# APPENDIX 8

## ORGANIZATION AND MANAGEMENT

# ORGANIZATION AND MANAGEMENT

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# ORGANIZATION AND MANAGEMENT

## 8-1. Present Organization of RID

### (1) Project Management

Direct responsibility for project implementation rest with Royal Irrigation Department (RID), which consists of 22 divisions and 12 regional offices under the Director General with assistance of three Deputy Director Generals and two Chief Engineers (Figure 8-1). Each division is associated with the project implementation in its specific services. The design of rehabilitation works is carried out under the Design Division and construction is under the Construction Division and Roadway Construction Division. The design and construction of on-farm works is handled by the Land Consolidation Section of RID's O & M Division. Survey Division is in charge of all survey activities in the project area.

A Project Manager is directly responsible for day-to-day activities in the field and schedule of construction works. The Project Manager for Mae Klong Project has also been designated to be directly in charge of all irrigation, drainage and road construction and on-farm development. However, at present, it seems there is lack of coordination between on-going activities of RID's divisions as the Construction Division, Roadway Division, Project Office and the Land Consolidation Section, which operate independent program in the Mae Klong area.

The Central Office of Land Consolidation is in charge of planning and coordinating on-farm development works throughout Thailand. In addition, COLC's functions on the proposed project would be to prepare the issuance of Royal Decrees to permit land consolidation in the project area and to act as the liaison between RID and the farmers during the design and construction stages. Provincial Land Consolidation Officers would carry out the field level functions of COLC.

(2) Operation and Maintenance

The management, operation and maintenance of completed irrigation projects in the RID is under the Operation and Maintenance Division with some activities under the joint effort of the Hydrology Division, and the Water Operation Board and Center.

In 1967, the Water Operation Board was established by the order of the Director General RID. The Board is to formulate a general policy on water operation considering irrigation requirements under different crop patterns, flood control, power generation, navigation, domestic water supply, and salt water intrusion control. The Director General is the Chairman. There are four board members: the Chief Engineer, a Special Grade Engineer from the Operation and Maintenance Division, a Special Grade Engineer from the Hydrology Division, and the Executive Secretary.

Under the Board, there is the Water Operation Center which is responsible for the execution of the Board decisions. The Center is headed by the Executive Secretary of the Board and assisted by three other experts; namely, a Hydrologist from Hydrology Division, an Agronomist of the O & M Division, and an Irrigation Engineer from the Greater Chao Phya Project. The Center also has a Secretary. The Executive Secretary is responsible for formulating a water operation plan, to report to the Board, issue orders for daily water operation, coordinate with other Government Agencies on matters related to water operation, and request special Board meetings, if warranted by weather, flood, or other emergency conditions.

The operation and maintenance of the project completed is undertaken by the regional office in the field level. The Project Engineer of Kamphaeng Saen Sub-project Office is under the regional director of Region X, RID. Under the Project Engineer, three water masters are responsible for delivering the irrigation water with assistance of 24 zone men who operate and maintain the facilities and water delivery to the area covering about 1,600 ha (10,000 rai).

Quantity of water to be delivered to the laterals are estimated by zone men in accordance with the request from farmers every week. The regional director decides the quantity of water to be deliverd at the main intake of the Vajiralongkorn dam based on the request from each sub-project office and other project offices. And, gate tenders operate the gates and checks in the canal based on the capacities estimated by each lateral and/or sub-lateral, under the project engineer of sub-project. Only three common irrigators who are responsible for checking the quantity of water to supply to the farm land through farm ditches for the area of about 160 ha (1,000 rai) are presently assigned in the Kamphaeng Saen sub-project area due to shortage of O & M fund. The O & M roads along the canals are already provided or scheduled to be constructed. It was provided for irrigation canals and not for drainage canals. The telephone services are available only to connect between regional office and sub-project office headquarters but no provision are available within the project area.

## 8-2. Project Management and Coordination

### (1) Project Organization

The RID has a great deal of experience on the execution of irrigation project as well as on-farm development project for many years. The RID should be then the Executing Agency for the Kamphaeng Saen Project in expecting smooth and effective execution and success of the Project.

Inasmuch as implementation of several projects in the Greater Mae Klong Basin area are scheduled, the Mae Klong Project Director would be appointed as same level as Deputy Director General and responsible for the implementation of all expected projects in the Mae Klong Project area and concurrently he should assume the duty for supervising and assisting the Kamphaeng Saen Project execution.

The project manager, under the Mae Klong Project Director, should be directly responsible for the execution of the project. Under him, five (5) section chiefs, project engineer for engineering, construction and equipment management and project officer for administrations

and project supporting services should be assigned for the project. Planning and design of irrigation and drainage would be undertaken by staffs of the Mae Klong Project Office in Kanchanaburi under the Project Director, as design section would be created with enough experienced staffs. With assistance of Land Consolidation section, O & M Division, planning and design of on-farm facilities as well as detail surveys should be made in the project office under the project manager (Figure 8-2 and Figure 5-1 in main report).

The engineering section should work for planning and scheduling of the project execution including budgetary and disbursement schedule, design of on-farm facilities, detail survey for the design and construction works and reporting and recording of the project progress and implementation.

The construction section should carry out and/or supervise project construction works and prepare detailed monthly construction planning and scheduling based on the project construction schedule, and has three (3) field offices in the area.

The equipment management section should undertake the works for preparation of documents for procurement of equipment and materials, management and operation of workshop, storing and management of spare-parts, preparation of equipment working plan and schedule, maintenance of equipment, guidance of operation, etc.

The staffs of project supporting section should serve to take the concept of land consolidation to the farmers without exception and to obtain the written consent for the project implementation. In the meantime, after completion of planning and design of on-farm facilities, the staffs should immediately work to accelerate organizing of Water Users' Association and make land register for the charge of construction cost and O & M cost and train the farmers on water management.

(2) Project Management

Under the proposed organization, all design and construction would be carried out in the project site with assistance of staffs of Design Division, Construction Division, Roadway Division, Survey Division and Land Consolidation Section of O & M Division of RID in Bangkok. All equipment procured for the project would be undertaken by the Procurement and Property Division in collaboration with Mechanical Engineering Division. Topographical mapping has been carried out by the Topograhical Survey Division under the financial assistance of IBRD. However, additional and/or supplementary survey for detail design of irrigation and drainage canals, roads, facilities and on-farm facilities would be undertaken by staff of the project office.

For preparation and issuance of Royal Decrees concerning the execution of the project under the Land Consolidation for Agricultural Act (1974), COLC would act as main Executing Agency, before the construction period in areas to be incorporated under the project. The Provincial Land Consolidation Officer would carry out the field level functions of COLC, especially to promote on-farm development among farmers in the project area.

Responsibility for cadastral surveys and issuance of title deeds in all parts of the project area subject to on-farm development would rest with the Land Department of the Ministry of Interior. The Land Department, which has recently increase its staff for this, is presently carrying out the said cadastral surveys in the project area under the Chao Phya Irrigation Improvement Project II.

(3) Project Coordination

To ensure smooth cooperation between all Departments engaged in the project, the Project Coordinating Committee chaired by the Undersecretary of Agriculture would be established. The Committee would include the Project Coordinator, the Director-General of RID, the Mae Klong Project Director, the Project Manager and representative of the Ministry of Interior, Budget Bureau, Ministry of Finance and

other department and offices related with the project implementation. The Deputy Undersecretary of State for Agriculture would be appointed as Project Coordinator. His principal duties would include - coordinating all project activities among the agencies related to the project; ensuring the actions requiring higher approval by immediately bringing to the attention of the Under-Secretary and/or Minister; and, to exercise such powers in the implementation of the project. The committee would also has full power of all project activities, in order not to consume a long time specially for procurement, budgeting, staffing and the appointment of consultants. This Committee would also be able to expand those activities as a coordination for the implementation of future projects in the Greater Mae Klong area, if required.

At the field level, the project implementation coordinating Committee, composing of agencies related to the project such as RID, POLC, LD, ALRO, DAE, ARDD, BAAC, etc., would be established under the leadership of RID. The Committee should play an important role in the cadastral mapping and registration, substituted land schedule, promotion of agricultural supporting services, organization of farmers' group, cooperation and coordination among each agency and project, etc. The Committee would be chaired by the Mae Klong Project Director, who would be responsible for smooth execution of the project in close cooperation with those agencies in order to bring about a success for the project.

## 8-3. Proposed Organization for O & M

### (1) Organization and Management

The Operation and Management of the completed irrigation project is undertaken by RID under the administrative assistance of the Operation and Maintenance Division for each system. The Regional Directors are also responsible for the O & M of existing irrigation systems completed by RID in their jurisdictions.

For the Kamphaeng Saen Sub-project O & M Office, Project Engineer would be assigned. The Project Engineer under the Regional Director X

is responsible for O & M of the Kampaeng Saen Irrigation System which is the same system as existing one. Staffs of engineering, agricultural services, O & M, mechanical and administration section would assist him. Under the Chief of O & M, supervisors would be appointed to serve the O & M of an irrigable area covering about 20,000 ha with assistance of water masters, who would supervise zone man (or water operator). Common irrigator would distribute water to an irrigation unit which would be the smallest area for water management responsible by the RID (Fig. 5-2 in main report).

Common irrigator would manage the water distribution at the turnout which would cover an irrigation unit, area of about 40 ha to 60 ha. The irrigation unit, consisting of 4 to 5 irrigation sub-units covered an irrigable area of 8 to 12 ha, should also be one small unit of water users' association. Three irrigation units would be handled by one common irrigator (farmer), who will make the contract with the Project Engineer for the O & M office. Besides the water operation works, his performance is to report to zone man on water quantity required from farmers, to maintain the main ditches and perform the necessary works for water management.

Zone man would supervise 5 to 6 common irrigators and would support water master's works in estimating and reporting to water master about irrigated area and quantity of water delivered and to be delivered through the laterals and/or sub-laterals and perform the maintenance works of the laterals as well as drainage canals in the district assigned to him.

Water master would directly be responsible for water delivery and supervise about 5 zone men and some gate keepers, and his major works are as follows:

i) to examine and determine the cropping pattern suitable for the area based on water availability and estimate a quantity of irrigation water to be supplied from the canals to each

irrigation unit on weekly basis;

ii) to check and control the quantity of water passed at specified points according to the cropping pattern already laid down.

iii) to make record and statistical study of actual consumption of irrigation water based on invested and measured losses of water in the canal and at the terminal;

iv) to supervise the water operators and gate tenders and arrange for their works with regard to efficient water management and adequate maintenance of the canals and facilities;

v) to make monthly report on the water operation, specially irrigated land, and list of farm land irrigated during wet and dry seasons.

Project Engineer, as chief of O & M offices, for the Kamphaen Saen area would be responsible for all of the works on the Operations and Maintenance of the irrigation and drainage including maintenance of service roads. Maintenance works, such as repair, improvement and rehabilitation of the canals and facilities would rest with staff of Engineering Section. For promoting advanced cultures for irrigated agriculture to the farmers, Agricultural Supporting Section would play a critical role. Mechanical Section would deal with the management and maintenance of equipment and vehicles in the office. Staffs of Administration Section would help Project Engineer in the administrative matters including budget, finance, etc. O & M Section would deal with all of water operation and maintenance of canals and facilities. Supervisor who belongs to this section would be supervising the activity of water masters and be responsible for all O & M works in his jurisdiction (Fig. 8-3).

Under the proposed organization, the project would provide with 6 water masters' quarters, and 18 additional working stations, since 20 working stations for zone men and gate keepers have been built.

Procurement of equipment, vehicles and instruments for O & M would be made under the project. The communication facilities and telephone networks between office, water master quarters, working stations and gate keepers' house would be provided (see Appendix 9).

(2) Water Users' Association

As for effective use of water and increase of agricultural productivity, emphasis would be made on mutual cooperation among farmers in the irrigated land. There are at present several farmers' groups supported by the Government. Those are, however, mostly organized by the personal principle and might have difficulty in accepting water management under the present system.

The project, for efficient water operation, would formulate water management program, which would ensure to distribute water to each small unit of farm plot through provision of adequate on-farm facilities. An irrigation unit would cover an irrigable area of about 40 to 60 ha, which would be subdivided into 4-5 sub-irrigation units covering about 8 to 12 ha for each, and would be occupied by 10 to 20 farmers. This number might not be difficult to organize the group.

Proposed organization of water users' association would be set up in an irrigation unit. Main purpose of this group would be to manage the water effectively to distribute in their own farm land under mutual cooperation. For their use of water, RID would have responsibility to guarantee adequate quantity of water at the turn-out of an irrigation unit.

The water users' group would be expected to be a group to get loan from BAAC and become a "contact group" instead of "contact farmer" under the NAEP. Moreover, this group would favorably cooperate the collection of irrigation fee for the BAAC. Upon organizing the group, these units would be associated with each other in large scale of system for water management. This big scale of group would become the water association for the entire area of Kamphaeng Saen Project in future.

(3) Water Management Program

Water delivery to the lateral and sub-lateral canals would be on a constant and continuous supply basis, and be varied only depending upon the cropping schedules of sub-areas and climatic conditions. Flexibility would be provided for implementing rotational irrigation along the sections of laterals only during the land soaking and land preparation period and also during critical periods of short water supply.

It is envisaged that rotational irrigation would be the basis of water distribution. This would presuppose the training of the water operators and common irrigators on the intricacies of water management and the related agricultural practices. Initially, though, there may be a transition period where the usual method of simultaneous irrigation would continue to be practiced until all concerned are prepared to adopt the new method of rotational irrigation. At the outset, however, when facilities are already completed, diversion of controlled and measured discharge based on computed turnout requirement would be started. Discharge control would be done strictly by gate keepers and common irrigators upon instruction of the water master and water operator.

For effective water management, all farm plots commanded by one turnout would follow only one cropping pattern. This is especially important when crop diversification is considered. This would minimize difficulties connected with the application and removal of water and possible misunderstanding among water users.

Under the proposed practices, each rotational area as irrigation unit is about 40-60 hectares. The area is subdivided into 4-5 rotational units about 8-12 hectares. The rotational interval is based on a certain number of days, each unit getting its share of irrigation delivery and time proportional to its unit area.

Implementing rotational method necessitates the availability of water control and measurement facilities, scheduling and planning, working knowledge and active participation of both systems' personnel and water users. Since rotational irrigation means the supply of the correct amount of water at the right time and the proper sequence, orderly farming operations within a rotational area have to be planned and scheduled. Formation of a water users' association in each rotational area becomes imperative to facilitate communication, cooperation and participation in activities involving the water users as a group in the basic irrigation unit.

It is important to provide water measuring devices to complement regulating and control structures in implementing improved water management. Water measuring devices would have to be installed at the place near the intake at the branching points of main canals, laterals, and sub-laterals and at the farm turnouts where farm ditches begin.

## 8-4. Consultant Services

Although the RID has experience in project construction for irrigation and drainage works as well as on-farm development works, trained and well-experienced persons might not be enough to execute the project works in the light of so many projects carried out in Thailand. Therefore, experienced consultants would contribute to the project implementation in final design and construction supervision together with establishment of farmers' group for O & M.

