

## About the MRC

### Visions and Mission

#### VISION for the Mekong River Basin

An economically prosperous, socially just and environmentally sound Mekong River Basin

#### VISION for the Mekong River Commission

A world class, financially secure, International River Basin Organization serving the Mekong countries to achieve the basin Vision

#### MISSION of the Mekong River Commission

To promote and coordinate sustainable management and development of water and related resources for the countries' mutual benefit and the people's well-being

**The Mekong River Commission (MRC)** was established in 1995 by an agreement between the governments of Cambodia, Lao PDR, Thailand and Viet Nam.

[The Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin](#) came about as the four countries saw a common interest in jointly managing their shared water resources and developing the economic potential of the river. Signed on 5 April 1995, it set a new mandate for the organization "to cooperate in all fields of sustainable development, utilization, management and conservation of the water and related resources of the Mekong River Basin". The agreement brought a change of identity for the organization previously known as the Mekong Committee, which had been established in 1957 as the Committee for Coordination of Investigations of the Lower Mekong Basin - the Mekong Committee.

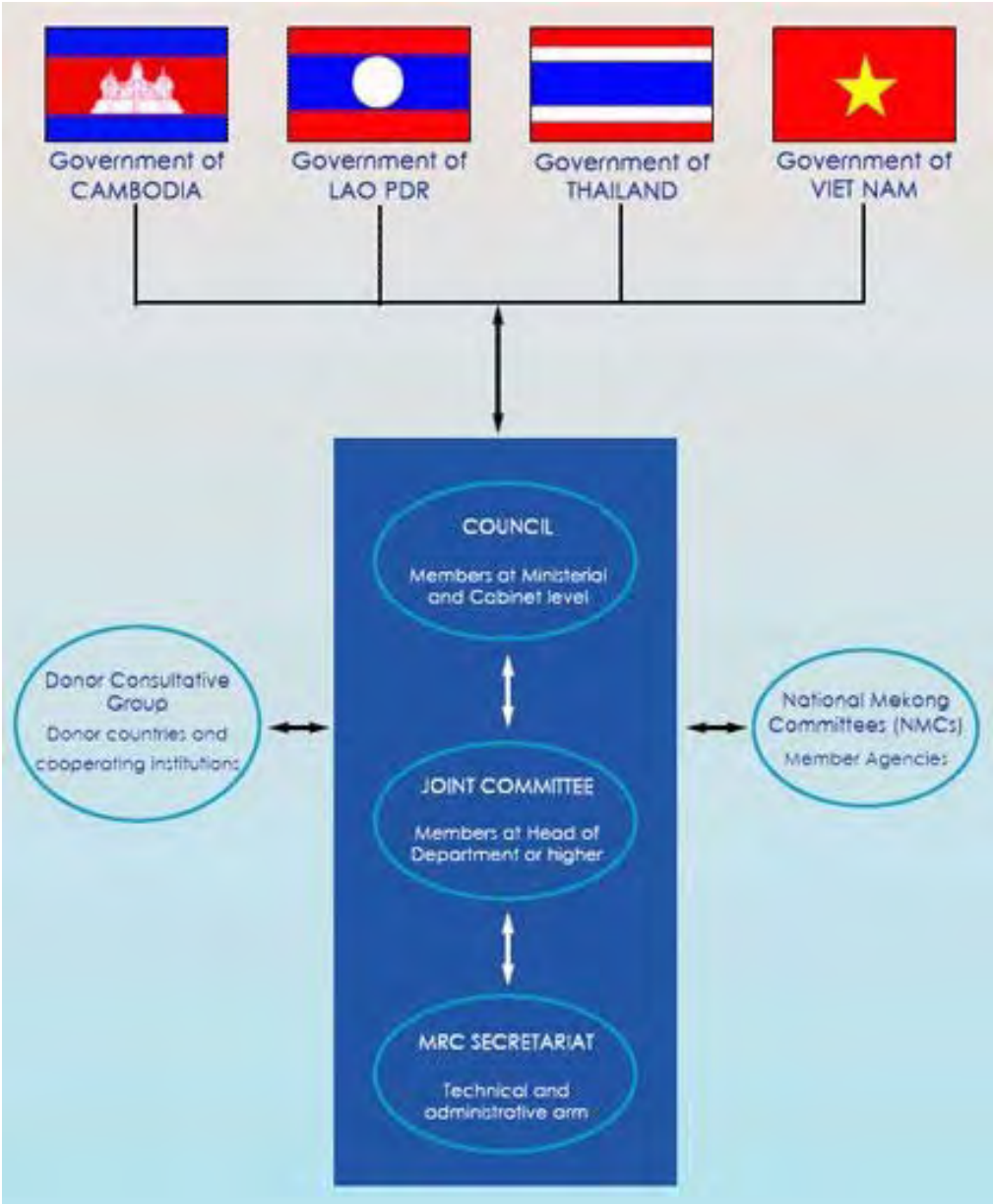
Since the 1995 Agreement, the Mekong River Commission (MRC) has launched a process to ensure "reasonable and equitable use" of the Mekong River System, through a participatory process with [National Mekong Committees](#) in each country to develop procedures for water utilization. The MRC is supporting a joint basinwide planning process with the four countries, called the Basin Development Plan, which is the basis of its Integrated Water Resources Development Programme. The MRC is also involved in fisheries management, promotion of safe navigation, irrigated agriculture, watershed management, environment monitoring, flood management and exploring hydropower options.

The two upper states of the Mekong River Basin, the People's Republic of China and the Union of Myanmar, are dialogue partners to the MRC.

The MRC is funded by contributions from the four member countries and from aid donors. Formal consultation with the donor community is carried out through an annual Donor Consultative Group meeting.

**Structure**

The MRC consists of three permanent bodies: The Council, the Joint Committee (JC) and the Secretariat.



**The Council**, which meets once a year, consists of one member from each country at ministerial or cabinet level. The Council makes policy decisions and provides other necessary guidance concerning the promotion, support, co-operation and co-ordination of joint activities and

programmes in order to implement the 1995 Agreement. The Council has overall governance of the Mekong River Commission.

### **Members of the MRC Council**

#### **CAMBODIA**

##### **H.E. Mr Lim Kean Hor**

Minister of Water Resources and Meteorology  
Chairman of Cambodia National Mekong Committee  
Member of the MRC Council for Cambodia

#### **LAO PDR**

##### **H.E. Ms Khempheng Pholsena**

Minister to the Prime Minister's Office  
Head of Water Resources and Environment Administration (WREA)  
Chairperson of Lao National Mekong Committee  
Chairperson of the MRC Council for 2008/2009  
Member of the MRC Council for the Lao PDR

#### **THAILAND**

##### **H.E. Mr Suwit Khunkitti**

Minister of Natural Resources and Environment  
Chairman of Thai National Mekong Committee  
Member of the MRC Council for Thailand  
Chairman of the MRC Council for 2009/2010

#### **VIET NAM**

##### **H.E. Dr Pham Khoi Nguyen**

Minister of Natural Resources and Environment  
Chairman of Viet Nam National Mekong Committee  
Member of the MRC Council for Viet Nam

**The Joint Committee (JC)** consists of one member from each country at no less than Head of Department level. The Joint Committee is responsible for the implementation of the policies and decisions of the Council and supervises the activities of the Mekong River Commission Secretariat. This body functions as a board of management.

### **Members of the MRC Joint Committee**

#### **CAMBODIA**

##### **H.E. Mr. Pich Dun**

Secretary General of Cambodia National Mekong Committee  
Acting Member of the MRC Joint Committee for Cambodia  
Cambodia National Mekong Committee

#### **LAO PDR**

##### **Mme. Monemany Nhoibouakong**

Permanent Secretary, Water Resources & Environment Administration  
Chairperson of the MRC Joint Committee for 2009/2010  
Member of the MRC Joint Committee for Lao PDR  
Lao National Mekong Committee Secretariat

#### **THAILAND**

##### **Mr Saksit Tridech**

Permanent Secretary  
Ministry of Natural Resources and Environment  
Vice-Chairman of Thai National Mekong Committee  
Member of the MRC Joint Committee for Thailand  
Thai National Mekong Committee

#### **VIET NAM**

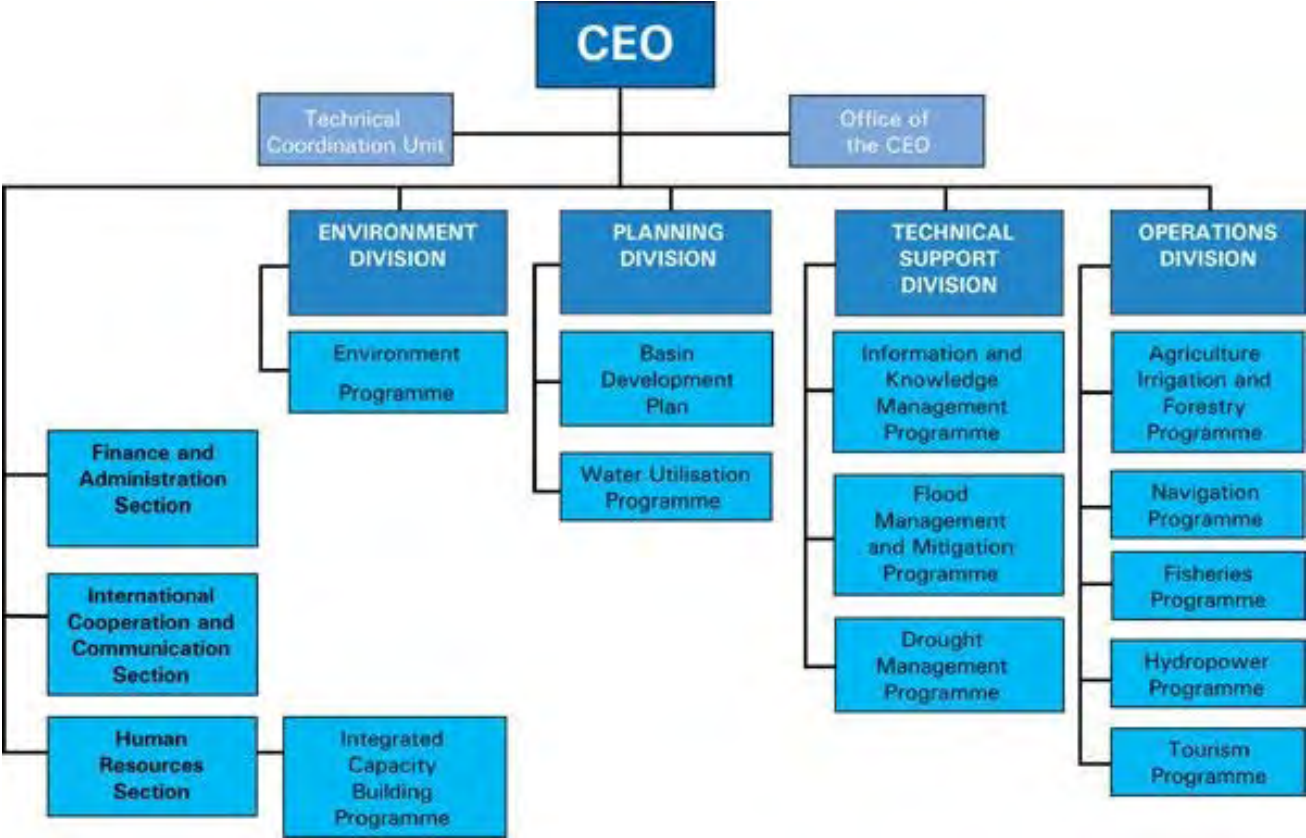
##### **Dr. Le Duc Trung**

Director General  
Member of the MRC Joint Committee for Viet Nam  
Viet Nam National Mekong Committee

**The MRC Secretariat**

The MRC Secretariat is the operational arm of the MRC. It provides technical and administrative services to the Joint Committee and the Council, is under the direction of a Chief Executive Officer (CEO) who is appointed by the Council. Under the supervision of the Joint Committee, the Chief Executive Officer (CEO) is responsible for the day-to-day operations of around 155 professional and general support staff. The Sixteenth Meeting of the MRC Council in Hua Hin, Thailand on 26 November 2009 decided that the MRC Secretariat would be permanently co-hosted in two locations, the Office of the Secretariat in Vientiane (OSV) and the Office of the Secretariat in Phnom Penh (OSP). The Assistant CEO is of the same nationality as the Joint Committee Chair and serves a one-year term. One of the two Directors located in OSP will be designated as Head of the Office of the Secretariat in Phnom Penh. The main counterparts for MRC activities in the four member countries are the National Mekong Committees (NMCs).

**MRCs operational structure**





Office of the Secretariat in Vientiane



Office of the Secretariat in Phnom Penh

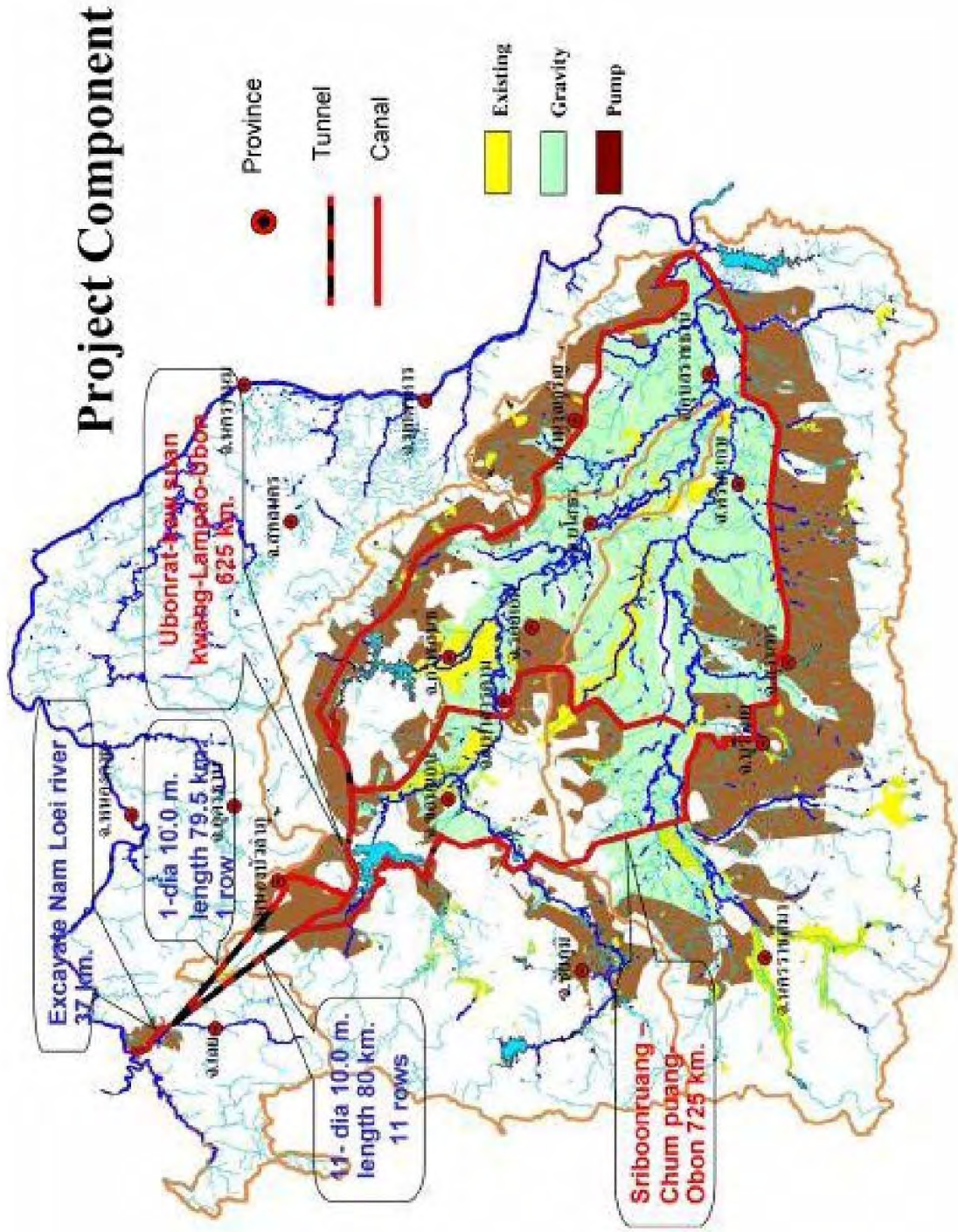
**The National Mekong Committees** coordinate MRC programmes at the national level and provide links between the MRC Secretariat and the national ministries and line agencies. The principal implementing agencies of the MRC programmes and projects are the line agencies of the riparian countries in the Lower Mekong Basin. They are served by the respective National Mekong Committee Secretariats in each country.

#### **Dialogue Partners China and Myanmar**

In 1996 The MRC held its first Dialogue Meeting with its Dialogue Partners China and Myanmar. On 1 April 2002 The People's Republic of China signed an agreement on the provision of hydrological information on the Lancang/Mekong River. Under this agreement China now provides water level data in the flood season from two stations located on the Upper Mekong in China. This information is fed into the MRC's flood forecasting system. Talks are under way to expand this data sharing agreement to include dry season levels. China contributes 16% of the flow of the Mekong River.

