

## Appendix 5.10

### Pump Irrigation using Pipeline

(in Nonkhong Sub-district, Nong Rue District, Khon Kean Province)

#### Basic Data

1. Water Source: Ubonratana Dam
2. Pump Station: the pump and main pipe is operational. The pipeline is HDPE with 355-710 mm.
3. Head Tank: 15 tanks (108 cubic meter)
4. Distribution points: 253
5. Farmers: 231
6. Benefit area: 1,996 rai
7. Management Transfer: RID attempted to transfer the management of the system to TAO but it was denied in 2004.
8. Problems
  - a. When the water level in Ubonratana dam is lower than 176 MSL, the pump cannot be operated.
  - b. Five technical problems were identified
  - c. No crop cultivation as planned.
9. During the visit, local contractors installed extended valve to each head tank.

#### Problems Identified by auditors

1. Non Khong Pump Irrigation is one of ten pilot pipe irrigation project constructed within the 8<sup>th</sup> National Economic Development Plan. The construction period is during 1997 -1999. It was completed in March 2002 or 511 days after the contract period since the contractor encounter financial problem.
2. Farmers cannot pay for the investment to install pipeline to their farms and 80 percent of them do not know that they have to pay. Those who can pay, they can invest not more than 1,000 Baht per rai or 8 percent of what the consulting firms estimate.
3. Farmers and local administrative organization were not consulted before and during construction. Water User Group was not formulated after the completion and no adoption of pump irrigation by TAO due to the insufficient of maintenance cost and unavailable of technical staff.

4. Most of the farmers are not willing to pay for electric cost since they usually get free service from government. Some farmers are willing to pay but not more than 200 Baht per rai per year.
5. The project cost is 51.21 million Baht but after construction 8 distribution points were broken. No free water supply in the first two years as promised.

Suggestion from Budget Bureau for future development of this kind of project

Pipe irrigation project aims to change farmers practice from mono cropping to commercial cropping to increase farmers income. Ten pilot projects were constructed covering the area of 50,000 rai. Total investment cost is 1060 million Baht. The second phase was planned to cover 1 million rai with the total budget of 28,000 rai. The bureau suggested the following issue before implementing the remaining phase;

1. Farmers in the beneficial area should participate in the decision making process. They have to obtain necessary data to support their decision such as electricity cost and maintenance cost, cost of distribution points to the farmer field. They must be willing to change their cropping pattern to commercial cropping.
2. The local administration organization should be ready to secure operation and maintenance budget for the project. It should also prepare technical staff to operate the scheme.
3. Involvement of agricultural agencies is necessary such as DOAE, DOF and LDD to plan together with farmers for commercial agriculture.
4. The availability of water source is important. Therefore, make sure that water is available through the year especially in dry season.



Pump Station



Pump Station



Intake Canal from Ubolrat Reservoir



Outlet Tank



Outlet Tank under repairing

## Appendix 5.11

### Irrigation Project of Thungsamrit

Date: 21 June, 2010 10:00-12:00 @ Thungsamrit OM Region Office(RID)

Interviewee: Mr. Nanochai, (Director: Thungsamrit OM Region Office)

#### 1. Introduction/Background

Irrigation Project of Thungsamrit was started on 1940 and 70 years passed since then. It is the oldest agricultural development in Thailand and only one gravity project equipped with irrigation system in the Mum river basin.

This area had lower water distribution efficiency at a time in the past, because of the narrow irrigation channel which has much waterweed, and was often damaged by flood in the wet season. This Irrigation Project was consisted 5 pumping irrigation systems in the upstream.

ASPL irrigation and drainage project was implemented from 2000 to 2003 on a budget of 370 million baht to improve efficiency of water distribution, water use, irrigation facility, agriculture, and farmers' income.

#### 2. Project Profile

##### 1)Condition of planted crops and irrigation

①Irrigation water in this area is taken by the Phimai weir (80m in width). Amount of discharge at this point is 1,000 MCM. At first, it was not enough water supply, so 4 water storage ponds in the upper Mum basin were constructed by government, storage capacity of these 4 ponds are shown as follow.

- Lam Takong 310MCM,
- Mun Bon 140MCM,
- Lam Chae 250MCM,
- Lam Pa Proeng (Upper & Lower) 213MCM

15MCM water is short in last year (2009) because amount of discharge is not enough.

At present, a plan to supply 30 MCM water is under the preparation due to the demand of 15 MCM water in the dry season of June and July.

- It is to spread the present pond (Nong Krang Pra) in Har Saeng Jang from the 12km distance of the Phimai weir by the excavation and to store 15 MCM water(similar system of Monkey Cheek). The storage system at upper part is gravity irrigation and lower part is pumping one.
- Construction of dike (20km) in both of the Mum river raising water level at Phimai weir by 2m and storing 15 MCM water.
- It stores 5MCM in the Lam Jakarat river.

②At first, the plan covering about 127,000 rai (5,208 farm households) in the farm land of Thungsamrit was substantially 96,211 rai prepared. At present, irrigation area of this project is 200,000 rai in total ,out of them, gravity irrigation area is 160,000 rai, pumping irrigation area is 40,000 rai. And about 5,000 rai area was irrigated in the dry season. Planted area of Jasmine rice is

120,000 rai, and it is for export. Because rice price is high and enough water was supplied last year. The planted area was 60,000 rai in the dry season, the yield was about 400kg/rai.

- ③At present in the irrigation area, it is short of 15 MCM water in the most necessary time, namely in June and July.
- ④In the irrigation area, Jasmine rice is planted in the wet season ,and sticky rice and vegetables are planted in the dry season.
- ⑤In this area, sticky rice is purchased for self-consumption.
- ⑥Income of farmers is 22,000baht per year.
- ⑦There is a project of cultivating Jasmine rice on 120 million rai containing rainfed area.  
This project has much benefit if they will use a large harvester.
- ⑧Transplanting will be started in July (usually in June) ,because it rained little especially.
- ⑨Jasmine rice has strong photo-sensitive, and its harvesting season is from November to December instead of transplanting period, so they can not change it's time in according to situation of the water supply. For this reason, it is the circumstance for some need additional pooling of 30 MCM, and is getting water supply by the project divided two periods.
- ⑩Water supply for irrigation canal is not enough, so it has been broadcasting for a long time.
- ⑪Five pumping station is operated by RID, and farmers pay for electricity costs. A WUG (Water Users Group) is organized and they collect the cost and pay it to RID. A part of electricity costs may be paid by TAO.

## **2)About Jasmine rice**

Jasmine rice in Thungsamrit is local original breed, that is single seed , and the name of “Hom Ma Li 105”. It is similar to another species whose name is “Thung KuLa Rong Hai” cultivated in other area. The price is about 160 baht / 5kg. In this area, Jasmine rice is in the majority and has resistance of salinity. Therefore, it is not damaged by salinity. In this area, it make a work about Jasmine rice, it shows the followings.

- ①Implementation of controlling qualities by GAP (Good Agricultural Practice)
- ②Restoring soil health by using organic manure
- ③Release fishes for provision of bugs
- ④Examination of non-mixing with other rice in the harvesting season

## **3. Findings**

### **1) Construction cost for irrigation facilities**

Construction cost for main irrigation facilities is 1.6 billion baht, and On-Farm facility cost is 0.8 billion baht. SP2 project is implemented for five years on a budget of 2.4 billion baht.

Implementation of the SP2 project will bring a harvest of 580~630kg/rai. But this year it was decided the budget of 165 million baht for construction of reservoir for two years. Constructed facilities are shown as follows.

- Construction of Nong Krang Pla
- Pipe Construction

— Improving Pumping Station

RID has a budget of 20 million baht for On-Farm construction. It is especially important to construct On-Farm facilities, and it will be estimated 0.5 billion baht to construct reserver's high up.

So cooperative of fund from Japan is expected now.

**2)Maintenance cost**

At present electric cost of pumping stations is paid by farmers. The total cost of pumping stations is 800,000 baht/year. The cost sharing rate by RID and farmers will be 6:4=RID: Farmers in according to DEDP rules in the future development.

**3)Impact of irrigation project**

Large scale project of irrigation (1999~2004,JBIC,ADB,3.7 million baht) brought the efficiency of one by constructing canal and distributing water equally.

Farmers' income is increasing by 55% after the irrigation project. Improvement of irrigation efficiency and drainages and up the price of rice brought income increase to farmers. (Rice price 9,000Baht/t:2008, 16,000Baht/t:2009)



(Photo Data Source: ASPL Evaluation Report)

**4)Activated WUG**

As it above mentioned, big irrigation improvement project brought On-farm systems and positive participation of water resource management and maintenance. And it triggered the WUG(water Users Group) participation, and was divided into 4 groups.

**5)Drainage facilities**

Flooding water in this area flows to Lam Sa Tad river running off north of this area and it causes the flooding. So there are some problems.

**6)Consistence of Operation and Maintenance Office**

Stuff :	Officer	11
	Employee	111
	<b>Total</b>	<b>122</b>
	Gate Keeper	9
	Pump Station	@2 x 5 = 10

#### 4. Lessons Learnt

The impacts of irrigation and drainage project are ①High efficiency of distribution water,②Improvement of drainage,③Establish of strategy commercial product(Jasmine rice),④Conscious awareness of farmers by the irrigation project.

##### 【Direct impacts】

- ① High efficiency of distribution water brought the increasing harvest increase and improvement of farmers' income.
- ② Improvement of drainage brought stability of agriculture because of the relief the flooding damage.

##### 【Indirect impacts】

- ③ Strategy commercial product(Jasmine rice)brought up the farmers' motivation for irrigation, and merit for price battle, of course up the farmers' income.
- ④ The hard irrigation project enhanced awareness of farmers, this point is most meaningful, and this impact will bring sustainable farming villages' development.

#### 5. Annex



## Appendix 5.12

### Thung Kula Ronghai Water-Resources Development Project

(Referred to “Formulation of Integrated Water Resources Management Plan for the Mun Basin” DWR 2006)

The “Thung Kula Ronghai” area had been suffered from the severe problems. Agricultural products were at a low productive level due to repeated flood and drought. Moreover, saline soil problem also spread all over the area. The government developed Thung Kula Ronghai in accordance with core plans No.1-3 (Year 1981-1996).

As a result, these fundamental problems were eventually solved and since then, successful result has brought about better living of farmers and higher income, but still lower than the average income of the Northeastern region.

Project Description: Thung Kula Ronghai area covers approximately 2.11 million rais as illustrated in attached Figure 1. Development plans are composed of water-resources aspect, soil-resources aspect, agriculture aspect, environment aspect, and integrated-sustainable aspect as follows.

To alleviate drought and inundation problems.

- 1) A storage ponds in farms, varying in size from 3,040-4,800 m<sup>3</sup> per 22 rais of farm area, is constructed to relieve water shortage problem during harvest seasons among 1,786,500 rais of farm area, and increase approximate 75,980 rais cultivated fields in dry season.
- 2) Improving weirs and enlarging rivers have been conducted in “Lam Siao Yai” and “Lam Plub Pla” to increase the efficiencies in drainage process among main rivers. These will help reduce flood area of about 107,300 rais, at the return period of 3 years. Furthermore, 9.3 MCM of the area can act as water sources for domestic consumption of nearby communities in dry season.
- 3) Weirs have been constructed in accordance with the public’s demand.
- 4) Improvement of drainage ditches have been made to benefit for water distribution management in Thung Kula Ronghai area.



