CHAPTER III.

BRIEF INTRODUCTION OF PRESENT STATE OF THE THAI AGRICULTURE

Brief introduction of the present state of the Thai agriculture

A. General matters

1 Geographical location

Latitude	between 6° N to 21° N
Longitude	between 98° E to 106° E

2 Area of her territory

	area	%
Mountainous area	211,000 km^2	41.0
Agricultural land	188,160 km^2	36.6
Residential land	25,700 km^2	5
Others	89,140 km^2	17.4
Total	514,000 km^2	100

3 Classification of Agricultural land

In 1980	Unit	Area	%
Agricultural land	1000 ha	18,816	100
(1) Paddy field	"	11,657	62.0
(2) Farmland	"	4,041	21.5
(3) Orchard	"	1,767	9.4
(4) Grassland	"	83	0.4
(5) Others	"	1,268	6.7

4 Climate

4.1 General statement

Seasons:

Dry season : from Nov. to Apr. (6 months)

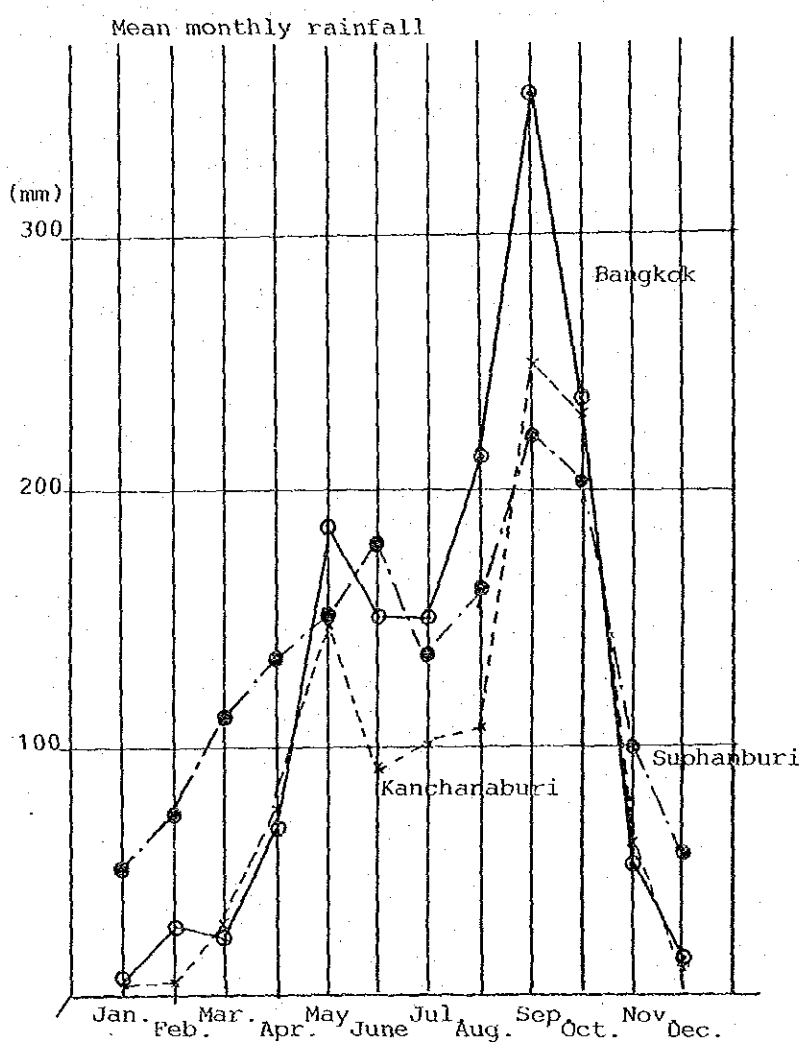
Wet season : from May to Oct. (6 months)

4.2 Temperature (monthly mean temperature (°c))

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Mean
Suphan buri	26.1	28.5	30.5	31.8	30.7	29.9	29.2	28.9	28.4	28.0	27.0	25.6	28.7
Bangkok	25.5	27.1	28.6	29.5	29.0	28.5	28.0	27.8	27.5	27.4	26.6	25.3	27.6
Kanchana buri	25.5	28.1	30.2	31.4	29.9	28.7	28.2	28.1	27.9	27.1	26.1	24.8	28.8

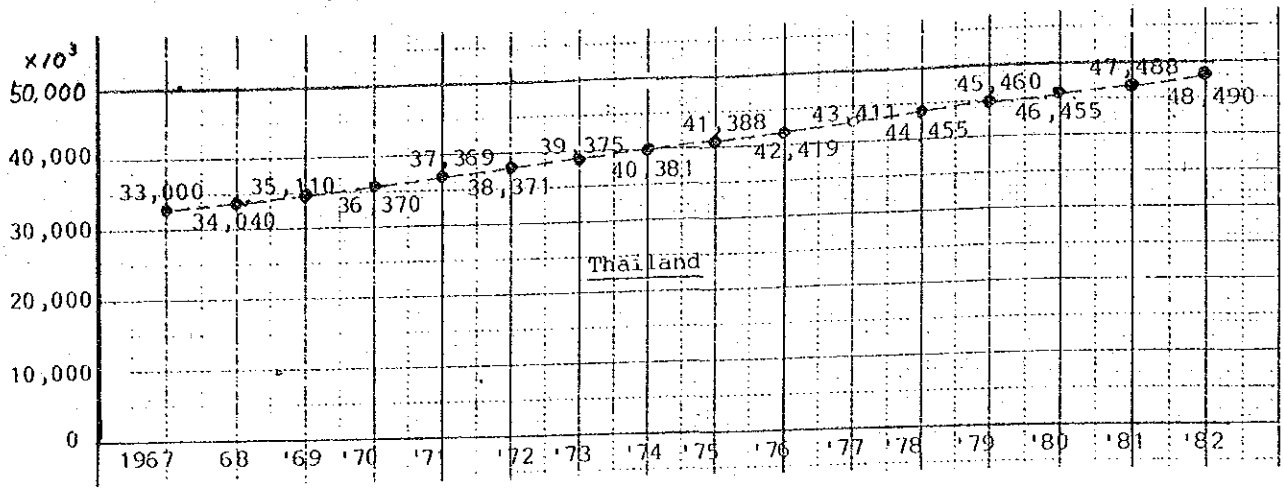
4.3 Rainfall (monthly mean rainfall) : mm

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Suphan buri	5.9	9.4	32.1	83.2	159.6	127.8	112.4	150.5	316.5	204.3	32.3	14.2	1,248.2
Bangkok	8.6	31.8	24.7	67.1	185.4	149.0	148.4	209.4	352.1	236.9	47.5	12.7	1,473.6
Kanchana buri	5.9	9.6	34.9	77.3	147.2	90.2	97.6	106.3	249.4	229.3	60.7	10.9	1,119.3

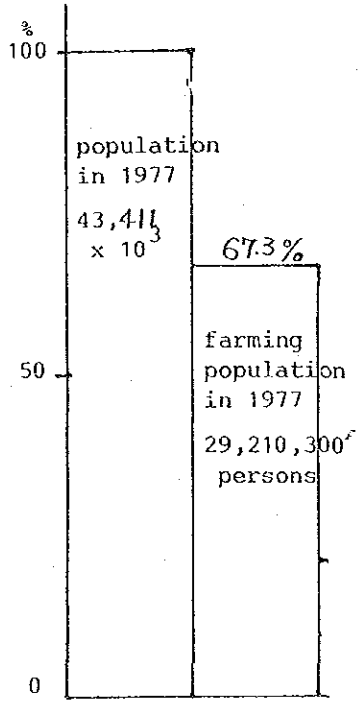

Mean monthly rainfall
(mm)
300
200
100
Bangkok
Suphanburi
Kanchanaburi
Jan.
Feb.
Mar.
Apr.
May
June
Jul
Aug.
Sep
Oct.
Nov
Dec.

5 Population

5.1 Whole population timewise

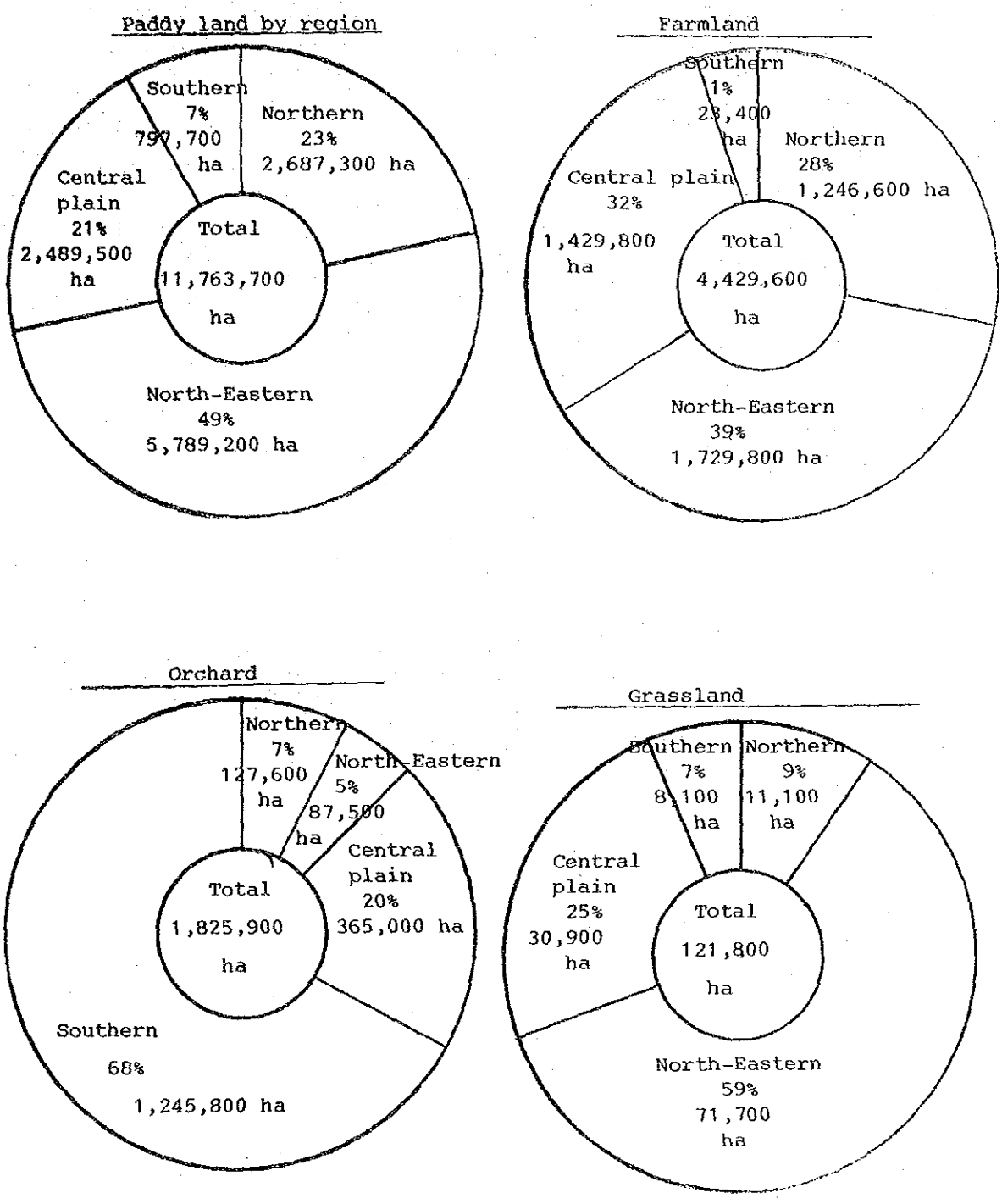


5.2 Farming population

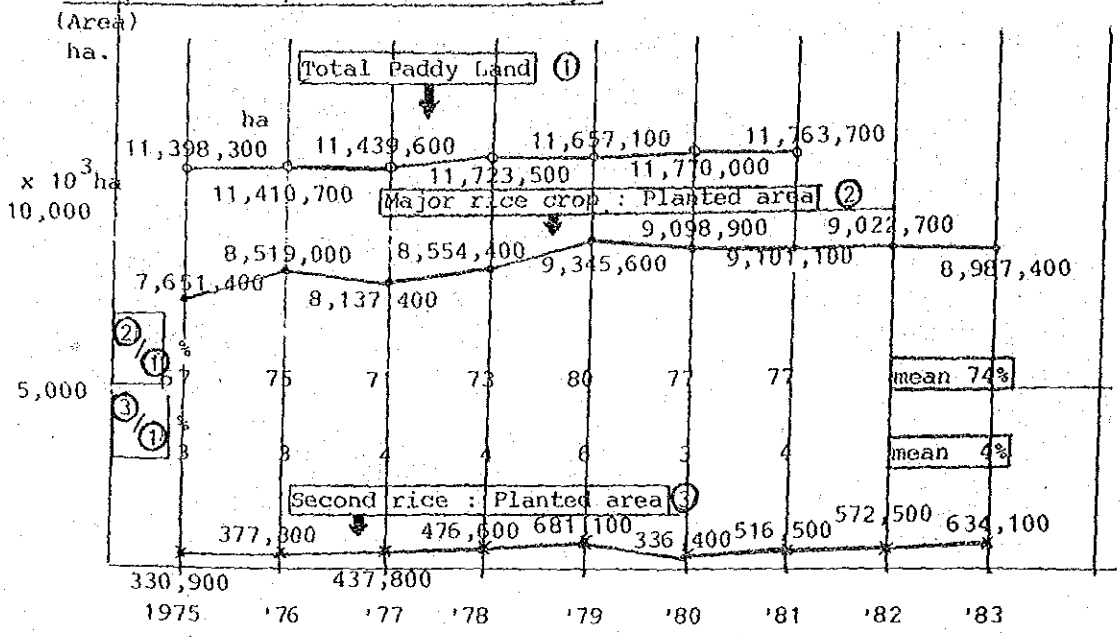


B. Present state of the Thai agriculture

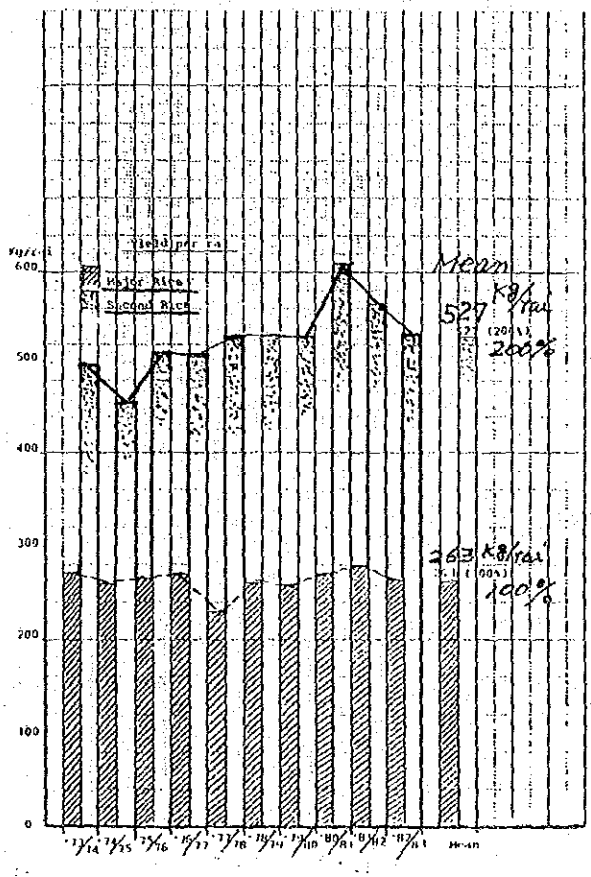
1. Distribution of Agricultural land by region (1981)