### Appendix 3.13.1 RID Diversion Plan

#### --Khong – Loei – Chi – Mun Water Diversion Project



Data Source: Power Point Data of RID

**Appendix 3.13.2 (1) Table of Project Plan abstracted from “Investment Plan on Water Management & Irrigation” provided by Water Development and Management Committee for Water Resources and Irrigation, July 2008 (NESDB)**

**1.1 Investment Plan on Water Management and Irrigation**

Project	Work unit	No. of project	Cost (Million Baht)						
			Total	2009	2010	2011	Y 2009-11	Y 2012-14	Y 2015-20
1. Water Sources Rehabilitation Plan	DWR	6,552	14,942	4,477	5,029	14,942	100,181	123,987	62,486
2. Irrigation System Development Plan	RID	1,120	285,653	15,484	33,888	50,809	16,213		
- Small Scale Irrigation Project	RID	940	15,213	4,536	6,226	5,451	25,816	22,113	
- Medium Scale Irrigation Project	RID	154	47,929	4,016	9,491	12,309	58,152	101,874	62,486
- Large Scale Irrigation Project	RID	26	222,511	6,932	18,171	33,049	17,915	4,194	
3. Inundation Mitigation Plan			22,109	3,587	6,397	7,729	17,915		
3.1 Watershed area rehabilitation plan			9,883	2,381	3,771	3,731	9,883		
1) Weir construction	DWR, DNP, RFD		1,906	372	817	717	1,906		
2) Forest revival and ecology improvement	DNP, RFD		1,819	548	606	663	1,819		
3) Vetiver growing	DNP, RFD		249	83	85	81	249		
4) Safety taking care for community in forest	DNP		403	138	128	137	403		
5) Water and Soil conservation, top soil protection, and land slide	LDD		5,506	1,240	2,133	2,133	5,506		
3.2 Inundation Protection Plan in community area	DPT		12,226	1,206	2,626	3,998	8,032	4,194	
<b>Total</b>			<b>322,704</b>	<b>23,548</b>	<b>45,314</b>	<b>73,480</b>	<b>118,096</b>	<b>128,181</b>	<b>62,486</b>

**Summary on Investment Plan on Water Management and Irrigation by Work unit**

Work unit	Cost (Million Baht)						
	Total	2009	2010	2011	Y 2009-11	Y 2012-14	Y 2015-20
<b>MOAC</b>	<b>291,156</b>	<b>16,724</b>	<b>35,021</b>	<b>52,943</b>	<b>104,688</b>	<b>123,987</b>	<b>62,486</b>
Royal Irrigation Department (RID)	285,652	15,484	32,888	50,810	99,182	123,987	62,486
Department of Land Development (LDD)	5,506	1,240	2,133	2,133	5,506		
<b>MONRE</b>	<b>19,318</b>	<b>5,617</b>	<b>7,075</b>	<b>6,627</b>	<b>19,319</b>		
Department of Water Resources (DWR)	16,022	4,603	5,961	5,458	16,022		
Department of National Parks, Wildlife and Plant Conservation (DNP)	3,058	852	1,037	1,168	3,058		
Department of Forestry (RFD)	239	162	77	-	239		
<b>Ministry of Interior</b>	<b>12,226</b>	<b>1,206</b>	<b>2,826</b>	<b>3,998</b>	<b>8,032</b>	<b>4,194</b>	
Department of public works and town & country planning (DPT)	12,226	1,206	2,826	3,998	8,032	4,194	
<b>Total</b>	<b>322,700</b>	<b>23,547</b>	<b>44,922</b>	<b>63,568</b>	<b>132,039</b>	<b>128,181</b>	<b>62,486</b>

### Appendix 3.13.2 (2) Inundation Mitigation Plan

Summary on Watershed Area Rehabilitation Plan and Inundation Mitigation Plan Year 2009-2011 : by Work Unit									
Work plan	Work unit	Cost (million Baht)				Target		Unit	
		Total	2009	2010	2011	2012	Total		
1 Watershed area rehabilitation plan		9,883	2,381	3,771	3,731	-	-		
1.1 Weir construction	DWR, DNP, RFD	1,906	372	817	717	-	139,408	places	
1.2 Forest revival and ecology improvement	DNP, RFD	1,819	548	608	663	-	1,075,410	rai	
1.3 Vetiver growing	DNP, RFD	249	83	85	81	-	148	M no.	
1.4 Safety taking care for community in forest	DNP	403	136	128	137	-	-		
1.5 Water and Soil conservation, top soil protection, and land slide	LDD	5,506	1,240	2,133	2,133	-	1,110,000	rai	
2 Inundation Protection Plan in community area	DPT	12,226	1,206	2,828	3,998	4,194	-		
<b>Total</b>		<b>22,109</b>	<b>3,567</b>	<b>6,599</b>	<b>7,729</b>	<b>4,194</b>			

Inundation Mitigation Plan Year 2009-2011 : by Several Work Unit									
Work plan	Work unit	Cost (million Baht)				Target		Unit	
		Total	2009	2010	2011	2012	Total		
<b>Watershed area rehabilitation plan</b>		<b>9,886</b>	<b>2,381</b>	<b>3,771</b>	<b>3,731</b>				
Department of Water Resource	DWR	1,080	126	525	429				
1 Watershed area improving weir		1,080	126	525	429		4,320	places	
Department of National Parks, Wildlife, and Plant Conservation	DNP	3,058	851	1,039	1,169		1,188,089		
1 Revival of watershed forest		1,065	345	360	360		295,750	rai	
2 Garden enrichment for 2-6 years old		318	14	105	200		334,700	rai	
3 Improving of ecology system in watershed area		114	48	33	33		173,120	rai	
4 Improving of ecology system in watershed area, Year no.2-6		117	4	43	70		216,640	rai	
5 Weir construction		806	231	288	288		132,083	places	
6 Vetiver growing		235	71	81	81		143	m no.	
7 Community buffer zone		118	37	41	41		34,745	km.	
8 Mountain water tap		31	16	8	8		417	places	
9 Community water tank		37	22	8	8		491	tanks	
10 Project management		217	63	72	82				
Department of Forestry	RFD	239	162	76	-		58,211	-	
1 Revival of the forest in watershed area Project		205	138	67	-		55,200	rai	
2 Weir Construction Project		20	15	5	-		3,005	places	
3 Vetiver Growing Project		14	9	4	-		6	m no.	
Department of Land Development	LDD	5,506	1,240	2,133	2,133		1,110,000		
1 Perennial tree growing included soil and water conservation in unused agricultural area		900	180	360	360		150,000	rai	
2 Soil and water conservation in agricultural area has risk of losing top soil		1,800	400	700	700		450,000	rai	
3 Soil and water conservation in area has risk of land slide		2,806	660	1,073	1,073		510,000	rai	
<b>Inundation Protection Plan in Community Area</b>		<b>12,226</b>	<b>1,206</b>	<b>2,828</b>	<b>3,998</b>	<b>4,194</b>			
Department of public works and town & country planning	DPT	12,226	1,206	2,828	3,998	4,194	-		
1 Design Study on Inundation Projection system in Community Area		354	35	154	77	88	19 provinces	32 places	
2 Policy scheme project		979	322	310	279	68	13 basins	22 places	
3 Construction of project system for Muang community area		10,893	849	2,364	3,642	4,038	18 provinces	39 places	
<b>Grand Total</b>		<b>22,109</b>	<b>3,587</b>	<b>6,599</b>	<b>7,729</b>	<b>4,194</b>			



### Appendix 3.13.2 (3) Water Sources Rehabilitation Plan

Water Sources Rehabilitation Plan, Fiscal Year 2009-2011 by Region : DWR									
Region	Year 2009-2011		Year 2009 Investment cost (Million Baht)	Year 2010 Investment cost (Million Baht)	Year 2011 Investment cost (Million Baht)	Benefit area (Million rai)	Beneficiary (household)	Storage Capacity (MCM)	
	No. of places	Investment cost (Million Baht)							Percentage
North	2,011	4,527	1,226	1,851	1,449	0.99	93,739	251.56	
Northeast	1,189	4,887	1,451	1,782	1,653	0.53	148,837	339.43	
Central	846	3,815	1,379	1,132	1,304	0.49	88,507	216.45	
South	2,506	1,713	421	671	622	0.18	28,479	27.57	
Whole Country	6,552	14,942	4,477	5,436	5,029	2.19	359,562	834.76	

Water Sources Rehabilitation Plan, Fiscal Year 2009-2011 by Activities : DWR									
Activities	Year 2009-2011		Year 2009 Investment cost (Million Baht)	Year 2010 Investment cost (Million Baht)	Year 2011 Investment cost (Million Baht)	Benefit area (Million rai)	Beneficiary (household)	Storage Capacity (MCM)	
	No. of places	Investment cost (Million Baht)							Percentage
Water source conservation	590	4,290	2,313	1,142	835	0.205	94,824	382.57	
Weir strengthen for ecology system	4,712	505	116	228	166	0.006	1,156	0.41	
Improving of water source structure	968	4,869	421	1,933	2,515	1.816	230,711	403.85	
Spillway	189	3,711	1,132	1,515	1,063	0.103	18,347	3.60	
Water distribute system	41	462	306	43	114	0.030	9,850	-	
Reservoir	52	1,105	189	580	336	0.029	4,674	44.32	
Whole Country	6,552	14,942	4,477	5,436	5,029	2.190	359,562	834.76	

**Appendix 3.13.2 (4) Summary on Work Plan/Investment Project (Land and Construction), Fiscal year 2009, DWR (Northeast)**

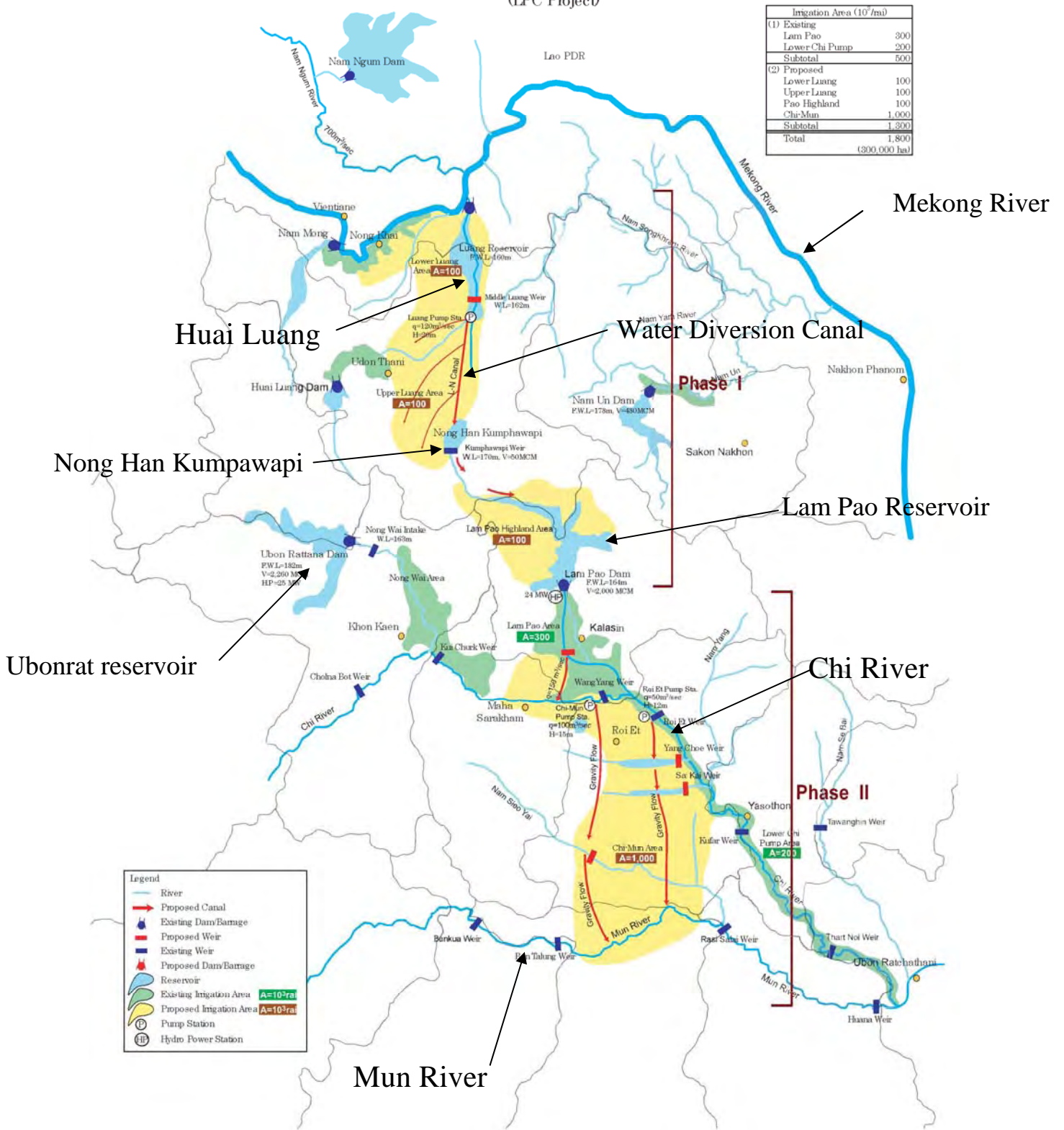
Unit: Million Baht

Provinces	Total		Ecology system strengthening		Reservoir		Water distribute system		Spillway		Water source conservation		Improving of water source structure	
	Places	Budget	Places	Budget	Places	Budget	Places	Budget	Places	Budget	Places	Budget	Places	Budget
<b>Whole Country Total</b>	<b>1,013</b>	<b>4,477,0000</b>	<b>538</b>	<b>116,2722</b>	<b>8</b>	<b>188,7700</b>	<b>19</b>	<b>306,6950</b>	<b>50</b>	<b>1,132,1709</b>	<b>312</b>	<b>2,312,9775</b>	<b>68</b>	<b>421,1144</b>
1 Nakhon Phanom	10	39.7350	-	-	-	-	-	-	1	13.8250	6	16.9100	3	9.0000
2 Mukdahan	26	40.0330	17	3.0850	-	-	-	-	1	20.0000	4	7.9480	4	9.0000
3 Loei	6	54.5700	-	-	-	-	-	-	2	42.5800	-	-	4	11.9900
4 Nong Khai	3	32.0450	-	-	-	-	-	-	2	20.0900	-	-	-	-
5 Udon Thani	29	9.9900	28	5.0000	-	-	4.9900	-	-	-	1	11.9555	-	-
6 Sakon Nakhon	21	51.5000	14	2.5000	-	-	-	-	1	5.0000	1	30.0000	5	14.0000
7 Chaiyaphum	27	114.4000	14	2.5000	-	-	-	-	2	61.5000	10	49.7000	1	0.7000
8 Kalasin	6	29.5300	-	-	-	-	-	-	1	6.5800	5	22.9500	-	-
9 Nong Bua Lam Phu	6	87.2620	2	0.3640	1	12.6800	-	-	3	74.2180	-	-	-	-
10 Nakhon Ratchasima	18	77.0000	-	-	-	-	-	-	1	23.0000	16	51.0000	1	3.0000
11 Buri Ram	12	69.5497	-	-	-	-	30.0000	-	-	-	8	33.5497	3	6.0000
12 Surin	78	275.0000	-	-	-	-	-	-	1	15.0000	76	250.5000	1	9.5000
13 Si Sa Ket	36	138.6000	-	-	-	-	8.0000	-	1	24.0000	33	104.6000	1	2.0000
14 Amnat Charoen	4	28.9990	-	-	-	-	-	-	1	16.9990	3	12.0000	-	-
15 Maha Sarakham	7	50.0000	-	-	-	-	-	-	-	-	7	50.0000	-	-
16 Ubon Ratchathani	4	42.5000	-	-	-	-	-	-	1	30.0000	3	12.5000	-	-
17 Khon Kaen	33	54.3851	20	4.5000	-	-	-	-	-	-	11	41.8851	2	8.0000
18 Roi Et	8	192.9388	-	-	-	90.6900	-	-	1	30.1500	3	29.4988	3	42.6000
19 Yasothon	6	22.5600	-	-	-	-	-	-	1	11.5100	5	11.0500	-	-
20 Phetchabun	11	40.6392	-	-	-	-	-	-	1	18.2500	3	8.9012	7	13.4880
<b>Total</b>	<b>251</b>	<b>1,451,2368</b>	<b>95</b>	<b>17,9490</b>	<b>2</b>	<b>103,3700</b>	<b>3</b>	<b>42,9900</b>	<b>21</b>	<b>412,7020</b>	<b>195</b>	<b>744,9478</b>	<b>35</b>	<b>129,2780</b>

• Appendix 3.13.3 DWR Diversion Plan

--- Huai Luang – Lam Pao – Chi (LPC) Water Diversion Project

Luang-Pao-Chi Integrated Water Management Project (LPC Project)



### Appendix 3.13.4 Overview of Khong – Chi – Mun Project (DEDP)

#### (Kong - Chi - Mun Development Plan)

The feasible developed irrigable area of Kong - Chi - Mun project shall have total area of 4.98 million rai, which can be divided in 3 phases of development, with the total period 42 years. **Figure 1** shows the developing plan of Kong - Chi - Mun project and **Table 1** shows the detailed developing plan.

#### (1) Development Plan Phase 1

Total 9 years of development (1992-2000), shall be divided into 3 steps. The 1st and 2nd step for the inter water resources development, while the 3rd step will be the diversion water from Mekong river. Details of development shall be summarized as follows:

1) 1st step : Improvement of existing irrigation system of Lam Pao O&M project with the total irrigable area of 305,000 rai. The statistic from dry season crop during 1987-1988 showed that there are only 15% of the total area.

2) 2<sup>nd</sup> step : Construction of weirs in Mun and Chi river, in order to provide source of water for the existing pumping stations located in Mun and Chi river. Result in the increasing of 0.403 million rai of irrigable area. The 13 weirs to be constructed are shows in **Table 1**.

**Table 1 List of weir to be constructed in Chi and Mun river and tributaries**

No.	Chi River	Mun River
1	Kumpawapi weir	Chum Phuang weir
2	Chonnabot wier	Ban Khwao weir
3	Maharakham weir	Ban Talung weir
4	Wang Yang weir	Rasi Salai weir
5	Yasothon - Phanom Prai weir	Hua Na weir
6	That Noi weir	Lam Dom Yai weir
7	-	Lam Se Bok weir

3) 3<sup>rd</sup> step : Pumping water from Mekong river - Huai Luang - Kumpawapi and divert into Lam Pao dam. From Lam Pao dam the water will be diverted to Lower Chi basin, and from Chi basin to Lam Se Bai - Lam Se Bok and Lower Mun basin. The development of 3<sup>rd</sup> step will result to the increasing of 1.615 million rai by constructing diversion canals and weirs along the main and its tributary as shown in **Table 2**.

**Table 2 List of projects in 3<sup>rd</sup> step of Phase 1 Development Plan**

No.	Sub Basin of Mekong river	Chi river and Tributary	Mun river and Tributary
1	Huai Luang project	Kamalasai weir	Lam Se Bai weir
2		Lam Pao weir	Pa Ao weir
3		Roi-et weir	Nong Kaeo weir
4		-	Nong Kung weir
5		-	Huai Samran weir

4) Summary of Kong-Chi-Mun Development Plan Phase 1 : Under the development plan phase 1, total area of 2.323 million rai shall be developed, including 0.305 million rai existing area and 2.018 million rai of new developing area. Main components are the pumping water from Mekong river and divert to Chi and Mun basin with the maximum discharge as follows :

<b>Item</b>		<b>Discharge (m<sup>3</sup>/sec)</b>
1.	Pumping station at Huai Luang river mouth (Mekong river)	95
2.	Pumping station at Ban Don Muang (Ban Na Mai) and diversion canal from Ban Don Muang-Nong Han Kumpawapi	89
3.	Improvement of Nong Han Kumpawapi-Lam Pao	-
4.	Diversion canal Yasothon-Se Bai	50
5.	Diversion canal Yasothon-Rasi Salai	45
6.	Diversion canal Se Bai-Se Bok	30

### (2) Development Plan Phase 2

Total 16 years of development (2001-2016), the plan are including diversion from Mekong river to the upper Chi basin, upper and middle basin of Mun. Pumping station shall be located at Ban Wieng Kuk, Nong Khai province, divert water into Nong Han Kumpawapi, then to the Lam Pao reservoir. The CM8 canal shall divert water from Lam Pao reservoir to upper Chi basin and upper and middle Mun basin, which shall be connected to other 4 canals, namely H1, CM8 Ext, KC-CB and CB-SR. The total developing area is approximately 1.693 million rais, the details of pumping station and diversion canals are as follows :

<b>Item</b>		<b>Discharge (m<sup>3</sup>/sec)</b>
1.	Pumping station at Ban Wieng Kuk and diversion canal D	215
2.	Diversion canal CM8 upstream of H1 canal	243
3.	Diversion canal CM8 downstream of H1 Canal	201
4.	Diversion canal Lam Pao-Nam Pong (H1)	42
5.	Pumping station at Nong Pak Tob and diversion canal KC-CB	29
6.	Pumping station at Ban Tha Chang and diversion canal CB-SR	15

### (3) Development Plan Phase 3

Total 17 years of development (2014-2033), by pumping water from Mekong river at Chiang Kan district, Loei province and divert water to upper Mun basin (upstream of Samrit weir). The total developing area is approximately 0.964 million rai, the project components are including 8 diversion canals and 3 hydro-electric power stations.

