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PROJECT COMPLETION REPORT
OF THE
MAE NAM PRACHANTAKHAM IRRIGATION PROJECT

by

MG-12 GROUP ONE
ASEAN ADPC, BANGKOK, THAILAND
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SUMMARY AND RECOMMENDATIONS

The agricultural sector is still the largest sector in the economy of Thailand, contributing to 17% of the Gross Domestic Product of the country and 30% of the total exports of the country. Within the agricultural sector, paddy is the single largest commodity. Rice exports forms about 1/3 of the total agricultural exports.

However, the agricultural sector in Thailand is facing some critical times. Growth in the agricultural sector during the period 1982-1986 was only 2.1% per annum compared to the target of 4.4%. Paddy production has also remained rather stagnant since 1980 and paddy yield in Thailand is among the lowest in Asia.

In order to expand paddy production, several measures have been undertaken including the introduction of high yielding varieties of paddy seeds, introduction of modern technology and expanding the areas under irrigation. In 1986, the total accumulated irrigated area in Thailand was only about 24 million rai or about 18% of the total farm holdings in Thailand.

The Mae Nam Pranchantakham project area faced critical water shortages especially during the end of the wet season and the dry season. The project was conceived to reduce the

effects of drought by supplying the area with regulated supply of water from the river. Due to the critical water shortage even after the project was implemented, the main crop of paddy could only be planted once. Output from paddy forms a major source of income for the farmers. On the average paddy forms 54% of the total net income of the farmers.

The major component of the project works consists of the construction of a river regulator and canals. A demonstration plot was also provided to enable the farmers to observe the new irrigation system and for the introduction of HYV of paddy seeds.

The project was started in 1982 and is expected to be completed in 1989. Total project costs is estimated to be 362,337,311 baht and operations and maintenance costs at 1,253,920 baht per annum. The benefits from the project would be from the net incremental benefits as a result of higher net returns from irrigation.

The farm budget analysis of comparisons between the rainfed/transplanted vs irrigated/transplanted and rainfed/broadcasting vs irrigated/broadcasting shows that the net profit / rai was higher for the irrigated areas. A benefit cost analysis shows that the project, from an economic point of view was not feasible, since the BC ratio was only 0.142.

A proposed cropping pattern was recommended, with the introduction of tree crops such as mango and the introduction of dry season crops. A better BC ratio of 1.093 was observed, with an internal rate of return of 12.69%

However, before the new proposed cropping pattern can be established, certain recommendations are suggested which need further detailed studies to enable the project to achieve its desired economic benefits. The recommendations are:

- i) A feasibility study to determine the viability of the construction of a reservoir upstream to store water during the dry season.
- ii) Introduction of HYV paddy seeds which are also fast maturing so that the wet season crops can mature faster to enable the dry season crops to take advantage of the residual water available.
- iii) An organized water user organisation to ensure efficient water distribution especially during the dry season and minimize water losses.
- iv) Extension services to promote drought-resistant dry season crops.

PROJECT COMPLETION REPORT OF THE
MAE NAM PRACHANTAKHAM IRRIGATION PROJECT

1. INTRODUCTION

This project completion report forms part of the course content of the training program of MG-12. The report was prepared by a 7 member team from ASEAN countries, lead by a group adviser. (see Appendix 1 for composition of study team) The field study for the project was conducted from 20th March 1989 to 23rd March 1989 and the final report was completed on 12th April 1989.

In Thailand, agriculture forms a major portion of the economy of the country and within the agricultural sector, paddy is the single most important commodity. With only about 18.6% of the total farm holdings in Thailand under irrigation, irrigation projects are very important, not only to increase productivity but also to ensure enough water supply for both dry and wet season cultivation.

The selection of the Mae Nam Prachantakham Irrigation Project was based on observations that while most irrigation project were successfully, there were instances when projects faced numerous problems during implementation due to weaknesses in the project preparation stage.

2. BACKGROUND

2.1. Economic Situation in Thailand

Thailand is emerging as one of the Newly Industrialised Countries (NIC) in Asia. The transition from an economy based on agriculture however was not a smooth one. During the Fifth Plan (1982 - 1986), world economic recession, trade barriers, high real interest rates and falling prices of agricultural commodities severely affected the economic growth of the country. The average economic growth rate was 4.4% during the Fifth Plan period compared to the target of 6.6%. Growth in the agricultural sector was also affected with the annual growth rate during the period 1982-1986 at 2.1 % compared to the target of 4.4%.

However despite of the slow growth of the agricultural sector, agriculture forms a major portion of the economy of Thailand. In 1988, it was estimated that the agricultural sector contributed to 17% of the total Gross Domestic Product of the country. The total agricultural export of the country was Baht 83,259 million in 1987 forming about 30% of the total export of the country.

Within the agricultural sector, paddy is the largest single commodity. In 1987, total rice exports was about 4,443,301 metric tons valued at Baht 22,703 million. The rice exports formed 27.3% of the total agricultural exports or 8% of the total exports of the country. Exports of rice in 1987 was mainly to countries such as Iran, China and Singapore (Appendix 2).

However, the trend of paddy production in Thailand is facing some critical periods. Total output has remained rather stable during the period 1980-1987. In Table 1, the paddy production in 1980/81 was about 17.3 million metric tons, increasing to 20.2 million metric tons in 1985/86 but declined to 18.0 million metric tons in 1987/88.

Paddy yield in Thailand is also low as compared to some of its neighbouring countries. In 1986, the yield per rai of paddy for Thailand was 328 kg/rai as compared to 860 kg/rai for China, 637 kg/rai for Indonesia and 431 kg/rai for the Philippines (Appendix 3).

In order to expand paddy production in Thailand, several measures were undertaken example the introduction of High Yielding Varieties (HYV), increasing the area under irrigation and the introduction of modern farming technology to the farmers. However, farmers are confronted with serious problems like land ownership and inefficient landuse. An estimated 50% of agricultural land has no title deeds which results in unimproved soils and land being left idle. In 1986, the total accumulated irrigated areas in Thailand was 24,447,077 rai which was only about 18.8% of the total farm holdings in Thailand.

With the problem encountered during the Fifth Plan, the Sixth Plan (1987-1991) was drawn up to further enhance the economic development of the country. The development guidelines in the Sixth Plan are as follows:

Table 1. Rice (Major and Second Rice) : Area Planted, Production and Yield
Thailand

	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88
Area Planted (1,000 rai)	60,110	59,970	50,134	62,596	62,329	63,422	61,571	58,474
Production (1,000 tons)	17,368	17,774	16,879	19,549	19,905	20,264	18,868	18,042
Yield (kg/rai)	302	312	302	326	331	330	328	318

Source : Agricultural Statistics of Thailand Crop Year 1987/88
Center for Agricultural Statistics, Office of Agricultural Economics

- i) Increase the efficiency of national development
- ii) Improve the production system and marketing and raise the quality of the basic economic factors
- iii) Increase the distribution of income and prosperity into provincial regions and rural areas.

Various programmes will be carried out during the Sixth Plan period in order to achieve the objectives. Among the programmes are the development of natural resources and the environment. Water resources development forms a component of the development of natural resources and in this respect, emphasis on water resources development will be on improving the efficiency in existing large scale and medium scale water resource projects.

Development plans for water resources are coordinated by three agencies, the Royal Irrigation Department, Department of Mineral Resources and Office of Accelerated Rural Development. More economic benefits will be derived from an emphasis on managing water use in extension activities.

2.2. Economic Situation in Prachinburi Province

In Prachinburi province, paddy is a major crop accounting for about 60.6% (1,899,251 rai) of the total farm land in the province. However, the planted area of paddy was only 1,375,244 rai or 72.6% of the total paddy land. The province produced about 324,558 metric tons of paddy in 1987/88 with

a yield of 244 kg/rai, much lower than the national average of 318 kg/rai. The low output of paddy could in part be due to the lack of irrigation facilities in the province, where the total accumulated irrigated areas was 387,187 rai or 12.4% of the total farm land.

3. PROJECT RATIONALE

Irrigation project aims to expand a country's potential for agricultural production by exploiting new sources of water. Depending on hydrologic and other technical considerations, irrigation projects may involve:

- i) storage or diversion projects which are constructed for storing or lifting water for cultivated areas at the required time and drainage when not required, including construction of regulators, redredging of natural distribution and drainage canals for better efficiency in water distribution and drainage.
- ii) Tank irrigation projects which are constructed to store water for cultivation and domestic consumption.

Through irrigation projects and good water management, farmers can increase their crop yields, cultivate unused land and practice multiple cropping. The reduction of risks associated with a stable water supply should also encourage farmers to adopt modern technology.

4. PROJECT IDENTIFICATION

In the project area, the broadcast sown paddy was established with the start of the monsoon rain in May and thereafter grows as an inundated crop in bunded fields. In the case of the transplanted crop, nursery establishment takes place in May and seedlings are transferred in June. Seventy percent of the mean annual rainfall occur during the four months of June to September and drought occur frequently at the beginning and at the end of the growing season.

Floods occur regularly during the wet season due to the river overtopping its banks and to overland flow from the foothills to the northwest. Crops are lost from both causes, but droughts are the most serious. The project was conceived to reduce the effects of drought by supplying the service area with regulated supplies of water from the river. The supply level for gravity irrigation has to be achieved by means of a gated regulator in the deep river-bed. It is not considered to be feasible to provide any protection to the irrigated land from overbank flooding from the river, but some protection will be provided against overland flooding from outside the service area by use of the new canals banks for intercepting and guiding the flood water.

5. PROJECT AREA AND DESCRIPTION

5.1. Location

Mae Nam Prachantakham Irrigation Project is situated in the eastern part of the Central Region of Thailand, in the province of Prachinburi in the district of Prachantakham. (see Map 1) The project area is accessible by a good macadam road on the main highway from Bangkok and is about 180 km from Bangkok.

5.2. Climate

The climatic condition of the project area is tropical. Annual average rainfall over the period 1951-1975 is recorded as 2,036 mm. The average number of rainy days in a year is recorded as 141. The rainfall distribution is unimodal in character, with nearly 90% of the precipitation falling in the monsoon months of May to October. However even during the monsoon, crop growth is subject to periods of moisture stress in the critical late part of the season and some supplementary irrigation becomes essential if good rice harvests are to be ensured. In Table 2, it can be observed that during the month of November and December, the mean monthly rainfall was low, for November, the mean monthly rainfall was 39.5 mm and for December, the mean monthly rainfall was only 7.2 mm.

