FINAL REPORT

Classification and Inventory of Wetland/Aquatic Ecosystems in the Lower Mekong River Basin of Thailand

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Abbreviations

ADB	Asian Development Bank
AFFCA	Aquatic Flora and Fauna Conservation Area
AIT	Asian Institute of Technology
BCST	Bird Conservation Society of Thailand
CIDA	Canadian International Development Agency
DANCED	Danish Cooperation on Environment and Development
EPA	Environmentally Protected Area
GEF	Global Environment Facility
GIS	Geographic Information System
GOs	Governmental Organizations
ICLARM	International Center for Living Aquatic Resources Management
IMW-LMB	Inventory and Management of Wetlands in the Lower Mekong Basin
IOs	International Organizations
IUCN	The International Union for Conservation of Nature and Natural Resources - The World Conservation Union
JICA	Japan International Cooperation Agency
MNRE	Ministry of Natural Resources and Environment
MRC	Mekong River Commission
n.d.	No date
NGOs	Non-Governmental Organizations
OEPP	Office of Environmental Policy and Planning
PFFS	Provincial Freshwater Fishery Station
SIDA	Swedish International Development Authority
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

Executive Summary

This report reviews and compiles data and information on wetland/aquatic ecosystems in the Mekong River basin of Thailand with particular reference to wetland types, ecology, functions, values, importance, threats, and economic valuation of wetland types.

Methodologies include information gathering; rapid appraisal by experts and stakeholders; review, compilation and analysis; and consultation with experts and stakeholders at the national meeting.

Wetland classification system of Thailand has mainly the same structure as the system of the Mekong River Commission. This classification system has been applied, at the national and site levels, in Thailand's wetland classification, delineation, mapping, inventory, management planning and research since 1993. Applications of GIS and remote sensing in wetland research and management are reviewed.

According to this classification system, wetlands of all freshwater types can be found within the Mekong River Basin of Thailand. Riverine (rivers, streams, floodplains) and lacustrine (lakes, ponds) types are dominant, having the biggest number of sites as well as the largest areas. Ricefields is the largest man-made wetlands of the basin. In addition, seasonal and permanent saline lakes, ponds, marshes and swamps are present in some areas of the northeastern region.

Based on the review on wetland functions and values, socio-economic valuation, obtainable benefits from some wetland types and sites, rapid valuation and judgement of experts and stakeholders, priority wetland types suggested for further inventory are : rivers, streams; floodplain grasslands; floodplain marshes/swamps; flooded forests; lakes, ponds; marshes, swamps; and ricefields.

Roles and activities of relevant agencies in wetlands management are listed, describing "who is doing what" for priority wetland types.

Should Thailand require site selection for further inventory and detailed data collection, results of the review on the National Wetlands Inventory, wetland sites assessment and threats analysis also suggest the priority wetland sites for different wetland types. Issues to be considered for further detailed inventory are also listed.

Classification and Inventory of Wetland/Aquatic Ecosystems in the Lower Mekong River Basin of Thailand

1.0 INTRODUCTION

The Mekong River, the longest river in Southeast Asia and the 12th longest river in the world, flows for approximately 4,880 km from its origin on the Tibetan Plateau in China to the South China Sea in Vietnam. The Mekong River Basin, the 21st largest river basin in the world, has a total land area of 795,000 sqkm and the approximate 65 million inhabitants dependent on its natural resources (Mekong River Commission, 1997).

The Mekong River flows approximately 2,400 km through Thailand, from Chiang Khong District in Chiang Rai onwards to Khong Jiam District in Ubon Ratchathani. Approximately 23% or 184,000 sqkm of the Mekong River Basin is in Thailand, covering parts of the northern region and the whole of the northeastern region (Figure 1). Thailand has about 36% or over one-third of the country's territory and population within the Mekong River Basin. The Thai Mekong Basin area supports 20.5 million people (Mekong River Commission, 1997).

Lowlands of the Mekong tributaries and a large proportion of the flat and low-lying areas in the Mekong River Basin are wetlands, annually inundated areas, lakes, and marshes. These wetland/aquatic ecosystems play a vital role in the lives of the rural communities and the development of the Mekong River Region. Wetlands provide water, essential food sources, and generate important products such as firewood, medicines, and building materials. Wetlands also perform valuable functions and services vital to daily life such as flood control, nutrient retention, recharge of groundwater, water purification, and water transport. Wetlands have valuable ecosystem attributes such as unique biological diversity and cultural heritage. In addition, wetlands provide major economic opportunities. Rural low-income people have used and depended on wetlands and wetland resources for centuries.

There are various types of wetlands and many development options depend on the appropriate choice of wetland types. Therefore, it is important to have sufficient knowledge about the types, extent and distribution of wetlands, production levels and the potential functions and values of wetlands and wetland resources.

The Environment Program of the Mekong River Commission has a mission to promote cooperation and collaboration among the member states in the use, conservation, management and maintenance of the Mekong River Basin's environment assets and ecological balance. The purpose of Component A2 : People and Aquatic Ecosystems is to provide timely information on trends and changes in the dynamics of aquatic habitats to

prevent or minimize harmful effects particularly on the rural poor who are highly dependent on the Basin's aquatic productivity.

Figure 1 The Mekong River Basin.

Source : Mekong River Commission (1997)

This report on "Classification and Inventory of Wetland/Aquatic Ecosystems in the Lower Mekong River Basin of Thailand" has been prepared during September 2002 to March 2003 for the Mekong River Commission – Environment Programme to facilitate the completion of wetlands inventory and valuation activities within the Mekong River Region.

1.1 Objectives

To review and compile data and information on wetland/aquatic ecosystems in the Mekong River basin of Thailand with particular reference to wetland types, ecology, functions, values, importance, threats, and economic valuation of wetland types.