The main components of Kong-Chi-Mun diversion project are as follow:

- 1) Mekong diversion canal : has 3 routes;
  1. Diversion canal route A main components are :
    - Huai Luang regulator at Phone Phisai district, Nong Khai province
    - Huai Luang reservoir at Phon Phisai district
    - Pumping station at Huai Luang regulator, of 95 m<sup>3</sup>/sec
    - Pumping station at Ban Don Muang, 89 m<sup>3</sup>/sec
    - Kumpawapi weir and dike around Nong Han Kumpawapi
    - Diversion canal from Nong Han Kumpawapi to Lam Pao reservoir
  2. Diversion canal route D main components are :
    - Pumping station at Ban Wieng Kuk, Muang district, Nong Khai province, 215 m<sup>3</sup>/sec
    - Diversion canal from Ban Wieng Kuk to Nong Han Kumpawapi

- Siphon at Huai Suai and Huai Luang,
  - 1 Railway bridge
  - Regulator or weir at Nong Han Kumpawapi
  - Diversion canal from Nong Han Kumpawapi to Lam Pao reservoir (Improvement of existing river)
3. Diversion canal route west (WR210) main components area :
- Weir/Barrage at Loei river mouth
  - Nam Loei reservoir
  - Pumping station at Loei river mouth, 18 m<sup>3</sup>/sec
  - Loei-Chi diversion canal
  - Tunnel length of 10.60 km
  - 9 reservoirs along diversion canal namely, Huai Nam Lai reservoir, Nam Puai reservoir, Nam Mong reservoir, Huai Pha-niang reservoir, Nam Pong (Ubonrat) reservoir, Nam Chern reservoir, Huai Sam Mo reservoir.
  - 3 hydro-electric power stations
  - La Han Na weir

2) Diversion system and distribution system in Chi-Mun basin :

The distribution system and distribution system will be the extension of the main diversion from Mekong to Lam Pao reservoir, Ubonrat reservoir and La Han Na weir. There are including 5 routes of diversions as follows :

1. Lam Pao reservoir - Ku Fa weir Diversion : water shall be released through the river out let of Lam Pao Dam to Ku Fa weir (Yasothon - Phanom Phrai weir) by the natural river such as Lam Pao and Chi river with no improvement. Water will be distributed into the tributaries such as Lam Se Bai and Lam Se Bok.

2. Kok Khwak Diversion or Ku Fa-(Yasothon)-Rasi Salai Diversion Canal : divert water from Chi river to Mun river by construct and improvement of Kak Khwak canal from Ku Fa weir (Yasothon-Phanom Phrai) to Sieo Yai, then released to Mun river, upstream of Rasi Salai weir.

3. Ku Fa (Yasothon-Phanom Phrai)-Lam Se Bai-Lam Se Bok Diversion : diversion from Mekong river to Ku Fa weir (Yasothon-Phanom Phrai) and continued to Lam Se Bai and Lam Se Bok for the irrigable area of Tha Wang Hin weir (Lam Se Bai) and Pa Ao weir in Lam Se Bai, Nong Kaeo weir, Nong Kung weir, and Lam Se Bok weir in Lam Se Bok.

4. CM8 Diversion Canal : start from Lam Pao reservoir to Chi river, across Chi river to the northeastern part of Mahasarakham, cross Thung Kula Rong Hai and end to Mun river at Ban Talung weir, total length of canal 215 km. There are 2 lateral canal;

- H1 canal at km 28+100 of CM8 to Huai Sai Bat, Nam Phong and Chi river at upstream of Mahasarakham weir.

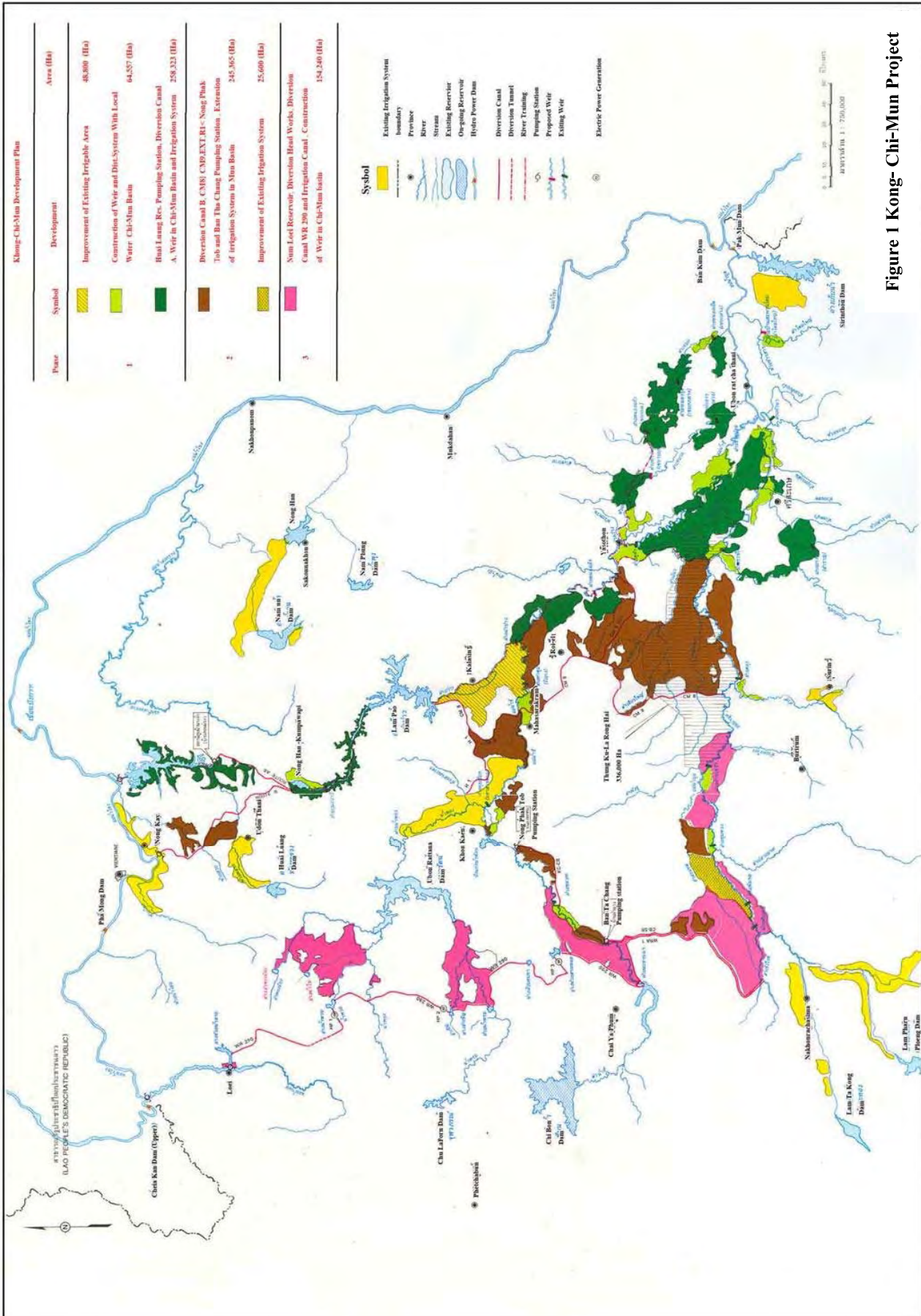
- CM8 Ext at km 127-300 of (CM8 to Chi river at upstream of Ku Fa weir (Yasothon-Phanom Phrai)

5. CB-SR Diversion Canal (Chonnabot-Samrit) and WRA 1 :

Start from Chi river or the water diverted from Mekong river to Chonnabot weir and La Han Na weir shall be diverted to Mun river at upstream of Samrit weir, then to Chum Phuang weir and Ban Khwao weir. The development shall be divided into 2 phases;

- construction of CB-SR canal in order to divert water from Chonnabot weir to Chum Phuang weir

- construction of WRA1 canal in order to divert water from La Han Na weir to Thung Samrit weir, Chum Phuang weir and Ban Khwao weir.



**Figure 1 Khong- Chi-Mun Project**

**Table 3 Khong-Chi - Mun Development Plan (1992-2033)**

Details Development Plan		Total Area(rai)	
		Wet	Dry
<b>(1) Development Plan Phase 1 (1992-2000)</b>			
1. Rehabilitation of Lam Pao O&M Project		305,000	152,500
2. Development of irrigatation area for 13 weirs along Chi-Mun and its tributary		403,480	150,400
3. Pumping Station at Huai Luang river mouth and develop irrigation area around Huai Luang reservoir and the area between Huai Luang reservoir and Lam Pao reservoir		173,650	82,380
4. Development of Kamalasai and Roi-et weir, Increase irrigable area of Kumpawapi and That Noi weir		531,290	206,830
5. Construction of irrigation canal from Yasoyhon-Rasi Salai, Developpe area along the diversion canal, increase irrigation area of Rasi Salai, Huai Samran, and Hua Na weir		485,570	204,760
6. Construction of irrigation canal from Yasothon-Se Bai-Se Bok and developpe irrigation area of Lam Se Bai, Annat Charoen, Nong Kaeo, Nong Kung, and Lam Se Bok weir		424,010	189,360
<b>Total Phase 1</b>		<b>2,323,000</b>	<b>986,230</b>
<b>(2) Development Plan Phase 2 (2001-2016)</b>			
1. Mekhong pumping station at Ban Wiang Kuk, developpe irrigation area along canal, Improvement of Kumpawapi weir, Pao river from Kumpawapi to Lam Pao reservoir		70,000	21,000
2. Construction of CM8 canal(1st phase), irrigation canal and irrigation system of Lampao-Nam Pong(H1), construction of pumping system from Maharakham, Chonnabot weir(Nong Phak Tob Pumping Station), expansion of Maharakham, Chonnabot, and Wang Yang weir		131,840	5,320
3. Construction of CM8 canal(2nd phase), construction of Chonnabot-Mun pumping station(Ban Tha Chang pumping station), development of Nong Phak Tob and Tha Chang irrigation area, and extension of irrigation area of Ban Thalung weir		1,491,690	559,610
<b>Total Phase 2</b>		<b>1,693,530</b>	<b>585,930</b>
<b>(3) Development Plan Phase 3 (2017-2033)</b>			
1. Mekhong pumping station at Chiang Kan district, Loei province, divert to Chi river at Khreng Khro district, Chaiyaphum province, development of irrigation area along WR290 canal		643,960	168,520
2. Extension of irrigation area in Mun basin		320,100	163,110
<b>Total Phase 3</b>		<b>964,060</b>	<b>331,630</b>

Reference: Khong-Chi-Mun feasibility study by Department of Energy Development and Promotion,1992



## **Appendix 3.13.5 Overview of SP2 (1)**

### **Stimulus Package 2 (SP2)**

#### **Background**

Stimulus package 2 (SP2) has been approved by the cabinet since January 13, 2009, the total budget of 116,700 million baht, aimed to solve a short term problems of the country within first 6-9 month of the year 2009. Forecasting the economic situation by IMF, it is expecting economic slowdown by 0.5 to 1.0% which will cause more problem in the lay-off of labour in every sector. The concept of stimulus package 2 (2010-2012) is to create the jobs and incomes in the project invested by government sector.

#### **Objectives**

1. Build-up stability in food and energy sector, including the increasing of production efficiency in the agricultural and industrial sector of the country.
2. To improve the fundamental public services, in both economic and social aspect, which shall upgrade in the quality of people's life.
3. Enforcing and creating the potential from tourism incomes.
4. Adjust the new basic income of the country by creative economy.
5. Upgrade the quality of education and modern knowledge.
6. Reform the public health system with high standard for Thai people.
7. Creation of professionals and incomes in order to upgrade the quality of life for community level.

#### **Conditions for Plan/Project**

1. Consistence with the objectives of SP2.
2. New plan/projects which are ready for the implementation as soon as the budget approval.
3. The plan/project shall support the increasing of capacity and competition of the country, upgrade the level of people's quality, and shall stimulate the simultaneous investment in private sector.
4. Result to the distribution of jobs in many areas of the country.

#### **Target**

1. Economic stimulation by the investment cost from government sector, approximately 5% of GDP.
2. Create new jobs for approximately 1.6 million people within 3 years, which can help 85% of the jobless people in 2009.
3. Distribution of investment in the fundamental public services to the province and rural area.



## Stimulu Package 2

### 1. Improvement of Distribution Efficiency, Small Scale Water Resources Development, for agriculture, industry, and agricultural production efficiency

#### Water Resources

**Improvement and Rehabilitation fo Water Resources:** total investment budget 20,216.51 MB, incremental storage capacity 1,518 mm., beneficiary area 3.3 million rai, by development of water resources in the rainfed area of 6,562 projects, benefit to the total 464,682 households to have water for domestic uses and agricultural uses.

**Development and Increasing of Irrigation Efficiency:** total investment budget 175,144.62 MB, incremental storage capacity 4,133 mm., beneficiary area 15.20 million rai, development of projects in the irrigation area of 26,768 projects such as Ta Pi Pum Duang basin development project, total 641,875 households shall have water for domestic, agriculture, and industry

**Flood Protection:** total 831 projects with total investment budget 30,283.51 MB, reduce flood crisis and can protect inundated area for 39 communities. Reduce erosion of 2.5 m.ton/year in the area of 150,000 rai. cause hiring of 31,664 labours

#### Development of Production Technology and Agricultural Production Standard

**Development of seedlings including crop for food and crop for energy:** total investment budget 5,000 MB, by (1) improvement and spreading of hereditities total bueget 4,444.69 MB, such as rice, cassava, sugar cane, oil palm etc., (2) Modernize agriculture total budget 250.29 MB, and (3) Study and development of production efficiency total budget 305.02 MB

## Appendix 3.13.6 Overview of Water Grid

### Water Grid (Network)

Water Network or Water Grid is the modern irrigation concept for sustainable and efficiency water management. The water network shall be one of solution in order to solve water resources problems including the reiterated drought and flood problem.

The concept of water network project is to convey water from one area to another area. The diverted water shall flow through the canal or pipeline or water tunnel. Distribution will be done from the areas which have excess of water to the areas which have less water or lack of demanded water. The diverted water shall benefit to many activities such as domestic, agriculture and industrial etc. The other objective of water network is to solve flood problem by releasing the flood water to the area where lack of water.

Water network shall be defined as small scale water network at local level, in which, the system shall be designed only with in the small tributary, one tributary of group of connected tributaries. The regional water network shall cover the benefit area more than local area, such as, from one sub-basin to another sub-basins, but not across the main basin. The components of water network for sub-basin level and tributary level are shown in **Fig. 1**, while the network from canal or pipeline of main network to water users is shown in **Fig 2**.

In the year 2003, DWR conducted “Master Plan Study for Chi basin Water Resources Management, concluded that there are 19 potential water network system in Chi-basin. In the year 2010, the Strategic Environmental Assessment (SEA), Feasibility Study (FS), Environmental Impact Assessment (EIA) and Detailed Design (DD) of these 19 water networks are on-going by DWR.

The list of 19 water network area shown in **Fig 3** and **Table 1**.

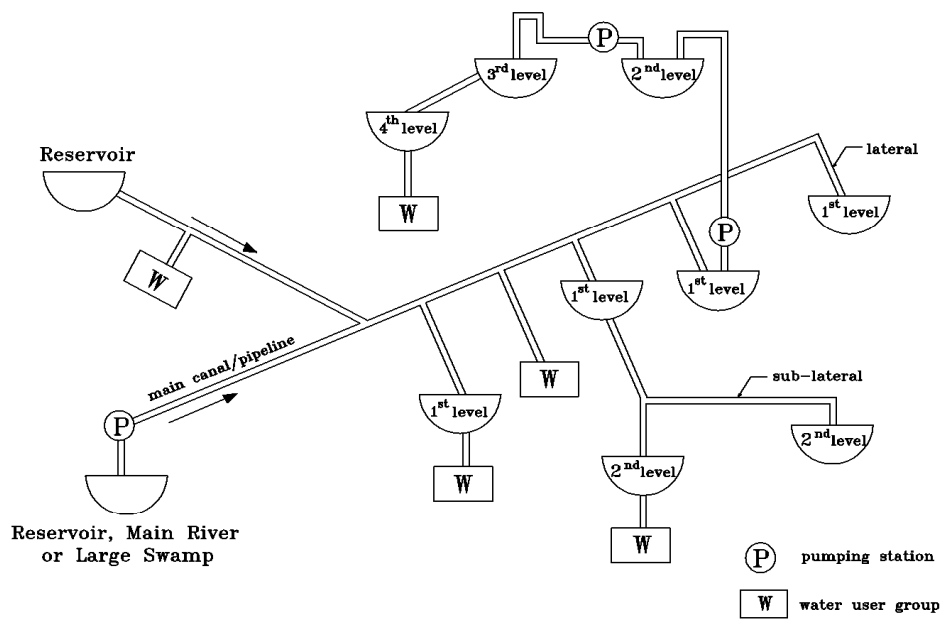


Fig. 1 Components of Water Network System at the Sub-basin and Tributary Level

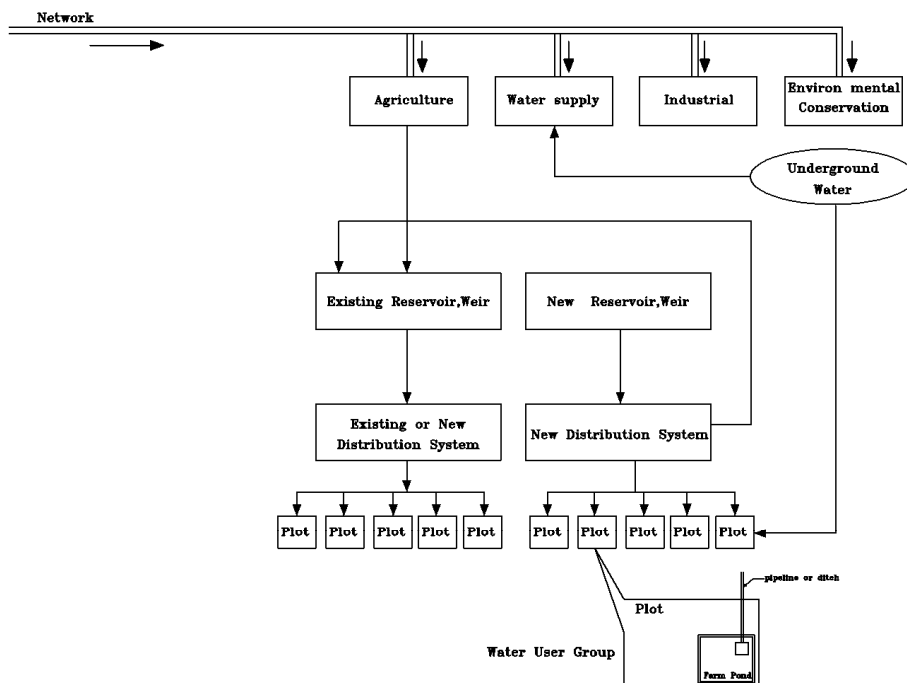


Fig. 2 Canal or Pipeline from Network to Water User Group



**Table 1 List of 19 Water Network Systems by DWR**

Items	Potential / Project	Benefit Areas (Rai)	Study and Design Budget (Million Baht)			
			Total	2010	2011	2012
1	Tub Sakae Water Network System, Phase 2	10,943	37.19	24.00	13.20	
2	Huai Sam Mor Basin Development, Phase 2	11,449	16.20	16.20		
3	Chi Water Network System, Part 4, Roi Et, Phase 2	24,992	30.00	18.00	12.00	
4	Phu Kradueng Water Network System, Loei, Phase 2	8,323	11.40	11.40		
5	Mekong-Nam Som-Phen-Na Klang Water Network (NG.02-1)	2,500	11.40	11.40		
6	Mekong Retarding Areas Network (NG-04-1)	320,200	145.78		83.99	61.79
7	Normal Reservoirs Network (NG-04-2)	43,380	48.59	24.60	24.00	
8	Nam Songkram-Nam Yam Water Diversion (NG.15-2)	26,400	21.60	21.60		
9	Retarding Areas Network, Nam Songkram Basin (NG.15-3)	76,600	59.39	30.00	29.40	
10	Lam Pao-Huai Songkram Water Network (NG.17-1)	28,970	61.19	35.99	25.20	
11	Lam Pao-Wang Sam Mor-Kranuan Water Network (NG.17-2)	99,130	166.77		59.99	106.78
12	Ubolrat- Ban Fang-Nong Reua Water Network (NG.10-5)	43,780	71.99	35.99	35.99	
13	Lam Pao-Sahaskhan-Nong Kung Si Water Network (NG.17-3)	53,930	93.58	51.59	41.99	
14	Lam Pao-Kham Muang Water Network (NG.17-4)	12,320	23.40	18.00	5.40	
15	Ubolrat-Ban Koksoong Water Network (NG.10-1)	10,730	21.60	21.60		
16	Ubolrat-Huai Bong-Phu Kao Water Network (NG.10-2)	8,250	12.60	12.60		
17	Phu Wieng-Nam Chuen Water Network (NG.10-3)	21,900	35.99	35.99		
18	Nam Pong-Si Boon Rueng-Nong Na Kham Water Network (NG.10-4)	8,250	16.20	16.20		
19	Ubolrat-Phu Phan Water Network (NG.10-6)	30,980	55.79	35.99	19.80	
<b>Total</b>		<b>843,027</b>	<b>940.64</b>	<b>421.13</b>	<b>350.94</b>	<b>168.57</b>

## **Appendix 3.13.7 Overview of the Project for improvement of irrigation efficiency**

### **Project for improvement of irrigation efficiency**

The RID' s project for improvement of irrigation efficiency has no specific descriptions of work done in the project. It is upon the conditions of each project, but the main issues can be divided into 2 parts:

1. Structural measures: there are mainly 3 alternatives;

1.1 Earthed canal system:

This type of project incidentally has low irrigation efficiency due to the loss of water during the operation such as percolation and evaporation. This Kind of projects need canal lining.

