	12.894M
	TOTAL	<u>\$25,394M</u>

GOALS: To improve the well-being of the poor majority and to contribute towards decreasing Indonesia's dependence on food imports.

PURPOSE: Reducing or eliminating the annual destruction by floods, increasing production of rice and other food crops, and developing feasibility studies and final designs for additional projects.

TYPE OF PROJECT: Large-scale.

TECHNOLOGY USED: Intermediate technology and hand labor when possible. Mechanical compaction will be used for compacting levees, and for dredging existing canals.

DOCUMENTS REVIEWED: Project paper (140 pp).

PROJECT ORIGIN AND BASE LINE DATA: Project is based on a 1975 study by Engineering Consultants, Inc.

BENEFICIARY INVOLVEMENT: Farmers will construct farm watercourses.

ACTUAL STARTING DATE: N/A

COMPLETION DATE: N/A

LOGICAL FRAMEWORK: Consists of 4 pages attached to reviewed documents.

PERT CHART: Consists of 2 pages attached to reviewed documents.

GENERAL DESCRIPTION

The Citanduy Basin Master Plan provides for land reclamation, additional irrigation systems, and dam construction for hydroelectric power. This project undertakes the initial phase of the Master Plan, concentrating on flood control.

TECHNICAL:

1. Flood control system. About 182 km of levees on the Citanduy River (130 km), the Ciseel River (34 km), the Cilolang River (10 km), and the Cikawung River (8 km), including the diversion of the Ciseel River into the Citanduy, will be constructed. An operations and maintenance system (O&M) will be established with five district maintenance offices, about a 50-man staff including trained management, and an adequate supply of equipment, transportation and communications facilities.

2. Irrigation and Drainage.

(a) The seven existing technical and semi-technical systems covering 12,447 ha will be rehabilitated. The rehabilitation includes major works (weir, primary and secondary canals, secondary drains, etc.), tertiary canals, and terminal irrigation networks;

(b) One new irrigation system covering 600 ha, including major works, tertiary canals, farm service ditches, and secondary drainage will be constructed;

(c) The existing major drains will be improved;

(d) The desilting basin at Pataruman diversion will be rehabilitated;

(e) Adequate O&M for the irrigation systems will be established;

(f) Viable water users' associations for all irrigation systems will be established; and

(g) An adequate number of trained people will be serving on the staff of the agriculture extension service in the project area.

3. On-Farm Developments. In addition to construction, the project provides for farmland developments, such as:

- (a) Terminal irrigation networks (quaternary canals and on-farm ditches);
- (b) Water management programs;
- (c) Soil conservation education programs;
- (d) Establishment and support to irrigation water users' associations; and
- (e) Improved irrigation operation and maintenance programs for the terminal irrigation networks.

In addition, the Ministry of Agriculture will receive technical assistance, training (in-country and overseas), and equipment for the project area.

INSTITUTIONAL

Several years ago, the GOI established the Citanduy Project Steering Committee composed of senior representatives from the concerned GOI ministries and directorates (Ministries of Public Works, Agriculture, Interior, and the Planning Board). This provides coordination at the top level. All construction aspects, other than the quaternary canals and farm service ditches, will be administered by the Project Officer in Banjar, which is under the Directorate General of Water Resources Development (DGWRD). The Project Office, which is GOI's special arrangement to administer projects of this type, has been functioning, since its establishment in 1969, in a limited way in repairing and constructing the flood control system. Construction will be done by Indonesian private contractors through competitive bidding. The equipment to be financed by the loan will be owned by DGWRD and provided to the contractors on a rental, lease or other appropriate basis.

The construction of the terminal irrigation systems (quaternary canals and farm service ditches), the establishment of water users' associations, and the operation and maintenance (O&M) of the terminal systems will be administered by the Agency for Agricultural Education, Training and Extension (AAETE), within the Ministry of Agriculture. The staff of the Subdirectorate for Land and Water Conservation (SLWC), a separate part of the Ministry of Agriculture, would provide technical help to AAETE in the design and construction of the terminal systems.

SOCIAL

When full production is reached, the equivalent of 2,500 permanent additional man-years of productive on-farm employment will

be created by the irrigation investments. During the five-year construction period, a total of about 40,000 man-years of unskilled temporary employment will be created.

FINANCIAL/ECONOMIC

A project budget is given on page 56 (attached).

IRR is 18% for the total project, and 18.2% for the irrigation and drainage subproject.

A sample farm budget (one hectare) is given on page 89 (attached). Donated farm labor will have a value of \$7.22/ha.

(1) AID. The AID \$12.5 million loan will directly finance the foreign exchange cost of:

- (a) Improved equipment for construction, operations and maintenance;
- (b) Supervision of construction;
- (c) Consultant services for feasibility studies, design work, and technical assistance; and
- (d) Overseas training.

AID will reimburse the GOI through FAR procedures for a portion of the local currency costs of:

- (a) Construction work on the flood control, levees, irrigation systems including terminal networks, and drainage (new and existing);
- (b) In-country training costs; and
- (c) Construction of terminal irrigation networks.

(2) GOI. The GOI will finance the following local currency costs:

- (a) Part of the construction costs;
- (b) Local currency costs of contracts for supervision of construction, feasibility studies and design work, and technical assistance;
- (c) Part of in-country training costs; and

(d) Part of costs of construction of terminal irrigation networks.

The GOI portion is estimated to be about \$12.8 million.

The GOI will also provide the rupiahs to finance initially those local currency costs which AID will reimburse under the FAR procedures. The GOI will provide adequate funding for O&M operations, extension services, and operation of the Project Manager Office. Agreement on the exact amounts to be provided will be a condition precedent for disbursement.

The GOI will provide adequate manpower for the Project Manager's Office, O&M, extension service activities, and counterparts as needed for consultants' technical assistance activities, studies and design work.

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Disbursement Schedule Total Project

(Thousands US\$)

	FY 77	FY 78	FY 79	FY 80	FY 81	Total
1. Construction	(2317)	(4272)	(3940)	(5456)	(2079)	(18064)
a. Flood Control - Levees	1950	2600	2600	2600	2079	11829
b. Flood Control - Siphon	--	--	--	481	--	481
c. Flood Control - Diversion	--	--	--	966	--	966
d. Irrigation - Rehabilitation	367	455	776	1260	--	2758
e. Irrigation - New	--	320	--	--	--	320
f. Major Drains	--	897	--	--	--	897
g. Secondary Drains	--	--	564	--	--	564
h. Desilting Basin	--	--	--	249	--	249
2. Consulting Services	(454)	(614)	(507)	(358)	(167)	(2100)
a. Supervising Engineer	105	250	220	358	167	1100
b. Technical Assistance	349	364	287	--	--	1000
3. Equipment for Construction	1800	--	--	--	--	1800
4. Training	100	175	85	--	--	--
5. Technical Assistance -						
Agriculture	66	155	155	44	--	--
6. Terminal Irrigation Systems	--	126	250	440	204	1020
7. Studies & Designs	(580)	(790)	(240)	--	--	(1610)
a. Upper Watershed Cropping	200	450	240	--	--	890
b. Sideraja Irrigation - Design	200	110	--	--	--	310
c. Banjar Irrigation - Design	55	25	--	--	--	80
d. C. Java Irrigation Feas. Study	60	--	--	--	--	60
e. C. Java Irrigation - Design	--	100	--	--	--	100
f. Upper Citanduy Irrig. Feas. Study	65	--	--	--	--	65
g. Upper Citanduy Irrig. - Design	--	105	--	--	--	105
Total	5317	6132	5177	6298	2450	25374

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Project Paper - Page 89

RICE CROP BUDGET
PROJECTED SITUATION FOR A 4 MT/HA. CROP

	<u>Rupiahs (000)</u>	<u>US \$</u> <u>Equivalent</u>
Gross Receipts		
Rice, 4 metric tons (rough rice)	250.8	604.30
Expenses		
hired labor (harvest), 26 days	7.7	18.55
seed, 30 kg	2.7	6.50
fertilizer: TSP, 75 kg	10.6	25.55
Urea, 200 kg	24.0	57.80
insecticide	2.1	5.05
rodenticide	0.2	0.50
custom plowing, buffalo, 25 hrs.	24.8	59.75
equipment costs	14.9	35.90
rice storage facility	<u>9.0</u>	<u>21.65</u>
Total expenses	96.0	231.30
Plus 10% contingency	<u>9.6</u>	<u>23.10</u>
	105.6	254.40
Net Income	Rp. 145.4	\$349.90

Based on the project yields with and without the project and the associated net income, it is projected that the total increase in annual net farmer income from rice production will equal Rp. 1,096 million (\$2.64 million) ten years after project initiation.

TITLE: First Irrigation Rehabilitation Project

REPORT NO.: IN-W-1

COUNTRY: Indonesia

REGION: Asia

KEYWORDS: System rehabilitation (5); surface irrigation (3); water users' association (3).

SUMMARY: In order to boost domestic production of rice, three existing irrigation systems in Java were rehabilitated and a new system was built in Sumatra.

LOCATION: Three subprojects on the north coast of Java, one in Sumatra.

CLIMATE: Ar

CROPS: Rice.

SOILS: Alluvial soils in Java, sandy silt in Sumatra.

TARGET GROUP: The irrigating farmer.

BEGIN: September 1968 END: March 31, 1977 AREA: 198K ha

NUMBER OF FARMS: 450K

CONTRIBUTION:	IDA Credit	US\$ 5.0M
	GOI and local farmer's share	49.0M
	TOTAL	<u>US\$ 54.0M</u>

GOALS: The project repaired three neglected irrigation systems in Java and assisted in the completion of a fourth in Sumatra. It demonstrated that reliable irrigation water is crucial in enabling farmers to achieve maximum benefits from the use of other related agricultural inputs. Actual rice production increased 160% from pre-project levels.

TYPE OF PROJECT: Rehabilitation of pre-WWII irrigation systems.

TECHNOLOGY USED: Heavy equipment used to expedite construction and repair of major canals and dams while labor worked on smaller structures.

DOCUMENTS REVIEWED: Project Completion Report, Appraisal Report.

PROJECT ORIGIN AND BASE LINE DATA: Pelita I, the first five year plan (1969-1974), placed a high priority on increased rice production. The initial step taken to meet this goal was the restoration of large existing irrigation systems.

BENEFICIAL INVOLVEMENT: GOI to establish water charges at a level consistent with the farmers' ability to pay. This would include all O&M costs.

GENERAL DESCRIPTION

Since the Second World War, many irrigation systems in Java have fallen into a state of disrepair. As a response to Indonesia's increasing reliance on imported rice, the GOI determined that the most suitable way to meet this drain on the country's balance of payments would be to refurbish old, but basically sound irrigation systems.

TECHNICAL

At credit closing, the following works had been completed: 570 km of primary canals; 1,100 km of secondary canals; 550 km of tertiary canals; 1,530 structures; 360 km of drains; and 300 km of access roads.

INSTITUTIONAL

The Directorate General of Water Resources Development within the Ministry of Public Works was responsible for execution of the project. Once the project works were completed, the O&M of all subprojects were handed over to the respective provincial governments. Water Users' Associations have been formed on all tertiary units for operation and maintenance of the units, also Irrigation Advisory Committees have been established in all subproject areas for coordinating the provision of water and other inputs.

SOCIAL

The Sumatra subproject is a transmigration settlement where Javanese are resettled to a less densely populated island. General income redistribution and employment generation were not explicit objectives of the project, however, it is clear that most project benefits accrued to families having small landholdings.

FINANCIAL/ECONOMIC

In spite of cost overruns, the ERR of 50% given in the project appraisal is also the estimate put forth in the project completion reports. This reason for this agreement is that increases in yields were considerably greater than those forecast at appraisal and these were coupled with a boom in market prices. Because this is the first project of this type undertaken by the World Bank in Indonesia, cost recovery estimates were not given since the beneficiaries' ability to repay was unknown.

INDONESIA
FIRST IRRIGATION REHABILITATION PROJECT

Basic Data Sheet

<u>AMOUNT</u>	<u>Original</u>	<u>Disbursed</u>	<u>Cancelled</u>
	US\$5,000,000	US\$4,987,972	US\$12,028
<u>PROJECT DATA</u>	<u>Original Plan</u>	<u>Revisions</u>	<u>Actual</u>
First attention - Bank Files			Jan 19, 1968
Board Approval	Sept 3, 1968		Sept 3, 1968
Credit Agreement	Sept 6, 1968	Dec. 22 1970 (reallocation of proceeds) July 27, 1978 (reallocation of proceeds)	Sept 6, 1968
Credit Effectiveness	Jan 1, 1969	Feb 4, Feb 28, 1969	March 28, 1969
Last Disbursement			March 9, 1977
Credit Closing	June 30, 1974	Dec 31, 1975; Dec 31, 1976 (delayed to enable procurement of parts)	March 25, 1977
Total cost (US\$ million)	8.8	Dec 1969- US\$20-25 million June 1970- US\$31 million Nov. 1975- US\$47 million Dec 1975- US\$56.8 million	US\$54.0 including US\$4.3 million of additional works to be executed with local funds.
Economic Rate of Return (%) (by subproject)	37 Glapan Sedadi 56 Rentang 41 Cisedane 47 Way Seputih		39 Glapan Sedadi 68 Rentang 58 Cisedane 31 Way Seputih

MISSION DATA

	<u>Month/Year</u>	<u>No. Persons</u>	<u>Man-weeks*</u>	<u>Date of Report</u>
Appraisal	March 1968	4	12	Aug 14, 1968
Supervision I	July 1969	4	4	Sept 8, 1969
II	January 1970	2	2	Jan 16 1970
III	March/April 1970	2	4	May 28, 1970
IV	Sept 1970	2	4	Oct 12 1970
V	May/June 1971	2	3	July 9 1971
VI	February 1972	2	3	April 19 1972
VII	Oct/Nov 1972*	2	3	Jan 3 1973
VIII	April/May 1974	2	2	June 4 1974
IX	Jan/Feb 1975	4	2	April 4 1975
X	November 1975	4	3	Jan 27 1976
XI	Aug/Sept 1976	5	3	Oct 18, 1976

Basic Data Sheet (Continued)

	<u>Month/Year</u>	<u>No. Persons</u>	<u>Man-weeks*</u>	<u>Date of Report</u>
Project Review				
Mission	March 1974	8	4	April 15, 1975
Completion	March 1977	3	<u>3</u>	May __ 1977
		Total	52	

*From 1971 onwards supervision missions also supervised other rehabilitation projects in Indonesia. Project Review Mission reviewed all ongoing irrigation rehabilitation projects in Indonesia. Supervision from November 1972 to April 1974 was performed by Irrigation Engineer assigned to Resident Mission, Jakarta.

FOLLOW-ON PROJECTS, prepared by consultants engaged under Credit 127-IND.

Credit 220IND of US\$14.5 million for the third rehabilitation Project covering 202,000 ha.

INDONESIA
FIRST IRRIGATION REHABILITATION PROJECT

Schedule of Disbursements

<u>IBRD/IDA fiscal year and quarter</u>	<u>Appraisal estimate^{a/}</u>	<u>Actual Disbursement</u>
	----- <u>US\$ million</u> -----	
<u>1968/69</u>		
1st		
2nd		
3rd	0.16	
4th	0.31	0.31
<u>1969/70</u>		
1st	0.46	1.78
2nd	2.77	1.95
3rd	2.98	2.06
4th	3.18	2.35
<u>1970/71</u>		
1st	3.38	2.42
2nd	3.78	2.57
3rd	3.88	2.69
4th	3.93	2.92
<u>1971/72</u>		
1st	4.08	3.17
2nd	4.18	3.40
3rd	4.28	3.64
4th	4.38	4.10
<u>1972/73</u>		
1st	4.48	4.29
2nd	4.58	4.53
3rd	4.68	4.74
4th	4.78	4.74
<u>1973/74</u>		
1st	4.88	4.79
2nd	4.98	4.80
3rd	5.00	4.81
4th		4.82
<u>1974/75</u>		
1st		4.82
2nd		4.86
3rd		4.87
4th		4.90
<u>1975/76</u>		
1st		4.92
2nd		4.95
3rd		4.97
4th		4.97

Schedule of Disbursements (Continued)

IBRD/IDA fiscal year and quarter	Appraisal estimate ^{a/} ----- US\$ million -----	Actual Disbursement -----
<u>1976/77</u>		
1st		4.97
2nd		4.97
3rd		4.99
Closing Date	6/30/74	3/25/77
Undisbursed balance of US\$12,027 was cancelled		

a/ No estimate given in appraisal report. Figures shown are projected at the time of credit signing.

TITLE: Second Irrigation Rehabilitation Project

REPORT NO.: IN-W-2

COUNTRY: Indonesia

REGION: Asia

KEYWORDS: System rehabilitation (5); surface irrigation (3); water-course and canal lining (3); water users' association.

SUMMARY: The project concentrated on the repair and completion of the Djatiluhur system, the largest in Indonesia.

LOCATION: Java.

CLIMATE: Ar.

CROPS: Rice.

SOILS: Alluvial deposits and volcanic mud flows.

TARGET GROUP: The irrigating farmer.

BEGIN: 1970 END: 1978 AREA: 200K ha

NUMBER OF FARMS: 200K

CONTRIBUTION:	World Bank	US\$ 18.5M
	GOI	US\$ 59.4M
	TOTAL	<u>US\$ 77.9M</u>

GOALS: To provide reliable irrigation water so that farmers may realize the maximum benefits from the use of other related agricultural inputs.

TYPE OF PROJECT: Large-scale irrigation system rehabilitation.

TECHNOLOGY USED: Both machinery and labor used in repair and construction of canals, roads, dams and pumping plants.

DOCUMENTS REVIEWED: Appraisal Report, Project Completion Report.

PROJECT ORIGIN AND BASE LINE DATA: Pelita I, the first five year plan (1969-1974) placed a high priority on increased rice production. The initial step taken to meet this goal was the restoration of large existing irrigation systems.

BENEFICIARY INVOLVEMENT: The GOI is to establish water charges at a level consistent with the farmer's ability to pay. In principle, this would include all O&M costs.

ACTUAL STARTING DATE: 1970

COMPLETION DATE: March 1979

GENERAL DESCRIPTION

Since the Second World War, many irrigation systems in Java have fallen into a state of disrepair. As a response to Indonesia's increasing reliance on imported rice, the GOI determined that the most suitable way to meet this drain on the country's balance of payments would be to refurbish old, but basically sound irrigation systems and to modify and extend newer projects.

TECHNICAL

Irrigation II consisted of:

1. Rehabilitation and improvement of the Curug barrage and pumping plants, main canals and irrigation distribution systems, and construction of drains, flood protection works, roads and telecommunication facilities in the Jatiluhur command area;
2. Rehabilitation and improvement of tertiary canals in the area;
3. A study of the optimum utilization of the reservoir and unregulated water supplies in other rivers.

INSTITUTIONAL

The Djatiluhur project is administered by the Djatiluhur Authority, a multipurpose, semiautonomous body responsible to the Ministers for Economy, Finance and Industry and advised by a council consisting of the Ministers of Public Works, Home Affairs, Finance and Agriculture. The Authority receives all of its development funds from the Directorate General of Water Resources Development (DGWRD), however, it has considerable flexibility in how it dispenses this money. Water Users' Associations (WUA) are responsible for O&M below the secondary canal outlet usually employing a water master to oversee the day-to-day allocation of water. Farmers contribute a share of their harvest to defray the costs incurred by the WUA.

SOCIAL

The majority of project benefits accrued to the 80%-90% of the project population who are in the poverty target group.

FINANCIAL/ECONOMIC

Beneficiary analysis at Djatiluhur indicates that 80%-90% of the project's beneficiaries have income at or below the critical consumption level and should not be expected to contribute to cost recovery.

Although project costs were of the order of 100% above appraisal estimates, higher than expected yields and a boom in the world price of rice caused the Project Completion Report to give an ERR of 53% while the Appraisal estimate had been 45%.