The Terms of Reference for consulting services would be as follows:

### General

The services to be performed by the Consultants to be engaged by the Government of Thailand through MOAC would be classified in two parts: PART A - to assist the Government in planning and design of project works so as to upgrade the existing irrigation and drainage system and to develop on-farm facilities in the project area; and

PART B - to assist the project manager in smooth execution of project and establishment of farmers group. Part A is expected to be completed in not more than twelve months and Part B in about sixty months.

Detailed Terms of Reference for Part A

For Part A, the consulting firm shall field a team composed of, among others, a Irrigation and Drainage Engineer, Design Engineer for on-farm facilities, Equipment Engineer, O & M Expert, Agri-institutional expert and other specialists as required in preparing the project works.

The main activities of the Consultants during the course of Part A performance shall be:

(a) The preparation and review of detailed designs and cost estimates for the rehabilitation and improvement of works on the irrigation and drainage system and for the on-farm development works.

(b) The preparation of tender documents and the evaluation of bids for civil works to be contracted and for the procurement of equipment.

(c) Development of detailed plans and programs for the implementation of the engineering aspects of the project with emphasis on such works as land levelling and realignment of farm boundaries, and to develop detailed recommendations on the time phasing of the works and on the manpower and equipment requirement.

(d) Preparation of a plan of operation for the farmer organizations and agricultural extension and training services.

(e) Recommend operation and maintenance procedures and estimate manpower, budgets, and water delivery schedules.

(f) Preparation of quarterly and annual progress reports.

Detailed Terms of Reference for Part B

Long-term assignments covers over five-year period of implementation will be required for experts in the field or irrigation and drainage engineering and on-farm development works, whereas the specialists in the fields of operation and maintenance, and farmer organization will be required for shorter periods.

(a) Supervision of construction works for irrigation, drainage and road works and for the on-farm development works.

(b) Other services such giving advice and assistance for O & M in the preparation of Operation Manual and establishment of farmers' organization.

FIGURE 8-1. RID ORGANIZATION CHART

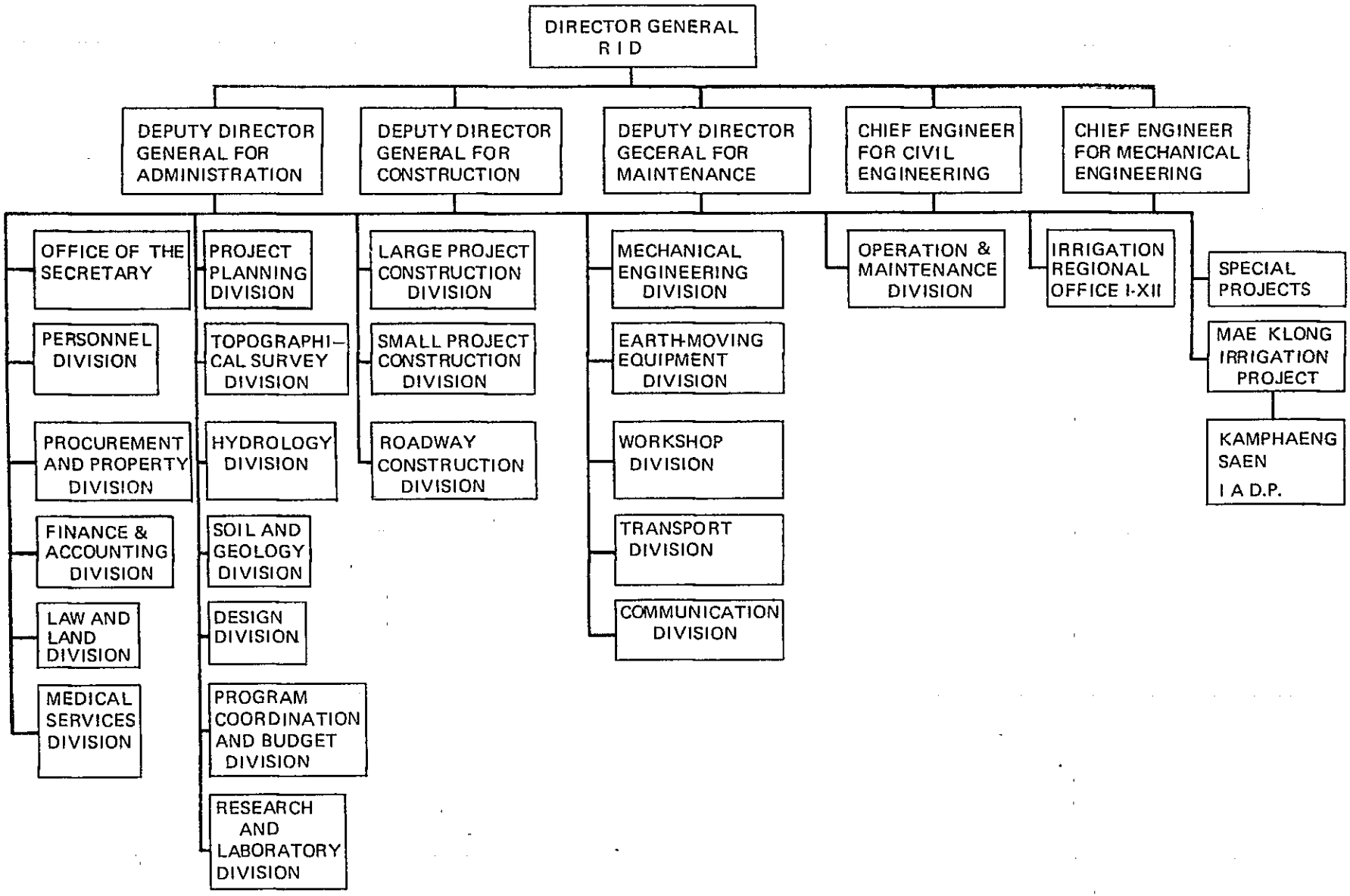
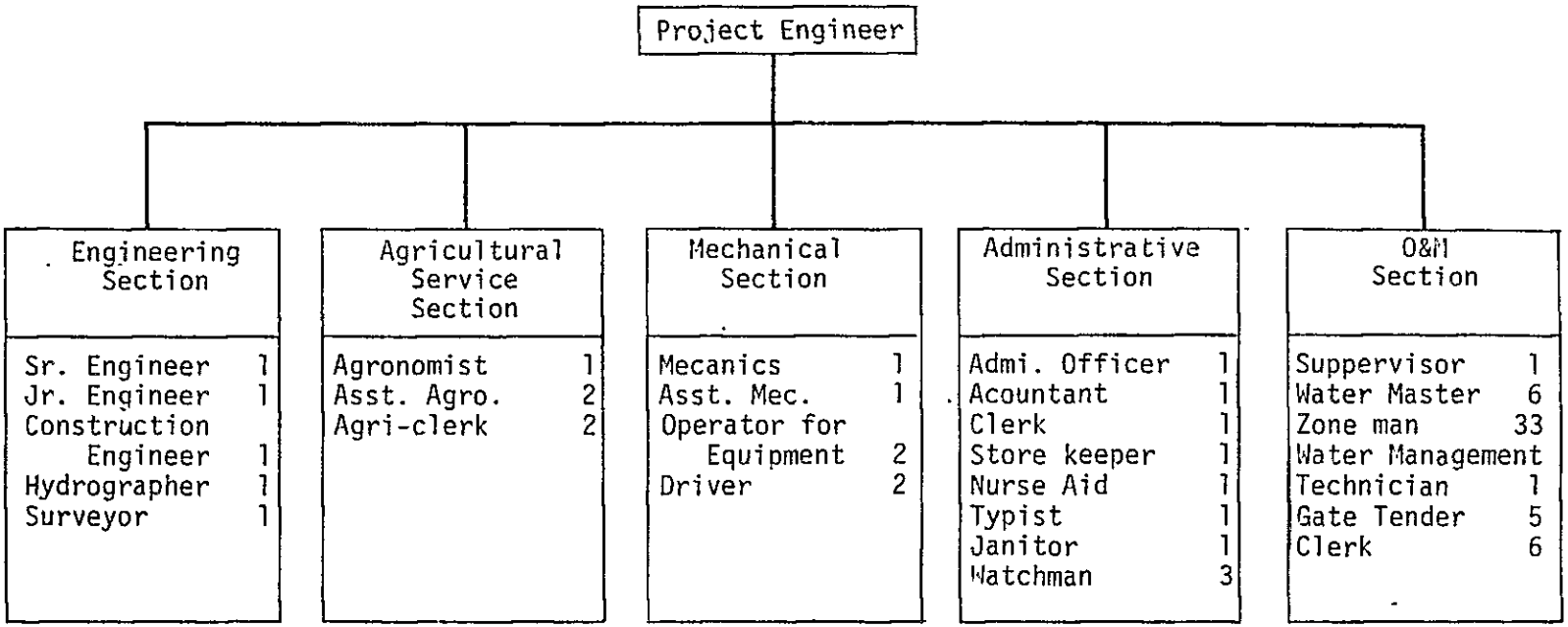
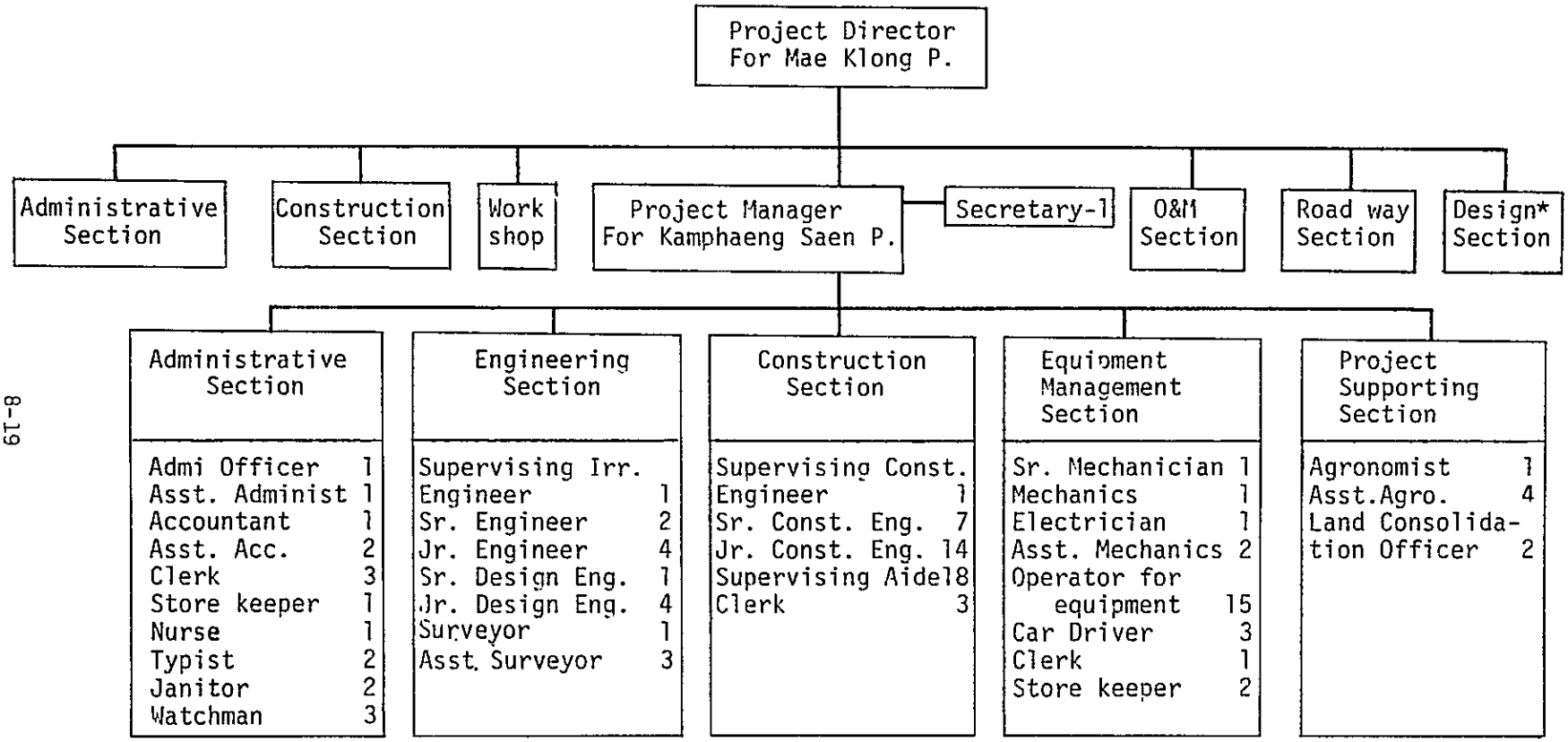


FIG.8-2. Staffing Plan For O&M
For Kamphaeng Saen I.A.D.P.
(28,000 ha)




Note: 1. Common Irrigation should be appointed by the contract (154 persons).
2. Labor for O&M should be hired as temporary staff.

FIG. 8-3. STAFFING PLAN FOR PROJECT IMPLEMENTATION
FOR KAMPHAEN SAEN I.A.D.P.




Note: 1.* Should create with at least 3-design Engineer & 1-draftman & 1-surveyor.

2. In the staffing pland common labors to assist surveyor, operator, etc. are not included.

# APPENDIX 9

# PROJECT COSTS AND IMPLEMENTATION

# PROJECT COSTS AND IMPLEMENTATION

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# PROJECT COSTS AND IMPLEMENTATION

## 9-1. Construction Method and Schedule

### (1) Construction Method

Upgrading and improvement schemes involves design, construction or improvement of lateral/sub-laterals, service roads, drainage canals, irrigation facilities in canals.

Major works such as improvement of irrigation canals and facilities, drainage canal improvement and some of on-farm development works would be undertaken by contract. On the other hand, about 60% of on-farm facilities would be carried out by force account (Table 9-1).

Several contractors with adequate experience and equipment for irrigation works are available in Bangkok and in the regions. Staff required to supervise contract as well as force account works would be made available through the RID field offices. Construction equipment would be provided for force account works. Farmers in the area would be given priority to supply unskilled labor.

### (2) Implementation Schedule

Survey and Mapping

Topographic maps of the project area in scale of 1/4000 with a contour line of 25 cm. interval would first be prepared for the design of on-farm facilities, if necessary. Strip maps along the proposed channels in the project areas would be surveyed, when a detailed topographic map is not available, for alignment of channels. For design of main canals and laterals, profile and cross-section levelling survey would be conducted.

Design

The Mae Klong Project officer would design irrigation and design

drainage canals and facilities in Kamchanaburi.

On-farm facilities would then be designed by staffs of the Engineering Section at the field offices based on topographic maps in the scale of 1/4000 with adequate contour lines.

Equipemnt Procurement

Equipment would be procured for force account works and operation and maintenance of irrigation systems. Procurement of equipment would be scheduled to cope up with the proposed implementation schedule.