1.2 Concrete lining system:

Most of the existing projects under this category have low irrigation efficiency due the damages such as broken lining concrete, broken hydraulic structures (check structure, farm turn-out etc. ), and many project have problems in the lost of farm turn-out gate.

1.3 Water Level:

Most of problems come from the design and construction method that made the water level at each control point inadequate (connection of main and lateral canal and farm ditch, etc.). But some cases are occurred in the earthed canal type due to the erosion of canal bed.

2. Non-structural measures: many issues shall be concerned;

2.1 Improvement of organization such as water user group;

Some projects have only the name but no activities or some projects have water user groups but no support from the government side etc.

2.2 Improvement of land use and cropping pattern,

(1) It is found out to grow more rice in I-san area and theoretically rice requires more water than the other crops, how to design a efficient land use good for farmers' s consume, in comes, and good for less water requirement.

(2) Improvement of paddy calendar; As the I-san culture that they lack of family labors, so they start the preparation of paddy field since April because the family members come home for Song Kran Day. At that time, it has slight rainfall but no run off, and insufficient to do cultivation. Growing rice shall take much more period until harvesting in November. There is some possibility to adjust the cropping pattern or calendar so that it requires less irrigation water.

For the project to improve irrigation efficiency, it is required to study as follows:-

- ① Investigate the existing system by walk through the project area.
- ② Review the hydrology and capital of water Resources.
- ③ Review the land use and cropping pattern.
- ④ Design on what category shall be applied, structural measures or Non-structural measures or both.

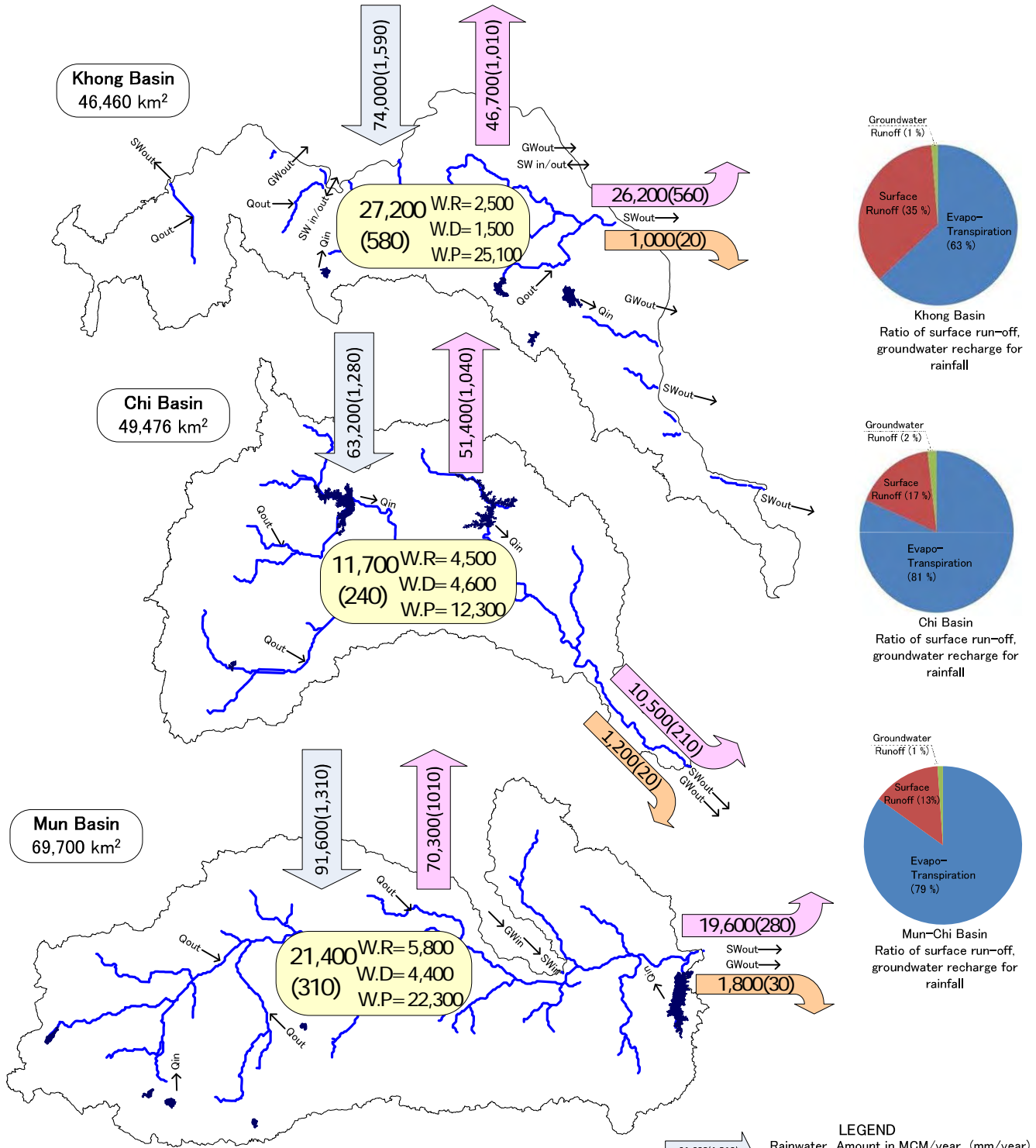


### Appendix 3.15.1 Local Administration and Number of Municipality/ Tambon in the Northeast

as of 2009

Province	Amphoe (District)	Municipality (Tesaban)			Non-Municipal Tambon (Sub-district)
		T. Nakhon (City)	T. Muang (Town)	(sub- District)	
Roi Et	20	-	1	37	164
Kalasin	18	-	1	68	81
Khon Kaen	26	1	2	60	162
Chaiyaphum	16	-	1	24	117
Nakhon Phanom	12	-	1	16	85
Nakhon Ratchasima	32	1	2	69	262
Buri Ram	23	-	2	46	160
Maha Sarakham	13	-	1	15	128
Mukdahan	7	-	1	21	32
Yasothon	9	-	1	16	70
Loei	14	-	1	23	76
Si Sa Ket	22	-	2	23	191
Sakon Nakhon	18	-	1	25	114
Surin	17	-	1	23	148
Nong Khai	17	-	2	22	102
Nong Bua Lam Phu	6	-	1	15	51
Udon Thani	20	1	2	45	132
Ubon Ratchathani	25	1	3	23	211
Amnat Charoen	7	-	1	9	53
<b>NE Total</b>	<b>322</b>	<b>4</b>	<b>27</b>	<b>580</b>	<b>2,339</b>

Appendix 3.15.2 Connectional Basin Water Balance of Khong, Chi and Mun Basin



Water Balance of Khong/Chi/Mun

Balance Items	Khong Basin		Chi Basin		Mun Basin		Mun-Chi Basin	
	(mcm)	%	(mcm)	%	(mcm)	%	(mcm)	%
<b>&lt;Hydrology&gt;</b>								
Rainfall	74,000	100	63,200	100	91,600	100	154,800	100
Evapotranspiration	46,700	63	51,400	81	70,300	77	121,700	79
Surface Water Runoff	26,200	35	10,500	17	9,100	21	19,600	13
Groundwater Runoff	1,000	1	1,200	2	600	2	1,800	1
<b>&lt;Water demand &gt;</b>								
Current Water Demand (total)	2,500	100	4,500	100	5,800	100	10,300	100
Agricultural Water Demand	2,100	85	4,100	90	5,100	87	9,200	89
Domestic Water Demand	380	15	470	10	730	13	1,200	12
<b>&lt;Water Developed&gt;</b>								
Current Water Development (total)	1,500	100	4,600	100	4,400	100	9,000	100
Effective Reservoir Capacity	1,400	94	4,400	97	4,200	96	8,600	96
Groundwater Withdraw	90	6	160	3	180	4	340	4
<b>&lt;Developing Potential&gt;</b>								
Developing water (total)	25,100	100	12,300	100	22,300	100	34,600	100
Developing water (surface)	24,200	96	11,200	91	20,800	93	32,000	92
Developing water (groundwater)	900	4	1,100	9	1,600	7	2,700	8

**LEGEND**

- 91,600(1,310) Rainwater Amount in MCM/year (mm/year)
- 70,300(1010) Evapotranspiration in MCM/yara (mm/year) (sum of the local evapotranspiration and the evaporation from lakes, swamps, etc.)
- 19,600(280) Surface runoff in MCM/yaer (mm/year)
- 1,800(30) Groundwater runoff in MCM/yaer (mm/year) (sum of the groundwater amount run-off the basin)
- 27,200 WR=2,500 (580) W.D=1,500 W.P=25,100 Effective Rainfall (Rainfall-ET)
- Qout → Infiltration of surface water to groundwater
- SWout → Surface water leaving Basin
- GWout → Groundwater water leaving Basin
- Qin ← Outflow of groundwater to surface water
- SWin ← Surface water entering Basin
- GWin ← Groundwater entering Basin

Conventional Basin Water Balance

### Appendix 3.15.3 Potential Project List of Medium Scale Reservoir & Irrigation Project in NE

(Data Source : Preliminary Study on Potential of Medium Scale Reservoir Development using GIS)

Basin	No.	Subbasin code	Subbasin Name	Number of Project	Capacity (MCM)	Irrigation Area(rai)
<b>Kong</b>	1	02.10	MaeNamKong section3	0	0.00	0
	2	02.11	Nam Mand	1	4.50	1,000
	3	02.12	Nam San	0	0.00	0
	4	02.13	Mae Nam Kong section4	1	0.66	700
	5	02.14	Huai Nam Puan	1	2.50	2,000
	6	02.15	Mae Nam Loei Lower	6	123.86	96,992
	7	02.16	Mae Nam Kong section5	0	0.00	0
	8	02.17	Huai Nam Som	1	0.00	8,000
	9	02.18	Nam Mong	6	44.60	43,250
	10	02.19	Mae Nam Kong section6	1	6.00	6,179
	11	02.20	Nam Suai	1	0.00	10,692
	12	02.21	Huai Luang	5	21.64	29,011
	13	02.22	Huai Dan	0	0.00	0
	14	02.23	Mae Nam Kong section7	2	8.00	11,900
	15	02.24	Mae Nam Songkam Upper	5	1.50	28,200
	16	02.25	Mae Nam Songkam Lower	2	0.00	107,800
	17	02.26	Huai Kong	2	0.00	32,000
	18	02.27	Huai Hee	4	19.20	17,000
	19	02.28	Huai Nam Yam	2	1.00	20,000
	20	02.29	Huai Nam Ou	5	32.57	40,590
	21	02.30	Huai Tuay	11	8.41	10,790
	22	02.31	Mae Nam Kong section8	0	0.00	0
	23	02.32	Nam Pung	0	0.00	0
	24	02.33	Huai Nam Kam	2	18.30	75,000
	25	02.34	Mae Nam Kong section9	0	0.00	0
	26	02.35	Huai Bang Sai	2	22.90	10,000
	27	02.36	Huai Muk	0	0.00	0
	28	02.37	Huai Bang E	1	4.60	5,162
	29	02.38	Mar Nam Kong Lower	2	28.00	11,000
<b>Total</b>				<b>63</b>	<b>348.24</b>	<b>567,266</b>

Basin	No.	Subbasin code	Subbasin Name	Number of Project	Capacity (MCM)	Irrigation Area(rai)
<b>Chi</b>	1	04.02	Lam Nam Chi Upper	6	141.17	86,000
	2	04.03	Lam Sa Pung	1	32.00	24,000
	3	04.04	Lam Kra Jung	4	216.94	115,000
	4	04.05	Lam Kan Choo	6	58.82	38,100
	5	04.06	Lam Nam Chi section2	4	51.51	36,600
	6	04.07	Huai Sam Mor	1	20.00	12,000
	7	04.08	Lam Nam Chi section3	2	50.69	31,500
	8	04.09	Lam Nam Pong Upper	11	116.74	72,900
	9	04.10	Huai Pyoi	4	114.34	71,200
	10	04.11	Lam Pa Neng	6	97.96	61,000
	11	04.12	Nam Prom	4	86.29	0
	12	04.13	Lam Nam Chern	4	91.00	0
	13	04.14	Lam Nam Pong Lower	3	220.41	137,600
	14	04.15	Huai Sai Bhat	2	55.85	34,800
	15	04.16	Lam Nam Chi section4	1	72.98	45,600
	16	04.17	Lam Pao Upper	3	73.74	46,000
	17	04.18	Lam Pan Chad	3	73.17	46,300
	18	04.19	Lam Pao Lower	3	12.37	8,250
	19	04.20	Lam Nam Young	6	33.67	24,400
	20	04.21	Lam Nam Chi Lower	0	0.00	0
<b>Total</b>				<b>74</b>	<b>1,619.65</b>	<b>891,250</b>

Basin	No.	Subbasin code	Subbasin Name	Number of Project	Capacity (MCM)	Irrigation Area(rai)
Mun	1	05.02	Lam Nam Mun Upper	0	0.00	0
	2	05.03	Lam Sae	0	0.00	0
	3	05.04	Lam Pa Phoeng	4	22.51	18,405
	4	05.05	Lam Ta Kong	2	19.84	9,919
	5	05.06	Lam Chieng Kai	8	31.96	27,100
	6	05.07	Lam Jak Rat	0	0.00	0
	7	05.08	Lam Nang Rong	0	0.00	0
	8	05.09	Lam Pa Tea	0	0.00	0
	9	05.10	Lam Pai Mard	0	0.00	0
	10	05.11	Lam Nam Mun section2	0	0.00	0
	11	05.12	Huai Ake	2	31.30	24,000
	12	05.13	Lam Sa Tad	0	0.00	0
	13	05.14	Lam Pang Choo	0	0.00	0
	14	05.15	Huai Ta Kon	0	0.00	0
	15	05.16	Lam Chi	1	4.90	2,450
	16	05.17	Lam Pab Par	0	0.00	0
	17	05.18	Lam Tao	0	0.00	0
	18	05.19	Lam Seaw Noi	0	0.00	0
	19	05.20	Lam Seaw Yai	3	31.70	25,250
	20	05.21	Huai Tab Tan	1	11.50	6,000
	21	05.22	Lam Nam Mun section3	0	0.00	0
	22	05.23	Huai Sam Ran	1	10.31	8,200
	23	05.24	Huai Ta	2	15.18	7,800
	24	05.25	Huai Ka Yun	2	50.00	24,400
	25	05.26	Huai Pong	6	49.10	34,075
	26	05.27	Lam Say Bye	7	51.51	40,575
	27	05.28	Lam Say Bok	15	85.60	72,865
	28	05.29	Lam Dom Yai	4	53.99	33,500
	29	05.30	Lam Nam Mun Lower	0	0.00	0
	30	05.31	Huai Tung Lung	4	24.67	25,195
	31	05.32	Lam Dom Noi	2	9.70	10,000
<b>Total</b>				<b>64</b>	<b>503.77</b>	<b>369,734</b>

Basin	Number of Project	Storage Capacity (MCM)	Irrigation Area (1,000rai)
Kong Basin	63	348	567
Chi Basin	74	1,620	891
Mun Basin	64	504	370
Total	201	2,472	1,828

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No.	Types of Projects or Business	Capacity
		day or more
<b>16</b>	Liquor and alcohol production industry	-Liquor and alcohol producer that has a production capacity of 40,000 liters per month -Wine or beer producer that has a production capacity of 600,000 liters per month
<b>17</b>	Factories that recycle waste products according to the Factory Law	All capacities
<b>18</b>	Power plants	- Power plants that have a production capacity of 10 megawatt per day or more
<b>19</b>	Expressways	All capacities
<b>20</b>	Highway and roads according to the Highway Law that go through the following areas: 20.1 Reserved forest areas 20.2 National parks 20.3 The plain area level 2 according to conclusion of the cabinet 20.4 Mangrove forest 20.5 Fifty meters from beach areas 20.6 Areas 2 kilometers from world heritage sites 20.7 Areas 2 kilometers from ancient remains, antiques, national parks, historical parks and national museums	All capacities All capacities All capacities All capacities All capacities All capacities All capacities
<b>21</b>	Public metal transit system	All capacities
<b>22</b>	Ports	-Capacity for vessels of 500 gross tons or more -Quay length of 100 square meters or more - Total port area is amount of 1,000 square meters or more
<b>23</b>	Marinas for docking boats for sport and recreational purposes	Marinas that have a capacity of 50 vessels or more or an area of 1,000 square meters or more
<b>24</b>	Man-made land projects	All capacities
<b>25</b>	Construction or enlargement of buildings close to or in the sea 25.1 Walls close to the beach 25.2 Dams against sand, surfs and water 25.3 Dam against surfs outside the beach	length of 200 square meters or more All capacities All capacities
<b>26</b>	Air transportation projects 26.1 construction of or enlargement of commercial water airports. 26.2 Water airports	Runway length of 1,100 meters or more
<b>27</b>	Building according to the Building Control Act 27.1 located in an area beside the river, lake, beach or close to or in a national park or historical park	Buildings that are 23 meters or taller or have all area of 10,000 square meters or more

No.	Types of Projects or Business	Capacity
	27.2 used for a retail or wholesale business  27.3 used as an office building	Buildings that are 23 meters or taller or has a total area of 10,000 square meters or more  Buildings that are 23 meters or taller or have all area in amount of 10,000 square meters or more
<b>28</b>	To allot the land for habitation or commerce according to the Land Development Law	Projects that have more than 500 plot of land or the area more than 100 Rai
<b>29</b>	Hospitals according to the Medical Premises Law 29.1 located in an area close to the river, lake, beach within 50 meters 29.2 Out of 29.1	Hospitals that have 30 or more patients beds  Hospitals that have 60 or more patients beds
<b>30</b>	Hotels according to the Hotel Act	Hotels that have 80 rooms or more or have a usable area of 4,000 square meters or more
<b>31</b>	Condominiums according to the Building Control Law	Condominiums that have 80 rooms or more or have a usable area of 4,000 square meters or more
<b>32</b>	Dam Projects 32.1 Capacity 32.2 Area	100 millions cubic meters or more  15 square kilometers or more
<b>33</b>	Irrigation Projects	Those that have area of irrigation 80,000 Rai or more
<b>34</b>	All projects that are located in the plain area level 1 according to conclusion of the cabinet	All capacities



**Appendix 4.2.1 Surface Water Quality Standard in Thailand**

Parameter	Units	Statistic	Standard Value for Class***				
			1	2	3	4	5
1. Colour, Odour and Taste	-	-	n	n	n	n	-
2. Temperature	C	-	n	n'	n'	n'	-
3. pH value	-	-	n	5-9	5-9	5-9	-
4. Dissolved Oxygen	mg/l	P20	n	6	4	2	-
5. BOD (5 days, 20 C)	mg/l	P80	n	1.5	2.0	4.0	-
6. Coliform Bacteria	MPN/100ml	P80	n	5000	20000	-	-
- Total Coliform			n	1000	4000	-	-
- Faecal Coliform			n		5.0		
7. NO - N	mg/l	Max.allowance	n		0.5		
8. NH -N	"	"	n		0.005		
9. Phenols	"	"	n		0.1		
10. Cu	"	"	n		0.1		
11. Ni	"	"	n		1.0		
12. Mn	"	"	n		1.0		
13. Zn	"	"	n		0.005*,0.05**		
14. Cd	"	"	n		0.05		
15. Cr (hexavalent)	"	"	n		0.05		
16. Pb	"	"	n		0.002		
17. Hg (total)	"	"	n		0.01		
18. As	"	"			0.005		
19. CN <sup>-</sup>	"	"	n		0.1		
20. Radioactivity	Becquirel/l	"	n		1.0		
- Gross $\alpha$		"	n		0.05		
- Gross $\beta$		"	"				

Surface Water Quality Standard in Thailand (continue)

Parameter	Units	Statistic	Standard Value for Class***					
			1	2	3	4	5	
21. Pesticides(total)		''						
- DDT	µg/l	''	n		1.0			
- α BHC	''	''	n		0.02			
- Dieldrin	''	''	n		0.1			
- Aldrin	''	''	n		0.1			
- Heptachlor & Heptachlor epoxide	''	''	n		0.2			
- Endrin	''	''					none	

Note : P = Percentile value

n = naturally

n, = naturally but changing not more than 3 C

\* = when water hardness not more than 100 mg/l as CaCO<sub>3</sub>

\*\* = when water hardness more than 100 mg/l as CaCO<sub>3</sub>

\*\*\* = Water Classification

Source : Notification of the Ministry of Science, Technology and Energy ( B.E. 2537 (1994.)), published in the Royal Government Gazette, vol. 111, No.163, dated February 24, B.E. 2537 (1994)

## **Appendix 4.2.2 Criteria of international, national and local importance of wetland**

In the National Inventory of Wetlands of Thailand, wetlands are classified into 3 levels of importance: international, national, and local, according to the following criteria.