INDONESIA

Irrigation II: Estimated and Actual Project Costs

	<u>Appraisal Estimates</u>		<u>Actual Expenditures</u>		<u>% Overrun^{b/}</u>
	<u>Rp million</u>	<u>US\$ million</u>	<u>Rp million</u>	<u>US\$ million</u>	
Land acquisition	110	0.29	2,098	5.1	1,650
Rehabilitation works					
Construction	(7,205)	(19.07)	(21,768)	(52.7)	
O&M during construct.	<u>c/</u>	<u>c/</u>	(5,979)	(14.4)	
Subtotal	<u>7,205</u>	<u>19.07</u>	<u>27,747</u>	<u>67.1</u>	<u>252</u>
Maintenance					
Equipment	765	2.02	309	0.7	-65
Consultants ^{d/}					
Services ^{d/}	1,190	3.21	1,365	3.3	2
Administration and					
Overhead	1,150	3.01	691	1.7	-43
Contingencies	3,555	9.40	--	--	--
<u>Total Project Cost</u>	<u>13,975</u>	<u>37.00</u>	<u>32,210</u>	<u>77.9</u>	<u>110</u>

a/ Financial costs expressed in current values.

b/ In dollars costs.

c/ Not separately estimated at appraisal.

d/ Includes funding for design of Irrigation III works (US\$420,000).

TITLE: Irrigation Rehabilitation Project III

REPORT NO.: IN-W-3

COUNTRY: Indonesia

REGION: Asia

KEYWORDS: System rehabilitation (5); surface irrigation (3);
water users' association (3).

SUMMARY: In order to boost domestic production of rice, three existing irrigation systems were repaired and improved.

LOCATION: Java and Sulawesi.

CLIMATE: Ar.

CROPS: Rice, primarily, also soybeans, chillies, casava and vegetables.

SOILS: Alluvial and volcanic.

TARGET GROUP: The irrigating farmer.

BEGIN: 1970 END: December 1978 AREA: 200K

NUMBER OF FARMS: 260K

CONTRIBUTION:	World Bank	US\$14.5M
	GOI	US\$50.6M
	TOTAL	<u>US\$65.1M</u>

GOALS: 1. To provide reliable irrigation water so that farmers may realize the maximum benefits from the use of other related agricultural inputs.

2. To increase annual rice production by 123,000 tons in seven years.

TYPE OF PROJECT: Repair and improvement of surface irrigation systems.

TECHNOLOGY USED: Both machinery and labor used in repair and construction of canals, roads, and drainage works.

DOCUMENTS REVIEWED: Appraisal Report, Project Completion Report.

PROJECT ORIGIN AND BASE LINE DATA: Pelita I, the first five year plan (1969-1974), placed a high priority on increased rice production. The initial step taken to meet this goal was the restoration of large existing irrigation systems.

BENEFICIARY INVOLVEMENT: The GOI is to establish water charges at a level consistent with the farmers' ability to pay. In principle, this will include all O&M costs and a portion of the capital cost.

ACTUAL STARTING DATE: 1971

COMPLETION: December 1979

GENERAL DESCRIPTION

Since the Second World War, many irrigation systems in Java have fallen into a state of disrepair. As a response to Indonesia's increasing reliance on imported rice, the GOI determined that the most suitable way to meet this drain on the country's balance of payments would be to refurbish old, but basically sound irrigation systems.

TECHNICAL

Irrigation III included:

1. The rehabilitation and improvement of the Ciujung and Pemali-Comal irrigation systems on Java and of the Sadang system in South Sulawesi, including tertiary development, drainage and roads; and
2. The setting up of suitable operation and maintenance organizations.

INSTITUTIONAL

PROSIDA (Projek Irigasi IDA) was established within the Directorate General of Water Resources Development (DGWRD) with the sole duty of executing IDA-financed (and later Bank-financed) irrigation rehabilitation projects. PROSIDA, in close association with the Provincial Irrigation Services, is responsible for executing project works and will turn the projects over to the Provincial Services after rehabilitation.

Responsibility for O&M of the systems below the secondary canal outlet belongs to the water users' associations (WUA) within the systems. Most WUA's have appointed full-time water masters who allocate water on a day-to-day basis and to carry out needed routine repairs. Farmers contribute a share of their harvest to defray the costs incurred by the WUA.

SOCIAL

The majority of project benefits accrued to the 80%-90% of the project population who are in the poverty target group.

FINANCIAL/ECONOMIC

The beneficiaries are to bear the full cost of O&M through the collection of water charges.

Although project costs were on the order of 100% above appraisal estimates, a boom in the world price of rice caused the Project Completion Report to give an ERR of 44% while the appraisal estimate had been 37%.

INDONESIA

Irrigation III: Estimated and Actual Project Costs^{a/}
(Current US\$ million)

	Appraisal					%
	Estimate	Actual Expenditures				
	March 1970	Ciujung	Pemali- Comal	Sadang	Total	
<u>Civil Works^{b/}</u>						
Barrages, weirs & canal structures	5.80	4.07	15.44	3.02	22.53	
Canal & drainage earthworks	6.50	1.05	4.69	7.68	13.52	
Roads, offices, buildings, camps & communication	2.00	1.00	2.17	1.91	5.08	
O&M during construction	1.40	0.54	1.03	0.77	2.34	
Administration	2.90	1.13	2.52	1.93	5.58	
Pilot tertiary units	--	0.42	0.59	0.21	1.22	
Land acquisition	--	0.18	0.17	0.91	1.26	
O&M equipment	1.30	0.61	1.27	0.95	2.83	
Survey & Design	--	0.29	0.37	0.30	0.96	
Subtotal	<u>19.90</u>	<u>9.29</u>	<u>28.25</u>	<u>17.68</u>	<u>55.22</u>	<u>178</u>
<u>Management</u>						
Roads, offices, buildings, camps & communication	--	0.04	0.11	0.06	0.21	
O&M during construction	--	0.07	0.15	0.11	0.33	
Survey & design	--	0.62	1.39	0.85	2.86	
Consultant services	2.30	0.36	1.31	0.89	2.56	
Machinery, equipment & vehicles	--	0.41	1.33	0.83	2.57	
Administration/overhead	0.30	0.26	0.67	0.41	1.34	
Subtotal	<u>2.60</u>	<u>1.76</u>	<u>4.96</u>	<u>3.15</u>	<u>9.87</u>	<u>280</u>
Physical contingencies	4.40	--	--	--	--	
Price contingencies	2.30	--	--	--	--	
Subtotal	<u>6.70</u>	--	--	--	--	
TOTAL	<u>29.20</u>	<u>11.05</u>	<u>33.21</u>	<u>20.83</u>	<u>65.09</u>	<u>123</u>

^{a/} Financial costs expressed in current values.

^{b/} Appraisal estimates include tertiary structures and first 50m of tertiary canals.

PROJECT ORIGIN AND BASE LINE DATA: Engineering design and economic analysis for all subprojects have been completed by the ADC.

BENEFICIARY INVOLVEMENT: Farmers will contribute labor to the principal workers, complete the system on their own fields, and provide O&M through farmer associations.

ACTUAL STARTING DATE: July 1974

COMPLETION DATE: N/A

LOGICAL FRAMEWORK: None given.

PERT CHART: None given.

GENERAL DESCRIPTION

The Agricultural Development Corporation (ADC) of the Ministry of Agriculture and Fisheries has begun construction of 88 small to medium-scale projects. The range of sizes is 70-6,000 ha, and the average is 750 ha. This AID loan will finance approximately 50% of the costs of completing up to 66 such projects, chosen on the basis of IRR.

TECHNICAL

The projects, of medium scale, are designed by ADC and constructed by private contractor, who will sometimes rent ADC machinery.

The works to be provided vary with each project, but may include additional pumping plants, canals, reservoirs, or drainage works. The Project Paper does not provide information on the technical aspect of the project.

INSTITUTIONAL

The ADC has designed the projects, and will let bids and provide continuous inspection of the work. The engineering staff of ADC is considered to be well-equipped to handle this job.

The projects will be operated by Farm Land Improvement Associations (FLIA), which will maintain and manage all aspects of the system, including collection of water charges and debt-servicing of the systems after completion of construction.

SOCIAL

The project is labor-intensive and will provide employment in the rural areas.

FINANCIAL/ECONOMIC

Of the 88 subprojects proposed by ADC, AID will finance only those with IRR = 22% or greater. Twenty-two percent is approximately the cost of capital in Korea. Thus, there remain 66 subprojects with a range of IRR from 22% to 123%, with most of them below 85%. The IRR does not include the sunk costs which have been invested for previous work on the projects. The IRR is quite sensitive to changes in the price of rice and barley; a reduction of 15% in prices will halve the IRR.

Total cost of completing the 66 subprojects is \$65.3M. AID will contribute \$17.2M and ROKG will contribute 15.2M of this amount. Thus, not all of the 66 subprojects will be completed under this loan.

AID will disburse up to 75% of the cost of any subproject. The funds will be disbursed when the subproject is certified complete, on an actual cost reimbursement system.

Contractors submit bids which must have costs within a fixed range of unit costs published by the ROKG. New prices are negotiated each year as mediated by the government.

Farmers contribute labor to jointly-used irrigation structures at a value of about 10% of capital costs. Average farm incomes will increase about 125%, or about \$412.

TITLE: Agricultural Development - Irrigation

PROJECT NO.: 439-0065.3

COUNTRY: Laos

REGION: Asia

KEYWORDS: Small-scale irrigation (3); pumps (1).

SUMMARY: The project was intended to:

1. Construct small-scale irrigation systems throughout Laos;
2. Provide training to the RLG Irrigation Service to give it the capability for design, construction, and O&M of irrigation facilities.

LOCATION: N/A

CLIMATE: Aw

CROPS: N/A

SOILS: N/A

TARGET GROUP: N/A

BEGIN: 1964. END: 1979. AREA: 15.9K ha

NUMBER OF FARMS:

CONTRIBUTION: USAID \$4.772M through FY 1970.

- GOALS:
1. To strengthen the domestic Lao economy and also to save foreign exchange through increasing agricultural production.
 2. To administratively and technically upgrade the RLG irrigation service to enable it to plan, design, construct, operate and maintain an adequate irrigation program in accord with available Lao resources and to assist the RLG to develop the laws needed to support such a program.
 3. To help establish a broad base of popular support for the RLG by improving the economic lot of the people, especially by increasing the returns to farmers.

PURPOSE: Not given.

TYPE OF PROJECT: Implementation of small-scale irrigation; institution-building.

TECHNOLOGY USED: Not given.

DOCUMENTS REVIEWED: Three Project Appraisal Reports: January 1969, December 1969, August 1970; about 20 pages each.

PROJECT ORIGIN AND BASE LINE DATA: N/A

BENEFICIARY INVOLVEMENT: N/A

ACTUAL STARTING DATE: 1964

COMPLETION DATE: N/A

LOGICAL FRAMEWORK: N/A

PERT CHART: N/A

GENERAL DESCRIPTION

This project summary is based on three Project Appraisal Reports, which contain only limited information.

TECHNICAL

Over 170 small projects have been constructed (August 1970), ranging from a few hectares up to around 200 ha. One larger project, the Nam Tan, will irrigate about 3,000 ha in the wet season of which 1,000 ha will have a full supply in the dry season. Several other larger projects are being investigated.

In addition to about 200 small pumps being used for supplemental irrigation by individual farmers, 42 pumps capable of irrigating 800 ha were in use during the 1969 dry season.

Total land receiving wet season supplemental irrigation is 15,900 ha and, of this, 7,600 ha can also be irrigated in the dry season.

Fifty-one employees of the Irrigation Service and related technicians will receive degree training, 63 will receive three-year certificate training, and 600 will receive Aide training. As of August 1970, the output has been 228 men receiving Elementary Aide training, and 72 men receiving Advanced Aide training.

INSTITUTIONAL

The implementing agency is International Voluntary Services (IVS).

SOCIAL

A major constraint to the progress of this project was the worsening security situation.

TITLE: Muda River Irrigation Project

REPORT NO.: M-W-1

COUNTRY: Malaysia

REGION: Asia

KEYWORDS: Operation and maintenance (5); farmers' associations (5).

SUMMARY: The construction of two dams provides reservoirs from which irrigation water is diverted. These diversions supplement normal rainfall to enable farmers to grow two crops of rice during the year. Computerized scheduling of reservoir releases is used.

LOCATION: States of Kedah and Perlis.

CLIMATE: Ar

CROPS: Rice.

SOILS: Deep alluvial deposits of clays and silts.

TARGET GROUP: The irrigating farmer.

BEGIN: February 1, 1966 END: December 31, 1973. AREA: 98K ha

NUMBER OF FARMS: 61K.

CONTRIBUTION:	World Bank	US\$ 45.0M
	GOM	US\$ 61.5M
	TOTAL	<u>US\$106.5M</u>

GOALS: To introduce perennial irrigation to the whole Kedah-Perlis Plain, through construction of a storage reservoir on the Muda and the upgrading and extension of the drainage and irrigation systems.

TYPE OF PROJECT: Large-scale construction and rehabilitation of dams, canals and drainage facilities.

TECHNOLOGY USED: Heavy machinery used in construction of dams, tunnels, canals, tide gates, and roads.

DOCUMENTS REVIEWED: Project appraisal, completion reports, and performance audit report.

PROJECT ORIGIN AND BASE LINE DATA: Developed in accordance with the policy of attaining self-sufficiency in rice production through construction of irrigation systems to serve traditional rainfed paddy areas.

BENEFICIARY INVOLVEMENT: Very little actual farmer involvement, although land taxes and water rates are to be raised.

ACTUAL STARTING DATE: April 1966

GENERAL DESCRIPTION

Since about 1900, it has been Government policy to provide, wherever possible, irrigation and drainage to existing paddy areas, primarily to insure the main-season crop against losses and secondarily to permit double cropping. The Muda Project is a large-scale effort to employ this policy as a means of permitting Malaysia to achieve self-sufficiency in rice production.

TECHNICAL

The major project works include: the Muda and Pedu Dams, of concrete and rockfill construction respectively; a tunnel connecting them; a headworks and main canal system; improvement of the existing canals, and construction of new distributary canals; drainage construction and ancillary works. No provision was made for on-farm works. The project has a rather elaborate, computer-controlled operations system for estimating diversion requirements.

INSTITUTIONAL

The Muda Agricultural Development Authority (MADA) is a semi-autonomous agency responsible for operating the irrigation system and for supplying agricultural services to the farmers. MADA is statutorily responsible to the Minister of Agriculture and Rural Development and, having no revenue of its own, is also under the budgetary control of the Ministry of Finance. However, MADA, in fact, enjoys considerable independence, as a result of its achievements and prestige. MADA's operating budget for 1974 came to US\$53/ha.

SOCIAL

The overall distribution of farm income worsened during the period 1966-1972, while the distribution of farm size improved. The introduction of double cropping has substantially increased the total farm labor output.

FINANCIAL/ECONOMIC

The final project cost was US\$840/ha, 7% above the appraisal estimate. This overrun was entirely accounted for by extra works added to the project. In spite of the higher project cost, the completion report gives an ERR of 18% as opposed to the Project Appraisal's estimate of 10%. The recovery of funds through water charges and land taxes is well below the actual rate of O&M expenditure.

MALAYSIA
MIDA IRRIGATION PROJECT

Cost Estimates^{a/}

<u>Item</u>	<u>Appraisal Report</u> October 14, 1965	<u>Final Cost Estimate</u> Mid-1973
	----- M\$ million	-----
<u>Major Works</u>		
Muda Dam	15.3	23.38
Pedu Dam	33.3	23.13
Saiong Tunnel	19.3	14.05 ^{b/}
Main Canals	38.9	61.10 ^{b/}
Access Roads ^{c/}	9.0	9.61 ^{d/}
Reservoir Clearing	5.0	**
River Improvements	0.8	0.03 ^{e/}
Subtotal	121.6	131.30
<u>Distribution System</u>		
Irrigation and Drainage	58.3	59.12
Coastal Dikes	2.1	5.19
Link Roads	--	4.93
Additional Works ^{f/}	--	4.88
Control Scheme	0.6	1.60
Booster Stations	--	0.27
Subtotal	61.0	75.99
<u>Agricultural Development</u>		
Credit Survey	--	0.85
Farmers' Development Centers	--	6.91
Subtotal	--	7.76
<u>Overheads</u>		
Design and Supervision	--	
--Consultants ^{g/}	--	13.70 ^{h/}
--DID	8.1	3.06
Housing and Offices	**	3.59
Commissioning	**	2.48
O&M Equipment	4.4	3.24
Subtotal	12.5	26.07

Cost Estimates (Continued)

<u>Item</u>	<u>Appraisal Report</u> October 14, 1965	<u>Final Cost Estimate</u> Mid-1973
	----- M\$ million -----	
<u>Total Capital Cost</u>	195.1	241.12
Contingencies	28.4 ^{i/}	*
O&M During Construction	5.1 ^{i/}	3.45 ^{i/}
<u>Total Project Cost</u>	228.6	244.57
Interest During Construction	20.7	25.80
GRAND TOTAL	249.3	270.37

a/ Both columns exclude costs prior to appraisal. As several sources of information, using different categories, have been used in compiling this table, the total differs from some published figures.

b/ Includes land acquisition of M\$2.5 million.

c/ Constructed by Public Works Department.

d/ Little clearing was carried out.

e/ Most of the river improvement works were postponed.

f/ Includes: repairs, drainage improvements and pilot projects for on-farm development.

g/ Consultants were not listed separately in the Appraisal Report cost estimate - possibly they were included in the civil works items.

h/ Costs of M\$1.8 million for planning and design prior to 1966 excluded.

i/ Figure of M\$9.5 million apparently includes equipment (M\$4.4 million).

j/ Includes DID costs through 1973. Additional State costs of M\$11.6 million are excluded, as these would have been incurred without the project.

MALAYSIA

LOAN 434-MA: MUDA IRRIGATION PROJECT

Allocation of Loan Proceeds

<u>Category</u>	<u>Allocation</u> US\$	
	<u>Original</u> Nov. 17, 1965	<u>Final</u> Aug 22, 1973
1. Civil Works	\$ 29,400,000	\$ 33,914,129
2. Operating and Maintenance and Communications Equipment	1,900,000	846,711
3. Consulting Services	2,600,000	1,639,160
4. Interest and Other Charges during Construction	6,900,000	8,600,000
5. Unallocated	4,200,000	00
Total	<u>\$, 45,000,000</u>	<u>\$ 45,000,000</u>

TITLE: Kemubu Irrigation Project

REPORT NO.: M-W-2

COUNTRY: Malaysia

REGION: Asia

KEYWORDS: Farmers' associations (5); pumps (3); surface irrigation (3).

SUMMARY: A diesel pumping station provides water to achieve double cropping of rice over an area of 19,000 ha.

LOCATION: Kelantan State.

CLIMATE: Ar

CROPS: Rice

SOILS: Alluvial sandy clay to clay loam.

TARGET GROUP: The irrigating farmer.

BEGIN: June 1967 END: December 1973 AREA: 19K ha

NUMBER OF FARMS: 22K

CONTRIBUTION:	World Bank	US\$10.0M
	GOM	US\$18.7M
		<hr/>
	TOTAL	US\$28.7M

GOALS: The project was designed to intensify the cropping pattern from partially irrigated single cropping of rice to total double cropping; in this objective it has succeeded, as paddy production has grown from 24,000T in 1967 to 77,000T in 1974, and is expected to reach 98,000T in 1980.

TYPE OF PROJECT: Medium-scale construction of canals, pumping stations and support works.

TECHNOLOGY USED: Concrete-lined canals, laterite-based roads, diesel powered pumps.

DOCUMENTS REVIEWED: Project appraisal, completion report and performance audit report.

PROJECT ORIGIN AND BASE LINE DATA: Developed in accordance with the policy of attaining self-sufficiency in rice production through construction of irrigation systems to serve traditional rainfed paddy areas.

BENEFICIARY INVOLVEMENT: Very little actual farmer involvement although land taxes and water rates are to be raised.

GENERAL DESCRIPTION

Since about 1900, it has been Government policy to provide, wherever possible, irrigation and drainage to existing paddy areas, primarily to insure the main-season crop against losses and, secondarily, to permit double cropping. The Kemubu project is a medium-scale effort to employ this policy as a means of permitting Malaysia to achieve self-sufficiency in rice production.

TECHNICAL

The project works consist of a diesel-pumping station on the Kelantan River, a canal system to serve 19,000 ha, drainage and flood control works, and ancillary facilities. Quaternary canals, which serve units of about 20 ha, were originally intended to be constructed by the farmers, however, this was found to be impracticable and quaternaries for about 40% of the area were added by the government.

INSTITUTIONAL

In 1973, the Kemubu Agricultural Development Authority (KADA) was set up as a semiautonomous agency responsible for operating the irrigation system and supplying agricultural services to the farmers. KADA is statutorily responsible to the Minister of Agriculture and Rural Development and, having no revenue of its own, is also under the budgetary control of the Ministry of Finance. KADA's operating budget for 1974 came to US \$69/ha, however, the high cost of operating the pumping stations absorbed a significant portion of these funds.