Construction

Construction work would be planned to be completed in a period of six years, including preparatory works, such as additional survey, final design, equipment procurement and other administrative preparation for construction and procurement.

Construction schedule was worked out taking into account, work volumes and climatic conditions, etc. (Fig. 4-1 in main report)

9-2. Cost Estimates

(1) Project Cost

The construction cost estimates were based on prices as of July 1979 and the exchange rate of ฿20.00 to US $1.00. The estimated total project cost amounts to about ฿654.10 million. The total project cost includes the field cost, contingencies, engineering and general expense and expected price increase (Table 9-2).

The project costs are composed of local currency of ฿374.20 million (US$18,710,000) and foreign currency of ฿279,900million (US$13,995,000). Foreign component comprises of costs of equipment procurement for construction and O & M and services, steel bars,

cement (50%), fuel, oil and others, such as depreciation of equipment for contract works, gates, steel works, etc. While local component consists of labor costs, woods, sand and aggregate for concrete and others produced in the country. The total cost of equipment-procurement and services was ₱92.1 million excluding price increase and ₱104.88 million including price increase, respectively.

Field Cost

The field cost consists of the construction cost of engineering works for the project including construction materials, fuel and oil, equipment rentals, labor and right-of-way. The major items of works included in the estimates for project costs are as follows:

i) Improvement and construction costs of irrigation canals including canal structures;

ii) Improvement or construction costs of drainage channels including flood protection works and service roads as well as the related structures based on field surveys or data obtained through field investigation;

iii) Construction costs of on-farm development works based on layout and quantity estimated by sample areas study;

iv) O & M equipment (Table 9-3) & buidling cost;

v) Construction equipment costs for force account works (Table 9-4); and,

vi) Consultant's services and trainings (Table 9-5).

Physical Contingencies

Allocation for contingencies is included in the total base cost to cover minor differences in actual and estimated quantities, unforseeable difficulties in construction, possible changes in plan because of site conditions or uncertainties regarding foundation conditions. A 10 percent contingency factor was adopted for all civil works.

Investigation, Engineering and General Expenses

This item will cover all costs for pre-construction investigation studies, surveys, engineering design and specifications, construction engineering and supervision, and general administrative expenses. The cost for this item was estimated to be 10 percent of the field cost plus physical contingencies.

Expected Price Increase

Costs due to expected price increases over the implementation period amount to ₱152.6 million, or about 30% of total project costs, assuming the following annual inflation rates:

| | |
|---|---|
| Civil Works | 9% |
| Equipment and Services | 7% |

Unit Costs

The costs of construction materials used in the unit cost estimates were based on the prevailing prices in each region as of July 1979. The requirements of construction materials for major items of construction works were estimated on the basis of the RID estimates on similar works in previous irrigation projects.

The labor costs were estimated based on the wage rate of RID as of July 1979 and of average accomplishment of a laborer or a group of laborers for every type of job as experienced by the RID in previous projects.

The unit costs for construction under contract also include 5.4% for taxes, 10.5% for profit and 6% for engineering supervision and overhead.

(2) Operation and Maintenance Cost

Cost for operation and maintenance of irrigation systems was estimated as to necessary expenditures, such as personnel expenditures, operation and repair cost of equipment and vehicles, material cost for rehabilitation of facilities, and other administrative expenditures (Table 9-6).

Personnel expenditure is the salary of personnel for operation and maintenance of irrigation systems and estimated based on the proposed organization.

Annual equipment cost consists of annual cost of depreciation for equipment and vehicles having a life of 10 years and fuel, oil and others for operation. Repair cost of equipment was estimated to mechanic's salary and spare parts.

Cost for supplies is necessary to provide materials such as cement, steel bars, steel plates and others for rehabilitation of facilities.

Administrative and general expenditures were estimated at 16 percent of personnel expenditures. This is included in the cost of office maintenance, office stationeries, water, light, expenses for conference on agricultural supporting services and other miscellaneous expenses.

9-3. Disbursement Schedule

The project expenditure was estimated for six years by each item based on the construction schedule aforementioned. In the first year, it would be mostly expenses for pre-construction works and construction of minor works. Most of expenditure would start from second year, 1981/82, for main contract works. Procurement of equipment and supplies would be completed by the middle of second year. (Table 9-7).

Table 9-1. Proposed Construction Method of Civil Works

| Work Item | Force Account Works | Contract Works |
|---|---|---|
| A. Irrigation & Drainage Systems | | |
| 1. Irrigation | ° Improvement of head gates<br>° Repair of turnouts | ° Reconstruction of road crossings<br>° Heightening of embankment<br>° Construction of foot bridges |
| 2. Drainage | ° Construction of new drainage canals<br>° Construction of flood protection dikes<br>° Removal of drainage clverts | ° Improvement of existing channels<br>° Construction of drainage regulators<br>° Construction of bridges |
| B. On-farm development | | |
| 1. Type A development | 60% | 40% |
| 2. Type B development | 60% | 40% |
| 3. Type C development | 100% | - |
| C. O & M Facilities | | |
| 1. Project head quarters | - | 100% |
| 2. O & M buildings | - | 100% |

Table 9-2. Cost Estimates

| Item | Quantity | Units | Costs | | |
|---|---|---|---|---|---|
| | | | Local | Foreign | Total |
| A. Irrigation & Drainage Systems | | | ----------(฿'000)---------- | | |
| 1. Irrigation System | | | | | |
| a. Heightening of embankment | 47,774 | m. | 37,930 | 19,370 | 57,300 |
| b. Improvement of road crossings | 22 | Nos. | 1,100 | 570 | 1,670 |
| c. Improvement of head gates | 4 | Nos. | 150 | 390 | 540 |
| d. Foot bridges | 93 | Nos. | 5,300 | 160 | 5,460 |
| e. Repair of turnouts | 311 | Nos. | 150 | 150 | 300 |
| sub total | | | 44,630 | 20,640 | 65,270 |
| 2. Drainage System | | | | | |
| a. Improvement of existing channels | 108,326 | m. | 1,780 | 2,770 | 4,550 |
| b. New drainage canals | 68,270 | m. | 570 | 630 | 1,200 |
| c. Drainage regulators | 7 | Nos. | 7,870 | 9,400 | 17,270 |
| d. Flood protection works | 32,820 | m. | 1,090 | 3,180 | 4,270 |
| e. Bridges (incl. foot bridges) | 193 | Nos. | 8,380 | 4,050 | 12,430 |
| sub total | | | 19,690 | 20,030 | 39,720 |
| 3. Land expropriations | 125.4 | ha. | 6,270 | - | 6,270 |
| Total | | | 70,590 | 40,670 | 111,260 |

| Item | Quantity | Units | Costs | | |
|---|---|---|---|---|---|
| | | | Local | Foreign | Total |
| | | | ----------(฿'000)---------- | | |
| B. On-farm Development | | | | | |
| 1. A-type development (Paddy) | 2,655 | ha. | 15,280 | 9,130 | 24,410 |
| 2. A-type development (Sugarcane) | 1,220 | ha. | 4,990 | 3,680 | 8,670 |
| 3. B-type development | 11,675 | ha. | 89,820 | 50,480 | 140,300 |
| 4. C-type development | 1,650 | ha. | 22,680 | 11,150 | 33,830 |
| Total | | | 132,770 | 74,440 | 207,210 |
| C. O&M Facilities | | | | | |
| 1. Project head quarters | | | 900 | 220 | 1,120 |
| 2. O&M buildings | | | 5,040 | 1,260 | 6,300 |
| 3. O&M equipment | | | 560 | 10,700 | 11,260 |
| Total | | | 6,500 | 12,180 | 18,680 |
| D. Physical contingencies (10%) | | | 20,930 | 11,660 | 32,590 |
| E. Engineering, admin. etc. (10%) | | | 35,850 | - | 35,850 |
| F. Construction Equipment | | | 3,110 | 59,100 | 62,210 |
| G. Consultants Services | | | 11,440 | 22,260 | 33,700 |
| Total A-G | | | 281,190 | 220,310 | 501,500 |
| H. Expected price increase | | | 93,010 | 59,590 | 152,600 |
| Grand Total | | | 374,200 | 279,900 | 654,100 |

Table 9-3. Equipment for O & M

| Item | | Quantity | Unit Cost | Total Cost |
|---|---|---|---|---|
| | | | (฿1,000) | |
| Dragline | 0.6 $m^3$ | 1 | 1,820 | 1,820 |
| Backhoe | 0.35 $m^3$ | 1 | 920 | 920 |
| Grader | 3.1 m | 1 | 870 | 870 |
| Bulldozer | 15 ton | 1 | 1,170 | 1,170 |
| Loder | 1.6 $m^3$ | 1 | 1,060 | 1,060 |
| Jeep | 1,500 cc | 4 | 190 | 380 |
| Truck | 6 ton | 1 | 250 | 250 |
| Truck 2 ton | 6 ton | 1 | 100 | 100 |
| Dump truck | 6 ton | 1 | 270 | 270 |
| Truck (water) | 6 ton | 1 | 300 | 300 |
| Pickup | 0.75 ton | 2 | 80 | 160 |
| Concrete mixer | 0.22 ton | 1 | 38 | 38 |
| Pump | 100 mm | 5 | 22 | 110 |
| Motor cycle | 75 cc | 20 | 14 | 280 |
| Survey equipment | Transit | 2 | 20 | 40 |
| " " | Levell | 4 | 17 | 68 |
| " " | Staff | 10 | 2 | 20 |
| " " 50m | Tape | 20 | 4 | 80 |
| " " 2m | Poll | 20 | 1 | 20 |
| Telephone | 40 line | 1 | L.S | 800 |
| Weed cutter | with Engine | 20 | 15 | 300 |
| Misc. equipment | | | L.S | 244 |
| Sub-total | | | | 9,300 |
| Spare parts (15%) | | | | 1,400 |
| Total | | | | 10,700 |

Table 9-4. Equipment & Vehicles for Construction

| Item | Quantity | Unit Cost[a] | Total Cost |
|---|---|---|---|
| | | (₤1,000) | |
| Tractor, crawler, 180 HP | 2 | 1,780 | 3,560 |
| Tractor, Crawler, 140 HP | 4 | 1,170 | 4,680 |
| Tractor, swampy, 140 HP | 2 | 1,290 | 2,580 |
| Tractor, crawler, 90 HP | 5 | 710 | 3,550 |
| Backhoe, crawler, 0.8 $m^3$ | 2 | 1,680 | 3,360 |
| Backhoe, crawler, 0.35 $m^3$ | 4 | 920 | 3,680 |
| Scrape-dozer 6.4 $m^3$ | 5 | 2,190 | 10,950 |
| Motor grader 110 HP | 6 | 1,000 | 6,000 |
| Motor grader 65 HP | 3 | 540 | 1,620 |
| Roller, 6-8 ton | 8 | 530 | 4,240 |
| Roller, tire 15 ton | 1 | 635 | 635 |
| Truck, dump 6 ton | 4 | 270 | 1,080 |
| Truck, dump 2 ton | 10 | 100 | 1,000 |
| Truck, water | 1 | 300 | 300 |
| Truck, fuel | 1 | 580 | 580 |
| Truck, flatbed, 2 ton w/crain | 1 | 170 | 170 |
| Truck, flatbed 8 ton | 4 | 270 | 1,080 |
| Welding equipment | 1 | 70 | 70 |
| Station wagon, 4x4 | 2 | 250 | 500 |
| Jeep, utility vehicle, 4x4 | 6 | 190 | 1,140 |
| Truck, pick up, 3/4 ton, 4x4 | 4 | 80 | 320 |
| Misc. tools and equipment | | L.S | 205 |
| Office stationaries | | L.S | 100 |
| Sub-total | | | 51,400 |
| Spare parts (15%) | | | 7,700 |
| Total | | | 59,100 |

Table 9-5 Cost for Consulting Services & Trainings

| | | |
|---|---|---|
| I. Consulting Services | | |
| I-1. FOREIGN CURRENCY PORTION | | |
| A. Remuneration (Foreign consultants) | | US$880,000 |
| B. Out-of-pocket expenses | | US$ 60,000 |
| 1. International Travel expenses | | (US$ 24,000) |
| 2. Reimbursable cost items & others | | (US$ 36,000) |
| C. Contingencies | | US$140,000 |
| | Sub-total | US$1,080,000 |
| | | (฿21,600,000) |
| I-2. LOCAL CURRENCY PORTION | | |
| A. Remuneration (Local consultants) | | ฿ 5,600,000 |
| B. Living allowances and quarter | | ฿ 1,300,000 |
| C-1. Local communication transportation etc. | | ฿ 350,000 |
| C-2. Taxi charge | | ฿ 650,000 |
| D. Printing of reports | | ฿ 210,000 |
| E. Office consumables | | ฿ 90,000 |
| F. Local employees | | ฿ 1,800,000 |
| G. Cost for reimbursement of taxes | | ฿ 300,000 |
| H. Contingencies | | ฿ 1,100,000 |
| | Sub-total | ฿11,400,000 |
| | Total | ฿33,000,000 |
| II. Trainings | | |
| II-1. FOREIGN CURRENCY PORTION | | |
| A. International travel expenses | | US$ 8,000 |
| B. Per-diem (US$50 x 8person x 60day) | | US$ 24,000 |
| C. Data and other cost | | US$ 8,000 |
| D. Contingencies | | US$ 3,000 |
| | Sub-total | US$ 33,000 |
| | | (฿ 660,000) |
| II-2. LOCAL CURRENCY PORTION | | |
| A. Preparation expenses | | ฿ 40,000 |
| | Sub-total | ฿ 40,000 |
| | Total | ฿ 700,000 |
| | GRAND TOTAL | ฿33,700,000 |

Table 9-6. O & M Cost

| Item | Cost (฿'000) |
|---|---|
| 1. Salaries & wages | |
| 40 - Staffs | 1,200 |
| 154 - Common irrigator | 1,110 |
| 70 - Labors & operator | 1,230 |
| Sub-total | 3,540 |
| 2. Equipment operation | |
| Amortization | 1,320 |
| Repair and maintenance | 90 |
| Fuel & oil | 1,900 |
| Sub-total | 3,310 |
| 3. Materials & supplies | |
| Materials (cement, steel etc.) | 100 |
| Office supplies | 60 |
| Office maintenance | 30 |
| Sub-total | 190 |
| 4. General expenditures (10%) | |
| Sub-total | 570 |
| TOTAL | 7,610 |
| O & M cost per ha. | ฿465/ha[a/] |

a/ This was estimated to an irrigable area of about 16,380 ha.