MAP 1: LOCATION OF PRACHINBURI PROVINCE AND PRACHANTAKHAM TOWN

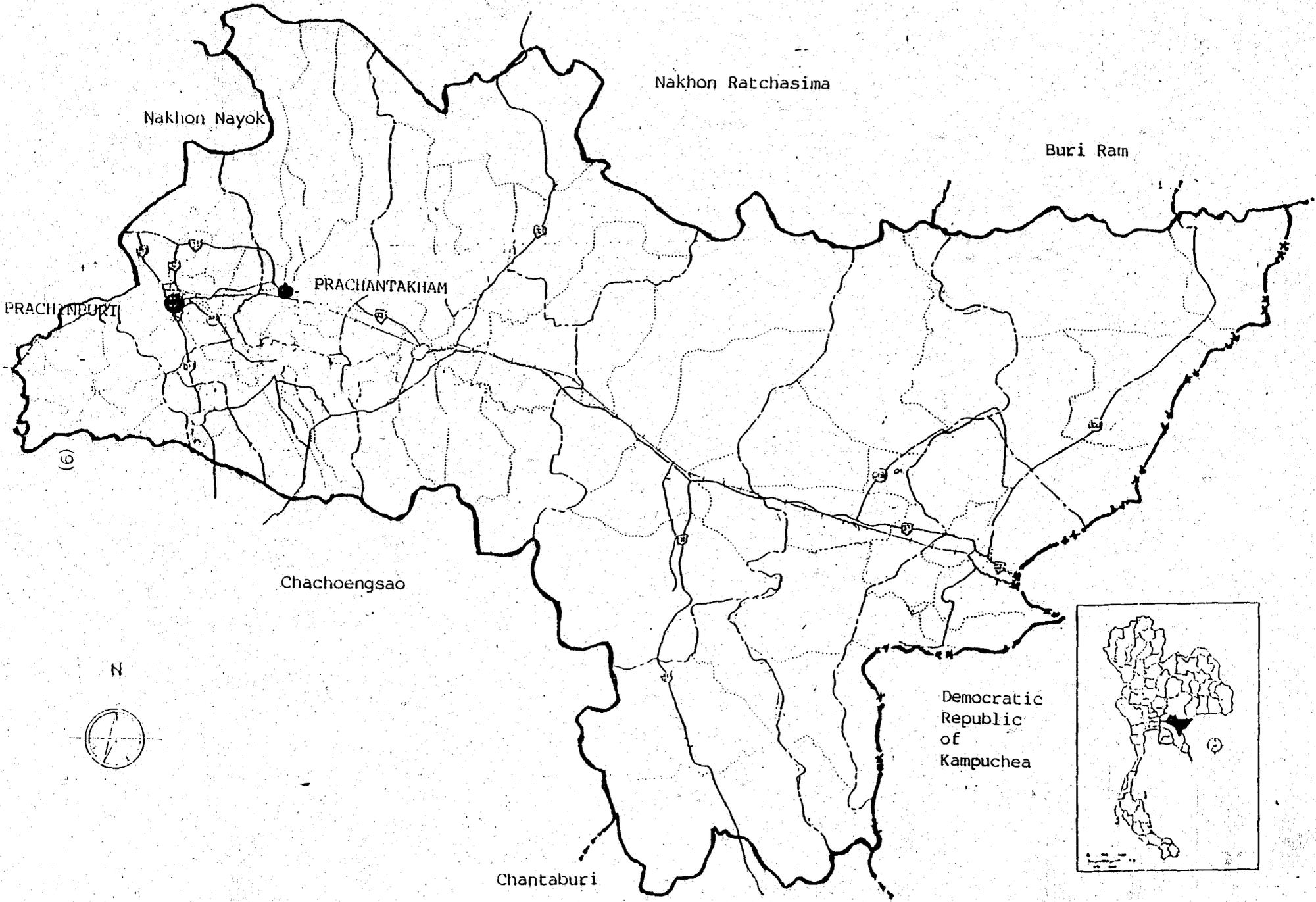


Table 2. Mae Nam Prachantakham Rainfall Pattern 1951-1975

Rainfall (mm)	Jan	Feb	Mar	Apr	May	June	July	August	Sept	Oct	Nov	Dec	Year
Mean	6.4	31.4	69.4	122.8	208.2	285.3	322.3	370.4	382.6	191.3	39.5	7.2	2,036.8
Mean Rainy Days	1.1	2.3	5.2	9.3	17.5	19.6	22.0	22.8	21.8	14.8	4.6	0.8	141.8
Max in 24 Hrs	36.8	84.0	126.0	109.0	125.0	168.0	123.6	161.3	126.0	106.8	63.7	85.5	168.0

Source : Royal Thailand Government, Medium Scale Irrigation Package Project
Feasibility Study, Annexes, 1981.

5.3. Soil and Topography

The soil in the project area are described as old alluvium, sandy loam to sandy clay loam of poor to moderate fertility. Topographically, the project area is flat and drainage is described as being poor to moderate.

5.4 Economic Activity in the Project Area

5.4.1 Agricultural Practice

The project area comprises 15,535 rai under farm holdings at an average farm size of 22.5 rai. However some of the farmers also owned land outside the project area and the average farm size of the farmers including land outside the project area was 33.6 rai.

The present arable cropping is confined to a single wet season rice crop. Varieties grown are local traditional types. In addition, the project area has tree crops such as mango, grown as a garden crop around the homestead.

The cropping pattern of the single rice crop consists of the broadcast crop sown in May and the transplanted crop planted in June, both coming into harvest in December. This pattern gives a cropping intensity of approximately 100% of the cultivable land.

Both tractor tillage and animal draft were employed in land preparation for rice cultivation. In farmers interview, it was revealed that in broadcast crop, the initial tillage operation was often carried out by tractor to secure a satisfactory tilth. Thereafter, the seed is sown dry and covered by bullock drawn harrows. For the transplanted crop, the general practice was buffalo tillage. The survey revealed that 80 % of the farmers own buffalo for tillage purposes.

5.4.2. Farm Income

The farmers in the project area practice a high level of self-subsistence. About 41.7% of the paddy grown is for own consumption and only about 45% of it is sold. Table 3 reveals that there is not much difference in the distribution pattern of paddy output between the farmers in the non-irrigated areas and the irrigated areas.

With paddy being the sole crop grown, paddy output forms the major source of income for the farmers. On the average, paddy output form about 54% of the total net income of the farmers. In Table 4, it can be seen that there were substantial variations in the proportion of income derived from paddy output. In the non-irrigated areas, paddy income form 48% of the total income of the farmers, however for the irrigated areas, paddy income forms 63% of the total net income of the

Table 3. Distribution of Paddy Output in Mae Nam Prachantakham Irrigation Project

Utilization	Rainfed		Irrigation		Total Project Area	
	Kg	%	Kg	%	Kg	%
Total Output	44,800	100.0	33,970	100.0	78,770	100.0
Seed	3,040	6.8	1,700	5.0	4,740	6.0
Own Consumption	17,320	38.7	15,520	45.7	32,840	41.7
Sold	19,940	44.5	15,500	45.6	35,440	45.0
Others	4,500	10.0	1,250	3.7	5,750	7.3

Source : Field Survey, April 1989.

Table 4. Net Income Per Farm For Mae Nam Prachantakham
Irrigation Project

Activities	Baht/Farm					
	Rainfed	%	Irrigated	%	Total Project	%
Paddy	11,065.0	47.90	12,197.85	62.67	11,560.6	53.60
Other Crops	1,199.8	5.20	6.25	0.03	677.7	3.20
Livestock	1,683.3	7.28	3,100.00	15.93	2,303.1	10.70
Fisheries	411.1	1.78	259.29	1.34	344.7	1.60
Hired Labor	3,927.7	17.00	1,080.00	5.55	2,681.9	12.50
Cottage Industry	2,404.4	10.40	1,090.00	5.60	1,829.3	8.50
Commerce	2,411.1	10.44	428.57	2.20	1,543.7	7.20
Government Service	-	-	1,114.29	5.73	487.5	2.30
Others	-	-	185.65	0.95	81.2	0.40
T o t a l	23,102.4	100.00	19,461.90	100.00	21,509.7	100.00

Source : Field Survey, April 1989.

farmers. Off-farm income was especially high in the non-irrigated areas forming about 40% of the total net income, whereas for the irrigated areas, it formed only about 20%.

5.4.3. Paddy Marketing

Crop marketing in Thailand is basically a private sector activity and is generally export-oriented. Agricultural products accounts for about 30% of all Thailand exports and a generally efficient adaptable marketing system has developed to move crops from the farms to the export market centered in Bangkok.

The marketing of paddy in Thailand is largely undertaken by the private sector. A hierarchy of market has been established. At the village and farm level, rural merchants and commission agents will make offers for farm paddy and will arrange delivery to a merchant in the central market- usually the provincial capital or major district towns. The merchant at the central market may sell some rice locally but most of it is sold to wholesale merchant and brokers at the Bangkok terminal market. This market is generally dominated by a few trading houses.

Prices are principally determined by the prevailing net export price, after allowing for charges and taxes levied by the government. The large trading houses regularly publishes the prices at which they will buy

unlimited quantities of rice, for each grade. These published prices then forms the basis for prices quoted by the central market and the rural market, with due allowance for transport costs, processing, storage costs, risk and quality.

A survey of agricultural marketing studies in Thailand concluded that the system is basically efficient. Marketing margins are low and prices throughout the system responded quickly to changes in terminal market conditions and the share of prices quoted on the Bangkok market actually received by the farmers is high. Table 5 shows the average wholesale price of paddy in Bangkok Metropolis in 1988 which averages around 4.1 baht/kg for paddy N0.1 in January to 3.8 baht/kg in October. In the survey, the prices of paddy sold by the farmers averages around 3.7 baht/kg to 3.9 baht/kg, which was close to that of the wholesale price in Bangkok.

