Institution and Water Management of the River Basin in Thailand: Case Study of Mae Klong River Basin

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Topic to be presented

- Introduction
- Description of Thailand and Mae Klong
- System Approach for Land and WRM
- River Basin Committee
- Conclusion

1. Introduction

- Increasing in use of land and water resources
- Need of integrated Water Resources Management (IWRM) for river basin management
- Development of decision support system
- New tools such as GIS and multiple goal optimization

These requirements lead to the development of a DSS with

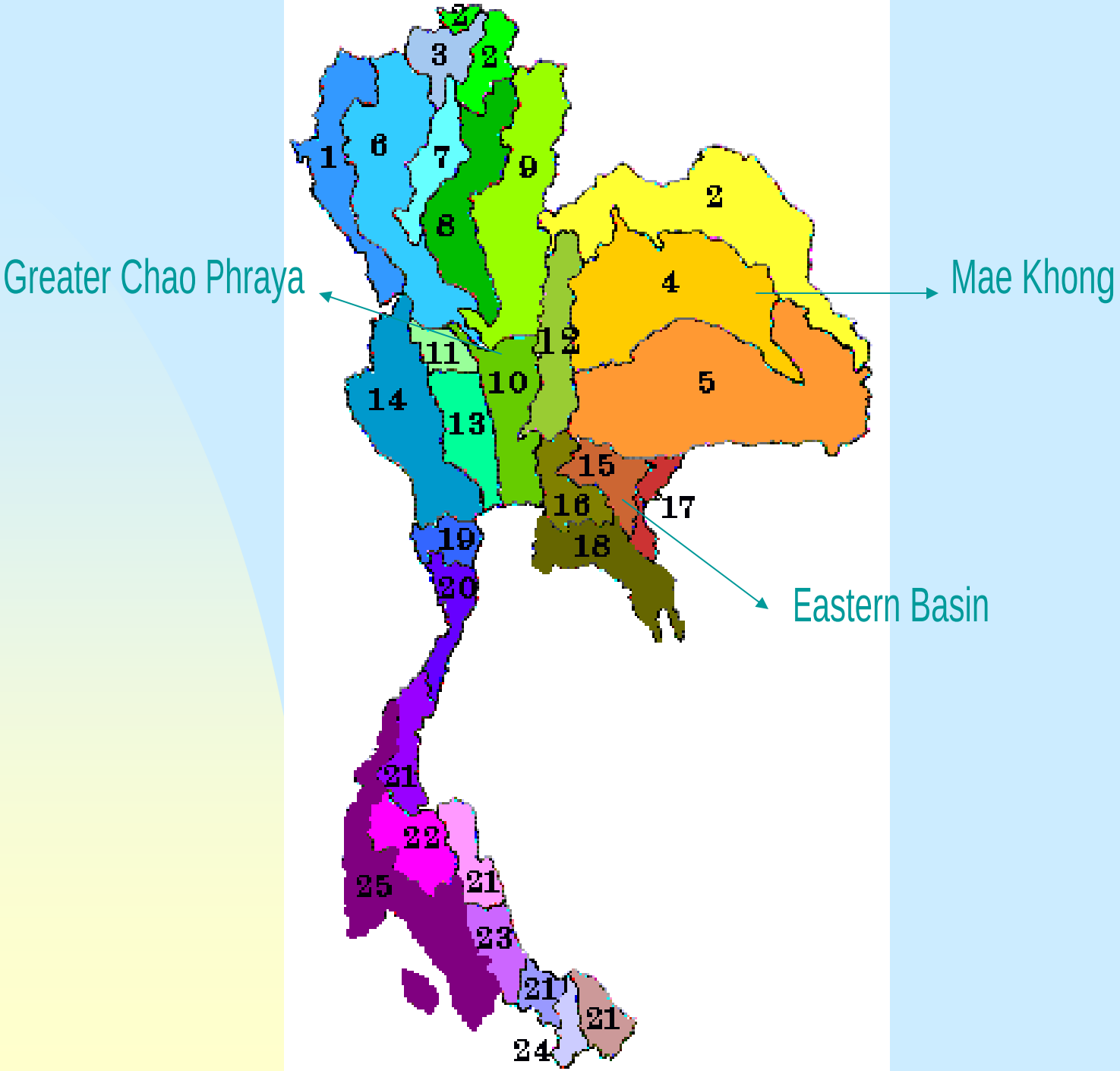
- Analysis of land and water resources
- Taking into account of stakeholder opinion
- Use of GIS and multiple goals analysis
- Prototype system with cost effectiveness

The need of river basin committee to be legal platform for planning, allocation and conflict resolution.