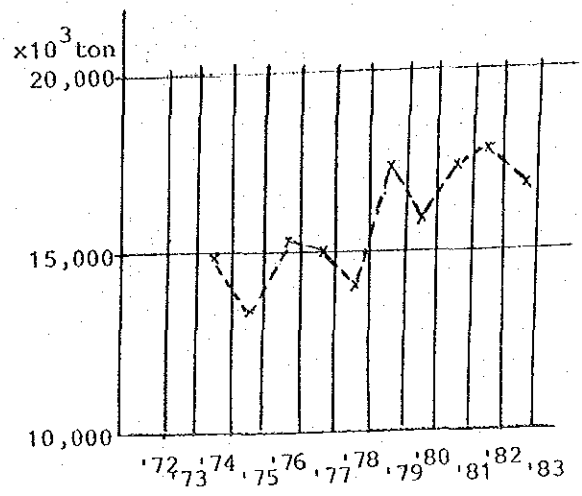
2. Paddy land and planted area annually



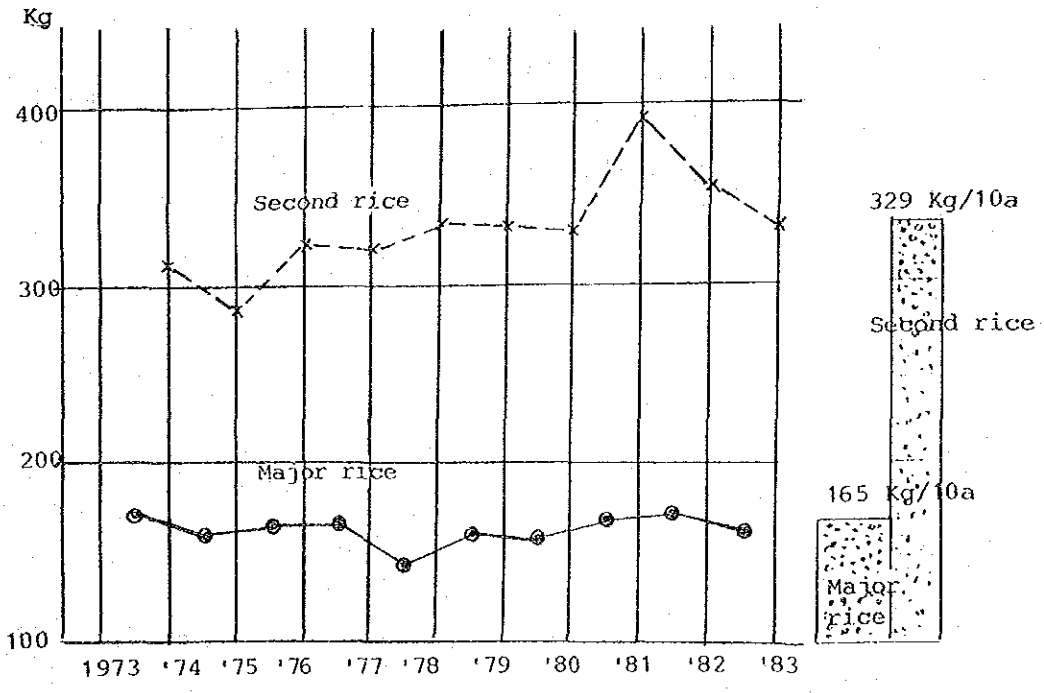
Yield per rai



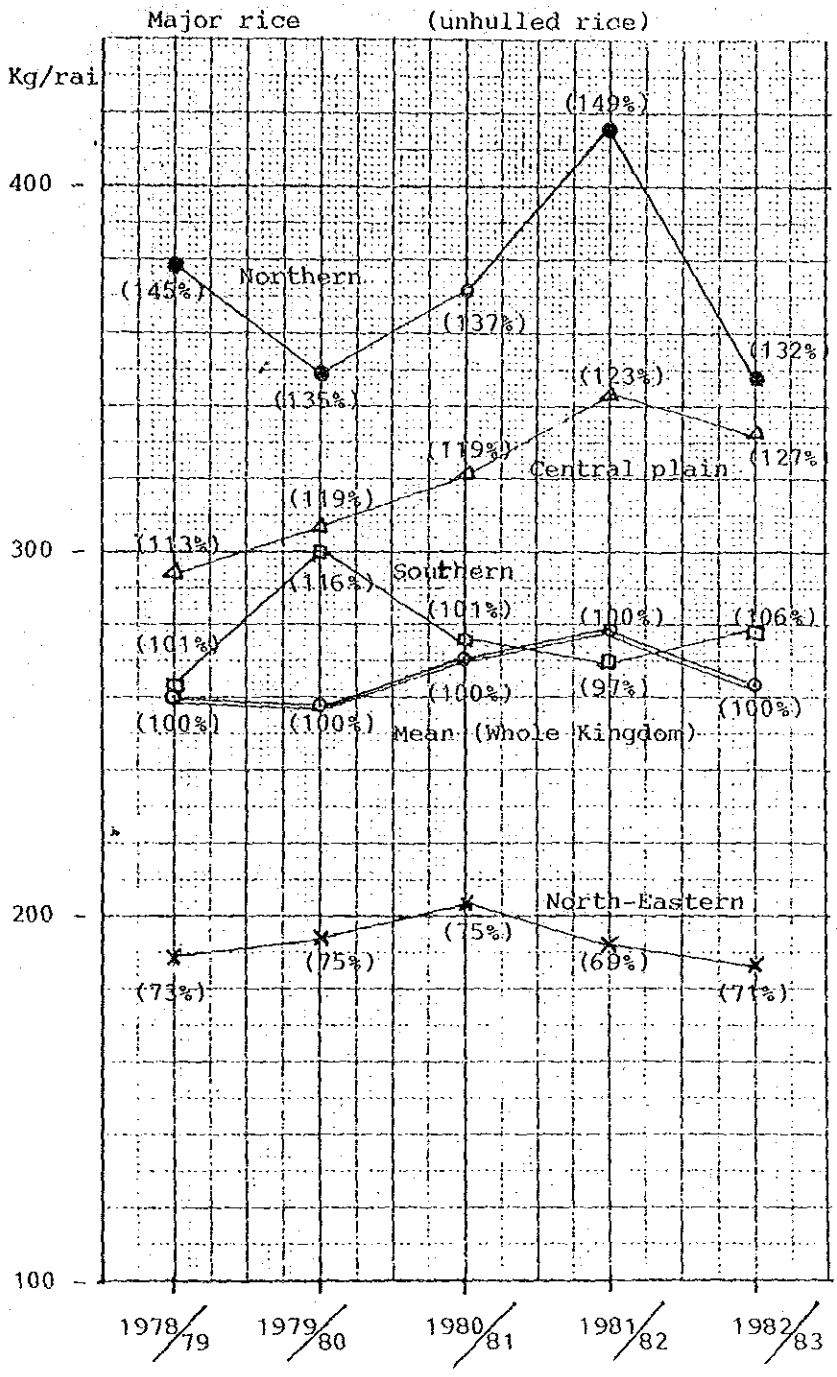
3. Annual Production of rice



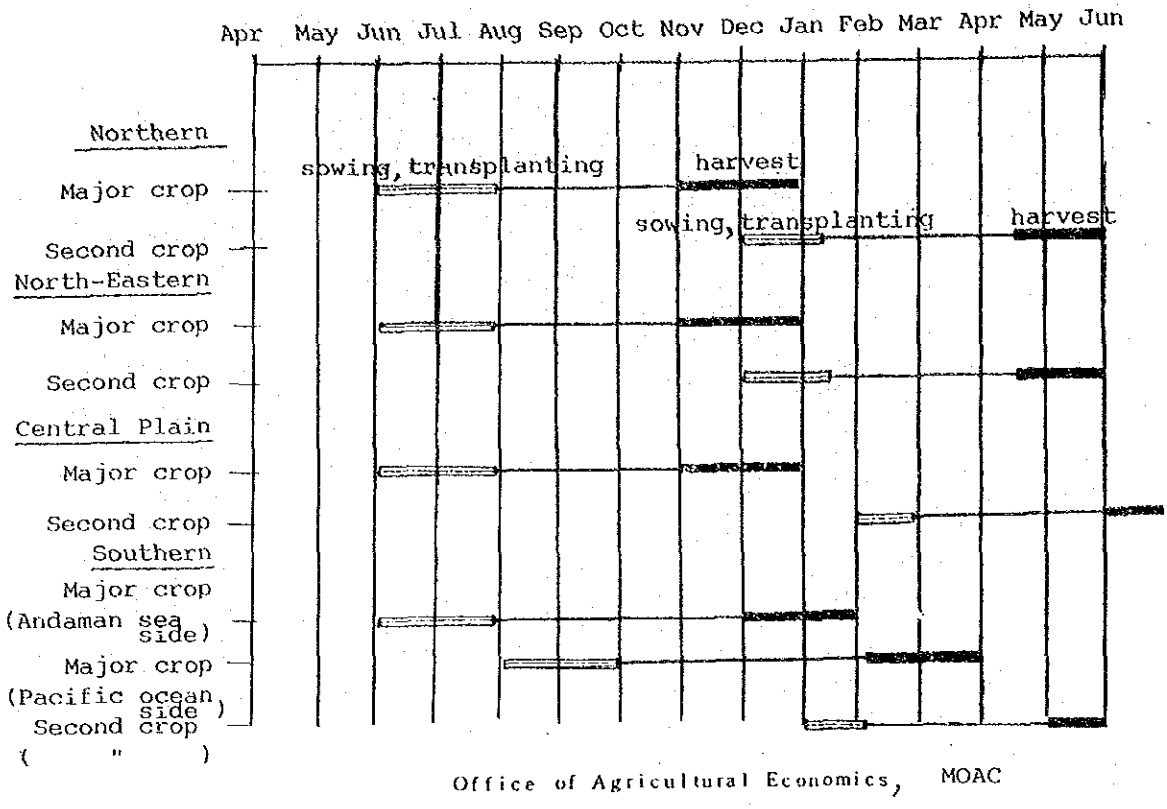
4. Yield per 10 a



5. Yield per rai (Kgs) by region



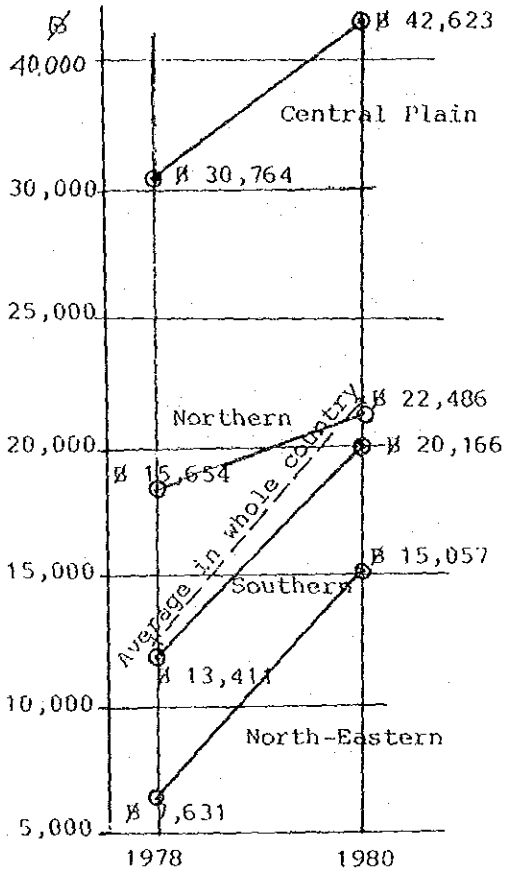
6. Typical rice cropping season



Office of Agricultural Economics, MOAC

7. Agricultural income per household

Average in the whole country		
	1978 ฿ 14,901 (100%)	1980 ฿ 23,209 (100%)
North-Eastern	51%	65%
Northern	105%	97%
Central plain	206%	184%
Southern	90%	89%



8.

Number of farmhouse : 4,406,000 families

Average agricultural land per farmhouse : 4.27 ha

9. Retail price of rice

Year	Nonglutinous rice ฿/ton	Glutinous rice ฿/ton
1976	4,517	4,448
77	4,550	4,306
78	5,206	5,803
79	5,220	5,959
1980	6,509	5,570
81	8,320	7,545
82	8,160	7,920

10. Producers' price of rice

Year	Nonglutinous rice ฿/ton
1976	2,407
77	2,116
78	2,494
79	2,501
1980	2,994
81	3,435
82	2,938

Data Source (2.14, 2.15) : Thailand : International Trade Department unhulled rice including 5 % of crushed rice.

11. Countries where Thai rice is exported

(unit : 1,000 ton)

	1979	1980	1981	1982
Total	2,797	2,818	3,143	3,818
1. Asia	1,436 (52%)	1,307 (46%)	1,322 (42%)	1,367 (36%)
(1) ASEAN	929	983	682	777
(2) Indo-china	153	118	116	26
(3) Others	354	205	523	564
2. Oceania	3	3	3	4
3. Middle and Near East	284 (10%)	477 (17%)	572 (18%)	650 (17%)
4. Africa	620 (22%)	554 (20%)	761 (24%)	1,487 ※ (39%)
5. North America	10	41	11	42
6. South America	305	63	47	-
7. Europe	134 (5%)	353 (13%)	422 (13%)	214 (6%)
(1) EEC	57	134	83	100
(2) Eastern Europe	58	210	332	65
(3) Others	19	9	8	48
8. Others	5	3	3	55

Data source : Customs Department

※ Senegal, Nigeria.

12. Production and Export of the main agricultural production in Thailand

(unit : 1,000 ton)

	1979	1980	1981	1982
1. Unhulled rice	15,757	17,368	17,775	16,878
(pollished rice:66%)	(10,400)	(11,463)	(11,732)	(11,139)
(1) Major crop	14,646	15,405	15,758	14,774
(2) Second crop	1,111	1,963	2,017	2,104
(3) Amount of Export	2,797	2,818	3,143	3,818
((3)/whole unhulled rice)	(17.8%)	(16.2%)	(17.7%)	(22.6%)
2. Cassava	11,101	16,540	17,744	17,788
(pellet : 37%)	(4,107)	(6,120)	(6,565)	(6,582)
Amount of Export pellet	3,695	4,811	5,620	6,995
3. Maize	2,863	2,998	3,449	3,002
Amount of Export	2,014	2,175	2,547	2,894
4. Natural rubber	534	465	508	560
Amount of Export	521	455	472	550

13. Farm equipment

(unit : units)

	Thailand		
	① 1975	② 1982	② / ① %
2 Wheel Walking Tractor	90,001	323,846	360
4 Wheel Farm Tractor	14,575	45,688	313
Big Tractor	13,338	61,840	464
Sprayers	1,310,464	169,089	13
Rice Threshing Machine	3,955	30,091	761
Rice Mills	24,658	6,391	26

Data Source : Agricultural Statistics of Thailand 1982/1983

CHAPTER IV.

BRIEF INTRODUCTION

OF

IRRIGATION DEVELOPMENT IN THAILAND

A. Present state of irrigation development by RID

In 1982, the Department of Royal Irrigation completed a total of 2,833 projects :

* Projects under the National Economic and Social Development Plan (the large and medium-scale irrigation program). These 478 projects benefit irrigated areas of about 20.7 million rai.

* Urgent programs in line with government policy (the small-scale irrigation program). These 2,355 projects benefit irrigated areas of approximately 3,512 million rai.

1. Small-scale Irrigation Program

Small-scale irrigation work is small-sized work designed for the development of all kinds of water sources to alleviate the need of villagers for water for household consumption and for agriculture through out the year, especially during the dry season when they have to face water shortages.

The types of work vary according to the need in each locality, the condition of the water course and topographical suitablility water storing, damming, shifting, pumping, water supplying from canals and underground water development.

Moreover, the program is designed to solve other problems involving water, such as the drainage of flood water in affected farmland, flood controls during high tide, developing the cultivation of seaboard areas, and prevention of the incursion of salt water.

As part of the Governmnet's attempt to develop rural areas, the Royal Irrigation Department has accelerated the construction of small irrigation projects to benefit as fast and as many localities in each region of the country as possible. budget for the construction of each project in SSIP is limited to four million bath, and the construction period for most projects should not take more than one year.

The Royal Irrigation Department began the Small Scale Irrigation Program (SSIP) in 1977 and as of 1982, a total of 2,355 projects have been completed. Approximately 3.4 million rai, covering every region of the country, have been irrigated.

More than half (1,250 projects) of the total number are located in the Northeast. The La Laeng Reservoir at Tambon Wang Mai Daeng in Prathai District of Nakorn Ratchasima, for example, was completed in September, 1982 at a cost of about 1.4 million baht. It can irrigate about 20 square kilometres of farmland and

benefits more than 2,000 people in seven villages in Tambon Wang Mai Daeng, especially La Laeng villagers who live closest to the reservoir. According to a member of the villagers, twice the previous amount of paddy production is expected with such a good supply of water from the reservoir.

As for 1983, the Department has a budget of 1,345 million baht for the construction of 500 projects throughout the country, 255 of which will be located in the Northeast.

2. Medium-Scale Irrigation Projects

This year the Royal Irrigation Department is implementing the construction of 46 medium-scale irrigation projects, 37 of which are the continuing projects from 1982 and nine of which are newly launched projects, throughout the Kingdom.

These medium-scale projects have a total budget of about 200 million baht. The construction period of each is between two and five years.

There are 15 projects in the North under construction , 10 projects in the Northeast, 10 projects in the Central region, and 10 projects in the South.

In addition, there is a project in the area under the control of the 1-4th Army Region that is being developed for the sake of national security.

3. Large-Scale Irrigaiton Projects

The Royal Irrigaiton Department is implementing the construction of 14 large-scale irrigation projects all over the country.

3.1 Phitsanulok Irrigation Project : This project is located at Bann Hat Yai, Amphoe Prompirarm, Phitsanulok Province. It comprises small-scale dams, a water supply system in farmlands.

The implementation of construction is divided into 4 phases:

Phase 1 comprises the construction of Naresuan Dam, the water drainage system and the irrigation system in farmland. The construction will be completed by 1985.

Phase 2 comprises the development of 83,000 rai of farmland of the upper Nan River or which is generally known as the "Tung Sarn" area. The construction has already begun this year and will be completed by 1986.

Phase 3 comprises the development of 338,750 rai of farmland of the left bank of the Nan River.

Phase 4 comprises the development of total 415,000 rai of farmland on the left bank of the Nan River.

The Phitsanulok Irrigation Project, once completed, will be able to irrigate farmland of about 1,443,000 rai on both sides of the Nan River.

3.2. Ground Water Development Project for Irrigation : This project located at Nai Muang District, Amphoe sawankalok, Sukhothai Province, has been designed to utilize ground water for irrigation. It comprises ground water drilling, the construction of ground water pumping stations and the designing of a water supply system. This project will supply water to a total 80,000 rai of farmland. Begun in 1976, it will be completed by 1986.

3.3. Mae Ngat Project : This project is located at Chor Lae District, Amphoe Mae Taeng, Chiang Mai Province. It comprises the construction of water supply system and a water drainage system.
The Mae Ngat Project will be able to supply water to 188,000 rai of farmland in the areas of Amphoe Mae Taeng, Mae Faek Irrigation project, Old Mae Ping Irrigation project and Mae Nam Ping small-scale dams. In addition, this project will prevent floods in Chiang Mai and at the same time generate 5,000 kilowatts of electricity per hour. The period of construciton is between 1976 and 1985.

3.4. Mae Kuang Project : This project is located at Luang Nua District, Amphoe Doi Sakhet, Chiang Mai. It comprises the construction of water storage dams and a water supply and water drainage system to farmland. The project will be able to supply water to 125,000 rai of farmland and at the same time prevent flooding in the areas of the Kuang River. The period of construction is between 1976 and 1988.

3.5. Mae Klong Yai Project: This project is located at Muang Chum District Amphoe Tah Muang, Kanchanaburi. It comprises the construction of Vachiralongkorn Dam, a water supply system, a water drainage system and an irrigation system including the construction of dams to prevent the incursion of salt water from the sea. It will supply water to 2.6 million rai of farmland during the rainy season and 1.8 million rai during the dry season. The period of construction is between 1964 and 1989.

3.6. Bang Barn Project : This project is located at Amphoe Phra Nakhon Si Ayutthaya, Ayutthaya province. It is a project conprising the construction of 12 water-pumping stations with the installation of 30 electric water pumps, a water supply system, a water drainage system and the construction of dams to prevent flooding. To be completed this year, the project will supply water to 137,000 rai of farmland in Amphoe Bang Barn, Amphoe Sena, Amphoe Bangsai, Amphoe Bang Pa-In and Amphoe Phra Nakhon Si Ayutthaya, Ayutthaya province

and Amphoe Pah Moke, Angthong Province.

3.7. Dom Noi Project : This project, at Amphoe Piboon Mang Saharn, Ubon Ratchathani Province, is a permanent project that pumps water from the Sirindhorn Reservoir. The project comprises the construction of water pumping stations and a water supply system. The project is able to supply water to 150 000 rai of farmland under the project. The period of construction is between 1968 and 1983.

3.8. Huay Luang Project : This project, at Baan Kok Sa Ard, Nikom Song Kroh District, Amphoe Muang, Udon Thani province, comprises the construction of irrigation dams,a water supply system and a water drainage system. The project will be capable of supplying water to 80,000 rai during the dry season.
It will prevent flooding in the areas of Udon Thani province. The period of construction is between 1969 and 1984.

3.9. Pattani Project : The project is located at Baan Kura, Amphoe Muang, Yala province. With dams, a water supply system, a water drainage system and an irrigation system for farmland, it will supply water to 320,000 rai of farmland and at the same time prevent flooding in Pattani province. The period of construction is between 1967 and 1987.

3.10. Munoh Project : In Kosit District, Amphoe Sungai Kolok, Narathiwat province, the project comprises the construction of a water drainage system, water supply system at Satorn Island and the construction of dam in order to prevent the incursion of salt water from the sea. This project drains water from the basin of Kolok River and from the areas of Chai Ploo Toh Daeng in order to prevent salt water from flooding the plains along the coast. The drainage system and dam affects 100,000 rai in the plain, and the water supply system, 9,000 rai of farmland at Satorn Island.

3.11. Bang Wad Project : Located at Tung Thong District and Ka Tooh District, Amphoe Ka Tooh, Phuket province, the project, to be completed this year, comprises the construction of reservoir for household comsumption and industrial purposes in Amphoe Ka Tooh and Amphoe Muang, Phuket province. This project will also prevent floods.

3.12. Upper Moon River Project : The project, in Baan Na, Chorakehin District, Amphoe Kornburi, Nakhon Ratchasima province, comprises

the construction of two dams : the Upper Moon Reservoir and the Lam Sae Reservoir, the construction of a water supply system, a water drainage system and an irrigation system in farmlands. This project, capable of supplying water to 191,400 rai of farmland, will be completed in 1988.

3.13. Nong Koh Project : The project is located at Baan Nong Koh, Nong Kham District, Amphoe Sri Racha, Chon Buri province. It comprises the construction of 26-million-cubicmetre reservoir for storing water for industrial purposes in the Laem Chabang areas and at the same time for supplying water to 7,500 rai of farmland in Lam Huay. In addition, this project will supply water to Bang Phra Reservoir with the construction of a 5,400-metre concrete klong to supply water from a drainage station. The period of construction is between 1980 and 1983.

3.14. Water pipe laying Project at Dokkrai-Mab Ta Pud : The project is located at Baan Dokkrai, Tasit District, Amphoe Pluak Daeng, Rayong province. Water pipes will be laid between the Dokkrai Reservoir and Mab Ta Pud. The distance is around 26,500 kilometres. The project comprises the construction of water pumping stations, water level control towers at each station and at the end of the pipe. This project is to supply water to the areas of industrial estates and Gas Separation Plant. The period of construction is between 1983 and 1984.

To comply with the government campaign to develop rural areas, especially poverty stricken districts, as fixed in the Fifth National Economic and Social Development Plan (1982 - 1986), the Royal Irrigation Department has plans to develop water sources. by expediting the development of small water sources to farmland outside irrigated areas, the Department will be able to cope with the irregularity of natural conditions.

Moreover, the Department is also planning to provide some irrigated areas with complete water supply systems, and it is considering introducing electrical pumps in various regions.

Each of these projects costs about 100 - 2,000 million baht financed by many financial sources - the Asian Development Bank (ADB), the World Bank(WB), the Overseas Economic Cooperation Fund (OECF), the US Agency for International Development (USAID) and Krrditanstalt fur Wiederaufbau (KFW) of Germany.

4. Financial Support from ADB

The Government signed a loan with the ADB for 920 million baht for five projects to boost agricultural production on a total of 105,500 rai so as to raise income level and living standards of farmers of 3,618 families. For this project, a supplementary budget of 897 million baht was spent to hire an engineering consultant company to design and carry out the construction. These projects are:

- Huay Mae On Project for the construction of a reservoir in Sankamphaeng District of Chiang Mai at a cost of about 222.5 million baht.
- Thung Wat Singh for pumping water form Krathong Canal in Wat Singh District, Chainat province, to the high plain in the same district. About 52,500 rai in the rainy season and 21,000 rai in dry season will be affected.
- Tha Chanuan-Wat Khok Project for the irrigation in Manorom District in Chainat.
- Prachantakharm River Project, an irrigation in Prachantakharm District of Prachin Buri.
- Khlong Wang Tanoad, a project to construct a dike to prevent sea water incursion in Chanthaburi Province.

The Asian Development Bank also extended loans for another four projects in the South to help with technology. These projects are:

- Tha Thong Project - for the construction of a weir in Surat Thani province to supply water to 44,375 rai of farmland in Amphoe Donsak and Amphoe Kanjanapradit. Construction is expected to begin in 1985.
- Tha Chang Project - for the construction of a weir in Amphoe Tha Chang and Amphoe Punpin of Surat Thani Province to supply water to about 31,250 rai of farmland. Construction is expected to begin in 1985.
- Tha Thon Project - for the construction of a weir in Amphoe Sichon of Nakhon Si Thammarat to irrigate about 15,625 rai of farmland. Construction is expected to begin in 1984.
- Park Phanang Basin Project - covering seven districts in three provinces : Nakhon Si Thammarat, Phatthalung and Songkhla. About 1,467,000 rai of farmland is believed to benefit from the project.