The formation of Farmers' Associations has been encouraged to develop self-governing, self-financing organizations which would provide credit, marketing services and extension advice to their members. Cooperatives and Farmers' Associations are being brought together to form Farmers' Organizations which are to be independent of KADA.

SOCIAL

Under pre-project conditions, about 97% of the project area families had incomes below the national 40-percentile level. Although it is unlikely that the project has significantly improved income distribution within the project area, it is clear that its national impact has been progressive.

ECONOMIC

The final project cost was US \$1,160/ha, 27% above the appraisal estimate. The Appraisal Report also predicted an ERR of 13.0%, whereas the Completion Report gives a value of 10.5%. The recovery of funds through water charges and through land taxes is well below the actual rate of O&M expenditure.

MALAYSIA
LOAN 500-MA: KEMUBU IRRIGATION PROJECT
Cost Estimates

<u>Item</u>	<u>Appraisal Report</u>	<u>Final Cost Estimate</u>
	March 31, 1967	Mid-1973
	M\$ million	
Design ^{a/}		1.300
Land Acquisition	4.149	11.600
Civil Works - Pumphouse	3.500	1.800
-Flood Protection Dikes	0.401	0.496
-Irrigation	28.750	19.000
-Structures and misc.	***	10.383
-Quaternary canals and roads ^{b/}	--	3.367
-Drainage	4.302	9.414
-Diversion Dams	1.754	0.390
-Service to 800 ha ^{c/}	1.200	--
-Building for O&M	0.720	0.900
-Farmers' Development Centers ^{b/}	--	1.300
Equipment - Pumping Stations	3.500	2.700
-Booster Pumps ^{d/}	--	0.225
-O&M Equipment	0.363	0.480
Subtotal	48.639	63.355
Supervision of Construction	1.300	2.889
Physical Contingency ^{e/}	1.750	--
Total Project Cost	51.689	66.244
Equivalent in US\$ million at exchange rate of M\$3.00 = US\$ 1.00 ^{g/}	17.230	22.081
Interest During Construction	1.286	1.306
GRAND TOTAL (US\$ million)	18.516	23.387

^{a/} Cost of design by consultants in 1963 and 1964 not included in appraisal cost estimate.

^{b/} Not included in project at appraisal.

^{c/} Three pump stations; civil works cost included under "irrigation"; pumps included under equipment."

^{d/} Two of the five pump stations not included in project at appraisal but later found to be least cost solution to serve certain areas.

^{e/} No price contingencies included.

^{f/} Does not include possible contractors' claims.

^{g/} Approximate exchange rate from 1963-1971, during which time the major part of expenditure took place.

MALAYSIA

LOAN 500-MA: KEMUBU IRRIGATION PROJECT

Allocation of Loan Proceeds

<u>Category</u>	<u>Allocation</u> <u>-----US\$-----</u>	
	<u>Original</u> <u>June 15, 1967</u>	<u>Final</u> <u>January 21, 1974</u>
1. Civil Works	\$ 7,626,00	\$ 8,385,090.31
a) Canals and Control Works	*	7,250,812.86
b) Pumping Equipment	*	1,134,277.45
2. Operating and Maintenance Equipment	121,000	0
3. Consulting Services	433,000	309,240.14
4. Interest and Other Charges during Construction	1,286,000	1,305,669.55
5. Unallocated	534,000	0
Total	<u>\$10,000,000</u>	<u>\$10,000,000.00</u>

TITLE: Small-Scale Irrigation I

PROJECT NO.: 492-0274

COUNTRY: Philippines

REGION: Asia

KEYWORDS: Farmer associations (5); credit (1); pumps (1).

SUMMARY: The project will increase small farmer income by organizing them into small-scale Irrigators' Service Associations (ISA's), to set up small irrigation systems for more efficient use of water resources. The farmers will learn improved farming, processing and marketing practices, as well as technology to maximize labor, capital and land utilization.

LOCATION: Various provinces.

CLIMATE: Ar.

CROPS: Rice.

TARGET GROUP: Irrigator's Service Associations (farmers).

BEGIN: 1976 END: 1978 AREA: 40K ha

NUMBER OF FARMS: 25,000.

CONTRIBUTION:	USAID	\$ 7.3M
	GOP	11.6M
	TOTAL	<u>\$18.9M</u>

GOALS: To increase rice production in order to reach and maintain self-sufficiency by 1977.

PURPOSE: To increase small farmer income in the project areas.

TYPE OF PROJECT: Large-scale institution-building.

TECHNOLOGY USED: Simple technologies.

DOCUMENTS REVIEWED: Project Paper (150 pp).

PROJECT ORIGIN AND BASE LINE DATA: The Farm Systems Development Corporation has been organizing ISA's since 1974.

BENEFICIARY INVOLVEMENT: High.

GENERAL DESCRIPTION

The project is organized into three phases, expected to last 10 years and cost a total of \$286M. Only the first phase has been planned in detail; AID will underwrite \$7.3M of the \$18.9M costs of this first phase, expected to last three years. The three phases are:

1. Organization of the ISA's and construction of the irrigation systems;
2. Training of the ISA management, debugging of the irrigation systems, introduction of improved production methods (fertilizers, herbicide); and
3. Introduction of post-harvest processing and marketing methods, and possible crop diversification.

TECHNICAL

The following projects are eligible for financing by FSDC:

1. Farm support facilities (irrigation systems, storage facilities, sprayers, grain dryers, threshers);
2. Farm mechanization (hand tractors, power tillers).
3. On-farm transportation equipment (new and used trucks, jeeps and trailers);
4. Modernization, restoration or enlargement of any of the above items.

The FSDC will investigate and design the irrigation facilities. The leaders of the ISA's will be given extensive training in organizational management and the ISA members will be trained in irrigation system operation, production and post-harvest methods.

INSTITUTIONAL

Formation. Irrigators' Services Associations (ISA), consisting of about 100 farmers each, will be formed. These will provide a channel for credit and irrigation training to the farmer; they will be considered as the focus of agricultural development by all government and private organizations. The primary objective of the ISA's will be introduction of small irrigation systems, to improve rice yield and allow double cropping. It is believed that smaller systems will be more successful than the previous large-scale systems.

In the past two years, FSDC has organized 256 ISA's, incorporating 14,000 farmers, 6,500 ha, and 44 pumps.

Development. The FSDC will be enlarged to serve double the present number of farmers, and much more credit will be available.

Support. Coordinated assistance is expected from the National Electrification Administration, the National Irrigation Administration, the Provincial Development Assistance Program, and USAID.

ECONOMIC

A summary of yearly disbursements is given on page 2 (attached).

The IRR on similar previous projects (channeled through ISA's) was 129% average.

Economic cost data is given for: operating costs and revenues for a one-and-one-half hectare farm (pp. 115-125); cost of irrigation systems (p. 148); operating costs for irrigation (p. 166).

Project Paper - Page 2

a. Project Costs

<u>Funding Category</u>	<u>(\$ or \$ Equivalent in M) Disbursement Period</u>			<u>Total Disbursement</u>
	<u>FY 76</u>	<u>FY 77</u>	<u>FY 78</u>	
<u>AID Loan Inputs</u>				
Commodities (FX)	1.4	--	--	1.4
Credit				
Program (LC)				
i. Pumpsets	0.7	0.7	--	1.4
ii. Rehabilitation	0.7	1.1	--	1.8
iii. Farm Support				
Systems	--	0.7	0.7	1.4
iv. Gravity Systems	0.2	0.3		0.5
<u>AID Grant Input</u>				
Tech Assist.	0.2	0.3	0.1	0.6
Training (FX)	0.1	0.1	--	<u>0.2</u>
Subtotal AID				7.3
<u>GOP Inputs</u>				
Credit Program*	1.6	2.0	3.5	7.1
Filipino A/E Services	0.1	0.1	0.1	0.3
Program Administration	0.7	0.8	0.9	2.4
<u>Farmer</u> (Labor)	0.5	0.6	0.7	1.8
Total Project Cost	6.0	6.4	6.5	18.9

*This does not include annual recurring production credit inputs by GOP through Masagana 99 and related credit programs.

TITLE: Bicol Integrated Area Development II

PROJECT NO.: 492-0275

COUNTRY: Philippines

REGION: Asia

KEYWORDS: Land consolidation and resettlement (5); irrigation systems (5); access roads (3).

SUMMARY: The project will finance inputs in five categories on a 2,300 hectare area farmed by 1,230 farmers, including:

1. Construction and installation of major physical facilities, including irrigation and drainage canals, electric turbine and other pumps and pumphouse, all-weather service roads, and farm access paths, a multi-purpose community building for each of seven communities, and one elementary school;
2. New community homesite development and relocation of farm-houses and households from scattered field locations to planned community homesites;
3. Land consolidation and tenure reform;
4. A series of interrelated organizational development, training and extension activities to transmit modern agricultural and irrigation technology and some basic principles of cooperative organization, leadership, preventive health, nutrition, family planning and backyard garden and livestock project possibilities; and
5. Applied agricultural research to determine optimum rice production technological packages for extension efforts in the area.

LOCATION: Bula, Bicol Region.

CLIMATE: Ar.

CROPS: Rice.

SOILS: Sandy clay loam.

BEGIN: 1977 END: 1982. AREA: 2,300 ha.

NUMBER OF FARMS: 1,230.

CONTRIBUTION:	USAID	\$2900K loan
	GOP	2561K
	TOTAL	<u>\$5461K</u>

TARGET GROUP: All farmers in the region.

- GOALS:
1. Increase agricultural production and productivity per hectare;
 2. Increase productive employment opportunities;
 3. Reduce crude population growth rate (before migration);
 4. Improve health and nutritional status;
 5. Make elementary education available to all project area children; and
 6. Increase farmer participation and leadership in social and economic development.

- PURPOSE:
1. Farmers practicing appropriate modern crop production technology;
 2. Farms utilizing and maintaining new irrigation and drainage systems and cultivating at least two crops annually;
 3. Farmers utilizing and maintaining all-weather crop service road and farm path networks;
 4. Reduced home-to-farm and lot-to-lot travel time;
 5. Farm families adopting backyard projects to raise livestock and vegetables;
 6. Improved land tenure security;
 7. Significant increase in the prevalence rate of family planning acceptors;
 8. Improved sanitary environment;
 9. Improved meal planning and food preparation;
 10. Improved access to elementary education facilities for Barangay San Jose residents; and
 11. Irrigation Associations and other new organizations functioning effectively.

TYPE OF PROJECT: Medium-scale integrated area development package.

TECHNOLOGY USED: Canals, electric pumps.

DOCUMENTS REVIEWED: Project paper (190 pp).

PROJECT ORIGIN AND BASE LINE DATA: Development planning in the region started in 1967, and the pilot phase of this project (AID-funded) began in 1973.

BENEFICIARY INVOLVEMENT: Farmers will form Irrigators' Associations and operate the irrigation system themselves.

LOGICAL FRAMEWORK: Attached to reviewed documents.

PERT CHART: Attached to reviewed documents.

TECHNICAL

1. Physical Facilities. The proposed project is divided into five phases. Each phase is a separate irrigation system and will have its own set of electrically-driven pumps to draw irrigation water from the Bicol River or from underground sources, depending on the location of the irrigable area. The areas range in size from 184 to 810 ha, and the pumping plants will vary in size from 0.3 to 1.215 m³/sec.

The area requires 154 km of irrigation canals: 23 km of main canals, 26 km of laterals, and 105 km of on-farm ditches or sublaterals. From each pumpsite stilling pond, the water will run through the main canals, lined with concrete blocks to minimize percolation losses. Lateral and sublateral canals will be constructed of compacted earth. Parshall flumes will measure the volume of water diverted to each lateral.

Good drainage to mitigate the level and duration of storm flooding is necessary to increase rice production. The drainage system is designed to drain excess water from the fields and redirect it to areas where irrigation water is needed. There will be a total of about 92 km of new drainage canal construction: 1.6 km of main drainage, 38.1 km of secondary drainage, and 52.5 km of on-farm drainage.

Coincident with the construction of irrigation and drainage canals, the project will construct some 33 km of service roads and 42 km of farm access paths. Service roads will parallel the main irrigation canals and laterals and will connect with the 20 km of larger secondary and feeder roads. The project will then enjoy a total road and access path density of one kilometer for every 24 hectares.

A three-room multipurpose building will be constructed in each of the seven project area barrios before the construction phase is begun. They will be first used as field administrative and work offices by the Project Management Office. One year after construction is complete, the building will be turned over to the community councils for use as multipurpose community halls. An eighth building of identical design will be constructed to serve as an elementary school in the one community that does not yet have a school.

2. Homesite Development. The project design includes the relocation of farm beneficiaries to a developed community. Road networks and drainage facilities will be provided in the new homesite areas, and the home lots will provide about 500 to 500 m² of land per household. The community site will

provide areas for a school site, chapel, a park, and other facilities that may be desired. Every household that relocates will be granted a flat \$40 for minor expenses of moving, as well as \$133 per household to purchase small, hand-operated household water pumps, materials for a new shallow well, and materials to construct a water-sealed pit privy.

3. Land Consolidation. The project will combine and reshape the separate farmland holdings of each farm family to form one contiguous holding within one or two kilometers from the operator's residence. No more than three hectares can be awarded to each farmer and his spouse.

4. Organizational Development. Seventy-four existing compact farms will be reorganized and 49 new ones organized as the basic production units, each one composed of an average of 17 ha of contiguous irrigated land tilled by about 10 farmers. These compact farms will serve as:

- a. channels for the introduction of farm technology;
- b. units to consolidate farm operations through cooperative action;
- c. a mechanism to facilitate improvement of on-farm water management practices;
- d. basic production units to purchase and operate small-scale farm machinery; and
- e. liability and guarantee groups for the acquisition of production and marketing credit.

5. Applied Agricultural Research. The project will fund an applied research program within the project area to determine the optimum package of high-yield seed varieties, fertilizer, pesticides, and other inputs specifically for the soil, climate and water conditions of the area.

INSTITUTIONAL

An interagency Project Management Office (PMO) will be established by the Bicol River Basin Development Project (BRBDP) and the Department of Agrarian Reform (DAR), the latter as the lead implementing agency which will appoint and supervise the project manager.

The PMO will be staffed with full-time technicians detailed from the various agencies and bureaus involved. The National Irrigation Administration (NIA) will provide the deputy project manager for physical development to supervise physical construction activities. The supervisory board of the PMO will be a subcommittee of the Bicol River Basin Coordinating Committee and will be composed of the regional directors of the primary participating agencies and chaired by the regional director of the DAR.

An Irrigators' Association will be formed for each phase of the project to take over, operate and maintain each irrigation system. This central body will be composed of all the members of the District Executive Boards. All district chairmen will automatically become members of the Board of Directors of their respective Irrigators' Associations, and they will elect their President and Vice President from among themselves. A trained watermaster will be selected and hired by the Board of Directors. A grievance officer will be chosen from among the members of the Board. Various committees for production, education, and training, water management, finances and development will be organized. The association will also have a full-time, bonded secretary/treasurer to be assisted by a hired bookkeeper.

SOCIAL

There is good reason to believe that the farmers will accept and successfully adapt to the proposed compact farming pattern proposed for the project area. It is less sure that the move to homesites will occur in the same proportions among farmers as compact farming. In any case, relocation to new homesite areas is to be made on a voluntary basis, households are to be compensated for the minor structural damages such moves entail, and no form of coercion is planned.

ECONOMIC

Costs of project outputs and annual cost estimates are given on pages 54-55 (attached).

The IRR for the project is 37%, and the economic benefit-cost ratio is 2.0 at a 15% annual discount rate.

Net real income of project area residents will increase from \$434 per household to \$1,500 annually, or an increase of 243%.

Annex B gives extensive tables of farms and project costs.

Repayment by USAID of project costs will be by the Fixed Amount Reimbursement Methods. The GOP will be responsible for cost overruns.

Project Paper - Page 54

COSTING OF PROJECT OUTPUTS BY INPUT SOURCE
BICOL IAD II-A (BULA-MINALABAC) PROJECT
(\$1,000)

<u>Output</u>	<u>Total Magnitude of Output</u>	<u>Inputs: AID Appropri. Loan</u>	<u>GOP</u>	<u>Total Input</u>
I. <u>Physical Facilities</u>				
Pumphouses built	11	<u>2,077.1</u>	<u>1,294.0</u>	3371.1
Pumps installed	29	99.4	71.3	170.7
Irrigation canals (km)	154) ^{1/}	355.7		355.7
Drainage canals (km)	92)	1,622.0	1,116.1	2738.1
Service roads & paths (km)	76)			
Hectarage irrigated	2062	<u>(2,077.1)</u>	<u>(1,187.4)</u>	<u>(3264.5)</u>
Multipurpose buildings	7		93.3	93.3
Elementary schoolhouse	1		13.3	13.3
II. <u>Homesite Development</u>				
Homesites completed	7)		<u>336.5</u>	<u>336.5</u>
Homesites developed and distributed	1010) ^{1/}		134.0	134.0
Households relocated	1010		47.0	47.0
Hand pumps installed or approved	1230		92.1	92.1
Water-sealed pit privies constructed or approved	1230		63.4	63.4
III. <u>Land Consolidation & Tenure Reform</u>				
Farmlots consolidated	2668)		<u>22.4</u>	<u>22.4</u>
Consolidated farms demarcated	1253) ^{1/}		22.4	22.4
New CLT's, leases, & titles issued (or old ones confirmed)	1230)			
IV. <u>Organization Development & Training</u>				
a. <u>Organizations formed:</u>				
Compact farms	123)			
District Irrigators' Assoc.	42)	Cost included in training		
Irrigators' Assoc. (IA)	5)			
Homemakers' Clubs	32)			
Youth Clubs	65)			
b. <u>People trained:</u>				
Project implementors	34)		0.06	0.06
Promotion Comm. Members	18) ^{1/}			
Barangay leaders	70		0.1	0.1
Compact farm members*	1230		30.6	30.6
Compact farm leaders	369		0.3	0.3

Continued

<u>Output</u>	<u>Total Magnitude of Output</u>	<u>Inputs: AID Approp. Loan</u>	<u>GOP</u>	<u>Total Input</u>
District IA officers*	68)			
IA Board Members*	42) <u>1/</u>		4.5	4.5
IA Watermasters*	5		4.6	4.6
Ditchtenders*	123			
Farmers (in health, etc.)	1230		10.7	10.7
Homemakers	1230		21.3	21.3
Youths	2460		42.7	42.7
V. <u>Applied Agricultural Research</u>			<u>12.8</u>	<u>12.8</u>
Applied Research Crops	10		12.8	12.8
PROJECT OPS. & <u>MGT.</u>		<u>45.1</u>	<u>152.3</u>	<u>197.4</u>
SUBTOTALS		2,122.2	1,932.9	4055.1

Table 4. ANNUAL COST ESTIMATES BY MAJOR PROJECT COMPONENT (INPUTS) AND FINANCIAL PLAN (\$1000)^{1/} BICOL IAD-III (BULA-MINALABAC) PROJECT

Project Component	YEAR:							AID LOAN			GOP LC
	1976-7	1978	1979	1980	1981	1982	Total	FX	LC	TOTAL	
I. Physical Facilities	371	740	797	940	494	28	3371	356	1721	2077	1294
a. Imported Equipment		(356) ^{4/}					(356)	(356)		(356)	
b. Construction Costs	(371) ^{2/}	(384)	(797)	(940)	(494)	(28)	(3015)		(1721)	(1721)	(1294)
II. Homeside Development	23	56	108	120	30		337				337
III. Land Consolidation & Tenure Reform	2	5	4	4	4	4	22				22
IV. Organizational Development and Training		24	22	21	23	24	115				115
V. Applied Agricultural Research		1	3	3	3	4	13				13
VI. Project Ops. & Mgt.	49	67	19	19	20	22	197	45		45	152
a. Imported Equipment		(45) ^{5/}					(45)	(45)		(45)	
b. Local Costs	49 ^{3/}	(22)	(19)	(19)	(20)	(22)	(152)				(152)
SUBTOTALS	445	894	953	1107	574	82	4055	401	1721	2122	1933
15% Contingency	67	134	143	166	86	12	608	60	258	318	290
SUBTOTALS	512	1028	1096	1273	660	94	4663	461	1980	2441	2222
Cost Escalation Factor ^{6/}	0	109	159	287	205	38	798	69	390	459	339
GRAND TOTALS	512	1137	1255	1560	865	132	5461	530	2370	2900	2561
										^{53%} 477	

^{1/} Derived from peso estimates, Table 13, Annex B, using an exchange rate of ₱7.5/\$ for 1976-9, ₱8.0/\$ for 1980-2. For further details see Tables 14-27, Annex B.