2. General Description

- 25 major river basins with problems in resources management

- 29 river basin committees


Greater Chao Phraya
Mae Khong
Eastern Basin
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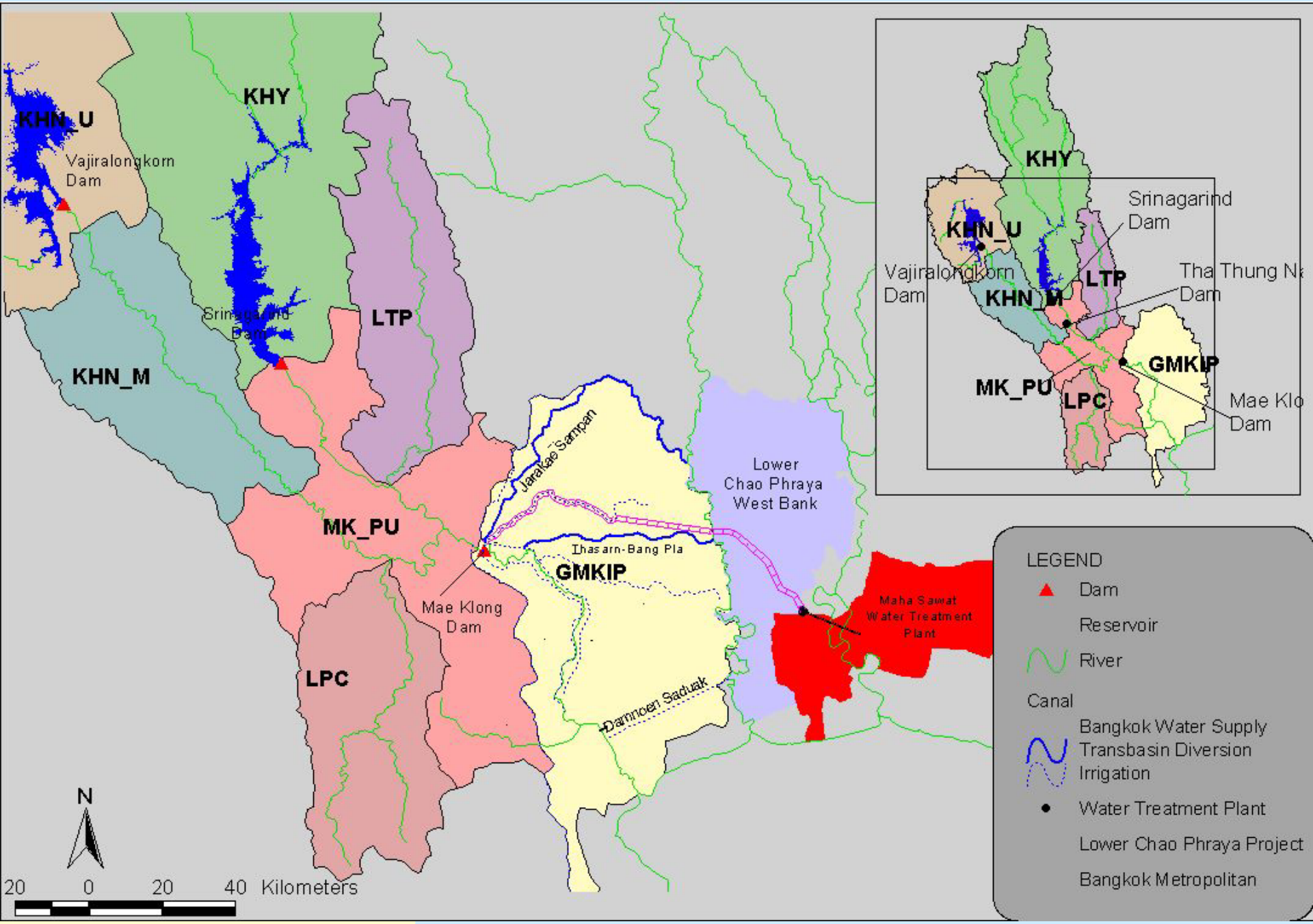
Region	No.	Watershed	Area (Km^2)	Annual Supply (mcm) (mcm) (mcm)	Annual Yield ($l/s/km^2$)	Annual Demand (mcm)
North	1	Salawin	17,920	8,570	15.16	1,220
	3	Kok	7,895	5,275	21.19	5,884
	6	Ping	33,898	7,308	6.84	574
	7	Wang	10,791	1,483	4.36	4,590
	8	Yom	23,616	3,324	4.46	2,923
	9	Nan	34,330	9,158	8.46	2,503
Northeast	2	Mae Khong	57,422	19,362	10.69	657
	4	Chi	49,477	10,269	6.58	1,254
	5	Mun	69,700	17,146	7.80	3,649
Central	10	Chao Phraya	20,125	4,629	7.29	12,977
	11	Sakaekrang	5,192	1,297	7.92	750
	12	Pasak	16,292	2,820	5.49	1,262
	13	Thachin	13,682	1,900	4.40	960
West	14	Mae Klong	30,837	12,373	12.72	6,244
	19	Phetchaburi	5,600	1,826	10.34	854
	20	West Coast-Gulf	7,100	1,420	6.34	3,449

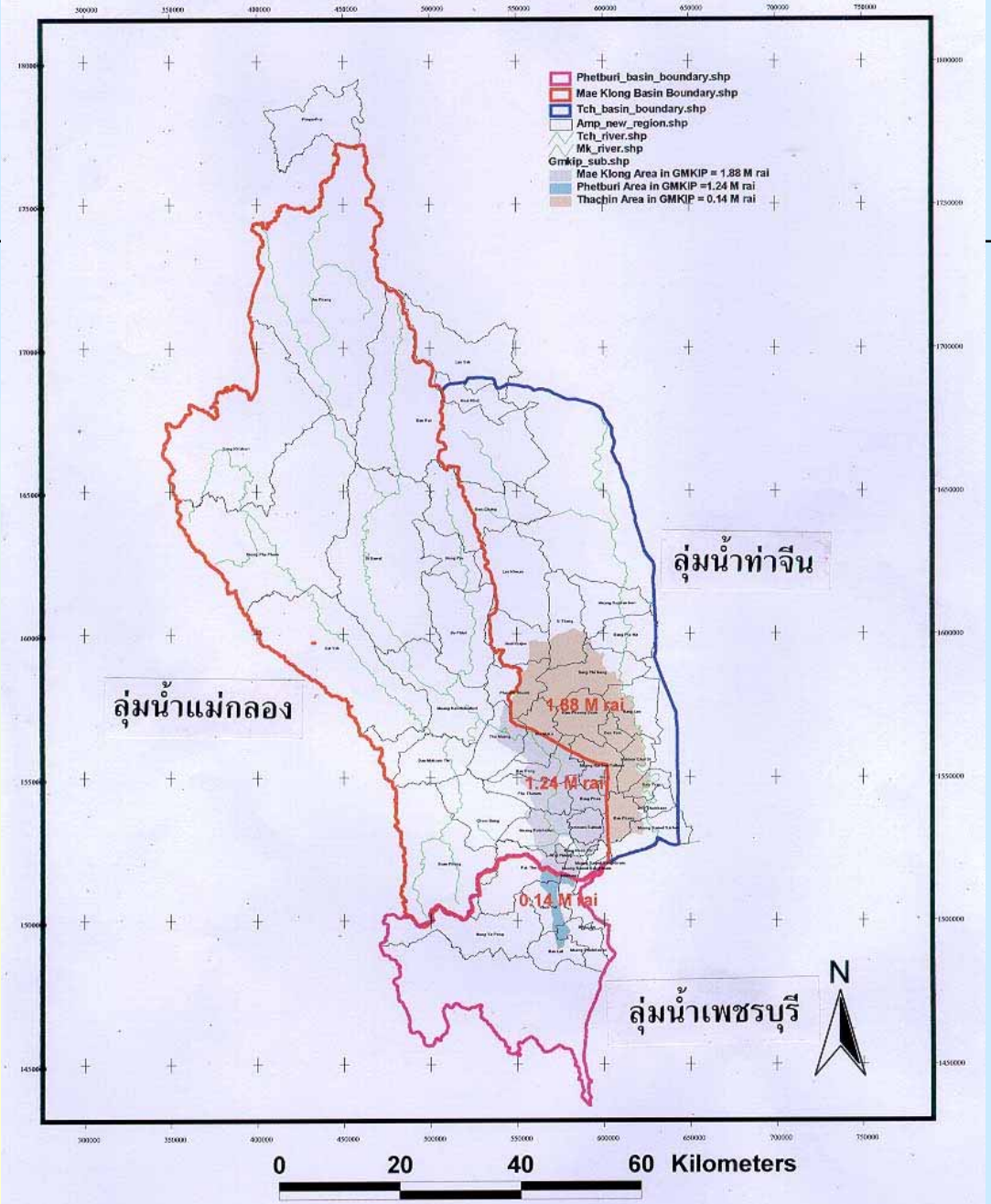
2. General Description of Study Area

- Major river basin with problem in resources management - area 30800 Km^2

- A large irrigation system with various users – Irrigation (0.5 million ha), Hydropower, Flood control, Environmental control, Water supply, Other uses