Terms of Reference for the National Wetland Expert for Classification and Inventory of Wetland/Aquatic Ecosystem is presented in Annex 1.

1.2 Methodologies

1.2.1 Information gathering process

From late September to December 2002, documents and reference materials relating to "Classification and Inventory of Wetland/Aquatic Ecosystems in the Mekong River Basin of Thailand" were collected from government agencies, academic institutions, non-government agencies, journals, personal contacts, and websites. The gathered and derived information are in forms of books, reports, technical papers, research papers, post-graduate thesis, published articles, unpublished papers, interviews, etc.. Lists of collected reference materials, contacted persons and visited websites are in References, Annex 2 and 3, accordingly.

1.2.2 Rapid appraisal

On January 31, 2003 at the Annual Wetlands Conference held by the Office of Natural Resources and Environmental Policy and Planning, at the Ministry of Natural Resources and Environment, on the occasion of the World Wetland Day, a number of experts and stakeholders were randomly sampled and asked to fill in a rapid appraisal form to give their opinion and prioritisation on wetland types, sites, and issues in the Northeastern Thailand for further detailed studies. Altogether 33 experts and stakeholders provided the inputs on the issues. Their names, positions and institutions are listed in Annex 4.

1.2.3 Review, compilation and analysis processes

Almost 100 reference materials from various sources were reviewed. Two key references for wetland classification are those of the Department of Land Development (1994 and 2000). Three key references for wetland inventories are Jintanugool and Round (1989),

Wolstencroft, Parr and Goodey (1993), and Office of Environmental Policy and Planning (2002).

Thailand's Wetland Classification System was simplified and re-grouped into 12 types. Assessment of 12 wetland types was carried out, based on their values, functions, and attributes, via ranking and scoring processes. Results from these processes, literature review and the rapid appraisal (1.2.2) were compared before prioritisation of wetland types was derived and recommended for more detailed inventory and valuation activities.

Important wetland sites in the Mekong River basin of Thailand were listed based on the results of wetland inventories described in 3 above-mentioned major reference sources. These important wetland sites are grouped according to their types and their management status as well as the national priority according to the Cabinet Resolution (August 1, 2000). Threats to those sites were analysed. Results from this process and from the rapid appraisal (1.2.2) were compared before prioritisation of wetland sites was derived and recommended for the purpose of monitoring changes of wetland/aquatic ecosystems and people's livelihood.

The review, compilation and analysis also covered issues of core data required in wetlands inventory and valuation, remote sensing and GIS applications in wetland research and management, agencies involved in wetland classification, inventory and valuation activities and their roles, and description of Ramsar Sites and other important sites within the Mekong River basin of Thailand.

1.2.4 National meeting on inventory of wetland/aquatic ecosystems in Thailand

On March 25, 2003, the national meeting on inventory of wetland/aquatic ecosystems in Thailand was held by the Thai National Mekong Committee Secretariat, Department of Water Resources, Ministry of Natural Resources and Environment, in cooperation with the Environment Programme of the Mekong River Commission Secretariat, at the Royal Princess Hotel, Bangkok. A total of 33 experts and stakeholders from government, non-government, and international organizations participated at the meeting. Their names, positions and institutions are listed in Annex 5.

Preliminary findings from 1.2.3 were presented. Participants provided comments on the preliminary findings and then were divided into 4 groups. Two group sessions were arranged in order to review and finalize the priority listing of wetland types and to identify "who is doing what" in prioritised wetland types. Results and suggestions from the national meeting were incorporated into this Final Report.

2.0 DEFINITION OF WETLANDS

The definition of wetlands used in Thailand is that provided by the Ramsar Convention Manual. Under the text of the Convention (Article 1.1 and 2.1) (http://www.ramsar.org/) wetlands are defined as : ***"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres and may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands".***

In Thai language, "wetlands" is called "Phuen Thi Chum Nam". Many Thai words for different types of wetlands include : Mae Nam, Nam, Lam Nam, Lahan, Huai, Kwae, Klong, Kaeng, Nam Tok, Wang, Mab, Doon, Tham, Bung, Pa Tham, Pa Bung, Goot, Beung, Bo, Sa, Kwan, Thale Sap, Tung, Nong, Ang Keb Nam, Na Khao, Bo Pla, etc..

3.0 WETLAND CLASSIFICATION SYSTEM OF THAILAND

Since 1990, the Inventory and Management of Wetlands in the Lower Mekong Basin (IMW-LMB) Project of the Mekong River Commission has supported the development of national capacities of riparian countries in wetland inventory techniques and management. The need to have a wetland classification system was recognized at an early stage of this project.

A "Wetland Classification System of the Lower Mekong Basin" was developed, proposed and adopted in April 1993 at the meeting of representative experts of the IMW-LMB Project in Vientiane (Mekong Secretariat, 1993) and has since been used in varying degrees in the four Lower Mekong Basin countries. The system is based on the system described by Dugan (1990) and has a stepwise hierarchical approach to wetland classification (Annex 6).

Thailand is a member country adopting and using the wetland classification system of the Mekong River Commission since 1993. Some modifications and amendments have been made as wetland classification and mapping activities have increased. This classification system was revised for Thailand's applications in at least 3 seminars held by the Department of Land Development in April 1994, June 1994, and in 2000. The latest revised version is shown in Table 1.

Table 1 Wetland classification system of Thailand.