^{2/} \$138 thousand = value of work completed in 1976, \$233 = amount budgeted CY 1977.

^{3/} \$36 thousand = Pilot Project Ops. & Mgt. through 1976, \$13 = est. for CY 1977.

^{4/} Pumps and spare parts.

^{5/} Vehicles, spare parts and typewriters.

^{6/} 1977 base year. Imported equipment escalated 15%/yr., all local costs 7%/yr, before conversion to dollars.

TITLE: Small Farmer Systems

PROJECT NO.: 492-0301

COUNTRY: Philippines

REGION: Asia

KEYWORDS: Pumps (3); Irrigators' Associations (5); irrigation management training (5); credit (3).

SUMMARY: The project establishes small farmer Irrigators' Associations so that the members may own, operate and maintain irrigation and other farm support systems under the GOP's program for assisting small farmers. It is anticipated that approximately 280 new Irrigators' Associations will be developed and some 600 existing Irrigators' Associations further assisted as a result of this project.

LOCATION: All 70 provinces

CLIMATE: Aw-Ar.

CROPS: Rice, vegetables.

TARGET GROUP: Small farmers (landowner-farmers, lessors, sharecroppers) and employees of the Farm Systems Development Corporation (FSDC).

BEGIN: 1978 END: 1980 AREA: 28,000 ha

NUMBER OF FARMS: 19,000.

CONTRIBUTION:	US	\$ 10.0M loan
		1.0M grant
	Denmark	1.9M
	GOP	10.5M
	TOTAL	<u>\$ 23.4M</u>

GOALS: An improved socioeconomic situation and quality of life for small farmer families in project areas and an increase in farmers' participation and leadership in their own social and economic development.

PURPOSE: To increase the incomes of small farmer families in project areas.

SUBPURPOSE: To increase agricultural production and other income-generating activities in the project area.

TYPE OF PROJECT: Large-scale, credit and training for irrigation systems.

TECHNOLOGY USED: Diesel or electric powered pumps, diversion dams, sprayers, two-wheeled tillers, threshers, grain dryers.

DOCUMENTS REVIEWED: Project Paper (200 pp).

PROJECT ORIGIN AND BASE LINE DATA: Project evolved from and continues the Small-Scale Irrigation Project. Evaluations have been made internally by the Farm Systems Development Corporation and externally by AID.

BENEFICIARY INVOLVEMENT: The farmers from the Irrigators' Associations construct laterals and watercourse structures, and pay back the cost of the system.

LOGICAL FRAMEWORK: Not available.

PERT CHART: Not available.

TECHNICAL

By project completion, 280 new irrigation systems will be installed and operating, and 200 old Irrigators' Association systems will be upgraded or rehabilitated.

The average Irrigators' Association covers 100 ha and represents 70 farmers. The chief impetus to formation is the farmers' need for water to ensure sufficient reserves in the wet season and possible double-cropping in the dry season. By pumping or diverting from a nearby stream, and building the necessary watercourse system, single crop harvests have been increased from 1.8 to 2.7 MT in the wet season, and to 3.5 MT in the dry season. Past problems with poor pump quality have been overcome, and a V-belt drive system has replaced the flat-belt system.

At present, water management mostly concerns lining of canals, although improved scheduling and land-leveling are future possibilities. Other production techniques are being introduced at this time. For 100 ha, these would include:

10	5-gallon	sprayers	\$ 60	unit cost
4	8-HP	hand tillers	2,900	
1	1 MT/hr	thresher	1,950	
2	3 MT/day	dryer	1,480	

Four demonstration farms will be constructed, at a cost of \$2.8M.

INSTITUTIONAL

Project output includes 400 new Irrigators' Associations organized, 700 FSDC field staff trained, 50K members of farm families trained, 160 Irrigators' Associations benefiting from water management inputs, and farm support packages provided to 100 Irrigators' Associations.

Agricultural extension agents live near farmers in VISTA-type conditions. Their training is spread over two years in stages that approximately parallel the growth of the Irrigators' Associations (initiation, maintenance, bookkeeping, water management, production equipment, etc.).

About \$1M will be spent in technical assistance to the FSDC, of which \$715K is to provide expatriate advisors and \$285K will train Philippine technicians, using seminars, short courses and field visits to other countries.

The Irrigators' Associations have the following structure:

1. Board of Director
2. Irrigation Management Committee
3. Business Management Committee
4. Audit and Inventory Committee
5. Education and Training Committee
6. Grievance Committee
7. General Membership

SOCIAL

There have been some minor problems in the Irrigators' Association organizations, generally involving attempts to combine two traditional community groupings into one Irrigators' Association. This can be avoided in the future. In cases where a sharecropper provides up to 70% of his harvest to the landowner, it appears that the economic incentives to the sharecropper are still acceptable.

FINANCIAL/ECONOMIC

See AID budget on page 82.

The AID funds are administered under a fixed amount reimbursable (FAR) system, whereby funds are disbursed at the time that the FSDC verifies completion of each stage of work.

IRR = 51% (assuming only 50% of land is double-cropped, and that production support packages are being used).

The average project cost is \$200-\$260/ha, which is very low even for Philippine projects.

For double-cropped irrigated land, labor requirements are 2.76 times those for nonirrigated land (costing \$.50-\$.90/man-day). At present, threshing is done by commercial contractor.

Log Frame Annex C p. 4.

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TABLE S
Illustrative Activity Budget
Sources and Applications of Funds
(Millions of US\$)

<u>Total Life of Project Applications</u>		4th	1st	2nd	3rd	4th	1st
		FY 78	FY 79	FY 79	FY 79	FY 79	FY 80
		Jul-Sept '78	Oct-Dec '79	Jan-Mar '79	Apr-Jun '79	Jul-Sept '79	Oct-Dec '79
Gravity	7.4	.6	.8	2.0	2.0	1.0	1.0
Pump	6.2	1.4	1.6	1.0	1.0	.6	.6
Up & Rehab	.8	--	.2	.2	.2	.2	--
FSS	1.2	.2	.2	.2	.2	.2	.2
Commodities	1.0	--	--	.5	.5	--	--
Training & Demonstration Training	2.8	.3	.3	.6	.6	.6	.4
Administrative	<u>3.0</u>	<u>.5</u>	<u>.5</u>	<u>.5</u>	<u>.5</u>	<u>.5</u>	<u>.5</u>
	22.4	3.0	3.6	5.0	5.0	3.1	2.7
<u>Sources</u>							
AID	10.0	1.4	1.7	2.3	2.3	1.3	1.0
Danish	1.9	--	--	.6	.7	.2	.4
GOP	<u>10.5</u>	<u>1.6</u>	<u>1.9</u>	<u>2.1</u>	<u>2.0</u>	<u>1.6</u>	<u>1.3</u>
	22.4	3.0	3.6	5.0	5.0	3.1	2.7

B-74

TITLE: Lam Nam Oon Integrated Rural Development

PROJECT NO.: 493-0272

COUNTRY: Thailand

REGION: Asia

KEYWORDS: System rehabilitation (3); surface irrigation (3).

SUMMARY: This project is a joint RTG/AID integrated rural development effort to increase agricultural productivity in a section of Northeast Thailand. The project includes:

1. The completion of the Lam Nam Oon irrigation system;
2. Construction of a road network;
3. Implementation of an on-farm water supply system; and
4. An integrated program of community development.

LOCATION: Northeast Thailand.

CLIMATE: Aw.

CROPS: Paddy, tobacco, maize, sugarcane, cotton.

SOILS: Acidic, suitable for rice in their present condition, but will require lime before upland crops can be cultivated.

BEGIN: July 1977 END: July 1982 AREA: 75k ac.

NUMBER OF FARMS: 10,000.

CONTRIBUTION:	AID	US\$	4.5M
	RTG		39.3M
	TOTAL	US\$	<u>43.8M</u>

GOALS: Increases in agricultural production are expected to amount to 82,800 metric tons annually.

PURPOSE: The purpose of the activity is to reduce the recurring flood damage from the Lam Nam Oon River and to supply supplemental irrigation water for crops during the wet season and irrigation of additional crops during the dry season.

TYPE OF PROJECT: Integrated rural development including a major irrigation component.

TECHNOLOGY USED: Zoned earth dam, concrete-lined canals.

DOCUMENTS REVIEWED: Project Paper (92 pp and seven annexes); Capital Assistance Paper (23 pp and seven annexes).

PROJECT ORIGIN AND BASE LINE DATA: Based on preliminary studies, jointly conducted by AID/W and mission personnel, a PID was prepared and submitted to AID/W and approved in November 1974. The PRP was then prepared by the mission with TDY assistance.

BENEFICIARY INVOLVEMENT: No charge is made for irrigation water because merit is gained by the gift of water in Theravada Buddhist countries.

LOGICAL FRAMEWORK: Attached to reviewed documents.

GENERAL DESCRIPTION

Due to the combination of excessive flow during the rainy season and insufficient flow during the dry seasons, full exploitation of the agricultural potential of the Lam Nam Oon River basin is impossible without water storage reservoirs and water distribution systems.

TECHNICAL

The LNO project area consists of all the arable area downstream from the dam which is to be supplied with irrigation water, an area totaling 75,000 acres. Under the project, construction will be completed on the distribution (main/lateral canals) and drainage systems; the project road system; and land improvements, including land consolidation on 26,300 rai, ditches and dike construction on 159,500 rai, as well as the establishment of three pilot projects with their associated operational research programs.

Within the irrigation system, water is supplied through two canals, the left and the right main canals, and is distributed to the lateral canals by gravity and/or pumps. The canals and laterals are concrete-lined, whereas the on-farm distribution system supplied from the canals and laterals by farm turnout structures (FTO's), is not lined. As of March 1977, 80% of the left main canal and laterals and 30% of the right main canal and laterals were completed. By 1981, both systems will be completed, a total of 345 km of canal and lateral construction.

The total drainage system, natural watercourse channels supplemented by construction of 300 km of surface drain ditches will be completed by 1983. The drains will minimize the hazards resulting from surface flooding and soil erosion, high water tables with attendant waterlogging of the soil, and salt in the groundwater.

The principal features of the Lam Nam Oon project include a multipurpose dam and storage reservoir and a network of canals, lateral and related water control structures to provide seasonal and year round irrigation to downstream farm lands. In addition to irrigation, the project will provide benefits for flood control, fish culture and domestic water supply.

The dam will be located on the Lam Nam Oon River at Ban Nong-bua Village. It will be on zoned earth construction, requiring an estimated total of 3,800,000 m³ of material. The dam will be approximately 3,000 m long at its crest elevation, 188.50 above mean sea level (MSL). It will be protected against overtopping by an uncontrolled overflow type spillway, 250 m in length at

crest elevation of 185.0 m MSL, to be constructed in a natural saddle, about one km upstream from the left abutment. The spillway will be concrete-lined with chute and stilling pool and an outlet channel, which will discharge into the main stream some distance below the dam. As presently designed, the spillway crest flowing at 1.5 m depth, has a capacity to discharge floods of 1,000 year frequency, at a rate of 920 cms while still maintaining an adequate factor of safety.

The watershed of the Lam Nam Oon River above the dam site covers approximately 1,111 km² of densely wooded terrain, which is rolling and hilly on the west and south and relatively flat, with gentle slopes on the east. The proposed reservoir will provide regulated storage for 475,000,000 m³ of runoff from the drainage area and space for about 45,000,000 m³ of sediment deposition. At its full retention level, (elevation of 185.0 m MSL), the reservoir will cover about 85.0 km² of light forest land and will inundate four villages of 125 homesteads and about 860 acres of farmland. About 960 people will be directly affected, however, provision is planned for their resettlement in other acceptable locations.

The concrete headwork at the dam includes gated irrigation outlets on the right and left sides of the dam and a river channel discharge structure to provide a minimum one cms release for domestic use of the villages located downstream. The outlet structure on the right of the dam will have a design capacity of 22 cms to provide irrigation water for approximately 49,300 acres of irrigable area, that on the left will have a design capacity of eight-and-one-half cms to serve 18,800 acres.

The irrigable distribution system will provide water to about 68,120 acres of irrigable farmland. It will be constructed in two stages. The initial development will include a right side main canal approximately 24 km in length to serve 24,400 acres (to be increased by 25,360 acres in the second stage); a left side main canal about 30 km in length to serve 18,800 acres; about 62 km of laterals; and related concrete water control structures. In order to ensure optimum efficiency in water use, prevent wasteful and detrimental seepage, etc., all canals will be lined with approximately 10 cm of concrete.

INSTITUTIONAL

At the national level, project policy, direction and coordination will be provided from the National Irrigated Agriculture Committee through the National Coordinating Committee for the LNO Integrated Rural Development Project, which, in turn, will appoint members and vest day-to-day project administrative responsibilities at the national level in a senior level working committee.

At the field level, policy direction and coordination will be provided by the Provincial Coordinating Committee chaired by the Governor of Sakon Nakhon.

Project field operation and management will be headed by a Project Field Director and will include three Assistant Field Directors, as well as Team Leaders from the various RTG departmental cadres.

ENVIRONMENTAL

The irrigated agriculture system of the Lam Nam Oon should have few adverse effects on environmental values, but should contribute to the welfare of the region.

SOCIAL

The project design places a heavy emphasis on social welfare considerations and participation of beneficiaries and local governmental institutions so that the overall well-being of the project participants, not just their incomes, will be improved. Available data establishes that project area farmers are within AID's target population and are among Thailand's poorest. Local customs and social characteristics have been carefully considered and the project design adapted to them wherever possible. No cultural impediments have been found. Women play an important role in the project.

ECONOMIC

In the long run, the farmers stand to benefit handsomely if they seize the opportunity the project affords them. If the farmers are not required to pay for land improvement, the financial rates of return are very high (92% for the consolidated area, 285% for D/D). No great significance should be attached to the magnitude of these IRR's nor the difference between them as the only investment is foregone income for the first year or two and the amount foregone is relatively small for the D/D farmer.

Average Northeast farmers would probably be restive and slow to adopt required new practices given the initial period of foregone income. But, having seen the longer range benefits on demonstration farms, these farmers can be expected to respond energetically. Model farmers will more readily accommodate the apparent risks because of their position in the community and because extension workers will be able to concentrate their efforts and encouragement on them.

Loan funds not to exceed \$3,500,000 will be utilized to finance the U.S. dollar costs of the project. Baht requirements will be provided by the Royal Irrigation Department (RID) from its budgeted receipts. The RTS has always provided the baht contribution to AID loan and grant projects on schedule and, on occasion, has advanced baht in excess of agreed upon levels. Any foreign exchange requirements in excess of the AID loan, necessitated by changes or additions to the plan for the activity, will be provided by the RTG. In the case of the ongoing AID irrigation loan, changes and additions by RID have increased the cost in dollars and baht by \$15.25 million or 87%, and all additional costs have been funded by the RTG. This project is planned for only 26% USAID loan financing with the RTG budget providing the remaining 74% of the required financing. As in other recent loans to Thailand, the RTG will undertake a commitment to fund any and all cost overruns, both local currency and foreign exchange.

The loan application includes RTG commitment to fund the local-currency component.

It should be noted that it is the policy of the RTG and RID to provide water for irrigation at no charge to the farmer. AID and IBRD have counseled otherwise, but the RTG does not appear to be prepared to modify this policy at this time. On the other hand, the RTG has always provided adequate budget to RID for O&M on existing irrigation works. Furthermore, the Dikes and Ditches Act provides that the individual farmers are responsible for the maintenance of the farm water distribution system from the lateral canals to their fields, and if RID, as is the standard practice, provides construction or maintenance services, this is paid for by the individual farmer.

The projected ERR of the project ranges from 25.8%, as the most favorable estimate, to 15.2% under the worst expected conditions. Appended to the summary are financial impact tables, a summary of project benefits, and a log frame.

The rate of exchange used in this project paper is US\$1.00 = Baht 20.00.

Table 3

Financial Impact - Consolidated Area Farmer

(US \$)

<u>Year</u>	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
A. Off Farm Income	260	225	175	125	50	--
B. Gross Value of Farm Produce	412	410	610	1,110	1,610	2,360
C. Cost of Inputs	50	150	250	350	500	620
D. Net value of Farm Produce ^{1/}	362	260	360	760	1,110	1,740
E. Total Income A+D ^{1/}	622	485	535	885	1,160	1,740
F. Total Income without Project	622	653	686	720	756	794
B-87 G. Benefit stream without having to pay capital cost		-168	-151	+165	+404	+946 etc. (IRR 92%)
H. Benefit stream if \$115/rai paid for development		-2,468	-151	+165	+404	+946 etc. (IRR 22.6%)
I. Annual payment on loan of \$2,300, 4 year grace period w/o interest, repayment, period 20 years w/interest at 10%		--	--	--	--	270.16 etc.

^{1/} Includes subsistence

Table 4
Financial Impact - Ditches & Dikes Area Farmer
(Baht)

<u>Year</u>	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
A. Off-Farm Income	260	225	175	125	50	--
B. Gross value of Farm Produce	412	510	860	1,360	1,710	1,994
C. Cost of Inputs	50	150	250	350	400	460
D. Net value of farm crops ^{1/}	362	360	610	1,010	1,310	1,534
E. Total Income A&D ^{1/}	622	585	785	1,135	1,360	1,534
B-82 F. Total Income Without Project	622	654	686	720	756	794
G. Benefit Stream without having to pay capital cost		-69	+99	+415	+605	+790 etc. (IRR 285%)
H. Benefit stream if \$50/rai paid for development		-1,069	+99	+415	+604	+790 etc. (IRR 42.9%)
I. Annual payment on loan of \$1,000, 3 year grace period w/o interest, repayment period 20 years w/interest at 10%		--	--	--	117.46	117.46 etc.

^{1/} Includes subsistence.

TITLE: Land Settlements

PROJECT NO.: 493-0289

COUNTRY: Thailand

REGION: Asia

KEYWORDS: Land settlements (5); tubewells (3); pumps (3).

SUMMARY: This five year project is a joint RTG/AID pilot effort to improve the utilization of land in eight land settlements of Northeast Thailand. Among the services the project will furnish will be small water subprojects, such as community farm ponds and wells needed to diversify crops and allow for some limited year-round cultivation in rainfed areas.

LOCATION: Northeast Thailand.

CLIMATE: Aw.

CROPS: Paddy, maize, cotton, mung beans, cassava.

SOILS: Primarily a broad range of ultisols; deep and heavily weathered.

TARGET GROUP: Resettled farmers.

BEGIN: 1979 END: 1984 AREA: 576k ac

NUMBER OF FARMS: 44,375.

CONTRIBUTION:	AID	4.1M
	Peace Corps	0.3M
	RTG	4.1M
	TOTAL	<u>8.5M</u>

GOALS: Wet season supplementary irrigation will increase yields permitting earlier starts on paddy nurseries and protection from drought. Dry season irrigation will permit some degree of multiple cropping.

PURPOSE: To increase agricultural productivity and to raise the standard of living in the Northeast section of Thailand.

TYPE OF PROJECT: Large-scale integrated community development, including a major water resource development component.

TECHNOLOGY USED: Small earthen catchments, low-lift pumps, tubewells.

DOCUMENTS REVIEWED: Project Paper (45 pp and 13 annexes).

PROJECT ORIGIN AND BASE LINE DATA: Since 1935, the Royal Thai Government has managed planned rural land settlements.

BENEFICIARY INVOLVEMENT: Beneficiaries will be expected to furnish some of the labor necessary for construction and maintenance of water supply systems.

LOGICAL FRAMEWORK: Attached to reviewed documents.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

The project includes three major activities designed to improve incomes and levels of living of approximately 44,000 farm families residing within the boundaries of the eight land settlements. These activities include:

1. The construction of upgrading of laterite roads within the settlements;
2. The provision of domestic water supplies; and
3. The provision of technical agricultural assistance designed to raise yields of agricultural commodities, both for home consumption and for cash sales.

