สำนักงานวิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

# Chapter 3
# The Study Site

## 3.1 Northeast Region / Khon Kaen Province

Thailand can be divided into seven physiographical regions, namely Central plain, Southern coast, Northeast plateau, Central highlands, North and west continental highlands and peninsular Thailand. Khon Kaen province, where the study site is located, belongs to the Northeast plateau. Its physiographical characteristics are described as follows:

> The undulating or rolling landforms in the northeast plateau comprise of several small watersheds which drain into two principal rivers, the Chi and Mun, flowing into the Mekong River. The physiographic pattern of high plateau is typical in this region (Aekaraj, 1997).

The Northeast region has the total river basin area of about 168,846 $km^2$ with an average annual run-off volume of 434,969 million $m^3$/year(Aekaraj, 1997). Among those river basins, the watershed of the Phong River almost covers the entire Khon Kaen province (USAID, 1993).

The average annual rainfall in the Northeast region for the 30 years, between 1966 and 1996 was 1,384.2 mm of average annual rainfall, which actually exceeds the figures for the Central and North region. However, the rainfall distribution in the Northeast region is rather uneven, and reservoir storage in the region is not sufficient to store enough water to cover local demand, which causes water shortage within the region during the dry season (Aekaraj, 1997). Therefore, despite the fact that the annual rainfall is not less than that of the Central and North regions, the Northeast region suffers from water shortages, and it is increasingly difficult to meet growing demand for water. In every basin of the Northeast region, there are competing water uses among agriculture, energy, municipal and industrial development, tourism and fresh water fish production (USAID, 1993).

The largest dam in the Northeast is the Ubol Ratana dam. The Ubol Ratana dam is a multipurpose dam that regulates the flow of the Phong River through Khon Kaen province, built in 1967 by the Electricity Generating Authority of Thailand. The reservoir is 2,025 MCM, and the hydro generating capacity of the dam is 25 MW. The dam discharges 50,000 to 4,200,000 $m^3$ daily and an average of 1.77 BCM per

year (USAID, 1993).

Large-scale irrigation projects in the Northeast are less efficient compared to those in the Central region due to more difficult soil and topographic conditions (Plusquellec and Wickham, 1985). During the 1950s and 1960s, in the Northeast region, the RID built more than 200 small to medium sized irrigation projects which ranged from 2,000 to 3,000 rai in service area size (USAID, 1993).

One major irrigation project implemented in the Northeast region is the Small Scale Irrigation Programme (SSIP). SSIP was initiated by the Royal Irrigation Department in 1977. The programme aims to provide small scale irrigation to those areas which did not benefit from large scale and medium scale irrigation systems (Saito, 1997).

The SSIP had five following objectives:
1. Rainy season agricultural production;
2. Supply of water all year around;
3. Water supply for livestock;
4. Dry season production for household consumption; and
5. Water supply for aquaculture (World Management Association, 1992).

The Northeast Small Scale Irrigation Project (NESSI) was another major irrigation project implemented in the Northeast to rehabilitate seven medium scale irrigation systems in the region and develop a model for improving agricultural productivity at other medium and small scale irrigation sites in Northeast. The project was initiated by the Royal Thai Government and USAID in 1980 for a period of five years and targeted approximately 30,000 poor farmers in seven provinces in the region, namely Mahasarakham, Roi Et, Kalasin, Mukdaharn, Ubon Ratchatani, Buri Ram and Nakorn Ratchasima (Johnson, et al. 1989).

The project consisted of the following components.
1. Rehabilitation of existing main and lateral canals to recover their serviceability. Construction of main ditches and farm ditches to ensure equitable water distribution to individual farm plots;
2. Improvement of water distribution efficiency by adopting rotational delivery method;
3. Adoption of a participatory maintenance approach whereby RID is responsible for the main system maintenance while the water users groups are responsible for the on-farm system maintenance;
4. Agricultural extension services to increase agricultural productivity;
5. Credits provided by the Bank of Agriculture and Agricultural Cooperatives (BAAC); and
6. Marketing and agricultural production inputs (Team Consulting Engineers, 1989).

There were two consecutive projects aiming to enhance farmers' participation in O&M of irrigation systems in the Northeast. The first project, the Small Scale

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Irrigation Systems Project (SSIS), was implemented from 1985 to 1987 targeting 18 projects in four provinces in the Northeast. namely Khon Kaen, Mahasarakham, Roi Et and Chaiyaphum. Under the project, Water Resource and Environment Institute (WREI) and Rural Development Institute (RDI) of Khon Kaen University carried out research to fulfil the following two objectives.

1. To look for appropriate methods for practical widespread implementation of small scale irrigation projects for government agencies such that use, operation and maintenance are voluntarily carried out by farmers; and
2. To experiment with the role of community organisers in small scale irrigation project development activities (WREI and RDI, 1987).