5. Financial Support from the World Bank

In August 1983, the Irrigation Department will sign a contract with the World Bank to borrow 1,035 million baht to add to a supplementary budget of 1,118 million baht for a feasibility study of six irrigation projects covering 151,950 rai of farmland. At present, PRC/ECI & REC Consultant Company is conducting the feasibility study of these projects :

- Mae Sai Project in Chiang Rai Province. About 489 million baht will be spent on the construction of a drainage system, water release systems and irrigation systems in 41,750 rai of farmland to begin in 1984.
- Mae Sod Project in Tak Province. Mae Sod Dam will be renovated and a drainage system and irrigation systems will be constructed in 1985. Construction cost is estimated at 107 million baht.
- Nam Rid Project in Uttaradit Province. The drainage canals will be extended. This development project also includes the construction of two pumping stations and irrigation systems for 34,300 rai of farmland. To begin in 1985, it is scheduled for completion in 1988.
- Mae Sarieng Project in Mae Hong Son Province. This is a new project for the construction of a weir equipped with a water release system, a drainage system and an irrigation system for farmland covering about 5,000 rai. It will be implemented in 1985 and scheduled for completion in 1986. Construction cost is estimated at 100 million baht.
- Khlong Tron Project in Phitsanulok Province. This new project is scheduled to be launched in 1984 and completed in 1988. The construction includes a dam and a weir equipped with a water release system, a drainage system and an irrigation system in the farmland. About 492 million baht will be spent.
- Lam Sonthi Project in Lop Buri. To be located at Amphoe Chaibadarn, the project will be for the construction of a weir equipped with a water release system, a drainage system and an irrigation system for farmland of 37,500 rai. The construction period will be from 1985 to 1987, and the cost will be around 392 million baht.

6. Financial Support from KFW

Farmers from Amphoe Thart Phanom in Nakhon Phanom Province, living on about 90,000 rai of farmland which receives water only from the Kam River

are now filled with hope since the Government has plans to implement Nam Kam - Project to pump water from the Dam River to their farms. Right now, Gitec, a German consultant company is jointly conducting a feasibility study with a Thai consultant company, NECCO Thailand, with financial support of 4.5 million DM from the Federal Republic of Germany.

7. Financial Support from OECF

The Japanese Government, through the Overseas Economic Cooperation Fund (OECF), has agreed to give assistance for five projects in Chiang Mai, Saraburi Phetchabun and Rayong.

- Project for the construction of water pipes from Dokkrai Reservoir at Amphoe Pluak Daeng in Rayong to the industrial zone at Tambon Mab Ta Pud.

  As part of the Eastern Seaboard Development Project, a 26.5-kilometre water pipe with the diameter of 1.35 metres is being installed from the reservoir to the Mab Ta Pud area in Rayong where heavy industries are to be located. A water pumping station is also being constructed at the reservoir, as are the storage tank with a capacity of 4,000 cubic metres and a water terminal with a capacity of 28,000 cubic metres.

  In early April this year, the Royal Irrigation Department signed a contract with the Italian Thai Development Corporation Ltd for this project which is financed by OECF and a supplementary budget from the Thai Government. Total cost of the project is 544,095,314 baht. Upon completion in 1984, the gas station at Mab Ta Pud will receive water for the industries and the people for their consumption and utilization.

- Mae Kuang Project. The project is designed to help irrigate about 125,000 rai of farmland at Amphoe Doi Saket in Chiang Mai. Implemented in 1976, the project covers the construction of a 62-metre-high and 645-metre-wide clay dam with a capacity of 325 million cubic metres, equipped with a water release system and a drainage system. It is scheduled to be completed in 1988.

  The project, which will cost a total of 4,472,887,000 baht, is being financed by OECF in a form of a 1,698,341,000 baht loan and a supplementary budget provided by the Thai Government.

- Baan Mor-Kaeng Khoy Pump Project - to be located at lower Pasak

River in Saraburi Province. The Japanese Government, through JICA (Japan International Cooperation Agency), agreed to provide a free grant to Thailand for the feasibility study of the project. OECF also granted a ¥ 190-million loan for the design of the construction of a pumping station installed with seven 750-horse-power pumps to irrigate about 87,500 rai of farmland.

Nong Pla Lai Dam Project. The Royal Irrigation Department has devised this project to develop Nong Pla Lai Dam into a large reservoir with a capacity of 200 million cubic metres, equipped with a water release system.

Upon completion, the project will be able to supply water to about 22,800 rai of land for public consumption and utilization and for the industries in Rayong Province as part of the Eastern Seaboard Development Project.

The Japanese Government offered a free grant assistance for the feasibility study and the Thai Government also received a 320-million-yen loan from OECF for the design of the construction.

- Upper Pasak Project - divided into four smaller projects, the feasibility studies of which are financed as a free grant by the Japanese Government.

  Upon its completion, about 84,380 rai of farmland will benefit from the project.

8. Financial Support from USAID

This is a small-scale irrigation project for the Northeast to cost a total of US$ 16.95 million and is supported mostly by USAID.

The Asian Institute of Technology (AIT) has conducted a feasibility study of the development of the medium-sized reservoirs in the Northeast and suggested developing seven reservoirs in Roi Et, Kalasin, Mukdahan, Ubon Ratchatani, Buri ram and Nakhon Ratchasima.

In addition to the developing of the reservoirs and water systems, more irrigation systems in the farms will be constructed. The project is also designed to boost production, disseminate agricultural knowledge to the farmers in the irrigated areas and development in other Northeastern provinces

Implemented in 1981, the project is expected to be finished in 1986.

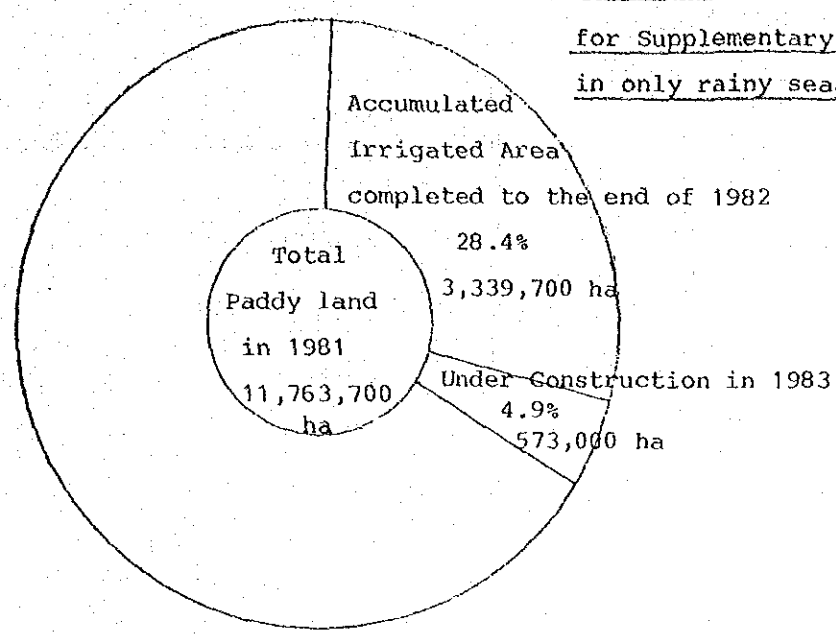
9. Other Projects Supported by Overseas Financial Sources

Water release systems of Pattani Irrigation Project. Pattani project has a dam equipped with three water release systems, able to supply water to about 320,000 rai of farmland. However, the water release systems are not completed due to the lack of financial support. Therefore, the World Bank agreed to extend to Thailand a 380-million-baht loan to speed up the completion. With the loan and a supplementary budget of 600 million baht from the Thai Government, the first system is expected to be completed in 1986 and the rest of the support will be for the completion of the second and the third, the designs of which will be finished in 1984.

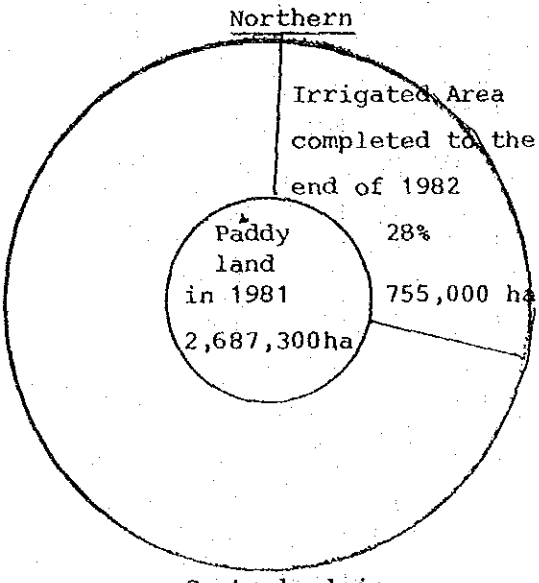
MaeKlong Project, Period 2. The World Bank offered to Thailand a loan of 1,215.5 million baht for the development and extension of the water release systems and drainage systems which were constructed in 1975 during Period 1. Part of the loan will be paid for the construction of the irrigation systems in the farmland on the right and upper left sides of the MaeKlong River and the construction of the drainage systems on both sides of the river. All have been launched since 1982 and will be completed in 1989.

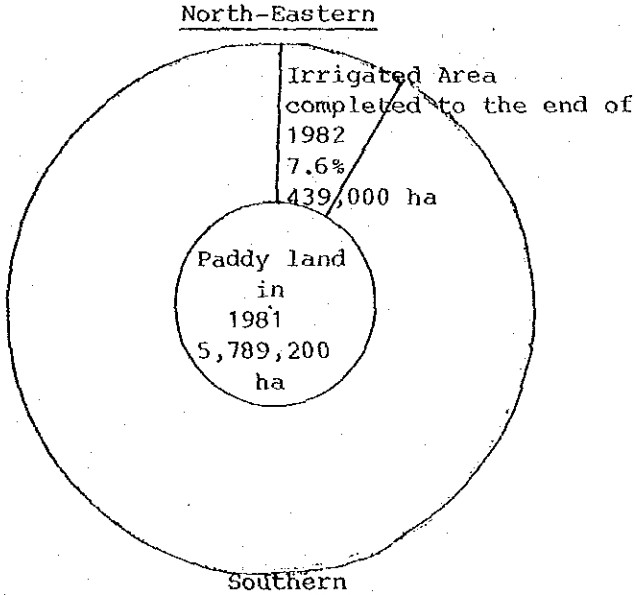
B. Brief introduction of irrigation development in Thailand

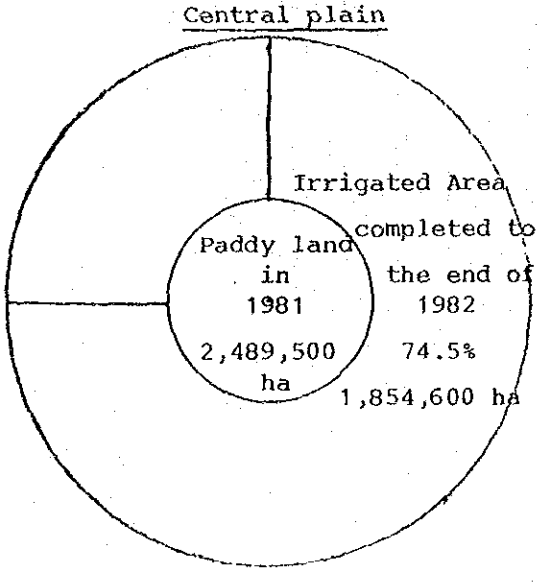
1. Water Resources Development completed to the end of 1982

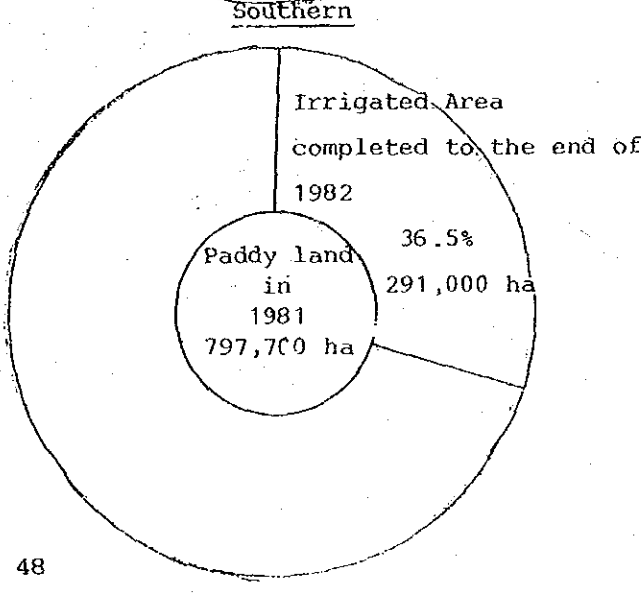


2. Accumulated Irrigated Area : Completed to the end of 1982, by region









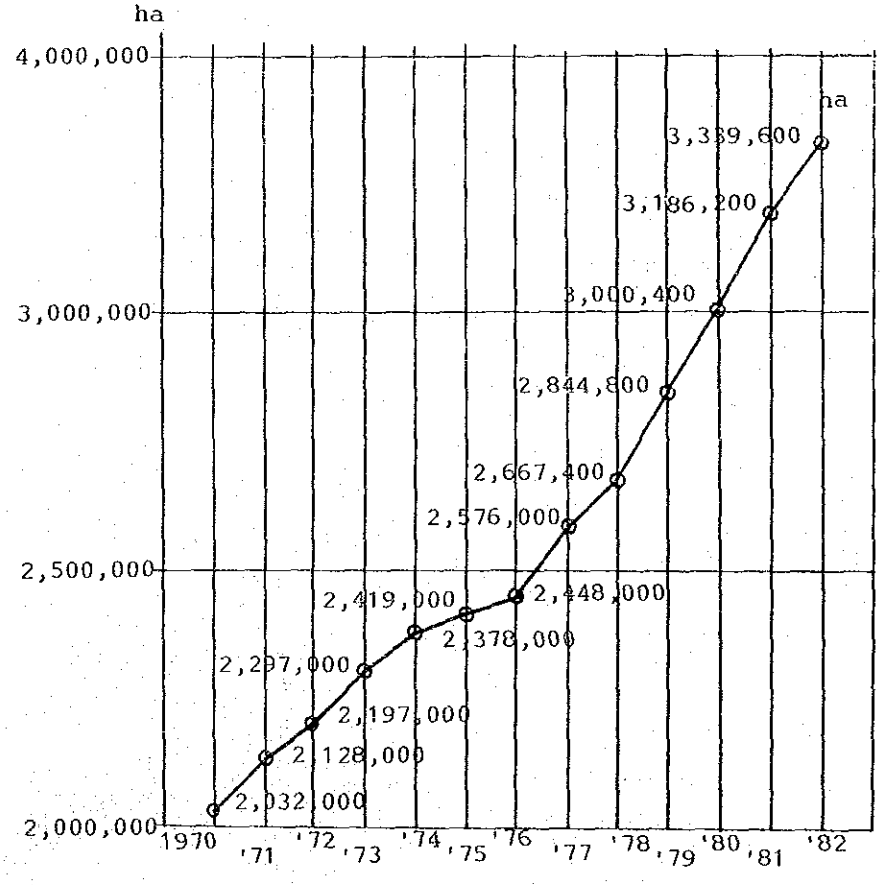
3. Water Resources Development in Thailand by Region

completed to the end of 1981 and under construction in 1982

capacity : (unit : Mill.m^3)

	Total	Northern	North-Eastern	Central plain	Southern
Large Project & Midium scale project	29,128.13 (100%)	23,432.39 (80%)	3,850.16 (13%)	1,833.88 (6%)	11.7 (1%)
Small scale project	365.71 (100%)	39.79 (11%)	305.02 (83%)	18.32 (5%)	2.58 (1%)
Total	29,493.84 (100%)	23,472.18 (79%)	4,155.18 (14%)	1,852.20 (6%)	14.28 (1%)

4. Irrigation development Annually



5. Dams in Thailand

Name	Unit	Bhumibol	Sirikit	Chulabhorn	Kang Krachan	Lam Phra Phloeng	Kiu Lom	Pran Buri
Purpose		I.P.F.	I.P.F.	P.	I.P.F.	I.F.	I.F.P.	I.F.
Name of River		Ping River	Nan River	Phrom River	Petchburi River	Lam Phra Phloeng	Mae Wang	Pranburi
Catchment area	Km^2	26,368	13,130	545	2,200	807	2,700	2,029
Average Annual Discharge	McM	8,600	7,006	170	880	116	574	320
Design flood discharge	m^3/S	6,000	8,000	1,800	4,720	1,530	2,900	1,760
[Dam] Type		Concrete Arch	Earth fill Dam	Rock-fill Dam	Earth fill Dam	Earth fill Dam	Concrete gravity	Earth fill Dam
Bedrock		Quartzite (Kei-Can)	Quarrs Porhyry (Sekieinangan)	Sandstone	Sandstone	Sandstone	Sandstone, Quartzite	Sandstone
Dam height	m	154.0	113.6	70	58.0	49	42	42
Lenght of Crest		486	800	700	760	673	135	1,500
Volume content of dam	m^3	970,000	9,800,000	1,640,300	3,425,000	1,377,000	40,000	3,990,000
[Spillway]								
Type		Tunnel Type	Tunnel Type	Shoot Type	Over-flow Type	Glory Type and Over-flow Type	Ogee gate Type	Ogee gate Type
Gates		Radial gates - 2	Radial gates-2	Radial gates-2			Radial gate-5	Radial gates-2
Max.Capacity	m^3/S	6,000	3,250	1,000	1,380	ordinary 400 emergency 1,130	2,900	ordinary 1,000 emergency 760
[Reservoir]								
Gross capacity	McM	13,462	9,000	188	710	320	112	650
Effective capacity	"	8,600	8,800	165	640	145	106	375
Reservoir area	Km^2	300	260	12	50	18.6	16	47
Effective depth	m	47	60	20	24	23	13	18
[Operation agency]		EGAT	EGAT	EGAT	RID			
[Water Power plant]								
Type		Indoor	Indoor	Indoor	Semi-Outdoor			
Max.discharge	m^3/S	600	582	13.4	47			
Effective head	m	123.2	78.0	366	43			
Capacity of facility	MW	420 (6 x 70 MW)	375 (3 x 125)	40 (2 x 20 MW)	19 (1 x 19 MW)			
Annual capacity of power generation	KWH	$1,600 \times 10^6$	965×10^6	140×10^6	81×10^6			
Operation agency		EGAT	EGAT	EGAT	EGAT			
[Construction]								
Commencement		1961	1968	1970	1963	1967	1967	1970
Completion		1964	1972	1972	1966	1970	1972	1977
Contructor		-	-	Ohbayashi	RID			

Name	Unit	Sirindhorn Dam	Takhong Dam	Nam Pung	Lam Pao	Ubol Ratana	Nam Un	Srinagarind
Purpose		I.F.F	I.F	I.P	I.F	I.P.F	I.F	I.F.P
Name of River		Lam Dom Noi	Lam Takhong	Nam Pung	Lam Pao, Huai Yang	Nam Pong	Nam Un	Quae Yai River
Catchment area	Km^2	2,097	1,430	297	5,960	11,980	1,100	10,880
Average Annual Discharge	McM	1,313	212	106	1,363	1,750	365	4,600
Design flood discharge	m^3/S	1,000	2,130	300	950	2,500	850	7,100
[Dam] Type		Rock-fill dam	Earth fill dam	Rock-fill dam	Earth fill dam	Rock-fill dam	Earth fill dam	Rock fill center core
Bedrock		Silt, Rock	Sandstone		Silty-clay	Sandstone	Silty-clay	Quartzite, Sandstone, limestone
Dam height	m	42.0	40.3	40.0	33.0	32	30.0	140.0
Length of Crest	m	940	527	1,720	7,800	800	3,300	610
Volume content of dam	m^3	585,000	853,000	730,000	4,270,000	575,000	2,626,000	12,300,000
[Spillway]								
Type		Shoot type	Overflow type	Shoot type	Ogee gate type	Overflow type	Glory type	Shoot type
Gates		Radial gate-3	Radial gate-7		Radial gate-3	Radial gate-3		Radial gate-3 (10.0 x 9.5 m)
Max.capacity	m^3/S	1,000	ordinary 1,530 emergency 600	300	850	2,500	ordinary 390 emergency 460	2,420
[Reservoir]								
Gross capacity	McM	1,550	310	150	2,450	2,500	520	17,745
Effective capacity	McM	900	290	122	1,260	1,920	475	7,470
Reservoir area	Km^2	292	44	20.2	380	410	85	419
Effective depth	m	50	16	14.0	11	8	10	21.0
[Operation agency]		EGAT		EGAT		EGAT		EGAT
[Water power plant]								
Type						Semi-Outdoor		Indoor
Max.discharge	m^3/S	47		4.4		200		798
Effective head	m	30.3		88		18.5		105
Capacity of facility	MW	24 (2 x 12^{MW})		6 (2 x 3^{MW})		25 (3 x 8.3)		720 (3x120^{MW}, 2x180^{MW})
Annual capacity of power generation	KWH	73 x 106		15 x 10^6		65 x 10^6		1,160 x 10^6
Operation agency		EGAT		EGAT		EGAT		EGAT
[Construction]								
Commencement		1968	1964	1964	1964	1964	1968	1974
Completion		1971	1969	1965	1968	1965	1974	1980
Contructor		Maeda - Kogyo		NEA		West Germany		

Name	Unit	Khao Laem	Pattani	Kra Sieo				
Purpose		I.F.P	I.F.P	I.F				
Name of River		Quae Noi River	Pattani	Krasieo				
Catchment area	Km^2	3,720	2,080	1,200				
Average Annual Discharge	McM	5,500	1,460	165				
Design flood discharge	m^3/S	7,100	6,134	260				
[Dam] Type		Concrete faced Rock-fill dam	Rock-fill dam	Earth fill dam				
Bedrock		Limestone	Standstone	Limestone				
Dam height	m	90	85.0	32.5				
Length of crest	m	910	422	4,250				
Volume content of dam	m^3	8,000,000	2,900,000	9,000,000				
[Spillway]								
Type		Shoot type	Shoot type	Overflow type				
Gates		Radial gates	Radial gates-2					
Max.capacity	m^3/S	3,200	4,500	260				
[Reservoir]								
Gross capacity	McM	7,450	1,360	240				
Effective capacity	"	4,800	1,100	200				
Reservoir area	Km^2	352	51	48				
Effective depth	m		32.0	9				
[Operation agency]		EGAT	EGAT					
[Water power plant]								
Type		Indoor	Indoor					
Max.discharge	m^3/S	167	45					
Effective head	m	53	47					
Capacity of facility	MW	300 (3 x 100)	60 (3 x 20 MW)					
Annual capacity of power generation	KWH		196×10^6					
Operation agency		EGAT	EGAT					
[Construction]								
Commencement		1980	1976	1972				
Completion		1985	1981	1981				
Contructor		Italian-Thai	Italian-Thai					

CHAPTER V.