### **Wetlands of international importance**

According to the Ramsar Convention Manual (Davis, 1994) and the Resolution VI. 2 of the Brisbane Conference (the 6th Meeting of the Contracting Parties to the Ramsar Convention in Brisbane, Australia, 1996), a wetland is identified as being of international importance if it meets at least one of the criteria set out below:

#### **(1) Criteria for representative or unique wetlands**

A wetland should be considered internationally important if :

- (a) it is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biogeographical region; or
- (b) it is a particularly good representative example of a natural or near-natural wetland, common to more than one biogeographical region; or
- (c) it is a particularly good representative example of a wetland, which plays a substantial hydrological, biological or ecological role in the natural functioning of a major river basin or coastal system, especially where it is located in a trans-border position; or
- (d) it is an example of a specific type of wetland, rare or unusual in the appropriate biogeographical region.

#### **(2) General criteria based on plants or animals**

A wetland should be considered internationally important if :

- (a) it supports an appreciable assemblage of rare, vulnerable or endangered species or subspecies of plant or animal, or an appreciable number of individuals of any one or more of these species; or
- (b) it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna; or
- (c) it is of special value as the habitat of plants or animals at a critical stage of their biological cycle; or
- (d) it is of special value for one or more endemic plant or animal species or communities.

#### **(3) Specific criteria based on waterfowl**

A wetland should be considered internationally important if :

- (a) it regularly supports 20,000 waterfowl; or
- (b) it regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity or diversity; or
- (c) where data on populations are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.

#### **(4) Specific criteria based on fish**

A wetland should be considered internationally important if :

- (a) it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity; or
- (b) it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

### **Wetlands of national importance**

A wetland is identified as being of national importance if it meets at least one of the criteria set out below :

(1) Criteria for representative or unique wetlands

A wetland should be considered nationally important if :

- (a) it is a particularly good representative example of a specific type of natural or near-natural wetlands, common to Thailand; or
- (b) it is an example of a specific type of wetland, rare, unique or unusual in Thailand; or
- (c) it is a particularly good representative example of a wetland, which plays an outstanding role in natural, biological, ecological or hydrological systems; or
- (d) it is of substantial value in maintenance of Thai lifestyle and Thai culture.

(2) Criteria based on plants or animals

A wetland should be considered nationally important if :

- (a) it supports species of plant or animal, rare, vulnerable or endangered in Thailand; or
- (b) it is of special value for maintaining the genetic and biological diversity of Thailand; or
- (c) it is of special value for one or more native plant or animal species or communities.

(3) Criteria based on legal status and management practices

A wetland should be considered nationally important if :

- (a) it is a wetland of any type within a protected area or a reserved area.

### **Wetlands of local importance**

A wetland is identified as being of local importance if :

(1) Criteria based on legal status and management practices

A wetland should be considered locally important if :

- (a) it is a wetland listed as 'natural sites of national importance as nature reserves' according to the Cabinet Resolution (7 November 1989).

(2) Criteria based on values to local communities

A wetland should be considered locally important if :

- (a) it is of substantial value in supporting lifestyle of Thai communities including provision of water, food, fiber, fuel, medicines, and raw materials for household income generation; or
- (b) it is of substantial value in maintenance of local society, culture, traditions, religion, history, and folklores, and provision of recreation, tourism, local transport and communications; or
- (c) it is substantial value in supporting food chains, water quality, flood control and local climatic stability, without change in the ecological characters of the wetland.

### Appendix 4.2.3 Fauna and flora in Kud Ting reservoir, Bung Khong Long Non-Hunting Area and Nong Han Kumpawaphi

#### (1) Kud Ting reservoir

a. Aquatic Plant – Total of 59 species are found in the area and can be classified in 4 groups as follow

- At the coast of the area :37 species
- Floating plant: 11 species
- Submerge plant: 11 species and
- Immediate at water surface: 6 species

*Vallisneria Spiralis* and *Utricularia Auria* are dominant species in the area. Twenty-two out of 59 species support communities for their consumption, animal feed or handicrafts.

b. Aquatic Animals

Total of 113 fish species are found in the area. Among them more than 56 species are native species and migratory fish from Khong river. Fish has been processed through drying and fermentation for consumption. In addition, three species of freshwater shrimp are found in the area including *Caridina laevis*, *Macrobrachium lanchesteri* and *Macrobrachium thai*.

c. Birds

More than 100 bird species have been observed in the area.

d. Forest Resources-

Eastern part of the area is covered by terrestrial forest . Forest survey has been conducted in February 2007 by World Wildlife Fund and found that there are 4 most abundant species in the area including *Dipterocarpus obtusifolius*, *Polyalthia cerasoides*, *Garcinia cowa* and *Saointhus sp.* It has been reported that there are 150 forest plant species in the area. Due to its richness in biodiversity in Kud Ting, Thailand has processed to registered as second Ramsar Sites for northeast region.

#### (2) Bung Khong Long Non-Hunting Area

There are 5 islands within the wetland area and Don Sawan island where Non-Hunting Office is located, is the largest with total area of 250 rai. Results of the survey for its biodiversity characteristics during 1998 to 2000 are as follows:

a. Aquatic plants-

At least 23 species of aquatic plants are found in the area including submerged plants, floating plants and emerged plants. Example of aquatic plant found in different areas are summarized as follows:

Area	Species Found
Shallow water communities	<i>Utricularis aurea</i> , <i>Hdrilla verticillata</i> , <i>Salvinia cucullata</i> , <i>Nelumbo nucifera</i> , <i>Nymphaea lotus</i> , <i>Nymphoides indica</i> , <i>Limnocharis flava</i> , <i>Jussiaea repens</i> , <i>Nepenthes sp.</i> , <i>Cypenrus sp.</i> , <i>Chara zeylanica</i> , <i>Blyxa echinosperma</i> and etc.
Open water communities	<i>Utricularis aurea</i> , <i>Hdrilla verticillata</i> , <i>Chara zeylanica</i> , <i>Blyxa echinosperma</i> .
Overlaying dense and floating co, unities	<i>Imperata cylindrical</i> , <i>Colocasia esculenta</i> , <i>Saccharumarundinaceum</i> , <i>Eleocharis dulcis</i> , <i>Lasis spinosa</i>

a. Fish

Twenty –three families in 39 genera and 61 fish species were founded in the area. Cyprinidae is the most dominant family (21 species). Seven species are endemic to Khong river including *Clupeichthys aesarnensis*, *Boraras micros*, *Rasbora spilocerca*, *Oryzius mekongensis*, *Brachygobius mekongensis*, *Odontobutis auramus* and *Monotrete suvattii*. Three species are considered as threaded including *Clarias batrachus*, *C. macrocephalus* and *Indostomus spinosus*.

b. Birds

Thirteen orders in 28 families, 52 genera and 67 species are found in the area. Among them Order Passeriformes in 10 families, 16 genera and 23 species is the most dominant.

c. Amphibians

Three families in 3 genera and 6 species are found including *Rana erythraea*, *R. macrodactyla*.

d. Reptiles

Eight families in 8 genera and 10 species are found in the area. *Calotes versicolor* is the most dominant species.

e. Mammals

Two species of mammals are founded including *Callosciurus finlaysoni* and *Tamiops mccllellandii*.

**(3) Nong Han Kumpawaphi**

Biodiversity of the site has been survey by Khon Kaen University in 2006 (after completion of earth dike and water gate in 1994) results of the survey can be summarized as follow

a. Plant Species:

Area	No. of Species	Dominant species
Lake area	14	<i>Hydrilla verticilla</i> , <i>Najas graminea</i> , <i>Eichornia crassipes</i> , <i>Nehumbo nucifera</i> and <i>Nymphaea lotus</i>
Floating plant area	31	<i>Eichornia crassipes</i> , <i>Mimosa pigra</i> , <i>Cyperus imbricatus</i> , <i>Hymenachne pseudointerupta</i> , <i>Leersia hexandra</i> , <i>Arundo donax</i> , <i>Scirpus grossus</i>
Emerging plant area	37	<i>Mimosa pigra</i> , <i>Colocasia esculenta</i> var. <i>aquafilis</i> , <i>Scirpus grossus</i> ; <i>Cyperus imbricatus</i> , <i>Nehumbo nucifera</i> , <i>Brachiaria mutica</i> , <i>Hymenachne pseudointerupta</i> , <i>Arundo donax</i> , <i>Leersia hexandra</i>
Island	98	<i>Zizyphus mauritiana</i> , <i>Pithecellobium dulce</i> , <i>Magnifera indica</i> , <i>Dipterocarpus alatus</i> , <i>Eucalyptus camaldulensis</i> ,
Earth dike	26	<i>Pithecellobium dulce</i> , <i>Zizyphus mauritiana</i>
Farmland outside the dike	20	<i>Scirpus grossus</i> , <i>Mimosa pigra</i> , <i>Nehumbo nucifera</i> ; <i>Hymenachne pseudointerupta</i> , <i>Cyperus imbricatus</i>

b. Fish

Fish survey has been carried out through purchasing of fish and interview fishermen at four fish landing areas in Nong Han Kumpawaphi during June to August in 2006. Results of the survey are as follows

	10-11 June 2006	8-10 July 2006	5-6 August 2006	Overall
No. of Family	16	18	18	18
No. of species	35	39	38	46

Seven order in 18 families and 46 species of fish are found during the survey. Their distributions by

family are as follows:

<b>Families</b>	<b>Number of species</b>
<i>Cyprinidae</i>	17
<i>Belontiidae</i>	4
<i>Bagridae</i>	4
<i>Channidae</i>	3
<i>Cobotidae</i>	3
<i>Mastacembelidae</i>	3
<i>Clariidae</i>	2
<i>Nandidae</i>	2
<i>Siluridae</i>	2

Six species include *Cyclocheilichthys apogon*, *Cyclocheilichthys repasson*, *Hemicorhynchus siamensis*, *Osteochilus hasselitti*, *Parachela siamensis*, *Puntius brevis* are usually found in large number in every survey. These species are commonly used for fermented fish production. *Monopterus albus*, *Ompok bimaculatus*, *Channa striata* and *Notopterus notopterus* are commonly caught by fishermen.

#### c. Birds

Fifty- two species of birds are found during the survey in June, July and August 2006. Maximum number of bird are found in July (45 species of 800 birds) while the lowest is in June (41 species of 495 birds). According to Thai Data Red List, it is found that there are 5 species exist in the conservation list and can be summarized as follows:

<b>Species</b>	<b>Status</b>
<i>Ardea purpurea</i>	Endangered species
<i>Ploceus manya</i>	Vulnerable species
<i>Ploceus hypoxanthus</i>	Vulnerable species
<i>Haliastur indus</i>	Near threatened
<i>Nettapus coromandelianus</i>	Near threatened

## ***Appendix 5 Case Study Report / Review of Completed Projects***

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## Appendix 5.1

### Nong Han Kumphawaphi Development Project

#### A. Kumphawaphi Udon Thani province

Date: March 26, 2010

#### 1. Project characteristic

Kumphawaphi weir project, located in Lam Pao river in A. Kumphawaphi, Udon Thani province, is one of the Lam Pao water diversion in Khong-Chi-Mun project.

#### 2. Objective of the project

This report is for developing Kumphawaphi weir project up to its potential on efficient water management and flood protection in A. Kumphawaphi and project's surrounding areas.

#### 3. Location of the project

Kumphawaphi weir project is located at Ban TaMuang T.WiengKum A. Kumphawaphi, Udon Thani province. Grid 48QTD 902-880, 5643 III (Map 1:50,000)

#### 4. Previous project characteristic

Kumphawaphi weir project is to construct weir equipped with gate and dike along Nong Han Kumphawaphi for storing water in Lam Pao and Nong Han. The project can control water level in Lam Pao river up to 6 kilometers or to drawdown and drain excess flood during flood season, reduce sedimentation along weir's face upstream. Upstream of the weir, 14 pumping stations (from 1992) and irrigation canals are constructed to irrigate areas of 35.9 sq.km. and for annual water consumption. The main project components are Nong Han Kumphawaphi reservoir, weir equipped with gate, dike and irrigation canal as follow

#### Nong Han Kumphawaphi reservoir

Catchment area	1,310	sq.km.
Annual runoff	311	mcm
Surface area	36	sq.km.
Dead storage elevation	+166.00	m.(MSL)
Low Water Level	+166.70	m.(MSL)
Retention elevation	+169.50	m.(MSL)
Retention storage	102	mcm.
Flood Discharge	300	m <sup>3</sup> /s

#### Weir equipped with gate

Radial gate	5	gates.
Gate width	12	m.
Total width (include column)	66	m.
Gate Height	3.80	m.
Total length of concrete base	36.00	m.
Height of concrete base above bed elevation	0.20	m.
Height of gate above bed elevation	4.00	m.
Width of cutoff	55.00	m.
Length of erosion protection		
Upstream	10.00m.	
Downstream	30.00m.	

## 5. Crop Statistic in the project's area

No.	Tambol	Crop/Agriculture Area (rai)									
		rice	sugarcane	cassava	kenaf	soybean	ground bean	mango	coconut	vegetable	Mull bury
1	Tum Tai	13,165	3,800	260	30	-	4	45	25	20	5
2	Na Muang	22,572	802	200	50	-	-	75	60	119	-
3	Pan Don	14,080	1,540	250	7	-	-	450	250	219	-
4	Share Lae	19,874	5,035	1,161	715	33	40	38	27	122	40
5	HuaiKerl	7,832	8,208	42	245	-	-	102	80	23	5
6	Um Jan	20,392	760	300	75	-	-	35	27	-	10
7	Vieng Kam	10,857	31,070	1,050	3,960	-	-	115	45	147	45
8	Tha Li	12,232	9,282	148	-	-	224	62	35	-	-
9	Ser Per	19,596	670	716	-	-	450	738	128	177	10
10	Pa Suk	12,540	108	15	-	-	-	150	95	209	15
11	Pa Ko	18,055	24,872	130	705	-	-	80	65	109	12
12	Sri Or	9,967	6,850	60	93	-	-	35	20	226	10
13	Nong War	12,586	7,863	50	280	-	-	12	9	31	10
14	Chieng Vae	20,499	20	-	-	-	-	12	7	-	-
15	Kumphawaphi	3,950	1,543	1,650	15	-	-	152	175	192	40
16	HuaiSamPad	15,908	300	70	50	-	-	45	20	20	20
	Total	234,105	102,723	6,102	6,225	33	718	2,146	1,068	1,614	222

Source: Amphoe Kumphawaphi's agriculture office

## 6. Project's Water requirement .

: unit MCM

Water use Activity (Type)	Number/Water requirement		Water requirement/year	
	Yr.2538(1995)	Yr.2558(2015)	Yr.2538(1995)	Yr.2558(2015)
Water Supply	100,000 persons 200 liters/person/day	200,000 persons 200 liters/person/day	7.30	14.60
Village's consumption (without water supply) Industry	500,000 person 100 liter/person/day 240 days (30,000cu.m/day)	240 days (37,500cu.m/day)	1.83 7.20	- 9.00
Ecological Maintenance (September-June)	240 days (rate 1 cu.m /sec)		20.74	20.74
RID	Rainy season 70,000 rai (800 cu.m/rai) Dry season 62,000 rai (1,200 cu.m/rai)		140.40	140.40
Total			177.47	184.74

## 7. Project evaluation

Existing Nong Han Kumphawaphi is natural water body receives water from 11 streams with 36 sq.km. water surface area and 102 mcm storage, and is with 5 gates of size(width and height) 12 X 3.80 meter, dike along boundary of Nong Han Kumphawaphi of 112.4 km., 47 concrete drainage pipes of 1.2 m-diameter equipped with flap gate and 14 pumping stations with irrigation canal to assist irrigation area of 55,000 rais in 29 villages 7 tambols 1 amphoe and 2 sub amphoes. Completed in 2537(1994), it received limited maintenance budget resulting in dense weed covered 70% of its surface area that block water storage and drainage in the area. As a result, flooding in the areas surrounding Nong Han Kumphawaphi happens every rainy season avoiding wet season agricultural activities in the areas.

### Problems

1. Sedimentation and Weed Nong Han Kumphawaphi is natural water body receives water from 11 streams that bring tremendous sediment and weed into every year, resulting in dense weed cover and storage reduction especially at their river mouths connecting Nong Han Kumphawaphi.

2. Water delivery Due to high sediment and dense weed that reduce and retard water near pumping stations results in unable to irrigate during dry season.

3. Drainage Areas surrounding Nong Han Kumphawaphi are low lying area separated by dike along Nong Han Kumphawaphi, are easily flooded in wet season and in some areas are often flooded even though gates are fully lifted during wet season.

### Solutions

#### 1. Sedimentation and Weed

1.1 Dredging and weed removal along border of Nong Han Kumphawaphi by dredging trench of 20 meter-width along the borders to allowing flow of water from tributaries to Nong Han Kumphawaphi and to weir easily. The reason for not dredging all is to avoid ecological impact since it is a wetland and shelter of various birds.

1.2 Construct fence to control weed in the Nong Han Kumphawaphi for easily control and removal weeds.

#### 2. Water delivery

2.1 Dredging trench and constructing weed protecting fence around pumping stations to allow pumping water during dry season.