Table 9-7. Annual Expenditures Schedule
(฿ million)

| Work Item \ Project Year | 1st | | 2nd | | 3rd | | 4th | | 5th | | 6th | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | F.C. | Total | F.C. | Total | F.C. | Total | F.C. | Total | F.C. | Total | F.C. | Total | F.C. |
| 1. Irrigation system | - | - | 23.64 | 7.91 | 22.28 | 9.88 | 7.83 | 0.10 | 11.52 | 2.75 | - | - | 65.27 | 20.64 |
| 2. Drainage system | - | - | 8.87 | 5.38 | 7.44 | 3.17 | 13.56 | 6.00 | 5.85 | 3.71 | 4.00 | 1.77 | 39.72 | 20.03 |
| 3. On-farm develop. | - | - | - | - | 44.94 | 16.58 | 60.20 | 20.72 | 58.96 | 21.45 | 43.11 | 15.69 | 207.21 | 74.44 |
| 4. O & M facility | 1.12 | 0.22 | - | - | 6.30 | 1.26 | - | - | - | - | - | - | 7.42 | 1.48 |
| 5. Land expropriat'n | 3.27 | - | 3.00 | - | - | - | - | - | - | - | - | - | 6.27 | - |
| 6. Physical Contingencies | 0.44 | 0.02 | 3.55 | 1.32 | 8.09 | 3.09 | 8.15 | 2.69 | 7.64 | 2.80 | 4.72 | 1.74 | 32.59 | 11.66 |
| 7. Engineering, admin. | 5.95 | - | 5.38 | - | 5.38 | - | 5.38 | - | 5.38 | - | 5.38 | - | 35.85 | - |
| 8. O & M equipment | - | - | - | - | - | - | - | - | 5.63 | 5.35 | 5.63 | 5.35 | 11.26 | 10.70 |
| 9. Const. equipment | 24.88 | 23.64 | 37.33 | 35.46 | - | - | - | - | - | - | - | - | 62.21 | 59.10 |
| 10. Consultant | 13.55 | 8.98 | 4.31 | 2.92 | 3.96 | 2.59 | 3.96 | 2.59 | 3.96 | 2.59 | 3.96 | 2.59 | 33.70 | 22.26 |
| Sub-total | 52.21 | 32.86 | 86.08 | 52.99 | 98.39 | 36.57 | 99.08 | 32.10 | 98.94 | 38.65 | 66.80 | 27.14 | 501.50 | 220.31 |
| 11. Expected price increase | 1.80 | 1.13 | 10.30 | 6.12 | 23.13 | 8.65 | 34.09 | 11.08 | 45.11 | 17.38 | 38.17 | 15.23 | 152.60 | 59.59 |
| Total | 54.01 | 33.99 | 96.38 | 59.11 | 121.52 | 45.22 | 133.17 | 43.18 | 144.05 | 56.03 | 104.97 | 42.37 | 654.10 | 279.90 |

# APPENDIX 10

# PROJECT ECONOMY

# PROJECT ECONOMY

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# PROJECT ECONOMY

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# PROJECT ECONOMY

## 10-1. General

67% of the total households in the Project Area are farm households and the working people whose ages are between 16 and 65 years old are engaged in agriculture.

Average farm size in this area is 3.45 hectares for farm-households including landless farmers, and 4 hectares for farm-households excluding landless.

The socio-economic survey conducted by RID in February 1979 gives some economic indicators related to agriculture in the Project Area as follows;

Average farm-size of 64 surveyed farmers is 3.84 hectares, 95% of farmers plant paddy, and 70% of paddy growing farmers plant paddy only. The second most important crop is sugarcane which occupies 25% in number of growers but only 8% in cropped area. Other crops are planted in very small scale.

As for animal husbandry, 94% of farmers breed one to four kinds of animals. Scales of raising are rather small except swine and ducks as follows.

No. of animals and breeders among the 64 farms surveyed

| | Breeders | Animals | Average (per breeder) |
|---|---|---|---|
| Swine | 51 | 664 | 13.0 |
| Chicken | 42 | 2,005 | 47.7 |
| Cattle | 18 | 80 | 4.4 |
| Ducks | 17 | 3,472 | 206.2 |
| Buffaloes | 5 | 10 | 2.0 |
| Total | 60 | - | - |

10-2. Present Farm Income

(1) Agriculture Income

Based on the sample survey, the gross cash income from crops per farm with an average farm-size of 3.84 ha (24 rai) was estimated at 23,790 Baht and cash expenditure at 8,500 Baht as shown below.

Average cash income per farm-household

(Unit: Baht/farm)

| Crop | Production (kg) | Sold (kg) | Price (Baht/kg) | Value (Baht) |
|---|---|---|---|---|
| Paddy | 9,728 | 6,755 | 2.48 | 16,750 |
| Sugarcane | 19,862 | 19,862 | 0.28 | 5,560 |
| Vegetables | 360 | 360 | 2.50 | 900 |
| Others | 359 | 359 | 1.63 | 580 |
| Total | | | | 23,790 |

Production cost for crops was estimated based on the same survey as follows:

Production cost for crop production

(Unit: Baht/farm)

| Crops | Fertilizer | Agro-chemicals | Hired labor | Trans-port | Other | Total |
|---|---|---|---|---|---|---|
| Paddy | 2,432 | 441 | 1,813 | 280 | 745 | 5,712 |
| Sugarcane | 316 | 13 | 738 | 876 | 291 | 2,234 |
| Vegetables | 65 | 82 | 234 | - | 57 | 438 |
| Others | - | - | 105 | - | 16 | 121 |
| Total | 2,813 | 536 | 2,890 | 1,156 | 1,109 | 8,505 |

Cash income from live stock per farm is as follows.

Cash income from livestock per farm

| Livestock | No. of sold animals | Price (Baht) | Value (Baht) |
|---|---|---|---|
| Swine | 6.8 | 360 | 2,448 |
| Ducks | 52.5 | 17 | 893 |
| Chicken | 17.6 | 45 | 792 |
| Cattle | 0.03 | 4,400 | 132 |
| Total | - | - | 4,265 |

Off-farm incomes such as the incomes earned by off-farm labor and the income obtained without investment (gifts from relatives, land rent, interest, etc.) had been estimated. Average amounts of them per household are 4,210 Baht and 1,050 Baht, respectively.

Then net income per household was calculated as follows:

Net income per household

| Source | Gross income | Expenditure | Net income |
|---|---|---|---|
| Crops | 23,790 | 8,505 | 15,285 |
| Livestock | 4,265 | 2,100 | 2,165 |
| Off-farm labor | 4,210 | 420 | 3,790 |
| Others | 1,050 | 0 | 1,050 |
| Total | 33,315 | 11,025 | 22,290 |

(2) Living Cost

Socio-economic survey gives the information on living expenditure in the project area as shown in the following table.

Average living cost per household
(Baht)

| Item | Amount (Baht) | Proportion (%) |
|---|---|---|
| Food | 5,290 | 40 |
| Cloths | 1,340 | 10 |
| Housing | 1,140 | 9 |
| Medical care | 1,040 | 8 |
| Education | 920 | 7 |
| Social | 3,300 | 25 |
| Miscellaneous | 190 | 1 |
| Total | 13,220 | 100 |

Number of households: 64

Total population: 386

The average number of family in the surveyed households is six. The total cost of 13,220 Baht shown above is considerably smaller than 28,560 Baht of the average living cost per family in the outskirt of Metropolitan Bangkok where 39% of households are farmers. The reported amount of 13,220 Baht is likely to be more or less under-estimated by the farmers interviewed, especially for the item of miscellaneous.

10-3. Market Prospect and Price

(1) Market Prospect

Rice

Over the past 15 years, domestic consumption of rice grew at an average annual compound growth rate of 3.5% while production grew at 3.1%. Exports declined over the period, fluctuating between 2.11 and 0.85 million tons; Thailand's share of world rice exports fell from 20% in the early 1960s to less than 15% at present. In view of projected increases in domestic and world market demand there will be no problem in the incremental productions of milled rice in the Project Area.

Farmers in the Project Area may sell their paddy to local mills or merchants at the farm gate or the mills. Transport from farm gate to local mills is readily available and rates are competitive. Most paddy produced in the Project Area is milled locally; surplus production is sent to Bangkok by trucks through a well-developed system of road. The wholesale price of paddy is also competitive in its rate.

Sugarcane

Thailand is climatically suited to large scale sugar production, but the country did not reach self sufficiency until about 1970. In 1971, Thailand began to export large amount of sugar and 4 years later sugar was one of Thailand's top foreign exchange earners.

However, the sugar industry is currently facing difficulties as a result of the deline in world prices following on the fast increase in production and stocks which occurred in response to the high sugar prices of 1973-75.

Annual world sugar consumption averaged about 72 million tons in 1970, but it is expected to grow to about 94 million tons by 1980 and about 109 million tons by 1985. However, in the mid-1980s the production capacity of the importing countries will be insufficient to meet the increase in demand, and import demand is likely to rise again.

There are many sugar mills in the Mae Klong basin and the cane growers can sell their sugarcane to the mills through quota-men or merchants. Quota-men and merchant provide fertilizers and credit for farmers in advance which are repaid after harvesting of sugarcane.

(2) Price

The price structure for paddy used in the financial and economic analysis is presented in Table 10-1. The present financial farm gate price is based on prices prevailing in the Project Area in 1978, updated to 1979.

The economic prices for paddy are derived from the export price for rice FOB Bangkok at the assumption that 20 percent of the rice produced in the Project Area is five percent broken and remainder 25 to 35 percent broken.

The prevailing price for sugarcane is 280 Baht per ton and the price is used as the present financial price for sugarcane. The economic prices of sugarcane at present and in future are derived from the international market prices of sugar projected by the World Bank. In the derivation, the prices of sugarcane are obtained by deducting the production cost (excluding raw material cost) and marketing cost form the international market prices of sugar (Table 10-2).

As for fertilizers, ammophos (16-20-0) is most common in the Project Area, prices of which are averaged at 3.13 Baht per kilogram. Therefore, the present price of ammophos for financial analysis is determined at 3,130 Baht per ton. The present prices of urea and TSP are estimated at 94% and 140% of ammophos respectively. The prices for economic analysis are derived from international market prices projected by the World Bank, as follows:

Prices of Fertilizers

| | Present | | Future | |
|---|---|---|---|---|
| | Financial | Economic | Financial | Economic |
| Ammophos | 3,130 | 2,810 | 5,140 | 4,620 |
| Urea | 2,950 | 2,650 | 4,840 | 4,350 |
| TSP | 4,400 | 3,960 | 7,230 | 6,500 |

10-4. Product Costs

(1) Costs for Rice Production

Cultivation

Cash cost for cultivation includes expenses for machineries and animals used for preparation of seedbeds and paddy field. These costs were estimated based on projected man-day for cultivation

using farm machinery and animal. The costs were estimated based on rental charge, operation costs and other necessary expenses for cultivation but excluded any labor costs. Unit costs for cultivation using farm machinery and animals were estimated to be ฿680/ha (฿109/rai) and ฿380/ha (฿61/rai), based on the actual cost surveyed by RID in February 1979. Rate of mechanization for cultivation was assumed at 80% at present and in future without project and increase to 90% in future with project because the land would be consolidated under the project.

Seeds

Based on the survey, present level of seed rate per hectare ranges from 4.7 kg/rai to 30 kg/rai and is averaged at 12.5 kg/rai for transplanting paddy and 27 kg/rai for broadcasting paddy. These rates are to include the loss in germination and loss of seedlings caused by the delay in transplanting due to untimely water supply.

With improved practices, the present seed rates per hectare are expected to go down in the future to a reasonable rate. In future without project, the rate would improve a little. In future with project, the seeding rate is assumed to be 45 kg/ha (7.2 kg/rai) for transplanting paddy.

The price of HYV seeds are a little higher than the common farm gate price of paddy. Then, the price of seed at present and in future with project was estimated to be ฿2.9/kg and ฿3.6/kg, respectively.

Fertilizer

The present use of fertilizers in the Project Area is relatively extending to the dry season transplanting paddy but a little for the wet season paddy, especially for the broadcasting paddy. Farmers use mostly Ammo-phos (16-20-0, 20-20-0). In future with project, fertilizer utilization would be increased to achieve the expected yields. The ammo-phos would be continuously used as a base fertilizer. In addition, the urea would be used as a supplementary nitrogen component

from the economic point of view. The fertilizer components were assumed as follows based on present use of fertilizers.

| Component | Unit | Wet Season Paddy | | | Dry Season Paddy | |
|---|---|---|---|---|---|---|
| | | Broad-casting | Irrigated A | Irrigated B | Irrigated A | Irrigated B |
| Present | | | | | | |
| N | (kg/ha) | 2 | 5 | 8 | 16 | 22 |
| P | (kg/ha) | 3 | 6 | 10 | 20 | 28 |
| Future Without Project | | | | | | |
| N | (kg/ha) | 3 | 8 | 19 | 22 | 27 |
| P | (kg/ha) | 4 | 10 | 24 | 28 | 34 |
| Future With Project | | | | | | |
| N | (kg/ha) | - | 38 | 60 | 62 | 65 |
| P | (kg/ha) | - | 30 | 40 | 44 | 48 |

## Chemicals

The agro-chemicals being used in the Project Area at present consist of various kinds and qualities. It is, therefore, very difficult to estimate the costs for chemical treatment based on applied quantities and corresponding costs. Consequently, estimation of costs for agro-chemicals treatment was made on a lump-sum basis by referring to average cost of ฿24 per rai surveyed by RID.

## Harvesting

Cost for harvesting was estimated same as the costs of hauling from the field to house, threshing costs by using tractor and machine and others after harvesting. The rate of harvesting cost was based on the surveyed data at about ฿50 per Kwion (about 1 ton) in bundles.

## Production Costs

The costs for rice crop production were estimated to each paddy by irrigation conditions for economic analysis (Table 10-3) and financial analysis (Table 10-4), on the basis of physical inputs which is shown in Table 10-5.

Others

Other costs compose of miscellaneous expenditures excluding land taxes and interest. These costs were assumed to be about 5% of production costs.

(2) Costs for Sugarcane Production

Cultivation

Most of sugarcane land are plowed by using 4-wheel tractor. The rental charge for this tractor is about ฿93/rai according to the surveyed data by RID in February 1979. Costs for cultivation, therefore, were estimated for mechanized one based on this rate and for animals at the rate of ฿60/rai, respectively.

Nursery

Sugarcane is commonly ratooning and renewed every three years. According to the surveyed data, present level of nursery rate per hectare ranges from 0.47 ton/rai to 0.82 ton/rai with an average of 0.67 ton/rai. The price of nursery was assumed to be about 110% of farm gate price harvested.

Fertilizer

The Ammonium sulfate is the main fertilizer applied to sugarcane. Present quantity of ammo-sulfate per hectare is about 156 kg on average, which is equivalent to about 33 N kg/ha. In future without and with project, use of fertilizer would increase to about 42 N kg/ha and 86 N kg/ha, respectively.

Chemicals

Present use of agro-chemicals is little. In the future, the area treated by chemicals and its quantities would increase gradually. The costs for chemicals treatment were estimated on lump-sum basis.

Other Costs

The costs for transportation fee from the field to sugar mills, irrigation costs by pump and other miscellaneous costs for productions were considered as other costs.

Production Costs

The production costs for sugarcane were estimated based on the cost items mentioned above and physical inputs shown in Table 10-6. Then, economic and financial crop production costs are shown in Tables 10-5 and 10-6, respectively.