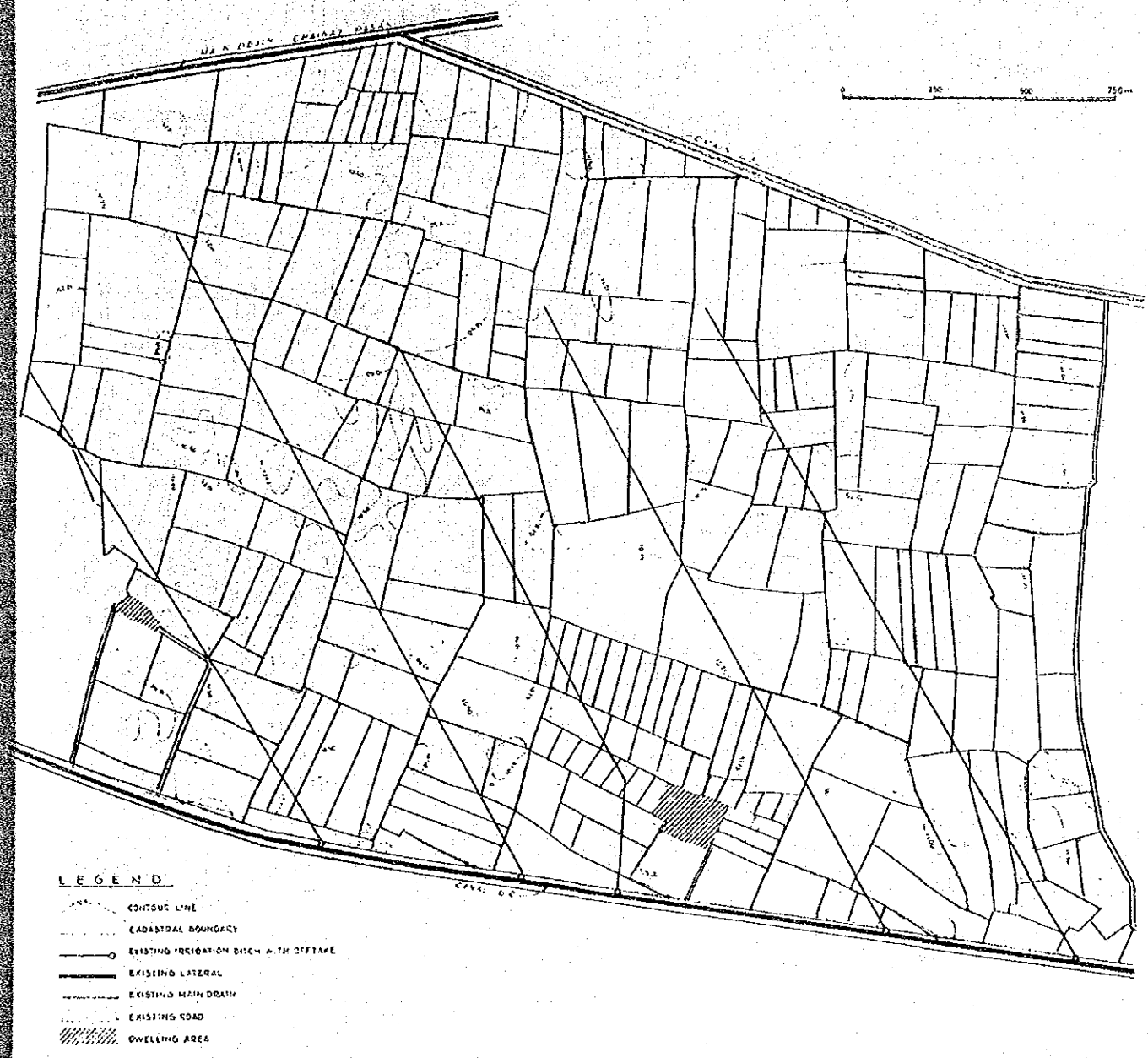
ON-FARM DEVELOPMENT PROJECTS

A. On-farm development projects

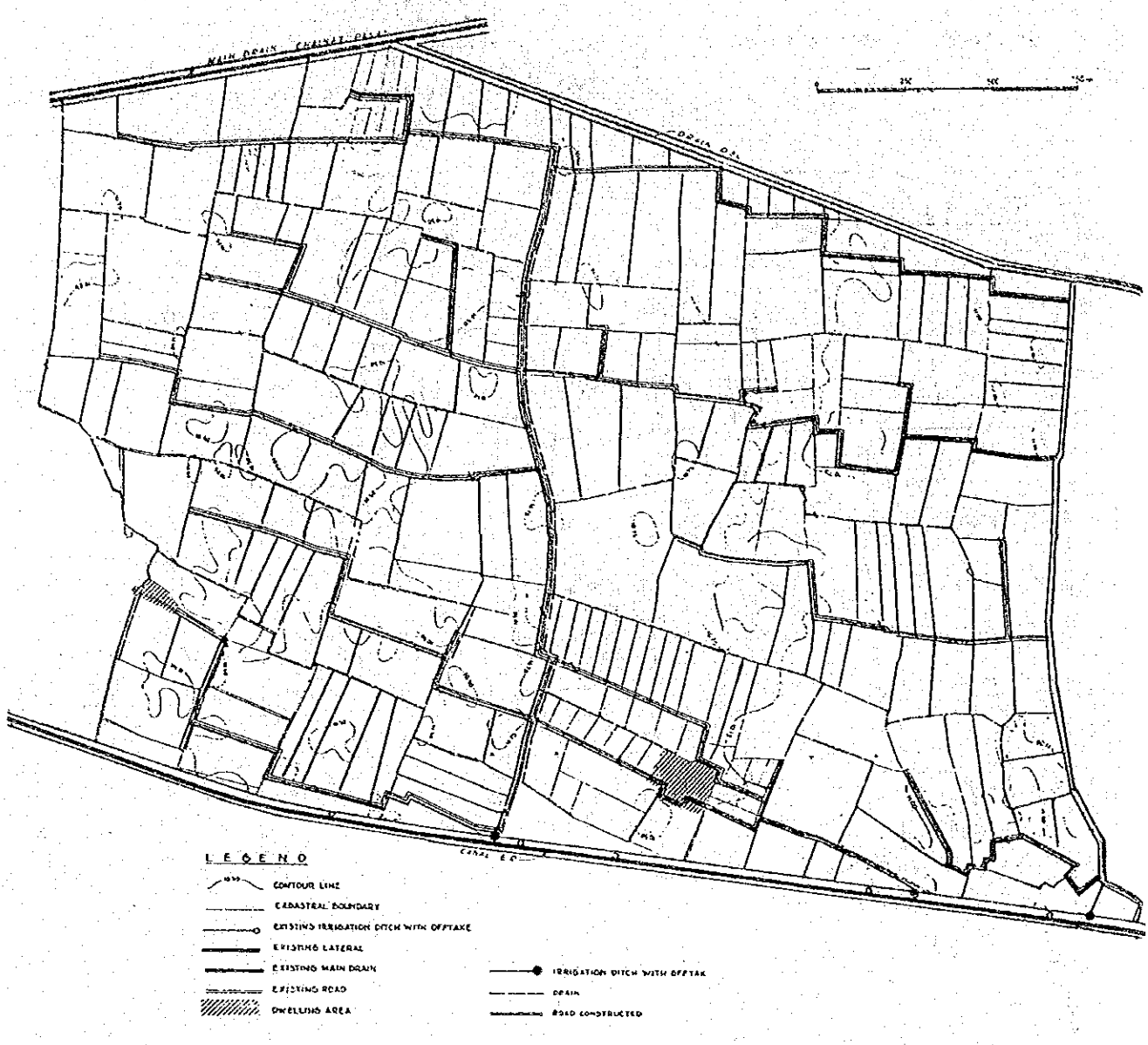
On-farm development project can be classified as follows:

- On-farm development project
  - Dikes & ditches project
  - Land Consolidation project
    - Extensive method
    - Intensive method

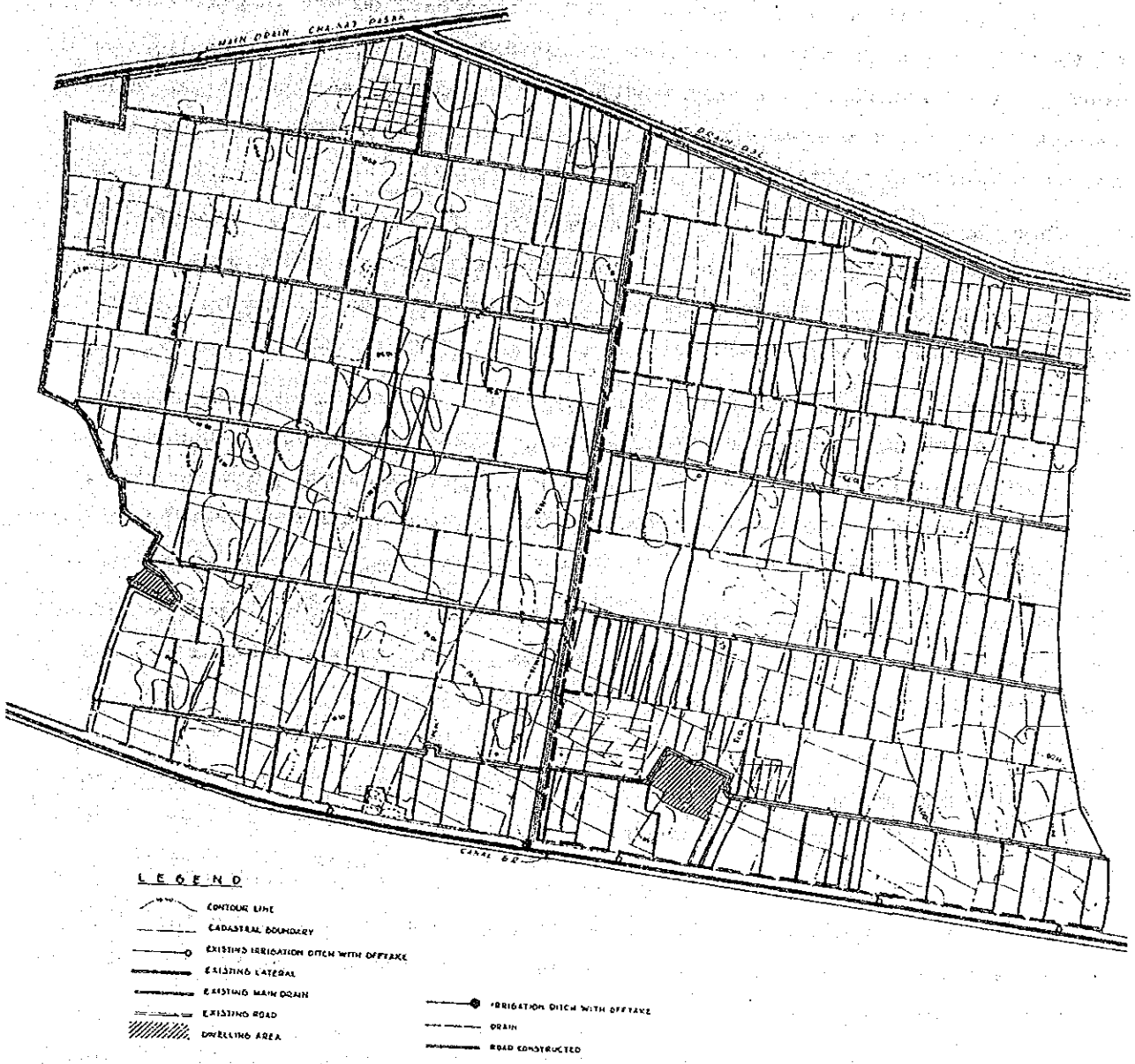
Dikes & Ditches Project



Extensive Land Consolidation



Intensive Land Consolidation



B. The Background of Land Consolidation in Thailand

Paddy cultivation in Thaialnd, which has been carried out in vast paddy fields of about 9 million hectares, produces its annual yield of approximately 16 million tons of rice (unhusked rice equivalent) and about 3 million tons of the annual produce have been exported to those Southeast Asian countries and others which have been suffering from chronic shortages of foodstuffs.

Thus, as compared with other Southeast Asian countries, Thai agriculture has been maintaining considerably stable-paddy production, which as the nucleus of the agriculture, is playing a vital role in the national economy, contributing to the improvement in the balance of payments to a great extent.

The latest achievement of the country's rice farming depends on not only the blessed natural conditions but also on the investment made in the infra-structure water use facilities many years ago. Particularly, the main irrigation and drainage canals provided by the Royal Irrigation Department should be further examined internationally.

Recently, however, the population of Thailand has been explosively increasing exceeding a three per cent annual growth rate, much as other Southeast Asian countries are.

If the population continues to rise at this current rate, the surplus capacity now used for rice exports will have to be diverted to the countries domestic rice needs within less than 10 years.

The 4th National Economic and Social Development Plan (1977-1981) involved a schedule for the diversification and stabilization of exports by farm production increase and multiple cropping so as to enact a countermeasure against the future severe economic situation.

Farm production increase, particularly in paddy production, will indispensably require production increase per unit acreage for double cropping.

In order to realize the program, the following measures should perhaps be taken :

a) The high yield varieties e.g. the RD varieties in Thailand should be introduced to possibly large acreages and the land consolidation should be provided so as to carry out proper water management.

b) Irrigation water should be secured for dry season croppings and the terminal irrigation facilities should be completely provided for efficient water utilization.

c) The agriculture supporting services should be positively promoted for improvement and extension of the farming techniques and the farmer's organizations in the above mentioned direction.

As mentioned already, since the end of World War II, the construction of main irrigation and drainage facilities has been expedited to produce good effects for securing water. Better water utilization, however, has not been made yet due to the absence of on-farm facilities such as secondary, and tertiary canals, water- intake systems to the fields and land consolidation.

Thus, the Government of Thailand has come to recognize the fact that the increase in paddy yield is inevitably required to realize on-farm development as early as possible.

Under such circumstances, the Government has formulated a plan of on-farm development, particularly the land consolidation progress as the core of the plan, (so called Irrigated Agriculture Development), and took necessary legal and institutional measures with the enforcement of the Land Consolidation Act (1974) and the Agricultural Land Reform Act (1975) for the smooth execution of the development program.

The government carried out the administrative reorganization that had transferred the Royal Irrigation Department, which formerly belonged to the Ministry of Interior, to the Ministry of Agriculture and Cooperatives, and established the new Central Land Consolidation Office in charge of planning and execution of land consolidation projects, and the Agricultural Land Reform Office for the promotion of land reform.

C. Dikes and Ditches Projects

Dike and Ditch Projects are a kind of terminal irrigation facility development project in order to distribute irrigation water effectively from the main irrigation system to each plot in completed irrigation project area.

In former times, in spite of the fact that irrigation systems had been constructed, lots of problems such as unirrigable areas still remained and therefore, as one of the methods of solving the problem, Dike and Ditch projects were adopted.

The project has been conducted since the Dikes and Ditches Act was promulgated in 1962.

Generally speaking aobut the details of the project, the irrigation system including the Chainat Basin comploted, though, because of wide intervals in between the secondary canals (2-5 km) its object, which was to distribute irrigation water toward its command area, could not go beyond the confines of the previous flooding irrigation. Such being the case, the Thai Government enacted this act and started digging earth ditches as branchs of secondary canals at 400 m intervals under direct management.

Length of the dug ditch : 1~4 Km

Design ditch discharge : 1 l/s/ha (uniformly)

However, farmers rated the project low. According to an investigation in the central plain by the Royal Irrigation Department and NEDECO (a Dutch consultant company), it was found out that about 70 % of the implemented area had some faults.

They were:

i) In about 50 % of the implemented areas, discharge was insufficient.

ii) There were no control facilities for discharge.

iii) Longitudinal slopes were in adequate, so that water does not flow smoothly.

iv) Since ditches are constructed with disregard to the boundary of ownership, distribution of irrigation water cannot go well.

v) Sub-ditches branching off a leading ditch had never been constructed, so the command area of the ditch was limited.

vi) Operation and maintenace of the ditches were very poor.

As shown in the drawing on page , the reason why this project cannot be effective would be explained that even if many ditches are dug, there still remains areas of plot to plot irrigation because of their interval and no sub-ditches.

The topography of the proposed area of the projects are always very flat though each plot has some undulations.

In the case of sending irrigation water from a low plot to a high plot, deep standing water is required at the low plot, and this becomes one of the obstructive factors for irrigation.

Moreover, plots which have higher elevation than the elevation of the water level in the ditches would be left as unirrigable ones.

Such being the case, dike and ditch projects cannot achieve their purpose of developing terminal irrigation.

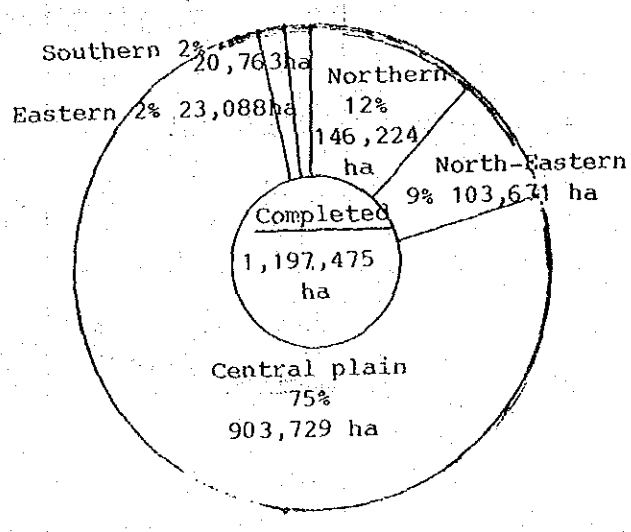
Secondly, 1 l/s/ha of the designed duty of the water was so little that it was not able to cover all command areas.

Thirdly, irrigation water hardly reaches the termination of the ditch because of the small section, the long length, the gentle slope, erosion and deposited soil by flowing water, the luxuriant growth of weeds, holes dug by crabs and rats and cracks occurring in the dry season.

Furthermore, bad maintenance is also one of the obstructive factors.

Taking these facts into account, in the existing circumstances the Land Consolidation project had been initiated in the areas where Dike and Ditch projects had already been constructed.