TECHNICAL

1. Meeting Basic Water Requirements. Although significant volumes of gravity water are currently available only at the Lam Nam Oon and Huai Luang settlements, the Ubonrat settlement could, with development of additional pumping from the stream below Ubonrat Dam, develop limited irrigation in addition to dry season vegetable farming and domestic water supplies. The remaining five settlements are without benefit of any major reservoir and/or reliable river and will have to continue to rely on rainfed agriculture and limited water supplies from streams, groundwater and small ponds.

Reaching every village and farmer in those five settlements and supplying them with basic water requirements will be a difficult task which will require a concerted effort of the Department of Public Welfare in concert with other agencies, coupled with increased participation of the settlement officials and local farmers. A number of village level projects are being implemented in the Northeast, notably the well drilling and village pond activities of the Office of Accelerated Rural Development (ARD) and of the DPW, and the small reservoir development activity of the Royal Irrigation Department (RID). The former aims at supplying drinking water to more than 2,000 villages in the Northeast with acute water shortages. The ARD is conducting limited well drilling construction in the project settlements. Most ARD wells are limited in capacity providing only enough water for domestic uses and small vegetable gardens.

2. Groundwater Potential - Deep Wells. The ARD and the Department of Mineral Resources are conducting construction of wells

in some project settlements. A record of some of the wells constructed by the Department of Mineral Resources is available.

The depths of these wells range from 70 to 527 feet. The average depth is 226 ft. The yields range from four to 75 gpm with an average yield of 26 gpm. The quality of water produced is generally good, although ferrous iron is present in several wells in amounts which can be detected by taste.

The Department of Mineral Resources data (confirmed by observation) show that very limited water (26 gpm) is available at an average depth of 26 feet. Some of the deep wells have run into salt barrier and the water developed is too brackish for domestic use.

3. Shallow Wells. Shallow wells in Northeast Thailand are one meter in diameter, range up to five or six meters in depth, and are lined with concrete ring cassions usually to the bottom, with the lower rings perforated to permit water to enter from the water-bearing strata. These wells may be open with water lifted by rope and bucket or covered by a concrete lid and water lifted by a hand pump.

There are a number of these wells in project settlements, and the operational condition of the open wells varies from those contaminated with debris and not usable to those operating and well cared for. Maintenance of open hand-dug village wells will continue to be neglected until the villagers are health-conscious enough to perceive the need to maintain a good and relatively clean domestic water supply. After all, maintenance of a hand-dug well is clearly within the villagers' capabilities, but, in all too many instances, they just do not do it.

On the other hand, a hand-dug well, with a concrete cover and hand-pump, is ideal for providing a relatively clean water supply. But repair of the hand-pump usually requires capability and parts beyond the villagers' means, thus the pump may be inoperable for prolonged periods before someone, usually a government agent, repairs or replaces it. A partial resolution might be to provide a concrete well cover which could be removed when the pump is inoperable. The villagers would then be assured access to a relatively clean domestic water supply.

ARD has constructed some deep wells in the settlements and will continue this program. The Government plans to provide Northeast villages with more than 4,000 deep wells, and some of these wells may be located in the settlements. However, the national program is administered through the districts

and provinces. The settlements are not part of this administrative network, and, historically, benefit little from these programs.

The water resources experts at Khon Kaen University consider small ponds the most appropriate response to the water problems in the Northeast. They have instituted a small pond development program which is assisting local governments build and maintain small ponds. They think continued effort at educating the local population and providing adequate technical assistance in design and followup extension will solve most of the problems which have been seen connected with the village self-help ponds.

A study of village ponds conducted by Khon Kaen University looked at ponds built in nearby villages which received no government programs and which were not serviced by the agricultural extension service. Although the study is not yet complete, it is expected to conclude that small ponds less than 100,000 m may have little economic impact due to mismanagement. However, the ponds do lead to increased vegetable gardening; reduced mortality of farm animals, and marginally increased drinking water availability. The major drawback was frequent contamination due to unsanitary conditions in the watershed.

4. Watershed Diversions. In Lam Nam Oon, diversion channels can be constructed in the watersheds to direct substantial runoff into fields to supplement rainfall. However, very limited areas of the other settlements have the necessary undulating or hilly topography which provides suitable conditions for diversions. On most of the settlements, little uncultivated land is available from which runoff water may be diverted.

INSTITUTIONAL

The Royal Thai Government has over 40 years of experience in managing planned rural land settlements. Today, this experience is shared by 13 separate governmental agencies which administer different types of land settlements. Each agency has its own budget, personnel, equipment, settlement area, and policy objectives. Since several agencies are involved in settlement administration, some observers feel there is a lack of coordination which contributes to work duplication and resource inefficiency. However, there is little evidence to support this view, given the fact that there is no uniform land settlement policy which would require uniform administration or interagency coordination. Rather, there are

different types of land settlements, even within the control of each agency, with separate sets of objectives and priorities.

The Department of Public Welfare, through its division of Self-Help Land Settlements, is by far the major organization responsible for settlement administration. It became involved with land settlement administration in 1940, as a direct result of Prime Minister Phibun Songkhram's desire to provide land to the landless poor. Beginning with settlements in the provinces of Saraburi and Lopburi in the central region, the Department gradually expanded its scope of responsibility to include a total of 56 settlements in 38 provinces. Today, this responsibility encompasses a total area of 1,121,670 ha, with a population of 534,714 registered settlers.

The Department of Public Welfare is one of 12 departments in the Ministry of Interior, the second largest ministry in the Royal Thai Government. It is organized to provide a variety of welfare-related services, of which Self-Help Settlements are its largest function. Within the Department, the Division of Self-Help Land Settlements is the key planning and implementation unit. With its US\$21 million budget and more than one-fourth of the departmental personnel, this Division is nearly equal in size to many departments, and it often behaves accordingly. It develops policy, mobilizes foreign assistance, and implements policy.

The Division of Self-Help Settlements is divided into central and field units which employ a total of 1,944 government officials and nearly 300 additional personnel. Also important to the Division is an informally organized Training Subdivision at the departmental level, which cooperates closely with the Division in providing orientation and training programs for its officials. Within the Division of Self-Help Settlements, the central level structure is headed by the Director of the Division, who is assisted by five subdivision chiefs who function as Assistant Directors of Planning and Programming, Settlement Administration, Settlement Development, Engineering and Credit. According to official figures, 245 officials staff the central office in Bangkok, although, unofficially, some personnel assigned to the settlements actually work in Bangkok.

The field units of the Division officially consist of 56 self-help land settlements, the Northeast Self-Help Settlement Training and Development Center, Thai-German Demonstration and Training Center, and the Center for Coordinating Asian Development Bank Loans. These units employ a total of 1,698 officials and they report directly to the Director of the Division. The key administrative positions consist of the Director of the Division and the five chiefs of subdivisions in Bangkok, and the Settlement Superintendents in the field. Similar in concept to the position of governor or district officer, the superintendent is the key link in the system of administration. He has authority commensurate with his

responsibility for all activities, except police and courts, which are the responsibility of district officials in his settlement. His duties consist of 95 specific responsibilities which range from general housekeeping functions of correspondence and filing to such developmental and security activities as promoting family planning and training Village Scouts. Regardless of what Bangkok officials say is official policy, settlement policy is, in fact, what individual superintendents do. Consequently, settlement policy differs somewhat according to the priorities and performance of each superintendent and his settlement staff.

SOCIAL

Socials goals of this project are:

1. To provide for those who would otherwise migrate to congested urban areas as a means of making a living in the settlements;
2. To reduce the incidence of crime and to eliminate disputes regarding the possession of land; and
3. To enable the people to earn a livelihood on their own land.

ENVIRONMENTAL

The project has significant potential for enhancing human environmental resources and values and little potential for adverse effects on existing natural resources and values. The project involves no sensitive nor critical negative environmental aspects, such as affecting endangered species, unrealistic energy commitments or irrevocable use of any precious natural resources, or foreclosing of essential future potentials for continuing development of the affected areas.

The overall conclusion is that the Land Settlements Project would be highly acceptable from an environmental point of view, as well as of highest-level importance in demonstrating effective approaches for helping improve the economic and socioeconomic status of poor people in the Northeast. Properly planned and implemented, the benefit/cost ratio for the project should be higher than for alternative methods of achieving this same objective.

ECONOMIC

When the economic costs and benefits for technical agriculture, water and road development are computed, the IRR for the Land Settlements Project is 17.2%.

TECHNOLOGY USED: A diversion dam of concrete, navigation locks, drainage works, lined and unlined canals with most of the work done by machine.

DOCUMENTS REVIEWED: Staff Appraisal Report (29 pp and 18 annexes).

PROJECT ORIGIN AND BASE LINE DATA: Finds reported in the Staff Appraisal Report were gathered during an appraisal and a re-appraisal mission.

BENEFICIARY INVOLVEMENT: Beneficiaries will be charged for O&M costs, development of on-farm works and a portion of the capital cost of other project works.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

Through the provision of perennial irrigation, on-farm development and supporting agricultural services, the project would result in a considerable increase in cropping intensity and yields of rice and a wide variety of other crops in an area currently under rainfed subsistence farming. The project would also generate significant employment opportunities.

TECHNICAL

The proposed project would provide irrigation and drainage for 97,000 ha on the west bank of the Nan River in the provinces of Phitsanulok Phichit and Nakhorn Sawan. This is the first stage of a 139,000 ha project. The second stage, to irrigate 42,000 ha on the east bank and for which construction is scheduled to begin in 1980, would be served by the diversion dam constructed for the first phase. The project would include:

1. Phitsanulok diversion dam and navigation lock on the Nan River;
2. Main, lateral and sublateral unlined canal systems and roads to serve 97,000 ha;
3. Improvement of 120 km of existing main drains and the construction of 215 km of new ones along with flood control works;
4. On-farm development of 97,000 ha, consisting of the provision of ditches, drains and roads to nearly every farm, as well as land leveling and boundary realignment, where required; and
5. Four pilot projects of about 500 ha each to demonstrate improved farming techniques to the farmers and to train project personnel during the construction period.

Under the project, about 14,000 ha of cultivable land would be added to the present area of 83,000 ha through swamp drainage and the clearing and land shaping of scattered small areas of scrubland. The project also includes:

1. Detailed preparation of a second stage development of 42,000 ha;
2. A water resource study of the Chao Phya and Mekong Basins;
3. An administration and organization study of institutions concerned with irrigation development; and

4. The preparation of further irrigation projects.

Consultants would be engaged to assist project staff with the planning, design and implementation of the works, and the detailed preparation of the second stage. Consultants will also be engaged to assist with the Chao Phya Basin study, the administration and organization study, and preparation of further irrigation projects.

PROJECT WORKS

1. Phisanulok Diversion Dam. The diversion dam, to be located on the Nan River about 30 km north of the city of Phitsanulok, would comprise a concrete barrage, a navigation lock, and an earth embankment. The barrage would be constructed on dry ground and the river would be diverted through it by means of an earth closure dam. Detailed designs for these structures have been completed and site preparation works are underway. As the navigation lock represents a major investment (about US\$10 million), and it appears that the present design would exceed requirements, an economic study of the optimum size of lock would be included in the proposed design review. The revised proposal would be submitted to the Bank for its review and comment.
2. Irrigation Canal System. The main canal would begin just upstream of the diversion dam and would extend for 170 km on the right bank. Check structures would be provided at approximately 10 km intervals. About 110 lateral and sublateral (secondary) canals, having a total length of about 760 km, would be constructed. The head reach of the main canal would have sufficient capacity to meet future demands of the left bank canal, in the second stage development. Tertiary outlets, each serving an average of 85 ha, would be provided on each side of the main and secondary canals. All canals would be unlined and flanked by a laterite surface service road. About 50 km of the major service roads would be surfaced with asphalt. This road network would provide an adequate feeder road system for the existing major roads.
3. Drainage and Flood Control. Drainage of the project area would be mainly to the Yom and Phichit Rivers. For the main drainage, about 120 km of natural channels would be improved and deepened, while about 215 km of new collector drains would be constructed. About 150 structures would be required. A levee bank, about 200 km in length, would be built along the left bank of the Yom to ensure that floodwaters in the Yom do not damage the project area. In the first year of project implementation, the Royal Irrigation Department (RID) and the project consultants would study the return period for floods causing damage to the right bank of the Yom River and investigate

whether measures to alleviate damage are needed. Available data indicates that any such damage would be relatively minor.

4. On-Farm Development. The objective of on-farm development, which includes all works below the outlet to the tertiary canal, would be to provide the irrigation channels, drains, access roads, and leveling necessary to realize the projected cropping pattern and yields. The intensity of the works to be carried out would be determined on the basis of land classification, topography, the shape and size of the holding and the expected cropping pattern. For about 70% of the project area, where plots are large and moderately level, the on-farm works would not involve major boundary realignment and only minimal leveling would be undertaken under the project. To enable a rational layout of the infrastructure and to reduce costs to an economical level, boundary realignment would be required for areas where the topography is more uneven and the land is divided into small irregular plots. Such realignment would involve minor exchanges of land between owners, with minimal effects on the actual size and location of the farm. A greater degree of leveling and shaping would be required in these areas.

5. Pilot Projects. In order to accelerate agricultural development in the project area, a number of pilot projects would be constructed in the first two years of the project to examine alternative types of on-farm development and the optimum degree of leveling, to demonstrate irrigation techniques to the farmers in the surrounding areas and to train field level extension workers. Four areas of about 500 ha each would be chosen, spaced throughout the project area. Each pilot project would include a lateral canal and all the necessary on-farm works and would form a permanent part of the project. Water would be supplied initially from barge-mounted pumps in the Nan or Yom River. After a gravity supply of water becomes available, pumping would be discontinued. The sites of the first two pilot projects have been chosen, and the first will be constructed in the 1975 dry season.

ENVIRONMENTAL

The introduction of irrigation to the project area would tend to increase groundwater levels, thereby benefiting village water supplies, which are mainly from wells. However, no problems of waterlogging or salinity are expected. As in other irrigation areas in Thailand, some infestation of water hyacinth can be expected, particularly in the main drains. This would be controlled by chemical or mechanical means.

The project would have both beneficial and adverse effects on fish production. Construction of canals and roads would create

many borrow pits which are prized by the local people for fish and frog production. On the other hand, the provision of drainage and the reduction in swampy areas together with a marked increase in the use of chemical pesticides could be detrimental to fish production, especially in the lower reaches of the system.

Irrigation can sometimes lead to the spread of disease vectors. The most serious of these diseases, schistosomiasis (bilharzia), does not exist in the area, but the situation should be carefully monitored. Malaria has been eliminated from the area and does not present a problem. Waterborne diseases, such as cholera, typhoid, and dysentery, are not likely to be exacerbated by the project, as the villagers rely on rainwater or wellwater for drinking. An assurance was obtained during negotiations that the Government would undertake annual surveys in the project area to monitor the incidence of water-associated diseases and take appropriate action to halt the spread of any such diseases.

INSTITUTIONAL

In order to improve coordination between RID, and the various departments providing agricultural supporting services, RID was transferred in 1972 to the Ministry of Agriculture and Cooperatives (from the former Ministry of National Development) and a Central Committee for Irrigated Agriculture, consisting of the heads of all the relevant departments in the Ministry of Agriculture and representatives of other ministries was set up. The Committee, under the chairmanship of the Undersecretary of State for Agriculture, meets periodically to establish priorities for irrigated agriculture and coordinate activities of the various departments in the execution of irrigation projects.

In view of the magnitude and importance of the project, the Government would establish a Project Executive Committee with authority to make all major decisions on matters such as budgets, staffing and procurement. The Executive Committee would have the Minister of Agriculture as chairman and include senior representatives of relevant ministries and departments (e.g., Finance, Budget Bureau, Civil Service Commission). The purpose of establishing the Committee is to expedite decisions on major issues which would otherwise have to be referred to a number of different agencies.

The Undersecretary of State for Agriculture would be appointed as Project Coordinator and would meet periodically with representatives of the Departments engaged in project implementation to resolve any routine coordination problems. The Government would also appoint a Project Director, a Project Manager, a Project Land Officer, and a Project Extension Officer, each with qualifications, powers, and responsibilities acceptable to the Bank. Assurances in respect to these appointments were obtained during negotiations.

Coordination of project activities at the field level would be effected through Provincial Coordinating Committees established in the Phichit, Phitsanulok, and Nakhorn Sawon provinces, under the chairmanship of the respective Governors. Each Committee would include the senior field representatives of RID, the Department of Extension and branch managers of the Bank for Agriculture and Agricultural Cooperatives. An assurance was obtained from the Government at negotiations that it would establish these committees within three months of loan signing.

To facilitate the information flow to the Executive and Coordinating Committees, the consultants appointed for the project would assist each of the departments concerned in the preparation of annual work programs and progress reports; the latter would identify any problems being encountered in project implementation, or in coordination between departments and recommend solutions to such problems.

SOCIAL

The project would not only utilize the underemployed labor in the area, but would also provide work to unemployed labor from neighboring areas as well as from other parts of Thailand. It is expected that some families will migrate permanently to the area and settle on land rented or bought from present owners.

ECONOMIC

The annual gross value of production is expected to reach US\$70 million (B 1,400 million) at full development (14 years after project commencement), compared with a current level of US\$20 million (B 400 million). Using farm-gate prices, the incremental net value of production due to the project at full development would be about US\$36 million (B 720 million). Using shadow wage rates for labor and including rice taxes, the incremental economic benefits will be US\$34.0 million (B 680 million) per annum at full development, giving an economic rate of return of about 20%. This analysis does not account for substantial secondary benefits from facilities to be constructed under the project (e.g., an improved transportation network), benefits from livestock production or returns from crops such as cotton and sugar, which might be introduced and which would be more profitable than some crops presently included in the cropping pattern. The quality of the available data does not warrant a refinement of the economic analysis to incorporate these additional factors, but it is reasonable to assume that, if they could have been quantified and evaluated, the economic rate of return on the project would have been significantly higher.

Included with this summary is a table of cost estimates

Sensitivity Tests--Variation in Internal Rate of Return

B-98

	<u>Favorable % Change in Cost/Benefit Stream</u>		Base	<u>Unfavorable % Change in Cost/Benefit Stream</u>	
	20%	10%		10%	20%
<u>Benefits</u>					
Changes in Border Rice Price	24.4%	22.0%	19.7%	17.0%	14.0%
<u>Costs</u>					
Construction Costs	23.5%	21.5%	19.7%	18.2%	17.0%
Labor Shadow Rate	20.6%	20.2%	19.7%	19.3%	18.8%
Farm Inputs	21.2%	20.5%	19.7%	18.9%	18.2%

THAILAND
PHITSANULOK IRRIGATION PROJECT

Cost Estimates: Summary
(mid-1975 prices)

<u>Item</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>% Foreign Exchange</u>
	<u>-----B Million-----</u>			<u>-----US\$ Million-----</u>			
Diversion Dam (Table 2) ^{1/}	194.6	129.8	324.4	9.7	6.5	16.2	40
Irrigation System (Table 3) ^{1/}	645.5	430.4	1075.9	32.3	21.5	53.8	40
Drainage System (Table 4) ^{1/}	51.2	34.1	85.3	2.6	1.7	4.3	35
Flood Control (Table 4) ^{1/}	29.1	14.7	43.8	1.4	0.8	2.2	35
On-farm Development (Table 5)	298.1	243.9	542.0	14.9	12.2	27.1	45
Telecommunications (Table 6)	2.1	8.4	10.5	0.1	0.4	0.5	80
Pumping Equipment (Table 6)	2.0	8.0	10.0	0.1	0.4	0.5	80
Buildings (Table 6)	<u>13.1</u>	<u>2.9</u>	<u>16.0</u>	<u>0.6</u>	<u>0.2</u>	<u>0.8</u>	<u>20</u>
Subtotal	1235.7	872.2	2107.9	61.7	43.7	105.4	41
Engineering and administration (Table 7)	123.0	7.0	130.0	6.2	0.3	6.5	5
Vehicles & equipment (Table 7)	9.5	53.5	63.0	0.5	2.6	3.1	84
Consultants (Table 7)	9.0	51.0	60.0	0.4	2.6	3.0	85
Studies (Table 8)	<u>36.0</u>	<u>40.0</u>	<u>76.0</u>	<u>1.8</u>	<u>2.0</u>	<u>3.8</u>	<u>52</u>
Total	1413.2	1023.7	2436.9	70.6	51.2	121.8	42
Contingencies							
Physical	257.4	113.7	271.1	7.9	5.7	13.6	42
Price	<u>869.4</u>	<u>622.6</u>	<u>1492.0</u>	<u>43.5</u>	<u>31.1</u>	<u>74.6</u>	<u>42</u>
GRAND TOTAL	2440.0	1760.0	4200.0	122.0	88.0	210.0	42

^{1/} Estimates in Tables 2 through 4 are in end 1974 prices and have been increased by 6% to give the mid-1975 costs shown in this table.