Level I	Level II	Level III	Level IV	Level V
Salt water (S)	Marine/Coastal (SM)	Subtidal (SMS)	non-vegetated (SMS1)	rocky beds (SMS1a) unconsolidated beds (SMS1b)
			vegetated/coral (SMS2)	natural coral reefs (SMS2a) artificial coral reefs (SMS2am) natural seagrass beds (SMS2b) natural seaweed beds (SMS2c) seaweed farms (SMS2cm) mariculture (SMS2dm)
		Intertidal (SMI)	non-vegetated (SMI1)	coastal beaches (SMI1a) artificial coastal salt works (SMI1am) coastal mudflats (SMI1b) coastal culture (SMI1bm) coastal cliffs (SMI1c) coastal saltflats (SMI1d) coastal tide pools (SMI1e)
			vegetated/coral (SMI2)	intertidal coral reefsSMI2a) coral farms (SMI2am) intertidal seagrass beds (SMI2b) intertidal seaweed beds (SMI2c) seaweed farms (SMI2cm) coastal mangroves (SMI2d) coastal mangrove plantation (SMI2dm)
		Nontidal (SMN)	non-vegetated (SMN1)	nontidal mariculture (SMN1am) nontidal salt works (SMN1bm)
	Estuarine (SE)	Subtidal (SES)	non-vegetated (SES1)	rocky beds (SES1a) unconsolidated beds (SES1b)
			vegetated/coral (SES2)	estuarine subtidal corals (SES2a) estuarine subtidal coral farms (SES2am) estuarine subtidal seagrass beds (SES2b) estuarine subtidal seaweed beds (SES2c) estuarine subtidal seaweed farms (SES2cm) estuarine subtidal mariculture (SES2dm)
		Intertidal (SEI)	non-vegetated (SEI1)	estuarine beaches (SEI1a) estuarine mudflats (SEI1b) estuarine cliffs (SEI1c) estuarine salt flats (SEI1d)
			vegetated/coral (SEI2)	estuarine intertidal corals (SEI2a) estuarine intertidal coral farms (SEI2am) estuarine intertidal seagrass beds (SEI2b) estuarine intertidal seaweed beds (SEI2c) estuarine mangrove swamp (SEI2d) estuarine intertidal mangrove plantations (SEI2dm) estuarine salt marshes (SEI2e)
	Coastal lagoon(SC) Inland saltlake(SI)	coastal saline/brackish/fresh lagoons inland saline lakes/ponds/marshes/swamps		

Fresh water (F)	Riverine (FR)	River (FRR)	perennial rivers (FRR1)	pools in perennial rivers (FRR1a) channels in perennial rivers (FRR1b) artificial perennial canals (FRR1bm) perennial rapids (FRR1c) perennial waterfalls (FRR1d) perennial hot springs/streams (FRR1e) perennial underground/subterrain streams (FRR1f)
			seasonal rivers (FRR2)	pools in seasonal rivers (FRR2a) channels in seasonal rivers (FRR2b) artificial seasonal canals (FRR2bm) seasonal rapids (FRR2c) seasonal waterfalls (FRR2d) seasonal hot springs/streams (FRR2e) seasonal underground/subterrain streams (FRR2f)
		River Banks/Beaches/Bars (FRB)		
		Riverine Floodplains (FRF)	floodplain grassland (FRF1)	natural floodplain grassland (FRF1a) floodplain wet rice (FRF1am) floodplain crops, other than rice (FRF1bm)
			floodplains trees/shrubs (FRF2)	seasonally flooded trees/shrubs/forest (FRF2a) (artificially) seasonally flooded plantations (FRF2am)
			seasonal floodplain lakes (FRF3)	
			seasonal floodplain ponds (FRF4)	
			seasonal backswamp/marshes (FRF5)	natural seasonal backswamp/marshes (FRF5a) artificial seasonal wet rice (FRF5am) artificial seasonal wet plantations (FRF5bm)
	Lacustrine (FL)	Lakes (>8 ha) (FLL)	permanent lakes (FLL1)	natural permanent freshwater lakes (FLL1a) artificial permanent freshwater lakes (FLL1am)
			seasonal lakes (FLL2)	natural seasonal freshwater lakes (FLL2a) artificial seasonal freshwater lakes (FLL2am)
		Ponds (<8 ha) (FLP)	permanent ponds (FLP1)	natural permanent freshwater ponds (FLP1a) freshwater aquacultural ponds (FLP1am) sewage treatment ponds (FLP1bm) farm ponds (FLP1cm) cooling ponds (FLP1dm) borrow pits, excavated ponds (FLP1em) others (FLP1fm)
			seasonal ponds (FLP2)	natural seasonal freshwater ponds (FLP2a) artificial seasonal ponds (FLP2am)
	Palustrine (FP)	Permanent (FPP)	(grass) permanent flooded grassland (FPPa) (sedges) permanent freshwater marshes (FPPb) (trees/shrubs) permanent swamps (FPPc)	
		Seasonal (FPS)	(grass) seasonal flooded grassland (FPSa) (grass) artificially seasonally flooded plantation (FPSam) (sedges) seasonal flooded marshes (FPSb) (trees/shrubs) seasonal flooded swamps (FPSc) (trees/shrubs) artificially seasonally flooded plantation (FPScm)	

Source : Department of Land Development (1994, 2000).

The structure of Thailand's wetland classification system is hierarchical progressing from systems and subsystems to classess and is able to be further subdivided to detailed units which can be used at local levels. Five major systems forming the highest level of this classification hierarchy are : Marine/Coastal, Estuarine, Riverine, Lacustrine and Palustrine. Marine/Coastal and Estuarine systems each have 3 subsystems : Subtidal, Intertidal and Nontidal. Riverine system has 3 subsystems : Rivers, Riverine Banks/Beaches/Bars, and Riverine Floodplains. Lacustrine has 2 subsystems : Lakes and Ponds. Palustrine has 2 subsystems : permanent and seasonal marshes and swamps. Within the subsystems, classes are based on vegetative life forms, or on substrate materials, or on flooding regime, and on human interference.