The Farmer Participation in Small Scale Irrigation Project (FPSS) was implemented as a follow up to SSIS. The project aimed to enhance farmers' participation in management of small scale irrigation systems in the Northeast by introducing community organisers hired and supervised by RID. The project was implemented by WREI and RDI from 1990 to 1992. The project improved both farmers' participation in irrigation management and understanding among RID officials about farmers' participation (WREI and RDI, 1989, 1993).

In addition to SSIP, NESSI and SSIS, there have been many water resource management projects implemented in the Northeast Thailand. Some of the significant projects are listed below.

Table 3-1 Key irrigation projects in Northeast Thailand

| Implemented in Khon Kaen | | | |
|---|---|---|---|
| | Executing Agency | Budget | Project Period |
| Khon Kaen (Municipality) Water Supply Expansion Project | PWA | NA | 1991- |
| Regional Cities Development Project/Khon Kaen Municipal Sewerage System and Sewage Treatment Oxidation Ponds | IBRD | NA | 1991- |
| Farmer O&M Training Project | Kfw | US$3M | 1990-93 |
| Misc. Weir Projects | PDA/RTG | NA | 1986- |
| People's Volunteer Weir Program | DOLA/RTG | US$100M | 1985- |
| Farmer Participation in Small Scale Irrigation Projects (SISS, FPSS II, FPSS III) | Ford | US$1M | 1985-92 |
| Thai Australia Village Water Supply project | ADAB | US$5M | 1983-86 |
| Rainwater Tank Project | CIDA/PCDA | NA | 1981-85 |
| Nong Wai Irrigation Project | IBRD<br>ADB<br>Kfw | US$5M<br>US$24M<br>US$92M | 1975-86 |
| Ubol Ratana Dam | IBRD | NA | 1960-65 |

| Not implemented in Khon Kaen | | | |
|---|---|---|---|
| Northeast Water Management and Systems Improvement Project (NEWMASIP) | EEC/RTG | US$34M | 1991-97 |
| Thai-New Zealand Small Watershed Development Project | New Zealand | US$19M | 1988-90 |
| Northeast Small Scale Irrigation Project (NESSI) | USAID/RTG | US$11M | 1980-89 |

Source: USAID, 1993

## 3.2 Water Resource Management in Thailand

Thailand receives two monsoons, the southwest monsoon and the northeast monsoon, which govern the climate of Thailand. The southwest monsoon accompanied by heavy rain begins in mid-May and lasts until mid-October. The northeast monsoon, which is dryer and cooler, comes from mid-October to mid-February (Aekaraj, 1997). There are 25 rivers running in Thailand, among which Chao Praya (178,000 $km^3$) is the largest and drains most of the Central and Northern regions (USAID, 1993).

As a major rice exporting country and with around 60% of the population in the agricultural sector, irrigation water supply has been one of the national priority issues in Thailand. Agricultural use of water was the main reason for developing the interest in more efficient use of water in Thailand, where water had been treated as a free resources until the early 1970s without facing any serious constraint. The major factors contributing to the growing interest in efficient use of water were:

(a) the rapid increase of dry season cropping since the mid-1960s;
(b) the introduction of rice varieties requiring higher water control standards; and
(c) the completion of irrigation facilities for almost all irrigable areas in some river basins, under prevailing levels of water resource development (Plusquellec and Wickham, 1985:1).

The most serious concern in water management in Thailand is the provision of water during the dry season, which is officially between January and June. This is especially prominent in the Central Plain's main river basins (the Chao Praya, Maeklong, Ban Pakong, and Ta Chin basins) which supply the majority of water within the country (Christensen and Boon-Long, 1994). Rainfall patterns and quantities vary from year to year. When the annual rainfall is relatively small, the country may face a water shortage. On the contrary, if they have a large amount of rainfall, then the country may suffer from floods. During the last ten years, Thailand experienced severe water shortages in 1992, 93, 94 and 97 (Saito, 1997).

The demand for water has been increasing for agriculture, industry and domestic uses. Irrigation consumes by far the largest share of water among all the water uses in the country. Irrigated rice production expanded from 70,000 rai in 1957 to approximately 4.5 million rai in 1990, most of which is located in the Central Plain river basins (Christensen and Boon-Long, 1994). Besides rice production, other crops also require irrigation as diversification of agriculture and production during the dry season has been promoted.

While the demand for water is growing, the supply per capita is limited or might be even declining. The TDRI working paper (Christensen and Boon-Long, 1994) reports reduction of the water flow into the Bhumibol and Sirikit dams, the two major dams in the lower North's main river basin which supply most of the water used in the Central Plain. Main reasons for the reduction are increased water consumption in the North, the destruction of watersheds through deforestation, and less rainfall in recent years.

Allocation of water to various sectors in the country is becoming an increasingly difficult task. In Thailand, there are eight ministries with over 30 agencies/departments and some 20 committees responsible for water resource management (USAID, 1993). There has not been a single water allocation principle which all the concerned agencies can agree upon (Christensen and Boon-Long, 1994). Lack of coordination among responsible agencies is often criticised as an obstacle for

efficient water management in Thailand. Major government agencies concerned for water management and allocation are listed below.