2.2 Constructing Lam Pao Barrage at A.SriTat for water management and to expand irrigation area at Kumphawaphi weir.

#### 3. Drainage

3.1 Land procurement of surrounding the repetitive flooding area to expand flooding area of 5,750 rai.

3.2 Dredging Lam Pao (downstream of Kumphawaphi weir) till Ban TaHi T.JumPi A.Sritat Udontani province for 8,900 kilometer long to allow Kumphawaphi weir's drainage into Lam Pao to flow easily to mitigate flood around Nong Han Kumphawaphi during wet season

3.3 Construct 50 intake structures at Nong Han Kumphawaphi where repetitive flood occurs almost every year.

3.4 Construct barrage or rubber weir at tributaries mouths which drain into Nong Han Kumphawaphi and also dredging all streams to manage water during wet season and to mitigate water scarcity during dry period.

#### 8. Project's Budget.

No	Items	Amount	Unit	Budget-million Baht
1	Land procurement to enlarge storage	5,750	rai	250
2	Lampao dredging (downstream of KumPaWaPi weir)	8,900	km.	60
3	Lampao Barage	1	location	80
4	Dredging trenches around NongHarnKumPaWaPi	40	km.	30
5	Constructing intakes around NongHarnKumPaWaPi	50	location	20
6	Dredging 11 tributaries	22	km.	20
7	Constructing rubber weirs	2	location	30
Total				490

#### 9. Expected benefits

- A retention pond in Upper Lam Pao basin for flood mitigation and water storage
- for agriculture, livestock and water consumption that assist people of 30 village 2 local administrations 3,500 household of 10,000 persons
- Natural fish breeding source
- Natural fresh water conservative tourist place
- Income source for local people

#### 10. Pump Electric Cost Shearing

- RID 70%
- Farmer 30%



Nong Han Kumphawaphi Barrage



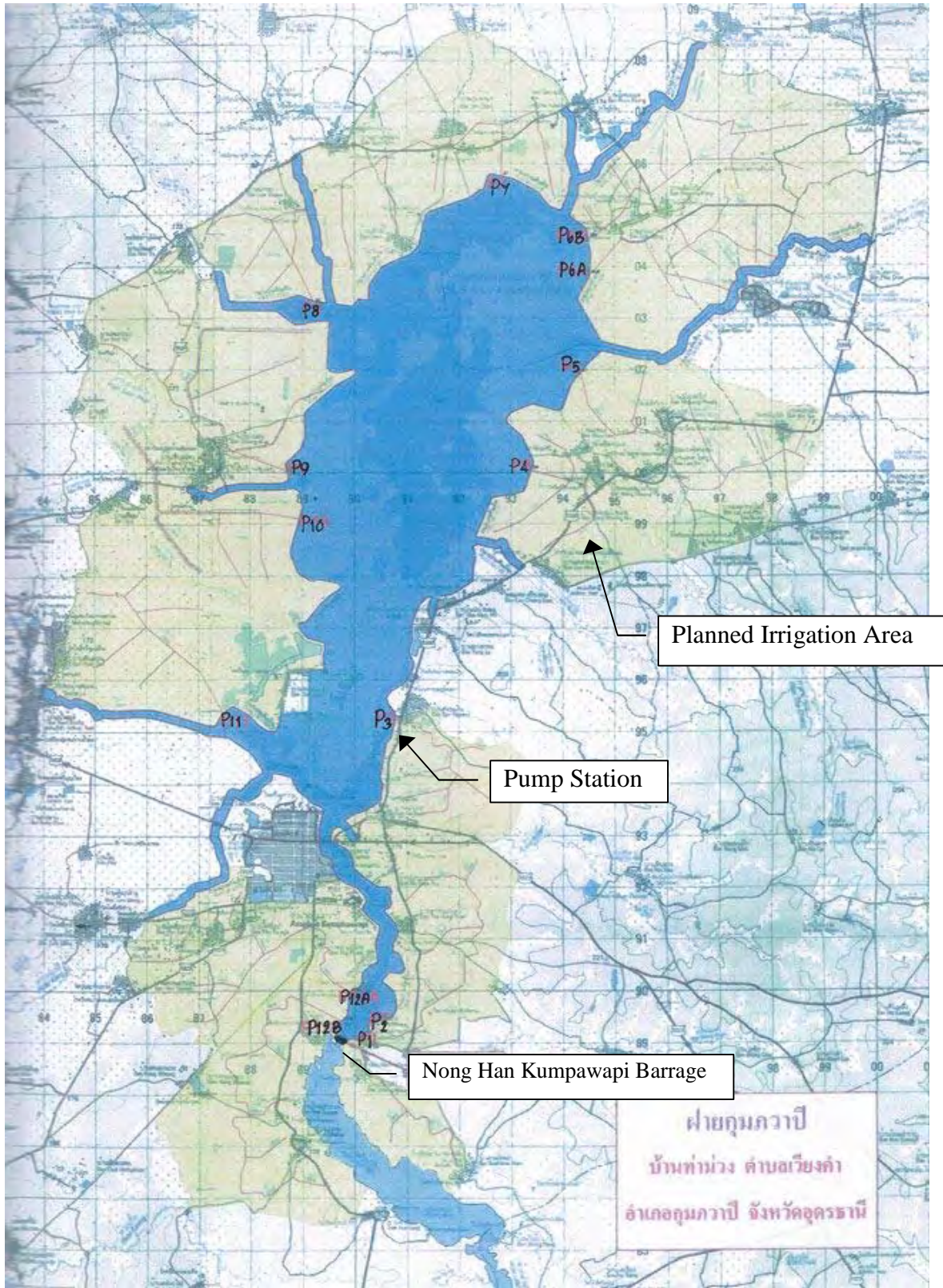
Gate of Barrage  
(Radial Gate)



Upstream side of Barrage



Downstream side of Barrage



**General Plan of Nong Han Kumphawaphi**

## Appendix 5.2

### Huai Sam Mo (HSM) Sub-River Basin

Date: June 12,2010

#### 1. Basic Information

HSM is one of 20 sub-basins in Chi river basin. It extends into two provinces that cover Kok Po Chai district of Khon Kaen province, and Consawan district, Kang Kro district, and Phu Khiew district of Chaiyaphum province. HSM covers 729 square kilometers or 180,150 acres (455,652 rai) that covers 1.47% of the Chi river basin area. Agricultural area covers 318,718 rai which is 70 percent of the total area. Irrigated area covers 5,000 rai (3,000 rai using water released from the hydro power plant in upstream area and 2,000 rai in downstream area using water from natural reservoir). The residential area comprises 9% of the area with local residents of 12,139 households and 53,972 people. Annual rainfall and water demand are as follows.

- Annual rainfall of 1,210 mm.
- Total run-off 149 million m<sup>3</sup>
- Supplementary water supply from hydropower 30 million m<sup>3</sup>
- All storage capacity 32.91 million m<sup>3</sup>
- Water demand for all sectors 51.70 million m<sup>3</sup>
- insufficient water 18.79 million m<sup>3</sup>

(Integrated Water Resource Management Center, Khon Kean University)

#### 2. HSM as pilot project of Chi river basin

HSM was selected as a pilot site for Upper Chi River Basin under the policy of the Ministry of Natural Resources and Environment for integrated natural resource management with local participation of people and good governance in solving water-related problems. The site was selected because it covers more than one province. Moreover, the characteristics of HSM represent other sub-basins. During 2002-2009, several agencies support HSM to identify its needs and strategies such as MRC-GTZ, World Bank, WWF, Khon Kean University and the Department of Water Resource. The sub-basin working group was established in 2002 as a coordinating body for the development. Local Administration Organizations were active participants of the development process. HSM has identified five development strategies as follows;

1. Community water resource development
2. Promotion of organic agriculture and income generation activities

3. Institutional Development and Environment Rehabilitation
4. Development of local curriculums, local knowledge study and community rules
5. Promotion of women and youth roles

### **3. HSM as the research site on integrated water resource management**

The Integrated Water Resource Management Center from Khon Kean University conducted the multidisciplinary research in HSM during January to December 2009. The research team members comprised of university lecturers in the field of agriculture, engineering and social sciences. Reports published by the center are,

- Efficiency of Irrigation Water User and Relationship with a Forest Ecosystem in HSM, Chaiyaphum province
- Research on Format System of Agricultural Farm by Effective Using Water and Economize in Huai Sam Mo Catchment
- Water Storage in Huai Sam Mo
- The Potential evaluation and management of Ground Water in Huai Sam Mo
- The Potential Development of village Ground water supply in Huai Sam Mo

#### **Annex:**

##### **A. Finding on the Engineering Aspect**

1. It is only 3,000 rai of the irrigation area along the main canal irrigated by water of 30 MCM after the hydropower –generation supplied from another basin. Comparing the amount of water irrigated with the water required in irrigation of paddy field generally in rainy season, it might be say that water after hydrogenation does not utilized effectively. Therefore, the proposed plan to construct the diversion canal to store unused water to the 7 ponds of left side and 3 ponds of right side of the power generation plant shall be effective to increase the irrigation area in the rainy season.
2. The other-hand, equity to access to the irrigation water is not secured due to the difficulty to lack of lateral canal. Only the farmers who have farmland beside the main canal can access water. Therefore, the lateral and tertiary canal construction is necessary to secure the equity to access water.
3. Due to insufficiency of irrigation water, underground dam is proposed to the basin. However, the existing topo-geographical condition is considered almost as the same condition as that after construction of underground dam. Therefore, it is necessary to study further.

## **B. Findings on Lessons learnt during the field survey on Huai Sam Mo Project**

### **In Chaiyaphum By: Agriculture Group (June 12, 2010)**

- 1) In the Project promotion and implementation, the close collaboration among the two provinces concerned and Amphoes and other institutions as Basin Committee, sub-basin working group and international aid agencies was important to secure a success story.
- 2) Similarly, to respect the opinions of local people as represented by the working group and NGOs and also of the related River Basin Committee was so important in the project promotion and implementation as well as the post project O & M activities.
- 3) It was not clearly confirmed if the water diversion for power generation had been done before the subject Project planning, but anyway the water thus availed may cause benefits in the agricultural production in the Huai Sam Moh area.
- 4) Through the use of stored water in the dry season which had been retained for the purpose of flood mitigation in rainy season, a kind of adequate collaboration between the upstream basin and the lower-stream basin could be realized. This will lead to an overall higher agricultural production in this particular basin as a whole.
- 5) Pilot project is aimed to enable application of the project experience to the other areas with similar conditions (There is a surplus water in the donor basin and the surplus water may cause higher head if diverted to neighboring other basin.). This pilot project is the case of an effective water utilization which derived from water diversion for power generation purpose. It is considered that there would be very few areas favored with the similar conditions. Therefore, in the aspect of water resource management, it seems difficult to apply the experience (Good practice) in other areas, though it is fairly possible to do it in the social and institutional aspects.

Note: No much information could be confirmed on agriculture related issues, though questions were repeatedly made. It is seemed that the sub-basin working group is more interested in the aspects of institutions and environmental conservation but not on the irrigation area expansion as well as production increase/efficiency.

### **c. Finding and lesson Learnt from Environment Aspect**

Findings and lesson learned are derived from project paper s entitled " Three years experience in the Pioneer stage in Huai Sam mo sub-basin(HSMSB) Management planning December 2008" , "Utilizing the local knowledge into the watershed management plan: The case of Huai sam mo watershed. together with discussion with huai sam mo Sub-basin working group at site office and field visit on june 12,2010.



With the clear vision of HSMSB to manage water resource in a sustainable manner and rehabilitate natural environment, the five development strategies have been established and partially implemented.

**Environmental findings:**

- a. Surface water quality protection Application of organic fertilizer and pesticides in rice farming is capable to protect chemical contamination of water courses. This is evident at Nong Saiwan tai village at Kaeng Khro district Chaiyaphum province.
- b. Aquatic ecology protection Application of organic fertilizer and pesticides is not only protect water quality but also benefits to aquatic ecology in watercourses such as plankton and fish. Develop fishery conservation zone and control usage of fishing gears are capable to enhance fish production and protection of fish species. This is evident at Non Kyrum village and Kud Lop in the HSMSM.
- c. Soil Conservation Vegetation in the bareland especially in slope area is capable to protect soil loss from erosion. This is evident at Saiwan tai village.
- d. Forest Conservation Forest conservation in connection with religious practice( Forest temple) is capable to control deforestation. This is evident at Ponetong temple, Nong Kae village.

**Lesson Learned**

As the project is ongoing and certain environmental resources are protected, it cannot be concluded at this stage that the natural environment at sub-basin level can be rehabilitated. However with the sound development strategies and implementation, there are high potential of success.

**D. Additional information about Huai Sam Mo Pilot Project from Environment Group**

On 14<sup>th</sup> June

Interviewed: Mr. Somkhid Singsong

Prepared by Kitao (Mr. Warapong & Dr. Jamlong)

- A. MRC involved in Huai Sam Mo (HSM), since HSM is one of Chi River basin. When MRC looked for pilot project area, DWR 4 secretary of 5-T introduced the site to MRC.
- B. MRC provided fund the planning meeting.
- C. World Bank donate fund to MRC and MRC supports Huai Sam Mo pilot project. In addition, WB gave HSM fund to formulate an action plan.
- D. KCU and DWR supported the pilot project in terms of technique.
- E. WWF had a project site in Manchakiri and Coca Cola Ltd. implemented a study tour to the HSM. Coca Cola Ltd. has a plan to support WWF for three years.
- F. There are river basin committees in Kon, Mun and Chi River, each. However, there is no sub-basin committee under the river basin committees. In case of Huai Sam Mo, the members are

called as “working group”. Concerning regulation, the working group follows the regulations/rules of upper level, namely, those of Chi River basin committee.

- G. Huai Sam Mo covers some parts of 2 provinces and 16 Tambons, however, it has independent budget and no relationship with provinces and Tambons. Tambon Administrative offices do not play a role in the pilot project in term of financial support.
- H. Water resource management (not integrated one) is a part of watershed management. The latter includes everything such as eco-system.
- I. MRC supports duplication of the pilot project into 19 sub-basins. At present, half of them try to implement the same activities shown as below:
  - a. Participation in watershed management
  - b. Integrated water resource management
  - c. Planning of community sub-basin (watershed management at community level)

## Appendix 5.3

### Huai Luang Estuary Barrage Project

Date: 25 June 2010

Interview to : Project OM Office Chief, Mr. Somchai Kwannonderm

#### 1) Introduction/Background

- The project site is located at Chum Pone, Phonpisai district, Nong Khai province beside the Khong river. The Huai Luang flows more than 100 km in length and discharged to Khong river.
- The Huai Luang has a catchment area of 4,340 km<sup>2</sup> in total consisting of the main river with 3,600 km<sup>2</sup> and the large tributary of Huai Dan with 740 km<sup>2</sup> and annual runoff is estimated as ranging from 874 MCM to 1,236 MCM. The catchment area in the Huai Luang is formed with plateau and covered mostly with rainfed farming area.
- There is a large scale project with the Huai Luang reservoir with the effective capacity of 136MCM and irrigation area of 100,000rai (16,095ha) at the upstream.
- Huai Luang has a estuary barrage at confluence with the Mekong river constructed by DEDP in the Khong-Chi-Mun project.
- Under the Khong-Chi-Mun project, DEDP had the irrigation development plan of 9 pump irrigation systems with 99,000rai along the Huai Luang river downstream where has appearances of inundated swamp in the wet season, and construction of dike 20km in length (with top EL 162m, W=4.0m) surrounded the swap area of 53,000rai and land compensation had been taken place at some extent.
- In the year of 2002, the mandate for operation and maintenance as well as the water use for the Luang river were transferred to RID from DEDP. After transferred the facility of the Huai Luang estuary barrage from DEDP, RID has turned over the project and planned to advance the project.
- Some problems in terms of land compensation are emerged now between the villagers and government. Then, the coordination committee (national level) directed RID to survey the project on 2009.
- At present, RID is conducting the survey regarding the inundation area, farmland area and number of people affected if water level is maintained at WL160m in the flood.
- In accordance with the survey result, RID will decide the development plan and conduct the following process.
  - Survey the flooding area and number of people affected by impoundment
  - Selection of the option among “A” and “B” (refer to below)
  - Compensation of land in accordance with the selected option
  - Feasibility study and review the previous design (redesign, however, FS and EIA reports are not found which DEDP has conducted before )
- RID considers that the project has already been started based on the approval of the government for construction of Khong-Chi-Mun project on 11 January 1984.

- Accordingly, SEA or EIA process is not required to conduct to advance the project and Feasibility Study could be finished within short period because of revision only on the previous study.
- Therefore, it is expected that further 3 to 5 years will be necessary to start the construction of the project.

## 2) Project Profile

- Alternatives of the Project :

### Original Plan of DEDP (Option “A”)

The flooding area (lower than EL 160m) is designated at 53,000 rai and dike was constructed with about 20km in length surrounded the flooding area. Land compensation will be made for the flooding area of 53,000 rai, while more wide area would be suffered from flood.

### Alternative Plan (Option “B”)

All area lower than EL 160m where inundated in flood is compensated. No dike will be constructed. Flooding area will be amounted to 110,000 rai.

- Out of 53,000 rai which is required to compensate the land acquisition, only 14,000 rai has been compensated. The area of 23,000 rai is the communal area. People owning the remaining area of 16,000 rai have complained in compensation.
- No irrigation area is existed, however, 12 pump stations (10m<sup>3</sup>/min in average) owned by TAO are operated at the upstream.
- Project planning committee organized by RID will select the one alternative from the above.
- The maximum Run-off of the Huai Luang is 2,200MCM in the year of 2002.
- Storage capacity of the Huai Luang reservoir at the estuary is estimated at 156MCM when WL 160m and 14.4MCM when WL 155.5m.
- Huai Luang Barrage: W 7.0m x H 11.0m x 3 units with Fish Ladder x 1 row, threshold of barrage EL 149m, top of Gate EL 166.5 m.
- The barrage gates are opened during three months from July to September.
- Organizational Structure: RID, Nong khai Provincial Irrigation Project Office, 2 officers, 6 supporting staff.

## 3) Findings

- Species of fish in the Huai Luang river are almost the same with those of Mekong river.
- As a policy of DEDP, no land compensation has been enhanced in the construction project.
- Storage capacity of 156 MCM is considered to be enough water volume for irrigation area of 99,000 rai if it compares with the Huai Mon project of which available water volume is 24 MCM (storage 14 MCM + 10 MCM from Mekong river) and irrigation area is 54,000 rai.

- LPC project would be the next project after settled the Huai Luang Estuary Barrage Project. However, the feasibility study shall be made taking into consideration of the LPC project which will be followed to the Barrage Project.
- At present, the land under EL 160m is covered for compensation in case of both option “A” and “B”. However, LPC project is expected the storage water of Huai Luang upper the WL 160m up to WL 162m. Therefore, new dike shall be required to protect the land between EL160m~162m from flood.

#### 4) Lesson Learnt

- When project is planned, the people shall be involved in the beginning of project planning.
- The matters concerning land compensation are the most sensitive thing for any project.

#### 5) Annex ( Photo,)



## Appendix 5.4

### Huai Mong Project

Date : 24<sup>th</sup> June 2010

RID Huai Mong Project O & M Office, RIO5, RID: Director Mr. Prasong Phongsawas

#### 1.Introduction/Background

Huai Mong is the pumping irrigation area constructed by DEDP about 30years ago. By the reorganization of the government in 2002, the facility and its operation and maintenance has been transferred to RID.

Hearing and investigation results in RID O & M Office (RIO5) are as follows.