TITLE: Chao Phya Irrigation Improvements Project

REPORT NO.: T-W-2

COUNTRY: Thailand

REGION: Asia

KEYWORDS: Surface irrigation (3); irrigation rehabilitation (3);
double cropping (5).

SUMMARY: The project was designed to improve existing irrigation systems covering a gross area of 17,000 ha in the Northern Chao Phya plain. The project aimed at increasing production of irrigated crops through higher wet-season yields and an expansion of dry-season cultivation.

LOCATION: Northern Chao Phya Plain.

CLIMATE: Ar.

CROPS: Paddy.

SOILS: Heavy clay loams or clays derived principally from mixed riverine alluvium; good for rice cultivation.

TARGET GROUP: The irrigating farmer.

BEGIN: 1974. END: 1978 AREA: 17k ha.

NUMBER OF FARMS: 6,600.

CONTRIBUTION:	IDA	US\$	5.5M
	RTG		5.1M
	TOTAL	<u>US\$</u>	<u>10.6M</u>

GOALS: The main direct effect of the project would be an increased production of rice and, to a lesser extent, of soybeans, mung-beans, and peanuts.

PURPOSE: To increase the incomes of people living in the project area and to improve Thailand's balance of payments position.

TYPE OF PROJECT: Large-scale irrigation rehabilitation and expansion.

TECHNOLOGY USED: Unlined canals and drains, land leveling.

DOCUMENTS REVIEWED: Staff Appraisal Report (25 pp and 15 annexes);
Project Performance Audit Report (75 pp).

PROJECT ORIGIN AND BASE LINE DATA: The Chao Phya Irrigation Improvement Project was appraised in June 1972 and the Credit Agreement was signed in May 1973.

BENEFICIARY INVOLVEMENT: The Government has decided to recover all operation and maintenance costs and as much of the investment cost as possible from the beneficiaries.

ACTUAL STARTING DATE: 1974

COMPLETION DATE: 1979.

GENERAL DESCRIPTION

The increased dry-season flow produced by the Bhumiphol and Sirikit reservoirs was expected to lead to a rapid increase in double-cropping, especially in the northern Chao Phya Plain. During the late 1960's, the Government and the Bank became concerned at the apparent slow growth of double-cropping. The Bhao Phya Irrigation Improvement Project was the first major undertaking aimed at accelerating the expansion of double-cropping.

TECHNICAL

The proposed project would improve irrigation facilities and supporting services to all farmers in an area of about 17,000 ha in the Northern Chao Phya Plain. This would enable an increase in wet-season rice yields as well as the cultivation of rice and some upland crops during the dry season. The project would include:

1. Rehabilitation of irrigation canals, drains and roads serving 17,000 ha;
2. On-farm development works involving the construction of irrigation and drainage ditches, farm roads, land leveling, and realignment of farm boundaries on 10,000 ha, and the repair or construction of farm irrigation and drainage ditches and minor works related thereto on 7,000 ha; and
3. Provision of integrated supporting agricultural services to farmers, including the necessary buildings, vehicles and equipment.

A firm of consultants would be engaged to assist project staff with the preparation of final designs and the implementation of work, and to carry out a feasibility study for a second stage project in the Northern Chao Phya Plain. Project works would be constructed during the dry season only and completed in four years.

PROJECT WORKS

1. Rehabilitation works. Although only minor works would be required on the main system, which has been recently overhauled, except for a short reach of five kilometers, extensive desilting and repair works would have to be carried out on the secondary canals (119 km) and drains (66 km), serving the project area. About 10 additional check structures would be built to improve water regulation and new secondary drains totaling 21 km would be opened to improve the drainage of low-lying lands. No lining of canals would be necessary. Rehabilitation works

would also include repairs on 68 km of existing feeder and service roads. The construction of about 37 km of new feeder roads of single-lane, earth surface standard would also be included in the project.

2. On-Farm Development Works. On-farm development works would be carried out on 10,000 ha, or about 60% of the project area where double-cropping is proposed. To permit the design of an efficient distribution network, the boundaries of farmholdings, which are presently irregular in shape, would be realigned. This would involve only minor exchanges of land between owners, combined with the leveling and bordering of fields, and the construction of tertiary irrigation and drainage canals, structures and farm roads. This integrated procedure, which conforms to standards developed in the pilot projects, produces a uniform rectangular layout of the farms, and the irrigation system, gives all farms access to ditches and roads, and is more efficient for both farming and irrigation operations. Over the remaining 7,000 ha, which would be limited to the production of a wet-season rice crop, existing ditches would be repaired and water-regulating structures installed. Some additional irrigation and drainage ditches would be constructed where required.

3. Water Supply. The Bhumiphol and Sirikit reservoirs provide a regulated water supply during the wet season to about 700,000 ha in the Northern Chao Phya Plain. After making allowances for other uses (mainly power, navigation and salinity control), these reservoirs can provide about 3,700M m³ for dry-season irrigation. On the basis of recent reservoir operation studies, these releases could meet the dry season requirements of about 400,000 ha or nearly 60% of the total area, provided that adequate networks are constructed, to enable the present low irrigation efficiency to be raised from 25%-30% to 50%-55%. Thus, even if the present plans for the development of double-cropping can be realized, water availability would not become a constraint for another 15 to 20 years.

4. Water Demand. Irrigation requirements for the proposed cropping pattern were determined from information obtained at the Samchok experiment station. These results check closely with the theoretical computation of consumptive use, as determined by standard methods. Taking into account an overall efficiency of 55%, the total diversion requirements at the headworks of each subproject would be about 100M m³, or an average of 11,800M m³ per ha per annum of net irrigable land, for a cropping intensity of 160%.

Headworks supplying water to both subprojects, as well as the two conveyance canals which have been overhauled during

the last year except for one short reach of five kilometers, are in good condition and would require only minor works in order to be able to supply the water requirements of the project area in both wet and dry seasons, in a satisfactory manner. This is not the case, however, with the secondary irrigation and drainage canals totaling 119 km and 66 km, which are badly silted and whose banks are, in many places, severely eroded. The existing structures for water control, especially tertiary canal turnouts, also need extensive repairs and installation of gates. Existing wooden bridges suffer from neglected maintenance and have to be replaced by concrete structures. Maintenance of existing feeder roads totaling about 68 km is also required.

To ensure effective operation of the system, besides rehabilitation of existing works, some new construction is also required, including the reshaping of natural waterways used for conveyance of irrigation water over about 23 km, the construction of 21 km of secondary drains and 37 km of feeder roads. In order to retain command at 70% of full water supply levels during the dry season, about 10 new cross-regulators would be constructed and, where necessary, the canal banks would be raised. Tertiary turnouts would be replaced by constant head orifice structures, where appropriate. All structures would be provided with graduated scales and stream gauges would be recalibrated.

5. On-Farm Works. With the completion of the above works, full water control would be guaranteed in the main system, but additional works would have to be carried out to ensure proper water control at farm and interfarm levels. Since, at full development of the plan, only 60% of the total area would be irrigated, two types of layout are proposed according to anticipated land use: one for double-cropping and one for wet season rice only.

6. Intensive double-cropping layout. Over selected areas, totaling about 10,000 ha, where soils and topography are better suited for dry season cultivation of rice and upland crops, a dense network of irrigation and drainage ditches would be constructed with an average spacing of 150-200 m. Control structures would permit the delivery of water in regulated quantities to each farm. Farm roads using spoil from land leveling would be constructed along the irrigation ditches to permit access to farms during the dry season. Land clearing and leveling would also be carried out to achieve a high degree of water control needed for efficient irrigation. Since the minor network has to be based on surface topography, it will intersect the current parceling pattern. To ensure that all farms have direct access to the irrigation and drainage ditches and farm roads, it would be necessary to

rearrange most holdings in the area. Such rearrangement would involve minor exchanges of land with only minimal effects on the actual size of the farm.

7. Layout for wet season rice. Extensive remodeling of the existing irrigation ditches would be carried out on the remaining 7,000 ha. Where necessary, additional irrigation ditches would also be constructed and water control structures and farm turnouts provided to secure regulated water deliveries to all farms. Since the field-to-field irrigation would be replaced gradually by direct irrigation to farms, a network of drainage ditches would also be necessary for the rapid evacuation of surplus water toward the main drains. The distribution system would be completed with spot leveling over areas of rough topography to permit the degree of water control required by high yielding rice varieties. Reparceling of land would be carried out on a modest scale only along the ditches to permit an efficient design, but a cadastral survey would cover the entire area as a prerequisite for issuing land titles to all farm owners.

INSTITUTIONAL

Until recently, the Royal Irrigation Department (RID), under the Ministry of National Development, was responsible for the construction, as well as the operation and maintenance of all irrigation works, while the Ministry of Agriculture provided supporting services to farmers, particularly extension and research. With strong leadership and large budget allocations, RID was able to implement an extensive construction program of water regulation works. Most of the emphasis, however, was placed on the construction of storage reservoirs and the main irrigation and drainage networks, with little investment being made in the distribution networks to bring the water down to the farm level, as it was felt that these works would be done by the farmers themselves. At the same time, the Ministry of Agriculture was unable to establish an efficient field organization because of poor funding and a proliferation of responsibilities between its eight departments, each concerned with a particular aspect of irrigated agriculture. Furthermore, coordination between RID and the Ministry of Agriculture had been almost nonexistent.

Overall responsibility for construction, operation and agricultural development of the project would rest with the recently formed Office of Irrigated Agriculture, headed by the Deputy Undersecretary of State for Agriculture, acting in the capacity of Project Director. The Project Director would formulate the annual plan of operations, prepare project budgets and approve the appointment of key personnel to the project organization. Under his office, tender documents would be prepared and issued and contracts awarded.

The Project Director would report directly to the Central Policy Committee for Irrigated Agriculture, which has recently been established under the chairmanship of the Undersecretary of State for Agriculture and comprises the heads of all departments involved. This Committee would be responsible for the formulation of policies, the establishment of priorities, as well as the approval of the annual budget and plan of operations.

A project manager, with an office in Chainat and reporting to the Project Director, has already been appointed. He would be responsible for the planning and implementation of day-to-day activities in the field. A project supervisor in each subproject area would be responsible for construction supervision and the operation and maintenance of the completed works. The project organization would have four sections: administration, engineering (including operation and maintenance), extension and training, and credit and farmers' organizations.

Full-time professional staff would be seconded to the Office from the Ministry of Agriculture. These staff would continue to receive technical support from their respective departments and backup specialists would visit the project area as required. During the initial four-year construction period, about 240 people would be employed in the project's central headquarters and the three field offices. After construction is completed, a substantial proportion of the professional personnel would be transferred to work on the second stage project. It would be a condition of effectiveness of the credit that the Government has established a project organization acceptable to IDA. Assurances were obtained during negotiations that the Government would continue to employ, during the implementation of the project, a project manager, with experience and qualifications acceptable to IDA, to be responsible for the planning and implementation of the project in the field, and would ensure that all staff seconded to the project organization would work exclusively under the administrative responsibility of the project organization.

SOCIAL

Some consolidation of land holdings has been necessary to make sound water management possible.

ENVIRONMENTAL

Since all arable land in the project is, at present, cultivated in the wet season, the introduction of irrigation during the dry season is not expected to produce significant changes in ecology. Improved drainage from the project may slightly aggravate drainage problems in undeveloped areas downstream, but this would be remedied

when the overall drainage system for the Chao Phya Plain, presently under study by the Royal Irrigation Department, is implemented. It is expected, however, that the project would have some adverse effects on fish production in a limited area and provision has been made in the project for an inland fisheries development scheme which would be a part of the agricultural support program in the project area.

ECONOMIC

Using a project evaluation period of 30 years, the economic rate of return is 26%, compared to 15% at appraisal. The project's increased cost, reduced area, and lower target yields have been offset by the higher rice price and higher cropping intensity. Since wage rates in the project are reported to be higher than in the surrounding areas, the economic rate of return was also tested for its sensitivity to labor costs. It was found that, even assuming an economic labor cost equivalent to the peak season market rate of B 40 per man-day, the economic rate of return would still be 21%. If the wet season benefits alone are considered, the project has an economic rate of return of 11%.

At appraisal, the project was intended to demonstrate ways to overcome the slow growth of dry season cropping in the Chao Phya Plain. In 1972, the area of dry season cropping was about 107,000 ha, compared with a potential of about 450,000 ha which could be supplied with water from the Bhumiphol and Sirikit reservoirs. However, since 1972, the dry season cropped area has grown rapidly and reached about 400,000 ha in 1978. This was largely due to a sharp increase in paddy prices which rose from US\$45/ton in 1972 to US\$115/ton in 1978, providing strong incentives to farmers. About 200,000 ha of the dry season cropped area is now irrigated by low-lift pumps in the Southern Chao Phya Plain in areas formerly devoted to a single wet season crop of flood-dependent rice. In these areas, farmers have given up wet season cultivation in favor of dry season cropping. The remaining 200,000 ha are double cropped, of which 150,000 ha are irrigated by gravity and 50,000 ha by low-lift pumps. Gravity irrigation can be found in areas where conditions are well-suited to double cropping, such as large tracts of level land with access to irrigation canals.

It is now apparent that the low paddy price prevailing prior to 1972 was the main constraint on the use of dry season water.

Appended to this summary are a comparison of paddy yields, given at appraisal with those revised in the completion report, and a summary of estimated and actual final costs.

THAILAND

CHAC PHYA IRRIGATION IMPROVEMENT PROJECT

PROJECT COMPLETION REPORT

Paddy-Cropped Areas and Yields at Full Development

	Without Project				With Project			
	Appraisal		Revised ^{a/}		Appraisal		Revised	
	Area (ha)	Yield (ton/ha)	Area (ha)	Yield (ton/ha)	Area ^{b/} (ha)	Yield (ton/ha)	Area (ha)	Yield (ton/ha)
<u>Wet Season</u>								
Broadcast	6,500	1.9	1,450	2.0	3,000	2.3	--	--
Local Transplant	8,900	2.3	4,340	2.8	5,500	3.5	1,650	3.5
HYV	1,600	2.8	8,680	3.0	8,500	4.8	11,900	4.2
<u>Dry Season</u>								
HYV	--	--	7,960	3.0	6,500	4.9	13,550	4.4

a/ Based on continued growth in areas adjacent to the project area as indicated by existing conditions.

b/ Net area mistakenly equated to gross area (para 4.04).

THAILAND
CHAO PHYA IRRIGATION IMPROVEMENT PROJECT
PROJECT COMPLETION REPORT
Final Cost and Appraisal Estimate

	Appraisal Estimate	Final Cost
	-----(US\$ '000)-----	
Rehabilitation works	1,424	1,575
On-farm works		
Design	365	637
Construction	2,150	7,230
Subtotal	<u>2,515</u>	<u>7,867</u>
Buildings	289	304
Vehicles and equipment	2,040	3,604
Management	879	1,020
Consultants		
Stage I	840	1,177
Stage II	100	358
Mae Klong	50	140
Subtotal	<u>990</u>	<u>1,675</u>
Stage II Study	583	608
Base Cost	<u>8,720</u>	<u>16,653</u>
Contingencies	1,880	--
Total	<u>10,600</u>	<u>16,653</u>
Less Stage II/Mae Klong	(733)	(1,106)
Estimated residual		
value of equipment	(480)	(2,199)
Net Cost of Stage I	<u>9,387</u>	<u>13,348</u>
<u>Area Developed</u>	----- (ha) -----	
Intensive	10,000	15,900
Extensive	7,000	--
Total	<u>17,000</u>	<u>15,900</u>

TITLE: Chao Phya Irrigation Improvement Project II

REPORT NO.: T-W-3

COUNTRY: Thailand

REGION: Asia

KEYWORDS: Surface irrigation (3); irrigation rehabilitation (3);
on-farm water management (3).

SUMMARY: The project consists of irrigation system rehabilitation such as canal reshaping, additional structures and road and drain improvement as well as on-farm development works constructed on the Northern Chao Phya.

LOCATION: Northern Chao Phya

CLIMATE: Aw.

CROPS: Paddy

Soils: Fine-textured marine clays and marl-based clays.

TARGET GROUP: The irrigating farmer.

BEGIN: 1977 END: 1982 AREA: 201k ha

NUMBER OF FARMS: 130,000.

CONTRIBUTION:	World Bank	US\$ 55.0M
	RTG	57.0M
	TOTAL	<u>US\$ 112.0M</u>

GOALS: The overall paddy production should increase from 202,000 tons in the future without the project, to 375,000 tons at full project development.

PURPOSE: Approximately 24,400 farm families and another 2,000 families of landless laborers would benefit directly from increased production and employment opportunities.

TYPE OF PROJECT: Large-scale rehabilitation and improvement of an existing irrigation project.

TECHNOLOGY USED: Hand labor will be used for some ditch-digging and embankment trimming, as well as for repairing concrete structures. Machinery will be used for major works.

DOCUMENTS REVIEWED: Staff Appraisal Report (79 pp and three annexes);
World Bank Working Paper No. 299 (41 pp).

PROJECT ORIGIN AND BASE LINE DATA: The Staff Appraisal Report is based on the findings of two pre-appraisal missions and an appraisal mission.

BENEFICIARY INVOLVEMENT: An annual irrigation charge would approximate annual expenditures on the operation and maintenance of the system.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

The construction of three pilot projects and service roads in the Mae Klong area, together with mapping and feasibility studies in both Northern Chao Phya and Mae Klong would provide a basis for further development of irrigation in both project areas.

TECHNICAL

1. Part A (US\$47 million). Rehabilitation of the main irrigation, drainage and road networks and on-farm development works to improve water control and farm access to serve a net cultivable area of about 63,000 ha distributed among six sub-project areas in the Northern Chao Phya Plain.
2. Part B (US\$14 million). Rehabilitation works only, to improve water control and operational efficiency, for an area of 138,000 ha (additional to the Part A area), as well as topographic mapping for about 300,000 ha of the Northern Chao Phya Plain.
3. Part C (US\$13 million). Topographic and cadastral mapping of about 50,000 ha, construction of three pilot projects and 360 km of service roads and associated works in the Mae Klong irrigation area.
4. Part D (US\$3 million). Consultant services for implementing the above works, preparing feasibility studies for a third stage project in the Chao Phya Plain and a second stage of development at Mae Klong and for studies of agricultural supporting services.

Provision would also be made under the project for improvements in operation and maintenance, a fisheries development program and project monitoring and evaluation. Each of the engineering components is described in more detail below.

1. Part A (Rehabilitation and On-Farm Development). Rehabilitation works are required to restore and upgrade the existing irrigation, drainage, roads and communications systems serving the subproject areas, to enable efficient operation and to maximize water availability in the dry season. Works would include:
 - a. reshaping of canals, with enlargement of capacity in critical sections;
 - b. full canalization of natural watercourses where this is justified because of heavy water losses;

- c. replacement of deteriorated or obsolete canal structures;
- d. additional check structures to ensure full command of all laterals and outlets at flows down to 40% of the full design flow;
- e. replacement of wooden road bridges by concrete structures (where justified by traffic and/or maintenance considerations), along with addition of new bridges over canals and drains;
- f. installation of telephone lines to complete the connection of all zonenmen's and gate tenders' houses;
- g. enlargement and extension of main and collector drains, to give adequate drainage to all subproject areas, at least in the dry season (adequate drainage at all times would not be feasible without massive investments);
- h. reconstruction or improvement of service roads along the canals; and
- i. construction of additional houses for O&M staff.

On-farm development works would be implemented over nearly all of the 63,000 ha included in Part A. There would, however, be some small, low-lying areas with little or no development potential, which would be excluded. The subproject area boundaries are being drawn to exclude any large tracts of this kind. The standard (or intensity) of development would be varied between and within tertiary command areas to suit the agro-economic potential of each small area, in a manner similar to the procedures adopted for the Phisanulok Project. Factors which would be taken into account by the designers include:

- a. topography;
- b. size and shape of holdings;
- c. land capability;
- d. depth of flooding;
- e. present cropping pattern and intensity; and
- f. the farmers' attitudes towards land development and other technological innovations.

Design criteria which would be flexibly applied include:

- a. the average spacing of ditches, drains, and roads;
- b. whether or not boundary realignment would be required;
and
- c. the need for land leveling.