Table 3-2 Government agencies involved in water management in Thailand

**Ministry of Agriculture and Cooperatives**
- Office of the Permanent Secretary
- Royal Irrigation Department
- Department of Agricultural Extension
- Department of Agriculture
- Royal Forest Department
- Land Development Department
- Department of Fisheries
- Department of Livestock Development
- Agricultural Land Reform Office
  - Royal Rain Making Research and Development Institute

**Ministry of Interior**
- Local Administration Department
- Department of Public Works
- Department of Public Welfare
- Office of Accelerated Rural Development
- Department of Community Development
- Department of Lands
- Metropolitan Water Works Authority
- Provincial Water Works Authority

**Ministry of Public Health**
- Department of Health
  - Environmental Health Division

**Office of the Prime Minister**
- Electricity Generating Authority of Thailand (EGAT)

**Ministry of Industry**
- Department of Mineral Resources
- Department of Industrial Works

**Ministry of Communications**
- Department of Harbours
- Meteorological Department

**Ministry of Defence**
- Naval Hydrological Department
- National Security Command Headquarters

**Ministry of Science, Technology and Environment**
- Department of Energy Development and Promotion
- National Environment Board

**National Research Council of Thailand**

Source: USAID, 1993:13

Table 3-3 Main governmental agencies for implementing the rural infrastructure development plan of the 8th National Plan

| Agencies involved | Domestic Water Supply | | | Agricultural Water Use | | | |
|---|---|---|---|---|---|---|---|
| | Wells | Ponds | Piped Water | Large Scale | Medium Scale | Small Scale | Farm Pond |
| MOAC | | | | | | | |
| ALRO | x | x | | | | x | x |
| DLD | | x | | | | x | |
| CPD | | | | | | x | x |
| MASU | | x | | x | x | x | x |
| RID | | x | | x | x | x | x |
| DOF | | | | | | x | |
| MOI | | | | | | | |
| DOLA | x | x | x | | | x | |
| ARD | x | x | x | | | x | |
| PWD | x | | x | | | x | |
| PWA | | | x | | | | |
| MPH | | | | | | | |
| DOH | x | x | x | | | | |
| MI | | | | | | | |
| DMR | x | | | | | | |
| MOSTE | | | | | | | |
| DEDP | | | | x | x | | |

Source: Sanyu Consultants, 1998

ALRO Agricultural Land Reform Office, Ministry of Agriculture and Cooperatives
ARD Office of Accelerated Rural Development, Ministry of Interior
CPD Cooperative Promotion Department, Ministry of Agriculture and Cooperatives
DLD Department of Land Development, Ministry of Agriculture and Cooperatives
DEDP Department of Energy Development and Promotion, Ministry of Science, Technology and Environment
DMR Department of Mineral Resources, Ministry of Industry
DOH Department of Health, Ministry of Public Health
DOLA Department of Local Administration, Ministry of Interior
MI Ministry of Industry
MOAC Ministry of Agriculture and Cooperatives
MOI Ministry of Interior
MOSTE Ministry of Science, Technology and Environment
MPH Ministry of Public Health
PWA Provincial Water Works Authority, Ministry of Interior
PWD Public Works Department, Ministry of Interior
RID Royal Irrigation Department, Ministry of Agriculture and Cooperatives

The Office of the National Water Resources Committee (ONWRC) is expected to take the role of central agency in water resource management in Thailand. One of its priority tasks is the formulation of an integrated water resources master plan for each river basin (Aekaraj, 1997). The ONWRC, together with the National Rural Development Committee, has the mandate of drafting guidelines and coordinating the activities of agencies responsible for various aspects of water management (Christensen and Boon-Long, 1994).

As the demand for water grows, demand management for water has become an important issue. In 1992, the National Research Council (NRC) drafted a Water Code aiming to introduce economic instruments for water resource management. Shortly after, the Department of Pollution Control (DPC) engaged the Law Faculty of Thammasat University to draft an alternative Water Code (Christensen and Boon-Long, 1994). Up to the present, neither of the drafts has been submitted to the Parliament to become the Water Code.

The Royal Irrigation Department (RID) under the Ministry of Agriculture and Cooperatives is the principle organisation concerned with irrigation development and management in the country. The forerunner of RID was the Canal Department which was established by King Rama 5$^{th}$ in 1903 for the construction of the canal system and the irrigation system in the Chao Praya Basin. Later the name changed to the Passage Way, the Water Division, and finally the Royal Irrigation Department in 1927 (Saito, 1998).

Until the 1960s, irrigation development by RID was concentrated mainly on the Chao Praya Plain. Irrigation canals in the Chao Praya Plain were designed to function as flood relief channels to redistribute floods as well. For the irrigation systems developed during this period, RID employed an extensive gravity approach. After the 1970s, new irrigation projects were initiated in other regions outside of the Chao Praya Plain. The major characteristics of the irrigation development of this period is the improvement of the tertiary systems and farm development works. It is understood now, however, that the said improvement would not produce full benefits unless the main system is improved simultaneously (Plusquellec and Wickham, 1985).