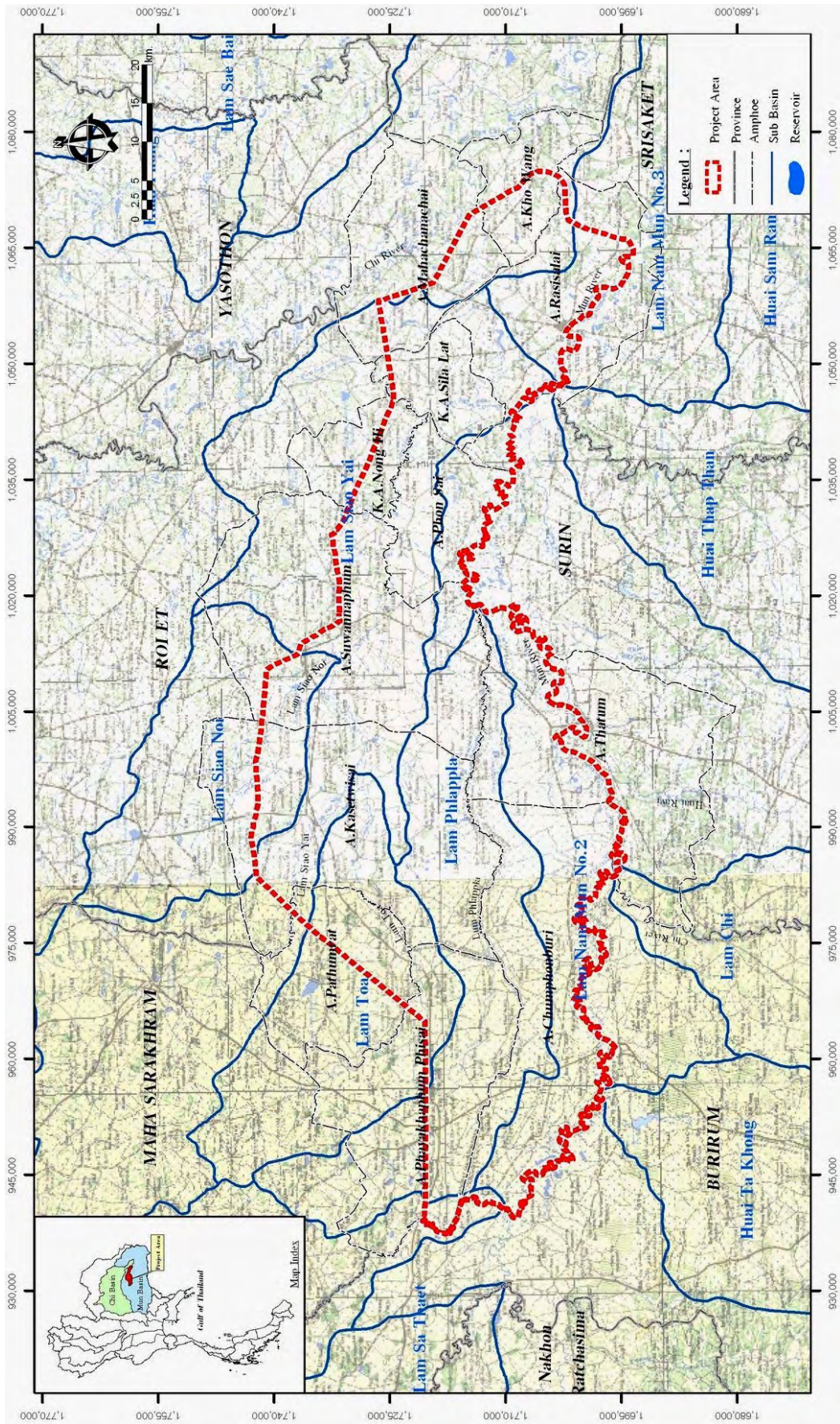


Figure 1 Thung Kula Ronghai Water-Resources Development Project

## Appendix 5.13

### Ubonrat Dam (Operated by EGAT)

#### 1. Background

For the Mekong River Basin Development, Thai government and the United Nations Lower Mekong River Survey committee have agreed to construct a dam across the Lam Nam Pong, which is major tributary of the Mekong River, in order to store rain waters and prevent flooding over the lower area, and utilize the stored water for power generation, irrigation, etc. Therefore, the National Energy Authority was assigned to construct the Pong Nip Dam, which is later called the “Ubonrat Dam (or Ubonrat Dam)” in the Lam Nam Pong.

#### 2. EGAT’s Power plants in N-E (as of Jan. 2010)

- Ubonrat dam (25.2 MW)
- Chulaporn (40 MW)
- HuaiKum dam(1.06 MW)
- NamPung dam(6 MW)
- Sirintorn dam (36 MW)
- PakMoon dam(136 MW)
- Lamtakong (500 MW)
- Total Hydro-power (744.26 MW.)
- NamPong (710 MW.)
- Windmill Lamtakong (2.5 MW)
- Solar cell (1.0 MW)

Total installed power 1,457.76 MW.

#### 3. Ubonrat Dam

Dam type-clay core rock fill

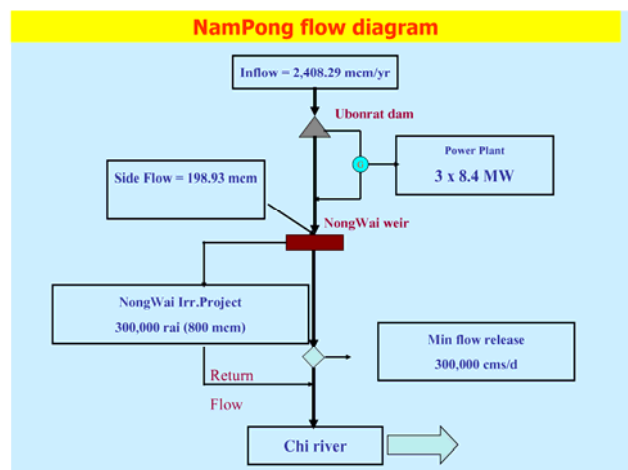
Res. Capacity: 2,431 MCM.

Surface area: 380 sq.km.

Retention level: 182 mMSL

Dam crest : 188.10 mMSL

Watershed area: 12,000 sq.km.



### 3. Water Utilization from Ubonrat Dam

#### (1). To irrigate agricultural lands

28,000 household, 300,000 rai

Ave water used 800 mcm /yr

#### Deficit Reservoir Operation (Dec-May)

- Flow release according to D/S water requirement
- Hierarchy of flow release

- Domestic use

- Irrigation, agriculture

- Environmental concern

- Electric generation

#### (2) Agriculture and domestic use upstream

50 pumping stations surround the dam reservoir

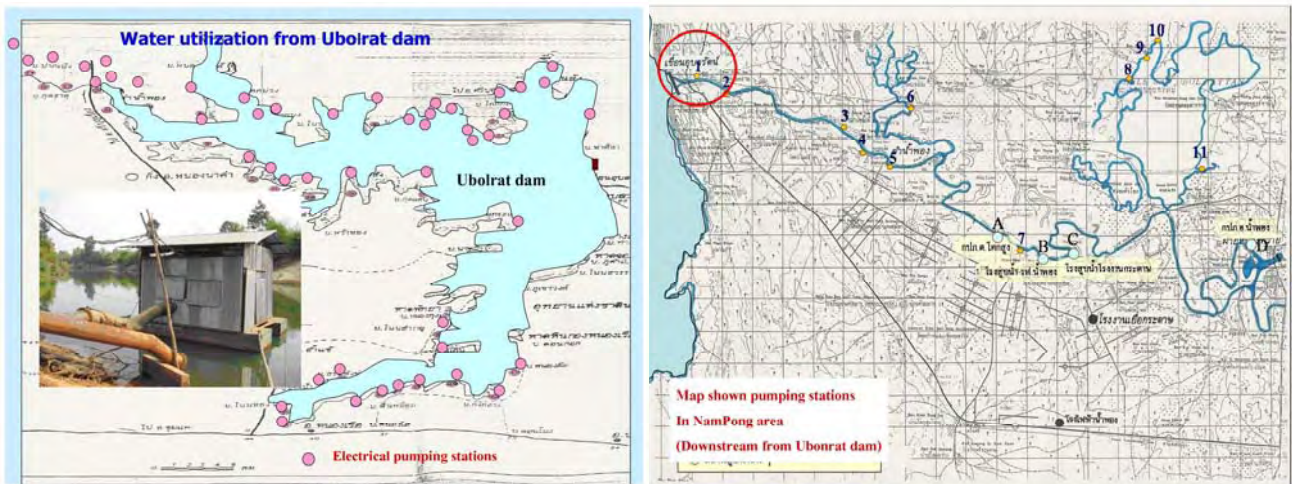
-Yearly water used 200 mcm

- Benefit area 77,373 rai

16 Station in Nongbualumpoo

24 Station in NongNaKum, PuWieng, NongRuer Khonkaen

10 Station in NoneSunk Nongbualumpoo



#### (3). Domestic uses : Khon kaen water supply 10 mcm.yr

#### (4). Flood mitigation

##### ➤ Decision making during flood

- Automatic Gate Control System (AGOS)

-Telemetering system of Ubonrat dam

- Monitoring down stream water level

- Monitoring weather and take into consideration
- Communicate with N-E Hydrological center, RID

- Collect and analyze data from 16 gauging stations
- Flood mitigation by controlling flow released through Spillway as low as possible
- Flow release is to be planned according to current situation

(5). Fishery

Annually 1,000,000 kg. worth 42 million baht

(6). Environmental concern

Ecological flow release 300,000 m<sup>3</sup>/d (3.47 m<sup>3</sup>/s)

(7). Power generation : Annually produce 55 M.kwh



## Appendix 5.14

### Sio Yai Case study report

#### 1) Background (date of visit/contact person)

The Nongbo lake is a natural salty lake. One farmer pumped water for pig farm and found it was salty in early 1970 accidentally and it was the start of salt making industry. The local politician initiated salt making factory and employed neighboring farmers. There is saline layer at the depth of 20-30m in the underground in the area. In case of drought, fish except Tilapia in the lake could not survive due to increase of salinity. Upland is not suitable for farming due to salinity and 50% of the land can be cultivated. People cultivate paddy in the lowland.

In 1990, a big-scale flood pushed the lake water to the downstream and the paddy field was severely damaged. It triggered the conflict between salt making factory and farmers in the downstream. The protest against the salt making developed into a big-scale social protest moving including participation of students. In 1991, the government declared the prohibition of the salt making and dispatched military to settle down the conflict.

#### 2) Project Profile

##### ✓ Name / Objective / Purpose

The government bought all of the land and started Sio Yai project (construction dike of the Nongbo lake and the Sio river) in 1992 to mitigate farmland damaged by the salt.

##### ✓ Area: Maha Sarakham province, A. Borabu

##### ✓ Implementation Agencies: RID

##### ✓ Funding: RID

##### ✓ Project Period: 1990-2002

##### ✓ Major Component: dike constructions, dredging, on-farm ditch and weir construction for irrigation 41,940rai

##### ✓ Organizational Structure: not specified

##### ✓ Number of beneficially stakeholders: no information

#### 3) Findings

- In 2005, people were attacked by severe drought and it was a start of WUG organization. 40 farmers join in the WUG. It has no cooperation with other WUGs. The members requested RID to supply water for rice cultivation in wet season. It was the first time after several years that they realized that water from Nongbo can be used for rice production. People cultivate jasmine rice and Rice Division 6 (Koho 6).

- For salt damage prevention, there are some measures as follows:

- 1) Land leveling and storage of water in the flat area
- 2) Application of organic materials (manure and rice husk)

- 3) Mung Bean sowing to be used as green manure, however this trial failed since buffalo ate them.
- The issue of saline water was solved, however, water shortage becomes main issue in the area. In 1993, a tapioca powder product factory initiated their operation, which needs a large amount of water. The factory used underground water before, they shifted to tap water use due to deplete of underground water in 2005. Local government tries to settle down by sanction against the factory.