#### 2.Project Profile

- (1) This agricultural beneficial area is located on amphoe Tha Bo, Nong Khai province. It has farmland area of 61,000rai in total, which is irrigated 54,000 rai in the wet season and 25,000rai in the dry season. There is a few pump irrigation system like this project in the whole RID's operating projects which irrigates all project area by using pumps only.
- (2) Irrigation and drainage facilities have passed for 30 years, which is getting deteriorated and should be renewal.
- (3) Average annual run-off of the area is 774 MCM. Of them, storage of water is about 14.3 MCM, but shortage of irrigation requirement is not coming about.
- (4) This project has been implemented as a part of precedent one in the Pamong Dam plan (Khong-Chi-Mun Project).
- (5) Main facilities
  - Estuary Barrage (Head Regulator) : 4 units of Roller Gate
  - Head Regulated Pumps (use as both irrigation and drainage) :  $2.3\text{m}^3/\text{s} \times 4\text{pumps} = 9.5\text{m}^3/\text{s}$   
(Wet season) drainage to Mekong river (Dry season) irrigation from Mekong river  
There are 4 units of Head Regulated Pumps, but only two units are operated for 8 hours/day because of electricity shortage in the area.
  - Irrigation Pumps : 10 (some of them are both irrigation and drainage functions )



**Fig. 1 Head Regulating Pumps ( $2.3\text{m}^3/\text{s} \times 4\text{units}$ )**

## **2.Findings**

### **(1) Irrigation and Flooding**

#### 1) Irrigation

RID director don't think expansion of irrigation area due to shortage of water in the dry season and payment of electricity expense, though farmers has the request of expansion. In addition, it is difficult to expand irrigation area because it is necessary to go so far as modifying Head Regulating Pumps. Pumping irrigation by themselves is putting in execution except this project area along Mekong river. There is also the area third crop is irrigated.

#### 2) Flooding

It had big floods two years ago due to water elevation of water surface of Mekong river and flowing from Srirachangmai area. Submerged conditions is continuing for three months, it made 4,000rai paddy field damage. (Dike of Mekong river is EL.170.0m, Flooding water level is EL.170.25m)

#### 3) In the dry season in this area, short supply is irrigated.

### **(2) Agriculture**

#### 1) State of crops

Main crop is rice. After harvesting rice, farmers plant vegetables (ex. tomato, tobacco, chili pepper). And that in this area , Flooding damage is more serious than drainage one.

#### 2) Yield of rice

600~800kg/rai (irrigation area), under 600kg/rai (rainfed area),

#### 3) State of rice planting

In the dry season, farmers yield rice to sell by broadcasting.

In the wet season, farmers yield rice to consume themselves by transplanting due to some weed.

#### 4) Influence of rice planting due to low rainfall this year

Cropping area is equivalent annual level of 25,000rai. Water discharge is not restrict, amount of water is 24 MCM. (14 MCM flow + 10 MCM discharge)

#### 5) Farm machines

All works for plowing and harvesting is by farm machines.

### **(3) Operation and Maintenance**

#### 1) Electric cost

Electric cost of Head Regulated Pumps is paid all by RID.

Electric cost of 10 irrigation pumps is paid by farmers and RID with low.

Per year cost — Farmers pay 0.75 million baht/year . RID pays 3.5 million baht/year

Per hour cost — Farmers pay 0.6 baht/ kWh ( converted 0.17baht/m<sup>3</sup>). RID pays 2.0 baht/ kWh (electric price is 2.6 baht/kWh)

Farmers by themselves decide to cost distribution by area and time in every group.

In case that rice production turns down due to flooding, TAO aids some of the electric cost.

#### 2) Maintenance projects

High dike leveling brought increasing amount of storage last year, and then it make 2,400 MCM water storage. It is no problems by land acquisition to construct dike.

3) On farm projects

In on farm, canal construction is 70% in the schedule, but actually 50% constructed. Farm road won't construct at all.

4) Farmers' organization

There is a WUA(Water Users Association) in every 10 pumping stations, every WUA consists of some WUG(Water Users Groups). There are 166 WUG in total, 4 groups of them is IWUG (Integrated Water Users Groups).

5) Operations

- Pumping operation is determined by RID as accepted requisition from farmers.
- Minimum water level of Huai Mong river is WL.163.5m. If water level of Huai Mong river is under WL.163.5m, 10 pumping stations can't be operated. So Head Regulating Pumps is operated , intake from Mekong river, and maintain water level. High dike leveling from 165.5m to 166.4 brought 2,400 MCM water storage.

6) Rehabilitations

Pumps can not do rehabilitation due to no budget. Though they are getting older, they can't be got some parts. Because pumps was old and made in Belgium, not in Thailand

### **3.Lesson Learnt**

Huai Mong is the all pumping irrigation area constructed by DEDP.

The specialty side of this area is that it can be taken stable water from Mekong, but the other is that it is susceptible area to the flooding effect.

In case that it is damaged by flooding, farmers are received flooding compensation and preferential treatment of electric cost extension by government. So they can farm at ease.

But pumping facilities has passed for 30 years, and they are getting older and made in foreign country, so it is difficult to do rehabilitation. In this area, it is necessary for not irrigation but drainage. In the near future, diagnostic function test should be accomplish and take action for it's result.

As the aspect of maintenance, main facilities of Head Regulating Pump is operated by RID and on farm facilities of 10 pumps is operated by farmers. Both RID and farmers are good relationship for operation and maintenance.



#### 4. Annex

##### Huai Mong NO.5 Pumping Station Hearing

We conducted hearing investigation with WUG readers in Huai Mong NO.5 Pumping Station. This WUG is one of IWUG.

- (1) Farm households 375
- (2) Number of pumps 4
- (3) Operation pumps ... irrigation 95%、 drainage 5%  
Dry season : Pumps is operated to fulfill every farmer's ponds in December and January continuously.(1.5 months, 8hr/day) :2,500rai  
If water is getting enough, farmers want to irrigate all.  
Wet season : in May and June (1.5 months, 300hrs)
- (4) Crops ... rice, tomato, tobacco, chili pepper, corn, egg plant, no fruit
- (5) Yield of rice  
Dry season : farmers yield rice to sell.  
Wet season : farmers yield sticky rice and Jasmine rice to consume themselves. 800kg/rai、  
12baht/kg
- (6) Land ownership ... (average)10~15rai/ farm household,(minimum)2rai/ farm household,  
(maximum)40rai/ farm household,  
3rai farmland bring households getting consumption themselves.
- (7) Machinery ...Harvesting is charged by professional company in the mid of Thailand.  
Expenses for commission  
Dry season : 500~600baht/rai Wet season : 700 baht/rai  
Harvesting machine costs 100 million baht, but there are some farmers to buy it.  
As harvesting, it is no land shape's problem to use machinery.



**Fig. 2 WUG Readers (NO.5 Irrigation Pump)**

## Appendix 5.5

### Lam Pao O&M Project

Office of Regional Irrigation 6, RID

#### 1. Background

Planning Project started in 1963 and finish construction in 1985

Budget 2,185 M.bath from WB

- Stage 1: 1963(2506)-1968(2511) construction of DAM, Irrigation canal, Drainage and tertiary use for area 100,000 rai, budget 678 M. bath  
in 1975(2518)-1980(2523) budget 307 M. bath
- Stage 2: 1980(2523)-1985(2528) Construction of Irrigation System 214,300 rai  
budget 1,200 M.Bath
- Total Budget 2,185 M.Bath for 314,300 rai from World Bank

#### 2. Catchment Area and Runoff

Lam Pao Sub Basin

- Drainage Area 8,084 sq.km.
- Runoff 2,677 MCM/Y

Chi river Basin

- Drainage Area 49,476 sq.km.
- Runoff 11,244 MCM/Y

Lam Pao Dam Basin

- Drainage Area 5,960 sq.km.
- Runoff 1,947 MCM/Y

#### 3. Dam Storage Volume and Flood Control

Reservoir EL.+166.00 m.msl.	Reservoir Area 570 sq.km.
Retention WL+164.00 m.msl	Volume 1,981 mcm
Max. storage EL.+165.700 m.msl.	Volume 2,450 mcm.
Active storage EL.+162.00 m.msl	Volume 1,430 mcm.
Min. storage EL.+150.00 m.msl.	Volume 450 mcm.
Inflow	2,000 mcm./yr.
Average rainfall	1,350 mm./yr.

#### 4. Dam Structure

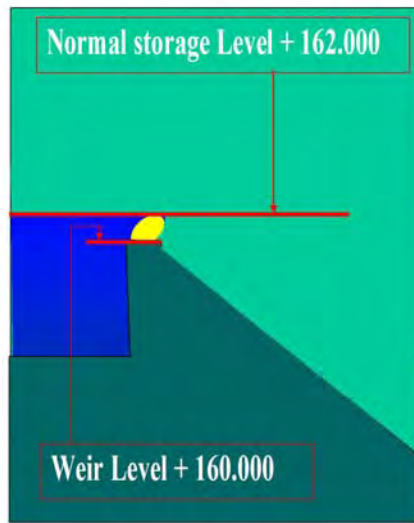
Earth Dam height	33 m.
Length	7,800 m.
Crest width	8 m.
Width of dam base	228 m.

Slope, upstream 1:3  
 Slope, downstream 1:2.5

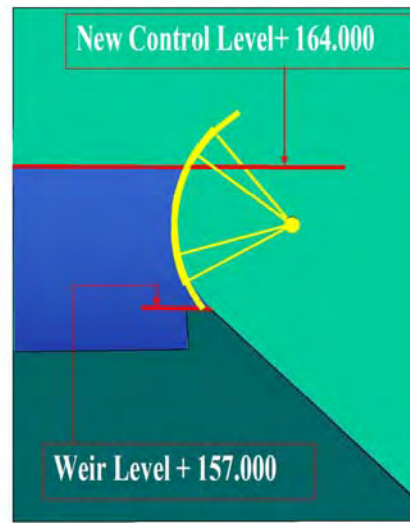
### 5. Spillway

#### Spillway (Original)

Type : Ogee weir  
 No. of opening (width) 3 (15 m. each)  
 Height of rubber weir 2 m.  
 Max. discharge 1,400 cu.m./sec.



Current Spillway



New Spillway

#### Spillway (Improvement)

Type : Ogee weir  
 No. of opening 4 (12 m. each)  
 Height of Radial Gate 5 m.  
 Max. discharge 2,216 cu.m./sec.

6. River Outlet : Diameter 3 m.  
 Length 114 m.  
 Max. discharge 80 cu.m./sec.

### 7. Irrigation Canal System

#### Head Regulator, Right Main Canal

Type : Square outlet size 2.10 m x 2.30 m.



Length 52 m.  
 Max. discharge 37 cu.m./sec  
 Commanded area 236,036 rai (37,765 ha)

Head Regulator, Left Main Canal

Type : circular outlet diameter 2.50m.  
 Number 1 row  
 Max. discharge 30 cu.m./sec.  
 Commanded area 72,927 rai (11,668 ha)



8. Irrigation Area

Area and Distribution-Drainage of the Project

Project area 314,300 rai (50,288 ha)  
 Irrigated area 308,963 rai (49,434 ha)  
 RMC 91.72 km and 232,860 rai  
 LMC 66.96 km and 81,440 rai  
 Total length of 112 laterals and sub-laterals 452.37 km.

9. Drainage Canal

Total length of 57 main drain 174 km.  
 Total length of 51 lateral drains and sub-lateral drains 74.35 km.  
 Total length of flood protection dike in Lam Pao and Chi rivers 75.85 km.  
 Total length of 1,134 ditches 2,300 km.



## 10. O & M Sections

### Lam Pao O&M Project

**Project area : 50,288 ha**

O&M Sect.1 reservoir area and headworks

O&M Sect.2 48,719 rai (7,795 ha)

O&M Sect.3 46,154 rai (7,385 ha)

O&M Sect.4 35,535 rai (5,685 ha)

O&M Sect.5 37,392 rai (5,982 ha)

O&M Sect.6 43,785 rai (7,005 ha)

O&M Sect.7 39,030 rai (6,245 ha)

O&M Sect.8 27,490 rai (4,398 ha)

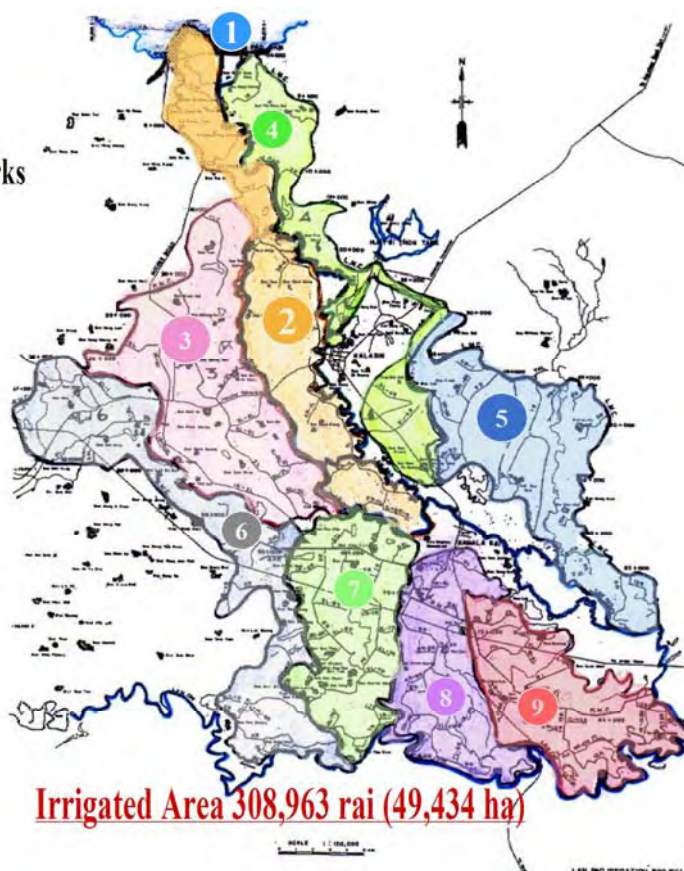
O&M Sect.9 30,858 rai (4,937 ha)

Muang District 90,488 Rai

Yang Talad District 79,062 Rai

Kamala Sai District 80,361 Rai

Kong Chai District 59,052 Rai



## 11. Production

Production value of crop in wet season, year 2008

Wet season rice, area	300,857 rai (48,137 ha)	992,828,000 baht
Upland crops-vegetables	218 rai	534,000 baht
Fish	2,283 rai	50,226,000 baht
Fresh water giant prawn	5,337 rai	346,905,000 baht
<b>Total</b>		<b><u>1,390,493,000 baht</u></b>

Production value of crop in dry season, year 2008/2009

Dry season rice, area	224,826 rai (35,972 ha)	809,373,000 baht
Upland crops-vegetables	7,207 rai	68,358,000 baht
Fish	2,201 rai	44,020,000 baht
Fresh water giant prawn	5,474 rai	410,550,000 baht
<b>Total</b>		<b><u>1,332,103,000 baht</u></b>

## 12. Telemetry

Number	Station Name	Code	Data	
			Rainfall	Water Level
1	Main Station	LP1	-	-
2	Kumpawapee Weir	LP2	X	X
3	E.65	LP3	X	X
4	Wang Sam Mor District	LP4	X	-
5	Somdej District	LP5	X	-
6	Lam Pao Dam	LP6	X	X
7	Downstream	LP7	X	X
8	Kamala Sai District	LP8	X	X
9	Wang Yang Weir	LP9	X	X
10	Roi Et Weir	LP10	X	X

## 13. Expansion of additional irrigation area

By Improvement of Lam Pao Dam Project in Kalasin Province, additional irrigation area of 225,000 Rai is planned using the new additional storage of 551 MCM. (Effective Storage Level from +162.00 to +164.00 m. msl.) with the budget of 6,300 million Baht (Dam Improvement Cost 3,000 million baht, Irrigation system 3,300 Million baht)



## Appendix 5.6

### Lam Phayang Pumipat (Water Diversion) Project

Date: 14 June 2010

Interview to : Project O&M Office, Mr. Somsak Chonporn

#### 1) Introduction/Background

The project is located at Kum Kao Sub-district, Khao Wong district, Kalasin province near the border of Mukdahan province. The project can be divided into two phases. The first phase is the upper Lam Phayang project started on 1995 with the irrigation area of 4,600 rai, of which the water source is upper Lam Phayang reservoir (3.5MCM) in Kalasin province.

The second part was implemented in 2009 in accordance with the royal initiation that was to construct the Huai Phai reservoir in the Huai Bang Sai river basin in Mukdahan province with the capacity of 10MCM and to supply irrigation water to the Lam Phayang irrigation area 12,000 rai at the Kalasin province side by means of water diversion by gravity through the tunnel 710 m in length (dia.3m) and the pipeline (dia. 1.2m~0.8m) installed in the tunnel. Water of the Huai Phai reservoir is also supplied to the irrigation area downstream of 1,000 rai in the Huai Bang Sai basin in the Mukdahan province.

#### 2) Project Profile

- Major Components :

##### Upper Lam Phayang Irrigation System (First Phase 1995)

Upper Lam Phayang Reservoir: original 3.5MCM, after improved 4.0 MCM

Irrigation water distribution by Pipeline system (72 outlets)

Irrigation Area: 4,600 rai, 507 households

Water leakage from 22 places out of 72 outlets due to stand pipe (not the steel pipe)

WUGs were organized at each outlet and outlet valve is controlled by the farmer nearby

IWUG will be organized in the near future by consolidating the WUGs belonging to the several outlets

##### Huai Phai Irrigation System (Second Phase 2009)

Huai Phai Reservoir: 10MCM,

Tunnel : 3m dia. x 710m, Pipeline in the tunnel: steel pipe dia. 1.2~0.8m

RC Water Pressure break Tank

Irrigation water distribution by Pipeline system (PVC & RC pipe dia. 1.0~0.6m)

Irrigation Area: 12,000 rai,

SCADA system for Control & Monitoring of Water Diversion

No WUG is organized yet.

- Organizational Structure: RID, Kalasin Provincial Irrigation Project Office

### 3) Findings

- Pipeline irrigation system by gravity flow with high efficiency
- Due to no end distribution system (on-farm level) at the outlets, farmer connects the end distribution pipe to outlet by themselves.
- Huai Phai reservoir has a storage capacity of 10MCM, of which 6MCM at upper part of reservoir can be utilized by both irrigation area at Kalasin and Mukdahan without any priority. However, 4MCM at lower part of reservoir is only for irrigation area 1,000rai at Mukdahan side because of original water source basin.  
No argument has been existed in terms of water use in between both beneficiaries because several discussions have been held at the planning stage of the project.
- Tunnel method was applied for water diversion because the route of diversion across the watershed area classified as “A1”.
- The reason to employ the pipeline system for distribution system is not clearly presented, but, the committee was organized from the many ministries concerned to figure the project plan.
- Only wet season paddy is cultivated. Farmer handcrafts in dry season without emigrant for work.
- Rice product yield is much improved after project from 300 kg/rai to 800 kg/rai in the upper Lam Phayang area(Phase 1).
- Jasmine rice is produced. The quality of it is very high, so it is called as “Khao Wong Rice” and people come to purchase it from outside province.
- Test run of the project was conducted once after construction. One major leakage occurred and was repaired by the contractor. Since then it was not yet operated due to the shortage of water in Huai Phai reservoir.

### 4) Lesson Learnt

- Pipeline system for distribution is much advantageous in water use efficiency
- Pipeline system for distribution needs high construction cost.
- Pipeline system for distribution is low water accessibility.
- Illegal water use has been reduced due to pipeline system.
- Water leakage is reduced in the new outlet system using steel pipe at the standing pipe instead of plastic pipe at first phase
- No controversial movement has been emerged in between water users of the Huai Pai reservoir due to conducting of participatory project planning process.