5.4.4. Agrobased Industries and Cottage Industries

Cottage industries forms a dominant lifestyle of the people in the project area. Almost all the household are involved one way or another in some type of cottage industries. This is especially so since in the dry season, crop farming is almost at a standstill. The most common type of cottage industries prevailing in

Table 5. Average Wholesale Price of Paddy in Bangkok Metropolis in 1988

	Baht/metric ton									
	Jan	Feb	Mar	Apr	May	June	July	August	Sept	Oct 1988
Paddy No.1	4,158	4,345	4,180	4,137	3,442	3,798	4,100	3,859	3,841	3,800
Paddy no.2	4,058	4,245	4,080	4,037	3,342	3,698	4,000	3,759	3,741	3,700

Source : Department of Internal Trade

the area is the making of bamboo hats and straw brooms. While the raw materials for bamboo hats were obtainable from within the project area, the raw materials for straw brooms had to be transported from other provinces in the Northern Region. Besides the cottage industries, it was observed that an agro-based factory was being constructed within the project area for the canning of bamboo shoots.

5.5. Social-Demographic Aspects

5.5.1. Demography

The majority of the farm family heads are within the middle-aged groups, with 69% within the age-group of 31-50 years old. A significant feature is that almost one-quarter of the family heads were uneducated and the rest had educational level up to primary school. The average household size is about 5.5 and the number of active workers per family is high with about 3 persons in the family actively engaged in farm activities.

5.5.2. Social Infrastructure

It was observed that the social infrastructural facilities in the area were adequate. Electricity was supplied to the project area in 1985 and the farm

roads in the area were in good conditions. Water supply in the area were obtainable either from the irrigation canal, from rainwater or from ground water. A rural health clinic was located along the main road and was thus easily assessible. There was also a community center with a library.

5.6. Institutions

5.6.1. Agricultural Extensions

The National Extension Project which was financed by the World Bank in 1977 provides for the establishment of an intensified and expanded extension service for most agricultural crops under the Department of Agricultural Extension. The project also includes the construction of regional training centers, provincial and district extension services and houses for extension workers. The extension worker serve as regular points of contact between the DOAE service and the farming community. Extension workers serve about 1,000 farm families. The main function of the extension worker is to demonstrate and recommend high yielding rice variety and also liaises with the farmers in organising Farmers Association, besides training of young workers.

5.6.2. Bank for Agriculture and Co-operatives (BAAC)

The BAAC was founded in 1966 as the successor to the Bank for Co-operatives. It is the main agricultural credit institution in Thailand. It provides loans to Agricultural Co-operatives, Farmers Associations and individuals who are members of the BAAC group. Loans to individual members may be of three kinds:

i) Individual loans which require the borrower to mortgage his land as security for the loan and a loan equal to half the value of the land may be advanced.

ii) Guaranteed loans where an individual loan may be obtained with an asset as security, provided two other BAAC group members will guarantee repayment.

iii) Group loans within a BAAC group, which must have at least 15 members, of which 5 or more may propose to take out a loan for some input package and may obtain this with collective responsibility for loan repayment without providing any security.

The main types of finance offered are short-term loans for seasonal input, medium scale loans for agricultural machinery and long-term loans for farm development work, tree crops and the redemption of private mortgage.

The BAAC receives general soft finance from the Bank of Thailand and the Overseas Economic Co-operation Fund (Japan). The fund from the Bank of Thailand carries only one percent interest rate and the soft loan finance allows BAAC to acquire most of its remaining funds at commercial rate, while still lending to farmers at concessional rate.

5.6.3. Agricultural Cooperatives

The first cooperative in Thailand was established in 1916, initially as credit societies and subsequently developed to include marketing cooperatives and consumer cooperatives. The structure was revised under the Cooperative Societies Act of 1968, to create a three tier system.

Village societies were merged to create district level primary agricultural cooperatives. These in turn were to be members of the Provincial Cooperatives Federation, itself a member of the National Co-operative Federation.

The new Primary Agricultural Cooperatives were intended to be multi-purpose, supplying credit, distributing agricultural inputs and consumer goods, marketing farmers produce and organising agricultural projects. The cooperatives are overseen by two government departments within the Ministry of Agriculture and Cooperatives. The Cooperative

Promotion Department supervises and regulates day-to-day operations of agricultural cooperatives and contributes part of the finances. The Cooperatives Audit Department has the responsibility of auditing accounts and monitoring adherence to regulations. In practice, the Agricultural Cooperatives are government established and controlled institution. The primary role has been the disbursement of credit, with relatively little involvement of the farmers themselves. The main source of credit is BAAC. The Prachantakham Agricultural Cooperative has its head office in the Prachantakham town, along with the district office of the Department of Cooperative Promotions. Farmers wishing to join the cooperative must join at the tamboon (community) level group. All members are eligible to receive credit and must offer some form of security, usually land. Request for credit are individually assessed by the loan officers of the cooperatives and the prevailing interest rate is 13% per annum.

5.6.4. Farmers Association

Farmers Association were established under the sponsorship of the DOAE. In general, one Association was established per extension worker or per Amphoe. The aim was to use the Association as a means of distributing extension advice, and low costs

agricultural inputs. In particular, the Association have been eligible to receive fertilizer on credit terms from the Farmers Marketing Organisation (FMO). In the project area it was revealed that about 50% of the farmers in the project area were members of the Farmers Association.

6. THE PROJECT

6.1. Project Objectives

The objectives of the Mae Nam Prachantakham Irrigation Project are as follows:

- i) To provide for a run of river irrigation system as to enable wet season cultivation of high yielding variety of rice.
- ii) To reduce the effects of drought by supplying the service area with regulated supplies of water from the river, and at the same time reduce the extent of flooding from the foothills.

6.2. Project Feasibility Study

A feasibility study of the Mae Nam Prachantakham Irrigation Project was prepared by the consulting firm of Sir Alexander Gibbs of United Kingdom in August 1981. In the feasibility report, the project costs was estimated at B 121,434,000 and the project was estimated to take 4 years to complete the construction.

The project area was estimated at 15,095 rai and the internal rate of economic return was estimated at 28%, at a discount rate of 12%.

6.3. Project Description

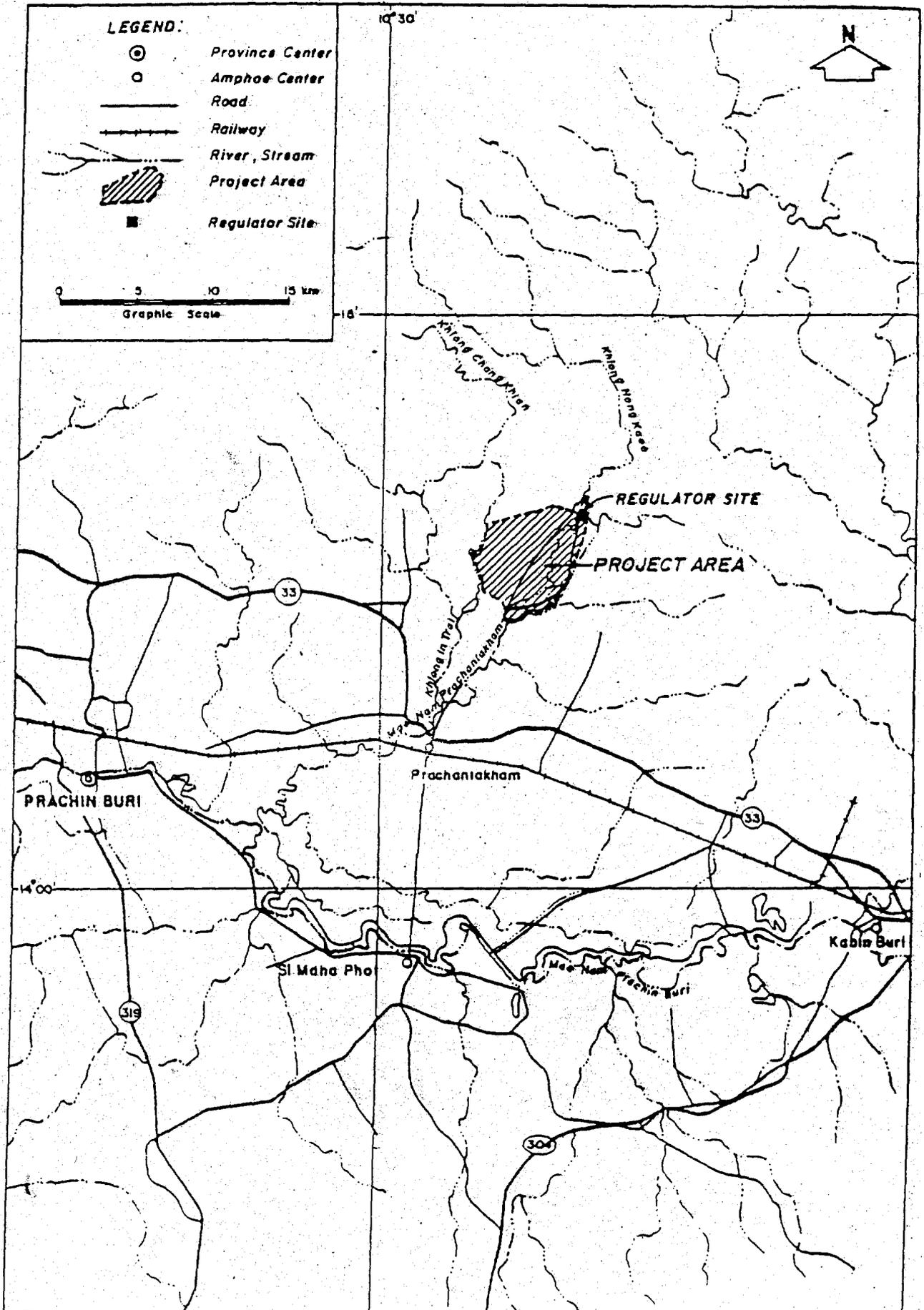
The project area is located on both banks of the Mae Nam Prachantakham river, in the upper part of the Bang Pa Kong Basin (see Map 2). A river regulator with two no.6 metre wide gates was constructed to raise the water upstream to provide command of the northern part of the project. A river closure bund, retention embankment and an emergency spillway were also constructed.

The two main canals intakes are located on either side of the river and are built on the line of the regulator embankment at a distance of around 400 metre from the structure (see Map 3). The right main canal was about 9.3 km in length, with a total command area of 4601 rai (see Table 6). Four lateral canals off-takes from the right main canal, with a total length of 11.74 km. The left bank canal has a length of 7.26 km and a command area of 2385 rai, with a single lateral canal of 2.9 km. Besides the canal system, a demonstration plot of 670 rai was provided.