The Thai wetland classification system is essentially the same as the system of the Mekong River Commission. The slight difference is in the first level, which simply states whether the system is salt or fresh water. This is described and coded for in the water types. The system details 8 wetland types and uses alphanumeric codes with an additional first level.

This wetland classification system has been applied in Thailand's wetland classification and mapping since 1993 (Department of Land Development, 1993). Based on this classification system, a wetland Map of the Mekong River Corridor in Thailand was produced by the Department of Land Development in 1993. In addition to 13 sheets of topographic maps (1:250,000), 10 scenes of LANDSAT TM imageries (1:250,000), i.e. TM 130-46 (19/8/92); TM 129-47 (19/8/92); TM 129-48 (3/9/92); TM 128-47 (3/8/92); TM 128-48 (19/8/92); TM 127-47 (9/4/89); TM 127-48 (24/12/91); TM 127-49 (3/4/92); TM 126-49 (26/3/92); and TM 126-50 (26/3/91) were used in this wetland classification mapping. The derived map depicts the existing wetland types, codes and areas within the Mekong River corridor (ca. 50 km) in Thailand. Of a total area of 4.46 million ha within 50 km cooridor of the Mekong River in Thailand, there is a total area of 985,152.79 ha of wetlands of 8 types, which was 22.08% of the total area. The dominant type was riverine floodplain rainfed and irrigated ricefields, having the largest area of 770,593.30 ha or over 78% of recorded total wetland area. See Table 2.

This classification system was also applied for semi-detailed survey at site level at Huai Nam Un wetlands, Amphoe Sri Songkhram, Nakhon Phanom, using SPOT imageries and topographic base-maps (Department of Land Development, 1993).

More importantly, Thailand's wetland classification system was applied in the National Wetland Inventories (the North, the Northeast, the Central and the East, and the South) during 1995-1999. According to this wetland classification system, the Office of Environmental Policy and Planning (1999) reports that the Northeast of Thailand, which lies in the Mekong River basin, has at least 1,999.53 sqkm of wetland areas (1.18% of the total area of the region or 0.39% of the total area of the country). Riverine and lacustrine wetlands are the dominant types having the biggest number of sites as well as the largest areas (Table 3). Table 3, however, does not include the most important man-made wetland type, i.e. ricefields, which covers the largest area in the Northeast.

Table 2 Wetland types and areas within 50 km corridor of the Mekong River in Thailand.

Codes	Wetland types	Area	
		Hectares	%
FRR1c	Riverine : Permanent rivers & streams with perennial rapids	81,794.08	1.83
FRB	Riverine : Banks, beaches and bars	1,900.45	0.04
FRF1mn	Riverine floodplain : Floodplains wet rice, including rainfed & irrigated rice	770,593.30	17.28
FRF2	Riverine floodplain : Seasonally flooded trees, shrubs & grass in river flats or flooded river basins	55,774.18	1.25
FRF5	Riverine floodplain : Seasonal backswamps & marshes	14,891.90	0.33
FLL1	Lacustrine : Permanent freshwater lakes	18,522.17	0.42
FLL1m	Lacustrine : Permanent dams & reservoirs	32,025.92	0.72
FLL2	Lacustrine : Seasonal freshwater lakes, including floodplain lakes	9,650.79	0.21
Total wetland area		**985,152.79**	**22.08**
Uc	Non-wetlands	3,475,583.40	77.92
Total		**4,460,736.19**	**100.00**

Source : Department of Land Development (1993).

Table 3 Types, number and area of wetlands in the northeastern Thailand.

Codes	Wetland type	Number of sites	Area (sqkm)
FRR, FRF	Riverine : rivers, streams, floodplains	8,053	1,091.54
FLL, FLP	Lacustrine : lakes, ponds, reservoirs	6,168	836.00
FPP, FPS	Palustrine : marshes, swamps	368	49.79
FRR1c, FRR1d, FRR2c, FRR2d, FRB	Others	161	21.80
	Total	**14,750**	**1.999.13**

Source : Office of Environmental Policy and Planning (1999).

Although a national wetland map has not yet been produced, most important wetland sites nationwide have been marked and located on the topographic maps (1 : 50,000). In 2001, the Department of Land Development has produced the Land Use Maps covering the Mekong River Basin of Thailand. The maps also depict and provide detail on wetland types and areas based on Thailand's wetland classification system (Chandrachai, 2003).

4.0 WETLAND INVENTORY IN THAILAND

A Directory of Asian Wetlands (Scott, 1989), the first compilation of information on wetlands of Asia, contains descriptions of 42 wetland sites of Thailand which are considered to be of international importance especially as waterfowl habitats. Those 42 important wetland sites have a total area altogether of approximately 25,100 sqkm or 4.9% of the country area.

In the late 1995, the Office of Environmental Policy and Planning initiated the "National Inventory of Wetlands" Project, with partial funding from the Danish Cooperation for Environment and Development (DANCED) Program. This project was the first Thailand's national wetland inventory. A network of researchers of 4 academic institutions, namely Kasetsart University, Khon Kaen University, Prince of Songkhla University and Mahidol University, was established to carry out the national wetland inventory during 1996-1999 in the North, the Northeast, the South, the Central and the East, respectively. The outputs include the lists of wetlands of international, national and local importance; reports on the status of Thailand's wetlands; wetland maps and wetland database.

Results of the National Wetlands Inventory revealed that Thailand has at least 42,653 wetland sites, covering an area of 36,616.16 sqkm (22,885,100 rais) which is approximately 7.5% of the total area of the country (Office of Environmental Policy and Planning, 2002).