One major characteristics of the second stage of irrigation development after 1970s was land consolidation which was started in 1966 when the Royal Thai Government requested technical assistance from the Netherlands. The first project applying land consolidation was Chanasut Irrigation project in Sing Buri province and followed by Chao Praya Project under stage I and II, Phitsanulok Irrigation Project, Nong Wai Irrigation Project and others (Tongpan and Apibunyopas, 1988).

In the Northern region, farmers' cooperation under irrigation projects is particularly strong, whereas farmers' groups in other regions are not functioning very well. RID did not intervene in these local irrigation projects so as to protect the traditional farmers' irrigation organisations (Plusquellec and Wickham, 1985). RID has rather intended to encourage the traditional organisations to manage irrigation

systems. Muang Fai is a well known example of the traditional irrigation systems in Northern Thailand. Muang Fai is a traditional well-organised and small-scale gravity type of irrigation system managed by a group of farmers who grow rice using the same weir system (Tanabe, 1998). The farmers have the rights to water and the responsibilities in irrigation management, which include "the allocation, regulation and distribution of water according to schedules; maintenance and repairs; arranging ceremonies and rituals of worship; and managing disputes over water among farmers" (Tan-Kim-Yong, 1995:19). These activities are organised by leaders selected from water users. In order to assure the irrigation system operating in a good condition, leaders have the main responsibilities of mobilising labour for occasional repairs (Tan-Kim-Yong, 1995).

### Office of Accelerated Rural Development

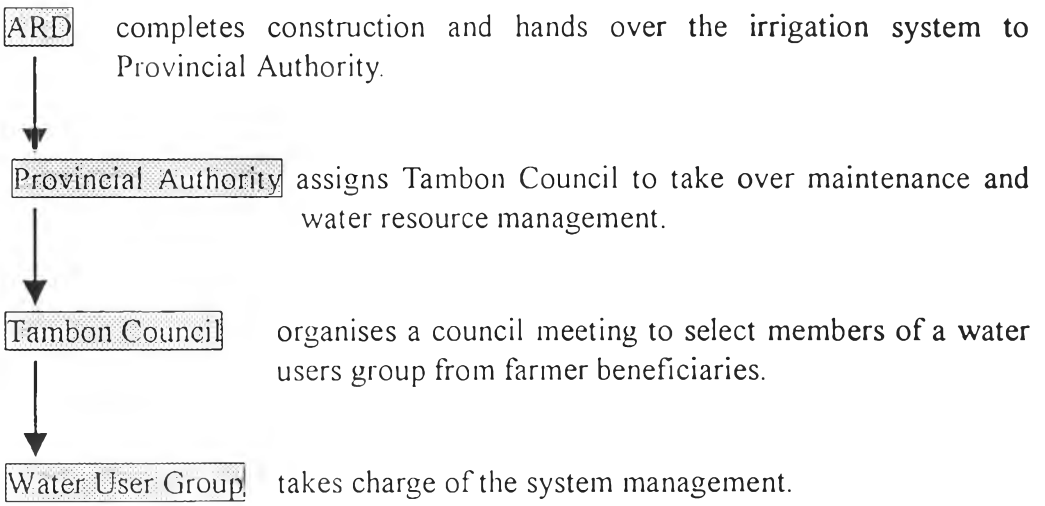
Aside from RID, another major government agency concerned with irrigation is the Office of Accelerated Rural Development under the Ministry of Interior. The Office of Accelerated Rural Development (ARD) was established in 1965 under the Office of Prime Minister and was moved to the Ministry of Interior in 1974. The main objective of ARD is to relieve rural deprivation and upgrade the quality of rural people's lives through accelerating development of physical infrastructure and implementation of social activities. Water resource development is one of ARD's activities. For the last 25 years, ARD has constructed small-scale* surface and groundwater resource, which fall into the following four categories:

1. pond construction;
2. water resource rehabilitation (for swamps or creeks which become shallow due to soil sedimentation);
3. construction of weir; and
4. construction of reservoir (Sasisuwan, 1994).

Responsibilities for the management of irrigation systems developed by ARD is passed on to the Provincial Authority, Tambon Council and finally water user groups as described below (Sasisuwan, 1994).

* According to Prime Ministry Act on National Water Resource Management 1989, small scale irrigation is defined as "all types of water resources namely reservoir, irrigation canal, pond, deep and shallow wells, swamps, creek or other water containers which consume less than 1 year of construction period and no compensation charge paid for land" (Sasisuwan, 1994:234).

Chart 3-1 Process of irrigation system development




Source: Sasisuwan, 1994

Since 1995, the Income and Occupational Division of ARD has applied the concept of the "New Theory**" initiated by His Majesty the King to its income promotion activities, especially construction of farm ponds as a small scale water resource for agricultural production. In the fiscal year 1998, ARD allocated 65 million baht to the construction of 2,400 farm ponds. In addition, ARD received 3.8 million baht from the United Nations Development Programme (UNDP) for another 200 farm ponds (ARD, 1999).