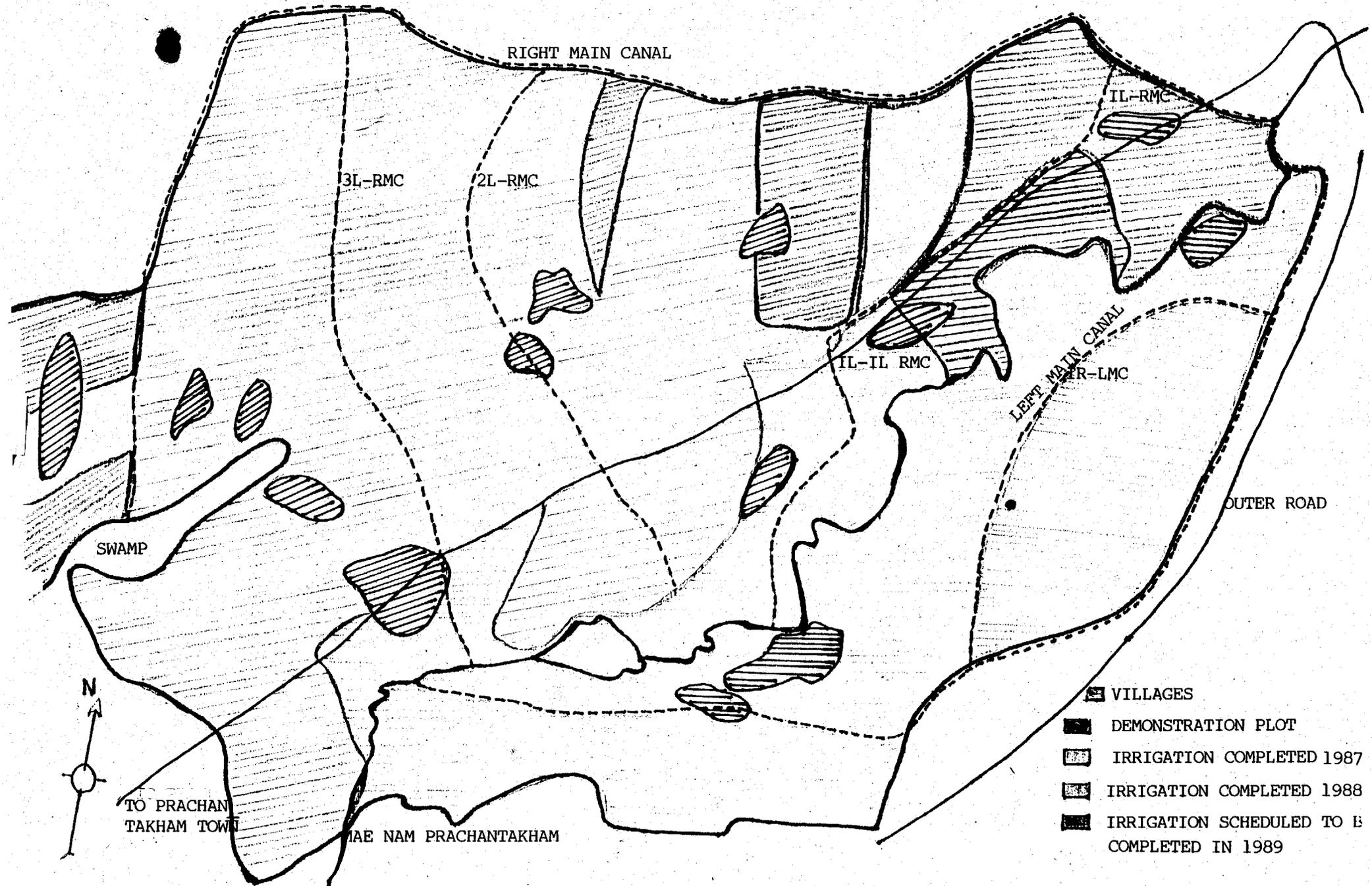
6.4. Project Implementation and Costs

The project was started in 1982 and is expected to be completed in 1989. At present a total of 224.3 million baht has been spent. The maintenance costs for the project is estimated to be about 1,253,920 baht per year (see Table 7). The total irrigated area at present is about 6245 rai or 40% of the total farm area (see Table 8).

MAE NAM PRACHANTAKHAM PROJECT



MAP 3: PROJECT SITE OF MAE NAM PRACHANTAKHAM IRRIGATION PROJECT



-  VILLAGES
-  DEMONSTRATION PLOT
-  IRRIGATION COMPLETED 1987
-  IRRIGATION COMPLETED 1988
-  IRRIGATION SCHEDULED TO BE COMPLETED IN 1989

N
↑
TO PRACHANTAKHAM TOWN
MAE NAM PRACHANTAKHAM

Table 6. Distribution of Canal System in Mae Nam Prachantakham Irrigation Project

	Canal	Length (Km)	Command Area (Rai)	Irrigable Area (Rai)
1	RMC	9.300	4,601	4,280
2	IL-RMC	7.120	4,402	4,097
3	IL-IL-RMC	1.420	895	832
4	2L-RMC	1.400	1,134	1,056
5	3L-RMC	1.800	1,267	1,179
6	LMC	7.260	2,385	2,222
7	IR-LMC	2.900	1,931	1,796
		31.200	16,615	15,462

Source : Mae Nam Prachantakham Irrigation Project Office.

Table 7. Investment and Maintenance Cost of Project

	Baht								
Year	1982	1983	1984	1985	1986	1987	1988	1989	1990 - 2012
Investment Cost	1,230,849	3,812,295	12,460,869	37,264,101	29,214,180	20,967,452	119,301,067	138,086,498	-
O & M Cost	-	-	-	-	-	-	-	-	1,253,920
Total Cost	1,230,849	3,812,295	12,460,869	37,264,101	29,214,180	20,967,452	119,301,067	138,086,498	1,253,920

Source : Mae Nam Prachantakham Irrigation Project Office.

Table 8. Total Project Area Under Irrigation

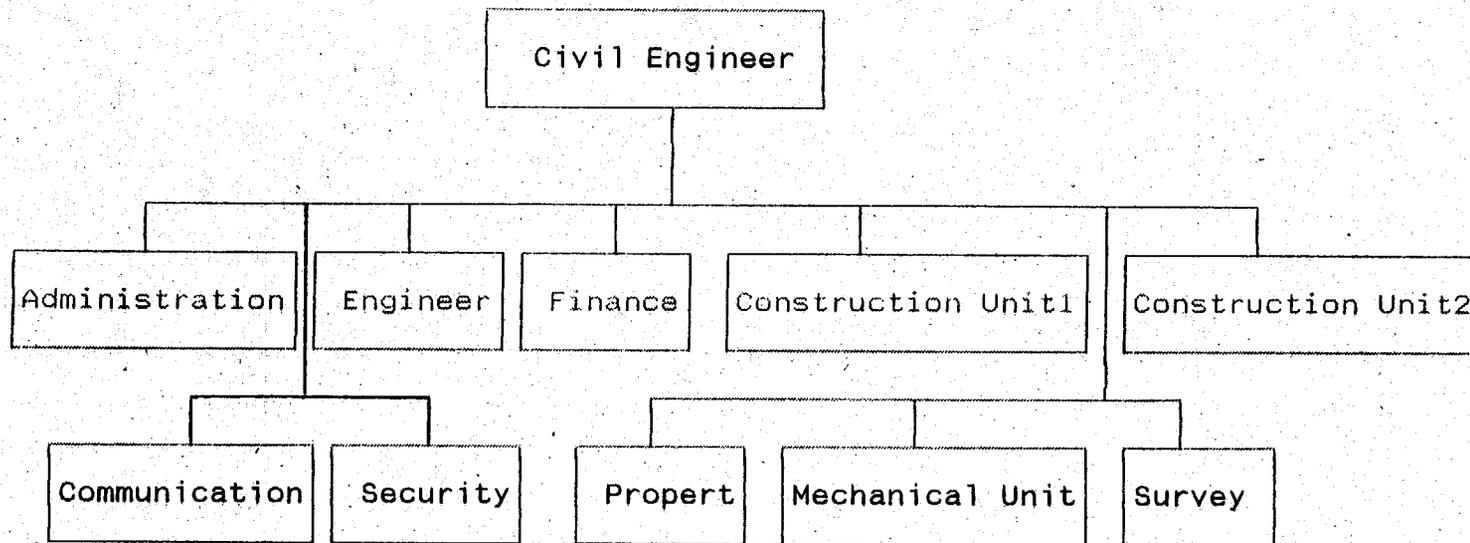
Year	Rai			
	1987	1988	1989	1990 - 2012
Total Area Irrigated	1,953	6,245	14,799	15,535
Irrigated Area Under Broadcasting	651	2,082	4,933	5,178
Irrigated Area Under Transplanting	1,302	4,163	9,866	10,357

Source : Mae Nam Prachantakham Irrigation Project Office.

Implementation of the project is carried out by a project team under the supervision of a civil engineer. The organisation chart of the project office is shown in Figure 1. After completion of the project in 1989, the project would be handed over to the Provincial office of the Royal Irrigation Department at Prachinburi. The Provincial office would set up an operations and maintenance team, directly under the Chief Engineer at the Province to supervise the operations and maintenance of the project. The provincial office has submitted its request for the necessary staff requirement for approval by the head office in Bangkok.

It is to be noted that the farmers in the area has little or no experience of irrigation and close cooperation and encouragement of the farmers by the operating staff is necessary to enable the scheme to operate efficiently. The formation of a formal organisation such as the Water User Organisation would help to formalise water arrangements between farmers and the shift responsibility of maintenance of the ditch and dikes to the farmers and to forestall any conflict that might arise as a result of inadequate water supply especially during the dry season.

Organization Chart of Mae Nam Prachantakham Irrigation Project Office



Source: Mae Nam Prachantakham Irrigation Office

7. METHODOLOGY OF THE EVALUATION STUDY

7.1. Objectives of the Evaluation Study

The objectives of the evaluation study on the Mae Nam Prachantakham Irrigation Project are as follows:

- i) To measure the economic impact of the project, comparing the areas with irrigation and the areas without irrigation.
- ii) To identify critical factors and issues facing the project.
- iii) To suggest and recommend improvements to the economic viability of the project so as to ensure better net benefits to the farmers.

7.2. Scope of the Study

The study area was confined to the Mae nam Prachantakhan Irrigation Project area and comparisons were made between areas which have received irrigation water and areas which have not received any irrigation water.

The crop year used during the interview with the farmers was based on the wet season of 1988 (ie May 1988 to November 1988). Therefore Year Zero (0) for the project was 1988 and the project life was estimated to be 30 years.