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, fibre, 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.

According to the above criteria, Thailand has at least 61 wetland sites of international importance, 211 wetland sites of national importance, and 27,838 wetland sites of local importance.

Detailed inventory headings as described below are used for Thailand's National Wetlands Inventory Project.

DIRECTORY HEADINGS :

1. REGION
2. REFERENCE NUMBER
3. NAME OF WETLAND
4. PICTURE
5. LOCATION MAP & TOPOGRAPHIC MAP SHEET(s)
6. GEOGRAPHICAL COORDINATES (range of latitudes, longitudes, center)
7. GENERAL LOCATION (nearest landmarks/towns, routes, accessibility)
8. AREA (rai and sqkm)
9. WETLAND TYPE(s) (following Thailand's wetland classification system)
10. DEGREE OF IMPORTANCE (international, national, local)
11. ALTITUDE (m., average above mean sea level, or max. and min.)
12. OVERVIEW OF SITE (short, precise, unique characteristics)
13. PHYSICAL FEATURES (origin : natural, semi-natural,man-made; geology and geomorphology; soil types and characteristics; watershed, basin/catchment area, downstream area especially in case of sites important for flood control; climate; hydrology including inflows and outflows, seasonal water balance, tidal

variation, average depth, frequency and inundation period, fluctuation and permanence; water quality, physio-chemical characteristics)

14. ECOLOGICAL FEATURES (main habitats and vegetation types)
15. NOTEWORTHY FAUNA (species diversity, dominant species, abundance)
16. NOTEWORTHY FLORA (species diversity, dominant species, abundance)
17. LAND TENURE (ownership of the site and surrounding areas)
18. CONSERVATION MEASURES TAKEN (legal status, management category, management practices from past to present)
19. CONSERVATION MEASURES PROPOSED
20. LAND USE (human population, principal human activities and main forms of land use)
21. POSSIBLE CHANGES IN LAND USE & PROPOSED DEVELOPMENT PROJECTS (major developments likely to have serious long-term effects)
22. DISTURBANCE / THREATS (natural causes and human activities at the site or off-site within the catchment area which may have a detrimental effect on natural character of the site)
23. HYDROLOGICAL / BIOPHYSICAL VALUES (e.g. recharge and discharge of groundwater, flood control, sediment trapping, prevention of coastal erosion)
24. ECONOMIC BENEFITS (e.g. water supply, fisheries, agriculture, grazing, timber production, energy resources, wildlife resources, transportation, recreation and tourism opportunities)
25. SOCIAL/CULTURAL VALUES (historical, local cultural and traditional associations, religious significance)
26. SCIENTIFIC RESEARCH/FACILITIES
27. CONSERVATION EDUCATION
28. RECREATION/TOURISM
29. MANAGEMENT AUTHORITY
30. JURISDICTION (territorial e.g. province, district, municipality, etc.; and functional e.g. Royal Forestry Department, Department of Fisheries, etc.)
31. REFERENCES
32. LIST(s) OF DETAILED DATA AVAILABLE (checklists of flora and fauna in which more details can be found)

Detailed information on "An Inventory of Wetlands of International and National Importance in Thailand" is presented in Office of Environmental Policy and Planning (2002).

5.0 WETLANDS IN THE MEKONG RIVER BASIN OF THAILAND

A Directory of Asian Wetlands (Scott, 1989), the first compilation of information on wetlands of Asia, contains descriptions of 42 Thailand's wetland sites of international

importance especially as waterfowl habitats. Among those sites, 19 wetland sites are within the Mekong River Basin.

Wolstencroft, Parr and Goodey (1993) carried out a survey of wetlands in the northeastern Thailand, assessed and described 24 wetland sites of importance and of greatest potential conservation value. The sites were assessed for concentrations of large waterbirds, including roosting, feeding and nesting areas, principal vegetation types, hydrology, and the nature and impacts of resource utilisation. Among those sites, 5 sites were found to be outstanding in terms of population numbers and diversity of large waterbirds, namely Bung Khong Long Wildlife Non-Hunting Area, Nong Han Kumphawapi, Bung Lahan, Sanambin Reservoir Wildlife Non-Hunting Area, and two artificially created reservoirs in the Huai Chorakhe Mak and Huai Talat Wildlife Non-Hunting Areas. These sites were identified as wetlands of international importance, using the criteria of the Ramsar Convention.

Results of the National Wetlands Inventory revealed that the northeastern region of Thailand has 14,750 wetland sites covering an area of 1,999.13 sqkm, 1.18% of the total area of the region and 0.39% of the total area of the country. According to the criterior for classifying level of importance of wetlands as described earlier in 4.0, the northeastern Thailand has at least 12 wetland sites of international importance, 45 wetland sites of national importance, and 532 wetland sites of local importance. Among those 45 sites of national importance, 12 sites are selected as of high priority (Office of Environmental Policy and Planning, 1999 and 2002).

Within the Mekong River basin of Thailand, results of the National Wetlands Inventory (the North and the Northeast) revealed that there are at least 15 wetlands of international importance and 15 priority wetlands of national importance according to the criteria of high fish and bird diversity (Office of Environmental Policy and Planning, 2002).

Altogether a total of 39 important wetland sites covering a total area of 1,601,082 ha in the Mekong River basin of Thailand as described in 3 key references : Scott (1989); Wolstencroft, Parr and Goodey (1993); and Office of Environmental Policy and Planning, 2002) are listed in Table 4.

Table 4 List of important wetland sites in the Mekong River Basin of Thailand.