As shown in the table below, one of the advantages of farm ponds as a small scale irrigation scheme is the high benefit-cost ratio. The farm pond construction of ARD with the financial support from UNDP used 20,500 baht per pond including 13,000 baht for construction, 3,000 baht for agricultural inputs, 1,000 baht for training and study tour and 2,000 baht for project management. While the annual net income of a pond owner from agricultural production is estimated to be around 9,600 baht 1-2 years after the pond construction (Development Cooperation Foundation, 1999).

** The "New Theory" proposed appropriate method on a small piece of land based on integrated agriculture. Farmers' land should be allocated in proportion of 30:30:30:10 for farm pond, paddy field, cultivated land for other plants and residential areas respectively (ARD, 1999: A).

Table 3-4 Cost and benefit of different irrigation schemes

| Category | Alternatives | | | |
|---|---|---|---|---|
| | Multi-purpose pond | Community pond | Small division weir | Small reservoir |
| Unit cost | Lowest | High | High | Very high |
| Beneficial area | Highest | Low | Average | Average |
| Utilisation | Year round | Year round | Seasonal | Seasonal |
| Water management | Simplest | Complicate | More complicate | More complicate |
| Maintenance | Simple | Complicate | More complicate | Most complicate |

Source: Development Cooperation Foundation, 1999:13

**Royal Irrigation Department**

At present, the RID has 45,868 officials in total, which is 30% increase in regular staff and 10% increase in contract staff compared to ten years ago. As for the financial status, the annual budget of the RID for 1998 is approximately 306 million baht, which is 3.3 times the budget of ten years ago, but about 30% decrease from 1997 (Saito, 1997).

The RID classifies irrigation systems into large scale, medium scale and small scale. Irrigation projects with a construction cost over US$8 million and a storage volume of more than 100MCM (million cubic meter) are categorised as large scale; projects with a construction cost of US$8 million - 0.32 million as medium; and projects with a cost of below US$0.32 million and can be constructed within one year as small scale (USAID, 1993). It is argued that many irrigation service areas are too large to supply water efficiently, and the optimum tertiary irrigation size would be about 20-25 farmers in the area of 312-375 rai (50-60 ha) at maximum (Plusquellec and Wickham, 1985). The 8th National Economic and Social Development Plan (1997–2001) recommends construction of small and medium scale irrigation to promote agricultural diversification and increase rural income. The RID's action plan, however, does not fully correspond to the 8th Plan. The action plan foresees the following irrigation development (Saito, 1997).

Table 3-5 Irrigation schemes in the pipeline, Thailand

| | medium scale (no. of district) | large scale (no. of district) | Total (no. of district) | area (ha) |
|---|---|---|---|---|
| 1997 | 39 | 1 | 40 | 89,288 |
| 1998 | 43 | 5 | 48 | 204,816 |
| 1999 | 33 | 7 | 40 | 227,630 |
| 2000 | 35 | 9 | 44 | 111,072 |
| 2001 | 54 | 4 | 54 | 120,307 |

Source: Saito, 1997

It has been argued that irrigation water charges should be introduced as an economic measure to control increasing demand for irrigation water. The RID has never charged irrigation users for water although it is legally authorised to collect such charges. The State Irrigation Act of 1942 authorises RID to collect water charges up to 0.50 baht per cubic meter from irrigation users. The Dykes and Ditches Act of 1962 and the 1974 Agricultural Land Consolidation Act also allows RID to introduce charges on land owners and other irrigation users for O&M and the capital investment of land improvements (Christensen and Boon-Long, 1994).

In practice, however, RID seems to be reluctant to introduce water charges. Since the establishment of RID, irrigation water has been regarded as a basic need for poor farmers that should be provided for free to support their agricultural production. Therefore, it is feared that introduction of water charges would face strong opposition of farmers. There are other problematic issues regarding water charges. For example, it is argued that the lack of clear property rights to water hinders the market mechanisms from setting prices of water (Christensen and Boon-Long, 1994). Irrigation projects have been implemented without considering how much water would cost. When water is not treated as an economic good, the market can not determine the price for water. Another well known problem may be the unreliable irrigation water supply. Irrigation management by the RID has focused on the main and secondary water ways, which does not always ensure water supply to the tail land (Saito, 1998). When water supply is unreliable, irrigation users would not be willing to pay for irrigation services.

Saito (1998), an irrigation advisor to the RID, recommends that water charges, particularly for O&M costs, should be introduced. In order for the water charges to be viable, he suggests that the following issues be addressed along with the introduction of water charges:

1. farmers' participation in irrigation planning;
2. improved irrigation management technology for reliable water supply; and
3. land consolidation.

While irrigation water charges are a means of direct cost recovery for irrigation services, there can be indirect cost recovery mechanisms. In Thailand, tax levies on rice exports, which have risen along with the increased volume of rice exports, can be considered as part of indirect cost recovery. However, financial mechanisms are not in

place to link the revenue from rice export levies and budget allocation for irrigation (Wade and Seckler, 1990).