Dike and Ditch Project to the end of 1981



1. Constructed Dikes and Ditches Projects

No.	Project	Province	Construction year		Completed to the end of 1981	Under construction in 1982
			Started	Completed		
	Regional Irrigation Office I Chiang Mai					
1	Nam Yuam	Mae Hong Son	1979	1979	1,680	-
2	Mae Taeng	Chiang Mai	1966	1975	23,680	-
3	Mae Faek	Chiang Mai	1971	1972	11,200	-
4	Mae Ping Kao	Chiang Mai	1971	1976	7,184	-
5	Mae Kuang	Chiang Mai	1975	1977	9,600	-
	Total				53,344	-
	Regional Irrigation Office II Lampang					
1	Mae Lao	Chiang Mai	1968	1969	24,522	-
2	Mae Yom	Phrae	1966	1974	35,840	-
3	Mae Wang-Mae Pung	Lampang	1969	1975	13,464	-
4	Kiu Lom	Lampang	1976		5,814	1,280
	Total				79,640	1,280
	Regional Irrigation Office III Phitsanulok					
1	Phitsanulok	Phitsanulok	1976		13,240	7,953
	Total				13,240	7,953
	Regional Irrigation Office IV Khaon Kaen					
1	Nam Phong	Khon Kaen	1975		17,409	5,986
2	Huai Luang	Udon Thani	1979		4,240	1,600
	Total				21,649	7,586
	Regional Irrigation Office V Ubon Ratchathani					
1	Nam Un	Sakon Nakhon	1975		11,488	2,608
2	Nam Un Settlement	Sakon Nakhon	1979		1,600	-
3	Lam Pao	Kalasin	1975		19,579	2,209
4	Dom Noi	Ubon Ratchathani	1971		14,443	1,088
5	9 small tanks	-	1969	1973	15,552	-
	Total				62,662	5,905

No.	Project	Province	Constructed year		completed to the end of 1981	under construction in 1982
			Started	Completed		
	Regional Irrigation Office VI Nakhon Ratchasima					
1	Lam Phra Phloeng	Nakhon Ratchasima	1966	1967	10,080	-
2	Lam Takhong	Nakhon Ratchasima	1971	1972	7,040	1,545
3	Upper Lam Takhong	Nakhon Ratchasima			-	454
4	Huai Ta-lat Tank	Nakhon Ratchasima	1968	1971	2,240	-
	Total				19,360	1,999
	Regional Irrigation Office VII Chai Nat and VIII Ayutthaya					
1	Greater ChaoPhya Former Dike and Ditch		1961	1972	724,391	-
	Irrigation Improvement Project II					
(1)	Sam Chuk	Suphanburi Angthong	1978		-	-
(2)	Don Chedi	Suphan Buri	1979		1,536	-
(3)	Borommathat (Stage I)	Chainat Suphan Buri	1975	1979	-	-
(4)	Borommathat (Stage II)	Sing Buri	1978		819	-
(5)	Sappaya Multipurpose Cooperative[1] (Borommathat)	Chainat	1970	1978	-	-
(6)	Sappaya Irrigated Agricultural Development (Borommathat)	Chainat	1979		-	-
(7)	Channasut[2]	Sing Buri	1969	1972		-
(8)	Channasut (StageI)	Chainat	1974	1977		-
(9)	Channasut(StageII)	Ang Thong Ayutthaya	1978		3,709	720
(10)	Phra-non Chaksi[3] (Yang Mani)	Sing Buri	1975	1976	-	-
(11)	Manorom	Chainat Nakhon Sawan Sing Buri	1978		912	-

No.	Project	Province	Constructed year		completed to the end of 1981	under construction in 1982
			Started	Completed		
(12)	Khok Kra-thiam	Lop Buri Saraburi Ayutthaya	1979		736	3,108
	Total for Irrigation Improvement Project II				7,712	3,828
2	Bang Ban	Ayutthaya Ang Thong			-	5,264
3	Khao Kaeo	Nakhon Sawan	1971		6,080	-
4	Sao Hai	Saraburi-Ayutthaya	1981		2,240	3,680
5	Khlong Phrieo	Saraburi-Ayutthaya	1969	1971	14,704	-
	Total				23,024	8,944
	Regional Irrigation Office IX Chon Buri					
1	Nakhon Nayok	Nakhon Nayok	1970	1971	23,088	-
	Total				23,088	-
	Regional Irrigation Office X Kanchanaburi					
1	Greater MaeKlong	Kanchanaburi Ratchaburi Nakhon Pathom	1969		166,376	- -
2	Phetchaburi	Phetchaburi	1963	1968	52,800	-
3	Pran Buri	Prachuap Khiri Khan			-	3,024
	Total				219,176	3,024
	Regional Irrigation Office XII Songkhla					
1	Tha Chiat	Phatthalung	1969	1971	14,824	-
2	Phya Hong	Phatthalung	1971	1972	2,359	-
3	Khuan Kut	Phatthalung	1971	1971	3,580	-
	Total				20,763	-
	Grand Total				1,268,049	61,282

D. Land Consolidation in Thailand

1. Introduction

Land consolidation, or on-farm development, is an essential follow-up to the major irrigation and drainage works that have been constructed in several regions in the Kingdom of Thailand. Its objective is to improve the physical production conditions, with emphasis on water control, in order to reach the agriculture development objectives of increasing the wet season rice production, initiating or expanding dry season cultivation, and creating additional rural employment opportunities.

In Thailand the growth in agricultural output over the past 15-20 years is mainly the result of expansion of the cultivated area. This possibility, however, is running out very fast.

Therefore, a future growth in agricultural output and relief of the pressure on land will largely depend on an increase in agricultural production per unit area. This can be achieved by raising the rice yields during the wet season as well as by increasing cultivation during the dry season. The increase in production per unit area can only be realized by adapting the agricultural practices to modern techniques and production methods. A prerequisite for this adaptation is a thorough improvement of the overall technical infrastructure down to farm level. It is in the scope of this improvement, aiming at intensification of agriculture by eliminating technical constraint such as lack of water control, that land consolidation becomes relevant.

2. Definition of land consolidation

The term "Land consolidation" often gives rise to confusion. The most frequent misunderstanding is that fragmentation of farm holdings is the only, or the main reason, to carry out land consolidation. In Thailand, however, this is not the dominating reason for land consolidation.

As applied up to date in Thailand, particularly in the Northern Chao Phya Plain, land consolidation can be defined as an integrated, technical method of land development at inter farm and at farm level, with the emphasis on water control. It comprises the construction of a minor irrigation and drainage system and of net-work of farm roads,

a certain amount of land levelling and also a limited amount of reparcelling to reduce fragmentation caused by the system of water-course and farm roads. Fundamentally, however, the size of the individual farm holding is not changed.

Hence, land consolidation in Thailand can be characterized as a technical method aiming at a more efficient use of the available land and water resources down to the farm level.

3. History of land consolidation in Thailand

In order to investigate the technical and socio-econonic feasibility of land consolidation in Thailand, the Royal Thai Government in 1966 requested technical assistance form the Netherlands, where land consolidation works have long been carried out. Based on the promising results of these studies, the Royal Irrigation Department (RID) initiated in 1968 the first land consolidation pilot project in The Central Plain of Thailand, located in the Chanasutr Irrigation Project, Changwat Singburi, Amphoe Bang Rachan. The implementation started in 1969 in a sample area of approx. 200 ha, to study design alternatives and implementation possibilities.At the end of the 1972 dry season the whole area of 1,200 ha and an adjacent area covering 650 ha were successfully implemented.

In the meantime, in two other locations, land consolidation pilot projects were initiated, the Sappaya multipurpose co-operative in the Northern Chao Phya Area (1970) and a small area in the Nong Wai Pioneer Project in Northeast Thailand (1971)

Based on the encouraging results of the land consolidation pilot area in Chanasutr and on the favourable outcome of feasibility studies, the Royal Thai Government decided to continue the land consolidation programme on a large scale in the Northern Chao Phya Plain. Credit was obtained from the World Bank (IDA) to partly finance the Stage I of the Chao Phya Irrigated Agriculture Development Project (1973 - 1977). The target of this project was to implement about 16,000 ha in the Chanasutr and Boromdhart Irrigation projects. The implementation of this project included some rehabilitation works on the main irrigation and drainage system, the execution of land consolidation works, and the development and/or strengthening of the supporting agricultural services. In November 1977, Stage II of the Chao Phya Project has started. Under this project, for which credit was obtained from the IBRD.

In the mean time, the implementation of land consolidation works has also started in the framework of the IBRD-assisted Phitsanulok Irrigation Project, the ADB-assisted Nong Wai Pioneer Agriculture Project, and US-AID assisted the Lam Nam Oon Project.

4. Prospects of land consolidation in Thailand

From past experience it is clear that in areas where land consolidation works have been implemented, a major contribution has been made to the improvement of the physical, economical and social situation of the farmers in those areas and to the development of the areas as a whole. The Thai Government, by recognizing these facts, has made its policy to expand the implementation of land consolidation works in various parts of the country, as is clearly reflected in the five year plan of the Central Office of Land Consolidation as well as in the fourth National Economic and Social Development Plan for 1977-1981. Apart from the land consolidation works planned in the Chao Phya Projects in the Central Plain, in the Phitsanulok Irrigation Project in the North and in the Nong Wai Pioneer Project in the Northeast, several new projects are presently under preparation in which land consolidation works are part of the proposed technical measures. They are the Mae Wang Irrigation Project in the North.

One important thing, however, should not be overlooked. That is the need for proper organization and implementation of the operation and maintenance of the land consolidation schemes. This is a must if the systems are to function efficiently and if agriculture is to develop satisfactorily. Principally, the farmers themselves are responsible for operating and maintaining the land consolidation schemes; however, assistance and support from the Government, particularly RID, is required in teaching the farmers the proper O&M methods. It appears that a combination of responsibilities between the Government and farmer will be the most appropriate way to successful O&M standards. Presently the Government is preparing an Irrigation Water-Use Act. This Act will form the backbone of the enforcement of proper O&M rules and regulations which will contribute to the success of land consolidation schemes.

5. Legislation and organization

In September 1974 the Land Consolidation Act was officially

promulgated. With the enactment the provisional phase came to an end and a more permanent stage started. After the enactment of the Land Consolidation Act, the Central Committee on Land Consolidation was established and preparation are now on the way to set up Provincial Committees on Land Consolidation.

The Central Land Consolidation Office, which is established within the Ministry of Agriculture and Co-operatives performs duties assigned by the Central Committee. Moreover, the Central Office supervises the Provincial Land Consolidation Offices, which are being set up in each province where land consolidation is to be carried out.

A Royal Decree prescribes the area selected for land consolidation works: the Royal Decree is enacted when published in the Government Gazette. If the Central Land Consolidation Committee opines it necessary to find out from every owner whether or not be agreed with land consolidation, it can conduct an opinion pool. If, in such a case, a majority of over one-half of all the land owners agree, the land consolidation procedures can start or continue.

To integrate the contributions of the various departments each project has its own organization, often consisting of a project directorate, which include senior representatives of the various key departments, a project manager and several project officers to co-ordinate the activities of the departments concerned.

6. Objects of Land Consolidation in Thailand

Briefly stated, they are:

i) With irrigation and drainage facilities at the farm level established, every plot can be directly and timely irrigated and is directly drainable.

ii) With farm roads built along the irrigation ditches, every plot is directly accessible.
Consequently, both agricultural inputs and outputs can easily be transported.
Farm mechanization is also encouraged.

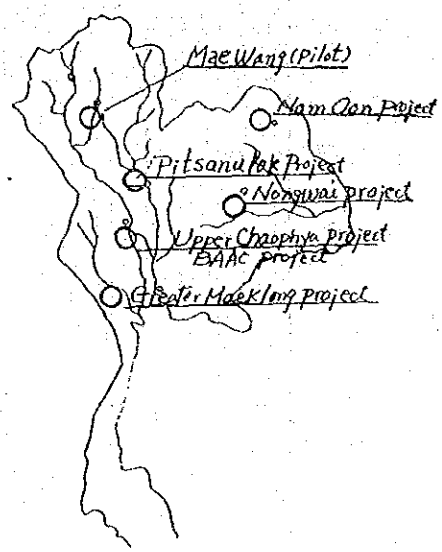
iii) The yield and cropping intensity have increased considerably, mainly due to double cropping, which results in a sharp increase in farmers' net income.

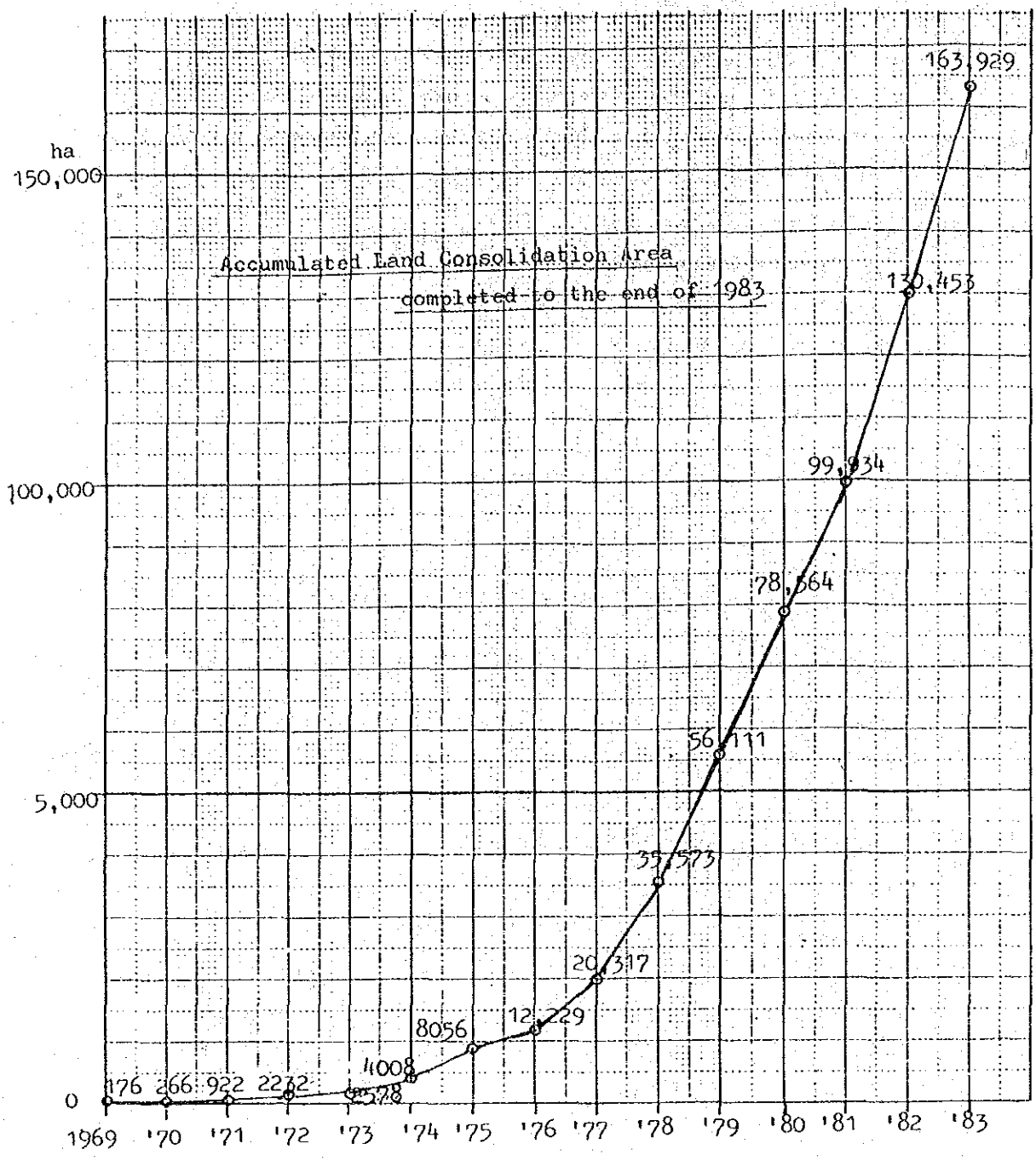
iv) Rural employment opportunities have highly increased even when farming practices are partly mechanized.
Apart from the farmers concerned, other occupational groups of the population in the implemented areas have also benefitted directly or indirectly from the project.

v) Socio-economic and living conditions in the implemented areas have greatly improved.

7. Implemented land consolidation area (ha)

No.	Project	Location	Area (ha)
1	Upper Chao Phya		86,457
	1.1 Pilot	Singburi	1,856
	1.2 Chao Phya Stage I	Singburi/ Chainat	15,391
	1.3 Chao Phya Stage II	Singburi Chainat Nakornsawan Lopburi Angthong Suphanburi Saraburi	63,019
	1.4 Sappaya Multipurpose Cooperative	Chainat	6,191
2	Nongwai Pioneer Agriculture	Khonkaen	11,037
3	Pitsanulok	Pitsanulok Pichit Nakornsawan	47,231
4	Nam Oon	Sakolnakorn	12,022
5	Mae Wang(Pilot Area)	Lampang	104
6	MaeKlong Irrigation Projects	Karnjanaburi	5,708
7	BAAC Project		1,191
8	King's project (Ayutthaya)		179
	Total area		163,929



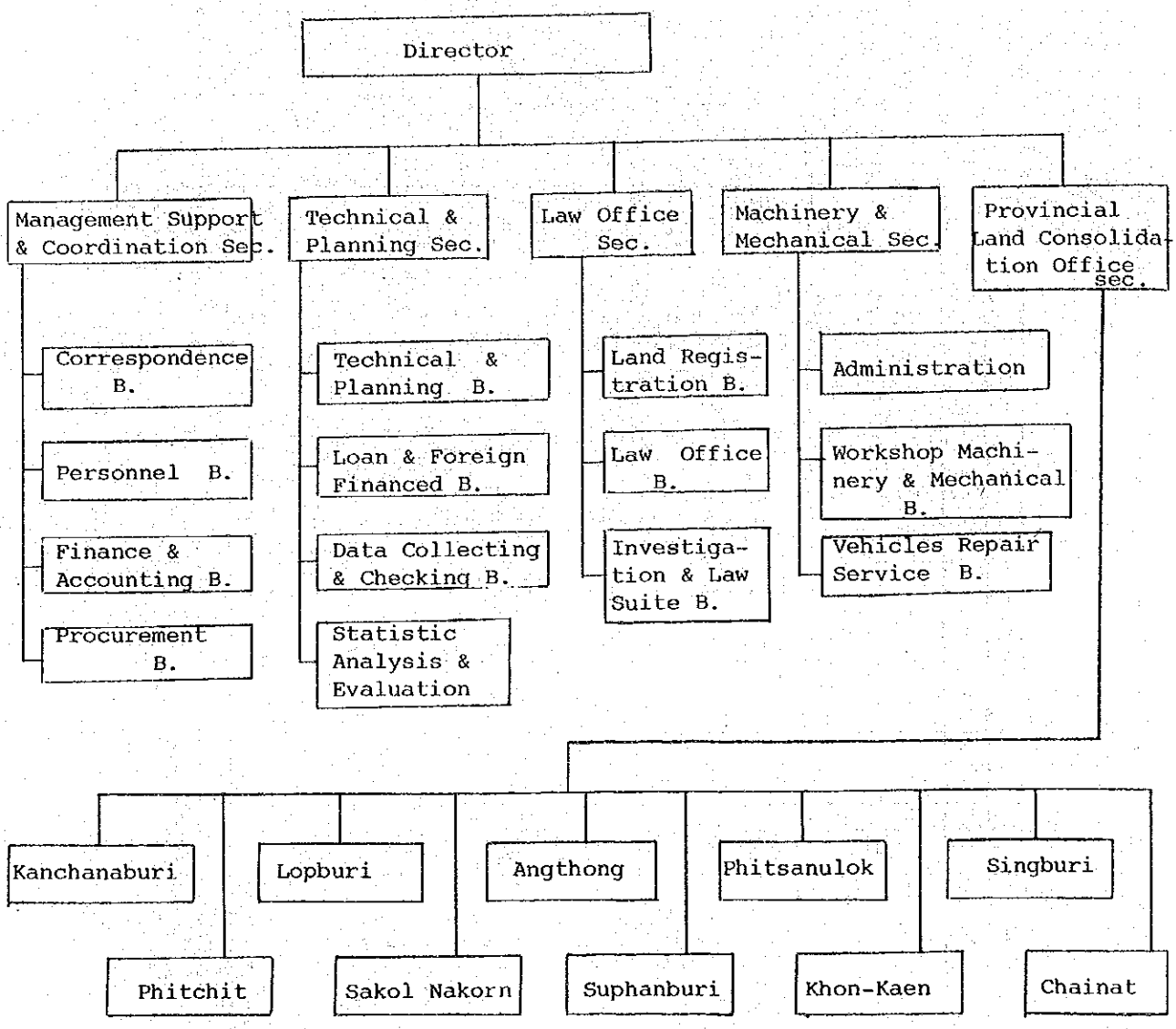

ha
150,000
100,000
5,000
0
Accumulated Land Consolidation Area
completed to the end of 1983
163,929
130,453
99,934
78,564
56,111
35,573
20,317
12,229
8056
4008
2578
2232
922
266
176
1969
'70
'71
'72
'73
'74
'75
'76
'77
'78
'79
'80
'81
'82
'83

Land Consolidation Works in Thailand since 1969 up to 1983 (6.25 rai = 1 ha)