KHN_U
Vajiralongkorn Dam
KHY
Srinagarind Dam
LTP
KHN_M
MK_PU
LPC
Mae Klong Dam
Jaraikae Sampan
Thasarn-Bang Pla
GMKIP
Damnoen Saduak
Lower Chao Phraya West Bank
Maha Sawat Water Treatment Plant
N
20 0 20 40 Kilometers
Tha Thung Na Dam
LEGEND
Dam
Reservoir
River
Canal
Bangkok Water Supply
Transbasin Diversion
Irrigation
Water Treatment Plant
Lower Chao Phraya Project
Bangkok Metropolitan

ลุ่มน้ำภาคตะวันตก

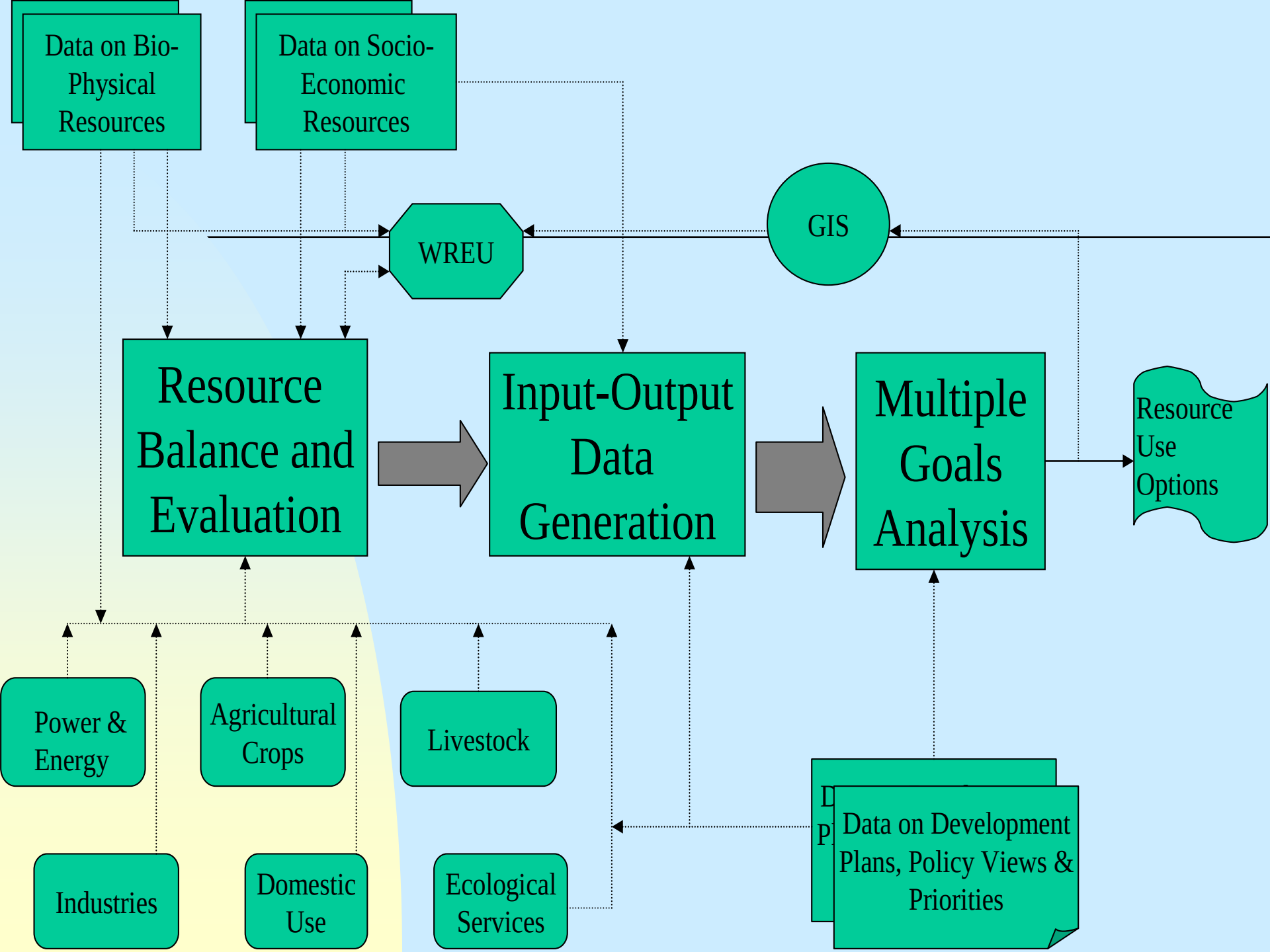


Climatic Data

- Three seasons: Summer, Rainy and Cool
- Annual rainfall 1000-1300 mm/year
- Mean temperature 28 ° C

3. System Approach for River Basin Management

- Exploratory analysis of options for allocation of land and water resources under multiple goal - LUPAS


Data on Bio-Physical Resources
Data on Socio-Economic Resources
GIS
WREU
Resource Balance and Evaluation
Input-Output Data Generation
Multiple Goals Analysis
Resource Use Options
Power & Energy
Agricultural Crops
Livestock
Industries
Domestic Use
Ecological Services
Data on Development Plans, Policy Views & Priorities

3. System Approach for River Basin Management

- Exploratory analysis of options for allocation of land and water resources under multiple goal – LUPAS
- Steps in model development