## 3.3 Nong Wai Irrigation System

**Background**

As part of the development of Mekhong river, the Thai Government agencies and the United Nations Agencies supported construction of a dam on the Phong River for electricity generation, irrigation and other purposes. Irrigation was considered an important component of this water resource development to make the financial investment worthwhile (RID, 1997). Construction of the Ubolratana Dam on the Phong River started in 1965 and completed in the same year. In the following year of 1966, construction of a diversion weir was started to establish sufficient hydraulichead for the left and right bank canals. The Electricity Generating Authority of Thailand (EGAT) made an agreement to maintain an average discharge of 55 CMS (cubic meter second) downstream from the dam, out of which 15 CMS are to be diverted to the right bank canal which served the Nong Wai Pioneer Agriculture Project (Sanyu, 1976c). The right bank canal was completed in 1972, and the left bank canal was finished later in 1979 (RID, 1997).

Reservoir specifications are provided by EGAT as follows.

Table 3-6 Technical specifications of Ubonratana Dam

| | |
|---|---|
| (A) Dam | |
| Type | rock fill with clay-core |
| Crest length | 800 m (incl. 100 m spillway) |
| Crest elevation | + 185.0 m (MSL) |
| Height | 32 m (above foundation) |
| Volume of dam | 515,000 $m^3$ |
| (B) Reservoir | |
| Normal high surface elevation | + 182.0 m (MSL) |
| Normal low surface elevation | + 175.0 m (MSL) |
| Available drawdown | 7 m |
| Maximum storage capacity | 2550 MCM (at + 182.0 m MSL) |
| Dead storage capacity | 650 MCM (at + 175.0 m MSL) |
| Active storage | 1900 MCM |
| Surface area | 410 sq. km (at _ 182.0 m MSL) |
| (C) Spillway | |
| Type | self regulating radial gate |
| Design flood discharge | 2500 CMS |
| Sill elevation | + 176.0 m (MSL) |
| (D) Penstock | |
| Maximum discharge | 210 CMS |
| Axis elevation | + 162 m (MSL) |
| (E) Tailrace | |
| Level during design flood | + 172 m (MSL) |
| Normal level | + 163 m (MSL) |
| Bottom level | + 159 m (MSL) |
| (F) Power house | |
| Type | underground |
| Generating capacity | 25,000 KW |
| Turbine output | 3 sets (8,780 KW/set) |
| Maximum head | 18.5 m |
| Minimum head | 12.0 m |
| (G) Irrigation | |
| Right main canal | |
| Capacity | 15 CMS |
| Irrigated area | 75,000 rai (12,000 ha) |
| Left canal | |
| Capacity | 35 CMS |
| Irrigated area | 223,000 rai (35,700 ha) |

Source: Sanyu Consultants Inc., 1976c:14

**Three Projects under Nong Wai Irrigation**

In order to increase the potential of the irrigation system, three projects were implemented in the Nong Wai Irrigation area, namely Nam Pong Agriculture Development Project (phase 1 and phase 2), and Nong Wai Agriculture Development Project (RID, 1997).

**a) Nom Pong Agriculture Development Project (phase 1)**

- Main activity: improvement of water ways in paddy field along the left side main canal
- Target area: Nam Pong Subdistrict and Muang Subdistrict of Khon Kaen Province, approximately 58,600 rai (9376 ha)
- Financial input: 126 million baht (World Bank)
- Project duration: 1975-1979

**b) Nom Pong Agriculture Development Project (phase 2)**

- Main activity: improvement of water ways in paddy field along the left side main canal
- Target area: Chiang Yuen Subdistrict and Kosumpisao Subdistrict of Mahasarakham Province, approximately 127,500 rai (20400 ha)
- Financial input: 11,051 million baht (West Germany Bank)
- Project duration: 1979-1986

**c) Nong Wai Agriculture Development Project**

- Main activity: land consolidation and improvement of water ways along the right side main canal
- Target area: Nam Pong Subdistrict and Muang Subdistrict of Khon Kaen Province, approximately 68,800 rai (11,008 ha)
- Financial input: 593 million baht
- Project duration: 1976-1983

Nong Wai Agriculture Development Project adopted a systematic approach to upgrade irrigation at the main and tertiary levels and to introduce water users' groups and rotation irrigation* (Plusquellec and Wickham, 1985). In addition to the construction of the irrigation system, the project included a component of agriculture development aiming at encouraging farmers to effectively use of irrigation water for agricultural production. The details of the project were as follows.

1. Agencies involved: Asian Development Bank made a special loan of approximately US$ 5000,000 to the Ministry of Agriculture and Cooperatives.
2. Project target area: 75,000 rai (12,000 ha) of paddy land located on the right bank of the Phong River in Khon Kaen province.
3. Objectives and activities: The project aimed at increasing agricultural productivity of the target area by promoting dry season rice cultivation and diversified agriculture. Activities included the following:
    1) land consolidation;
    2) training of agricultural techniques and promotion of dry season rice cultivation; and

* Rotation irrigation is understood in Thailand as the sequential delivery of water from a farm turnout (FTO) to successive parts of the FTO's service area. The rotation is controlled by diverting water into different field channels, which results in discontinuous or intermittent supply to all farms within the service area (Plusquellec and Wickham, 1985:42).