10-5. Economic Cost of Farm Labor

(1) Labor Supply

Based on the population census and socio-economic survey, farming population is estimated. Number of agricultural households including landless farmers is 6,620. The mean size of family is 6.7 persons, of which 3.85 persons are from 16 to 65 years of age. Assuming that 90% of them are workable, 3.5 persons are available for farming work. Total available farming population is then estimated at 23,170 persons.

On the basis of 25 days per worker per month, the total annual labor supply is 5.96 million man-day or 0.50 million man-day per month.

From 1969 to 1978, while the total population in Thailand grew to about 2.8% per year, the annual growth rate was 1.8% in the Project Area. Assuming that historical growth rates continue, available farm labor in the Project Area would total some 28,390 at full project development in 1990. This would give a total annual labor force for the Project Area of 6.67 million man-day, and a monthly average supply of 0.556 million man-day (refer to Appendix 6).

(2) Labor Requirement

Table 10-8 gives estimates of average monthly and annual labor requirements per ha for different rice crops and other crops.

The present labor requirements per hectare are determined, based on the socio-economic survey and information from extension officers. The labor requirements per hectare in future without project are assumed to be the same as the present ones, while mechanization of land preparation and threshing will be slightly increased corresponding to the increase in the intensity of farming work. With the Project, strict scheduling of operations would be essential to distribute water evenly to all farm plots. This in turn require further mechanization of land preparation.

(3) Economic Cost of Labor

The socio-economic survey gives the wage rate of 43 Baht for hired labor in peak agricultural seasons in the Project Area. The rate is assumed to reflect the opportunity cost of labor to the economy of the area at such times. As demand for labor increases, the labor cost rises. In months of high rural unemployment, which characterize most of the year, the opportunity cost of labor would be much lower. The economic cost of farm labor in the Project Area was, therefore, estimated by taking account of the generally prevailing rural unemployment and extreme fluctuations in labor demand.

The economic cost of labor at different times of the year for Project Area was determined by the use of a technique developed in the Phisanoluk Irrigation Project. It is postulated that the marginal opportunity cost of farm labor in the Project Area can be approximated by an S-shaped curve. The marginal opportunity cost is positive at all levels of labor demand and increases as more labor is employed in farm work. The increase is slow initially, reflecting the scarcity of alternative productive employment, but becomes more rapid as the labor supply is more used. At full employment in the Project Area,

the opportunity cost is assumed equal to a marked wage of 43 Baht per man-day during periods of heavy labor demand. As labor demand increases beyond this point, the market wage rate continues to rise until it reaches a maximum wage rate.

In practice, the S-shape curve is approximated by three straight line segments. Figure 10-1 gives that approximation for the Project Area. The graph shows the estimated relationship between the marginal opportunity cost of labor and the demand for labor expressed as a proportion of supply. The marginal opportunity cost for any labor demand can be read directly from the curve.

## 10-6. Project Benefits

### (1) Direct Benefits

Irrigation benefits are derived from the value of incremental agricultural production with and without the project less the cost of production and the imputed value of labor. The benefits were computed based on the expected increase yields for about 15,180 hectares of rice lands and 1,200 ha of sugarcane lands with the provision of better water management, effective drainage, improved crop cultivation and closely coordinated agricultural supporting services. Prices of rice, sugar and fertilizer were derived from world market price production for 1990. The total incremental net value of production for the whole project at full development amounts to ฿260.12 million (Table 10-10).

### (2) Other Benefit Effects from the Project

The intangible benefits were not included in the computation of project benefits. But the main project development features would not only induce multiplier effects in productivity and farm incomes but would also encourage rural development. The provision of on-farm facilities, specially farm roads would facilitate the distribution of agricultural products and inputs and appreciate the value of land. During the construction period, farmers would have the opportunity

to be employed by contractors and in force account works by the RID.

## 10-7. Economic Evaluation

### (1) Economic Cost

Initial Investment Costs

The total project cost is estimated at ฿488.10 million or US$24.41 million, including cost of project construction, and O & M equipment cost. The cost is the real value of all goods and services used for construction but excluded inflation cost and taxes.

O & M Cost

The annual O & M cost after completion of project construction would amount to ฿7.61 million for the whole project under the proposed organization, while O & M cost at present is about ฿0.23 million.

### (2) Economic Benefit

Economic benefit at full project development was estimated at ฿248.85 million or US$12.44 million (Table 10-11).

The economic cost of farm labor was estimated at shadow wage rate, equal to its opportunity cost taking into account the general prevailing rural employment and seasonal fluctuation in labor demand (Table 10-11).

### (3) Internal Economic Rate of Return

For making economic evaluation of the project, the official exchange rate in Thailand may understate the value of actual economy of foreign exchange used in carrying out the project and earned from larges rice exports, related to the value of domestic sources, because of import taxes and quantitative restrictions. For this reason specific conversion factors for broad categories of goods and services produced or consumed by the project were used to express all values in terms of the common unit of account. These conversion factos used in converting from domestic to border prices as well as other national parameters used in the economic analysis are followings.

A Summary list of national Parameters[a/]

| | |
|---|---|
| Standard conversion factor | 0.79 |
| Conversion factor for - consumption | 0.96 |
| - Fertilizer | 0.92 |
| - Insecticide | 0.88 |
| - Construction | 0.74 |
| - Government services | 0.65 |
| - Trade | 0.47 |
| - Transport | 0.76 |
| - Agricultural machinery | 0.88 |
| - Draft animals | 1.01 |

Notes: These factors were quoted from the reports on previous projects appraised by the World Bank.

Besides this, according to the project implementations schedule, some of on-farm development would be finished by mid-1973 and all works would be completed by mid-1986. It is assumed that farmers in the areas to be developed would lose one dry season crop while their farms are being developed. This results in negative benefits for these years. On average, individual farm would reach full development in year five; for the project area as a whole, full development is expected to be reache in FY. 1990/91.

By this way the internal rate of return was computed to measure the economic worth of the project assuming a 50-year economic life. For the whole project, the IRR is about 27.0 percent (Table 10-12.)

10-8. Sensivity Tests

To examine the impact of several assumption made in the ecohomic analysis on the rate of return, sensitivity test was made using several factors which are partly based on cost overrun and benefit delays. These factors are itemized as follows:

| Assumptions: | IRR |
|---|---|
| Case A - 2-year dalay in reaching full project benefit | 24% |
| Case B - 10% increase in construction cost | 25% |
| Case C - Combination of A and B | 23% |
| Case D - 10% decrease in the price of rice | 25% |
| Case E - Combination of A and D | 22% |

## 10-9. Financial Analysis

### (1) Crop and Farm Budgets

Crop and farm budgets have been prepared for the Project Area. Present and proposed cropping patterns and farming practices are discussed in Appendix 6. This chapter gives the basis for the calculation and economic production costs and examine the financial impact of the project on individual farms.

The farm budgets are calculated on a cash flow basis. Since family labor is not a catch input, only hired labor has been estimated at the shadow rate applicable for each month. For the given size of farm, the monthly requirements for hired labor was calculated by comparing the labor requirements for the proposed cropping pattern with the availability of a maximum of 75 man-days per month at peak season and 60 man-days per month at other times of the year and a total of 750 man-days per year of family labor.

Three farm models chosen to represent the farm size distribution in the Project Area, have been analyzed to examine the implications of the Project for income distribution.

Crop and farm budgets for farm size of 1.6 ha, 4.0 ha and 6.4 ha are shown in Tables 10-13 to 10-16, respectively.

### (2) Rent and Cost Recovery

In determining the extent of cost recovery and the relation of project charges to benefits, two indices were used as follows:

i) Rent Recovery Index: The ratio of incremental project charges to "project rent" before paying the charges. This index was defined both for standard farm models and for the project as a whole.

ii) Cost Recovery Index: The ratio of revenues from incremental project charges paid by all project beneficiaries to

project construction and incremental operation and maintenance costs. This index is defined for the entire project only.

Project Charge

As for the charge for project on-farm development costs, it was estimated based on 10% of input common facilities costs and all of land levelling costs with interest of 12%, repayment term of 18 years including 3-year grace period after completion of the project. O & M costs are current expenditures including salaries and wages for staffs, depreciation cost of maintenance equipment and facilities, repair costs of canals and facilities, fuels and others necessary for O & M purposes. The project charges were estimated as follows:

| Type of Development Level | Investment Cost (฿/ha) | Project Charge (฿/ha) |
|---|---|---|
| Type A for paddy field | 10,490 | 540 |
| Type A for sugarcane | 7,950 | 410 |
| Type B for paddy field | 13,940 | 720 |
| Type C for paddy field | 24,000 | 5,750 |
| O & M Cost | - | 375 |

Rend and Cost Recovery Indices

For the analysis of farm rent recovery index, two model farms, which have a farm size of 4.0 ha and land irrigated through extensive irrigation networks and adequate irrigation and drainage systems were sampled (Table 10-20).

Table 10-1. Structure of paddy price (Baht per ton)

| | | Present | | Future | |
|---|---|---|---|---|---|
| | | Financial | Economic | Financial | Economic |
| Bangkok FOB price | US$ | 295 | 295 | 360 | 360 |
| | Baht | 5,900 | 5,900 | 7,200 | 7,200 |
| Rice premium | Baht | 650 | - | 750 | |
| Export duty | " | 250 | - | 300 | |
| Municipal tax | " | 10 | - | 10 | |
| Exporter's margin[a/] | | 400 | 190 | 450 | 210 |
| Transport and handling[b/] | | 300 | 230 | 350 | 270 |
| Ex-mill price of rice | | 4,290 | 5,480 | 5,340 | 6,720 |
| Ex-mill price of paddy | | 2,830 | 3,620 | 3,520 | 4,440 |
| Milling cost[c/] | | 120 | 100 | 150 | 120 |
| Miller's margin | | 200 | 90 | 240 | 110 |
| Milling tax | | 60 | - | 70 | |
| Transport to mill[b/] | | 50 | 40 | 60 | 50 |
| Input price of paddy at mill | | 2,400 | 3,390 | 3,000 | 4,160 |
| Merchants margin | | 200 | - | 240 | - |
| Price of by-product | | 200 | 200 | 240 | 240 |
| Farm gate price of paddy | | 2,400 | 3,590 | 3,000 | 4,400 |

Note; a/ Conversion factor of 0.47 was used to convert from financial to economic price

b/ The conversion factor for transports etc. was put 0.76 to use

c/ The conversion factor for industry was put 0.8 to use

Table 10-2. Derivation of sugarcane price
(per metric ton)

| | | Present (1979) | | Future (1990) | |
|---|---|---|---|---|---|
| | | Financial | Economic | Financial | Economic |
| International price | | | | | |
| 1977 prices | US$ | 169.5 | 169.5 | 270.2 | 270.2 |
| 1979 prices | US$ | 211.9 | 211.9 | 337.8 | 337.8 |
| | Baht | 4,240 | 4,240 | 6,760 | 6,760 |
| Production cost | | 1,400 | 1,400 | 2,000 | 2,000 |
| Transport and handling[a/] | | 180 | 140 | 220 | 170 |
| Miller's Margin[b/] | | 30 | - | 800 | - |
| Exportor's margin[b/] | | 80 | - | 400 | - |
| Export tax | | - | - | 760 | - |
| Total cost | | 1,690 | 1,540 | 4,180 | 2,170 |
| Price of sugar | | 2,550 | 2,700 | 2,580 | 4,590 |
| By product | | 750 | 750 | 1,200 | 1,200 |
| farm gate price of sugar | | 3,300 | 3,450 | 3,780 | 5,790 |
| Price of cane | | 280 | 290 | 320 | 490 |

Note; a/ Conversion factor of 0.76 was used to convert from financial to economic price.

b/ The conversion factor of 0.46 was used for trade.

Table 10-3. Economic Crop Production Costs (excluding labor) [a/]
(Baht/ha)

| | Wet Season Paddy | | | Dry Season Paddy | | Sugarcane | |
|---|---|---|---|---|---|---|---|
| Present | Rainfed [b/] | Irrigated A [c/] | Irrigated B [c/] | Irrigated A [c/] | Irrigated B [c/] | Rainfed | Irrigated |
| Cultivation | 535 | 555 | 555 | 555 | 555 | 505 | |
| Seed (Nursery) | 730 | 345 | 345 | 345 | 345 | 450 | |
| Fertilizer | 40 | 85 | 140 | 280 | 395 | 330 | |
| Chemicals | 60 | 60 | 60 | 60 | 60 | 25 | |
| Harvesting [d/] | 105 | 135 | 175 | 160 | 185 | - | |
| Other costs | 75 | 60 | 65 | 70 | 80 | 3,910 | |
| Total | 1,545 | 1,240 | 1,340 | 1,470 | 1,620 | 5,220 | |
| Future without project | | | | | | | |
| Cultivation | 535 | 555 | 555 | 555 | 555 | 505 | |
| Seed (Nursery) | 440 | 320 | 320 | 320 | 320 | 755 | |
| Fertilizer | 90 | 275 | 555 | 645 | 785 | 1,120 | |
| Chemicals | 90 | 90 | 90 | 90 | 90 | 35 | |
| Harvesting [d/] | 135 | 155 | 215 | 185 | 225 | - | |
| Other costs | 65 | 70 | 85 | 90 | 100 | 5,040 | |
| Total | 1,355 | 1,465 | 1,820 | 1,885 | 2,075 | 7,455 | |
| Future with project | | | | | | | |
| Cultivation | | 580 | 580 | 580 | 580 | | 505 |
| Seed (Nursery) | | 240 | 240 | 240 | 240 | | 755 |
| Fertilizer | | 825 | 1,185 | 1,275 | 1,370 | | 2,270 |
| Chemicals | | 265 | 265 | 310 | 310 | | 90 |
| Harvesting [d/] | | 225 | 285 | 290 | 310 | | - |
| Other costs | | 105 | 130 | 135 | 140 | | 6,540 |
| Total | | 2,240 | 2,685 | 2,830 | 2,950 | | 10,160 |

a/ Assumption on physical imput and unit prices are given in Table 10-5&6.
b/ Rainfed lands are planted to broadcasting paddy.
c/ Irrigated A means land is irrigated with poor facilities and Irrigated B with adequate facilities.