	Names of Sites	Province(s)	Geographic coordinates	Areas / Length	Types	Scott (1989)	Wolstencroft et al. (1993)	OEPP (2002)
1	Chiang Saen Basin including Nong Bong Khai Wildlife Non-Hunting Area	Chiang Rai	20’ 10-18” N, 99’ 57’’ - 100’ 11” E	6,240 ha	Floodplains, rivers, streams, lakes, marshes, ricefields	3		3
2	Nong Luang	Chiang Rai	19’ 47-52” N, 99’ 57” E	1,471 ha	Lake, associated marshes, flooded grassland, ricefields	3		3
3	Nong Hang	Chiang Rai	19’ 30” N, 99’ 48” E	279 ha	Marshes	3		3
4	Nong Leng Sai	Phayao	19’ 23” N, 99’ 49” E	960 ha	Marshes	3		3
5	Kwan Phayao	Phayao	19’ 10” N, 99’ 52” E	2,053 ha	Lake, associated marshes	3		3
6	Kok River	Chiang Rai, Chiang Mai	19’ 30” – 20’ 12” N, 99’ 10” – 100’ 08” E	290 km	River, riverine pools			3
7	Bung Khong Long Wildlife Non-Hunting Area	Nong Khai	17’ 58” – 18’ 03” N, 103’ 59” – 104’ 02” E	1,290 ha	Lake, associated marshes, ricefields	3	3	3
8	Lower Nam Mong Basin	Nong Khai	17’ 48-57” N, 102’ 31-38” E	240 ha	Rivers, streams, floodplain lakes, ponds, marshes, ricefields	3	3	3
9	Nong Hua Khu Wildlife Non-Hunting Area	Udorn Thani	17’ 35” N, 102’ 37” E	11 ha	Marshes	3	3	3
10	Nong Han Kumphawapi	Udorn Thani	17’ 6-14” N, 102’ 59” - 103’ 05” E	4,500 ha	Lake, associated marshes, ricefields	3	3	3
11	Nong Han	Sakhon Nakhon	17’ 6-15” N, 104’ 7-20” E	12,520 ha	Lake, associated marshes	3	3	3
12	Nong Waeng Wildlife Non-Hunting Area	Chaiyaphum	15’ 55” N, 102’ 16” E	20 ha	Marshes	3	3	3
13	Bung Lahan	Chaiyaphum	15’ 35-40” N, 101’ 50-58” E	2,909 ha	Lake, associated marshes	3	3	3
14	Mun River and flooded forests	Maha Sarakham, Buriram, Surin, Sisaket	15’ 28” N, 103’ 00” E – 15’ 08” N, 104’ 25” E	60,400 ha	River, streams, riverine pools, rapids flooded forests, floodplains, marshes	3	3	3

15	Mun River alongside Kaeng Tana National Park	Ubon Ratchathani	15’ 18” N, 105’ 29” E	8,000 ha	River, riverine pools, rapids		3	
16	Lam Nam Chi	Chaiyaphum	15’54” N, 102’ 20” E – 15’59”N, 102’ 24” E	1,000 ha	River, streams, ox-bow lakes, floodplain marshes		3	
17	Confluence of the Mun and Chi Rivers	Sisaket, Ubon Ratchathani	15’ 10-15” N, 104’ 35-50” E	9,750 ha	Rivers, streams, flooded forests, ox-bow lakes, floodplain grasslands, marshes, ricefields	3	3	3
18	Lam Plai Mat	Buriram	14’ 47-57” N, 102’ 52” E	1,900 ha	River, streams, flooded forests, floodplain marshes, grasslands, ricefields	3	3	3
19	Huai Chorakhe Mak Reservoir Wildlife Non-Hunting Area	Buriram	14’ 53-55” N, 103’ 01-03” E	620 ha	Reservoir	3	3	3
20	Huai Talat Reservoir Wildlife Non-Hunting Area	Buriram	14’ 51-53” N, 103’ 03-06” E	709 ha	Reservoir	3	3	3
21	Sanambin Reservoir Wildlife Non-Hunting Area	Buriram	14’ 38” N, 103’ 05” E	571 ha	Reservoir, marshes, grasslands, ricefields	3	3	3
22	Lam Dome Yai and wetlands of Pa Yot Dome Wildlife Sanctuary	Ubon Ratchathani	14’ 15-30” N, 105’ 05” E	30 km 22,540 ha	River, streams, riverine pools, rapids, floodplains	3	3	3
23	Goot Ting Reservoir	Nong Khai	18’ 17” N, 103’ 44” E	2,200 ha	Reservoir		3	
24	Nong Kom Ko	Nong Khai	17’ 50” N, 102’ 44” E	944 ha	Floodplain backswamps/marshes		3	3
25	Nong Din Dam	Chaiyaphum	16’ 24” N, 102’ 07” E	22 ha	Lake, associated marshes		3	
26	Nong Bua Ban Khwao	Chaiyaphum	15’ 46” N, 101’ 55” E	12 ha	Pond		3	
27	Nong Tahan	Ubon Ratchathani	14’ 58” N, 104’ 56” E	11 ha	Pond		3	
28	Nong Khai Lake	Nong Khai	17’ 52” N, 102’ 48” E	400 ha	Lake		3	
29	Nong Gah	Chaiyaphum	15’ 36” N,	235 ha	Reservoirs		3	