4) Annex (Photos, Map, and list of document collected)

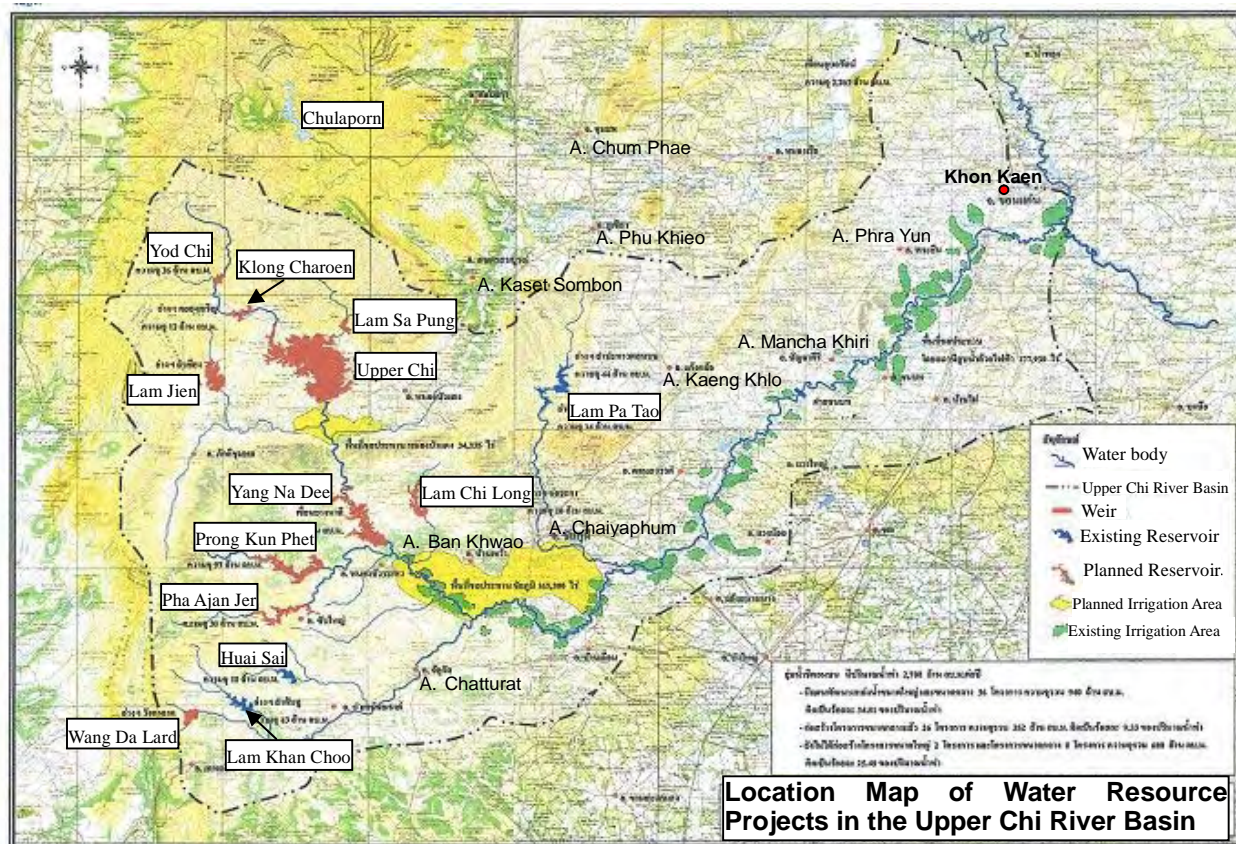


Saline soil around Nongbo Lake



Nongbo Lake surrounded by the dike

**Upper Chi River Basin Development Plan**



Source: Report summary: Upper Chi River Basin Development Plan, Chaiyaphum Province, RID, Construction office 13, large scale project office, July 2009

1) Introduction / Background

The Chi basin consists of 4 sub-basins as Upper Chi, Nam Phong, Lam Pao and Lower Chi sub-basins. There is no large reservoir in Upper and Lower Chi basins, therefore flood in these basins flows to downstream such as Khon Kaen, Kalasin, Maha Sarakham, Roi Et and Yasothon without control. In addition to that, drought in the Chi basin is caused by rainfall delay that affects agricultural area in rain-fed agricultural area including water scarcity for house consumption.

At initial stage, the Upper Chi Basin Development Plan was prepared and studied in 1964. Under the assistance of USBR (United State Bureau of Reclamation), “Preliminary of water resources development in Northeast basin”, namely, a Feasibility Study was implemented in 1971. The Project consists of construction of Chi Dam (capacity 1,860 MCM), Chi Diversion dam (capacity 90 MCM) and Chi-long water storage (110 MCM). All will support water for irrigated area of 224,000 rai in lower Chaiyaphum Province. However, those large scale projects were suspended by the Government for several decades. In 1988, it was advised by the European Communities (EC) to promote those projects term-wise, namely, short-term, medium-term and long term depending on implementation potential as shown below. At present, only construction of Lam Kan Choo Reservoir was complete and other projects have not been started. Out of those dams, the affected people by Yang Na Dee Reservoir construction and Prong Kun Phet Reservoir construction were interviewed by JICA Study Team.

a. Proposed short-term projects

Name of project	Water storage capacity and irrigated area	Current conditions as of 2010
Prong Kun Phet Reservoir*	96MCM and 100,000rai	It is suspended by protest of a local NGO (Assembly of the Poor) An social impact assessment by Kasetsart University was implemented and submitted to ONEP, yet to be approved
Lam Khan Choo Reservoir	42.6MCM and 47,500rai	Construction was complete (1991-1996), it irrigates 47,500rai

b. Proposed medium-term projects (large scale only)

Name of project	Water storage capacity and irrigated area	Current conditions as of 2010
Upper Chi Reservoir (Chi Bon Reservoir)	325MCM and 35,000rai	**RID has submitted EIA report to ONEP and the report has been already approved by the National Environmental Committee with condition. The condition is that RID can construct the reservoir, however, can not open the irrigable area (to construct canal system) due to saline soil problem. In addition to that, there are Land compensation and resettlement issues.
Yang Na Dee Reservoir*	70.21MCM and 165,300rai	

\* The highlighted project sites were visited by the JICA study team

\*\*Chi Bon Reservoir and Yang Na Dee Reservoir is the same package, meaning Chi Bon (Upper Chi) for upper reservoir and Yang Na Dee as the lower dam with the same irrigable area. Those 2 dams have the same problems.

c. Proposed long-term projects (medium scale only)

Name of project	Water storage capacity and irrigated area	Current conditions as of 2010
Yod Chi Reservoir	36MCM and 15,000rai	Not started
Klong Charoen Reservoir	12MCM and 5,000rai	Not started
Lam Jien Reservoir	50MCM and 40,000rai	Not started
Lam Chi Long Reservoir	11MCM and 6,000rai	Not started
Pha Ajan Jer Reservoir	30MCM and irrigated area is unknown	Not started
Wang Da Lard Reservoir	25MCM and 13,000rai	Not started
Lam Sa Pung Reservoir	32MCM and 24,000rai	Since the project area is under the Phkheaw Wildlife Sanctuary, the Commission Forest Reserves and Wildlife Protection did not approve the project

2) Profile of project, which were visited by JICA Study Team on 14<sup>th</sup> June 2010

(a) Yang Na Dee Reservoir

✓ Objectives:

- to develop water resource for agricultural area;
- to mitigate flood in community and agricultural areas;



- Water supply for house consumption, industry and tourism; and
- to develop of various sectors in Chi river basin
- ✓ water storage capacity: 70.21MCM
- ✓ Area to be irrigated: 165,300 rai
- ✓ Location: A. Ban Khwao, Chaiyaphum province
- ✓ Implementation Agencies: RID
- ✓ Total budget: 386 million Baht<sup>1</sup>
- ✓ Scheduled Project Period: not fixed
- ✓ Major Components :reservoir construction and canal system establishment

(b) Prong Kun Phet Reservoir

- ✓ Objective: To develop water storage capacity along Chi river, especially on Upstream of Chi river
- ✓ Water storage capacity: 97MCM
- ✓ Irrigated area:100,000rai
- ✓ Location: A. Nong Bua Rawae, Chaiyaphum province
- ✓ Implementation Agencies: RID
- ✓ Total budget: 233 Million Baht<sup>2</sup>
- ✓ Scheduled Project Period: not fixed
- ✓ Major Component: reservoir construction

3) Findings

The beneficiaries (also affected people) of Yang Na Dee Reservoir project welcome the project. The reasons for that are as shown below:

- Since the people have suffered from both flood and drought, they requested RID to construct the reservoir around 45 years ago. Therefore, people feel that positive impacts by the reservoir construction are more than the negative impacts.
- The negative impact is that the people’s land will be submerged after the construction. A part of 3 Tambons, namely, 16,000 rai will be submerged due to the project.
- RID implemented a study tour to the Lam Pao Dam twice so far, 40 people/village participated



People of Yang Na Dee Village, those who wait for the Yang Na Dee Reservoir construction for long time



Head of Yang Na Dee Village (right) will lose his farmland by the project, still he anticipates the project

<sup>1</sup> Source: Project Planning Division, RID, April 2009

<sup>2</sup> Source: the same above

in the tour to inspect the use of reservoir as aquaculture pond. The interviewed people joined and some of them have already started preparation of Tilapia culture. Therefore, the people anticipate the reservoir construction in terms of not only for flood/drought control but also their income increase.

On the other hand, some people and one local NGO protest against the Prong Kun Phet Reservoir project. The reasons for that according to a RID personnel and village head of Ban Kajuan are as follows:

- Originally, the affected people (around 170 households, Thai people only) migrated to their current places illegally around 40 years ago, where already had been specified as a forest conservation area under the control by the Royal Forest Department (RFD). The part of conservation area was deteriorated by the residents, therefore, RFD accepted that the deteriorated part of forest is provided as reservoir construction site to RID.
- Generally, RID does not have to provide illegal residents with compensation in case of involuntary resettlement, however, RID compromised to pay people B8,000/rai for farmlands. In addition to this amount, RID compensated for house constructions and planted crops. 80 households including the interviewed person, the village head of Ban Kajuan accepted the compensation and already moved to another area. However, the remaining people (90 households) did not accept the proposed compensation. RID had already finished payment (B20,000/rai) to the affected people by Lam Khan Choo dam project. Therefore, people to resettle are not happy with B8,000 /rai
- Even after the compensation payment, some households returned back to the area since the project was not started. Other people from outside also encroached to this area for compensation, since they got information that the residents can be paid.



Village head of Ban Kajuan, he has already received the compensation and moved



Distant landscape of the Prong Kun Phet Reservoir construction site

The NGO above mentioned (Assembly of the Poor) has different view on this matter as follows:

- The irrigated area is planned as 100,000rai, however, actual irrigated area will be decreased and it takes 10 years for the construction complete. There are many cases that surrounding people

cannot access to the benefit e.g. Rasi Salai weir.

- Amount of compensation fee provided to the affected people is satisfactory, however, it can lead to decrease of B/C ratio. In addition, some people purchased land beforehand to get the compensation.
- The affected people by the Prong Kun Phet Reservoir project are minority in terms of ethnicity, called as *Nyahkur*, a group of ancient Mon-Khmer and they rely on non-timber forest products such as palm tree for hand-craft and bamboo shoot or frogs as food. Therefore, the dam construction will give significant negative impacts on the people and it is difficult for them to access to compensation, since they do not have land title. Their occupational chances for them will be limited such as scavengers or prostitutes.
- Holistic study concerning environmental impacts is not implemented. Kasetsart University implements Social Impact Assessment (SIA) and some NGOs including Assembly of the Poor participate in the SIA as committee members. However, it gives only positive information to the people to persuade them. It is not participatory way but only one-way consultation.
- Water resource development is important in the Northeast and constructions of monkey cheek, weir and pond are more effective than dam constructions. RID is requested to change its concept concerning water resource development from only dam construction to other options based on people's idea.