Cost estimates have been prepared on the basis that 75% of the area would require "intensive" development, with the remainder being developed "extensively" at a significantly lower cost.

2. Part B (Rehabilitation). Rehabilitation works similar to those to be carried out under Part A would be constructed throughout an area of 138,000 ha, subdivided into 20 areas in 13 irrigation "projects". Works have been concentrated in defined areas, rather than scattered throughout the Northern Chao Phya Plain, in order to maximize benefits through complementary investments. This list would be reviewed by the consultants to ensure that only high-priority items are included. Investment per ha (about US\$80/ha) under this part of the project would not be as high as for the analogous works under Part A, as the agricultural potential and the need for water control and access would not be as great in the absence of on-farm development.

Large-scale topographic mapping is a prerequisite to any future irrigation improvement. Under the project, a start would be made on the systematic mapping of the whole Northern Chao Phya Plain. A survey grid, indexing system and control points, would be established for the whole Northern Chao Phya Plain, a gross area of about 700,000 ha. About 80,000 ha have been, or will have been, mapped in connection with the State I project and Part A of the present project. Under Part B of the project, an additional 300,000 ha would be mapped, to a scale of 1:10,000 with a 25 cm contour overlay. Areas with the greatest potential for future development would be selected for this program. Maps would be drawn in a suitable form for the design of rehabilitation works and for the planning of future on-farm works. At a later stage, the survey information could be replotted at a scale of 1:4,000 for the design of on-farm works, if desired.

3. Part C (Mae Klong Development). Improvement in yields and the resolution of conflicts between rice and sugarcane growers in the Mae Klong area would appear to be constrained by the present lack of water control and the lack of road access to the farms. While clearly some form of on-farm development will be required, it would be rash to go ahead with the large-scale implementation of systems developed elsewhere, as the topographic conditions and cropping patterns of the

Mae Klong area will require distinctive solutions. For this reason, a two-year program of pilot projects is proposed. Under the project, three pilot projects, each between 500 and 1,000 ha in size, would be constructed in locations which typify the major land form/crop combinations. The first site, a largely rice-growing area, has been identified and a preliminary design prepared. As in the case of Chao Phya, the emphasis would be on flexible design procedures to suit the agronomic potential and cropping pattern of each area. In sugarcane areas, the emphasis would be on good field drainage and road access, together with the gradual introduction of supplementary irrigation. In the rice areas, the objective would be secure and timely water delivery, road access and major drainage. Experience gained on the pilot projects would be incorporated in the feasibility study to be prepared under Part D of the project, which would pave the way for large-scale investment in the future.

Service roads have been constructed along only a few major canals in the Stage I area. Other canals have unshaped roadbeds or footpaths only.

Lack of main drainage is a major problem in the upper part of Stage I. RID is planning to complete the drainage network by 1979. About 497 km of drains and 179 structures will be constructed over this three-year period. As these works were included in the project description for the Mae Klong Project I, and the equipment for their force account construction was financed under the loan, these works would not be financed out of the proposed loan. The drainage program has been slowed by the age of the equipment, budgetary stringencies, land acquisition problems and the low priority attached, until recently, to this activity. An assurance has been obtained that RID would complete the construction of the main drainage network for the Stage I area before October 1, 1979.

Water supply for the Chao Phya Project area would be obtained from rainfall and the controlled discharges from the Bhumiphol and Sirikit dams. Bhumiphol Dam has an average annual inflow of 6,000M cubic meters and a live storage of 9,800M cubic meters, while Sirikit Dam has an inflow of 5,000M cubic meters and live storage of 7,200M cubic meters. Reservoir releases are based on an annual plan of operations agreed between RID and the Electricity Generating Authority of Thailand (EGAT). Dry season releases, from the two dams for irrigation, navigation and salinity repulsion, have increased from 5,200M cubic meters in 1972 to 6,700M cubic meters in 1974. Studies under the preliminary phase of the Chao Phya Basin Study have updated previous operational studies,

taking into account the continuing growth of dry season irrigation demand. The feasibility study shows that, based on a simple model of the Northern and Southern Chao Phya Plain, the average and peak demands from the project area can be met under the existing operational rules. However, it appears that little surplus water will be available for future expansion unless the operating rules are changed and/or the irrigation efficiency of the system is improved.

The irrigation water requirements for the proposed cropping pattern have been calculated on the basis of theoretical computations (Penman method). The net diversion requirements at the Chao Phya Barrage for a dry season rice crop would be 1,180M cubic meters, assuming a total system efficiency of 56%. Actual overall dry season efficiencies in the Northern Chao Phya Plain have increased from 14% to 38% in the last four years, without on-farm development. The peak irrigation requirements would 1.36 l/s/ha in April for high-yielding varieties or 0.8 l/s/ha in July for traditional varieties. Considering that only part of the area would be irrigated in the dry season, the present canal design criterion would generally be adequate and no problems are anticipated, although more detailed investigations will be made during final design. The annual average diversion requirements for the 63,000 ha under Part A of the project would be about 620M cubic meters, of which 440M cubic meters would be required in the dry season. Extensive sampling and detailed chemical analyses have shown the water of the Chao Phya River to be of excellent quality for sustained irrigation.

ENVIRONMENTAL

Since the project areas are, at present, irrigated in the wet season, the introduction of irrigation improvement and the expansion of dry season production is not expected to produce significant changes in environmental conditions. Drainage improvements would reduce the amount of stagnant water and thus reduce hazards from water-associated diseases. Schistosomiasis is not present in the Central Plain of Thailand. Better control of irrigation water, improved drainage and the increased use of chemical pesticides may be expected to have an adverse effect on fish production. To counteract this tendency, a program of fisheries development, based on private fishponds, has been included in the project.

INSTITUTIONAL

Direct responsibility for project implementation would rest with the Royal Irrigation Department (RID), which was also the

executing agency for all nine previous Bank Group-assisted irrigation projects in Thailand. RID's organization structure and manpower, and recommendations as to how the agency should streamline its activities in order to implement an increasing program of irrigation development in the years ahead, are discussed in the Irrigation Program Review. RID is presently selecting a consulting firm to assist it with developing and subsequently implementing specific programs along the broad lines recommended in the Irrigation Program Review.

Within RID, responsibility for Parts A and B of the project would rest with the Deputy Director-General (O&M) who would act as Project Director. Responsibility for day-to-day activities in the field for these two project components would rest with a full-time Project Manager, a senior RID engineer, reporting directly to the Project Director.

The design and construction of on-farm works under Part A of the project would be handled by the Land Consolidation Section of RID's O&M division. As was the case under the Stage I Project, the design of rehabilitation works would be handled by the construction group of the Land Consolidation Section. However, the Project (O&M) Engineers would be closely consulted on the scheduling of works and would contribute some equipment for their construction. All equipment purchased for rehabilitation works would revert to the Project (O&M) Engineers after the completion of rehabilitation. Topographic mapping for Parts A and B of the Project would be undertaken by a unit within RID's Survey Division, under the supervision of a chief surveyor for the project. RID is considering replacing the above arrangements with an On-Farm Development Division, under the Project Manager, to be fully responsible for the implementation of Parts A and B of the project, in accordance with the recommendations of the Irrigation Program Review. Implementation of this proposal may, however, be postponed until the proposed management consultants have completed the first phase of their study (end-1977).

At present, there is a notable lack of coordination between the ongoing activities of RID's divisions in the Mae Klong area, as the Construction Division, Roads Division, Project (O&M) Office, and the Land Consolidation Section operate independent programs in the area. The Construction Division is operating in accordance with priorities which were set 15 years ago, and there is no one in a position to decide on future priorities for the whole project. In order to overcome this problem, the Deputy Director-General (O&M) has been designated as Project Director (Mae Klong), to be ultimately responsible for all RID's activities in the Mae Klong, including construction activities outside Part C of the project, and to ensure that all the efforts of the several divisions of RID are fully coordinated and oriented towards a common goal. A Project

Manager (Mae Klong) has also been designated to be directly in charge of all irrigation, drainage, road construction and on-farm development. A chief surveyor would be appointed to take charge of all surveys and mapping. A condition of disbursement for expenditures under Part C of the project would be that RID has formally appointed a Project Director and a Project Manager, after consultation with the Bank.

Although RID would have direct responsibility for the project, various activities, particularly those involving procurement, budgeting, staffing and the appointment of consultants, require clearance and/or approval by several departments, the Minister of Agriculture or even the Cabinet itself. The process involved in obtaining these clearances is time-consuming and, particularly for procurement, a serious cause of delays in project execution. In order to overcome these problems under the Phisanulok Irrigation Project, the Cabinet established a Project Executive Committee to which it delegated full powers in respect to all project activities. As this Committee has been effective in executing work under the Phitsanulok Project, a similar Committee would be established for the Chao Phya Project. The Committee would be chaired by the Undersecretary of Agriculture and would include the Project Coordinator, the Director-General of RID, the Project Director, the Project Manager and representatives of the Ministry of Interior, Budget Bureau, Ministry of Finance, Public Prosecutor's Office and Civil Service Commission. Thus all the agencies which now approve proposals and documents sequentially would be able to take action simultaneously. The establishment of a Project Coordination Committee, with composition, powers, functions and procedures satisfactory to the Bank, would be a condition of its powers in respect to procurement to a Bidding Subcommittee, chaired by the Project Coordinator and including representatives from the Ministry of Finance and Budget Bureau, as well as the principal project officials from RID.

ECONOMIC

The economic rate of return for the project as a whole is estimated at 31%. Sensitivity of the rate of return for the entire area was tested to cost overruns, reduction and delay in benefits, and pricing of all incremental labor at the full employment market wage. The effects of these changes were as follows:

1. A 30% increase in construction and O&M costs: 33%;
2. A two-year delay in reaching full project benefits: 27%;
3. A 30% reduction in project benefits: 31%;
4. A combination of (1), (2), and (3): 18%; and
5. All incremental farm labor priced at B 25 per man-day: 36%.

These results indicate that the economic rate of return is not unduly sensitive to any of the major assumptions made in its derivation.

The rate of exchange used in this summary is 20 bahts = US\$1.

Included with this summary is a chart showing the proposed allocation of the proceeds of the loan.

PROPOSED ALLOCATION OF THE PROCEEDS OF THE LOAN

Category	Cost (including price contingencies)	Amount of Loan Allocated
A. <u>Chao Phya</u>		
(1) <u>Civil Works and Mapping</u>		
 <u>by Contract</u>		
On-farm development	16.8	8.6
Disbursement would be at 50% of total expenditure.		
(2) <u>Civil Works and Mapping by</u>		
 <u>Force Account</u>		
Rehabilitation (parts A&B)	25.6	
On-farm works	30.4	
Less: construction equipment	<u>11.2</u>	
Subtotal	44.8	17.4
Disbursement would be at 40% of total expenditure (excluding depreciation).		
(3) <u>Equipment and Vehicles</u>		
Construction equipment	11.2	
Miscellaneous equipment	<u>2.9</u>	
Subtotal	14.1	13.3
Disbursement would be at 100% of foreign expenditures or local expenditures exfactory, or 65% of total expenditures for imported items procured locally.		
(4) <u>Consultants' Services and Overseas Training</u>		
Implementation (Parts A&B)	1.7	
Feasibility Study - Chao Phya III	0.4	
Overseas Training	<u>0.1</u>	
Subtotal	2.2	2.2
Disbursement would be at 100% of total expenditures.		
B. <u>Mae Klong</u>		
(1) <u>Civil Works and Mapping</u>		
 <u>by Contract</u>		
Roads	9.4	4.8

Proposed Allocation of the Proceeds of the Loan (Continued)

Category	Cost (including price contingencies)	Amount of Loan Allocated
Disbursement would be at 50% of total expenditure		
(2) <u>Civil Works and Mapping by Force Account</u>		
Pilot project	1.7	
Miscellaneous	<u>2.3</u>	
Subtotal	4.0	1.7
Disbursement would be at 40% of total expenditure (excluding depreciation)		
(3) <u>Equipment and Vehicles</u>		
Miscellaneous	2.8	2.7
Disbursement provisions as for Category A(3).		
(4) <u>Consultants' Services and Overseas Training</u>		
	0.6	0.6
Disbursement would be at 100% of total expenditures.		
c. <u>Unallocated</u>		
Physical contingencies	7.6	3.7
<u>Expenditures Not Financed</u>		
Engineering, administration and other costs	<u>9.7</u>	<u>--</u>
<u>Total</u>	<u>112.0</u>	<u>55.0</u>

TITLE: Irrigation Project XI

REPORT NO.: T-W-4

COUNTRY: Thailand

REGION: Asia

KEYWORDS: System rehabilitation (3); Flood control (3).

SUMMARY: The project would improve and extend existing facilities covering 66,000 ha in the Meklong Basin and provide new facilities to serve 15,000 ha in the Pattani Basin. Both project areas will be served by Bank-financed dams. The project would allow effective utilization of water for year-round irrigation.

LOCATION: The Meklong and Pattani river basins in central and southern Thailand.

CLIMATE: Aw.

CROPS: Paddy, sugarcane.

SOILS: Predominantly heavy clays with some clay loams and sandy loams.

TARGET GROUP: The irrigating farmer.

BEGIN: 1980 END: 1986 AREA: 81k ha.

NUMBER OF FARMS: 30,500.

CONTRIBUTION:	World Bank	US\$ 80.0M
	RTG	106.0M
	TOTAL	<u>186.0M</u>

GOALS: As a result of the project, paddy construction would increase from about 185,000 tons to about 545,000 tons at full development and sugarcane production would rise from 30,000 tons to 450,000 tons.

PURPOSE: To improve the standard of living of the rural population and to improve Thailand's balance of payments.

TYPE OF PROJECT: Rehabilitation and extension of existing irrigation works in the Meklong Basin and development of a new irrigation system in the Pattani Basin.

TECHNOLOGY USED: Concrete-lined and unlined canals, roads, tide gates.

DOCUMENTS REVIEWED: Staff Appraisal Report (81 pp).

PROJECT ORIGIN AND BASE LINE DATA: The Staff Appraisal is based on the findings of a preappraisal mission in January/February 1979 and an appraisal mission in April/May 1979.

BENEFICIARY INVOLVEMENT: The Government will recover O&M costs and a portion of the initial investment from the beneficiaries.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

The proposed project would increase cropping intensities and yields on about 81,000 ha through the improvement, rehabilitation and extension of irrigation works. Rice would be the major crop grown during the wet and dry seasons and there would be about 5,000 ha of irrigated sugarcane grown in the Meklong area.

TECHNICAL

The project would provide for construction of new irrigation facilities and improvement of existing facilities to irrigate 66,000 ha in Meklong and 15,000 ha in Pattani. The main features would be:

1. Meklong:
 - a. improvement and enlargement of 157 km of the existing main canal and completion of 33 km of new main canal;
 - b. improvement and enlargement of the 206 km of existing lateral canals and construction of 103 km of new lateral canals and service roads;
 - c. completion of about 336 km of main and secondary drains; and
 - d. construction of tertiary canals, drains and farm roads.
2. Pattani:
 - a. improvement of 23 km of the existing right main canal and construction of the remaining 25 km;
 - b. construction of about 134 km of laterals and service roads;
 - c. construction of about 165 km of main and secondary drains; and
 - d. construction of tertiary canals, drains and farm roads.

In addition, the project would provide construction equipment, operation and maintenance equipment, buildings, and consulting services to assist in the design and implementation of project works and detailed engineering for the 30,000 ha remainder of the Pattani Stage I development.

PROJECT WORKS

1. Meklong. Rehabilitation works are required to upgrade the existing irrigation, drainage and road systems to enable efficient operation and to maximize water availability in the dry season. The 1R canal, originally constructed with a design capacity of 66.9 cu m/s, would be enlarged to 85.2 cu m/s to supply a service area of 50,700 ha with irrigation in the dry season. This would be accomplished by raising the concrete lining 0.40 m in the initial 17.4 km, installing concrete lining in eight kilometers of the presently unlined section, and cleaning and reshaping 11 km of unlined section. The capacity of the remainder of the existing canal is adequate. Cross-drainage structures would be installed to bypass flood flows from the western catchment area across the 1R canals. The upstream spoil bank would be shaped to provide a training dike for routing the flood flows into the cross-drainage structures. The remaining 33 km of the 1R canal (km 90 to 123) would be constructed to serve the lower part of the project area. The existing 2R canal capacity would be increased from 13.7 to 25.5 cu m/s and would provide full irrigation to 14,000 ha in the dry season. A supplemental intake structure would be installed at the headworks, the initial eight kilometers of canal would be widened and the lining replaced on the lower bank. The lining would be raised 0.60 m in the remaining four kilometers of lined section, and the width and depth would be increased in the 55 km of unlined section.

About 206 km of existing laterals would require enlargement and rehabilitation to deliver the required peak demand at the farm level in the dry season. About 30% of these laterals would be lined in areas where excessive seepage losses and erosion appear likely. The remaining 41 km of existing laterals and the 65 km of existing drains are adequate. About 103 km of new laterals and 336 km of drains would be constructed. Service roads along main and lateral canals and main drains would be five meters wide and paved with a 20 cm laterite surface.

The proposed type of on-farm development would be similar to that being implemented in the Northeast Irrigation Project Stage I and "Class B" areas in the Phitsanulok Project. Tertiary canals would be provided to serve units of about 60 ha. The maximum area served from one farm turnout would be four hectares and all farmers would have direct access to irrigation water and drains. Farm roads, three meters wide, would be provided along about 70% of the tertiaries which, together with service roads along laterals and drains, would provide all farmers with direct access to a road system. A minimum amount of boundary realignment would be necessary. Rough

leveling only in the vicinity of the new facilities and boundaries would be provided; any final leveling necessary would be the responsibility of the farmers. Paddy land over most of the project area is reasonably level, plots are generally large and level, and there is little fragmentation of holdings. Studies of sample areas show that a rational layout of tertiary canals, drains and farm roads can be achieved without recourse to the intensive land consolidation adopted in the Chao Phya Irrigation Improvement Project.

2. Pattani. The first 23 km of the right main canal would be repaired and cleaned, and water-regulating and delivery structures installed. The remaining 25 km of the right main canal would be constructed without lining except for about 2.5 km which passes through an area of permeable soils. Eight main lateral turnouts with head regulators, plus a number of small farm turnouts and minor structures would be provided in the new section.

The project would provide for the construction of about 134 km of laterals which would be unlined except for about 15% which pass through areas where excessive seepage and water loss appear likely. Service roads would be constructed along the main canal and laterals. About 165 km of drains would be constructed in the project to accelerate surface runoff during and after floods. Tide gates would be provided in drainage channels emptying into the sea to limit saline intrusion.

Paddy lands in the project area are generally level but fragmented and interspersed with rubber trees, coconut palms, and orchards, mostly owned by the paddy farmers. Project staff have found little support among the farmers for any significant rearrangement of paddy holdings. On-farm development would be similar to that adopted for Meklong and the average size of each tertiary unit would be about 60 ha. It would not be feasible, however, to provide each farmer with direct access to ditches and drains, and some field-to-field irrigation and drainage would be necessary. Also, to minimize encroachment on farm holdings, roads would be constructed only along some 30% of the total length of the tertiary canals.

WATER SUPPLY, DEMAND AND QUALITY

1. Meklong. The Meklong River has a catchment area of 25,600 square kilometers above Vajiralongkorn diversion dam, with a mean annual runoff of about 12,500 MCM, of which the Kvae Noi contributes about 50%, the Kvae Yai 40%, and other tributaries 10%. With the completion of the Ban Chao Nen and the Khao Laem

Multipurpose Dams, by 1985 about 8,860 MCM of regulated flow would be available to meet the requirements at Vajiralongkorn Diversion Dam. Water requirements for domestic and industrial uses, salinity and pollution control, and navigation have been estimated at 1,600 MCM annually. The remaining 7,260 MCM would be available for irrigation in the Meklong area. Extensive sampling and detailed chemical analyses have shown the water of the Kwaie Yai and Kwaie Noi to be of excellent quality for sustained irrigation.

2. Pattani. Water supply for the project would be obtained from rainfall and the controlled discharge from the Bang Rang Dam on the Pattani River, which is due to commence operation in 1981. Reservoir operation studies have been carried out by the Electricity Generating Board of Thailand to assess the capability of the reservoir to meet irrigation demands for a net irrigable area of 45,000 ha.