	Sark/Nong Lahan Key Nok		102’ 03” E					
30	Nong Bung Rawee	Chaiyaphum	15’ 46” N, 101’ 47” E	250 ha	Lake, associated marshes		3	
31	Wetlands of Phu Khieo Wildlife Sanctuary	Chaiyaphum	16’ 8-33” N, 101’ 21-53” E	156,000 ha	Streams, floodplains, marshes		3	3
32	Mekong River	Chiang Rai, Loei, Nong Khai, Nakhon Phanom, Mukdahan, Amnaj Charoen, Ubon Ratchathani	20’ 00-10” N, 100’ 15-30” E	> 2,400 km	River, riverine pools, rapids			3
33	Songkhram River and its floodplains	Udorn Thani, Sakhon Nakhon, Nong Khai, Nakhon Phanom	17’ 26” – 18’ 05” N, 103’ 32” – 104’ 45” E	1,300,100 ha	River, streams, flooded forests, floodplains			3
34	Doon Lam Pan Wildlife Non-Hunting Area	Maha Sarakham	15’ 46-47” N, 103’ 01-02” E	50 ha	Subterrain streams, marshes			3
35	Nong Pla Koon	Roi Et	16’ 20” N, 104’ 02” E	80 ha	Floodplain marshes			3
36	Bung Klua / Bo Kae	Roi Et	16’ 02” N, 104’ 02” E	75 ha	Reservoir			3
37	Nong Sam Muen	Chaiyaphum	16’ 23-25” N, 102’ 00-07” E	560 ha	Floodplain marshes			3
38	Kaeng La Wa	Khon Kaen	16’ 05-11” N, 102’ 40-43” E	1,120 ha	Floodplain lake			3
39	Huai Sua Ten	Khon Kaen	16’ 45-48” N, 102’ 45-48” E	1,040 ha	Streams, floodplains, reservoir			3

6.0 WETLAND FUNCTIONS AND VALUES

Wetland/aquatic ecosystems have roles, functions, and values of significant importance to community's way of life and well-being of life of humans, plants and animals. The Mekong River and its associated wetlands have, for thousands of years, supported the subsistent livelihood and economy. Wetland ecosystems provide direct and indirect benefits – which may be tangible or intangible – to people living in the vicinity. Wetlands provide "products" which are the basic needs, augmenting the diet, curing the sickness, providing housing materials, and enhancing the occupation and income of rural and urban inhabitants of the Mekong River Basin.

Wetlands provide significantly environmental benefits. Important wetland functions include water storage, groundwater recharge and discharge, storm protection, flood buffering and control, shoreline stabilization, erosion control, and retention of carbon, nutrients, sediments and toxicants, and regulation of local and global climates (Dugan, 1990).

At least 17 wetland functions and values can be listed (Choowaew, n.d.).

(1) Water supply
(2) Energy supply
(3) Flood control
(4) Salt intrusion prevention
(5) Shoreline stabilisation and erosion control
(6) Sediment retention
(7) Nutrient retention
(8) Toxicant retention
(9) Biomass transport
(10) Gene pool
(11) Biological diversity
(12) Harvestable resources
(13) Water transport
(14) Recreation and tourism
(15) Importance to history/culture/heritage
(16) Importance to nature education
(17) Parts of landscape and natural processes and balance

Obtainable benefits from wetlands are described in more detail as follows.

(1) Water supply

Humans, plants and animals may use water directly from wetlands for consumption. Wetlands are major source of water supply for rural households. Domestic, agricultural, livestock, aquacultural, recreational, and industrial sectors rely on surface and underground water withdrawals. When water moves from wetlands down into the underground aquifer, water is clean and may be drawn up again for consumption by nearby communities especially in dry season. In the northeastern Thailand, aquifers of

recent alluvium (depths ranging from 1-10 m below ground level) flank the main river channels. Rainwater seepage recharges groundwater resources, with an estimated 5-6% reaching the aquifers under the Korat Plateau. Groundwater supplies in the basin are mostly used domestically, but small quantities are used for irrigation and for food processing factories. Choowaew et al. (1994) reported that more than 75% of the water consumed for drinking and domestic use by households in the vicinity of Huai Nam Un wetlands, Songkhram River basin, was obtained from shallow wells.

As reservoirs, wetlands are major sources of water supply for consumption. Nong Han Sakhon Nakhon is a source of water supply for a total of 900,000 persons at the rate of 15,840 cu.m. per day (Department of Land Development, n.d.). Nam Un reservoir has 475 mcm regulating storage supplying water to an irrigated area of 170,300 rai.

(2) Energy supply

Riverine wetlands, the Mekong mainstream and its major tributaries, are important for development of hydroelectric energy. Pak Mun Dam on the Mun River, a major branch of the Mekong River, for example, produces 290 GWh/yr of electricity (on average during 1995-1999) (World Commission on Dams, 2000).

(3) Flood control

Marshes and swamps tend to reduce the flows as a combined result of their storage capacity and the resistance that flood waters encounter while flowing through marshes and marginal vegetation of swamps. By retaining rainfall and runoff, wetlands are natural storage and decrease the destructive flooding impacts downstream, avoiding the costly construction of dams, reservoirs, and flood control structures, as well as the socio-economic loss.

(4) Salt intrusion prevention

By balancing runoff, groundwater recharge and discharge, wetlands prevent inland intrusion of saline water.

(5) Shoreline stabilisation and erosion control

By reducing the energy of waves, currents, storms, and other erosive forces, wetland vegetation stabilise shorelines, canal/river banks and hold the sediment in place.

(6) Sediment retention

Wetlands may serve as pools where sediment can settle. Wetland vegetation slow down the water flow and increase sediment settling. Retaining sediment in upstream wetlands will lengthen the lifespan of downstream reservoirs and waterways and reduce adverse effects on coastal water quality and ecosystems.

(7) Nutrient retention

Wetlands may serve as pools where surplus fertilizer and nutrients in wastewater can be trapped. Wetland vegetation may remove nutrients from water passing through, improve water quality and prevent eutrophication. These nutrients support production of aquatic plants and fish.