#### 4) Lesson learnt

- Any project, which is formulated based on people's demand, can be acceptable and welcomed by them, even though some negative impacts are anticipated.
- Dam development promoter and protesters have contradictory views even in the same matters, e.g. the tribe in the Prong Kun Phet.
- All kinds of information should be opened in the transparent manner, showing both negative impact and positive impacts to the affected people

#### 5) List of document collected

- Collected report: "Upper Chi Basin Development Plan", RID, Chaiyaphum Province, Construction office 13, large scale project office, July 2009 (in Thai language)

## Appendix 5.16

### Huai Sappadoo Reservoir Irrigation Project (Medium Scale)

The project is under operation of Regional Office (RIO) 8.

Reservoir Total Capacity:	27,664,000 m <sup>3</sup>
Catchment Area:	168 km <sup>2</sup>
Irrigation Area:	Rainy Season 12,000 rai Dry Season 5,000 rai
Irrigation Canal Length:	28 km

Irrigation area is divided into seven (7) irrigation blocks. Rotational irrigation is executed among 7 irrigation blocks during 27 days in the rainy season.

In the dry season, paddy is cultivated only in No.1 block and bean and corn are cultivated in the block No.4,5,6 and livestock raising in No. 6and 7.

WUG is well functioning for management and maintenance of the project. Water allocation and maintenance work sharing is discussed in the meeting which is hold two times annually at the beginning of seasonal cropping.

Union due is collected only from the households cultivating paddy at the rate of 20 baht / rai. The collected amount is used for meeting cost and a part of maintenance cost.

The project is well managed and operated and it is resulted that 80 % out of whole villagers (700 households) own the pickup truck. This makes Huai Sappadoo Reservoir Project as the successful medium scale project.



Huai Sappadoo Reservoir



Irrigation Main Canal



Beneficial Area (Paddy field)  
(Block No.1)

## Appendix 5.17

### **Pilot Project for Poverty Alleviation and the Promotion of Food Security in Northeastern Thailand**

#### **① Lessons Learned**

Lesson 1: *The role of academic institutions in identifying problems facing the villagers and possible solutions thereof through participatory rural appraisal approach can be pivotal to poverty alleviation and food security.*

Using the participatory rural appraisal approach, academic institutions familiar with local conditions can identify problems confronting the villagers. They can potentially create awareness among them about the constraints which may prevent them to overcome their problems. The challenge may be enormous, but nonetheless academic staff can provide valuable guidance for the villagers in seeking solutions to their problems. Apart from academic institutions, research institutes or organisations of similar nature can carry out such tasks, which eventually lead to the identification of project activities at a later stage.

Lesson 2: *To arrive at a consensus, people's participation brings about common understanding of the stakeholders and, subsequently, facilitates the implementation of project activities.*

With people's participation, any project has a better chance of being accepted and sustained. Although success of the project output is not guaranteed, the villagers can understand why and how project output is attained. Over the course of implementation, they can help steer the way toward project goals. Difficulties or stumbling blocks can be reduced and even overcome with people's participation.

Lesson 3: *Villages are regarded as an integral part of poverty alleviation and food security. They are a unit of change.*

Villages comprise about 100 households, covering some 500 ha. of land, on the average. Within the villages, there are clusters, where farm houses are grouped together. But clusters are too small, and it can be a management problem, if efforts are directed at that level. On the other hand, villages are diverse, even if they are close by. This stems from the fact that natural resources and resource endowments are likely to be different among villages. In addition *Tambon* consists of a number of villages, usually 10-12, and has the advantage that, by law, *Tambon* Administrative Organisation is a legal entity. It is the local government at the lowest end of the strata, relatively well-equipped with staff, office space, and government budget including finance drawn from the revenue collected and

retained. The project thrust on villages will have to go through the TAO, if it is to have significant impact on poverty alleviation and food security.

Lesson 4: *Villages can be an efficient decision-making body, where they are given the opportunity.*

The villages in the past seldom made their own decision; it was up to higher authorities. At present, this has started to change; the bottom-up approach has become the rule of the day. The decision-making ability depends on the level of people's participation, and the level of knowledge acquired by the villagers and, more importantly, the village chiefs themselves. Networking, adoption of information technology and increased awareness of changes outside the villages have helped these village leaders to increase their capacity to deal with problems facing them. We have seen from the Pilot Project that village group leadership was instrumental to past achievements.

Lesson 5: *It is vital that the villagers adopt a common attitude toward project ownership, when dealing with project implementation, and subsequently, project output and outcome.*

The material assistance provided by the FAO was in most cases partial; the villagers had put up counterpart funding, mainly in kind, to complement the project inputs. Farmers' groups were formed to undertake and to supervise individual project activities. In so doing, they became owners of the Project, and took the responsibilities of achieving project output and outcome.

Lesson 6: *Wherever possible, a revolving fund is to be established in order to ensure a greater coverage to the rest of the village population, and sustainability after the project termination.*

The formation of farmers' groups was to ensure that part of the benefits received by members would be returned to the groups for further expansion. Cattle purchases were not sufficient to meet the needs of all members. With repayment at the end of the year, the money could then be used to buy more cattle which would benefit the rest of the group. Over time, all members would receive cattle they wanted. Thus there was a distinct advantage in setting up a revolving fund to finance cattle purchases. Such fund could continue, even at the end of the project.

Lesson 7: *The degree of participation and the quality of project output depends to a large extent on direct involvement and support of the agricultural extension service.*

Farmers' participation could be judged by the large turnout at meetings and by the questions and comments they made to local extension officers, particularly *Kaset Tambon*, and the team of project consultants. The visits were part of the project monitoring effort that worked out well. The two-way communication led to information-sharing and knowledge exchanges which proved to have important bearing on project output. The involvement of the agricultural extension service actually followed the directives given by the district and provincial committees, both of which operated under

the national committee. In addition, at the *Tambon* level, *Kaset Tambon* worked closely with the *Tambon* Administrative Organisation (TAO). This proved to be extremely valuable when the TAO provided extra funding to project activities.

Lesson 8: *Supervision and guidance by the government through multi-agency committees at varying levels contribute substantially to the smooth implementation of activities relating to poverty alleviation and food security, while assuring that government policies are being adhered to.*

It has been shown that the committees appointed under the Pilot Project have facilitated greatly to project implementation. Multi-agency coordination has been effective with the setting up of the committee comprising government departments involved in poverty alleviation and food security. At the national level, policy and programme coordination is more important, while coordination of field activities can be more easily executed through the mechanism of the provincial and district committees.

Lesson 9: *Farm inputs need to be readily acquired for distribution to the villagers. Untimely acquisition can end up in waste and delays in farm production.*

The delivery of fish fingerlings, seeds and seedlings was late for production as originally planned, and had to be postponed to the following cropping season. This could mean a delay of one year for certain crops suitable to be grown right after the rice harvest such as sesame. The fish had to be reared for a few months before being released into public ponds, when they were handed to the farmers in February, the time when the level of water was low. Thus more expedient acquisition of farm inputs is preferable. Under suitable guidance, the farmers' groups can themselves purchase these farm inputs in a relatively short time.

Lesson 10: *There are success stories in the Pilot Project from which other villages can learn and replicate.*

Success stories can be found in the pilot villages. Some of the examples are fish processing in Baan Thaboe which has proven to be a profitable business venture, tubewell construction in Baan Mieng and cattle production in Baan Taku and Baan Lumpuk. These and other success stories are explained in the next section.

## ② The Success Stories

### Success Story 1: Rice Cracker Production

The women's group in Baan Taku was established in 1999, producing woven cloth for sale. In 2002, it switched to rice cracker production with financial support from the *Tambon* Administrative Organisation (TAO), and later from the Pilot Project. The vacuum packaging and drying facilities,



valued at Baht 280,000 were provided by the FAO. They improved the quality and shelf-life of the cracker. The group had 24 members and was managed by 16 committee members. It had a system in which each member had to contribute her own labour to the production process. About 70% of the product is sold locally, ensuring that the market is less volatile. It had been producing the rice cracker for eight years, and in 2008 it produced 1000 kgs of the rice crackers and earned Baht 200,000. After deducting the costs of materials and dividends among the members, it retained Baht 100,000 for future production.

#### Success Story 2: Cattle Production

Fifty households registered themselves as the cattle raising group in Baan Taku, but since the money (Baht 216,500) provided by the FAO was sufficient to acquire 20 cattle for 20 of its members, the rest of the group would have to wait. The traditional practice adopted and promoted by the Livestock Development Department was that those who raised the cattle could retain the calves they produced and returned the cows for distributing to other members of the group. The process would take a few years before these members could have the opportunity to raise the cattle. The cattle-raising group in Baan Taku reached a consensus that those who received the cattle should repay in cash over a period of three years instead. The cattle would cost Baht 10,000 per head and the repayment scheme was Baht 3,000 for the first and the second year, and Baht 4,000 for the third year. Therefore all 50 members could receive the animals within four years instead of nine. So far the system was working quite well, and was actually adopted by another pilot village, Baan Lumpuk as well.

#### Success Story 3: Irrigation Improvement

Before the Pilot Project, only few households in Baan Taku could utilise the village water pond for farming. With the provision of water pumps and irrigation pipes by the FAO at the cost of Baht 58,000, twenty farm households started dry-season cropping in 26 rais of land in 2008. A year later, they expanded to 76 rais, growing valuable field crops and vegetables such as sweet corn, groundnut, cucumber and long bean. These were consumed within the households and the surplus sold in the market. In the wet season, pumping was used to irrigate the paddy field at times when water was needed. Such activities increased the level of food security among the villagers.

#### Success Story 4: Forage Production

Much of the farmland in Baan Aung was flooded in the wet season, because it is located near the Songkhram river. Cattle raising was difficult, as pasture was extremely limited. With the Pilot Project, a 30-rai tract of public land was acquired from the *Tambon* Administrative Organisation and converted into pasture. The land was sub-divided into 6 plots, each assigned to 5-6 group members. With Baht 150,000 from the Pilot Project, land preparation was carried out, and three shallow tubewells were constructed for irrigation purposes. Fertilisers were purchased and applied. Eucalyptus trees were planted as a hedge around the plot. The guinea grass recommended by the local livestock officer was grown and as a result, the forage production considerably reduced the

shortage of the cattle feed in the wet season. The 31-member group which owned 154 heads of cattle, in addition, agreed to charge initial contribution and annual payment among themselves. In 2009, the money collected was used to purchase two cows which members could borrow for rearing purposes. The seeds of the guinea grass were harvested and distributed to other villagers.

#### Success Story 5: Fish Processing

Two women's groups, consisting of 40 members altogether, have been established for ten years in Baan Thaboe, producing fermented fish for sale. The product could not be kept for a long time, and in order to extend its shelf-life, the Pilot Project allocated Baht 150,000 to purchase vacuum packaging machines and packaging materials for them. The product quality has since improved substantially, resulting in higher sales. In 2008, they produced 2,300 kgs of fermented fish and in 2009 the target was set at 4,000 kgs. The revolving fund for the two groups was Baht 140,000. As part of the agreement among group members, the profit was shared as follows: 50% for group members, 20% for maintenance and repair; 20% for the revolving fund; and 10% for community activities. The contribution by the women's groups to the village was well recognised.