Table 10-4. Financial Crop Production Costs (excluding labor)[a/]
(Baht/ha)

| | Wet Season Paddy | | | Dry Season Paddy | | Sugarcane | |
|---|---|---|---|---|---|---|---|
| Present | Rainfed | Irrigated A | Irrigated B | Irrigated A | Irrigated B | Rainfed | Irrigated |
| Cultivation | 590 | 620 | 620 | 620 | 620 | 575 | |
| Seed (Nursery) | 495 | 230 | 230 | 230 | 230 | 435 | |
| Fertilizer | 50 | 95 | 170 | 315 | 440 | 370 | |
| Chemicals | 70 | 70 | 70 | 70 | 70 | 30 | |
| Harvesting | 125 | 155 | 200 | 185 | 215 | - | |
| Other costs | 65 | 60 | 65 | 70 | 80 | 5,015 | |
| Total | 1,395 | 1,230 | 1,355 | 1,490 | 1,655 | 6,425 | |
| Future without project | | | | | | | |
| Cultivation | 590 | 620 | 620 | 620 | 620 | 575 | |
| Seed (Nursery) | 430 | 215 | 215 | 215 | 215 | 490 | |
| Fertilizer | 105 | 310 | 615 | 720 | 875 | 1,245 | |
| Chemicals | 100 | 100 | 100 | 100 | 100 | 40 | |
| Harvesting | 155 | 180 | 250 | 220 | 265 | - | |
| Other costs | 70 | 70 | 90 | 95 | 105 | 6,510 | |
| Total | 1,450 | 1,495 | 1,890 | 1,975 | 2,180 | 8,860 | |
| Future with project | | | | | | | |
| Cultivation | | 650 | 650 | 650 | 650 | | 575 |
| Seed (Nursery) | | 160 | 160 | 160 | 160 | | 490 |
| Fertilizer | | 915 | 1,315 | 1,415 | 1,520 | | 2,525 |
| Chemicals | | 300 | 300 | 350 | 350 | | 100 |
| Harvesting | | 260 | 335 | 340 | 365 | | - |
| Other costs | | 115 | 140 | 145 | 150 | | 8,440 |
| Total | | 2,400 | 2,900 | 3,060 | 3,195 | | 12,130 |

a/ Assupmtion on physical imputs and unit prices are given in Table 10-5&6.
b/ Rainfed lands are planted to broadcasting paddy.
c/ Irrigated A means land in irrigated with poor facilities and Irrigated B with adequate facilities.

Table 10-5. Physical Inputs and Unit Price for Rice Crop Production Costs[/c]

| | | | Physical Imputs | | | | | Unit Price[/a] | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Wet Season | | | Dry Season | | | |
| Present | | Unit | Rainfed[/e] | Irrigated A[/d] | Irrigated B[/d] | Irrigated A[/d] | Irrigated B[/d] | Unit | Price |
| Cultivation | -mechanical | (%area) | 70 | 80 | 80 | 80 | 80 | ฿/ha | 600(680) |
| | -animal | (%area) | 30 | 20 | 20 | 20 | 20 | ฿/ha | 385(380) |
| Seed | -nursery | (kg/ha) | 170 | 80 | 80 | 80 | 80 | ฿/kg | 4.3(2.9) |
| Fertilizer | -ammo-phos | (kg/ha) | 15 | 30 | 50 | 100 | 140 | ฿/kg | 2.81(3.13) |
| Threshing | -mechanical | (%area)[/b] | 5 | 5 | 5 | 5 | 5 | - | - - |
| | -manual | (%area)[/b] | 80 | 80 | 80 | 80 | 80 | - | - - |
| Future without project | | | | | | | | | |
| Cultivation | -mechanical | (%area) | 70 | 80 | 80 | 80 | 80 | ฿/ha | 600(680) |
| | -animal | (%area) | 30 | 20 | 20 | 20 | 20 | ฿/ha | 385(380) |
| Seed | -nursery | (kg/ha) | 120 | 60 | 60 | 60 | 60 | ฿/kg | 5.3(3.6) |
| Fertilizer | -ammo-phos | (kg/ha) | 20 | 60 | 120 | 140 | 170 | ฿/kg | 4.62(5.14) |
| Threshing | -mechanical | (%/ha)[/b] | 15 | 15 | 15 | 15 | 15 | - | - - |
| | -manual | (%/ha)[/b] | 70 | 70 | 70 | 70 | 70 | - | - - |
| Future with project | | | | | | | | | |
| Cultivation | -mechanical | (%area) | | 90 | 90 | 90 | 90 | ฿/ha | 600(680) |
| | -animal | (%area) | | 10 | 10 | 10 | 10 | ฿/ha | 385(380) |
| Seed | -nursery | (kg/ha) | | 45 | 45 | 45 | 45 | ฿/kg | (5.3)(3.6) |
| Fertilizer | -ammo-phos | (kg/ha) | | 150 | 200 | 220 | 240 | ฿/kg | 4.62(5.12) |
| | -urea | (kg/ha) | | 30 | 60 | 60 | 60 | ฿/kg | 4.35(4.84) |
| Threshing | -mechanical | (%area)[/b] | | 35 | 35 | 35 | 35 | - | - - |
| | -manual | (%area)[/b] | | 50 | 50 | 50 | 50 | - | - - |

/a Figures in parentheses are financial unit price.
/b Costs of threshing are estimated to be ฿50/ton for mechanical and ฿40/ton for manual so as to use tractor or animal for threshing and to be ฿42/ton for hauling of outputs.
/c Agro-chemical costs are provided as a lamp sum basis.
/d Irrigated A means lands are irrigated with poor facilities and irrigated B with adequate facilities
/e Rainfed land are planted to broadcasting paddy.

Table 10-6. Physical Inputs and Unit Price for Sugarcane Production Cost[a/]

| | Physical Inputs | | | Unit Price | |
|---|---|---|---|---|---|
| | Unit | Rainfed | Irrigated | Unit | Price[c/] |
| **Present** | | | | | |
| Cultivation-mechanical | (% area) | 95 | | ฿/ha | 510(580) |
| -animal | (% area) | 5 | | ฿/ha | 455(450) |
| Nursery (every three years) | (ton/ha) | 4.2 | | ฿/ton | 320(310) |
| Fertilizer -ammo-sulfate | (kg/ha) | 156 | | ฿/kg | 2.12(2.36) |
| **Future without project** | | | | | |
| Cultivation-mechanical | (% area) | 95 | | ฿/ha | 510(580) |
| -animal | (% area) | 5 | | ฿/ha | 455(450) |
| Nursery (every three years) | (ton/ha) | 4.2 | | ฿/ton | 540(350) |
| Fertilizer -ammo-sulfate | (kg/ha) | 200 | | ฿/kg | 3.48(3.87) |
| -TPS | (kg/ha) | 50 | | ฿/kg | 6.50(7.23) |
| -KCL | (kg/ha) | 30 | | ฿/kg | 3.25(3.62) |
| **Future with project** | | | | | |
| Cultivation-mechanical | (% area) | | 95 | ฿/ha | 510(580) |
| -animal | (% area) | | 5 | ฿/ha | 455(450) |
| Nursery (every three years) | (ton/ha) | | 4.2 | ฿/ton | 540(350) |
| Fertilizer -ammo-sulfate | (kg/ha) | | 410 | ฿/kg | 3.48(3.87) |
| -TPS | (kg/ha) | | 100 | ฿/kg | 6.50(7.23) |
| -KCL | (kg/ha) | | 60 | ฿/kg | 3.25(3.62) |

a/ Agro-chemical costs are provided as a lamp sum basis.

b/ Figures in parentheses are financial unit price.

c/ Transportation cost to the factory (฿90/ton), pumping irrigation cost for about 30% of area (฿660/ha) and miscellaneous costs were estimated in the item of other costs.

Table 10-7. Rice Crop Labor Requirement

| | Wet season | | | Dry season | |
|---|---|---|---|---|---|
| | Rainfed /a | Irrigated A /b | Irrigated B /b | Irrigated A /b | Irrigated B /b |
| Present | | | | | |
| Land preparation | 3 | 7 | 7 | 8 | 8 |
| Transplanting | 3 /c | 28 | 28 | 26 | 26 |
| Crop management | 5 | 9 | 9 | 12 | 12 |
| Harvesting | 29 | 35 | 35 | 34 | 34 |
| Total | 40 | 79 | 79 | 80 | 80 |
| Future without project | | | | | |
| Land preparation | 3 | 8 | 7 | 9 | 9 |
| Transplanting | 3 /c | 28 | 28 | 26 | 26 |
| Crop management | 5 | 9 | 11 | 13 | 13 |
| Harvesting | 29 | 35 | 35 | 34 | 34 |
| Total | 40 | 80 | 81 | 82 | 82 |
| Future with project | | | | | |
| Land preparation | | 9 | 9 | 10 | 10 |
| Transplanting | | 28 | 28 | 26 | 26 |
| Crop management | | 12 | 14 | 16 | 17 |
| Harvesting | | 34 | 34 | 34 | 34 |
| Total | | 83 | 85 | 86 | 87 |

/a Rainfed land are planted to broadcasting paddy

/b Irrigated A means lands are irrigated with poor facilities and Irrigated B with adequate facilities.

/c Seeding

Table 10-8. Monthly Labor Requirement

| | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wet Season Paddy/a | | | | | | | | | | | | | |
| Rainfed /a -P | 1 | - | - | - | 2 | 3 | 3 | 3 | 0 | 0 | 7 | 21 | 40 |
| $\overline{W}$ | 1 | - | - | - | 2 | 3 | 3 | 3 | 0 | 0 | 7 | 21 | 40 |
| Irrigated A-P | 4 | - | - | 2 | 3 | 15 | 13 | 5 | 3 | 3 | 7 | 24 | 79 |
| $\overline{W}$ | 4 | - | - | 2 | 4 | 15 | 13 | 5 | 3 | 3 | 7 | 24 | 80 |
| (1) W | 2 | - | - | - | 2 | 13 | 18 | 9 | 4 | 2 | 16 | 17 | 83 |
| (2) W | - | - | - | 2 | 12 | 19 | 10 | 14 | 19 | 7 | - | - | 83 |
| Irrigated B-P | - | - | - | - | - | 7 | 18 | 9 | 4 | 4 | 19 | 18 | 79 |
| $\overline{W}$ | - | - | - | - | - | 7 | 18 | 9 | 5 | 5 | 19 | 18 | 81 |
| (3) W | 2 | - | - | - | - | 2 | 12 | 19 | 11 | 4 | 17 | 18 | 85 |
| Dry Season Paddy/a | | | | | | | | | | | | | |
| Irrigated A-P | 4 | 18 | 9 | 4 | 4 | 19 | 18 | 2 | - | - | - | 2 | 80 |
| $\overline{W}$ | 5 | 18 | 10 | 4 | 4 | 19 | 18 | 2 | - | - | - | 2 | 82 |
| (1) W | 8 | 18 | 15 | 4 | 19 | 17 | 4 | - | - | - | - | 1 | 86 |
| (2) W | 13 | 20 | 11 | 16 | 19 | 5 | - | - | - | - | - | 2 | 86 |
| Irrigated B-P | 6 | 18 | 9 | 4 | 4 | 19 | 18 | 2 | - | - | - | - | 80 |
| $\overline{W}$ | 7 | 18 | 9 | 5 | 4 | 19 | 18 | 2 | - | - | - | - | 82 |
| (3) W | 2 | 14 | 19 | 9 | 7 | 19 | 15 | 2 | - | - | - | - | 87 |
| Sugarcane | | | | | | | | | | | | | |
| P | 8 | 8 | 9 | 7 | 10 | 15 | 12 | 7 | 0 | 0 | 3 | 9 | 88 |
| $\overline{W}$ | 8 | 8 | 9 | 7 | 10 | 15 | 12 | 7 | 0 | 0 | 3 | 9 | 88 |
| W | 8 | 10 | 12 | 9 | 10 | 15 | 12 | 7 | 0 | 0 | 3 | 11 | 97 |

/a Irrigated A (1) for cropping pattern type 1, (2) for type 2, (3) for type 3

P=Present, $\overline{W}$=Future without project, W=Future with project

Table 10-9. Total Monthly Labor Requirement

| | | Area (ha) | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ('000 man-days) | | | | | | | | | | | | |
| **Wet Season Paddy** | | | | | | | | | | | | | | | |
| Rainfed | P | 2,110 | 2 | - | - | - | 4 | 6 | 6 | 6 | 0 | 0 | 15 | 44 | 83 |
| | $\overline{W}$ | 2,110 | 2 | - | - | - | 4 | 6 | 6 | 6 | 0 | 0 | 15 | 44 | 83 |
| Irrigated A | P | 839 | 3 | - | - | 2 | 3 | 13 | 11 | 4 | 3 | 3 | 6 | 20 | 68 |
| | $\overline{W}$ | 839 | 3 | - | - | 2 | 3 | 13 | 11 | 4 | 3 | 3 | 6 | 20 | 68 |
| | W | 2,250 | 1 | - | - | 3 | 22 | 40 | 27 | 29 | 35 | 13 | 9 | 9 | 188 |
| Irrigated B | P | 4,131 | - | - | - | - | - | 29 | 74 | 37 | 17 | 17 | 78 | 74 | 326 |
| | $\overline{W}$ | 4,131 | - | - | - | - | - | 29 | 74 | 37 | 21 | 21 | 78 | 74 | 334 |
| | W | 12,620 | 25 | - | - | - | - | 25 | 151 | 240 | 139 | 50 | 215 | 227 | 1,072 |
| **Dry Season Paddy** | | | | | | | | | | | | | | | |
| Irrigated A | P | 4,761 | 19 | 86 | 43 | 19 | 19 | 90 | 86 | 10 | - | - | - | 10 | 382 |
| | $\overline{W}$ | 4,761 | 24 | 86 | 48 | 19 | 19 | 90 | 86 | 10 | - | - | - | 10 | 392 |
| | W | 2,560 | 31 | 50 | 30 | 34 | 49 | 19 | 2 | - | - | - | - | 1 | 216 |
| Irrigated B | P | 7,139 | 43 | 129 | 64 | 29 | 29 | 136 | 129 | 14 | - | - | - | - | 573 |
| | $\overline{W}$ | 7,139 | 50 | 129 | 64 | 36 | 29 | 136 | 129 | 14 | - | - | - | - | 587 |
| | W | 11,520 | 23 | 161 | 219 | 104 | 81 | 219 | 173 | 23 | - | - | - | - | 1,003 |
| Sugarcane | P | 1,220 | 10 | 10 | 11 | 9 | 12 | 18 | 15 | 9 | 0 | 0 | 4 | 11 | 109 |
| | $\overline{W}$ | 1,220 | 10 | 10 | 11 | 9 | 12 | 18 | 15 | 9 | 0 | 0 | 4 | 11 | 109 |
| | W | 1,200 | 10 | 12 | 14 | 11 | 12 | 18 | 14 | 8 | 0 | 0 | 4 | 13 | 116 |
| Total | P | 20,200 | 77 | 225 | 118 | 59 | 67 | 292 | 321 | 80 | 20 | 20 | 103 | 159 | 1,541 |
| | $\overline{W}$ | 20,200 | 89 | 225 | 123 | 66 | 67 | 292 | 321 | 80 | 24 | 24 | 103 | 159 | 1,573 |
| | W | 30,150 | 90 | 223 | 263 | 152 | 164 | 321 | 367 | 300 | 174 | 63 | 228 | 250 | 2,595 |

P=Present, $\overline{W}$=Future without project, W=Future with project.
Irrigate A & B= lands are irrigated with extensive & intensive facilities, respectively.