5) Annex



Intake Canal from Huai Pai Reservoir

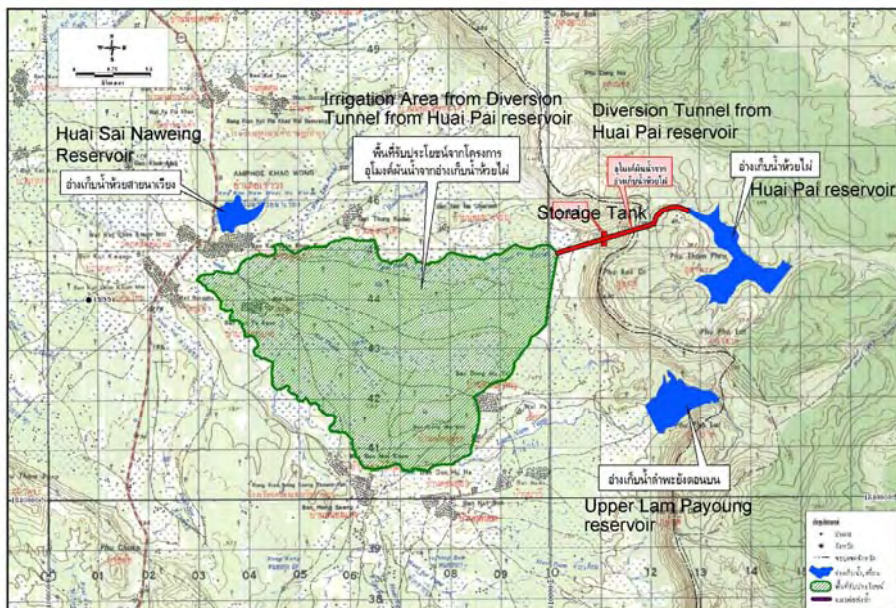


Beneficial Area of Huai Pai Project



Water Diversion Pipeline in the Tunnel from Huai Pai Reservoir

## Upper lam Payoung Diversion Project



## Appendix 5.7

### Land Consolidation Project Maha Sarakham Province

Date: 15 June, 2010 15:00-16:30 @ Land Consolidation project site

Interviewee: Mr. Pramate, chief of Maha Sarakham Provincial Land Consolidation Office, Farmer couple

#### 1. Introduction/Background

Starting from pilot area of 2,000 rai in 1996. Before Land Consolidation implementation, D&D type of on-farm system was constructed under Nong Wai Left Bank Project. Taking up of this Land Consolidation project is by top-down, but not farmers' request. So far 60,000 rai is completed. Another 50,000 rai is to be implemented in Nong Wai Irrigation area in Maha Sarakham.

#### 2. Project Profile

- 1) Name: Land Consolidation Project of Maha Sarakham province
- 2) Objective: 1. Convenient to access to own farm plot by farm road, 2. reduction of cost and time of transportation, 3. better management water
- 3) Area: 60,000 rai in Maha Sarakham. (Another 50,000 rai in the future)
- 4) Implementation Agencies: RID (Royal Irrigation Department)
- 5) Fund: Farmers' contribution (20% of construction cost, pay to BAAC: Bank for Agriculture and Agricultural Cooperatives) Remaining RTG.
- 6) Project Period: Since 1996 till present
- 7) Major Components:

Visiting site is located at 11R-LMC (Eleventh right side canal – Light Main Canal), middle stream of Left Main Canal, and just completed construction last dry season with extensive type (Concrete ditch, farm road, and drainage).

Construction cost for extensive type is 7,000 Baht/rai (average). In this area 90% is paddy planted area, and other 10% is mostly sugar cane and other minor crops. 70% of land can grow paddy in plan, but almost 100% is planted in dry season actually. This year, government tried to reduce dry season planting due to water shortage in Ubon Rattana Reservoir but farmers not followed.

Due to high water level of Chi river, drainage cannot drain out flood water. Small drainage by LC cannot reduce impact of flood.

Under the land consolidation project, works are on-going for construction of farm road, tertiary canals (Ditches) and drainage canals. No intensive works including re-shaping of land plot with leveling are included. (Extensive type) Under the extensive type, boundary of plots is in principle maintained as they are due to the preference of the owner farmers.

- 8) Organization Structure: Water User group, Water Management Organization
- 9) Number of Beneficially Stake Holders: unidentified

## 10) Others

- ① Farmers' prior consent is 80%. (more than 50% of farmer shall agree)
- ② Requirement: Area more than 500 rai, Enough Water Sources (Large scale, Medium, Pump), Land size 82-5 rai up)
- ③ Land utilization and ownership cannot be changed within 5 year after issuing land certificate. Change of land use shall be approved by Provincial Land Consolidation Committee chaired by Governor
- ④ Change of land use is only 0.2% mainly to construct farmers' own residence.
- ⑤ Annual implementation in Province: 4,000 rai/ year (2,000 – 5,000 rai depend on budget)

## 3. Findings

### 1) Agriculture and Benefit

- ① Farmers' felt benefits of land consolidation are: 1. Convenient to access to own farm plot by farm road, 2. reduction of cost and time of transportation, 3. better access to water
- ② Labour shortage and less young people interested in farming (even farmers themselves hope their children have better education and non-farm job with higher income)
- ③ Change from trans-planting to broad casting due to high labour cost (200 baht/ day/ person). Transplanting machine is introduced in some areas.
- ④ Harvesting by hired machine. Cost: Dry season B500/ rai Wet season B700/rai
- ⑤ Input Cost: Fertilizer 6-700/ rai, Pesticides: B100/rai
- ⑥ Production: Wet 7-800 kg/rai Dry 1,000 kg/rai Price: B5/kg +B2,000 /rai government support
- ⑦ Farmer cultivate 15 rai. This is enough for living if rice price is good as last year. But many years use government loan when they had damaged by flood.

### 2) Water Users Group and Operation & Maintenance

- ① Water User group (WUG) was formed 2years ago when Land Consolidation work started in this area
- ② WUG formed at turn out level. Water Management Organization at Lateral level to manage water.
- ③ Routine maintenance of cleaning of ditch, grass cutting and minor repair shall be done by farmers by themselves.
- ④ Farmer can request TAO to repair infrastructure and TAO set budget.
- ⑤ Major repair and rehabilitation can be done by Land Consolidation office using budget from Land Consolidation Fund, which is pool of money collected from farmers at 20% of construction cost.
- ⑥ Intake of ditch/ lateral canal is managed by zone man of RID O&M office. Due to policy of down-sizing of government organization, staffing of RID is not enough. Need to contract out maintenance work (cleaning and grass cutting of lateral canal).

#### 4. Lesson Learnt

Irrigation has been existing and there is no evident data on unit yield increase before and after the land consolidation works. Farm road is badly needed by the farmers and they are pleased with improved transportation access. Roads constructed under the project will surely cause convenience/benefit for easier farming works and transportation of farm products.

Farm mechanization is widely and progressively moving ahead in the area. Land preparation is done by two-wheel tiller and harvesting by combined-harvester mainly on contract (Hiring) basis. Mostly broadcasting is prevailing in the area and it is not realistic to imagine the farming might go back to manual labor, old-fashioned but popularly common in a decade or two decades ago. This implies that shaping of paddy field to suit to the mechanized work shall be one of the important elements in maintaining sustainable farm management and stable production.

In the land consolidation project area, paddy field shares as much as 90 % of the farm land in total, remaining about 10 % area for sugarcane planting. It may be necessary to consider possible change in the present practice to include some vegetable growing (Mixed farming) by more farmers for their consumption and sale some to the market.

#### 5. Photos taken



**Paddy Field after Land Consolidation**



**Irrigation Canal**



**Lateral canal managed by zone man of RID**

## Appendix 5.8

### Maha Sarakam Barrage Project (Middle Chi Project)

Date: 15 June 2010

Interview to : Project O&M Office, Water Distribution and Maintenance Section 2, P1 Pump Station

#### 1) Introduction/Background

Maha Sarakam Barrage is one of the project components of the Khong-Chi-Mun Project. Location of the barrage is on the Chi river (bypass channel) in Ban Kui Cherk, Amphoe Kosum Phisai, Maha Sarakam Province. Maha Sarakam water distribution system irrigates the right bank area of Chi river.

Maha Sarakam project irrigates 21,421 rai and belongs to Middle Chi Project which covers the irrigation area 107,150 rai in total extending in flood plain with the ground elevation about 150 m ~ 160 m.msl.

#### 2) Project Profile

##### (1) Maha Sarakam Barrage :

- Catchment area: 29,200 km<sup>2</sup>
- Annual Run-off: 3,940 MCM
- Design Flood: 3,200 m<sup>3</sup>/sec (return period: 100 year)
- River bed elevation: 138 m. MSL
- Barrage Structure: RC W 70 m
- Regulator : Steel Radial gate H 7m x W 12m x 6 units

##### (2) Water Distribution System :

###### 1) No.1 Pump Station ( located at 19 km upstream of Maha Sarakam Barrage)

- Pump Type: Vertical Mixed Flow
- Capacity: 3 m<sup>3</sup>/s/unit
- Maximum Head: 24 m
- Motor output: 1,000 kw (590rpm)
- Number of unit: 2 units
- Discharge pipe: Steel Pipe Dia. 1.5 m, 2 lines, Total length 1,487 m
- Head Tank: W 31.40 m x L 26.90 m x H 4.95 m
- Main Canal: Conc. Lining, 6 m<sup>3</sup>/s, L = 13,450 m
- Lateral Canal: 10 lines, total L = 19,387 m
- Irrigation Area: By Main Canal 9,400 rai, By Lateral Canal 13,846 rai  
Total Irrigation Area 19,258 rai (3,081 ha)

###### 2) No.2 Pump Station ( located at 19 km upstream of Maha Sarakam Barrage)

- Pump Type: Inclined
- Capacity: 0.4 m<sup>3</sup>/s/unit
- Maximum Head: 9.2 m
- Number of unit: 2 units
- Catchment area:
- Discharge pipe: Steel Pipe Dia. 0.5 m, 2 lines, Total length 20 m
- Head Tank: W 4.9 m x L 13.50 m x H 1.60 m
- Main Canal: Conc. Lining, MR 0.4 m<sup>3</sup>/s, ML 0.39 m<sup>3</sup>/s, L = 8,194 m
- Irrigation Area: Total Irrigation Area 2,163 rai (346 ha)

### 3) Budget for Construction

- |  |                  |
|--|------------------|
| • Construction of barrage (1989-1992)                                | 197,596,157 baht |
| • Construction of distribution system & pump house of P1 (1994-1997) | 155,329,631 baht |
| • Installation of 2 units of pump of P1 (1996-1997)                  | 32,500,000 baht  |
| • Construction of distribution system of P2 (2000-2002)              | 44,630,461 baht  |
| • Construction of pump house of P2 (2001-2002)                       | 6,262,533 baht   |
| • Installation of 2 units of pump of P2 (2002-2004)                  | 8,890,000 baht   |
| • Construction of distribution system ML of P2 (2003-2004)           | 6,590,000 baht   |
| • Ground Total   | 451,798,782 baht |

### 4) Organizational Structure: RID, Maha Sarakam O&M Project Office

### 3) Findings

- Pumps are operated during the period from end of June to October in wet season usually.
- No dry season crop is cultivated and no pump is operated.
- Maintenance for pump & facilities is carried out from May to June
- Around 150 numbers of WUG were organized in the irrigation area of P1 and P2.
- Leaders of the WUGs hold the meeting twice in the year at the beginning of crop seasons and request RID to supply irrigation water as scheduled.
- IWUG does not organized yet.
- Around 1,500 farmers are cultivated in P1 irrigation area and 400 farmers in P2 irrigation area.
- Annual electric costs of last year for pump operation are 900,000 baht for P1 and 50,000 baht for P2.
- Unit rate of electric is 2.7 baht per kwh. 0.6 baht per kwh is borne by farmer and remaining 2.1 baht by RID.

#### 4) Lesson Learnt

- No significant problem is existent in the project.

#### 5) Annex ( Photo, Map, List of Doc. Collected)

##### No.1 Pump Station



##### No.1 Pump Station : Rehabilitation of inlet canal from Chi river



## Appendix 5.9

### Nong Wai Operation and Maintenance Project

Khon Kaen Province, Regional Irrigation Office 6

#### **1. Background**

For the betterment of the Mekong River Basin Development, various Thai government agencies and the United Nations Lower Mekong River Survey committee have agreed after the survey of the major branches of the Mekong River, that it was necessary 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 “Ubolratana Dam (or Ubolrat Dam)” in the Lam Nam Pong, and the Royal Irrigation Department (RID) to construct the irrigation system to distribute water released from the power plant for cultivation on both bank of the Lam Nam Pong.

In 1965 (B.E.2508) RID undertook the construction of Headworks of the Nong Wai Weir in Nam Phong District, Khon Kaen Province, followed by the construction of the irrigation system in 1966 (B.E 2509) together with the project improvement in the form of irrigated agriculture development project over the existing irrigated agricultural areas and the extension as scheduled for higher efficiency in water distribution and utilization at the farm level and farm project. The development was phased as follows:

1975-1979 : improvement of irrigation system over the upper left bank of the project in the districts of Nam Pong, Muang Khon Kaen and Kranuan of Khon Kaen Province over an area of 9,400 ha under the Nam Pong Irrigation Project Phase I, with financial support from the International Development Agency (IDA).

1976-1983 : undertaking land consolidation works and improvement of irrigation system on the right bank of the Project in Nam Pong and Muang Khon Kaen Districts Khon Kaen Province over an irrigated area of 11,000 ha under the Nong Wai Pioneer Agriculture Project – Right Bank, with financial support from the Asian Development Bank (ADB).

1979-1985 : construction and improvement of the main and on-farm irrigation system on the left bank of the lower part of the Project in Districts of Chalang Yun and Kosum Phisai, Maha Sarakham Province over an area of 102,000 ha under the Nam Pong Irrigation Project-Phase II with financial support from the Kreditanstalt fur Wiederaufbau (KFW).



## 2. Project Boundaries

The project boundaries are as follows:

North: bounded by Khong – Udon Thani Highway, Nam Pong Sub-District, Nam Pong District, Khon Kaen Province.

South: bounded by Chi River, Kosum Phisai District, Maha Sarakham Province.

East : bounded by Kranuna District Khon Kaen Province.

West : bounded by Muang District, Khon Kaen Province.

## 3. Climate

Generally, the climatic condition in the project area is hot and humid with average annual rainfall of 1,200 mm.

## 4. Soils

Most of the project area is characterized by loam sandy loam with clay in alluvial plain.

## 5. Population

The project area lies under two provincial areas, Khon Kaen and Maha Sarakham with 143,857 populace (2008); of which 70,903 were male and 72,954 female.

Total population in Khon Kaen	98,462
Male	48,162
Female	50,300
Total population in Maha Sarakham	48,197
Male	24,162
Female	24,035

## 6. Main Watercourse

The Pong River or Lam Nam Pong is the only main watercourse flowing the project. It originates in the Phetchabun mountain range and forms the boundary line between Si Bounruang and Puh Wiang Districts of Udon Thani Project and Si Chomphu and Wiang District of Khon Kaen Province before flowing into the ubonratana Reservoir. After this point, it flows through the Nong Wai Operation and Maintenance project, and finally joins the Chi River at Tha Phra Sub-District, Muang District, Khon Kaen Province. The discharge capacity of Lam Nam Pong in the wet season is approximately 85 m<sup>3</sup>/s.

## 7. Rainfall

The project area is influenced by the southwest monsoon originating in the Indian Ocean, with average annual rainfall of 1,200 mm.

## 8. Project Description

The Nong Wai Operation and Maintenance Project is of weir type completed with distribution, drainage, flood mitigation, feeder roads, and telecommunication systems.

## **9. Nong Wai Weir**

The headworks is located at Ban Nam Phong, Nam Phong District, Khon Kaen Province. This weir is of ogee type reinforced concrete, with 5.90 m in height and 125.4 m in crest length, constructed across the river bed, 35 km south of the Ubonratana Dam or 33 km south of the city of Khon Kaen Province along the Khon Kaen – Udon Thani Friendship Highway.

The weir height can be augmented by 0.64 m. by pumping air into the rubber weir built on top of the concrete weir crest. The head regulators of the Right and Left Main Canals are able to distribute water to the cultivated areas on both bank of the Lam Nam Pong.

The maximum intake discharge is 53.0 m<sup>3</sup>/sec in total for both main canals.

## **10. Distribution System**

The distribution systems on both banks of the Lam Nam Pong are:

Right Distribution System consists of 1 main canal of 47,490 km, 15 laterals of 80,115 km, and 240 ditches of 530 m to convey water to the cultivated areas of 11,320 ha in Muang Khon Kaen and Nam Phong Districts, Khon Kaen Province.

Left Distribution System consists of 1 main canal of 82,900 km, 56 laterals of 299,864 km, and 584 ditches of 1,296,864 km to convey water to the cultivated areas of 30,944 ha in Muang Khon Kaen, Nam Phong, and Sam Sung Districts of Khon Kaen Province, and Ching Yun and Kosum Phisai Districts of Maha Sarakham Province.

## **11. Drainage System**

The drainage systems are also provided on both banks of the Lam Nam Pong.

Right Drainage System consists of 10 main canals and 11 laterals 80,338 km and 568 ditches of 410,580 km.

Left Drainage System consists of 5 main canals and 50 laterals of 274,832 km.

## **12. Flood Mitigation System**

The flood mitigation system consists of:

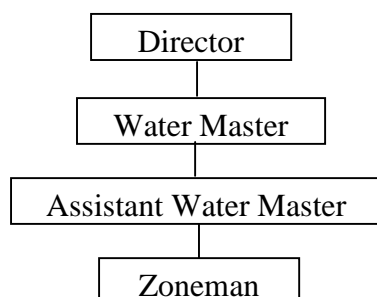
- Emergency spillway, 3.5 m high by 240 m long, able to release water at 1,000 m. and the reinforced concrete weir able to release maximum water at 1,500 m.
- Embankments along the right banks of the Nam Pong and Nam Chi, 27.517 km.
- Embankments along the left banks of the Nam Pong and Nam Chi, 75.494 km.

### 13. O&M road

The O&M roads of 566.286 km. serve as transportation routes for farm produce from the project areas to the markets.

### 14. Organization and WUG

The main diversion gate is operated by officers and facilities around paddies are maintained by WUG.



Off-farm	Zoneman (person)	28
	Density (person /km <sup>2</sup> )	0.067
On-farm	WUG	890
	Density (unit /km <sup>2</sup> )	2.144
	Farmers (person)	22,939

Reference: Development of Irrigation Management Model in Irrigation Projects, Thailand, Katsuhiro Higuchi, Osamu

### 15. Telecommunication System

The radio and telephone networks were installed to facilitate the water distribution on a rotational basis for total length of 277.564 km.

### 16. Benefits

1. To irrigate the cultivated area of 42,264 ha; of which 22,112 ha in muang Khon Kaen, Nam Phong and Kranuan Districts in Khon Kaen Province, and 20,152 ha in Chiang Yun and Kosum Phisai Districts in Maha Sarakham Province.
2. To enable 29,510 farm families in Muang Khon Kaen, Nam Phong, Kranuan Districts in Khon Kaen Province and Chiang Yun, Kosum Phisai Districts in Maha Sarakham Province to practice wet season rice cropping over 42,264 ha (264,150rai) and dry season rice cropping over 28,800 ha (180,000rai) with average yield of 650 kg/rai at a total income of 2,000 million baht/year.
3. To distribute raw water to the waterworks in Khon Kaen Province, Khon Kaen university, and Sriphacharindra Military Camp.
4. To encourage fish farming in paddy fields and natural watercourses over an area of 1,300 ha.
5. To maintain headwater downstream of the Ubonratana Dam for hydro-power generation.



**Nong Wai Weir**



**Right Main Canal**