#### Success Story 6: Tubewell Construction

With financial support of Baht 120,000 from the FAO through the Pilot Project, thirty tubewells were constructed in Baan Mieng village in 2008. But there were forty-nine farmers in the tubewell group. The group later decided that every member should have equal access to the tubewell project, and the first thirty farmers with the tubewells were requested to pay Baht 1,000 each to the group. With this as a revolving fund, ten more tubewells were constructed and another nine was planned for 2009. The water from the tubewells was used to grow vegetables such as shallot, chili, lettuce and long bean, for sale in the market and for their own consumption needs. The area irrigated was 69 rai, and the value of the production was estimated at Baht 2.85 million for the dry season of 2008-2009.

## Appendix 5.18

### The Project for Revitalization of the Deteriorated Environment in the Land Reform Areas through Integrated Agricultural Development / Stage 1” (PRO-IAD/ ALRO Project)

#### 1. Introduction/ Background

- Project is financed by Japanese ODA Loan and promote H.M. King’s Sufficiency Economy Concept through provision of farm pond

- Visited Site: Borabue District Hospital Green Market, Common plot for vegetable growing, learning site for Sufficiency Economy with standard size farm pond (1,260 cum) Mr. Sakorn, Expansion of farm pond with 6,000 cum Mr. Samboon

#### 2. Project Profile

1) Project Name: The Project for Revitalization of the Deteriorated Environment in the Land Reform Areas through Integrated Agricultural Development / Stage 1” (PRO-IAD/1

2) Project Objectives:

- - To increase farmer’s income for better standard of living of the farmers in the Land Reform Areas (LRAs) with development of agricultural infrastructure.
- To conserve the protected areas adjacent to LRAs and the environment in and around LRAs.
- To increase employment opportunities in LRAs through development of integrated agriculture.

Project Area: The project area is scattered over land reform Areas in 4 provinces of Khon Kaen, Maha Sarakham, Sakhon Nakhon and Mukdahan covering 300,000 rai (48,000 ha).

3) Implementation Agency: Agricultural Land Reform Office

4) Funding: Japanese ODA Loan 3,617 million Yen

5) Project Period: January 2001 – January 2011

6) Beneficiary Target farmers eligible to join in ALRO projects are those who hold a 4-01 certificate and amount to 20,520 farmers as of 2007, as given in table 1. The average farm size of eligible farmers is 15 rai (2.4 ha).

Table 1 Area and Beneficiaries of the Project

Province	District	Tambon	Village	Area (rai)	SPK 4-01 holder **		
					2001	2004	2007
Khon Kaen	8	17	88	107,300	2,800	4,803	7,544
Maha Sarakham	3	5	28	18,200	877	1,031	1,184
Sakhon Nakhon	4	9	80	115,080	3,335	6,456	7,824
Mukdahan	1	4	35	59,420	2,562	3,401	3,968
<b>Total</b>	<b>16</b>	<b>35</b>	<b>231</b>	<b>300,000</b>	<b>9,574</b>	<b>15,691</b>	<b>20,520</b>

\* Number of Districts, Tambons and Villages is number of concerned local administrations. Project area may be only part of these administrative boundaries.

#### **Findings on Lessons Learnt during the Field Visit June 15, 2010 (Maha Sarakham)**

##### Green Market at Bora Bu, Maha Sarakham

In the land reform areas, a project is being implemented to support integrated(Mixed) farming with

provision of farm pond and etc. Green market is one to promote organic farming in the project area. The green market has been operated in the compound of the Bora Bu hospital since 2016, regularly on every Tuesday from 06:00 to around 10:00. At present 15 farmer members join in the sales of their organic products, vegetables, fruits and some processed products. Organic farming has been guided and trained by the extension workers as well as the intensively operating skilled farmers and accepted by the member farmers positively due to the advantages in accelerating the improvement of soil property and farmers health.

#### Lessons Learnt:

\*In the effort to raise up the farm families' income in NE, value-adding organic farming is considered as one of the important factors.

\*Expansion of marketing area/volume with increased production of organic products through creating network in the neighboring areas may be one direction to be enhanced for further development of sustainability.

\*Number of the member farmers has been reduced to almost 1/2 as compared with the original number due to the difficulties in increasing the yield and transporting the products to the market. While there are some farmers intending to be a new member. In this concern, some counter-measures should be taken including increase of market places responding to the increased production and possible improvement in the access from farms to market, though not so easy in actual doing.

\*In the rainy season, vegetables are seemed not easy to be produced due to the difficulty of flooding and etc. In the dry season, however, cultivation is easier according to the member farmers and considered that integrated /combined farming with rice cropping may be one direction to improve the overall management as a whole.

#### Integrated farming practice with farm pond in ALRO area

Interview/hearing was made with a farmer in rain-fed area, where provided with a farm pond built under the ALRO-JBIC project. The capacity of pond is 6,000 CM and 3 number of farm labor manage 2.5 Ha farm land. They keep 3 heads of water buffaloes and 8 number of cows. Under the project, they converted their operation from <Paddy+cassava> to <Paddy+vegetables> and the vegetables are sold at the green market at the hospital.

#### Lessons Learnt:

\*In the areas where water supply by large scale irrigation system is difficult /impossible, providing farm pond individually for each farmer is considered as most effective way for improved production.

\*Cassava production brings about higher gross income but due to the higher cost of input as fertilizer and etc., the net income/profit is limited only at about 20,000 Baht. After the conversion as above-mentioned, the profit increases to about 40,000-50,000 Baht. This implies that the project contributed to the betterment of the quality of life since the farmers judge they do not need to go out for working in Bangkok and some cases in Taiwan and other overseas countries.

## Appendix 5.19

### **Sky Irrigation Project by PDA (Population and Community Development Association)**

Since the mid-1990s, farmers in the seasonally arid Northeast of Thailand have been using the Sky Irrigation or Vegetable Bank concept to obtain year-round supplies of irrigation water. The irrigation systems are designed for collective management and are used for intensive cultivation of cash crops by groups of villagers. To support this technique, villagers receive basic training in vegetable cultivation as well as accounting, management, and the formation and operation of a cooperative.

Vegetable Banks enable villagers to earn up to 3,000 Baht/month, which is several times their income before joining the project. The project has significantly improved the livelihood of villagers, and has reduced the migration rates out of rural areas.

Vegetable Banks are generally established on public land. Each member is allotted a plot of land approximately one-half rai (800 square meters). Water is pumped from a deep well or surface water source and stored in several concrete storage tanks. A system of pipes distributes water from these tanks to each plot. Villagers normally water their crops with watering cans.

Villagers in the project assist in the construction of the systems under technical advice of PDA staff. System establishment costs approximately 18,000 Baht/member and is paid back by the villagers. The repaid construction costs are used to construct new Vegetable Banks in other villages or for community projects according to the wish of the donors.





A village water management committee, consisting of 11 members, manages the Vegetable bank, collects water-usage fees from individual members, and helps in the production and marketing of the vegetables.

Vegetable banks are in operation in over 100 villages in the Northeast of Thailand. The Vegetable Banks are established through the Sky Irrigation Project with support of the German Agro Action, and by a number of private national and international sponsors under the Village Development Partnership program.

(<http://www.pda.or.th/eng/sky.asp>)

**Appendix 5.20**

**Small Scale Irrigation Project by Project Type**

NUMBER OF PROJCTS CLASSIFIED INTO PROJECT TYPES  
(Constructed during FY 1977 – FY 1997)

RID	Regions	Project Type					Budget	Irr.Area
Region		Reserv.	Weir	Reg.	Others	Total	(฿)	(Rai)
1-3	North	493	781	246	329	1,849	7,133,668,422.00	3,664,398
4-6	North-East	2,389	1,345	16	313	4,063	11,928,831,878.00	2,222,342
7-9	Central	493	645	107	144	1,389	6,387,670,868.00	2,130,954
10-12	South	68	533	188	200	989	5,356,024,882.00	1,285,120
	Total	3,443	3,304	557	986	8,290	30,806,196,050.00	9,302,814

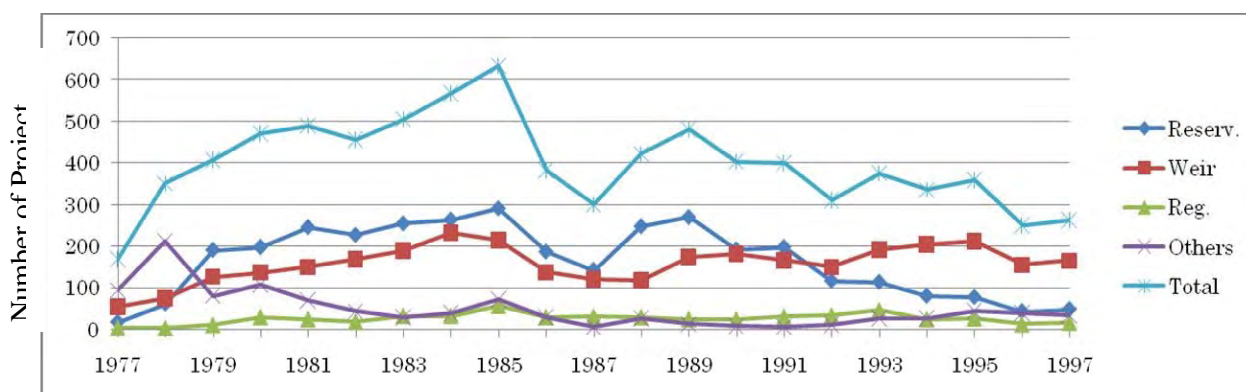
Source: 1988, RID, small scale project construction Division

Small Scale Irrigation Project Constructed in FY 1977 – 1997 (Project Type in RID. Region 1-12)

Fiscal year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Reserv.	17	61	190	197	245	226	254	263	290	186	142	247	269	191	197	116	113	80	77	43	48
Weir	53	74	126	136	150	168	189	233	215	137	120	118	174	181	166	150	191	204	212	155	165
Reg.	5	4	11	30	25	19	33	33	57	30	31	30	25	24	31	34	46	25	27	13	17
Others	94	212	81	108	70	43	29	39	72	29	7	27	13	8	6	11	26	27	44	39	34
Total	169	351	408	471	490	456	505	568	634	382	300	422	481	404	400	311	376	336	360	250	264

**SMALL SCALE IRRIGATION PROJECT (SSIP)**

Constructed in FY 1977 – 1997



Fiscal

## Appendix 5.21

### Lower Northeast Medium Scale Irrigation Package

(1) Reservoir and Dam		Lam Plai Mat	Nong Lum Puk	Huai Phlu
<u>Description</u>	<u>Unit</u>	<u>Sub-Project</u>	<u>Sub-Project</u>	<u>Sub-Project</u>
(i) <u>Location</u>				
Changwat		Nakhon Ratchasima	Nakhon Ratchasima	Buriram
Amphoe		Soeng Sang	Soeng Sang	Ban Kruat
Tambon		Nong Son Bun	Kut Bot	Nong Mai Ngam
Muban		Rat Burana	Nong Lum Puk	Nong Mai Ngam
(ii) <u>River Basin</u>				
River		Lam Plai Mat	Lam Plai Mat	Lam Chi Noi
Drainage area	sq.km	Lam Plai Mat	Huai Nong Lum Puk	Huai Phlu
Annual Mean	mm	485	25	21
Rainfall	MCM	1,065	1,065	1,312
Annual Mean Runoff		77.4	4.37	4.61
(iii) <u>Reservoir</u>				
Reservoir Area	sq.km	10.4	1.2	1.44
Total Resv. Capacity	MCM	97.3	4.38	6.32
Effect. Resv.	MCM	90.0	4.0	6.0
Capacity	MCM	7.3	0.38	0.32
Dead Water Capacity	EL-m	264.6	236.0	245.0
High Water Level	EL-m	261.8	235.0	243.8
Full Water Level	EL-m	246.6	228.6	233.7
Low Water Level				
(iv) <u>Dam</u>				
Type		Zone	Homogeneous	Homogeneous
Height	m	44.6	12.0	20.0
Length	m	1,160	1,156	844
Crest Elevation	EL-m	266.6	237.0	247.0
Flood Capacity	cu.m/s	984	100	83
Intake Capacity	cu.m/s	11.83	0.39	0.91
Embankment	10 <sup>3</sup> cu.m	1,656	190	275
Volume				
(2) <u>Diversion Weir</u>				
<u>Description</u>		<u>Lam Plai Mat Sub-Project</u>		
(i) <u>Location</u>				
Changwat		Buriram		
Amphoe		Pa Kham		
Tambon		Nong Bua		
Muban		Khok Khao Ya Kha		
(ii) <u>River Basin</u>				
Basin		Lam Plai Mat		
River		Lam Plai Mat		
Drainage Area		1,050 sq.km		
Annual Mean Rainfall		1,065 mm		