Table 10-10. Net Value of Production before Costing Labor
(For economic analysis)

| | | Area (ha) | Yield (ton/ha) | Farm gate price (฿/ton) | Gross value of production | Production Cost | Net value of Production | Project net value of Production (million Baht) |
|---|---|---|---|---|---|---|---|---|
| | | | | | (฿/ha) | | | |
| Paddy | | | | | | | | |
| Wet season | | | | | | | | |
| Rainfed | $\overline{W}$ | 2,110 | 2.0 | 4,400 | 8,800 | 1,355 | 7,445 | 15.71 |
| | W | - | - | - | - | - | - | - |
| Irrigated A | $\overline{W}$ | 839 | 2.3 | 4,400 | 10,120 | 1,465 | 8,655 | 7.26 |
| | W | 2,250 | 3.3 | 4,400 | 14,520 | 2,240 | 12,280 | 27.63 |
| Irrigated B | $\overline{W}$ | 4,131 | 3.2 | 4,400 | 14,080 | 1,820 | 12,260 | 50.65 |
| | W | 12,620 | 4.2 | 4,400 | 18,480 | 2,685 | 15,795 | 199.33 |
| Dry season | | | | | | | | |
| Irrigated A | $\overline{W}$ | 4,761 | 2.8 | 4,400 | 12.320 | 1,885 | 10,435 | 49.68 |
| | W | 2,560 | 4.3 | 4,400 | 18,920 | 2,830 | 16,090 | 41.19 |
| Irrigated B | $\overline{W}$ | 7,139 | 3.4 | 4,400 | 14,960 | 2,075 | 12,885 | 91.99 |
| | W | 11,520 | 4.6 | 4,400 | 20,240 | 2,950 | 17,290 | 199.18 |
| Sub-total | $\overline{W}$ | 18,980 | | | | | | 215.29 |
| | W | 28,490 | | | | | | 467.33 |
| Sugarcane | $\overline{W}$ | 1,220 | 60 | 490 | 29,400 | 7,455 | 21,945 | 26.77 |
| | W | 1,200 | 80 | 490 | 39,200 | 10,160 | 29,040 | 34.85 |
| Total | $\overline{W}$ | 20,200 | | | | | | 242.06 |
| | W | 29,690 | | | | | | 502.18 |

Incremental net value of production before costing labor = 260.12

Table 10-11. Economic Cost of Farm Labor

| | | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Labor requirement ('000 man-day) | W | 90 | 223 | 263 | 152 | 164 | 321 | 367 | 300 | 174 | 63 | 228 | 250 | 2,595 |
| | $\bar{W}$ | 89 | 225 | 123 | 66 | 67 | 292 | 321 | 80 | 24 | 24 | 103 | 159 | 1,573 |
| Labor requirement incl. remained sugarcane area ('000 man-day) | W | 125 | 258 | 301 | 183 | 206 | 383 | 419 | 331 | 174 | 63 | 242 | 288 | 2,973 |
| | $\bar{W}$ | 124 | 260 | 161 | 97 | 109 | 354 | 373 | 111 | 24 | 24 | 117 | 197 | 1,951 |
| Marginal opportunity | W | 9.6 | 12.3 | 14.4 | 10.4 | 10.9 | 19.6 | 21.9 | 16.3 | 10.2 | 9.1 | 11.8 | 13.5 | (10.6) |
| Cost | $\bar{W}$ | 9.6 | 12.3 | 10.0 | 9.4 | 9.5 | 17.8 | 19.0 | 9.5 | 8.7 | 8.7 | 9.6 | 10.7 | (10.1) |
| Marginal product cost of farm labor (฿ million) | W | 1.14 | 2.57 | 3.15 | 1.72 | 1.96 | 4.53 | 5.29 | 3.59 | 1.62 | 0.55 | 2.37 | 2.96 | 31.45 |
| | $\bar{W}$ | 1.13 | 2.59 | 1.49 | 0.87 | 0.98 | 4.00 | 4.34 | 1.00 | 0.21 | 0.21 | 1.06 | 1.87 | 19.75 |
| Incremental Marginal product of farm labor (฿ million) | W-$\bar{W}$ | 0.01 | (-)0.02 | 1.66 | 0.85 | 0.98 | 0.53 | 0.95 | 2.59 | 1.41 | 0.34 | 1.31 | 1.09 | 11.70 |

Incremental labor requiremnet = 1,022,000 man-days
W = Future with project $\bar{W}$ = Future without project
Economic cost for labor (฿ million); W = 30.30, $\bar{W}$ = 19.03.
Incremental labor demand = 1,022,000 man-day,
Economic cost of incremental labor = ฿11.4 x 0.96 = 11.0
Incremental economic cost of labor = ฿11.27 million

FIGURE 10-1 TYPICAL OPPORTUNITY COST CURVES FOR FARM LABOR

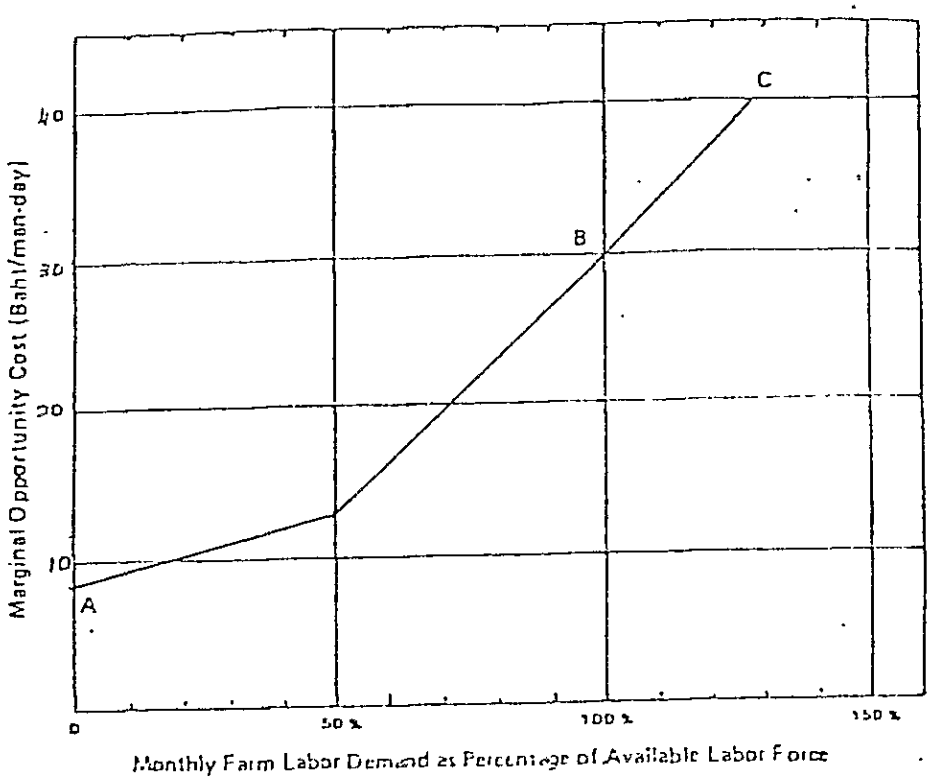


FIGURE 10-2 OPPORTUNITY COST CURVES FOR FARM LABOR

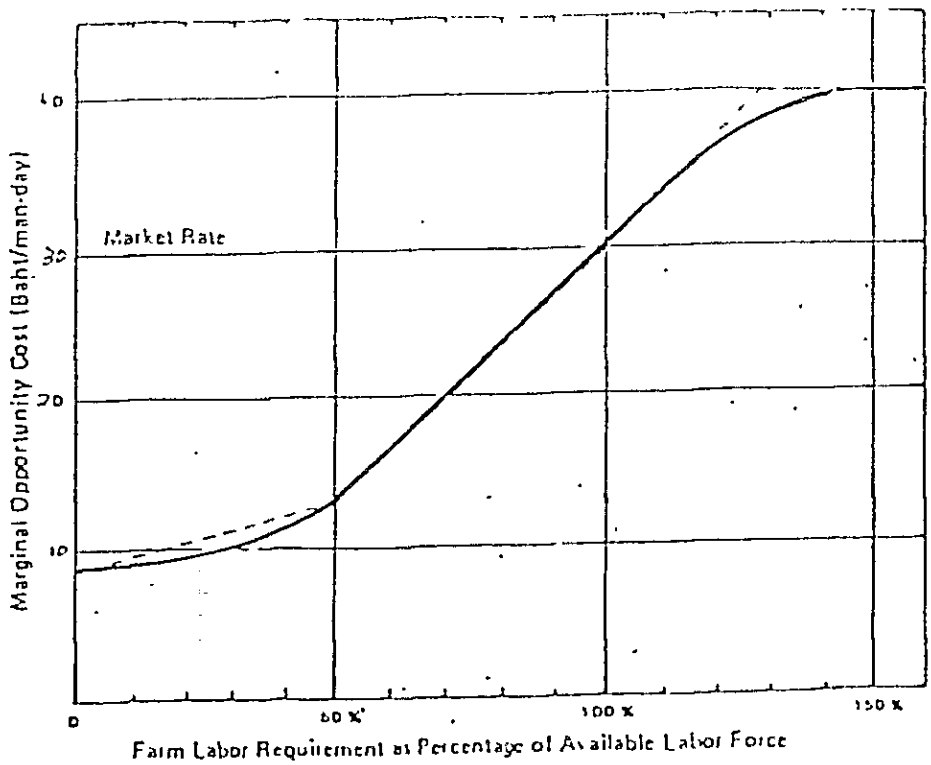

Table 10-12. Economic Cost and Return

| | Incremental(A) | | Incremental(B) | | Discount Rate | |
|---|---|---|---|---|---|---|
| | Capital | O&M | Benefit | (B-A) | 26% | 28% |
| 1. | 35.93 | 0.15 | | -36.08 | -28.64 | -28.19 |
| 2. | 60.76 | 0.15 | | -60.91 | -38.37 | -37.18 |
| 3. | 71.57 | 0.15 | -35.42 | -107.14 | -53.56 | -51.08 |
| 4. | 72.08 | 1.39 | -22.98 | -96.45 | -38.27 | -35.93 |
| 5. | 72.06 | 2.78 | 1.91 | -72.93 | -22.97 | -21.22 |
| 6. | 48.80 | 4.17 | 39.24 | -13.73 | -3.43 | -3.12 |
| 7. | | 5.56 | 124.43 | 118.87 | 23.57 | 21.11 |
| 8. | | 5.56 | 174.20 | 168.64 | 26.54 | 23.41 |
| 9. | | 5.56 | 211.52 | 205.96 | 25.72 | 22.33 |
| 10. | | 5.56 | 236.41 | 230.85 | 22.90 | 19.55 |
| 11.-50. | | 5.56 | 248.85 | 243.29 | 92.77 | 73.60 |
| Total | 361.20 | | | | +6.26 | -16.72 |

$$IRR = 26\% + \frac{6.26}{6.26 + 16.72} \times 2\% \fallingdotseq 26.5\%$$

Table 10-13. Crop Budgets /a

| | Wet Season Paddy | | | Dry Season Paddy | | Sugarcane | |
|---|---|---|---|---|---|---|---|
| Present | Rainfed /b | Irrigated A /c | Irrigated B /c | Irrigated A /c | Irrigated B /c | Rainfed | Irrigated |
| Yield (ton/ha) | 1.6 | 2.0 | 2.6 | 2.4 | 2.8 | 45 | |
| Farm gate price (฿/ton) | 2,400 | 2,400 | 2,400 | 2,400 | 2,400 | 280 | |
| Gross value of production (฿/ha) | 3,840 | 4,800 | 6,240 | 5,760 | 6,720 | 12,600 | |
| Production costs, excl. labor (฿/ha) | 1,395 | 1,230 | 1,355 | 1,490 | 1,655 | 6,425 | |
| N.V.P. without accounting for labor (฿/ha) | 2,445 | 3,570 | 4,885 | 4,270 | 5,065 | 6,175 | |
| Labor requirements (man-day/ha) | 40 | 79 | 79 | 80 | 80 | 87 | |
| Future without project | | | | | | | |
| Yield (ton/ha) | 2.0 | 2.3 | 3.2 | 2.8 | 3.4 | 60 | |
| Farm gate price (฿/ton) | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 320 | |
| Gross value of production (฿/ha) | 6,000 | 6,900 | 9,600 | 8,400 | 10,200 | 19,200 | |
| Production costs, excl. labor (฿/ha) | 1,450 | 1,495 | 1,890 | 1,975 | 2,180 | 8,860 | |
| N.V.P. without accounting for labor (฿/ha) | 4,550 | 5,405 | 7,710 | 6,425 | 8,020 | 10,340 | |
| Labor requirements (man-day/ha) | 40 | 80 | 81 | 82 | 82 | 87 | |
| Future with production | | | | | | | |
| Yield (ton/ha) | | 3.3 | 4.2 | 4.3 | 4.6 | | 80 |
| Farm gate price (฿/ton) | | 3,000 | 3,000 | 3,000 | 3,000 | | 320 |
| Gross value of production (฿/ha) | | 9,900 | 12,600 | 12,900 | 13,800 | | 25,600 |
| Production costs, excl. labor (฿/ha) | | 2,400 | 2,900 | 3,060 | 3,195 | | 12,130 |
| N.V.P. without accounting for labor (฿/ha) | | 7,500 | 9,700 | 9,840 | 10,605 | | 13,470 |
| Labor requirements (man-day/ha) | | 83 | 85 | 86 | 87 | | 97 |

/a Financial prices and costs are used.
/b Broadcasting paddy
/c Irrigated A and B mean lands are irrigated with poor and adequate facilities, respectively.

Table 10-14. Farm Budget-1.6 ha (10 rai) Farm

| | Present | | | | Future | | |
|---|---|---|---|---|---|---|---|
| | CR | CA | CB | SC+P | CA | CB | SC+P |
| Cropping | | | | | | | |
| Wet season paddy (%) | 90 | 16 | 51 | 25 | 88 | 100 | 50 |
| Dry season paddy (%) | - | 89 | 88 | 44 | 100 | 91 | 46 |
| Sugarcane (%) | - | - | - | 44 | - | - | 50 |
| Intensity (%) | 90 | 105 | 139 | 113 | 184 | 191 | 146 |
| Production paddy (ton) | 2.30 | 3.93 | 6.06 | 3.01 | 11.53 | 13.42 | 6.75 |
| sugarcane (ton) | - | - | - | - | - | - | 64.0 |
| Gross value of production (฿) | 5,530 | 9,430 | 14,555 | 16,095 | 34,580 | 40,255 | 40,715 |
| Production cost excl. labor (฿) | 2,230 | 2,435 | 3,435 | 6,230 | 8,275 | 9,290 | 14,375 |
| Hired labor (฿) | 0 | 0 | 440 | 0 | 960 | 1,070 | 130 |
| Land tax[a] (฿) | 50 | 50 | 50 | 50 | 75 | 75 | 75 |
| Interest[b] (฿) | 55 | 60 | 85 | 80 | 350 | 400 | 370 |
| Net value of production before project charge (฿) | 3,195 | 6,935 | 10,545 | 9,735 | 24,920 | 29,420 | 25,765 |
| Project charge | | | | | | | |
| On-farm development cost[c] (฿) | - | - | - | - | 865 | 1,150 | 905 |
| O & M cost[d] (฿) | - | - | - | - | 600 | 600 | 600 |
| Net value of production after project charge (฿) | 3,195 | 6,935 | 10,545 | 9,735 | 23,455 | 27,670 | 24,260 |

* Rounded to nearest ฿5.