7.3. Constraints of the Study

A major constraint of the study was the limited time available for the conduct of field survey. Due to this constraint, only a small but representative sample was used. Other constraints include the need for the farmers to recall the cost of production and other information particularly on the farm for the last cropping season, which may lead to some inaccuracies.

7.4. Derivations of Benefits and Costs

The direct benefit from the project would accrue from the net incremental benefits gained by the farmer as a result of irrigation. In deriving the net incremental benefits, two situations were compared:

i) Irrigated/ Transplanting vs Rainfed/
Transplanting

ii) Irrigated/ Broadcasting vs Rainfed/
Broadcasting

The net incremental benefits were derived by comparing the net return from the different types of planting.

Since it was estimated that only 1/3 of the total project area were suitable for broadcasting and the remaining 2/3 were suitable for transplanting, the net incremental benefit were thus derived. As the project had not reached its full

maturity stage, the percentage of land receiving irrigation water was thus estimated based on the proposed project works by the project office. It was thus therefore estimated that the area receiving irrigation water were as follows:

1987 - 1,953 rai
1988 - 6,245 rai
1989 - 14,799 rai
1990 - 15,535 rai

The direct costs of the project was primarily from the investment cost and the operations and maintenance costs. The investment costs that had so far been spent were as follows:

1982 - 1,230,849 baht
1983 - 3,812,295 baht
1984 - 12,460,869 baht
1985 - 37,264,101 baht
1986 - 29,214,180 baht
1987 - 20,967,452 baht
1988 - 119,301,067 baht

In 1989, it was estimated that 138,086,498 baht will be spent on the project. The project is expected to be completed in 1989 and handed over to the Provincial office of the Royal Irrigation Department at Prachinburi for operations and maintenance. The operations and maintenance costs is estimated to be about 1,253,920 baht per year for the rest of the project life.

7.5. Assumptions of the Study

Several important assumptions were used in the derivation of the benefits and costs of the project. The assumptions are:

i) The area under broadcast planting was assumed to be 1/3 and the area under transplanting to be 2/3 of the total area of the project. It is assumed that this proportion would remain constant through the project life.

ii) The yield of paddy was assumed to be constant during the first five years after project completion, since it would take time for the farmers to adjust to the new irrigation system and the adoption of HYV of paddy. However, after the fifth year, the yield is expected to increase to 350 kg/rai with the adoption of HYV and increase in farm inputs such as fertilizer.

iii) No conversion factors were used to convert the financial price of the project to its economic price. The financial price is assumed to be reflective of the economic price. (see Appendix 8)

7.6. Sampling Procedure

The area in the project was divided into different zones according to the proposed project works. A simple random sampling method was done to select the farmers from each zone. Due to the fact that the areas not receiving

irrigation water was larger, therefore more samples were selected from that area. Altogether 10 farmers were selected from the areas not receiving irrigation water and 7 farmers from the areas receiving irrigation water.

A pre-prepared questionnaire was then administered and the result tabulated and analysed. Informal discussions were also held with the village heads.

7.7. Data Sources

Besides the primary data collected from the field survey, other secondary data were also collected from the Provincial office of the Royal Irrigation Department, the Mae nam Prachantakham irrigation project office, the Office of Agricultural Economics, the Department of Agricultural Extension and the Royal Irrigation Department. References were also made to various publications such as the National Social and Economic Plan and various statistical publications.

8. ECONOMIC ANALYSIS

8.1. Farm Budget Analysis

Table 9 shows the farm budget per rai for the various cultivation method and comparisons between the irrigated areas and the non-irrigated areas. From the Table, the net profit per rai was the lowest for the rainfed/ transplanted method where the net profit per rai was - 133.23 baht, whereas for the irrigated/ broadcasting, the net profit per rai was the highest at 99.50 baht.

The higher net profit per rai for the irrigated/ broadcasting could be associated with the higher yield which was at 245.45 kg/rai. This in turn could be as a result of higher input use especially fertilizer which was about 3 times that compared to other types of cultivation (see Appendix 4).

For the irrigated/ transplanting, the yield was low at 176.99 kg/rai. This could be due to the insufficient water available from the irrigation system since the project is still under construction and the water distribution system has not reached its full capacity.

An analysis of the net return/ cash input reveals that the transplanting method of cultivation receives the highest net return/ cash inputs, with 601.68 baht for the rainfed/ transplanted and 534.56 baht for the irrigated/ transplanted. This phenomena could be associated with higher cash inputs by the broadcasting method of cultivation especially for

Table 9. Farm Budget

Farm Inputs	Baht/Rai			
	Rainfed Transplanting	Irrigated Transplanting	Rainfed Broadcasting	Irrigated Broadcasting
Labour/Machine/Animal	574.02	437.45	199.83	344.03
Farm Inputs	104.16	92.23	142.72	243.64
Other Cost	15.27	3.89	18.88	34.10
Fixed Cost	200.54	180.31	237.17	260.53
Total Cost of Production	893.99	713.88	598.60	882.30
Yield (kg/rai)	190.19	176.99	155.17	245.45
Net Profit/Rai	(133.23)	(5.92)	6.56	99.50
Net Return/Cash Input	601.68	534.56	456.37	453.99

Source : Field Survey, April 1989.

land preparation through the use of tractors as against the use of hand-drawn buffaloes for the transplanting method.

8.2. Economic Benefit of Project

From the farm budget, it was possible to derive the economic benefit of the project. In the calculations of the economic benefit of the project, no conversion factors was used. In Table 10, the net profit per rai for the respective type of paddy cultivation is shown and comparisons made between the rainfed/ transplanting vs irrigated/ transplanting and the rainfed/ broadcasting vs the irrigated/ broadcasting. The net incremental benefit per rai respectively from the two comparisons were 92.94 baht and 127.28 baht. However, since it was assumed that the yield after 5 years of project completion would increase the yield to 350 kg/rai, therefore the net profit/ rai for irrigated/ transplanting would be 196.12 baht, thus giving a net incremental benefit after the 5th year of 329.32 baht for the irrigated/ transplanting and for the irrigated/ broadcasting, the net incremental benefit after the 5th year is 421.14 baht. (see Appendix 5).

Using the cropping area as in Table 8, the net incremental benefit from paddy cultivation were derived. Table 11 show the net incremental benefit from paddy cultivation from 1987 to year 2012.

Table 10. Net Incremental Benefit From Paddy

Baht

	Net Profit/Rai		Net Profit/Rai	Net Incremental Benefit
Rainfed/ Broadcasting	6.56	Irrigated/ Broadcasting	99.50	92.94
Rainfed/ Transplanting	(133.20)	Irrigated/ Transplanting	(5.92)	127.28
		Irrigated/ Transplanting (After 5 Yrs)	596.12	729.32
		Irrigated/ Broadcasting (After 5 Yrs)	427.70	421.14

Source : Field Survey, April 1989.

Table 11. Net Incremental Benefit from Paddy

	Baht							
Project Year		0	1	2	3	4	5	6 - 30
Year	1987	1988	1989	1990	1991	1992	1993	1994 - 2012
Broadcasting	60,503.94	193,501.08	458,473.02	481,243.32	481,243.32	481,243.32	481,243.32	2,180,662.90
Transplanting	165,718.56	529,866.64	1,255,744.40	1,318,238.90	1,318,238.90	1,318,238.90	1,318,238.90	7,553,567.20
Net Incremental Benefit	226,222.50	723,367.72	1,714,217.42	1,799,482.22	1,799,482.22	1,799,482.22	1,799,482.22	9,734,230.10

Source : Field Survey, April 1989.

From the benefits and costs stream as shown in Table 11 and Table 12, the indicators of project worth were calculated. Table 13 show that the Benefit Cost ratio to be 0.142 and the net present value to be - 305,862,217 baht. This indicates that from the viewpoint of economic analysis, the project is not economically feasible, since for the project to be feasible the BC ratio must be greater than one and the net present value must be positive.

There was a substantial difference between the result of this study and that of the feasibility study. The IRR in the feasibility study was 28%. This difference could be accounted for by 4 reasons:

i) The project cost as estimated by the feasibility study was only 121.4 million baht compared to the actual cost of 362.3 million baht.

ii) In the feasibility report, benefits from the project will be derived after the 4th year since the project will only take four years to complete. However, it is estimated that the present project will take eight years to finish construction.

iii) The paddy yield after project completion as estimated by the feasibility report ranges from 400 kg/rai to 650 kg/rai. However from the actual field data collected, even with irrigation, the present yield is about 200 kg/rai and it is estimated that the best yield obtainable after maturity of the project would not be more than 400 kg/rai.

Table 12. Total Cost of Project

	Baht								
Year	1982	1983	1984	1985	1986	1987	1988	1989	1990 - 2012
Total Cost of Project	1,230,849	3,812,295	12,460,869	37,264,101	29,214,180	20,967,452	119,301,067	138,086,498	1,253,920

Source : Mae Nam Prachantakham Irrigation Project.

Table 13. Derivation of Project Indicator of Worth
12 % Discounting Factor

Baht						
	Benefit	DF	PV of Benefit	Cost	DF	Pv of Cost
0	949,590.22	-	949,590.22	224,250,813	-	224,250,813
1	1,714,217.40	0.893	1,530,796.14	138,086,498	0.893	123,311,243.0
2	1,799,482.20	0.797	1,434,187.31	1,253,920	7.160	8,978,067.2
3	1,799,482.20	0.712	1,281,231.33			
4	1,799,482.20	0.636	1,144,470.70			
5	1,799,482.20	0.567	1,020,306.41			
6 - 30	9,734,230.10	4.450	43,317,323.94			
			50,677,906.05			356,540,123.

BC Ratio = 0.142
NPV = - 305,862,217

iv) In the feasibility report, conversion factors were used to convert financial price to economic prices. The rationale for not using conversion factors in this study is listed in Appendix 8.

8.3. Proposed Cropping Pattern

From the above, it was obvious that the project is not economically feasible, nevertheless, since the project is already implemented and is near its completion, it is proposed that suitable changes be made to the cropping pattern to enhance the economic feasibility of the project. The proposed cropping pattern, however can only be implemented provided the following conditions are fulfilled:

i) Availability of enough water to permit dry season cropping either through water storage facilities at the upper reaches of the river or through the use of farm ponds.

ii) An organized and effective water user organisation to ensure efficient water distribution especially during the dry season.

iii) Soil improvements

iv) Extension services to promote the proposed new crops

From the field observations, it was found that almost all the farm households grow mango trees in their homestead.