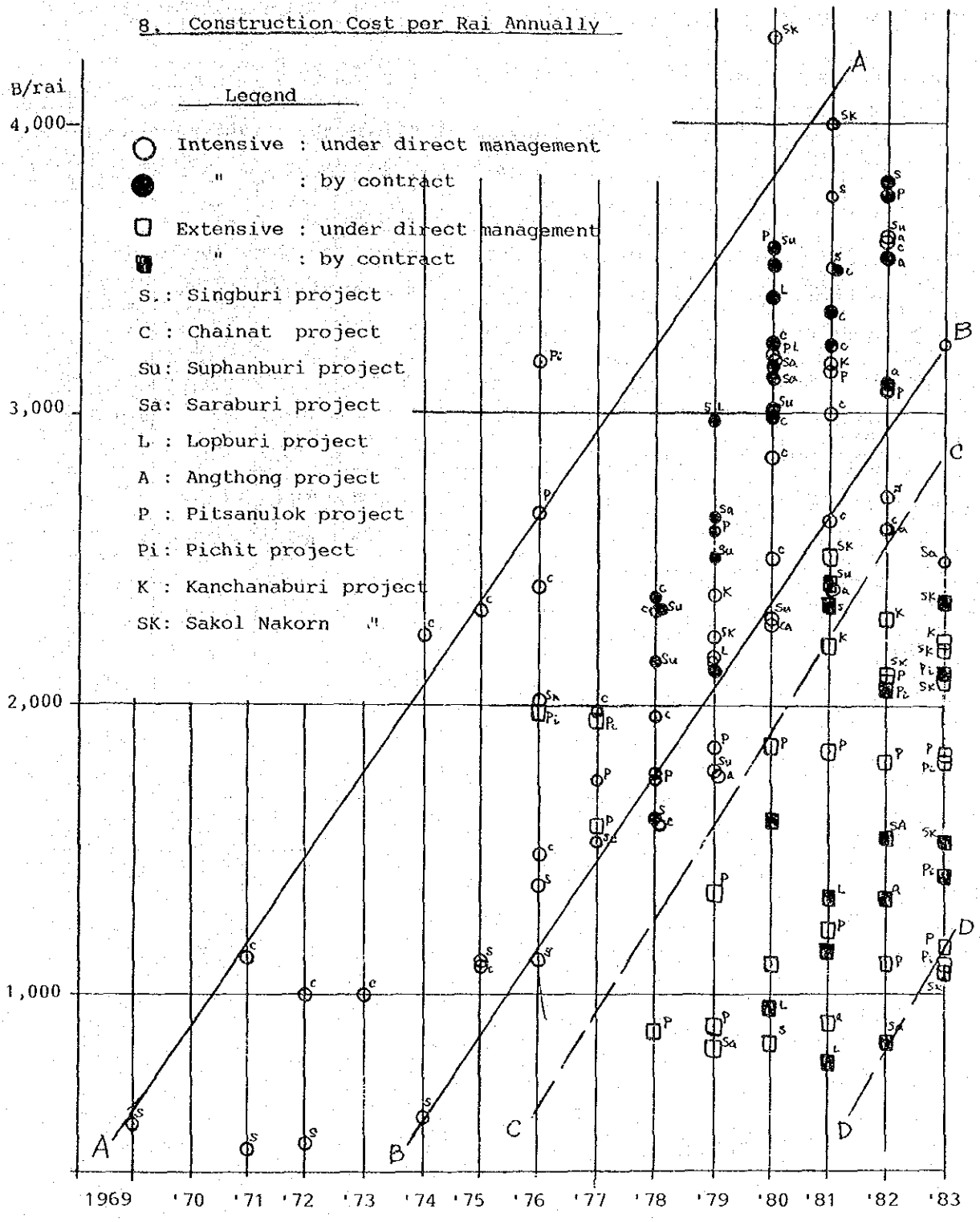
UNIT : Area (rai) ( ) Unit Cost ฿/rai

No.	Project	Location	Implemented Area in rai															Total
			Fy1969	Fy1970	Fy1971	Fy1972	Fy1973	Fy1974	Fy1975		Fy1976	Fy1977	Fy1978	Fy1979	Fy1980	Fy1981	Fy1982	Fy1983	
1	Upper Chao Phya																		
	1.1 Pilot	Singburi	1,100 (535)	-	3,329 (465)	7,189 (438)	-	-	-		-	-	-	-	-	-	-	-	11,600
	1.2 Chao Phya Stage I	Singburi Chainat	-	-	-	-	-	7,600 (978)	21,900 (1,089)		15,558 (1,460)	39,380 (1,500)	11,755 (1,972)	-	-	-	-	-	96,193
	1.3 Chao Phya Stage II	Singburi Chainat Nakornsawan Lopburi Angthong Suphunburi Saraburi	-	-	-	-	-	-	-		-	-	42,157 (1,972)	92,495 (2,090)	83,558 (2,509)	79,465 (2,718)	91,283 (3,079)	-	393,868
	1.4 Sappaye Multipurpose Cooperative	Chainat	-	-	773 (1,720)	1,018 (1,000)	2,164 (1,000)	1,337 (2,244)	3,400 (2,324)		3,480 (2,400)	5,174 (1,993)	1,888 (2,300)	3,352 (2,278)	3,228 (2,500)	3,588 (3,000)	4,738 (3,600)	5,700	38,596
2	Nongwai Pioneer Agriculture	Khonkaen	-	568	-	-	-	-	-		980 (2,113)	-	14,040 (2,352)	5,808 (1,198)	15,628 (3,703)	14,886 (2,528)	12,073 (2,103)	-	68,983
3	Pitsanulok	Pitsanulok Pichit Nakornsawan	-	-	-	-	-	-	-	In. Ex.	4,400 (2,796) (1,896)	6,000 (2,619) (1,986)	18,613 (1,750) (1,179)	26,643 (2,141) (1,202)	35,274 (3,493) (1,632)	25,834 (3,150) (1,690)	61,165 (3,374) (1,751)	117,267 (3,150) (1,488)	295,196
4	Nam Oon	Sakolnakorn	-	-	-	-	-	-	-		1,000	-	-	1,169 (2,940)	985 (4,717)	5,059 (3,287)	8,555 (2,076)	58,377	75,136
5	Mae Wang (Pilot Area)	Lampang	-	-	-	-	-	-	-		-	-	650 (2,068)	-	-	-	-	-	650
6	Maeklong irrigation Projects	karnjanaburi	-	-	-	-	-	-	-		-	-	-	231 (2,341)	330 (3,200)	3,129 (3,364)	4,785 (4,511)	26,750 (2,924)	35,675
7	BAAC Project		-	-	-	-	-	-	-		1,700 (1,088)	-	-	-	938 (2,850)	1,648 (3,750)	3,157 (3,800)	-	7,443
8	King's project (Ayuddhaya)		-	-	-	-	-	-	-		-	-	-	-	-	-	-	1,119 (6,141) (2,326)	1,119
	Total Area		1,100	568	4,093	8,190	2,164	8,937	25,300		26,078	50,554	89,103	134,608	140,333	133,562	190,756	209,213	1,024,559
	Accumulated Area		1,100	1,668	5,761	13,951	16,115	25,052	50,352		76,430	126,984	216,087	350,695	491,028	624,590	815,346	1,024,559	

Organization of Central Land Consolidation Office



8. Construction Cost per Rai Annually



Some comments on unit construction cost per rai of land consolidation

The following things can be said from the previous graph:

i) Group of the unit construction cost (U.C.) of the intensive development and Group of the U.C. of the extensive development can be clearly separated by the line of B.

ii) In the intensive development, difference between the value of the Supremum and the lowest limit by year is approximately ฿ 1,500 and about ฿ 280 is going up every year.

iii) Among the group of the U.C. of the intensive development, the U.C. by contract basis always occupy high position though, among the group of the extensive development they mix together.

iv) The U.C. of force account does not include the depreciation cost and regular maintenance cost of construction machines, the U.C. of contract, however, includes them.

Cost of Land consolidation work at Singburi Province

Item	Project	Year	(rai)		Kind of construction work (rai)		Cost of work (baht)	Cost per rai baht/rai	Remark
			Intensive	Extensive	Contracted work	Self-working			
1	Chanasoot	1969	1,100	-	-	1,100	588,500	535	Pilot area
2	"	1971	3,320	-	-	3,320	1,543,800	465	Pilot area
3	"	1972	7,180	-	-	7,180	3,503,840	488	Pilot area
4	"	1974	7,600	-	-	7,600	4,392,800	578	Chao Phya Project at 1st period
5	"	1975	14,800	-	-	14,800	16,250,400	1,098	"
6	"	1976	7,300	-	-	7,300	10,658,000	1,460	"
7	Yangmanee	1976	1,700	-	-	1,700	1,849,600	1,088	Voluhteer Project
8	Chanasoot	1977	17,680	-	-	17,680	26,520,000	1,500	Chao Phya Project at 1st period
9	"	1978	6,200	-	6,200	-	9,920,000	1,600	Chao Phya Project at 2nd period
10	"	1979	4,450	-	4,450	-	11,747,518	2,640	"
11	"	1979	4,760	-	4,760	-	14,132,770	2,969	"
12	"	1979	-	2,150	-	2,150	1,720,000	800	"
13	"	1979	-	1,240	-	1,240	992,000	800	Some parts of the area 13,430 rai remain at Angthong Province 12,190 rai.
14	Boromthat	1980	4,320	-	-	4,320	9,936,000	2,300	Some parts of the area 7,850 rai remain at Chainat Province 3,530 rai.
15	Boromthat	1980	-	2,680	-	2,680	2,278,000	850	
16	Manorom	1981	-	1,000	1,000	-	1,161,338	1,161	Some parts of the area 5,700 rai remain at Chainat Province 4,700 rai
17	Chanasoot	1981	1,648	-	-	1,648	6,180,000	3,750	Volunteer Project
18	Boromthat	1981	7,040	-	7,040	-	24,640,000	3,500	Some parts of area 11,240 rai remain at Chainau Province 3,240 rai
19	Boromthat	1981	-	960	960	-	2,258,150	2,352	Some parts of the area 11,240 rai remain at Chainat Province 3,240 rai
20	Chanasoot	1982	9,560	-	-	9,560	25,856,000	2,705	
21	Yangmanee	1982	960	-	960	-	3,648,000	3,800	Volunteer Project
		Total	99,618	8,030	25,370	82,278	179,776,716		

Lopburi Province

Item	Project	Year	(rai)		(rai) Kind of construction work		Cost of work (baht)	Cost per rai baht/rai	Remark
			Intensive	Extensive	Contracted work	Self-work			
1	Kokkratien	1979	7,900	-	7,900	-	23,192,900	2,936	
2	"	1980	8,350	-	8,350	-	28,999,250	3,399	
3	"	1980	-	4,800	4,800	-	4,535,014	945	
4	"	1981	1,640	-	1,640	-	5,166,061	3,150	Some parts of area 6,030 rai remain at Saraburi 4,390 rai
5	"	1981	-	6,500	6,500	-	5,023,012	773	
6	"	1981	-	2,573	2,573	-	3,391,996	1,318	Some parts of area 4,923 rai remain at Saraburi 2,350 rai
		Total	18,070	13,873	31,943	-	70,311,233		

Item	Project	Year	(rai)		Kind of construction work (rai)		Cost of work (baht)	Cost per rai baht/rai	Remark
			Intensive	Extensive	Contracted work	Self-working			
1	Sanpaya	1971	773	-	-	773	865,760	1,120	
2	"	1972	1,010	-	-	1,010	1,010,000	1,000	
3	"	1973	2,164	-	-	2,164	2,164,000	1,000	
4	"	1974	1,337	-	-	1,337	3,000,228	2,244	
5	"	1975	3,400	-	-	3,400	7,901,600	2,324	
6	Boromthat	1975	7,100	-	-	7,100	7,731,900	1,089	Chao Phya Project at 1st period
7	"	1976	8,258	-	-	8,258	12,056,680	1,460	
8	Sanpanya	1976	2,440	-	-	2,440	5,856,000	2,400	
9	"	1977	5,174	-	-	5,174	10,311,782	1,993	
10	Manarom	1977	21,700	-	-	21,700	32,550,000	1,500	Chao Phya Project at 1st period
11	"	1978	10,008	-	10,008	-	23,508,290	2,349	Chao Phya Project at 2st period
12	Boromthat	1978	1,800	-	-	1,800	2,880,000	1,600	"
13	"	1978	10,689	-	-	10,689	17,102,400	1,600	"
14	Sanpaya	1978	1,888	-	-	1,888	4,342,400	2,300	
15	Boromthat	1978	11,755	-	-	11,755	23,180,860	1,972	Chao Phya Project at 1st period
16	"	1979	1,800	-	-	1,800	3,150,000	1,750	Chao Phya Project at 2rd period
17	"	1979	7,680	-	-	7,680	13,440,000	1,750	"
18	Manarom	1979	6,400	-	6,400	7,680	13,440,000	1,750	"
19	"	1979	13,300	-	13,300	-	28,008,398	2,106	
20	Sanpaya	1979	3,352	-	-	3,352	7,635,856	2,278	
21	Sanpaya	1980	3,220	-	-	3,220	11,270,000	2,500	
22	Manorom	1980	3390	-		3,390	7,797,000	2,300	
23	Manorom	1980	11,970	-	11,970	-	38,658,256	3,229	
24	Boromthat	1980	7,800	-	7,800	-	23,287,356	2,985	
25	"	1980	3,530	-	-	3,530	8,119,000	2,300	Some parts of area 7,850 rai remain at Singburi Province 4,320 rai
26	Boromthat	1980	938	-	-	938	2,682,680	2,860	Volunteer Project
27	Manarom	1981	9,780	-	9,780	-	32,763,716	3,350	
28	Manarom	1981	7,600	-	7,600	-	24,562,460	3,232	
29	Manarom	1981	- -	4,700	4,700	-	5,458,290	1,161	Some parts of area 5,700 rai remain 1,000 rai at Singburi Province
30	Boromthat	1981	3,240	-	3,240	-	11,340,000	3,500	from the area 11,240 rai, the remaining at Singburi Province is 8,000 rai
31	Boromthat	1981	-	1,480	-	1,480	1,332,000	900	
32	Boromthat	1981	4,900	-	-	4,900	12,874,000	2,627	
33	Sanpaya	1981	3,500	-	-	3,500	10,500,000	3,000	
34	Sanpaya	1982	4,738	-	-	4,738	17,056,800	3,600	
35	Manorom	1982	4,338	-	-	4,338	11,278,800	2,606	
36	Manorom	1982	6,300	-	6,300	-	28,377,252	4,504	
37	Manorom	1982	8,962	-	8,962	-	39,552,704	4,504	
38	Sanpaya	1983	5700	-	-	5,700	18,240,000	3,200	
		Total	211,934	6,180	91,060	127,054	526,851,085		

Item	Project	Year	(rai)		(rai) Kind of construction work		Cost of work (baht)	Cost per rai baht/rai	Remark
			Intensive	Extensive	Contracted work	Self-working			
1	Samchuk	1978	4,600	-	4,600	-	10,741,000	2,335	Chao Phya Project at 2nd period
2	"	1978	8,860	-	8,860	-	18,977,497	2,142	"
3	Donjaedee	1979	4,300	-	-	4,300	7,525,000	1,750	"
4	Samchuk	1979	8,830	-	8,830	-	22,047,878	2,497	"
5	"	1979	4,450	-	4,450	-	11,323,536	2,544	"
6	"	1979	3,320	-	3,320	-	8,462,389	2,549	"
7	"	1980	5,700	-	-	5,700	13,110,000	2,300	"
8	"	1980	2,380	-	2,380	-	8,102,799	3,524	"
9	"	1980	7,800	-	7,800	-	23,494,514	3,012	"
10	Donjaedee	1980	5,450	-	-	5,450	12,535,000	2,300	"
11	"	1980	2,468	-	-	2,468	5,676,400	2,300	"
12	"	1980	-	9,600	9,600	-	15,370,732	1,601	"
13	"	1981	2,120	-	-	2,120	5,086,000	2,400	"
14	Samchuk	1981	8,015	-	-	8,015	19,236,000	2,400	"
15	"	1981	600	-	-	600	1,440,000	2,400	"
16	"	1982	1,500	-	1,500	-	6,366,133	4,244	"
17	"	1982	12,200	-	12,200	-	44,154,980	3,619	"
		Total	82,593	9,600	63,540	28,653	233,651,858		

Item	Project	Year	(rai)		(rai) Kind of construction work		Cost of work (baht)	Cost per rai baht/rai	Remark
			Intensive	Extensive	Contracted work	Self-working			
1	Kokkratiem	1981	4,390	-	4,390	-	13,828,663	3,150	Some parts of area 6,030 rai remain at Lopburi Province 1,640 rai
2	"	1981	11,400	-	11,400	-	35,508,932	3,122	
3	"	1982	-	2,350	2,350	-	3,098,014	1,318	Some parts of area 4,923 rai remain at Lopburi Province 2,573 rai
4	"	1982	-	8,000	8,000	-	6,806,810	815	
5	"	1982	7,240	-	7,240	-	32,870,982	4,540	
		total	23,030	10,350	33,380	-	92,113,401	-	
					Pilot area at Lampang Province				
1	Mae-Wang	1978	650	-	650	-	1,344,200	2,068	
					Ayudhaya Project according to the Royal's opinion				
1		1983	1,191	-	1,191	-	2,772,315	2,477	Cost of Land Consolidation work
						-	3,160,185	2,824	Cost of dike construction
						-	940,000	840	Cost of installation pump

Anthong province

Item	Project	Year	(rai)		Kind of construction work (rai)		Cost of work (baht)	Cost per rai baht/rai	Remark
			Intensive	Extensive	Contracted work	Self-working			
1	Chanasoot	1979	-	12,190	-	12,190	9,752,000	800	Some parts of area 13,430 rai remain at Singburi Province 1,240
2	"	1979	6,440	-	6,440	-	17,118,894	2,658	
3	"	1979	3,495	-	-	3,495	6,116,250	1,750	
4	"	1979	1,300	-	-	1,300	2,275,000	1,750	
5	"	1979	-	3,400	-	3,400	2,720,000	800	
6	"	1980	3,140	-	-	3,140	7,222,000	2,300	
7	"	1981	6,400	-	-	6,400	15,360,000	2,400	
8	"	1981	-	4,200		4,200	3,780,000	900	
9	"	1982	4,960	-	-	4,960	12,896,000	2,600	
10	"	1982	9,300	-	9,300	-	36,917,880	3,970	
11	"	1982	3,000	-	3,000	-	10,500,000	3,500	
12	"	1982	-	4,500	4,500	-	13,988,168	3,100	
13	"	1982	2,197	-	2,197	-	7,359,950	3,350	Volunteer Project
		Total	40,232	24,290	25,437	39,085	146,006,142	-	

Pitsanulok Province

Item	Project	Year	(rai)			Kind of construction work (rai)		Cost of work (baht)	Cost per rai baht/rai	Remark
			Intensive	Extensive		Contracted work	Self working			
				Type 1	Type 2					
1	Pitsanulok	1976	2,400	-	-	-	2,400	6,286,330	2,619	
2	"	1977	2,500	-	-	-	2,500	4,313,000	1,725	
3	"	1977	-	2,000	-	-	2,000	3,100,000	1,550	
4	"	1978	4,467	-	-	-	4,467	7,817,250	1,750	
5	"	1978	-	10,481	-	-	10,481	13,488,940	1,573	
6	"	1978	-	-	3,665	-	3,665	3,188,550	870	
7	"	1979	4,422	-	-	-	4,422	8,048,040	1,820	
8	"	1979	3,142	-	-	3,124	-	8,109,800	2,596	
9	"	1979	-	13,195	-	-	13,195	17,681,300	1,340	
10	"	1979	-	-	5,902	-	5,902	5,273,000	893	
11	"	1980	2,546	-	-	-	2,546	8,123,391	3,191	
12	"	1980	9,418	-	-	9,418	-	33,669,776	3,575	
13	"	1980	-	16,906	-	-	16,906	31,084,708	1,839	
14	"	1980	-	-	6,404	-	6,404	7,105,801	1,109	
15	"	1981	4,035	-	-	-	4,035	12,710,800	3,150	
16	"	1981	-	17,225	-	-	17,225	31,755,000	1,843	
17	"	1981	-	-	4,574	-	4,574	5,078,030	1,110	
18	"	1982	6,597	-	-	-	6,597	20,409,420	3,094	
19	"	1982	4,650	-	-	4,650	-	17,537,180	3,771	
20	"	1982	-	20,456	-	-	20,456	36,845,690	1,801	
21	"	1982	-	2,027	-	2,027	-	4,197,917	2,071	
22	Pitsanulok	1982	-	-	8,493	-	8,493	9,300,510	1,095	
23	"	1982	-	-	717	717	-	1,111,350	1,550	
24	"	1983	8,463	-	-	-	8,463	26,658,540	3,150	
25	"	1983	-	6,766	-	-	6,766	12,415,610	1,835	
26	"	1983	-	-	3,308	-	3,308	3,688,420	1,115	
		Total	52,622	89,056	33,063	19,936	154,805	338,990,353		

Pichit Province

Item	Project	Year	(rai)			Kind of construction work (rai)		Cost of work (baht)	Cost per rai Baht/rai	Remark
			Intensive	Extensive Type 1	Extensive Type 2	Contracted work	Self working			
1	Pitsanulok	1976	1,100	-	-	-	1,100	3,550,200	3,182	
2	"	1976	-	900	-	-	900	1,787,400	1,986	
3	"	1977	-	1,500	-	-	1,500	2,974,000	1,986	
4	"	1982	-	14,747	-	14,747	-	30,541,037	2,071	
5	"	1982	-	-	3,478	3,478	-	5,390,900	1,550	
6	"	1983	-	29,468	-	-	29,468	54,073,780	1,835	
7	"	1983	-	36,976	-	36,976	-	74,469,664	2,104	
8	"	1983	-	-	22,038	-	22,038	24,572,370	1,115	
9	"	1983	-	-	10,248	10,248	-	14,429,184	1,408	
		Total	1,100	83,591	35,764	65,449	55,006	211,793,535		