  3.1 Agro-Ecological Characterization

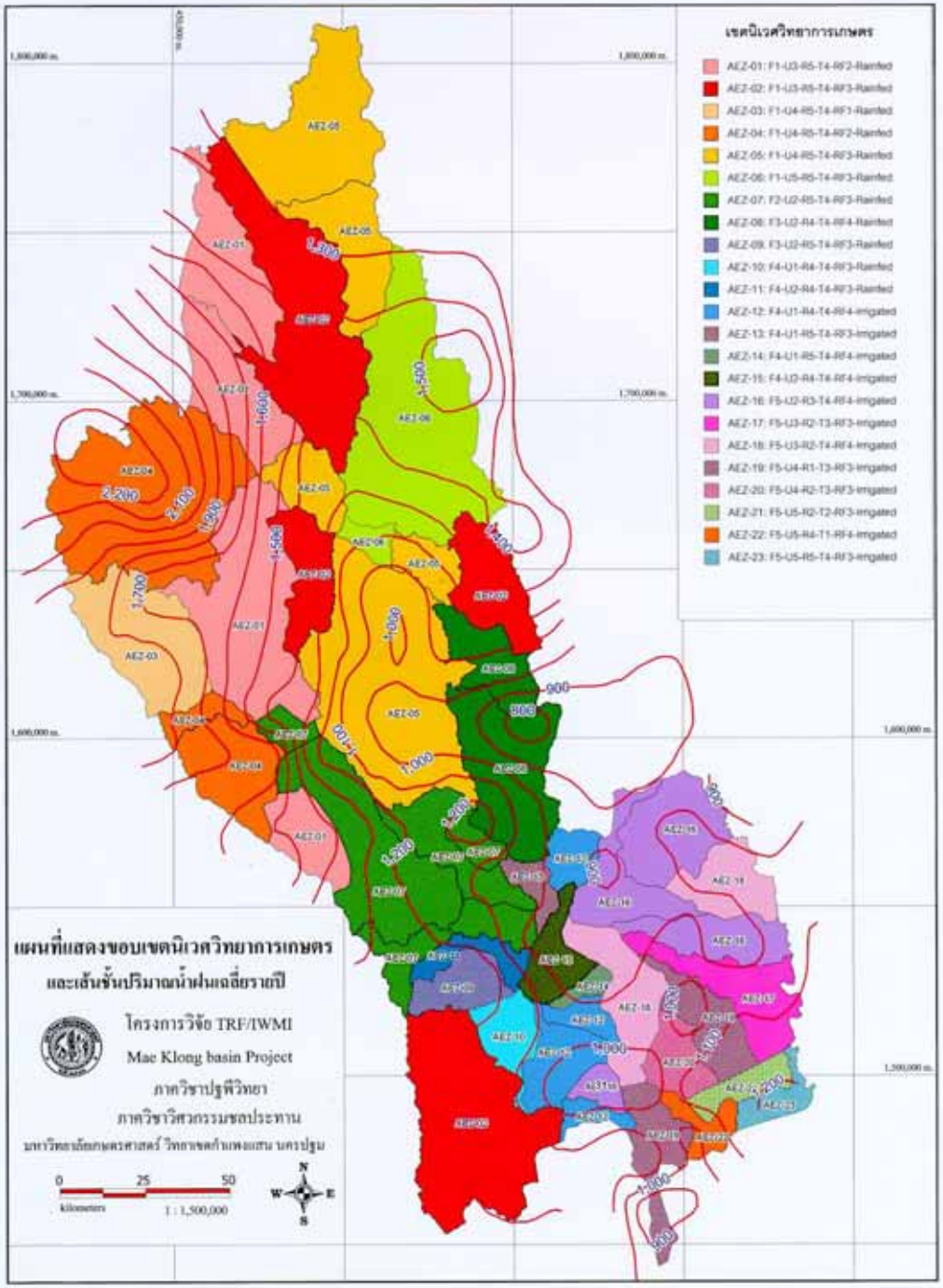
  3.2 Hydrology, Resources and Environment

  3.3 Institution and Stakeholder of River Basin

  3.4 Multiple Goal Optimization

3.1 Agro-Ecological Characterization

- Agro-ecological zone by overlaying maps of rainfall, soil and agricultural system into 22 ecological areas.
- Area is further according to hydraulic boundary.
- Due to time constraints: the first phase study area is divided to upstream and downstream – the target area is irrigation area (10 irrigation project).