(iii) <u>Weir Body</u>	
Type	Concrete Ogee Solid Gravity
Height	2.6 m
Length	240 m
High Water Level	EL 212.0 m
Full Water	EL 209.5 m

(iv) <u>Scouring Sluiceway</u>	
Sluiceway Length	20 m
Radial Gate	(6 m x 2.25 m) x 3 sets

(v) Intake Facilities	
Intake Capacity	9.29 cu.m/s
Intake Width	13.2 m
Sluice Gate	(2.2 m x 2.0 m) x 3 sets (1.8 m x 2.0 m) x 3 sets

(3) Canal System				
<u>Sub-Project</u>	<u>Lam Plai Mat</u>	<u>Nong Lum Puk</u>	<u>Huai Phlu</u>	
<u>Administrative Division</u>				
Changwat	Nakhon Ratchasima & Buriram (2)	Nakhon Ratchasima(1)	Buriram(1)	
Amphoe	3	2	1	
Tambon	8	4	2	
Muban	61		9	
(i) Lam Plai Mat Sub-Project				

<u>Description</u>	<u>Unti</u>	<u>Sub-Systems</u>					<u>Total</u>
		<u>Sra Khian</u>	<u>Ta Sang</u>	<u>Soeng Sang</u>	<u>Pa Kham</u>	<u>Thai Charoen</u>	
Intake Point		Dam		Dam	Weir	Weir	
Service Area	Ha	940		1,010	2,000	5,150	9,100
Discharge Capacity	cu.m/s	1.22		1.31	2.60	6.69	11.82
Length of Main Canal	km	25.8		12.3	30.4	26.4	94.9
No. of Lateral Canals		9		7	19	32	67
Length of Lateral Canal	km	9.6		17.4	20.9	72.3	120.2
Length of Drainage Canal	km	5.9		5.3	5.9	27.4	44.5

(ii) Nong Lum Puk and Huai Sub-Project			
<u>Description</u>	<u>Unti</u>	<u>Nong Lum Puk</u>	<u>Huai Phlu</u>
Intake Point		Dam	Dam
Service Area	Ha	300	700
Discharge Capacity	cu.m/s	0.39	0.91
Length of Main Canal	km	10.2	19.8
No. of Lateral Canals		3	10
Length of Lateral Canal	km	2.5	8.8
Length of Drainage Canal	km	—	0.7

## (4) On-Farm Work and Muban Communal Facilities

		Irrigation Service							
		Ordinary Service Unit		Muban Cooperative Service Unit		Collective Seedling Unit		Muban Pond	
		No.	Ave.Size (ha)	No.	Ave.Size (ha)	No.	Ave.Size (ha)	No.	Ave.S ize (ha)
<u>Lam</u>	<u>Plai</u>	336	27	55	14.5	63	2.4	31	1.4
<u>Mat</u> <u>Sub-Project</u>									
	Sra Ta Khian	37	25	8	11.3	11	2.9	5	1.1
	Soeng Sang	39	26	6	13.3	8	5.5	5	1.2
	Pa Kham	76	26	13	16.9	13	0.9	6	1.9
	Thai Charoen	184	28	28	14.6	31	2.1	15	1.5
<u>Nong</u>	<u>Lum</u>	15	20	4	7.5	4	2.3	31	1.4
<u>Puk</u> <u>Sub-Project</u>									
<u>Huai</u>	<u>Phlu</u>	37	19	7	5.7	9	0.3	7	0.9
<u>Sub-Project</u>									

Source: 1994. JICA F/S Report

## Appendix 5.22

### Key Indicators in Kok-Ing-Nan Water Diversion Project

#### 1. General Features of Chao Phraya and Kok-Ing Basin

Item	Unit	Chao Phraya Basin			Kok-Ing Basin
		Upper	Lower	Total	
(1) Basin Area	10 <sup>3</sup>	124.1	33.8	157.9	15.0
(2) Population, 1996	10 <sup>6</sup>	9.6	12.5	22.1	1.5
(3) Farm Land Area	10 <sup>6</sup> rai	23.8	12.3	36.1	2.4
(4) Water Resources	10 <sup>6</sup>	27.8	4.5	32.3	8.0
(5) Irrigation Area, Existing	10 <sup>6</sup> rai	6.6	8.0	14.6	1.0
Future(2016)	10 <sup>6</sup> rai	12.1	8.0	20.1	1.8
(6) Irrigation Intensity Existing	%	28	65	40	43
Future	%	51	65	56	75
(7) G.R.P. Per capita 1996	10 <sup>3</sup> rai	28	137	90	19
2016	10 <sup>3</sup> Baht	61	470	275	27

#### 2. Developed Water by project

- (1) Diversion Water by Project 2,000MCM
- (2) Dry Season Outflow at Sirikit Dam 2,810MCM

#### 3. Beneficial Area and Water Allocation

- (1) Municipal and Industrial Water Supply in Delta 825MCM
- (2) Irrigation Water Supply in Delta and Lower Nan 1,985MCM
- Total 2,810MCM
- (3) Incremental Dry season Area in Delta 714,000rai
- (4) Incremental Dry season Area in Lower Nan 469,000rai
- Total 1,183,000rai

#### 4. Outline of Project Facility

- (1) Kok Intake 140cu.m/sec at Kok River
- (2) Kok-Ing Diversion Canal 54.4km between Kok intake and Ing weir
- (3) Ing Diversion weir 175cu.m/sec at Ing River
- (4) Ing-yot Diversion Canal 11.1km between Ing Weir and Ing-Yot Tunnel
- (5) Ing-Yot Long Tunnel 52.9km with 7 Inclined Adits of 17.4km
- (6) Yao Flood Control Dam Rockfill Type, Reservoir Capacity of 32 MCM
- (7) Yao River Training River Length of 49km

- 5. Associate Irrigation Project Area in Kok-Ing and upper Nan 303,000rai

## 6. Project Cost

Kok-Ing-Nan Water Diversion Project	43,386 Million Baht
Including Related Projects such as Associate, etc.	55,083 Million Baht

## 7. Incremental Project Benefit

Municipal and Industrial Water Supply	2,766 Million Baht
Agriculture	11,722 Million Baht
Hydropower Generation	570 Million Baht
<u>Total</u>	<u>15,058 Million Baht</u>

## 8. Economic Evaluation

Raw Water Cost	1.3 Baht/cu.m
EIRR	15.8%

Source: 1999, JICA F/S Report (Summary)

## 9. Feasibility

According to the final report, it did not fixed whether the project is feasible or not, even though EIRR of the project sufficiently high. JICA considered that it was essential to implement EIA in planning process in addition to the project level EIA which had been implemented by the Government of Thailand. On the other hand, according to the F/S report prepared by the Government of Thailand, it is concluded that the project is feasible. However, the project has not yet been implemented, because it is affected by the economic crisis during 1997-2001 in Thailand<sup>1</sup>. The project is still listed up as one of projects to be implemented in the NESDB investment plan.

Following is the extract of the report on “The Study on the Kok-Ing-Nan Water Diversion Project in the Kingdom of Thailand: Main Report: Feasibility Study (1999, Nov.)”, which describes Conclusion and Recommendations.

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<sup>1</sup> Source: RID, 2002, Feasibility and Environmental Impact Study Kok-Ing-Nan Project, Executive Summary

## **CHAPTER 14. CONCLUSIONS AND RECOMMENDATIONS**

- (1)** The irrigated agriculture in the upper Chao Phraya basin tends to expand, reducing the flow of the Chao Phraya river at Chainat from where water is diverted and distributed to the existing large-scale irrigation projects in the delta. Water demand in the delta also tends to increase because of agricultural, urban and industrial development. If these tendencies continue as they are, water resources especially in dry season will become short seriously in future. (Under the current water resources development policy as well as agricultural development policy including crop diversification program, about 4,000 MCM of water will be deficient in dry season in future.) Probable shortage of water in future would be far beyond of saving by means of effective operation and management of water, however, it is an urgent necessity to consider the comprehensive measures of water resources management aiming at sustainable development of limited water resources.
- (2)** In case that decision is made to take actions to mitigate the chronic shortage of water prevailing over the Chao Phraya basin during dry season, water diversion as studied by the F/S can be considered as one of effective measures from engineering point of view. Possible actions inclusive of improvement of operation rules of the existing storage, such as some 640 MCM of additional dry season release from the Sirikit reservoir proposed by the F/S, should however be taken to cope with the immediate needs of dry season water. A series of water balance scenarios within a possible range are shown in this report for further consideration of appropriate actions by the Thai side. About 8,000 MCM of the water resources in the Kok and Ing basins are very valuable for the peoples living in the basin, however most of them are released unused to the Mekong river at present. On the basis of the maximum development of the potential water resources in eventual future, the JICA Study estimated the volume of water to be reserved in the basins and in turn available water for diversion. However, to lead the implementation of the proposed project into success, it is necessary to continue the public relation activities with full information regarding the EIA and other studies including participatory rural appraisal etc, aiming to arrive at the common consent and understanding among the residents in the donor basins.
- (3)** In view of the magnitude of influence that might be caused by the water diversion, public relation activities should be executed not only in the Kok, Ing and upper Nan basins but also in the direct beneficiary areas in the lower Nan and Chao Phraya delta, and further at the national level. Water allocation and operation in the Chao Phraya seem to be done well making the use of its scale merit, however, the risk of water shortage even in wet season in future should be fully recognized by all concerned.
- (4)** In view of a critical condition of balance between demand and supply of water, "Water Resources Management" in the Chao Phraya basin is of quite importance. It is therefore necessary to establish a responsible organization to take charge of this (Strengthening of National Water Resources Committee, Establishment of Basin Authority, etc.).
- (5)** For the sustainable development of water resources and rationalization of water use, it is recommended to collect water charge from water users. In the case of the water diversion, it is desirable to allocate a part of the collected charge for development of the Kok and Ing basins.
- (6)** The JICA environmental technical assistance study was carried out focusing on review of RID's EIA study and supplemental study in due consideration of watershed conservation and sustainable rural development. Regarding EIA as it ought to be, RID is recommended to refer the conclusion and recommendation of the JICA environmental technical assistance study for future consultation with OEPP.