Cost of Land Consolidation work at Karnjanaburi

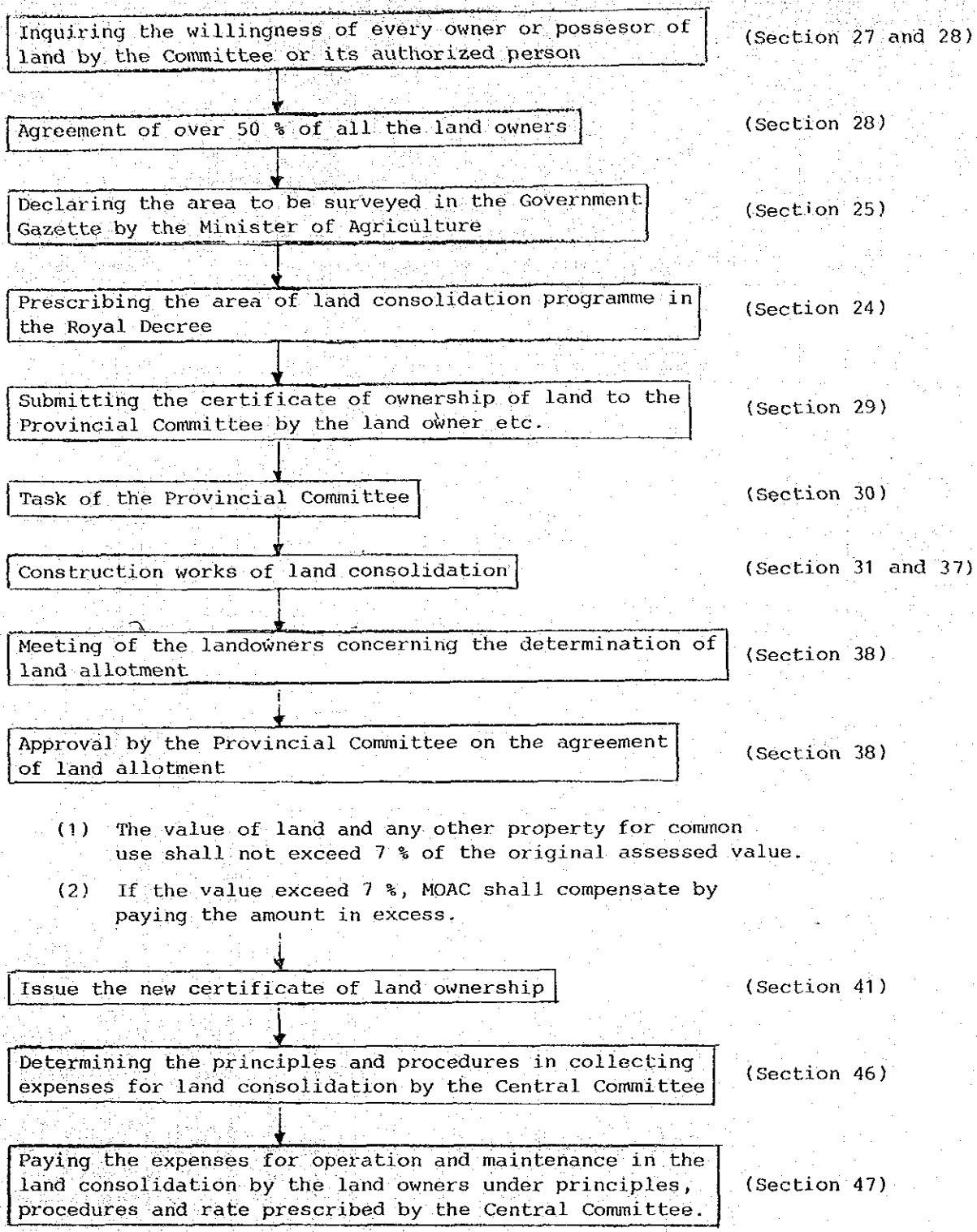
Item	Project	Year	(rai)		Kind of construction work (rai)		Cost of work (baht)	Cost per rai (baht/rai)	Remark
			Intensive	Extensive	Contracted work	Self working			
1.	Grate MaeKlong	1979	231	-	-	231	549,780	2,380	
2.	Grate MaeKlong	1980	730	-	-	730	2,336,000	3,200	
3.	Grate MaeKlong	1981	1,539	-	-	1,539	4,880,300	3,171.08	
4.	Grate MaeKlong	1981	-	440	-	440	968,100	2,200.23	
5.	Grate MaeKlong	1981	-	1,200	1,200	-	4,844,500	4,037.08	
6.	Grate MaeKlong	1982	-	1,560	-	1,560	3,588,000	2,300	
7.	Grate MaeKlong	1982	-	3,225	-	3,225	10,800,000 (7,200,000)	5,581.4	
8.	Grate MaeKlong	1983	-	20,100	20,100	-			
9.	Grate MaeKLong	1983	-	6,650	6,650	-	7,364,493 (7,364,493)	2,215	
		Total	2,500	33,175	27,950				

Cost of Land Consolidation work at Sakol Nakorn

Item	Project	Year	(rai)		Kind of construction work (rai)		Cost of work (baht)	Cost per rai (baht/rai)	Remark
			Intensive	Extensive	Contracted work	Self working			
1.	Nam Oon	1976	1,000	-	-	1,000	2,000,000	2,000	Unit 6 (First example plot) using the budget of ditches at Khonkaen
2.	Nam Oon	1979	1,169	-	-	1,169	2,688,000	2,299	Unit12 (Third example plot)
3.	Nam Oon	1980	985	-	-	985	4,245,350	4,310	Unit12 (Third example plot) added
4.	Nam Oon	1981	2,650	-	-	2,650	10,600,000	4,000	Unit13 Plot PA-3A
5.	Nam Oon	1981	-	2,400	-	2,400	6,000,000	2,500	Unit20 (Second example plot)
6.	Nam Oon	1982	-	8,555	-	8,555	17,934,000	2,096	Unit15 5,173rai and unit17 3,382 rai
7.	Nam Oon	1983	2,710	-	2,710	-	11,972,062	4,417	Unit 11
8.	Nam Oon	1983	-	5,775	-	5,775	12,127,500	2,100	Unit 1
9.	Nam Oon	1983	-	6,401	-	6,401	13,442,100	2,100	Unit 2
10.	Nam Oon	1983	-	15,910	15,910	-	17,849,634	1,122	Unit 4
11.	Nam Oon	1983	-	13,400	-	-	15,446,808	1,153	Unit 10
12.	Nam Oon	1983	-	8,073	8,073	-	19,086,180	2,364	Unit 16
13.	Nam Oon	1983	-	6,108	6,108	-	9,313,759	1,525	Unit 18
		Total	8,514	66,622	-	-	142,705,393	-	-

9. The Land Consolidation Procedure

9.1 By the Agriculture Land Consolidation Act



9.2 Detailed Implementation Process (from Mr.Paitoon Palayasoot)

1. Topographical and Cadastral Surveys

First, detailed topographical and cadastral surveys are carried out. These surveys are based on rectified aerial photographs enlarged to a scale 1:4,000. The topographical survey is based on a 40 x 40 m. grid system; the contour lines are drawn 0.25 m. apart on a map derived from the aerial photographs. The cadastral data are supplied by the local cadastral office and by the land owners themselves and recorded on the aerial photographs.

2. Land Classification Survey

Apart from the topographical and cadastral situation the reparcelling plan is based on the suitability of the land for cropping. It is aimed at interchanging pieces of land of the same suitability class between land owners.

3. Preliminary Plan

Based on the topographical, cadastral and soil suitability surveys and on specific design criteria, a preliminary land consolidation plan is designed, showing the irrigation ditches and drains, the farm roads and the provisional rearrangements of the plots.

4. Consultation with Farmer's Land Owners

The meetings with farmers are conducted in several phases. Before the actual survey started, meetings are arranged with all participating land owners to inform them of the plan and seek their co-operation. After the completion of the surveys and the preliminary land consolidation plan, the details of the plan are discussed at length with the farmers. The farmer's requests are incorporated in the plan as far as possible and the thus revised preliminary plan is, in principle approved of. Then work on the final plan begins. When it is completed, the plan is again submitted to the land owners for their comments and final decision.

5. Definite Plan and Agreement

The definite plan for land consolidation shows the lay-out of the irrigation ditches, drains, farm roads and structures and the final lay-out of the new plot boundaries. The required new field levels are calculated during the construction in the field based on 20 x 20 m. grid survey.

Up to the enactment of the Land Consolidation Act, a special agreement was prepared, specifying the procedures followed and the conditions met for the

realization of the plan. Each land owner signed the agreement if he agreed with the proposed measures.

6. Implementation

The Royal Irrigation Department starts the implementation of the works only after the Land Department has staked out the centre lines of roads and water-courses. The centre lines have to be determined very accurately with a view to their importance for a proper realignment of the new farm boundaries.

Most of the earth moving is done by bulldozers, track types as well as rubber wheel types, ranging from 140-170 HP. The area is first cleared of trees, bushes and ant-hills. Land levelling starts after the new farm boundaries have been stake-out, the level of the cleared land is surveyed in a 20 x 20 m. grid system and the new levels are calculated and staked out. The rough levelling by the bulldozers is often followed by a final smoothing of the field by a motograder. The average earth movement amounts to about 300 m^3/ha. over an average distance of 60 m.

The farm roads are designed to run alongside the irrigation ditches and the earth road body is, therefore, constructed simultaneously with these ditch bodies. The construction at present is being done with motorscrapers, of which most units are of the self-loading type. The fast moving motorscrapers haul soil from high spots and alongside drains to spread it over the road bodies under construction. Water is spread regularly over the earth bodies to assure a good compaction of the soil.

Irrigation ditches and drains are mainly excavated by hydraulic backhoes.

Finally, the various structures such as inlet, check and drop structures, division boxes and culverts are constructed on site and the new plots are returned to the farmers.

Operation and Maintenance at the Farm Level (from Mr. Paitoon Palayasoot)

It would be beyond the scope of this article to discuss the entire operation and maintenance in detail, but the operation and maintenance in the Chanasutr Land Consolidation area will be presented in the following sections.

The responsibility for an efficient operation and a proper upkeep of the major irrigation and drainage works rests with RID. The farmers themselves are responsible for operating and maintaining the system within the service units. This does not mean that RID and the farmers work independently. On the contrary,

without a proper co-operation and co-ordination between the management of the major systems and the farmers, an efficient operation would be impossible.

The operation of the irrigation and drainage systems includes three aspects, namely information, allocation of irrigation water and regulation of supply. Throughout the year, information on irrigation water demand and supply is required. Based on this information water allocation schedules are prepared. Regulation of the supply entails regulating of the gated and controlling of the water levels as well as supervising of the distribution of the irrigation water supply within the service units.

The Chanasutr Irrigation project is headed by a project engineer who is assisted by two watermasters. A watermaster is in charge of a region and supervises a number of zonemen and gate tenders. A zoneman supervises the irrigation in a zone of approximately 1,600 ha. The gate tenders are in charge of a structure, e.g. one of the headworks, a cross regulator or an offtake regulator.

Common irrigators supervise the operation and maintenance of the irrigation and drainage system in the service units. In the land consolidation areas implemented to date, the common irrigators have been chosen by the farmers. They are, however, still paid by RID. In the future, they are to be paid by and responsible to some type of water users' association.

The distribution of irrigation water is based on a rotational system. To this end, a rotation schedule is prepared in such a way that the farmers receive water at regular intervals, proportionally to the area of their cultivated land.

Maintenance of the land consolidation works is just as important to the project as operation. Maintenance should keep the system in the conditions as indicated in the design. Maintenance has to be carried out very regularly and should be checked by surveys.

RID is responsible for the maintenance of the main system, while the farmers themselves are, and should be, responsible for carrying out the maintenance activities in the service units. RID will only advise the farmers and assist them in staking out canal sections and repairing structures.

10. Intensive and Extensive Land Consolidation compared

Items	Intensive Land Consolidation	Extensive Land Consolidation
General	i) As with land readjustment and disposition of substitute land, precise guidelines leading to an optimal design of an On-farm system lay-out can be given. ii) An on-farm system lay-out is rational and corresponds to the purposes of land consolidation such as farming mechanization, grouping of farmland, logical water management and so on. iii) Since converted land can be shared by all participants, unfairness can be avoided.	i) No precise quidelines leading to an optimal design of an on-farm system lay-out can be given. ii) The relative importance of these considerations may differ according to the specific conditions in a certain area and the designer's own opinion/preference. iii) Land loss of individual plots must be born by its landowner; unfairness cannot be avoided.
Design	i) As mentioned above, Normalization of design techniques is available. ii) Surface soil treatment should be considered and examined from every angle. iii) Considering soil property, longitudinal slope, length, etc. lined-ditches should be adopted. Most of the existing problems in the land consolidation areas would be solved by adopting lined-ditches. iv) Considering trafficability in the rainy season, pavements for farm roads should be constructed. v) Refer to the report entitled "Study matters on Land Consolidation".	i) As mentioned above, Normalization of design techniques is impossible because of various conditions. However, the criteria and considerations taken into account in designing the on-farm lay-out can be described as follows: ii) Direct access to the ditches, the drainage system and to the road network is provided for approximately 100 per cent of the plots. iii) The alignments follow the plot bounderies. iv) Land loss of individual plots should preferably not exceed 7 percent (Land Consolidation Act Section 39). v) Narrow strips of land, not individually owned by the farmers are as much as possible used for the construction of the on-farm system.

Items	Intensive Land Consolidation	Extensive Land Consolidation
		vi) Ditches and drains located parallel to each other, without a farm road or existing road in between, are avoided. vii) Alignments passing housing areas/ villages are avoided. viii) The number of ditch-drain crossings are kept to a minimum. ix) The number of highway crossings are kept to a minimum. x) Preferable number of owners per service unit : 20-30. xi) Size of the service units preferable size = 25～50 ha minimum size = 17 ha maximum size = 70 ha xii) Length of the ditch: as far as my experience has shown me, preferably not exceeding 1,000 m, in the case of a length of run of more than 400 m an additional ditch with or without farm road and drain is provided intersecting the plot. xiii) Ditches pass over high grounds. xiv) Ditch alignments passing areas out of command are avoided as far as possible. xv) Plots are preferably not served by two different ditch systems. xvi) In the case of a ditch with a farm road, the ditch is located on the side of the road with the minimum number of entrance culverts: in the case of a ditch parallel to an existing road, the ditch is located on the side which gives the minimum number of farm

Items	Intensive Land Consolidation	Extensive Land Consolidation
		inlets crossing the existing road xvii) Field ditches are used for areas with very small plots to connect these plots to the ditch. The maximal areas served by a field ditch is 15 rai. xviii) Feeder ditches are preferably located in the right of way of canals and drains and in the narrow strip of land not individually owned by the farmers, irrigation of individual plots direct from feeder ditches is avoided. ixx) The number of the farmer inlets correspond to the scheme of farm water management. Drainage ditches i) Drain alignments follow low-lying areas. ii) The drain system should clearly delineate the service unit areas. iii) Existing borrow pits of main and Secondary canals can be used as tertiary drains. iv) In the case of high spoil banks along the secondary or main drains, tertiary drains are consturcted parallel to the banks on the side of plots. v) Maximal command area of the drains is approximately 120 ha, which is equal to a drain capacity of 635 l/sec (in this case, unit area drainage discharge is estimated using 10 year-probable rainfall of maximum 5 days-continuous rainfall of 190 mm and 3 ~ 4 days draining, capacity of 46 mm/day).

Items	Intensive Land Consolidation	Extensive Land Consolidation
		vi) In consideration of much leakage of water through the levees along the drainage ditch, farm outlets should be constructed.
Construction	Of problems concerning ground levelling works, land levelling works account for the most of the problems. Refer to the report entitled "Study Matters on Land Consolidation". i) Skilled operators are required for ground levelling works and land levelling works.	i) In this development method, since readjustment of arable land is not being conducted, the speed of construction execution is faster than in the intensive methods. ii) Skilled operators are required only for digging the ditches and drainage ditches.
Water management	As with readjustment of arable land, water management can easily be conducted. Refer to another chapter entitled "Farm Water Management".	Water managment programs seem to be like a train timetable and it is very difficult for water users to follow the program because of no plot-re-allotment. Refer to another chapter entitled "Farm Water Management".
Farming mechaniza-tion	This development method is possible to cope with future farming mechanization.	Some problems remain to cope with the future farming mechanization : On-farm system lay-out : plot size
Government policy	Unacceptable as of 1984.	At first, the intensive development method was adopted though, in 1981 the Government policy changed from intensive to extensive because of the area to be implemented and the budget.
Unit construction costs	As of 1983, unit construction costs were approximately ฿ 4,000. (See page)	As of 1983, unit construction costs have been approximately ฿ 2,000. (See page)

E. Operation and Maintenance fees (O&M fees) in completed land consolidation areas

The Thai Government imposes duty upon the landowners or recipients of rights to the land in completed land consolidation areas to pay O&M fees

The duty is prescribed by the Land Consolidation Act. The O&M fees are collected by the Agricultural Cooperatives and spent in accordance with the stipulations of the said cooperatives.

Kind of Development methods	O&M fees
Intensive	(1.6 ~ 1.8 persons)/rai x wage/day
Extensive	(1.35 ~ 1.6 persons)/rai x wage/day

Consideration of the O&M fees in the land consolidation areas are as follows:

1. Kinds of expense

i) Administration fee of Irrigation and Drainage ditches and other on-farm facilities.

ii) O&M fees

: Irrigation ditches

: Drainage ditches

: Farm roads

: Other on-farm facilities for common use.

2. Efficiency per unit work of O&M work

i) Regarding the main irrigation facilities administered by the O&M office of RID and the On-farm facilities administered by the Agricultural cooperatives; the main administrative per person is 400 ~ 500 rai (64 ha ~ 80 ha).

ii) Repairing and maintenance work

- Weed Control

Weed control in the irrigation ditches : 2 times/year

Farm roads : 1 time/year

and in this case, efficiency per unit work is about 267 m^2/day.

Irrigation ditches	0.028 persons/m	(35 m/1 person)
Drainage ditches	0.0165 "	(60 m/1 person)
Farm roads	0.0075 "	(133 m/1 person)

- Excavation of ditches

  Excavation of irrigation and drainage ditches : 3 m^2/1 person

  Excavation of irrigation ditches : 2 times/year

  (before irrigation in rainy season and dry season)

  Excavation of drainage ditches : 1 time/year.

Irrigation ditches	0.028 person/m	(35 m/1 person)
Drainage ditches	0.0167 "	(60 m/1 person)

- Farm roads repairs

  Farm roads repairs : 0.033 persons/m (30 m/1 person)

- Other facilities requiring repairs

  1 % / year of construction costs

3. Density of irrigation ditches, drainage ditches and other facilities

Kinds	Irrigation ditch (m/rai)	Drainage ditches (m/rai)	Farm roads (m/rai)	Other facilities (place/rai)
Intensive	7.89	6.60	7.62	0.176
Extensive	6.30	4.95	5.20	0.100

4. Table of efficiency per unit work

Kind of work	Intensive			Extensive			Remarks
	Quantity	man/m	man/rai	Quantity	man/m	man/rai	
O&M works	-	-	0.500	-	-	0.500	500 ฿/12 months
Repair and Maintenance							
Excavation	M/rai			M/rai			
- Irrigation ditches	7.89	0.028	0.221	6.30	0.028	0.176	
- Drainage ditches	6.60	0.0167	0.110	4.95	0.0167	0.083	
Weed control							
- Irrigation ditches	7.89	0.028	0.221	6.30	0.028	0.176	
- Drainage ditches	6.60	0.0165	0.109	4.95	0.0165	0.082	
- Farm roads	7.62	0.0075	0.057	5.20	0.0075	0.039	
Farm road repairs	7.62	0.033	0.252	5.20	0.033	0.172	
Total			1.469			1.228	
Co-operation administrative fee			0.100			0.100	
Grand Total			1.569			1.328	

5. Operation and Maintenance Fee from the farmers who have paddy fields within the on-farm development project area

man/rai	Baht/day					
	25	30	35	40	45	50
1.35	33.75	40.50	47.25	54.00	60.75	67.50
1.40	35.00	42.00	49.00	56.00	63.00	70.00
1.45	36.25	43.50	50.75	58.00	65.25	72.50
1.50	37.50	45.00	52.50	60.00	67.50	75.00
1.55	38.75	46.50	54.25	62.00	69.75	77.50
1.60	40.00	48.00	56.00	64.00	72.00	80.00
1.65	41.25	49.50	57.75	66.00	74.25	82.50
1.70	42.50	51.00	59.50	68.00	76.50	85.00
1.75	43.75	52.50	61.25	70.00	78.75	87.50
1.80	45.00	54.00	63.00	72.00	81.00	90.00

F. Repayment of the project cost of Land Consolidation

Regarding this matter, the Land Consolidation Act prescribes as follows:

SECTION 46. The Central Land Consolidation Committee shall determine the principles and procedures in collecting expenses for the consolidation of land in the area of land consolidation programmes from the owners of the land or the recipients of rights to the land as follows:

(1) All the expenses for the construction of irrigation and drainage systems, the construction of roads and paths of conveyance in the farms and public utilities for the common use of owners of the land or the recipients of rights to the land, shall be collected from the owners or the recipients of the rights to the land to assist in the defrayment of expenses which the government has paid in accordance with the rate which the Central Land Consolidation Committee prescribes from the actual expenses, whereby the owner or recipient of rights to the land shall pay the same in yearly installments of not less than ten per cent of the amount and the first installment shall be due in the third year from the year of completion in accordance with the land consolidation programme at the latest. The government shall assist with such expenses at not less than ten per cent.