However the area cultivated was limited and the variety grown generally were of the poor varieties where the maturing period was long and the fruits of inferior quality. The existing presence of mango cultivation could further be enhanced with the introduction of better varieties and technology. For the dry season cropping, it was feasible to grow groundnut and the net return from groundnut would benefit the farmers.

With due considerations to the above, the cropping pattern as shown in Table 14 is proposed, where during the wet season, $1/3$ of the area will be grown with transplanted paddy and another $1/3$ of the area with broadcast paddy. Another $1/3$ of the area is proposed to be cultivated with the long-term crop of mango. During the dry season, another crop of groundnut will be grown.

From the above cropping pattern, a new benefit-cost ratio of the project is derived. Table 15a and 15b shows that the net incremental benefit from the new proposed cropping pattern.

With the new cropping pattern, the BC ratio of the project is 1.093 (Table 16) and the NPV is 33,124,342 baht the economic internal rate of return is 12.69 % (see Appendix 6). From the above it can be concluded that the project is economically feasible. A switching value test was done to test the risk of the project. The switching value was:

Table 14. Total Area Under Proposed
Cropping Pattern for Mae Nam
Prachantakham Irrigation Project

Crop	Rai			
	1987	1988	1989	1990 - 2012
Wet Season Paddy Broadcasting	651	2,082	4,933	5,178.0
Dry Season Groundnut	-	-	-	5,178.0
Wet Season Paddy Transplanting	1,302	4,163	9,866	5,178.0
Mango	-	-	-	5,179.0

Table 15a. Net Incremental Benefit for Proposed Cropping Pattern

	Baht										
Project Year	0	1	2	3	4	5	6	7	8	9 - 30	
Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997 - 2012
Paddy Broadcasting	60,503.94	193,501.08	458,473.02	481,243.32	481,243.32	481,243.32	481,243.32	481,243.32	481,243.32	481,243.32	481,243.32
Paddy Transplanting	165,718.56	529,866.64	1,255,744.40	659,055.84	659,055.84	659,055.84	659,055.84	1,705,218.96	1,705,218.96	1,705,218.96	1,705,218.96
Groundnut	-	-	-	3,372,380.00	3,372,380.00	3,372,380.00	3,372,380.00	3,372,380.00	3,372,380.00	3,372,380.00	3,372,380.00
Mango	-	-	-	(14,371,725.00)	(10,358,000.00)	(10,875,900.00)	(1,035,800.00)	1,812,650.00	20,198,100.00	54,379,500.00	106,169,500.00
Total Net Incremental Benefit	226,222.50	723,367.72	1,714,217.42	(9,859,045.84)	(5,845,320.84)	(6,363,220.84)	3,476,879.16	7,371,492.28	25,756,942.28	59,938,342.28	111,728,342.28

Table 15b. Net Incremental Benefit for Proposed Cropping Pattern

Project Year	Baht									
	0	1	2	3	4	5	6	7	8	9 - 30
Total Net Incremental Benefit	949,590.22	1,714,217.42	(9,859,045.84)	(5,845,320.84)	(6,363,220.84)	3,476,879.16	11,142,111.80	29,527,561.80	63,708,961.80	115,498,961.80

Table 16. Derivation of Benefit

	Benefit	DF	PV of Benefit	Cost	DF	Pv of Cost
0	949,590.22	-	949,590.22	224,250,813	-	224,250,813
1	1,714,217.42	0.893	1,530,796.2	138,086,498	0.893	123,311,243.0
2	(9,859,045.84)	0.797	(7,857,659.5)	1,253,920	7.160	8,978,067.2
3	(5,845,320.84)	0.712	(4,161,868.4)			
4	(6,363,220.84)	0.636	(4,047,008.5)			
5	3,476,879.16	0.567	1,971,390.5			
6	11,142,111.80	0.507	5,649,050.7			
7	29,527,561.80	0.452	13,346,458.0			
8	63,708,961.80	0.404	25,738,420.5			
9 - 30	115,498,961.80	3.087	356,545,295.0			
			389,664,464.7			356,540,123.2

BC Ratio = 1.093
 NPV = 33,124,342

$$\text{SVT} = \frac{\text{PV of Benefit} - \text{PV of Costs}}{\text{PV of Benefit}}$$

$$= 8.5\%$$

The results of the switching value test indicates that the project is sensitive to changes in the benefits and costs of the project. A 8.5% decrease in the PV of Benefits or a 8.5% increase in the PV of Costs would reduce the NPV to zero..

9. OUTSTANDING ISSUES

A number of critical issues emerges from the implementation of the project. Due to the fact that the project has not yet reached its completion stage, the problems that has emerged could well be temporary, however, due considerations should be given to resolve these problems:

i) As a large proportion of the project area has yet to receive any irrigation water, the transitional period, where the farmers has to depend on rainwater for their cultivation has affected their output and thus cause uneasiness among the farmers on the worthiness of the project. During the pre-project situation, the farmer could depend on the runoff of water from the hillslopes, but with the construction of the main canals, this has blocked the water supply to the farms. Since the farmers are neither receiving irrigation water, their source of water supply for the crops are now severely curtailed.

ii) There is a need to introduce dry season cropping to increase the economic viability of the project. However, critical water shortages even during the wet season has pre-empted the introduction of dry season crops. Water storage facilities for dry season cropping is critical and this could take the form of a reservoir at the upstream of the river, or the construction of farm ponds to store water during the dry season. A feasibility study on the above is essential to determine the viability since the costs of the present

project is already on the high side.

iii) Improvements in the soil condition is necessary to improve the productivity of the crops. The low yields has forced the farmers to cultivate a larger area.

iv) In a situation where the water is a critical requirement for livelihood, and water shortages occur during the wet and dry season, the absence of an organised water management system could result in social conflict. It is heartening to note that the Provincial office of the RID are aware of the situation and that a formal water user organisation would be established once the project is completed. However, even during the transitional period, an experimental system could be introduced to familiarise the farmers with the new concept since the farmers in the area are new to the irrigation system.

v) A potential source of income for the farmers could be the cultivation of mangoes.

10. CONCLUSIONS AND RECOMMENDATIONS

The Mae Nam Prachantakham Irrigation Project was conceived to provide for regulated water supply for irrigation during the wet season and at the same time provide for some protection against overland flooding. The main benefit from the project was the increase in output of paddy through irrigation.

Comparisons of the farm budget between the rainfed areas and the irrigated areas shows that there were some net incremental benefits as a result of irrigation.

The total net incremental benefit after discounting was 50,677,906.05 baht while the project costs after discounting was 356,540,123 baht. This gives a benefit-cost ratio of 0.142.

As the project is approaching completion in 1989, it would be inconceivable to modify the project structure at this stage. However in order to increase the net benefits to the farmers and at the same time the economic viability of the project, a new cropping pattern was proposed. With the new cropping pattern whereby 1/3 of the area is devoted to transplanted paddy, 1/3 to broadcast paddy and another 1/3 to mango. the net incremental benefits was substantially increased. The new benefit cost ratio was 1.093 and an economic internal rate of return of 12.69%.

However, before the proposed cropping pattern can be implemented, certain pre-conditions must be fulfilled:

i) Adequate supply of water for both wet and dry season cropping

ii) Suitability of the land for the cultivation of mango and bamboo shoots.

In order to ensure that the project will attain economic viability and maximum net benefits would accrue to the farmers, the following recommendations are suggested:

i) A feasibility study to determine the viability of the construction of a reservoir.

ii) Introduction of HYV and fast maturing paddy seeds so that the wet season paddy can mature at a shorter time to enable the dry season crops to take advantage of residual water available.

iii) An organized water -user organisation be introduced so that an efficient water distribution system can be in place. This would help reduce conflicts between farmers and ensure equitable distribution of water and minimize water losses.

iv) Extension services to promote drought-resistant dry season crops and tree crops.

Composition of Study Team of Mae Nam Prachantakham
Irrigation Project

Group Advisor

Dr. Sarun Wattanutchariya - Thailand

Group Members

Mr. Edgar Zotomayor - Philippines
Mr. Chua Kok Ching - Malaysia
Mr. Bambang Suharwanto - Indonesia
Mrs. Ratna Siregar - Indonesia
Mr. Peerapong Laipat - Thailand
Miss. Kuakul Thummaphut - Thailand
Miss. Tassanne Chingduang - Thailand

Appendix 2

Thailand Principal Exports (Rice) by Country

metric tons

Countries	1982	1983	1984	1985	1986	1987
Iran	317,615	400,884	412,048	312,825	192,575	604,090
China	337,579	28,999	104,703	73,723	284,035	304,144
Singapore	177,342	178,911	216,718	209,606	258,463	256,683
U A Emirates	16,112	29,027	54,693	78,414	134,983	215,862
Hongkong	121,521	149,316	159,592	183,263	181,097	194,340
Malaysia	407,505	254,675	359,794	343,141	238,576	193,154
Saudi Arabia	94,856	72,995	92,175	156,366	191,874	119,715
Total Exports	3,784,143	3,476,480	4,615,803	4,062,240	4,523,597	4,443,301

Source : Monthly Economic Report of The Bank of
Thailand, Volume 78, 1988.