3) establishment and sustainable management of farmers' groups/agricultural cooperatives.

4. Implementation period and implementing agencies: 7 years from 1975 to 1981. Ministry of Agriculture and Cooperatives and 8 agencies (JICA, 1988).

Under the Nong Wai Agriculture Development Project, construction costs of irrigation facilities were planned to be partially reimbursed by beneficiaries as prescribed in the Land Consolidation Acts* issued in 1974 by the Government Authorities Concerned. The burden on the farmers was estimated Baht 955 per rai, or 44% of the costs at minimum (Sanyu, 1976a). The table below summarises the cost sharing ratio between the government and farmers.

Table 3-7 Cost sharing for land consolidation

| Components | Construction cost per hectare | Government Subsidy | | Farmers Burden | |
|---|---|---|---|---|---|
| | Baht | % | Baht | % | Baht |
| Land clearing | 442 | 0 | 0 | 100 | 442 |
| Land levelling | 4,687 | 0 | 0 | 100 | 4,687 |
| Irrigation ditches<br>Drainage ditches<br>Farm roads<br>Structures | 8,382 | 10<br><br>90 | 838<br><br>7,544 | 90<br><br>10 | 7,544<br><br>838 |
| Total | 13,511 | 6-56 | 838-1,207 | 94-44 | 12,673-955 |

Source: Sanyu Consultants Inc., 1976a:3

**Physical Characteristics of Nong Wai Irrigation**

The following details of the physical structure of Nong Wai Irrigation System is provided in the 1997 Annual Report of Nong Wai Irrigation.

(1) Facilities at the headworks compound
- Shortcut channel (length: 1 km, width: 157.20 m, depth: 7.75 m)
- Concrete weir (length 125.24 m, height: 5.90 m, maximum flow of water: 1,500 $m^3$/second)
- Water gates (4.00 x 2.25 m, right side: 2 gates, left side: 3 gates, maximum flow of water 200 $m^3$/second)
- Water gate to the right side main canal (3.00 x 2.00 m, maximum water delivery: 15 $m^3$/second, 2 gates)
- Water gate to the left side main canal (4.00 x 2.25 m, maximum water delivery: 35 $m^3$/second, 2 gates)

* The Land Consolidation Act of 1974 institutionalised a series of improvements designed to: (a) reallocate land so that farms comprise relatively few separate parcels which are oriented for efficient farm ditch layouts; (b) level most of the land; (c) construct field channels, roads, and drains; and (d) organise water user groups (Plusquellec and Wickham, 1985).

- Earth dike along Nam Pong river (height: 19 m from the bottom of the river, length: 450 m)
- Emergency drainage (height: 3.50 m, length: 240 m, maximum drainage capacity: 1,000 $m^3$/second)

(2) Water delivery system (separate into two systems: right side and left side of Nam Pong river)
- Right side system: 1 main canal (length: approximately 47.490 km), 15 secondary canals (length: approximately 80.116 km), 235 water ditches (length: approximately 469.783 km), covered area approximately 70,000 rai (11200 ha) in Nam Pong Subdistrict and Khon Muang Subdistrict of Khon Kaen Province
- Left side system: 1 main canal (length: approximately 82.909 km), 56 secondary canal (length: approximately 296.262 km), 614 water ditches (length: approximately 1,356.411 km), covered area approximately 189,400 rai (30304 ha) in Nam Pong Subdistrict, Muang Subdistrict and Samsung Subdistrict of Khon Kaen Province, and Chiang Yuen Subdistrict and Kosumpisai Subdistrict of Mahasarakham Province

(3) Drainage system (separate into two systems: right side and left side of Nam Pong river)
- Right side system: 10 large drainage canals and 10 small drainage canals (length: 77.229 km), 568 drainage ditches at the field level (length: 410.580 km)
- Left side system: 5 large drainage canals and 47 small drainage canals (length: 274.832 km)

(4) Flood mitigation system
- Emergency drainage at the head of the irrigation system (height: 3.50 m, length: 240 m, drainage capacity: 1,000 $m^3$/second)
- Weir along Nam Pong river and Chi river on the right side of the project area (length: 27.517 km)
- Weir along Nam Pong river and Chi river on the left side of the project area (length: 75.494 km)

**Objectives and Responsibilities of Nong Wai Irrigation Project**

RID is operating the Nong Wai Irrigation Project to meet the following objectives and fulfil the specified responsibilities (RID, 1997).