(2) All expenses in levelling and grading of land and other activities of the land of the owner or recipient of rights to the land, in the event the authority undertakes the same, the owner or the recipient of rights to the land shall repay at the rate prescribed by the Central Land Consolidation Committee from actual expenses whereby the owner of the land or the recipient of rights to the land shall repay in installments the same as in (1)

In case of necessity, the Central Land Consolidation Committee shall consider reducing the amount of money or extending the period of repayment under (1) and (2) as it deems appropriate.

As reference data concerning this matter, the author would like to insert the Minute of the Sub-Committee meeting of the Central Land Consolidation Committee held on Oct.25, 1983.

1. The result of the study on means of repayment of the land consolidation project

A representative official from the Office of Agricultural Economics reported:

An object of the study as to amortisation that farmers must pay back for the land consolidation project is to set them a suitable and fair rate of repayment.

The Land Consolidation Act imposes a duty upon farmers to pay back the decided amortisation after the completion of the project.

At present, the net family income is used in order to consider the farmers' solvency regarding this matter and the said income is calculated from the net agricultural income which is produced from inplemented paddy fields minus living expenses. The net agricultural income is estimated by calculating the value of products using the Linear Programing Model.

Study data can be obtained using the daily farming allowance of farmers through the cropping year in each project.

After calculating the extent of the repayment rate, sensible analysis is undertaken in the case of there being some changes concerning factors in order to make the result of analysis more suitable and fair.

Normally, this analysis follows the suggestion of the World Bank, viz, the repayment rate should be about 50 % of the construction cost and the term of repayment should be 15 years with a 2 year period of deferment and with a 12 % interest rate.

The repayment rate per rai (0.16 ha) per year is calculated using the value of multiply the balance of the grand total of the construction cost and the subsidy by the Government by the Capital recovery factor which is in the standard table of the Economics Development Institute, World Bank.

The way of repayment is classified as follows:

(1) Repaying at one time.

(2) Repaying in installments without compound interest over a two year period of deferment.

(3) Repaying in installments with compound interest over a 15 year term of repayment.

In the study using the analysis method, in many projects such as the ChaoPhya Project, the Pitsanulok Project and the Nongwai Project, it was found that the results from the analysis revealed almost the same trends, namely, the net agricultural income of small scale farming farmhouses is higher than that of middle scale and large scale farming farmhouses.

It can be said that when the real expenses for livelihood are subtracted, the difference of amortisation expands and when the real production cost is subtracted, it becomes narrow. The repayment rate differs at each project depending on the objective sum of repayment influenced by the state liability.

Farmers in the project area ought to pay not only their amortisation but also water charges and operation and maintenance fees in proportion to the area of their own land. In connection with this matter, the result of the study showed that farmers in the Northern district and Central district are able to pay for them, but farmers in the Northeastern project area can not.

The projects which have already been studied by the Office of Agricultural Economics are:

(1) Intensive land consolidation project in upper ChaoPhya irrigation area, stage I.

(2) Intensive land consolidation project (Type-A) and extensive land consolidation project (Type-B,-C) in Pitsanulok irrigation area.

(3) Intensive land consolidation project in Nong Wai irrigation area

Project (1) and (2) receive the loan from the World Bank and Project (3) from the Asian Development Bank.

2. How to collect amortisation at the ChaoPhya Land Consolidation Project stage-2, the Pitsanulok Project and the Nong Wai Project

The Land Consolidation Project in the Pitsanulok irrigation area is divided into 2 types, intensive (Type A) and extensive (Type B and C). There is only intensive land consolidation in the Nong Wai Project.

1) Intensive Pitsanulok Project (Type A)

(1) The extent of amortisation for land consolidation project

In the case of the planted area in the dry season being 70 % of the planted area in the rainy season, the details are as follows:

฿/rai

Items	Real data 1/ 1977/78	Result of the analysis 2/	
		Case 1 3/	Case 2 4/
Net agricultural income	(88%) 900	1,206	1,120
Other net income	(12%) 123	-	-
Plus Family income	(100%) 1,023	1,206	1,120
Minus Family expenses	843	725 5/	725 5/
Grand total Net family income	180	481	395
Minus Repayment rate when government supports 50% of all the expenses	207	207	207
Grand total Savings	-27	274	188
Minus Repayment rate when government supports 10% of the public benefit expenses	384	384	384
Grand total Savings	-204	110	11

Remark

1/ In the year 1977/78 the rate of planted area is W:D = 100:39

2/ Result of the analysis when planted area is W:D = 100:70

3/ The Net family income in the case that product, quantity and price changing after the initial study were not taken into consideration

4/ Net family income when product quantity falls 5%

5/ Family expenses without the expenses of foodstuffs

(2) Repayment rate

a. According to the suggestion of the World Bank, the repayment rate of land consolidation is 50% of the real expenses. The interest rate is 12%. The term of repayment is 15 years with a two year period of deferment.

b. According to the policy, the government shall support 10% of the public benefit expenses. The interest rate is 12 %. Repayment within 15 years and a two year period of deferment.

Baht/rai

Percentage of support money	To all the expenses (Suggestion of World Bank)			To public benefit expenses (plotted policy)		
	Government pay	Farmers pay	Money rate (12% 15 years)	Gov. pay	Farmers pay	Money rate (12% 15 years)
10	281.10	2,529.90	372	199.60	2,611.40	384
20	562.20	2,248.80	331	399.20	2,411.80	355
30	843.30	1,967.70	289	598.80	2,212.20	325
40	1,124.40	1,686.60	248	798.40	2,012.60	296
50	1,405.50	1,405.50	207	998.00	1,813.00	266
60	1,686.60	1,124.40	165	1,197.60	1,613.40	237
70	1,967.70	843.30	124	1,397.20	1,413.80	208
80	2,248.80	562.20	83	1,596.80	1,214.20	178
90	2,529.90	281.10	41	1,796.40	1,014.60	149

2) Intensive Nong Wai Project

(1) The extent in paying back the money

In the case of the planted area in the dry season being 70% of the planted area of the rainy season according to the limit of water delivery of the project as in the following details:

Baht/rai

Items	Real data		Result of the analysis 5/	
	1979/80	1980/81 1/	Average of 2/ all 3 sizes	Average only M and L 3/
	(41)	(24)		
Net agricultural income	731	458	1,301	1,263
	(57)	(76)		
Other income	1,043	1,487	-	-
	(100)	(100)		
Plus Family income	1,774	1,945	1,301	1,263
Minus Family expenses	1,820	1,849	1,151 4/	938 4/
Grand total Net family income	-46	96	150	325
Minus Repayment rate when government supports 50% of all expenses	248	248	248	248
Grand total Savings	-294	-152	-90	77
Minus Repayment rate when Government supports 90% of public benefit expenses	215	215	215	215
Grand total savings	-261	-119	-65	110

Remark

1/ In 1980/81 Planted area : W:D = 96:49 damage caused by heavy flood.

2/ Average net income-small scale farming farmhouses which is in deficit because they have a small farm.Each family has 6.98 rai.

3/ Average net income of middle and large scal farming farmhouses.

4/ Family expenses excluding expenses for foodstuffs.

5/ The net family income in the case of the product, quantity and price changing after the initial study were not taken into consideration.

(2) Repayment rate

a. According to the suggestion of the World Bank, amortisation of land consolidation is 50% of the real expenses. Interest rate is 12 %. Term of repayment is 15 years with two year period of deferment.

b. According to the policy, the government shall support 90% of the public benefit expenses. Interest rate is 12%. Term of repayment is 20 years with five years' period of deferment.

Details are as follows:

Baht/rai

Percentage of support money	To all the expenses (Suggestion of World Bank)			To public benefit expenses (plotted policy)		
	Government pay	Farmers pay	Money rate (12%15years)	Government pay	Farmers pay	Money rate 12%20years)
10	337.40	3,036.60	446	196.80	3,177.20	426
20	674.80	2,699.20	397	393.60	2,980.40	399
30	1,012.20	2,361.80	347	590.40	2,783.60	373
40	1,349.60	2,024.40	298	787.20	2,586.80	347
50	1,687.00	1,687.00	248	984.00	2,390.00	320
60	2,024.40	1,349.60	198	1,180.80	2,193.20	294
70	2,361.80	1,012.20	149	1,377.60	1,996.40	268
80	2,699.20	674.80	99	1,574.40	1,799.60	241
90	3,036.60	339.40	50	1,771.20	1,602.80	215

3) Extensive Pitsanulok Project (Type B&C)

(1) The extent of amortisation for land consolidation

Planted area in dry season is 50% of planted area of rainy season. Details are as follows:

Baht/rai

Items	Type B			Type C		
	Real data 1/	Result of analysis 2/		Real data 1/	Result of analysis 2/	
		Case 1 3/	Case2 4/		Case1 3	Case 2 5/
Net agricultural income	(71) 799	1,102	1,007	(61) 555	952	821
Other net imcome	(29) 319	-	-	(39) 355	-	-
Plus Family income	1,118	1,102	1,007	910	952	821
Minus Family expenses		732 6/	732 6/	767	548 6/	548 6/
Grand total Net family income	207	370	275	143	404	273
Minus Repayment rate when gov. supports 50% of all expenses	132	132	132	80	80	80
Grand total Savings	75	238	143	63	324	193
Minus Repayment rate when gov. supports 10% of all expenses	238	238	238	44	144	144
Grand total Savings	-31	132	37	-1	260	129

Remarks

1/ In 1980/81 the rate of planted area : W:D of type B = 97:36 type C = 94:38

2/ Result of analysis when planted area : W:D = 100:50

3/ Net family income in the case of changing prices, quantity of products, and price of products does not change after being studied.

4/ Net family income in the case that the quantity of the products decreases by 5% variable cost and the price of the products does not change after being studied.

5/ Net family income in the case that quantity of products decreases by 5%, variable cost increases 10% but price of products does not change after being studied.

6/ Family expenses excluding expenses for foodstuffs because they were seperated in the model.

(2) Repayment rate

a. According to the suggestion of the World Bank, amortisation of land consolidation is 50% of the real expenses. The interest rate is 12%. The term of repayment is 15 years with a 2 year period of deferment.

b. According to the plotted policy, the government shall support 10% of public benefit expenses. The interest rate is 12%. The repayment within 15 years with a 2 year period of deferment.

Details are as follows:

Baht/rai

Percentage of support money	Type B			Type C		
	Government pay	Farmers pay	Money rate (12%15years)	Government pay	Farmers pay	Money rate (12%15years)
10 (policy)	180	1,620	238	109.10	981.90	144
20	360	1,440	212	218.20	872.80	128
30	540	1,260	185	327.30	763.70	112
40	720	1,080	159	436.40	654.60	96
50 (World Bank)	900	900	132	545.50	545.50	80

G. Farmer's Land Consolidation Project Financed by the Bank for Agriculture and Agriculture Cooperatives (BAAC)

1. Preface

The Government of Thailand has been making desperate efforts to expand the land consolidation project, though the results fell short of its expectation because of budget shortage and vast irrigable areas.

On the other hand, farmers' demands are increasing year by year. In order to meet the farmers' request, the Government undertook another land consolidation project, the so-called BAAC Project in 1978 at Amphoe Bangrachan, Singburi Province and at Amphoe Sankaburi, Chainat Province. Concerning this project, the Central Land Consolidation Committee established regulations as follows:

i) The Central Land Consolidation Office shall consider with the Provincial Governments, the Amphoe and other agencies concerned when necessity arises.

ii) The Government will give necessary support to farmers, eg., mapping, designing, cost estimation, making the contract documents, supervising and inspecting the work without any farmers' imposition.

iii) The land owners must pay by themselves for the construction cost and BAAC will help the land owners by giving them the long term loan.

iv) The construction work shall be conducted on contract basis.

v) Committees will be organized in provincial levels and they are in charge of the projects.

2. Working procedures

In starting the project, the following steps must be taken into account:

i) Submitting the request by the farmers.
The land owners must submit their request concerning this matter to the provincial Land Consolidation Office (PLCO) or contact the Division of Personnel or BAAC in the province.

ii) The PLCO will meet with the agencies concerned to examine the farmers' request in the provincial level.

iii) The PLCO will collect the necessary data to make the proposal to the CLCO for consideration.

iv) Officials of the PLCO and of other agencies concerned will have conferences with the land owners about the working steps.

If there are no problems, representatives of the land owners in the area must be chosen in order to work with the officials concerned as controllers and members of the inspection committee.

v) Officials concerned must collect and check the necessary data for design and cost estimation.

vi) The PLCO will propose design work to the committee and will set up a sub-committee to work together.

vii) The PLCO will prepare some documents for everyone who wants to join in the project in order to announce that the area has been prescribed for land consolidation according to the Land Consolidation Act, section 24 and 25.

viii) The BAAC will prepare the documents of giving the loan money for farmers as well as the loan contract.

ix) The sub-committee which the PLCO had set up will work with the representatives of the land owners to work out about hiring a contractor.

x) When the construction work starts, technical members in the sub-committee will inspect the work and make some reports concerning construction work to send to the Committee. BAAC will pay some of the construction price to the contractor according to the progress of work in each period.

3. The obligation of agencies concerned

1. PLCO and CLCO bear the following obligations:

- Assuming the leadership of farmers who join in the Project.
- Cooperating with agencies concerned.
- Considering the possibility of Land Consolidation work according to the farmers' request.
- Collecting physical data for the design work of Land Consolidation.
- Designing and evaluating the proposed Land Consolidation work.
- Declaring the Project area as Land Consolidation area according to the Land Consolidation Act.
- Inspecting the construction work.

2. RID and Provincial Land Consolidation will work together concerning the following:

- Considering the possibilities of Land Consolidation.
- Collecting physical data for consideration in design of construction work.
- Inspecting the construction work.

3. Department of Land has the following duties:
   - Making cadastral survey and cadastral maps.
   - Staking out of plot boundaries.
   - Issuing the document to show the right of ownership of the area when completed.

4. BAAC gives the services about loan money to farmers who join in the project.

4. Loan for land consolidation

1. Services the loan money for the participants.
2. The area to be consolidated should not be less than 300 rai.
3. The status of the people who want to get the loan must be that they are the owners of the land or tenants in the project area.
4. The subjects of loan.
   - for payment in agricultural product.
   - for purchase and maintenance of engines.
   - for Land Consolidation work.
   - for payment of debt (which will be considered suitably)
5. Loan for Land Consolidation will be considered for each farmer, but loan for other objectives will be considered according to the need.
6. Rate of interests on the loan will follow the regulation of BAAC.
7. Terms of Debt payment
   - Short-term-loan for usual production must be returned when growing season is finished, which is not more than 12 months, in special case not more than 18 months.
   - Medium-term-loan for agriculture assets (except the land consolidation work) such as, purchasing animals for farming, equipment, etc, must be returned within 3 years, in special case not later than 5 years.
   - Long-term-loan for agricultural development which includes Agricultural property and Land Consolidation, the period of the return of loan will be considered suitably for not over 15 years and grace period for not over 5 years.

- Long-term-loan for payment of past debt is limited to be paid within 10 years, in special case not over 12 years.

8. Security of the loan

- Short-term-loan for Agricultural product for one growing season is given for not more than 30,000 ฿ for each participant. Debtors must take responsibilities together. If the loan is more than 30,000 ฿, the land must be mortgaged.
- Medium-term-loan for agricultural assets (except Land Consolidation) is given to each participant as not more than 30,000 ฿, 2 BAAC customers must stand as grarantors for the farmers who want to raise a loan. If more than 30,000 ฿, the land must be mortgaged.
- Long-term-loan for Agriculture Development and Land Consolidation in each Project will be considered concerning the following matters:
  - mortgage
  - grarantors
  - debtors take responsibilities together.

5. Activities for construction work

BAAC Project started at Singburi. The farmers and the land owners donated money for land levelling payment in the area so that the government has managed to construct the irrigation ditches, drainage ditches and the roads. The owners also have helped by getting loan money from BAAC for land levelling. And agencies concerned helped the farmers in design work. At first, land levelling in the BAAC Project was carried out in Tambol Chaksri, Amphoe Muang, Singburi Province. Land levelling area was about 2,000 rai in 1978 and the cost was 500 ฿/rai by contract.

Progress of the BAAC Projects of land consolidation can be described as follows:

In 1980 BAAC land consolidation project constructed at Moo 5,6, Tambol Bangkud, Amphoe Sankaburi, Chainat Province.

- Working area : 938 rai
- Farmers who joined the project : 126 persons
- Cost of construction : about 2,674,000 ฿ (or 2,680 ฿/rai)
- By the above mentioned amount of money, 94 farmers who are the owners of the land raised a loan from BAAC for about 2,390,000 ฿. For the rest of the money, farmers didn't have to raise a loan from BAAC because they had their own money for payment.

For the return of the loan, the owners of the land which were less than 7 rai didn't have to pay the principal of the loan within 1 year but they had to return all the money within 10 years. For the owners of the land which was more than 7 rai, they had to return the loan within 7 years, including the period of one year that they didn't have to pay for the principal of the loan.

In 1981 Land Consolidation construction in the district of Moo 1,2 and 8, Tambol Sing, Amphoe Bangrachan, Singburi Province.

- Working area : about 1,682 rai
- Farmers who joined in the project : 142 persons.
- The return of the loan.
  - :- one who owns the land of 5 rai must return the money to the bank within 14 years.
  - :- one who owns the land of more than 10 rai must return the money within 8 years. Including the one-year period when farmers didn't have to pay for the principal of the loan.

In 1982 Land Consolidation construction in two areas:

Moo1, Tambol Jaksi, Amphoe Muang, Singburi Province

- Working area : about 960 rai
- Farmers who joined in the project : 77 persons
- Total cost of construction was about 3,683,900 ฿ or about 3,800 ฿/rai
- 58 owners of the land raised a loan of 2,905,373 ฿ from BAAC.

Moo 7 Tambol Sawengha, Amphoe Sawengha, Angthong Province

- Working area is about 2,197 rai
- Farmers who joined in the project : 244 persons
- Total cost of the construction was about 7,317,906 ฿/rai.
- 190 owners of the farm raised a loan of 7,289,099 ฿ from BAAC.

The return of the loan of this two districts are as follows:

- 1 year free from debt
- Debt charges 13 % interest per annum
- Owners of the land not more than 5 rai must pay the money back within 14 years.
- Owners of the land which is between 5-10 rai must pay the money back to the bank within 10 years.
- Owners of the land over 10 rai must return the loan within 8 years.
- In the year that farmers get low products, BAAC will give one year grace period.

Land Consolidation as BAAC Project in 5 plans which were already finished were about 7,777 rai. The total cost of construction was about 20.7 million baht.

The farmers also got more interested in Land Consolidation as BAAC project, in which the government has already got the preliminary request from them. Working area are about 57,348 rai which are in Singburi, Chainat, Suphanburi, Angthong, Nakorn Pathom, Prajeub Kirikan, Kanchanaburi, Ayuddhaya and Nakorn Srithammarat.

6. Direct advantages which the farmers who join in the project will get

Except from the normal advantages from Land Consolidation as BAAC Project, there are more advantages for the farmers as we can conclude as follows:

1. Cost of Land Consolidation work/rai is cheaper than the cost in the following year. In the case of Government's management, the government has to collect the money from farmers.
2. Before the Land Consolidation, farmers gained 35 tang/rai/year of products from the land but after the Land Consolidation, their products has been increasing. In 5 years, it will be a big amount of money. The sooner they consolidate their land, the more benefits they will get.
3. Farmers can watch over and gain their own benefit.
4. Farmers' cooperation with the work is good for the government because it is easier for the government to consolidate the land in order to increase the amount of agricultural products and farmers' income according to the government's policy. Moreover, this is a good sign that shows primary cooperation which will be good in other cases:
   - Water using, it will eliminate the problems of water shortage and will establish good understanding between farmers.
   - Repair of roads, drainage ditches, drainage and irrigation buildings which the farmers joined together in building.
   - Organizing the agricultural cooperatives, land consolidation and etc.