Rice : Yield for Thailand and Selected Countries

	kg/rai				
Countries	1982	1983	1984	1985	1986
Thailand	302	326	331	330	328
China	782	816	859	840	860
India	296	349	340	377	351
Indonesia	598	616	625	631	637
Philippines	382	400	407	428	431
Burma	504	491	496	504	500
Pakistan	418	401	398	384	411
Bangladesh	322	330	343	355	376

Source : Agricultural Statistics of Thailand Crop Year 1987/88
 Center for Agricultural Statistics,
 Office of Agricultural Economics

FARM INPUTS	RAINFED TRANSPLANTING			IRRIGATED TRANSPLANTING			RAINFED BROADCASTING			IRRIGATED BROADCASTING		
	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL
2. Farm Inputs												
a) Seed	-	38.16	38.16	-	33.19	33.19	-	52.41	52.41	-	43.64	43.64
b) Fertilizer	61.42	-	61.42	58.71	-	58.71	46.55	-	46.55	200.00	-	200.00
c) Herbicide	0.30	-	0.30	-	-	0.00	1.37	-	1.37	-	-	0.00
d) Insecticide	1.51	-	1.51	-	-	0.00	20.68	-	20.68	-	-	0.00
e) Pesticide	-	-	0.00	0.33	-	0.33	4.31	-	4.31	-	-	0.00
f) Fuel	2.77	-	2.77	-	-	0.00	17.4	-	17.40	-	-	0.00
Sub Total (2)	66.00	38.16	104.16	59.04	33.19	92.23	90.31	52.41	142.72	200.00	43.64	243.64
3. Other Cost												
Maintenance	15.27	-	15.27	3.89	-	3.89	18.88	-	18.88	34.10	-	34.10
Sub Total (3)	15.27	-	15.27	3.89	-	3.89	18.88	-	18.88	34.10	-	34.10
Variable Cost = (1)+(2)+(3)	159.08	534.37	693.45	173.4	360.17	533.57	148.79	212.64	361.43	527.81	93.96	621.77

Continued

FARM INPUTS	RAINFED TRANSPLANTING			IRRIGATED TRANSPLANTING			RAINFED BROADCASTING			IRRIGATED BROADCASTING		
	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL
4. Fixed Cost												
a) Depreciation	-	17.73	17.73	-	4.49	4.49	-	55.17	55.17	-	77.90	77.90
b) Landuse	-	133.00	133.00	-	154.53	154.53	-	111.00	111.00	-	153.53	153.53
c).Opp Cost of Capital	-	49.81	49.81	-	21.29	21.29	-	71.00	71.00	-	29.10	29.10
Sub Total (4)	0.00	200.54	200.54	0.00	180.31	180.31	0.00	237.17	237.17	0.00	260.53	260.53
Total Cost = (1)+(2)+(3)+(4)	159.08	734.91	893.99	173.40	540.48	713.88	148.79	449.81	598.60	527.81	354.49	882.30
Yield			190.19			176.99			155.17			245.45
Total Revenue			760.76			707.96			605.16			981.80
Net Profit/Rai			(133.23)			(5.92)			6.56			99.50
Net Return/Rai			67.31			174.39			243.73			360.03
Net Return/Cash Input			601.68			534.56			456.37			453.99

(i) Calculation of Net Profit/Rai for Irrigated/Transplanting
After 5 Years of Project Completion

Yield	=	350 Kg/Rai
Price	=	4.00 Baht/Rai
Total Revenue	=	1,400 Baht/Rai
Cost of Production	=	713.88 Baht/Rai
Add Increase in Fertilizer Input	=	90 Baht/Rai *)
Total Cost	=	803.88 Baht/Rai
Net Profit/Rai	=	596.12 Baht

(ii) Calculation of Net Profit/Rai for Irrigated/Broadcasting
After 5 Years of Project Completion

Yield	=	350 Kg/Rai
Price	=	4.00 Baht/Rai
Total Revenue	=	1,400 Baht/Rai
Cost of Production	=	882.30 Baht/Rai
Add Increase in Fertilizer Input	=	90 Baht/Rai *)
Total Cost	=	972.30 Baht/Rai
Net Profit/Rai	=	427.70 Baht

*) Assume Present Fertilizer Use = 12 Kg/Rai

Future Fertilizer Use = 30 Kg/Rai

Derivation of EIRR
Discounting Factor 13 %

	Benefit	DF 13 %	PV of Benefit	Cost	DF 13 %	Pv of Cost
0	949,590.22	-	949,590.22	224,250,813	-	224,250,813
1	1,714,217.42	0.885	1,517,082.41	138,086,498	0.885	123,311,243.0
2	(9,859,045.84)	0.783	(7,719,632.89)	1,253,920	6.610	8,978,067.2
3	(5,845,320.84)	0.693	(4,050,807.34)			
4	(6,363,220.84)	0.613	(3,900,654.37)			
5	3,476,879.16	0.543	1,887,945.38			
6	11,142,111.80	0.480	5,348,213.66			
7	29,527,561.80	0.425	12,549,213.76			
8	63,708,961.80	0.376	23,954,569.63			
9 - 30	115,498,961.80	2.696	311,385,201.00			
			341,920,721.46			356,540,123.2

$$\text{NPV} = - 14,619,401$$

$$\begin{aligned} \text{IRR} &= 12 + (13-12) \left[\frac{\text{NPV at 12 \%}}{\text{NPV at 12 \%} + \text{NPV at 13 \%}} \right] \\ &= 12 + 1 \left[\frac{33,124,342}{33,124,342 + 14,619,401} \right] \\ &= 12 + \frac{33,124,342}{47,743,743} \\ &= 12 + 0.694 \\ &= 12.694 \end{aligned}$$

Cost of Production and Output of Mango

Year	Baht/Rai									
	1	2	3	4	5	6	7	8	9	10 - 30
Cost of Production	2,775	2,000	2,100	2,700	3,400	3,600	4,500	4,500	4,500	4,500
Yield (Kg/Rai)	-	-	-	250	375	750	1,500	2,500	2,500	2,500
Total Revenue (At B10/Kg)	-	-	-	2,500	3,750	7,500	15,000	25,000	25,000	25,000
Net Return	(2,775)	(2,000)	(2,100)	(200)	350	3,900	10,500	20,500	20,500	20,500

Source : Department of Agricultural Extension.

CONVERSION FACTOR

The conversion factor is a number, usually less than one (1), that can be multiplied by the domestic market price, opportunity cost or value in use of a non-traded item, to convert it to an equivalent border price that reflects the effect of trade distortions on domestic prices of that good or service.

Once financial prices for costs and benefits have been determined and entered in the project accounts, the economic value of a proposed project to the nation as a whole is then estimated. However, before adjusting financial accounts to reflect economic values commences, an important fundamental consideration must be emphasized. Some adjustments will make a considerable difference to the economic attractiveness of a proposed project; others will be of minor importance and no reasonable adjustments would change the investment decision.

In the case of the study, there are two areas where there could be possible adjustments of the financial prices to economic values. However, no adjustment were done because it was felt that there would be no major changes to the final analysis of the project as the difference would be very minor.

The areas where the adjustments could be made are as follows:

a) Opportunity cost of labour

Economic appraisals of rural development projects in Thailand have generally assumed a "shadow wage rate" for labour less than the market wage. The justification has been that there is substantial underemployment, especially during the dry season. A World Bank study (Thailand: Case Study of Agricultural Input and Output Pricing, World Bank Staff working paper, No.365 April 1980) has cast doubts upon the validity of earlier analyses. The basic assumption of underemployment is questioned on the ground that there is substantial shift to the mechanisation of agricultural operation, that there is a substantial range of agricultural and non-agricultural employment opportunities in the dry season.

It is thus assumed that in the case of Mae Nam Prachantakham Irrigation Project, the market wage rate represent the true opportunity cost of labour. This is so because there were substantial off-farm activities in the area during the dry season and that Bangkok is only about 2 hours driving distance .

b) Agricultural Inputs and Outputs

For agricultural inputs and outputs, the assumption is that the market price of the inputs and outputs are good estimate of the opportunity cost, therefore we accept the market price directly as the economic price. Besides the amount of agricultural inputs are small and agricultural outputs are small in relation to the total agricultural production of the country..

FARM BUDGET COST/RAI

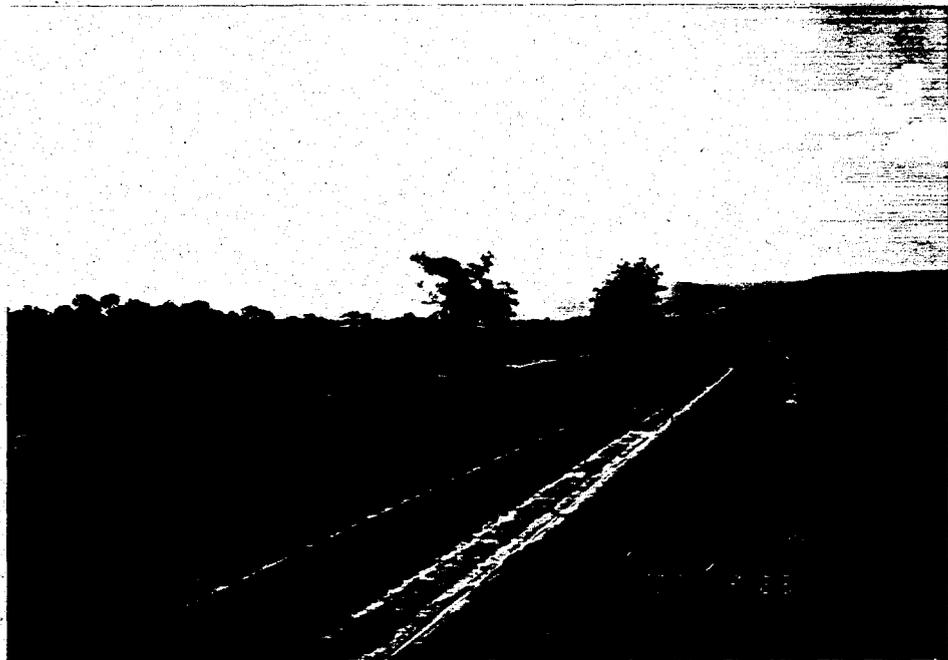
FARM INPUTS	RAINFED TRANSPLANTING			IRRIGATED TRANSPLANTING			RAINFED BROADCASTING			IRRIGATED BROADCASTING		
	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL	CASH	NON CASH	TOTAL
1. Labor/Machine/ Animal												
a) Seed Bed Prep	-	38.14	38.14	1.26	17.82	19.08	-	-	0.00	-	-	0.00
b) Land Prep	18.42	128.10	146.52	40.97	80.85	121.82	-	69.89	69.89	100.00	-	100.00
c) Planting	14.50	112.70	127.20	27.77	103.02	130.79	-	20.68	20.68	-	4.55	4.55
d) Fertilizer App	-	7.04	7.04	-	7.16	7.16	-	1.55	1.55	-	4.55	4.55
e) Insect App	-	2.29	2.29	-	-	0.00	-	1.38	1.38	-	3.41	3.41
f) Herbicide App	-	8.86	8.86	-	-	0.00	-	2.41	2.41	-	-	0.00
g) Pesticide App	-	1.78	1.78	-	0.33	0.33	-	10.86	10.86	-	-	0.00
h) Maintenance of the Field	-	6.84	6.84	-	6.52	6.52	-	7.24	7.24	-	-	0.00
i) Harvesting	23.20	168.21	191.41	21.88	102.79	124.67	24.1	41.4	65.50	169.16	33.84	203.00
j) Transportation	1.21	19.48	20.69	2.15	8.18	10.33	-	4.82	4.82	-	-	0.00
k) Threshing	20.48	2.77	23.25	16.44	0.31	16.75	15.5	-	15.50	24.55	3.97	28.52
Sub Total (1)	77.81	496.21	574.02	110.47	326.98	437.45	39.60	160.23	199.83	293.71	50.32	344.03