Modernization on Water Management Project

## Summary of Evaluation

<b>1. Outline of the Project</b>	
<b>Country: Thailand</b>	
<b>Project Name:</b> The Modernization of Water Management System Project in Thailand (MWMS)	
<b>Sector:</b> Agriculture	
<b>Type of Cooperation:</b> Technical Cooperation Project	
<b>Sector in Charge:</b> Department of Rural Development	
<b>Total Cost:</b> 574 million yen (estimation as of end of FY 2003)	
<b>Period of Cooperation</b>	1 Apr. 1999 – 31 Mar. 2004 (5 years)
	Follow-up Cooperation: 1 Apr. 2004 – 30 Sep. 2005 (1.5years)
<b>Partner Country's Related Organizations:</b> Royal Irrigation Department (RID) and Department of Agricultural Extension (DOAE), Ministry of Agriculture and Agricultural Cooperatives	
<b>Supporting Organization in Japan:</b> Ministry of Agriculture, Forestry, Fisheries	
<b>Related Cooperation: -</b>	
<b>1-1 Background of the Project</b>	
<p>Agriculture in Thailand largely depends on the water resource of the Chao Phraya River. Although the potential in the Chao Phraya Delta for high-value integrated cropping system is high, water recourse use is still inefficient due to the problems, such as lack of irrigation water in the dry-season and unplanned water use at the on-farm level. The Government of Japan implemented technical cooperation projects of "Irrigation Technology Center Project (Phase I&amp;II)" during 1985-1997 in cooperation with Royal Irrigation Department (RID) to develop appropriate technology for planning, designing, and construction of irrigation scheme and drainage facilities, and to establish water management technology. However, development of practical technical capacity on efficient water resource use was considered insufficient at the end of the projects. Therefore, the Government of Thailand requested the Government of Japan to implement a technical cooperation project on the improvement of practical on-farm level water management technique based on irrigation facilities developed by the previous technical cooperation projects.</p> <p>In response to the request, JICA conducted two preliminary studies and confirmed that the Government of Thailand aimed not only securing water resource in the dry season, but also promoting crop diversification and expansion of the planting area. Accordingly, "The Modernization of Water Management System Project in Thailand (MWMS)" was implemented from April 1999 for the project period of five years. After the completion of the project, a follow-up cooperation project was implemented for the period of 1.5 years to enhance the project effect.</p>	
<b>1-2 Overview of the Project</b>	
(1) Overall Goal	
<ol style="list-style-type: none"> <li>1) Farmers' income through sustainable farming is increased (10-20 years after the completion of the project).</li> <li>2) In the Upper East Bank of the Chao Phraya Delta, the planted acreage of dry-season's field crops that presupposes effective irrigation water utilization is expanded, and crop diversification is also promoted (3-5 years after the completion of the project).</li> </ol>	
(2) Project Purpose	
In dry-season's irrigation period, through effective irrigation water utilization, the planted acreage of dry-season's field crops in the Model Area (18R canal area) is expanded, and crop diversification is also promoted.	
(3) Outputs	
<ol style="list-style-type: none"> <li>1) Rehabilitation of on-farm level irrigation/ drainage facilities for cultivating both rainy-season's rice and dry-season's field crops at the Model Area and lateral level irrigation facilities, and expansion of related guidelines.</li> </ol>	

- 2) Development of water management method by utilizing tele-metering system for the Chao Phraya River Basin and decision support system to enable RID officers and farmers compare the planned and actual data of water allocation.
- 3) Establishment, training, and strengthening of water users' groups, and operation/maintenance of irrigation/ drainage facilities under lateral canal level by the water users' group.
- 4) Selection of field crops and their cultivation methods for dry-season, and acceleration of farming activities through establishment and strengthening of the farmers' groups and supporting system.
- 5) Training of RID, DOAE and selected farmers' group leaders through scheduled training courses and seminars by counterparts.

(4) Inputs

Japanese Side:

Long-term Experts 10 persons Provision of Equipment Appr. 63 million yen  
 Short-term Experts 30 persons Local cost Appr. 35 million yen (Total up to FY 2002)  
 Training in Japan 25 persons

Thai Side:

Assignment of counterparts 56 persons  
 Project Cost Appr. 49.5 million baht (Total up to FY2002)  
 Land, Building, and facilities  
 Others: Necessary equipment other than provided by JICA, Repair cost of 18R canal, tele-metering pilot project cost, etc

**2. Evaluation Team**

<b>Evaluator</b>	Takehiro Iwaki, IC Net Asia Co., Ltd		
<b>Field Study Period</b>	9 February 2009 – 30 June 2009	<b>Type of Evaluation:</b> Ex-Post Evaluation	

**3. Achievement after the Completion of the Project**

**3-1 Achievement of Project Purpose**

Indicator 1: By the end of March 2004, non-paddy field crops are cultivated more than 35 hector during the dry season in the model area

Indicator 2: Weekly water allocation plan at the lateral irrigation canal level is made for the

Chainat-Pasak canal area and implemented

As can be seen in the table below, cultivation of the non-paddy field crop during the dry-season has been shrunk. Therefore, it can be said that the project purpose has not been achieved nor sustained. On the other hand, development and implementation of the weekly water allocation plan at the lateral irrigation canal level has been maintained. The amount of actual allocation of the irrigation water compared to the planned amount has been within the target set by the follow-up cooperation.

Cultivation of the dry-season field crop in the model area	2004/5	05/6	06/7	07/8
Area of cultivation (hector)	20	3	3	2
Number of farms	25	3	2	1
Number of commodities	12	7	7	7

**3-2. Achievement of Overall Goal**

Indicator 1: Farmers' agricultural income through sustainable farming system (10-20 years after the completion of the project)

Indicator 2: By the end of 2009, dry-season field crop is practiced at more than 200 hector in the East Bank of the Chao Phraya Delta (3-5 years after the completion of the project)

As presented in the table below, cultivation area of the dry-season field crop in the in the East Bank of the Chao Phraya Delta has been drastically decreased since the time of the commencement of the project. Regarding increase in the farmers' income from agriculture, there was no appropriate statistic data available during the evaluation study.

However, many persons contacted during the study reported that the expansion of the paddy cultivation area and increase in the productivity due to the development of irrigation facilities and improvement in the water management have been contributing to the increase in the agricultural income of farmers .

Dry-season cultivation area in the East Bank of the Chao Phraya Delta	99/00	04/05	07/08
Cultivation area (,000 hector)	117.4	134.4	175.8
Dry-season paddy	114.6	133.3	175.4
Dry-season non-paddy field crops	2.8	1.2	0.4

### 3-3 Measures Taken Regarding to the Recommendations of the Terminal Evaluation

The extension of the project to have additional achievements based on the outputs gained was recommended by the terminal evaluation. Based on the recommendation, 1.5-year follow-up cooperation was implemented.

## 4. Result of Evaluation

### 4-1 Summary of the Evaluation Results

#### (1) Confirmation of Relevance

Although relevance of the project was considered high in terms of policy and needs for improvement in the water management system. However, overall relevance of the project is considered low because of the following reasons. Soil condition at the project model area was not suitable for the field crop cultivation, and needs of farmers on dry-season field crop was considered low. It is questionable whether there was sufficient consideration on the problems and countermeasures for the promotion of dry-season field crops. The framework of the project was considered logical, however, as the scope of the project was broadened, detail measures to solve the constraints on promoting dry-season field crop in the model area were not designed comprehensively.

Regarding the decision on the follow-up cooperation, careful examination of the constraints on dry-season field crop cultivation and feasibility of extension to the target farmers should have been done and proper countermeasures, including possibility of change in the project design, should have been carefully decided. It is questionable whether the pursuance of the achievement of the project purpose by the follow-up cooperation without any change in the original plan was a realistic decision.

#### (2) Confirmation of Effectiveness

As the project activities did not result in the achievement of the project purpose, effectiveness of the project is evaluated as low. There were not many farmers who cultivated dry-season field crop due to reasons such as unsuitability of the soil, relative low economic incentive on cultivating dry-season field crops, and higher risk for cultivating field crops.

#### (3) Confirmation of Efficiency

As discussed in the terminal evaluation, it can be said that the project was implemented efficiently in terms of dispatch of the Japanese experts, allocation of counterpart personnel, provision of equipment, and project management. However, as also pointed out in the terminal evaluation report, absence of long-term experts in the field of agronomy and delay in the dispatch of experts in the field of soil management seriously affected the project negatively.

#### (4) Impact

Overall goal of the project has been unlikely achieved. On the other hand, some positive impacts of the project were recognized in the field of on-farm facility and water management system as below. Negative impact of the project was not identified during the ex-post evaluation study.

- Contribution to the promotion of Participatory Irrigation Management (PIM) by the clarification of the role and of management methods of the water users' group.
- Extension of the U-shaped ditch, which is easier to construct, using less land, and more durable compared to the ordinal ditch.



- Contribution to the increase in dry-season rice cultivation areas and in the productivity through effective water management by the development of water allocation plans at river basin level and the water users' group.

#### (5) Sustainability

As the project purpose has not been achieved, there was no rationale for examining the sustainability of the project as a whole. Hence, in this ex-post evaluation study, sustainability of the project effect in the water management sector and dry-season field crop sector was examined respectively.

Sustainability of project effect in the field of water management sector is considered high. Policy to improve the water management system has been sustained. The government has put more importance on the water users' group in its water management policy. At the Upper-East Bank of the Chao Phraya Delta, concerned organizations of the project have been maintaining coordinated work for the development and implementation of the water allocation plan and other works. However, sharing of information between the organizations in the field and RID headquarters is appeared insufficient. It is also recognized that the effort to disseminate the products and lessons gained from the project have been insufficient.

For the dry-season field crop sector, the sustainability of the project effect cannot be considered as the cultivation of the dry-season field crop has been rarely practiced in the project model area. Farmers may practice dry-season field crop with the use of knowledge and skill learned from the project in the future when external factors turns advantageous to the cultivation of the dry-season field crop. However, the possibility to see this situation in the near future is considered low.

#### 4-2. Promoting Factors

It is considered that the promotion of Participatory Irrigation Management (PIM) in Thailand has contributed to the strengthening and expansion of the water users' group. Increasing awareness on environment and natural resource management is also recognized as another external factor which contributed to sustain the project effect. It can be said that direct benefits for the formers from project activities, such as increase in the water allocation and improvement of on-farm facilities, were important factors for the strengthening and expansion of the water users' group.

The project made effort to organize activities through various systems, such as water management decision making supporting system, water allocation coordination system by water allocation management committee, and participatory irrigation management system. This systematic and comprehensive implementation of the activities was considered effective for the continuation of the activities after the completion of the project.

#### 4.3 Disturbing Factors

It seems that real needs and constraints of farmers on practicing dry-season field crop were not well considered and reflected during the project planning. This is considered as a major factor to inhibit the generation of the project effect.

Unsuitability of the soil at the project model area for field crop cultivation and constrains for dry-season field crop cultivation were recognized by the concerned persons at the field level during the designing stage of the project. However, this recognition was not much considered in the project design. Therefore, it can be said that the achievement of project purpose was not highly realistic from the beginning of the project.

Relatively high price of rice is considered as a constraint for the emergence of the project effect. Although it was not possible for the project to control the rice price, monitoring of important external factor, such as rice price, and consideration of countermeasures, including the modification of the project design, is considered as an important part of the project management.

#### 4-4. Conclusion

The project purpose that promoting the dry-season field crop cultivation and crop diversification in the project model area has not been achieved at the time of this ex-post evaluation. Problems in the project design, such as selection of the model area where soil condition is not appropriate for the field crop cultivation and less attention to the needs and constraints on dry-season field crop cultivation, are considered as major constraints to

achieve the project purpose.

On the other hand, project activities in the field of water management, such as strengthening of the water users' group, have been widely accepted by the concerned people, including farmers in the model area, and continued to contribute to the expansion of cultivation area of dry-season rice crop and increase in the productivity. It is expected that these project effects accumulated in the model area is shared and introduced in the other area by the initiative of RID.