(1) Objectives of the project
- To deliver water to 257,000 rai (41120 ha) of agricultural field in the project area
- To support improvement of agricultural productivity and increase farmers' income
- To deliver tap water for the water supply in Muang Subdistrict of Khon Kaen Province

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- To support the promotion of fishery in rice field and natural streams in the project area
- To manage reserved water at the Ubonratana Dam for electricity generation

(2) Tasks and responsibilities of the project

Tasks and responsibilities of Nong Wai Irrigation Project can be summarised from the 1997 Annual Report of Nong Wai Irrigation Project as follows. Nong Wai Irrigation Project is responsible for managing the irrigation system to ensure delivery of water to the target area of 257,000 rai (41120 ha) in Nam Pong District, Muang District and Samsung District of Khon Kaen Province, and Chiang Yuen District and Kosumpisai District of Mahasarakham Province. RID assumes the responsibility in delivering water and maintaining the irrigation facilities in cooperation with concerned government agencies and farmers who benefit from irrigation water from Nong Way Irrigation Project. Specific tasks and responsibilities of RID are determined in the RID Act 607/2527 that came in effect on 4 June 1984 with the following contents.

- Overall management: RID is responsible for overseeing administration, financial management and procurement of the project as well as assuring security of the project area. These responsibilities are assigned to four units, namely administration unit, finance and accounting unit, procurement unit, and area protection unit.
- Engineering: RID is responsible for making activity workplans, composing budget, maintaining and improving irrigation facilities, monitoring and reporting. These responsibilities are assigned to three units, namely planning and budget unit, design and system improvement unit, and basic survey unit.
- Water management: RID is responsible for planning for water management, water delivery and water use to maximise the benefit of irrigation, and planning for crop planting together with farmers. These responsibilities are assigned to two units, namely water management and statistics unit and irrigation agriculture unit.
- Mechanics: RID is responsible for looking after vehicles, machinery, and communication facilities. This responsibility is assigned to three units, namely vehicle unit, machinery unit, and communication unit.
- Water delivery and system improvement: RID is responsible for irrigation water delivery and improvement of the irrigation system which includes rehabilitation of canals and irrigation facilities. These responsibilities are assigned to three units, namely administration unit, water delivery unit, and rehabilitation and maintenance unit.

**Rotational Irrigation**

The concept of rotational irrigation, which was introduced to Thailand in the mid 1970s, was applied to the Nong Wai irrigation system and became one of the successful cases of rotational irrigation in Thailand. Rotational irrigation enables diversified cropping and may also have some advantages over continuous irrigation. There are several preconditions for its implementation, the most important of which are:

(a) reliable flows through the farm turnout;

(b) an operations plan for the network;
(c) installation of measuring and control structures;
(d) agricultural extension services; and
(e) strong and sustained political commitment.
(Plusquellec and Wickham, 1985)

A pilot project of rotational irrigation managed by a water users' group was carried out on 900 ha of land in the project area. The outcome showed a rise in cropping intensity during the dry season from 23 % to 80 % after one year and 95 % after two years (Tongpan and Apibunyopas, 1988).

The Nong Wai irrigation system is managed by the RID Nong Wai project office and the RID regional office located in the city of Khon Kaen. Those two offices are responsible for O&M of the primary and secondary canals of the irrigation system that belong to RID. Farmers receiving water from the irrigation system, on the other hand, are looking after the tertiary and smaller ditches.

**Water Users' Groups**

Farmers in the project area were organised into some 600 groups with a total members of about 5,000 people. In 1977, Nong Wai Agricultural Cooperative was set up, based on the existing Pha Kue Agricultural Cooperative, to strengthen water management by water users' groups and collect tertiary level irrigation maintenance fees (Tongpan and Apibunyopas, 1988).

In the project feasibility study, it was planned that the government administration organisation would collect water charges to cover O&M costs for the terminal facilities until 1985, after which the Water Users Association would be responsible for O&M of the terminal facilities and collection of water charges (Sanyu, 1976d). Farmers were organised into groups of 8 to 12 within units of about 62.5 rai (10 ha). Water was supplied to all the group members at the same time for the period of about 24 hours every week. This rotation irrigation was practised during crop growth in the dry season and when water was relatively short in supply in the wet season (Plusquellec and Wickham, 1985).

Upon the fee collection, the leader of each water users' group could submit an O&M plan to Nong Wai Agricultural Cooperative for approval. A survey of water users' group leaders revealed that they wished to take care of maintenance activities themselves by water users' groups rather than leaving maintenance with the cooperative (Tongpan and Apibunyopas, 1988).

According to the 1997-98 annual report of the Nong Wai Agricultural Cooperative, as of 31 march 1998, the cooperative has 4,373 members from 68 local farmers' groups in two districts in Khon Kaen province. Water users' groups that belong to this cooperative used to collect fees from member farmers. It seems that many of the members had been fallen behind in their payments for a long period. A section of the annual report of the cooperative states that a committee meeting on 24 November 1997 has decided on the cancellation of the unpaid water fees of 130,296.36

baht in order to help water users' group members who are in financial difficulty (Nong Wai Agricultural Cooperative, 1997). Since then, collection of water fees has been abandoned.