ENVIRONMENTAL

The project would have a beneficial effect on the environment by providing a year-round water supply in an area presently dependent on uncertain rainfall. Its adverse effects would not be significant. The project areas are already flooded for paddy cultivation for about six months every year, so that double-cropping would not greatly increase the farmers' exposure to waterborne diseases or malaria. The canals would not be used for drinking water since the villagers rely on wells and rainwater for domestic use. Schistosomiasis is not present in the project area. A major emphasis in Thailand's rice-breeding program is to produce disease- and pest-resistant varieties; therefore, chemicals to control pests and diseases are used sparingly by Thai farmers.

SOCIAL

In the total project area, about 45% of the farm families are presently living on incomes at or beneath the absolute poverty level; at full development, this figure would decrease to about 15%.

INSTITUTIONAL

The Royal Irrigation Department (RID) would be responsible for project implementation. RID is now organized in 22 functional divisions and 12 regional offices, under a Director-General. Three Deputy Directors-General and two Chief Engineers assist the Director-General in the management of the Department. RID, together with

most of the agriculture-related government agencies, falls under the Ministry of Agriculture and Cooperatives.

For recent Bank-financed irrigation projects, RID has adopted a system of project management which is aimed at placing all aspects of project implementation under the control of a Project Manager, who reports to a Project Director. A similar system would be adopted for the proposed project. Each of the two project components would have a Project Manager responsible for day-to-day management and for coordination with the consultants, the functional divisions, and other government agencies. The Project Managers, both of whom have already been appointed, would report to the Chief of RID's Construction Division, who, in turn, reports to the Deputy Director-General (Construction). Work in each of the project areas would be under the supervision of a Project Engineer. RID also plans to establish in the near future a Loan Projects Unit to assist the project managers and the functional divisions in coordinating the implementation of all externally-financed irrigation projects. This would formalize an existing arrangement in which certain RID staff have routinely handled, in the case of externally-financed projects, such matters as procurement, disbursements, reporting, administration of consultants, and coordination with the Ministry of Agriculture and Cooperatives.

ECONOMIC

The economic rate of return for the proposed project is 32%. The economic rates of return for each component are 35% for Meklong and 23% for Pattani.

1. Sensitivity of the Economic Rate of Return. Sensitivity analysis has been carried out to determine which variables would be most crucial to the success of the project. As a measure, the crossover value was used, defined as the value of the variable tested for which the NPV discounted at 12% was zero. The crossover value may be interpreted as the value of the variable tested, beyond which the economic rate of return would be below 12%.

a. Project yields. The project is not very sensitive with respect to yields. Even if yields were to be 1/3 lower than anticipated, the rate of return would still be 12%.

b. Dry-season cropping intensity. It is assumed that, in the future, dry season cropping would increase to about 16,500 ha with the existing level of irrigation facilities in Meklong and to 55,000 ha at full development of the project. With the higher yields anticipated

in both seasons due to the project, dry season cropping would have to be limited to less than 12,500 ha before the economic rate of return would fall below 12%. In Pattani, where lack of irrigation facilities precludes any dry season cropping in the future without the project, if a second crop were to be grown on 1,900 ha with the project, the economic rate of return would still be 12%.

c. Price of rice. The crossover value represents in Meklong, a 55% decrease in the forecast world market price of rice and a 45% decrease in Pattani, which seems unlikely.

d. Construction costs. The cost of construction would have to increase to almost four times the present estimate for Meklong and more than twice for Pattani before the economic rate of return for either of the projects would fall below 12%.

e. Development period. The development period would have to be extended to 23 years for Meklong and 21 years for Pattani before the ERR would fall below 12%.

The rate of exchange used in this summary is 20 bahts = US\$1.

Attached to this summary are a table of present and projected yields, a table of economic costs and benefits, farm budgets, cost estimate summaries.

Table 5.2: PRESENT AND PROJECTED YIELDS

	<u>Present</u>		<u>Future Without Project</u>		<u>Future With Project</u>	
	<u>Meklong</u>	<u>Pattani</u>	<u>Meklong</u>	<u>Pattani</u>	<u>Meklong</u>	<u>Pattani</u>
	----- (ton/ha) -----					
<u>Wet Season</u>						
Rice						
Native rainfed	2.2	1.4	2.5	1.6	--	--
Native irrigated	2.5	--	2.8	--	3.5	2.5
HYV	--	--	3.2	--	4.0	3.0
<u>Dry Season</u>						
Rice - HYV	3.0	--	3.3	--	4.2	3.5
Sugar, irrigated	55.0	--	75.0	--	90.0	--

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IRRIGATION XI

Economic Costs and Benefits
(B million)

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ANNEX 4

Table 4

Year	Pattani			Meklong			Total Project			
	Incremental Costs Capital	O&M	Incremental Benefits	Incremental Costs Capital	O&M	Incremental Benefits	Incremental Costs Capital	O&M	Incremental Benefits	
1	1980	78.6	--	--	189.1	--	--	267.7	--	--
2	1981	190.9	0.4	6.4	435.6	0.8	56.1	625.5	1.2	62.5
3	1982	189.7	1.2	12.8	323.9	3.1	89.8	513.6	4.3	102.6
4	1983	64.4	3.3	25.6	272.8	8.1	168.4	337.2	11.4	194.0
5	1984	67.4	4.9	64.0	245.0	15.4	280.7	312.4	20.3	376.4
6	1985	--	5.8	115.1	177.6	22.2	505.2	177.6	28.0	620.3
7	1986	--	5.8	153.5	--	25.3	673.6	--	31.1	827.1
8	1987	--	5.8	184.1	--	25.3	808.3	--	31.1	992.4
9	1988	--	5.8	212.4	--	25.3	931.8	--	31.1	1,144.2
10	1989	--	5.8	243.0	--	25.3	1,032.8	--	31.1	1,275.8
11-30	1990-2010	--	5.8	255.8	--	25.3	1,122.6	--	31.1	1,378.4
	IRR:		23%			35%			32%	

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IRRIGATION XI

Cost Estimate Summary - Pattani

Item	Local B million	Foreign B million	Total B million	Local US\$ million	Foreign US\$ million	Total US\$ million	% Foreign Exchange
Right Main Canal Facility							
Canal rehabilitation - 0-24.5 km	22.6	15.0	37.6	1.1	0.8	1.9	40
Canal construction - 24.5-50.3 km	48.8	45.0	93.8	2.5	2.2	4.7	48
Lateral system	57.3	52.8	110.1	2.9	2.6	5.5	48
Drainage system	85.4	57.0	142.4	4.3	2.8	7.1	40
On-farm development	47.2	38.6	85.8	2.4	1.9	4.3	45
Less depreciation force acct., equip.	(1.2)	(22.8)	(24.0)	(0.1)	(1.1)	(1.2)	95
Subtotal - Civil Works	<u>260.1</u>	<u>185.6</u>	<u>445.7</u>	<u>13.1</u>	<u>9.2</u>	<u>22.3</u>	<u>43</u>
Equipment							
Construction	2.9	55.1	58.0	0.1	2.8	2.9	95
Operation and maintenance	0.5	9.5	10.0	--	0.5	0.5	95
Communication	0.2	0.6	0.8	--	0.1	0.1	75
Subtotal - Equipment	<u>3.6</u>	<u>65.2</u>	<u>68.8</u>	<u>0.1</u>	<u>3.4</u>	<u>3.5</u>	<u>95</u>
Buildings	12.0	3.0	15.0	0.7	0.1	0.8	20
Land Acquisition	98.9	--	98.9	4.9	--	4.9	--
Consulting Services	23.8	23.8	47.6	1.2	1.2	2.4	50
Engineering and administration	60.5	10.1	70.6	3.0	0.5	3.5	15
Base Costs	<u>458.9</u>	<u>287.7</u>	<u>746.6</u>	<u>23.0</u>	<u>14.1</u>	<u>37.4</u>	<u>30</u>
Physical Contingencies	38.8	28.1	66.9	1.9	1.4	3.3	39
Price increases	101.3	64.7	166.0	5.1	3.2	8.3	39
Total Cost	<u>599.0</u>	<u>380.5</u>	<u>979.5</u>	<u>30.0</u>	<u>19.0</u>	<u>49.0</u>	<u>39</u>

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IRRIGATION XI
Cost Estimate Summary - Meklong

Item	Local ----- (B million) ---	Foreign ----- (US\$ million) --	Total ---	Local ---	Foreign ---	Total ---	Foreign Exchange
<u>Rehabilitation</u>							
1R canal - 65 km	49.3	3.29	82.2	2.5	1.6	4.1	40
2R canal - 67 km	17.7	11.8	29.5	0.9	0.6	1.5	40
Laterals - 207 km	64.3	52.6	116.9	3.2	2.6	5.8	45
<u>Construction</u>							
1R canal - 33 km	71.0	65.5	136.5	3.5	3.3	6.8	48
Laterals - 103 km	90.4	83.5	173.9	4.5	4.2	8.7	48
Drains - 336 km	115.9	77.2	193.1	5.8	3.9	9.7	40
On-farm Devel. - 71,000 ha	399.6	327.6	727.2	20.0	16.4	36.4	45
Less depreciation force acct. equip.	(3.6)	(67.8)	(71.4)	(0.2)	(3.4)	(3.6)	95
Subtotal - Civil Works	<u>804.6</u>	<u>583.3</u>	<u>1,387.9</u>	<u>40.2</u>	<u>29.2</u>	<u>69.4</u>	42
<u>Equipment</u>							
Construction	9.5	178.0	187.8	0.5	8.9	9.4	95
Operation and Maintenance	1.5	28.5	30.0	0.1	1.4	1.5	95
Communication	0.3	1.0	1.3	--	0.1	0.1	77
Subtotal - Equipment	<u>11.6</u>	<u>207.5</u>	<u>219.1</u>	<u>0.6</u>	<u>10.4</u>	<u>11.0</u>	95
Buildings	12.0	3.0	15.0	0.6	0.1	0.7	20
Land acquisition	97.0	--	97.0	4.9	--	4.9	--
Consulting Services & Training	22.9	42.1	65.0	1.1	2.2	3.3	65
Engineering & Administration	143.4	25.3	168.7	7.1	1.3	8.4	15
Base Costs	<u>1,091.5</u>	<u>861.2</u>	<u>1,952.7</u>	<u>54.5</u>	<u>43.2</u>	<u>97.7</u>	44
Physical Contingencies	114.5	93.7	208.2	5.7	4.7	10.4	45
Price Increases	318.5	260.6	579.1	15.8	13.1	28.9	45
<u>Total Cost</u>	<u>1,524.51</u>	<u>2,115.5</u>	<u>2,740.0</u>	<u>76.0</u>	<u>61.0</u>	<u>137.0</u>	44

TITLE: Third Chao Phya Irrigation Project

REPORT NO.: T-W-5

COUNTRY: Thailand

REGION: Asia

KEYWORDS: Surface irrigation (3).

SUMMARY: The project is the completion of the development of irrigation on 800,000 ha of the Chao Phya Plain and includes measures to improve irrigation throughout the plain.

LOCATION: Chao Phya Plain.

CLIMATE: Aw.

CROPS: Paddy.

SOILS: Compact, heavy clay soils ideal for paddy.

TARGET GROUP: The irrigating farmer.

BEGIN: 1963 END: 1968 AREA: 800k ha.

NUMBER OF FARMS: 300k

CONTRIBUTION:	World Bank	US\$ 5.6M
	RTG	6.5M
	TOTAL	<u>US 12.1M</u>

GOALS: After making allowances for increasing local consumption, the additional annual production from the Chao Phya Plain available for export should realize about US\$50 million at future prices.

PURPOSE: The results of the three irrigation projects on the Chao Phya Plain are increased water supply, adequate control of its distribution and reduced risk of flooding.

TYPE OF PROJECT: Large-scale irrigation modernization and extension.

TECHNOLOGY USED: Canals excavated by machine, farm dikes built by hand, dredging of navigation channels, construction of roads.

DOCUMENTS REVIEWED: Staff Appraisal Report (20 pp and seven annexes).

PROJECT ORIGIN AND BASE LINE DATA: The Staff Appraisal Report is based on findings of missions which examined the project in 1961 and again in July 1962.

BENEFICIARY INVOLVEMENT: Because of the heavy existing levies on marketed rice, a water charge may not be instituted.

THIRD CHAO PHYA IRRIGATION PROJECT

DITCHES AND DIKES

Crop Yield, Gross and Net Return of Future Production

Crops	Yield tons/ha	Price ฿/ton	Per Hectare		
			Gross Value/ha	Production Cost	Net Return
-----bahts per hectare-----					
Paddy	2.8	700	1,955	560	1,395
Sugar Cane	40.0	100	4,000	800	3,200
Other Crops	--	--	3,500	560	2,840

----- 1,162,000 hectares -----					
Crops	Area '000 ha	Production '000 tons	Gross	Production	Net Value of
			Value	Cost	Production
----- in million bahts -----					
Paddy	1,152	3,218	2,252	645	1,607
Sugar Cane	10	400	40	8	32
Other Crops ^{1/}	90	--	315	50	265
	1,162		2,607	703	1,904
Increase			1,041	325	716

^{1/}Second crops during dry season

TITLE: Phasom Dam Project

REPORT NO. T-W-6

COUNTRY: Thailand

REGION: Asia

KEYWORDS:

SUMMARY: The proposed project is the fourth phase in the development of the Central Plain of Thailand. The project would permit the storage of the monsoon flood flows of the Nan River, which would ultimately be used during the dry season for the irrigation of 380,000 ha and as a dependable irrigation supply for 400,000 ha of wet season cropping.

LOCATION: Central and Northern Thailand.

CLIMATE: Aw.

CROPS: Paddy.

SOILS: Primarily marine clays.

TARGET GROUP: The irrigating farmer.

BEGIN: 1966 END: 1971. AREA: 400k ha.

NUMBER OF FARMS: 133,000.

CONTRIBUTION:	World Bank	US\$	26.0M
	RTG		50.1M
	TOTAL	<u>US\$</u>	<u>76.1M</u>

GOALS: After making allowance for domestic consumption of rice, it is expected that approximately 290,000 and 335,000 metric tons of rice from second cropping would be available for export from the Chao Phya and Nan River Valley areas respectively. The combined production increase would thus result in a 33% increase in the volume of rice exported from Thailand.

PURPOSE: To increase the standard of living of Thais in the project area, to increase government revenue, to produce paddy for home consumption and for export.

TYPE OF PROJECT: Reservoir construction for large-scale irrigation and hydropower projects.

TECHNOLOGY USED: Concrete buttress dam, penstocks, spillway, most construction will be performed with heavy machinery.

DOCUMENTS REVIEWED: Staff Appraisal Report (18 pp and eight annexes).

PROJECT ORIGIN AND BASE LINE DATA: Material presented in the Staff Appraisal Report was gathered during several missions which visited Thailand in 1965 and 1966.

BENEFICIARY INVOLVEMENT: Increased rice tax revenues are expected from the growth in rice production.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

The Phasom Reservoir could provide irrigation for about 180,000 hectares of second cropping in the Chao Phya area and for approximately 200,000 hectares of second cropping in the Nan River Valley area, where it would also provide a dependable irrigation supply for 400,000 hectares of first cropping.

TECHNICAL

The engineering works comprising the project would include the following:

1. The Phasom Dam including spillway and outlet works;
2. Minimum facilities to permit the future installation of power facilities at the Dam;
3. Five earth saddle dams;
4. Access roads and bridges;
5. Airfield;
6. Transmission lines and substations to provide construction power at the dam site and camp; and
7. A construction community and other related facilities.

The Phasom Dam would be a concrete flat-slab and buttress type structure. The dam would rise approximately 100 m above the streambed. The length of the concrete section would be approximately 800 m at the crest elevation of 166 m. Approximately 900,000 m³ of concrete would be required for the dam and appurtenant structures. The buttresses of the dam would be spaced approximately seven and a half meters center to center. In the river section, eight buttress spaces would be utilized for a radial gate-controlled spillway which would also accommodate four individual river outlet conduits so that the spillway and outlet works discharges would utilize the same apron and stilling basin. Adjacent to the spillway outlet works section, on the left side of the dam, would be a section including intakes for possible future penstocks utilizing 18 buttress spacings. In the areas used for outlet conduits and penstocks, the dam would be mass concrete of sufficient height to support the buttress sections. Underdrains would be provided where necessary to relieve uplift pressures. Foundation grouting and drain holes would be provided where required, to seal the foundation and provide pressure relief. A continuous concrete-bearing section would be entrenched in the foundation rock at the upstream

heel of the dam. A fault zone in the foundation near the right abutment would be excavated, filled with concrete and otherwise treated to be watertight and provide the support needed by the dam. A concrete parapet slightly over a meter high would be provided on the upstream side of the roadway across the dam crest.

The spillway would be an overflow crest type, 52 meters wide with a crest at elevation 154 m, and with a stilling basin extending downstream from the dam. Control would be by four 13.0 meter-wide by 6.50 meter-high automatic, electrically operated radial gates, with provisions for manual operation. The spillway would be designed to limit the discharge to 3,000 m³/second, assuming a 100-year flood with a peak inflow of 5,400 m³/second and also would limit the surcharge above normal water surface elevation 160 to six meters when passing the spillway design flood with a peak inflow of 8,000 m³/second. The maximum discharge of the spillway would be 4,500 m³/second with the water surface at elevation 165.7.

Four individual river outlets would be provided through the dam each consisting of a three meter diameter steel conduit encased in concrete, regulated by two hydraulically operated high pressure gates, 2.4 meters by 3.0 meters high. The upstream entrance to the river outlets would be protected from large logs and debris by a large-opening, steel grill trashrack. The discharges from the river outlets would be through the downstream spillway-face slab. The outlets would each have a discharge varying from 145 m³/second, with a nearly empty reservoir at elevation 112, to 225 m³/second, with a full reservoir at elevation 160. The outlets would be used to make irrigation releases.

Provision for a future power installation at the dam would be made by constructing the concrete foundations up to elevation 71.5 m above mean sea level for the powerhouse and installing four intakes and trashrack structures on the upstream face of the dam, so that, at some future time, the powerhouse could be completed without unwatering the foundation and power penstocks could be installed without removing the water from the reservoir. Approximately 50,000 m³ of concrete would be required for these works.

Five saddle dams, up to 35 m in height, would be constructed approximately 20 kilometers west-northwest of the main dam site at low points in the rim of the reservoir. The saddle dams would be constructed of approximately three million cubic meters of compacted earthfill, covered on the upstream side with riprap. The top of the saddle dams would be at elevation 168.0 and they would have a top width of five meters suitable for use as a maintenance road. The side slopes of the saddle dams would be constructed to 2.5:1 slopes, and the dams would be provided with a cutoff trench, as required in the foundation. The total volume of the saddle dikes is approximately three million cubic meters.

INSTITUTIONAL

The RID agrees that the Phasom Dam should be constructed by contract under international bidding procedures and that the Bank would be given an opportunity to comment on such awards before they are made. For that portion of the project to be constructed by force account by the Royal Irrigation Department (RID), substantial quantities of equipment and spare parts would be needed to supplement that which is now available to the Department. In addition, the RID would purchase supplies and materials required for incorporation into all parts of the project. The RID agrees that all such equipment and supplies would be purchased on the basis of international competitive bidding procedures and major contracts would be awarded only after the Bank has been given an opportunity to comment thereon.

The RID has substantially completed the work on the access road and has done considerable work on the camp facilities and on the bridges across the Nan River and on the Paad River, a tributary stream near the dam site. The RID would continue the work on the roads, bridges and camp facilities required for its own use and that of the consultants, and would perform any additional work as needed for the camp and roads. The RID would also undertake the construction by force account of the saddle dams and access road thereto, and would perform a portion of the excavation for the foundation of the Phasom Dam, prior to the time the contract is awarded to an international contractor. The RID has had experience in construction of similar works and is fully qualified to carry them out. The RID would be responsible for operation and maintenance of the project.

ECONOMIC

At full development, a measure of the economic benefits of the project in the Chao Phya area is an increase in the annual net value of production at farm prices of US\$11.6 million. Tax collections in the form of Rice Premium and Export Taxes on all rice produced would amount to US\$13.0 million, thus the annual incremental net value would be about US\$24.6 million. At this level, the average annual net return from second crop irrigation of rice in the Chao Phya area alone would range between six and 10 percent, depending on the assumed rate of second crop development. When the benefits from a possible future project in the Nan River Valley area are added, the economic returns increase considerably to between 11 and 14%. Even higher returns would result if second crops of higher value other than rice are grown and if the power benefits are taken into consideration.