Continued



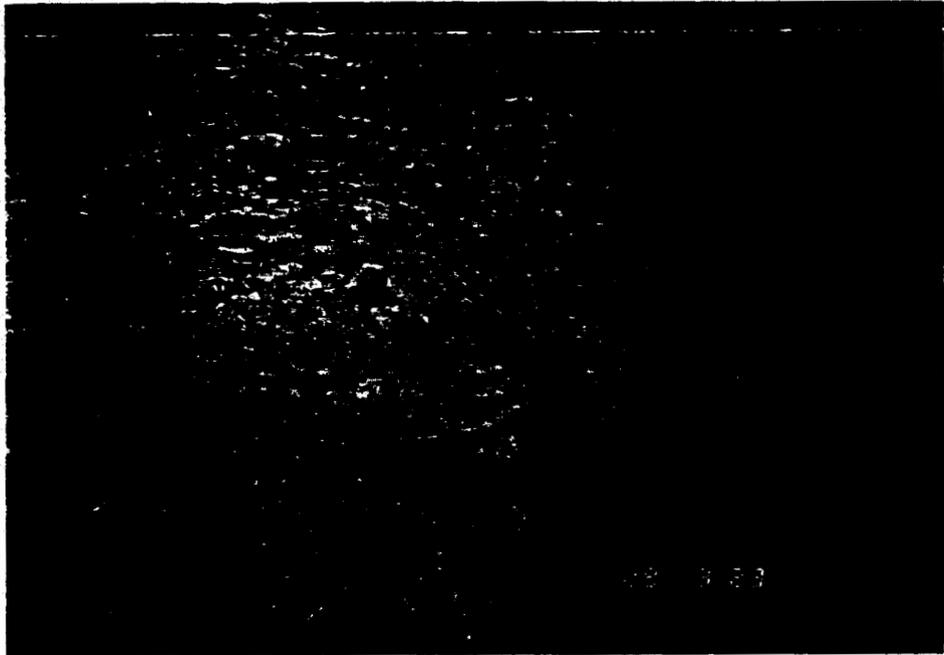
PICTURE 1

DISCUSSIONS BEING HELD AT THE ROYAL
IRRIGATION DEPARTMENT OFFICE IN PRACHINBURI



PICTURE 2

THIS PICTURE SHOWS THE RIGHT MAIN CANAL
WHICH IS 9.3 KM IN LENGTH.



PICTURE 3

THIS PICTURE SHOWS THE SOILS FOUND IN THE PROJECT AREA. NOTICE THE SOILS ARE SANDY



PICTURE 4

DISCUSSIONS BEING HELD WITH THE VILLAGERS AT ONE OF THE VILLAGE TEMPLE BEFORE THE START OF THE FIELD INTERVIEW



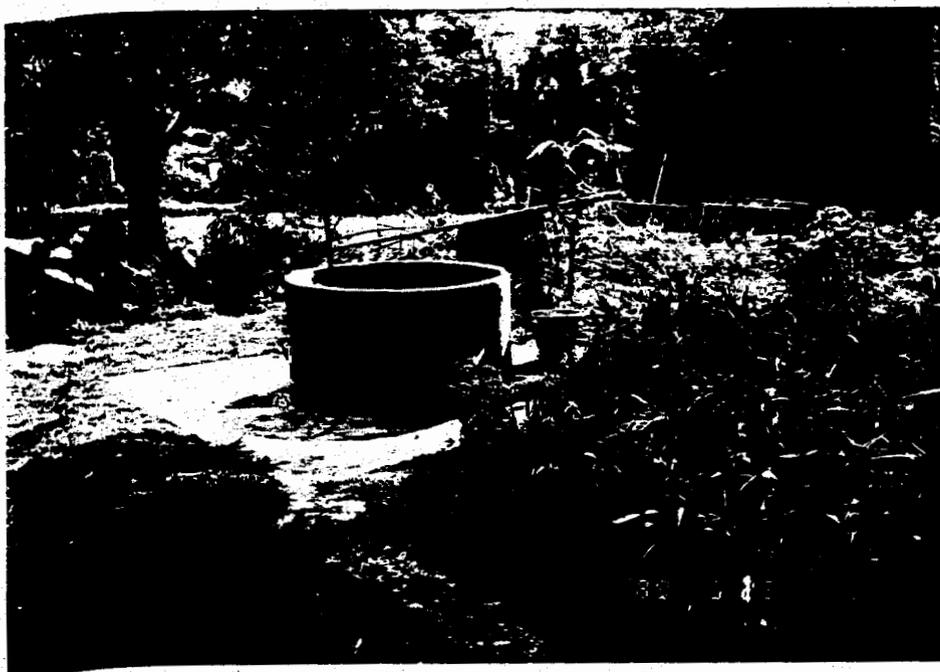
PICTURE 5

ONE OF THE MEMBERS OF THE STUDY TEAM
INTERVIEWING ONE OF THE FARMERS



PICTURE 6

A VILLAGE TEMPLE UNDER CONSTRUCTION
RELIGION IS AN IMPORTANT PART
OF THE LIFE OF THE VILLAGERS



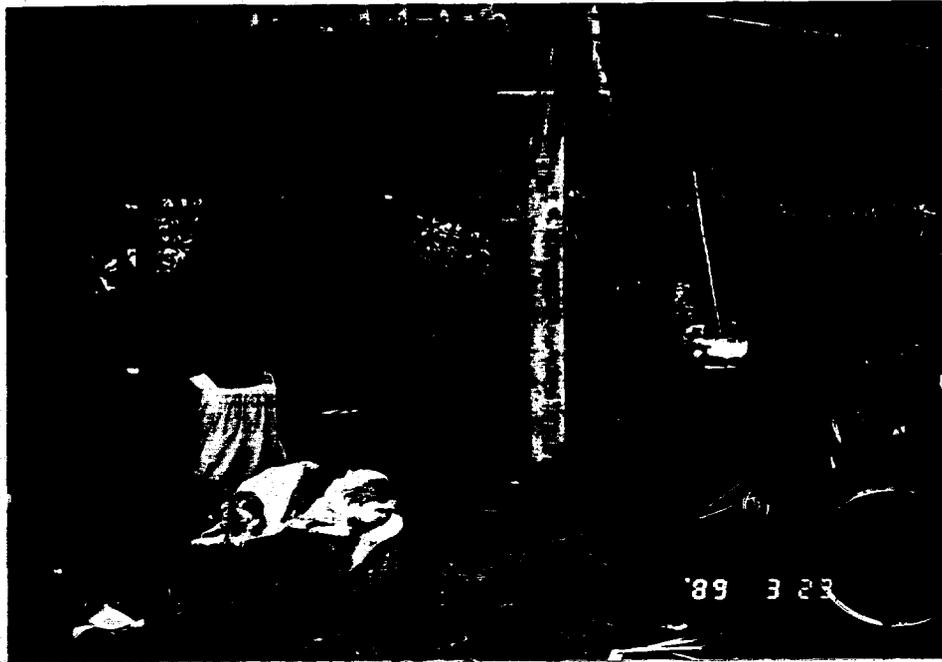
PICTURE 7

BESIDES WATER FROM THE IRRIGATION CANALS
AND FROM THE RAIN, GROUNDWATER IS ALSO
AN IMPORTANT SOURCE OF WATER SUPPLY



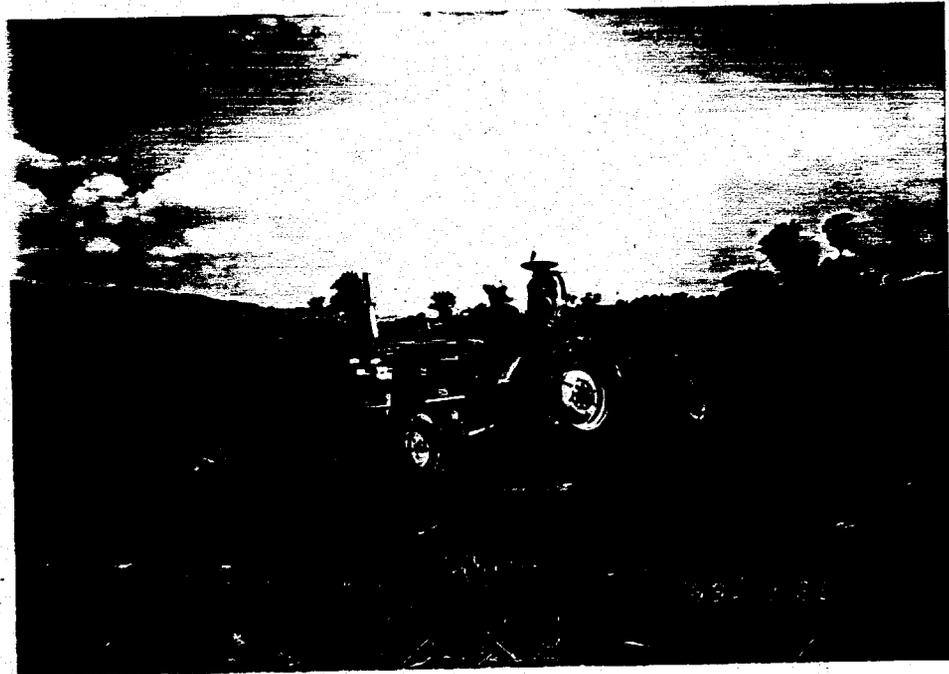
PICTURE 8

COTTAGE INDUSTRY IS AN IMPORTANT SOURCE OF OFF-FARM INCOME
FOR THE VILLAGERS. THIS PICTURE SHOWS ONE OF THE
VILLAGERS MAKING BAMBOO HATS



PICTURE 9

ANOTHER TYPE OF COTTAGE INDUSTRY IS THE MAKING
OF STRAW BROOMS. RAW MATERIALS FOR THE BROOMS
HOWEVER HAVE TO BE IMPORTED FROM
THE NORTHERN PROVINCES



PICTURE 10

LAND PREPARATION USING TRACTORS. THE MONSOON SEASON
IS DUE ANY TIME