เขตนิเวศวิทยาการเกษตร
AEZ-01: F1-U3-R5-T4-RF2-Rainfed
AEZ-02: F1-U3-R5-T4-RF3-Rainfed
AEZ-03: F1-U4-R5-T4-RF1-Rainfed
AEZ-04: F1-U4-R5-T4-RF2-Rainfed
AEZ-05: F1-U4-R5-T4-RF3-Rainfed
AEZ-06: F1-U5-R5-T4-RF3-Rainfed
AEZ-07: F2-U2-R5-T4-RF3-Rainfed
AEZ-08: F3-U2-R4-T4-RF4-Rainfed
AEZ-09: F3-U2-R5-T4-RF3-Rainfed
AEZ-10: F4-U1-R4-T4-RF3-Rainfed
AEZ-11: F4-U2-R4-T4-RF3-Rainfed
AEZ-12: F4-U1-R4-T4-RF4-Irrigated
AEZ-13: F4-U1-R5-T4-RF3-Irrigated
AEZ-14: F4-U1-R5-T4-RF4-Irrigated
AEZ-15: F4-U2-R4-T4-RF4-Irrigated
AEZ-16: F5-U2-R3-T4-RF4-Irrigated
AEZ-17: F5-U3-R2-T3-RF3-Irrigated
AEZ-18: F5-U3-R2-T4-RF4-Irrigated
AEZ-19: F5-U4-R1-T3-RF3-Irrigated
AEZ-20: F5-U4-R2-T3-RF3-Irrigated
AEZ-21: F5-U5-R2-T2-RF3-Irrigated
AEZ-22: F5-U5-R4-T1-RF4-Irrigated
AEZ-23: F5-U5-R5-T4-RF3-Irrigated
แผนที่แสดงขอบเขตนิเวศวิทยาการเกษตร
และเส้นชั้นปริมาณน้ำฝนเฉลี่ยรายปี
โครงการวิจัย TRF/IWMI
Mae Klong basin Project
ภาควิชาปฐพีวิทยา
ภาควิชาวิศวกรรมชลประทาน
มหาวิทยาลัยเกษตรศาสตร์ วิทยาเขตกำแพงแสน นครปฐม
0 25 50
kilometers
1 : 1,500,000
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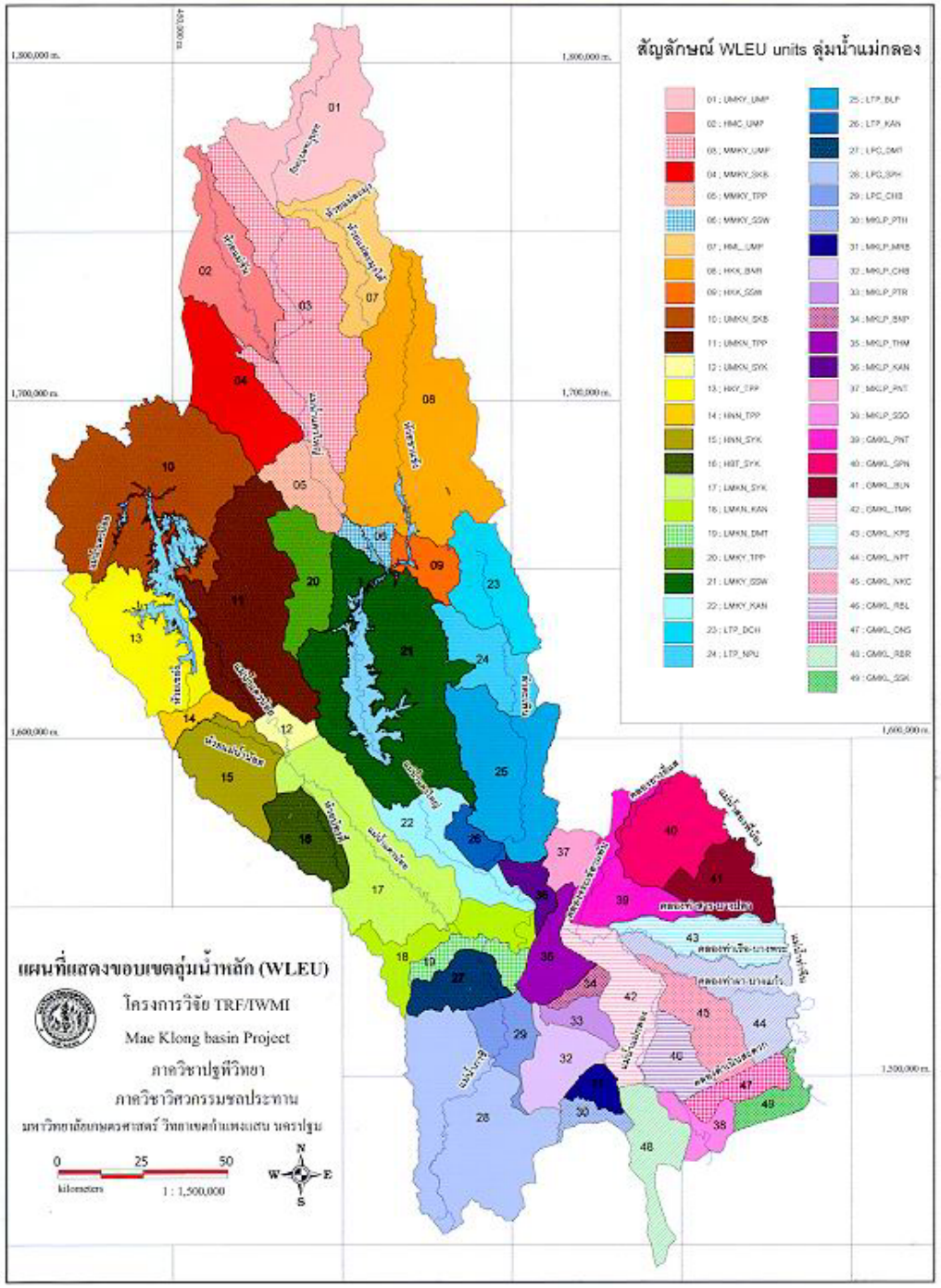
สัญลักษณ์ WLEU units ลุ่มน้ำแม่กลอง
01 : UMKY_UMP
02 : HMC_UMP
03 : MMKY_UMP
04 : MMKY_SKB
05 : MMKY_TPP
06 : MMKY_SGW
07 : HML_UMP
08 : HKK_BAR
09 : HKK_SGW
10 : UMKN_SKB
11 : UMKN_TPP
12 : UMKN_SYK
13 : HKY_TPP
14 : HNN_TPP
15 : HNN_SYK
16 : HBT_SYK
17 : LMKN_SYK
18 : LMKN_KAN
19 : LMKN_DMT
20 : LMKY_TPP
21 : LMKY_SGW
22 : LMKY_KAN
23 : LTP_DCH
24 : LTP_NPU
25 : LTP_BLP
26 : LTP_KAN
27 : LPC_DMT
28 : LPC_SPH
29 : LPC_CHB
30 : MKLP_PTH
31 : MKLP_MNB
32 : MKLP_CHB
33 : MKLP_PTR
34 : MKLP_BMP
35 : MKLP_THM
36 : MKLP_KAN
37 : MKLP_PNT
38 : MKLP_SGO
39 : GMKL_PNT
40 : GMKL_SPN
41 : GMKL_SUN
42 : GMKL_TMK
43 : GMKL_KPS
44 : GMKL_NPT
45 : GMKL_NKC
46 : GMKL_RBL
47 : GMKL_CNG
48 : GMKL_RBR
49 : GMKL_SGK
แผนที่แสดงขอบเขตลุ่มน้ำหลัก (WLEU)
โครงการวิจัย TRF/IWMI
Mae Klong basin Project
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0 25 50
kilometers
1 : 1,500,000
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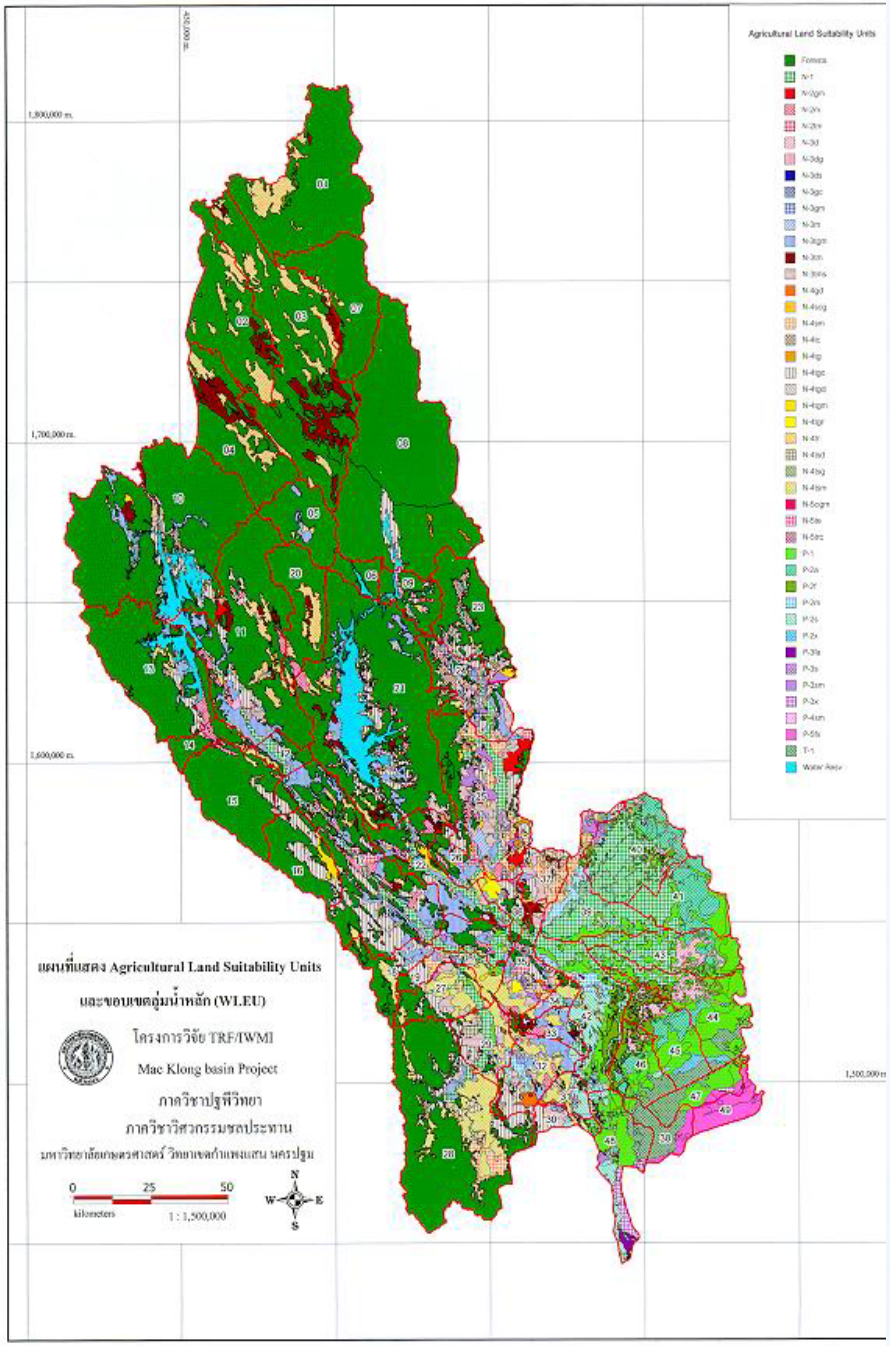
W
E
S