Regarding the dry-season field crop cultivation, farmers in the project model area may have an option to cultivate the field crop in the dry-season when economic incentive changed advantageously to the field crop, such as shortage of sufficient water for rice cultivation in the dry-season and decline in the rice price. However, the possibility that it would happen is considered low.

#### **4-5. Recommendations**

- (1) Sharing of project achievement in the field of water management system with other regional irrigation offices

Extended use of the project achievement in the field of water management system, such as U-shaped ditch and water users' group, was already observed during the ex-post evaluation study. The mechanism to share these project achievements should be established with the initiative of RID.

- (2) Review of the project achievement by RID

To promote the first recommendation mentioned above, it is considered important for RID headquarters to conduct a thorough review of the project. It can include field visit to the project site and implementation of a short study.

- (3) Survey on the water users' group and integrated water users' group

It is recommended to systematically understand the development and current situation of the water users' group and integrated water users' group in Thailand. The success factors, challenges and contribution of this project should be clarified. It is expected that this kind of study contribute to the further strengthening and expansion of the water users' group.

- (4) Improvement of the water management decision making supporting system

The water management decision making supporting system developed with the support of the project has been well used. Data regarding water resource and management are entered at each irrigation operation and management office, and shared through the website. However, RID also maintains its own database based on the same data sent from irrigation operation and management offices by FAX. Therefore, it is recommended for RID to consider the improvement of the system for more efficient operation of this system.

#### **4-6. Lessons learnt**

- (1) Lessons learnt regarding the project design

From the experience of the project, the importance of setting realistic project purpose by comprehensively analyzing various internal and external factors can be withdrawn as a lesson learnt. It is also important to carefully reflect the information and ideas of the stakeholders, particularly at the field level, to formulate a realistic project. The flexible project management including timely modification of the project design is also raised as an important lesson learnt from the project.

- (2) Importance of follow-up mechanism to expand and sustain the project effect

In this project, there were no concrete plans to expand and sustain the project effects after the completion of the follow-up cooperation. Eventually, the continuation and dissemination of the project related activities depended fully on the intention of the counterparts and the beneficiaries. It is important for a "model development project," like this project, to set a concrete follow-up plan with relevant stakeholders before the completion of the project.

***Appendix 6 Development Scenarios for The Northeast Region***

Appendix 6.1 Scenario and Potential Water Resources Projects in the Northeast  
(Irrigation Area)..... 6-1

Appendix 6.2 Scenario and Potential Water Resources Projects in the Northeast  
(Investment Cost)..... 6-2

Appendix 6.1 Scenario and Potential Water Resources Projects in the Northeast (Irrigation Area)

Potential Project	Existing	Scenario A				Scenario B				Scenario C				Total (incl. existing)	Long Term 2027~2040	Total (incl. existing)
		Short Term 2011~2016	Medium Term 2017~2026	Long Term 2027~2040	Total (incl. existing)	Short Term 2011~2016	Medium Term 2017~2026	Long Term 2027~2040	Total (incl. existing)	Short Term 2011~2016	Medium Term 2017~2026	Long Term 2027~2040	Total (incl. existing)			
<b>I. Development Project: Expansion of Irrigation Area</b>																
Routine Type Project		1,062	755	17,950	19,767	863	1,526	1,510	3,899	819	300	450	1,569			
Large Scale Project	2,454	199	213	0	2,866	0	600	800	2,454	0	300	400	2,454			
Upper Chi																
Chi Hoa Dam		34														
Yung An Dam		165														
Yung An Dam		165														
Phong Kim Phi Dam			213													
Lam Dong Yai																
Medium Scale Project	1,485	150			1,635	150	300	400	2,335	150	300	400	1,635			
Small Scale Project	565 (*)	150			715	150	300	400	1,415	150	300	400	1,415			
Estuary Barrage Type Project	(62)	219	276	50	545	219	0	50	207	219	0	50	207			
Nam Nam Kiem Project		26				26				26						
Nam Songnam Lower Project		93				93				93						
Huoi Luang Estuary Barrage			276													
Others				50	50											
<b>Pump Irrigation (Medium Scale)</b>		30			30	30	60	60	150	30	60	60	150			0
<b>Pump Irrigation (Small Scale)</b>	1,544	300			1,844	300	600	600	3,044	300	600	600	1,844			0
<b>Inter-basin Diversion Project</b>																
LPC Project (Phase I)		14	166		180	14	166		180	14	166		180			0
KLCM Project				17,900	17,900											0
Water Grid Project				(800)	(800)											0
Medium Scale Water Network																
<b>Rehabilitation Project</b>																
Large Scale Project		300	175	(670)	1,760	(375)	(2815)	(3175)	6,365	(900)	(675)	(555)	1,530			225
Lam Pao Dam		50	175		225	50	175		225	50	175		225			
Other Large scale project		(120)	(240)	(240)	(600)	(120)	(240)	(240)	600	(120)	(240)	(240)	600			
Medium Scale Project		(75)	(150)	(150)	(375)	(150)	(300)	(450)	900	(75)	(150)	(150)	375			
Small Scale Project																
Facilities Consolidation Project																
On-farm (Land Consolidation)	(300)	(55)	(225)	(280)	(560)	(65)	(2100)	(2485)	(2,680)	(55)	(110)	(165)	(2,680)			
<b>Rain-Fed Area (Farm Pond)</b>																
Individual Farm Pond	(55)	(50)	(100)	(205)	(310)	(65)	(100)	(150)	(315)	(400)	(100)	(150)	(705)			
Community Water Management	(0.05)	(50)	(100)	(150)	(205)	(80)	(100)	(150)	(330)	(50)	(100)	(150)	(480)			
<b>Water Reservoir</b>																
Project-wise																
Lam Pao Dam		200			200	200			200	200			200			200
Ubonrat (O/M under EGAT)		200			200	200			200	200			200			200
Other Large & Medium Reservoir		10	10	10	30	10	10	10	30	10	10	10	30			30
RBCs-wise																
Khung																
Chi																
N																
Regional Integration																
Total	6,048	1,522	940	17,960	26,470	1,323	1,711	1,520	10,602	1,279	485	460	8,272			14.5
Irrigation Rate (%)	10.6	(+) 2.7%	(+) 1.6%	(+) 31.5%	46.4	(+) 2.3%	(+) 3.0%	(+) 2.7%	18.6	(+) 2.2%	(+) 0.8%	(+) 0.8%	14.5			
<b>Beneficiaries (1,000 families)</b>																
New Irrigation	15 rabi/hi	141	203	1,241	1,585	149	389	462	1,001	475	165	217	857			
Rehab. and Improvement	15 rabi/hi	71	50	1,197	1,318	58	102	101	260	55	20	30	105			
Rain-fed Improvement	1 PPP/hi	20	53	45	117	25	45	211,666667	424	400	100	150	650			
Increase of Paddy Production (1,000 t/year)		438 t	311 t	7,395 t	8,124 t	356 t	629 t	622 t	1,606 t	337 t	124 t	185 t	546 t			
Major Paddy (340-> 590kg/rai)	250 kg/rai	266	189	4,488	4,942 t	216	382	378	975 t	205	75	113	592 t			
Dry Paddy (540kg/rai, 30%)	540 kg/rai	172	122	2,908	3,202 t	140	247	245	632 t	133	49	73	254 t			

Appendix 6.2 Scenario and Potential Water Resources Projects in the Northeast (Investment Cost)

Potential Projects	Scenario A				Scenario B				Scenario C			
	Short Term 2011~2016	Medium Term 2017~2026	Long Term 2027~2040	Total	Short Term 2011~2016	Medium Term 2017~2026	Long Term 2027~2040	Total	Short Term 2011~2016	Medium Term 2017~2026	Long Term 2027~2040	Total
<b>1. Development Project: Expansion of Irrigation Area</b>												
<b>Routine Type Project</b>	26,283	415,193	454,232	895,708 M.B. 96%	21,783	35,050	32,200	89,033 M.B. 42%	20,783	4,500	6,000	31,283 M.B. 37%
<b>Large Scale Project</b>	12,750	0	0	12,750	8,250	16,500	22,000	46,750	8,250	4,500	6,000	18,750
Upper Chi	4,500			4,500 0.5%	0			0	0			0
Chi Bon Dam	3,075											
Yang na Dee Dam	1,425											
Pong Khun Pet Dam	350											
Lam Dom Ya												
<b>Medium Scale Project</b>	6,000	0	0	6,000 0.7%	6,000	12,000	16,000	34,000 38%	6,000	0	0	6,000 19%
<b>Small Scale Project</b>	2,250	0	0	2,250 0.3%	2,250	4,500	6,000	12,750 14%	2,250	4,500	6,000	12,750 41%
<b>Estuary Barrage Type Project</b>	8,033	6,843		14,876 1.7%	8,033	0		8,033 9%	8,033	0		8,033 26%
Huai Nam Kain Project	6,033				6,033				6,033			
Huai Luang Estuary Barrage	2,000				2,000				2,000			
Nam Songram Lower Project		6,843				6,843						
Others												
<b>Pump Irrigation</b>	5,100	0	0	5,100 0.6%	5,100	10,200	10,200	25,500 29%	4,500	0	0	4,500 14%
Pump Irrigation (Medium Scale)	600	0	0	600	600	12,000	12,000	3,000	0	0	0	0
Pump Irrigation (Small Scale)	4,500	0	0	4,500	4,500	9,000	9,000	22,500	4,500	0	0	4,500
<b>Inter-basin Diversion Project</b>	400	408,350	454,232	862,982 96.3%	400	8,350	0	8,750 10%				
LPC Project (Phase I)		8,000				8,000						
KLCM Project		400,000	406,377	806,377								
Water Grid Project		47,855	47,855	47,855								
Medium Scale Water Network	400	350		750	400	350						
<b>2. Rehabilitation and Improvement of Efficiency</b>	5,725	14,675	12,000	32,400 M.B. 3%	7,225	45,800	51,075	104,100 M.B. 49%	5,725	12,950	10,275	28,950 M.B. 34%
Large Scale Project	3,400	8,300	4,800	16,500	3,400	8,300	4,800	16,500	3,400	8,300	4,800	16,500
Lam Pao Dam	1,000	3,500			1,000	3,500			1,000	3,500		
Others	2,400	4,800	4,800		2,400	4,800	4,800		2,400	4,800	4,800	
Medium Scale Project	1,500	3,000	3,000	7,500	3,000	6,000	9,000	18,000	1,500	3,000	3,000	7,500
Small Scale Project	0											
Facilities Consolidation Project												
On-farm (Land Consolidation)	825	3,375	4,200	8,400	825	31,500	37,275	69,600	825	1,650	2,475	4,950
<b>3. Improvement of Rain-Fed Area</b>	2,750	5,500		8,250 M.B. 1%	3,995	5,500	8,250	17,745 M.B. 8%	14,000	(5,500)	(5,500)	25,000 M.B. 29%
Individual Farm Pond (1,200cu.m)	(1,500)	(3,000)		(4,500)	(1,995)	(3,000)	(4,500)	(9,495)	12,000	(3,000)	(3,000)	(18,000)
Community Water Management	(1,250)	(2,500)		(3,750)	(2,000)	(2,500)	(3,750)	(8,250)	(2,000)	(2,500)	(2,500)	(7,000)
<b>4. Water Resources Management</b>												
Project-wise												
Lam Pao Dam												
Ubonrat												
Other Large & Medium Reservoir												
River Basin-wise												
Khong												
Chi												
Mun												
Regional Integration												
Total	34,758	435,368	466,232	936,358 M.B. 100%	33,003	86,350	91,525	210,878 M.B. 100%	40,508	22,950	21,775	85,233 M.B. 100%
	6,952	43,537	31,082	31,212	6,601	8,635	6,102	7,029	8,102	2,295	1,452	2,841