/a Based on ฿5/rai at present and assumed at ฿7.5/rai in future

/b Interest charged at 6%(1% per month). It is assumed that 50% of farmers borrow 80% of their cash needs at present and 80% would borrow 90% of their cash needs in future.

/c ฿540/ha for CA, ฿720/ha for CB and ฿410/ha for sugarcane area.

/d ฿60/rai

Table 10-15. Farm Budget-4.0 ha (25 rai) Farm

| | Present | | | | Future | | |
|---|---|---|---|---|---|---|---|
| | CR | CA | CB | SC+P | CA | CB | SC+P |
| Cropping | | | | | | | |
| Wet season paddy (%) | 90 | 16 | 51 | 25 | 88 | 100 | 50 |
| Dry season paddy (%) | - | 89 | 88 | 44 | 100 | 91 | 46 |
| Sugarcane (%) | - | - | - | 44 | - | - | 50 |
| Intensity (%) | 90 | 105 | 139 | 113 | 184 | 191 | 146 |
| Production-paddy (ton) | 5.76 | 9.82 | 15.16 | 7.53 | 28.82 | 33.54 | 16.86 |
| -sugarcane(ton) | - | - | - | 90.0 | - | - | 160.0 |
| Gross value of production (฿) | 13,825 | 23,580 | 36,385 | 40,245 | 86,450 | 100,630 | 101,790 |
| Production cost excl. labor (฿) | 5,580 | 6,090 | 8,590 | 15,575 | 20,690 | 23,230 | 35,940 |
| Hired labor (฿) | 1,750 | 3,915 | 6,270 | 3,800 | 11,875 | 12,230 | 6,630 |
| Land Tax/a (฿) | 125 | 125 | 125 | 125 | 190 | 190 | 190 |
| Interest/b (฿) | 135 | 145 | 205 | 205 | 875 | 1,005 | 930 |
| Net value of production before project charge (฿) | 6,235 | 13,305 | 21,195 | 20,540 | 52,820 | 63,975 | 58,100 |
| Project charge | | | | | | | |
| On-farm development cost/c (฿) | - | - | - | - | 2,160 | 2,880 | 2,260 |
| O & M cost/d (฿) | - | - | - | - | 1,500 | 1,500 | 1,500 |
| Net value of production after project charge | 6,235 | 13,305 | 21,195 | 20,540 | 49,160 | 59,595 | 54,340 |

* Rounded to nearest ฿5.

/a Based on ฿5/rai at present and assumed at ฿7.5/rai in future.

/b Interest charged at 6%(1% per month). It is assumed that 50% of farmers borrow 80% of their cash needs at present and 80% would borrow 90% of their cash needs in future.

/c ฿540/ha for CA, ฿720/ha for CB and ฿410/ha for sugarcane area.

/d ฿60/rai

Table 10-16. Farm Budget-6.4 ha (40 rai) Farm

| | Present | | | | Future | | |
|---|---|---|---|---|---|---|---|
| | CR | CA | CB | SC+P | CA | CB | SC+P |
| Cropping | | | | | | | |
| Wet season paddy (%) | 90 | 16 | 51 | 25 | 88 | 100 | 50 |
| Dry season paddy (%) | - | 89 | 88 | 44 | 100 | 91 | 46 |
| Sugarcane (%) | - | - | - | 44 | - | - | 50 |
| Intensity (%) | 90 | 105 | 139 | 113 | 184 | 191 | 146 |
| Production-paddy (ton) | 9.22 | 15.72 | 24.26 | 12.04 | 46.11 | 53.67 | 26.98 |
| -sugarcane(ton) | - | - | - | 144.0 | - | - | 256.0 |
| Gross value of production (฿) | 22,120 | 37,725 | 58,215 | 64,390 | 138,315 | 161,010 | 162,865 |
| Production and excl. labor (฿) | 8,930 | 9,745 | 13,745 | 24,920 | 33,100 | 37,170 | 57,505 |
| Hired labor (฿) | 3,465 | 8,895 | 13,145 | 9,850 | 23,355 | 23,870 | 15,705 |
| Land tax[a] (฿) | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| Interest[b] (฿) | 215 | 235 | 330 | 325 | 1,405 | 1,605 | 1,490 |
| Net value of production before project charge (฿) | 9,310 | 18,650 | 30,795 | 29,095 | 80,255 | 98,165 | 87,965 |
| Project charge | | | | | | | |
| On-farm development cost[c] | - | - | - | - | 3,455 | 4,610 | 3,615 |
| O & M cost[d] (฿) | - | - | - | - | 2.400 | 2,400 | 2,400 |
| Net value of production after project charge (฿) | 9,310 | 18,650 | 30,795 | 29,095 | 74,400 | 91,155 | 81,950 |

* Rounded to nearest ฿5.

/a Based on ฿5/rai at present and assumed at ฿7.5/rai in future.

/b Interest charged at 6% (1% per month). It is assumed that 50% of farmers borrow 80% of their cash needs at present and 80% would borrow 90% of their cash needs in future.

/c ฿540/ha for CA, ฿720/ha for CB and ฿410/ha for sugarcane area.

/d ฿60/rai

Table 10-17. Projected Agricultural Input Flow

| Item | Pre-project | Project Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11-50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paddy | | | | | | | | | | | | |
| Cultivation -mechanical (%) | 79 | 79 | 79 | 79 | 80 | 82 | 83 | 85 | 87 | 88 | 89 | 90 |
| Seed (ton) | 1,708 | 1,664 | 1,620 | 1,355 | 1,427 | 1,470 | 1,481 | 1,665 | 1,514 | 1,407 | 1,337 | 1,303 |
| Chemicals (%) | 20 | 20 | 21 | 21 | 27 | 37 | 44 | 58 | 72 | 82 | 89 | 92 |
| Fertilizer Ammo-phos (ton) | 1,739 | 1,812 | 1,885 | 1,594 | 2,027 | 2,634 | 3,395 | 4,741 | 5,326 | 5,780 | 6,056 | 6,190 |
| Urea (ton) | - | - | - | - | 83 | 250 | 500 | 835 | 1,169 | 1,419 | 1,586 | 1,670 |
| Thresthing -mechanical (%) | 5 | 6 | 7 | 8 | 13 | 17 | 22 | 25 | 29 | 32 | 34 | 35 |
| Sugarcane | | | | | | | | | | | | |
| Cultivation -mechanical (%) | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Nursery (ton) | 1,708 | 1,708 | 1,694 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 |
| Fertilizer Am.-sul. (ton) | 190 | 195 | 198 | 202 | 227 | 263 | 310 | 366 | 416 | 454 | 479 | 492 |
| TSP (ton) | - | 5 | 11 | 16 | 34 | 53 | 63 | 90 | 102 | 111 | 117 | 120 |
| KCL (ton) | - | 3 | 7 | 10 | 21 | 25 | 38 | 54 | 61 | 67 | 70 | 72 |

Table 10-18. Projected Agricultural Output Flow

| Cropped Area (ha) | Pre-project | Project Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11-50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wet season paddy | | | | | | | | | | | | |
| Broadcasting | 2,110 | 2,110 | 2,110 | 2,110 | 1,580 | 1,060 | 530 | 0 | 0 | 0 | 0 | 0 |
| Transplanting A | 839 | 839 | 839 | 839 | 1,190 | 1,540 | 1,900 | 2,250 | 2,250 | 2,250 | 2,250 | 2,250 |
| Transplanting B | 4,131 | 4,131 | 4,131 | 4,131 | 6,250 | 8,370 | 10,500 | 12,620 | 12,620 | 12,620 | 12,620 | 12,620 |
| sub-total | 7,080 | 7,080 | 7,080 | 7,080 | 9,020 | 10,970 | 12,930 | 14,870 | 14,870 | 14,870 | 14,870 | 14,870 |
| Dry season paddy | | | | | | | | | | | | |
| Transplanting A | 4,761 | 4,761 | 4,761 | 3,570 | 3,020 | 2,470 | 1,920 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 |
| Transplanting B | 7,139 | 7,139 | 7,139 | 5,350 | 6,450 | 7,540 | 8,640 | 11,520 | 11,520 | 11,520 | 11,520 | 11,520 |
| sub-total | 11,900 | 11,900 | 11,900 | 8,920 | 9,470 | 10,010 | 10,560 | 14,080 | 14,080 | 14,080 | 14,080 | 14,080 |
| Total for paddy | 18,980 | 18,980 | 18,980 | 16,000 | 18,490 | 20,980 | 23,490 | 28,950 | 28,950 | 28,950 | 28,950 | 28,950 |
| Sugarcane | 1,220 | 1,220 | 1,210 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| Yiald (ton/ha) | | | | | | | | | | | | |
| Wet season paddy | | | | | | | | | | | | |
| Broadcasting | 1.6 | 1.64 | 1.69 | 1.72 | 1.76 | 1.80 | 1.84 | - | - | - | - | - |
| Transplanting A | 2.0 | 2.03 | 2.06 | 2.09 | 2.22 | 2.39 | 2.57 | 2.73 | 2.96 | 3.13 | 3.25 | 3.30 |
| Transplanting B | 2.6 | 2.66 | 2.72 | 2.78 | 2.95 | 3.15 | 3.35 | 3.55 | 3.82 | 4.01 | 4.14 | 4.20 |
| Dry season paddy | | | | | | | | | | | | |
| Transplanting A | 2.4 | 2.44 | 2.48 | 2.52 | 2.63 | 2.84 | 3.26 | 3.45 | 3.79 | 4.05 | 4.22 | 4.30 |
| Transplanting B | 2.8 | 2.86 | 2.92 | 2.98 | 3.16 | 3.44 | 3.67 | 3.85 | 4.16 | 4.38 | 4.53 | 4.60 |
| Sugarcane | 45 | 46.4 | 48.1 | 49.1 | 53.8 | 58.9 | 64.3 | 70 | 74 | 77 | 79 | 80 |
| Production (1000 ton) | | | | | | | | | | | | |
| Paddy | 47.21 | 48.19 | 49.16 | 41.81 | 52.18 | 64.91 | 78.91 | 104.13 | 112.49 | 118.47 | 122.55 | 124.43 |
| Sugarcane | 54.90 | 56.61 | 57.72 | 58.92 | 64.56 | 70.68 | 77.16 | 84.00 | 88.80 | 92.40 | 94.80 | 96.00 |

Table 10-19. Cash Flow Projections For 4.0 ha Farm (CB)
(Baht)

| Cropping | Pre-project | Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8-22 | 23-55 |
|---|---|---|---|---|---|---|---|---|---|---|
| Wet season paddy (%) | 51 | 51 | 51 | 51 | 100 | 100 | 100 | 100 | 100 | 100 |
| Dry season paddy (%) | 88 | 88 | 88 | - | 91 | 91 | 91 | 91 | 91 | 91 |
| Intensity (%) | 139 | 139 | 139 | 51 | 191 | 191 | 191 | 191 | 191 | 191 |
| Cropped area | 4.0 | 4.0 | 4.0 | 4.0 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 |
| Gross value of production | 36,385 | 37,825 | 39,585 | 14,750 | 66,830 | 72,350 | 78,315 | 84,170 | 95,600 | 95,600 |
| Cash production costs | 14,860 | 15,100 | 15,320 | 2,425 | 22,875 | 25,165 | 27,455 | 29,750 | 32,030 | 32,030 |
| Interest on production credit | 360 | 360 | 365 | 60 | 990 | 1,085 | 1,185 | 1,285 | 1,385 | 1,385 |
| Net value of production | 21,525 | 22,365 | 23,900 | 12,265 | 42,965 | 46,100 | 49,675 | 53,135 | 62,185 | 62,185 |
| Livestock income | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 |
| Other net income | 4,840 | 4,840 | 4,840 | 4,840 | 4,840 | 4,840 | 4,840 | 4,840 | 4,840 | 4,840 |
| Net farm income before taxes and project charge | 28,530 | 29,370 | 29,905 | 18,270 | 48,970 | 52,105 | 55,680 | 59,140 | 68,190 | 68,190 |
| Land tax | 125 | 125 | 125 | 125 | 120 | 120 | 120 | 120 | 190 | 190 |
| Project charge | | | | | | | | | | |
| O & M cost | - | - | - | - | - | - | - | 2,735 | 2,735 | - |
| On-farm development | - | - | - | - | 1,425 | 1,425 | 1,425 | 1,425 | 1,425 | 1,425 |
| Net farm income after taxes and project charge | 28,405 | 29,245 | 29,780 | 18,145 | 47,425 | 50,560 | 54,135 | 54,860 | 63,840 | 66,575 |
| Incremental net farm income after taxes and project charge | - | 84 | (-) 1,375 | 10,260 | 19,020 | 22,155 | 25,730 | 26,455 | 35,435 | 38,170 |

Note. Rounded to nearest ฿5 See Table 10-16 for explanation of rows

Table 10-20. Cost and Rent Recovery /a

| | 4.0ha - Farmer | | Total |
|---|---|---|---|
| | CA | CB | Project |
| Incremental gross value of production | 52,130 | 45,140 | 209.67 |
| Less ; Incremental - production costs (including hired labor) | 20,930 | 18,060 | 76.24 |
| Equals ; Incremental net cash income | 31,200 | 27,080 | 133.43 |
| Less ; Incremental - payment to landlord | - | - | 0.92 |
| - imputed return on capital /b | 630 | 540 | 2.29 |
| - imputed value of family labor /c | 690 | 0 | 8.61 |
| - imputed value of management /d | 5,210 | 4,510 | 20.97 |
| - depreciation on farm equipment /e | 3,500 | 3,500 | 14.33 |
| - allowance for risk /f | 5,210 | 4,510 | 20.97 |
| Equals ; Project rent | 15,960 | 14,020 | 65.34 |
| Project rent as of incremental net cash income (%) | 51 | 52 | 49 |
| Incremental project charge /g | | | |
| - on-farm development cost | 2,160 | 2,890 | 18.76 |
| - O&M cost | 1,500 | 1,500 | 6.14 |
| sub-total | 3,660 | 4,380 | 24.90 |
| Rent recovery index (%) | 23 | 31 | 38 |
| Project cost (capital and recurrent) | | | 352.55 |
| Cost recovery index (%) | | | 19 |

/a... All Baht value are in 1979 constant Baht and rounded to nearest ฿10 or ฿10,000 ; Project cost is present value with 15% of discount rate and over 50 year repayment period.

/b... Assuming 10% of incremental cash investment ; incremental cash, investment estimated at 30% of cash needs.

/c... Family labor value at ฿30 in future

/d... 10% of incremental gross valur of production

/e... Assuming ฿875/ha based on survey data.

/f... 10% of incremental gross value of production

/g... On-farm development cost estimated at ฿540/ha for CA, ฿720/ha for CB and O&M - ฿60/rai.