คลองส่งน้ำและคลองระบายน้ำ
โครงการชลประทานแม่กลองใหญ่

รูปที่ 9


Agricultural Land Suitability Units
แผนที่แสดง Agricultural Land Suitability Units
และขอบเขตลุ่มน้ำหลัก (WLEU)
โครงการวิจัย TRF/IWMI
Mac Klong basin Project
ภาควิชาปฐพีวิทยา
ภาควิชาวิศวกรรมชลประทาน
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kilometers
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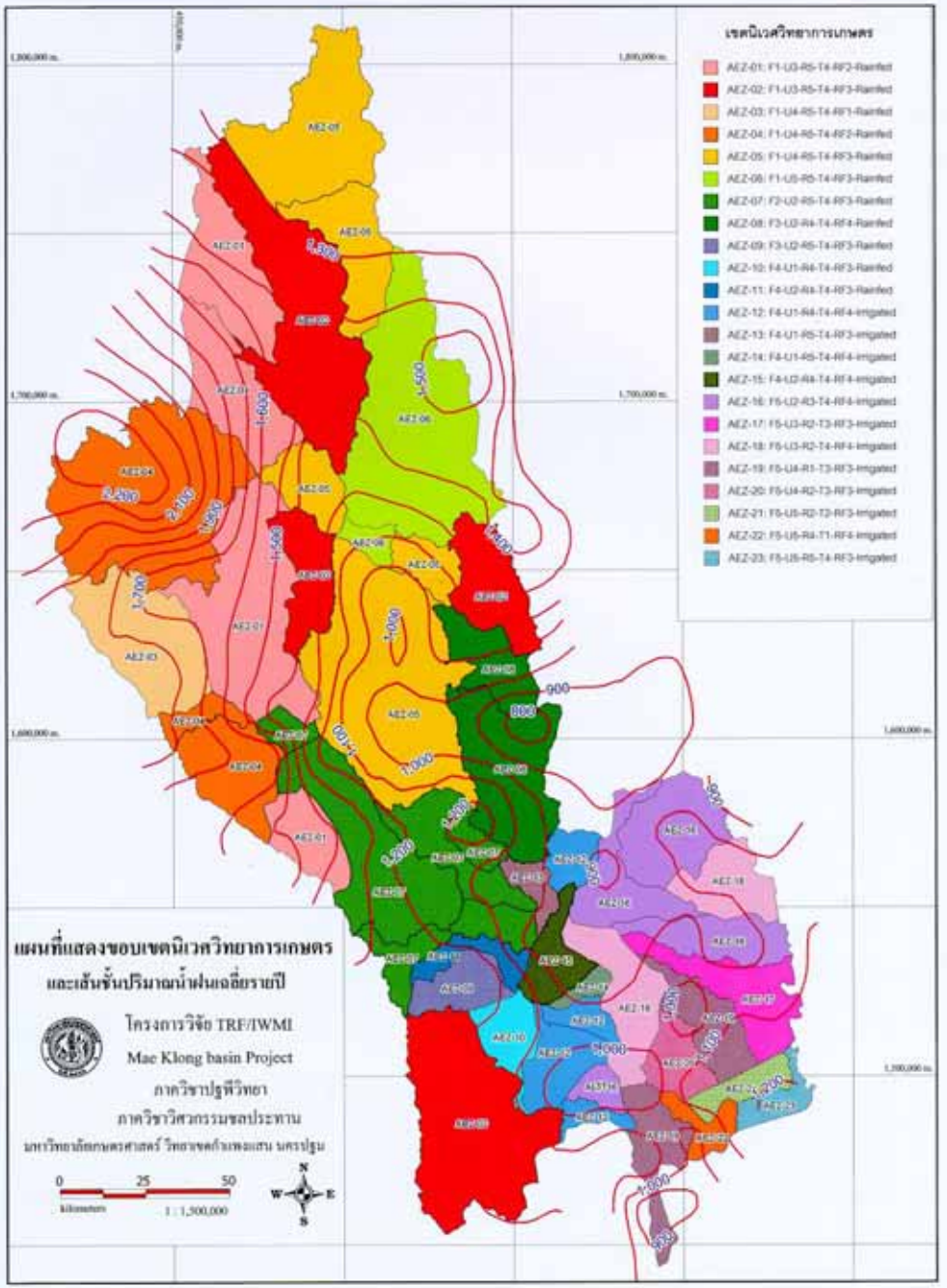
เขตนิเวศวิทยาการเกษตร
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0 25 50
kilometers
1 : 1,500,000
N
W E
S

3.2 Hydrology, Water Resources and Environment

- Water use: irrigation, hydropower generation, domestic & industrial consumption, ecosystem, and transbasin diversion.
- A) Total diversion dam release 9000 mcm

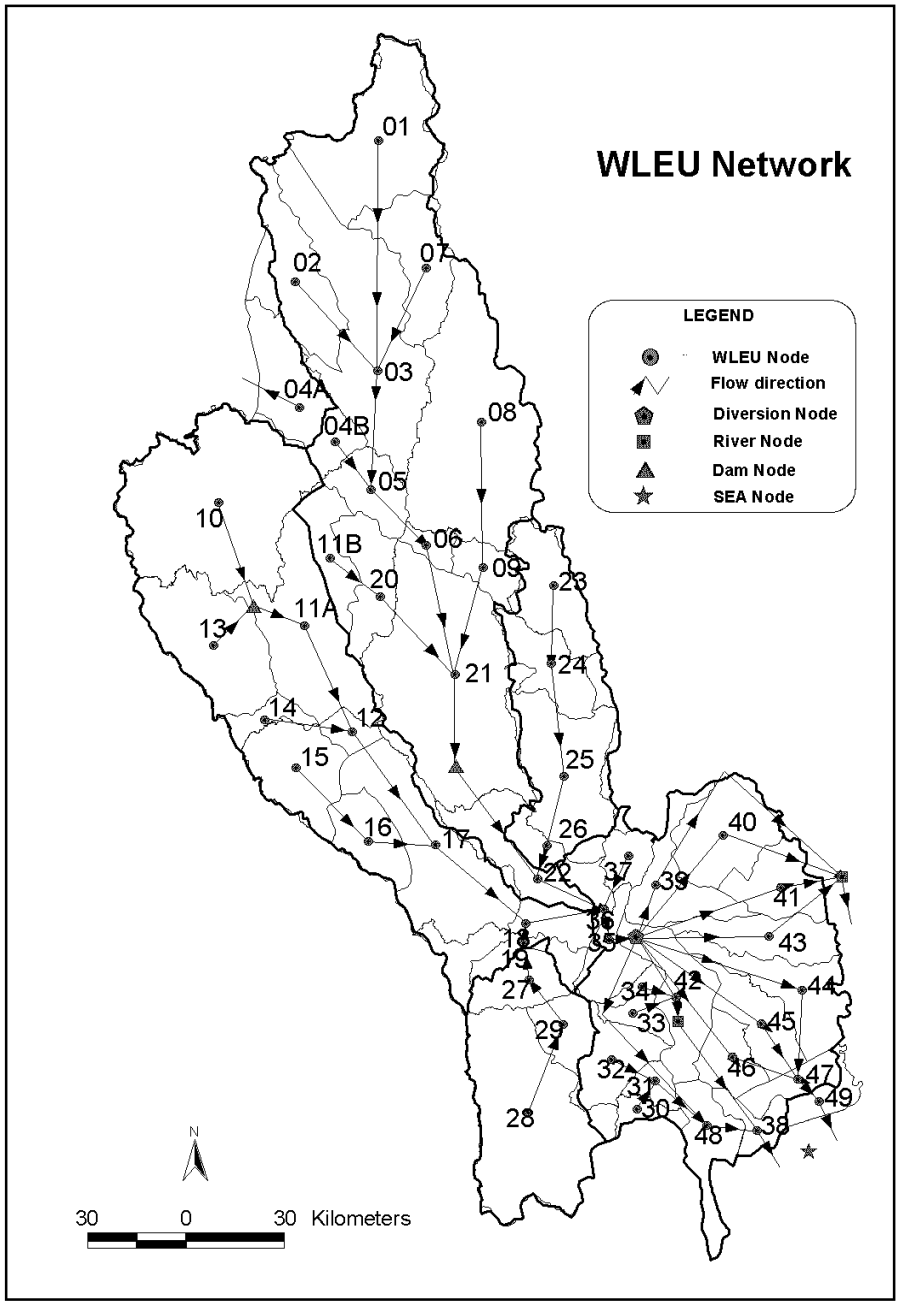
  (plus 2000 mcm side flow)

  B) 5000 mcm for irrigation

  C) 1500 mcm for downstream release

Water Resources of the basin

- Rainfall
- Surface runoff and inflow to the reservoirs
- Groundwater resources
- Evaporation and Transpiration
- Water Use
- Hydropower generation
- Water use in the irrigation system
- Domestic and industrial use


WLEU Network
LEGEND
WLEU Node
Flow direction
Diversion Node
River Node
Dam Node
SEA Node
01
02
03
04A
04B
05
06
07
08
09
10
11A
11B
12
13
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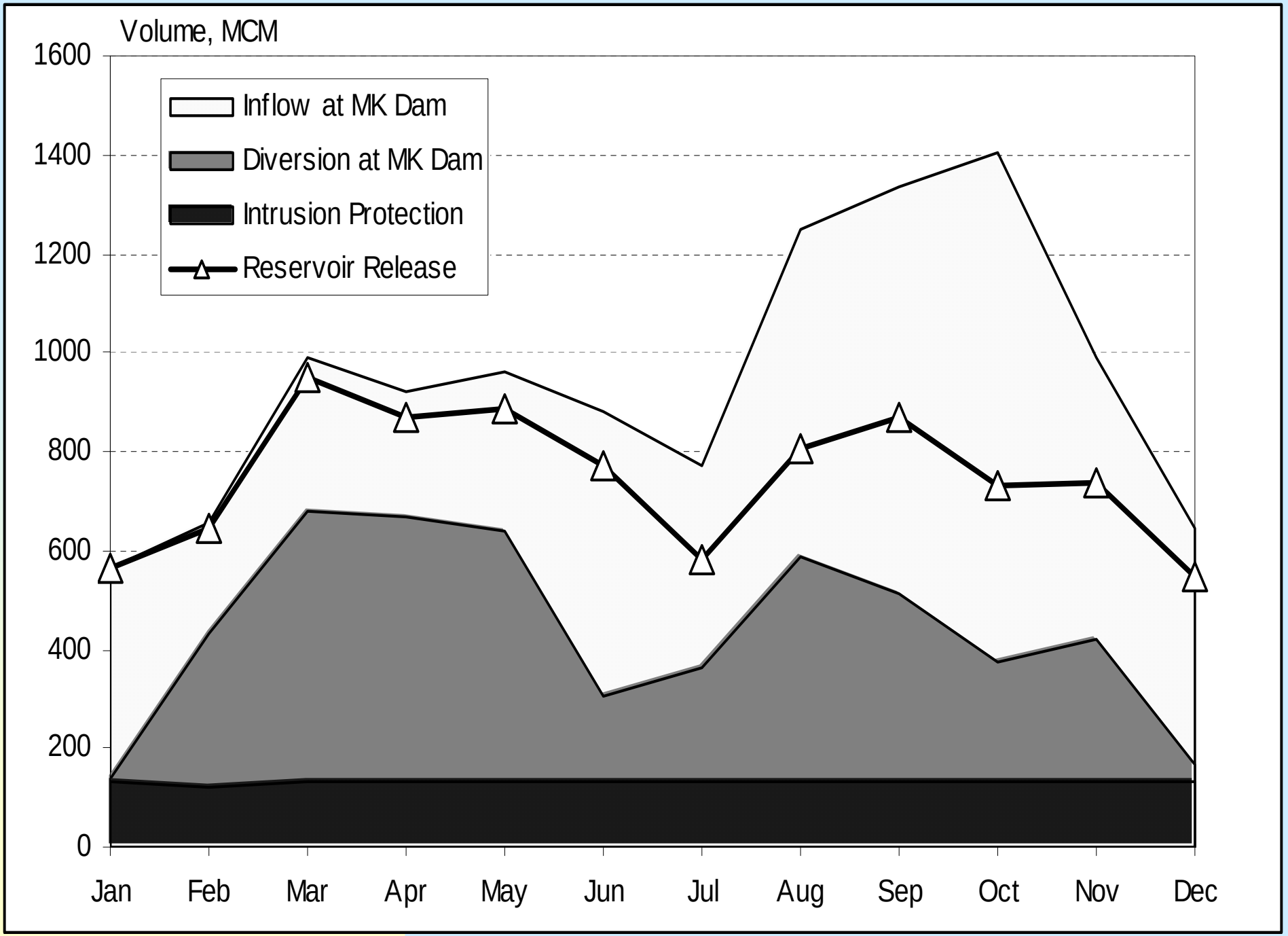
Volume, MCM
1600
1400
1200
1000
800
600
400
200
0
Inflow at MK Dam
Diversion at MK Dam
Intrusion Protection
Reservoir Release
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Water Resources of the basin (cont)

- The demand will be equal to supply but there may be some problem in the dry year.
- In addition more irrigation area will be developed in the near future that water shortage will be inevitable.

Water Quality

- Pollution control department monitors BOD, DO, FCB and TDS in the last 10 year.
- It was found that the water quality is better than the standard but some parts nearby the city at downstream location may have some indexes (BOD, DO) lower than the standard.
- Domestic, industrial and agriculture wastewater are the major source of pollution.
- Livestock and swine farm are the major sources for agriculture.

3.3 Institutional and Stakeholder

- Major stake holder: decision makers, implementing agencies and water users.
- Two stakeholders' meeting were arranged.

  A) The first was to get their viewpoint on priority, plan, objective, and scenarios.

  B) The second was to confirm their input and presented the concept of the model.

3.4 Multiple Goal Optimization Model

- Multiple goal linear programming

  Two objectives: to maximize land productivity (of the project)

  to maximize water productivity

  Constraints: Resources constraints (land and water resources)

  Development target or requirement

  Water requirement for each activities

  Other constraints

4. Analysis and Results

- Model calibration : adjustment of irrigation efficient and cropping pattern
- Total cultivation area for

  Wet season is 2.35 million rai (0.38 million ha)

  Dry season is 0.82 million rai (0.13 million ha)
- The water productivity is 4.158 baht/m3

  The land productivity is 7455 baht/rai

Table 2 Effect of land use change on land and water productivity

Case	Sugarcane Reduction (%)	Rice Reduction (%)	Water Use (MCM)	Land Productivity (Baht/Rai)	Water Productivity (Baht/m^3)	Remark
1	5	0	4217	7523	4.199	In case 1 to 7 sugarcane is substituted by vegetable and rice is substituted by orchard
2	0	5	4172	7660	4.321	
3	5	5	4170	7728	4.362	
4	10	5	4168	7797	4.403	
5	10	10	4121	8002	4.570	
6	15	10	4119	8071	4.612	
7	20	10	4117	8140	4.653	
8	0	5	4208	7819	4.373	Change to shrimp

5. Responsibility of RBO

-To give advice to the responsible agencies

-To determine the volume of water use, water allocation

-To monitor and evaluate the operation of the agencies

-To give opinions and advice to the National Water Resources Committee

-To operate water resources management

-To coordinate the operation of water resources management

-ETC

Major Stake Holders

1. Implementing Agencies
   - Provision and water allocation
   - Groundwater use
   - Water quality
2. Water Users
   - Local administrative
   - Water users e.g. agriculture, water supply, industry
3. Experts and NGOS

Targets of River Basin Management

- Efficiency in solving of river basin's problem
- Equity in allocation of water in the river basin
- Participatory process is adopted and effective

SWOT Analysis

- Strength: RBO, Participation, Integrated plan
- Weakness: Many agencies, Lack of information, Knowledge
- Opportunities: Government policy, Support by NGO
- Threats:Water law, Cooperation among agencies

6. Conclusion and Recommendation

1.The objective is to address the need of IWRM by development of DSS for stakeholder is achieved.

2. The prototype model is developed for the downstream area due to time constraint and data collection.

3. The river basin committee and public sector reform may promote people participatory to river basin management.

4. The case study of Mae Klong river basin shows lack of knowledge for water user therefore capacity building is essential.

Acknowledgement

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