(8) Toxicant retention

Toxicants such as pesticides often adhere to suspended sediment and can be retained in wetlands. Nearby ecosystems face with less harmful effects.

(9) Biomass transport

Nutrients and biomass can be transported along with water and runoff, distributing fertility to nearby wetlands. Annual flooding dominates the biotic production of wetlands by releasing nutrients from the soil, vegetation and inundated organic debris. Water, thus enriched, supports a bloom of plankton, fish and macro-vegetation. Fish populations utilize inundated habitats like flooded forest for reproduction and replenishment of fish stocks. The nutrient rich sediments are also transported downstream to inundation plains where they are deposited in fields and swamps.

(10) Gene pool

Wetlands are genetic reservoir for certain native plant and animal species, important source of new genetic material used in developing disease resistance and other desirable commercial traits.

(11) Biological diversity

Wetlands support a significant diversity of wildlife. Many endemic, rare and endangered species depend on wetlands to complete their life cycle. Many species can only live in wetlands. Loss of wetlands will eliminate wetland dependent species.

Wetlands of the Mekong River Basin are unique ecosystems, exceptionally rich in biodiversity and are habitats for a wide range of globally threatened species, providing water and primary productivity upon which numerous species of plants and animals depend for survival. Wetland ecosystems support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species.

Wetlands are an important storehouse of plant genetic materials. A wide range of floral species are found in wetlands. Wild rice in wetlands is an important source of new genetic materials in developing disease-resistant and higher-yield strains. The flooded forests of the middle Mun River have a diversity of over 100 species of flora which are not only important food sources of communities but also refuges, breeding, spawning grounds for fish and aquatic animals (Choosakul et al., n.d.).

The Mekong River has important riverine habitats for birds. Many sites along the Mekong River are considered to be Important Bird Areas (IBAs) by Bird Conservation Society of Thailand - BirdLife Thailand and BirdLife International (Round, 2002).

Open sand-bars : support nesting species (*Sterna acuticauda, Sterna aurantia, Sterna albifrons, Vanellus duvaucelii, Charadrius dubius, Glareola lactea*) and a great range of wintering species including species nationally at risk. Large and significant sandbars occurring upstream of Chiang Saen, at Sob Ruak are probably the single most important area of the upper Mekong for numbers wintering waterfowl.

Beds of tall grasses on sandbars : support many small birds, including warblers, roosting buntings, and nesting Red Avadavats *Amandava amandava.* A few Jerdon's Bushchats nest in such habitats, and the very scarce wintering chat White-tailed Rubythroat *Luscinia pectoralis* has also been recorded in similar reed or can-grass habitat from marshy areas around Chiang Saen. Significant areas of this habitat occur all the way along the Thai section of the Mekong from the Golden Triangle downstream at least as far as Chiang Khong.

Exposed bedrock and so-called braided channels : alternating with small sandy/shingly patches often occurs in association with *Homonoia riparia* scrub. This is probably the most diverse riverine habitat for birds, important for a range of species : *Anas poecilorhyncha, Esacus recurvirostris, Sterna aurantia, Hirundo smithii,* and *Saxicola jerdoni* and both resident and migrant warblers, Yellow-eyed Babbler *Chrysomma sinense* and Chestnut-capped Babbler *Timalia pileata*. Extensive tracts of this habitat occur downstream of Chiang Saen to Chiang Khong.

Vertical earth banks : constitute nesting habitat for colonies of Plain Martins, and probably also Blue-tailed Bee-eater *Merops philippinus.* Vertical earth banks of > 1m height occur both along the mainstream banks and on offshore islands.

Bung Kong Long Ramsar Site is a habitat of the globally threatened Baer's Pochard *Aythya baeri*, Thailand's critically endangered Purple Heron *Ardea purpurea*, the vulnerable Ferruginous Pochard *Aythya nyroca*, and is a habitat of a large number of Lesser Whistling Duck *Dendrocygna javanica,* Intermediate Egret *Egretta intermedia*, Little Egret *Egretta garzetta*, Pheasant-tailed Jacana *Hydrophasianus chirurgus,* and Garganey *Anas querquedula*.

Nong Bong Khai Ramsar Site is a habitat of 56 winter visiting bird species, including the globally threatened Baer's Pochard *Aythya baeri*, Thailand's critically endangered Purple Heron *Ardea purpurea*, Black Stork *Ciconia nigra* and Black Kite *Milvus migrans*.

An estimated 1,700 different species of fish are known to inhabit the waters of the Mekong mainstreams, tributaries, and associated wetlands (Mekong River Commission, 2001). Important fish species include the globally endangered endemic Mekong Giant Catfish *Pangasianodon gigas* the world's largest freshwater fish, *Boraras micros* the

world's third smallest fish inhabiting swamps of the Mekong floodplain, critically endangered globally Leaping Barb *Chela caeruleostigmata* and Dwarf Botia *Botia sidthimunki*, Jullien's Carp *Probarbus jullieni*, Golden Arowana *Scleropages formosus*, an endemic freshwater herring *Tenualosa thibaudeaui*, and another at least 30 endangered endemic fish species.

Rapids and deep pools of the Mekong River and tributaries are habitats for many endemic fish species which are not found elsewhere such as *Chitala blanci, Chitala lopis, Wallago leeri, Pangasius sanitwongsei, Mekongina erythrospila, Bangana behri, Mystus wyckioides,* Giant gouramy *Osphronemus sp.*, *Channa marulius*, and also are shelters and spawning ground for riverine species such as *Pangasius sp., Cirrhinus microlepis,* and *Cyprinid sp.*

Major tributaries of the Mekong such as the Mun River has at least 70 fish species(Duangsawasdi and Duangsawasdi, 1992). Flooded forests of the middle Mun River has a diversity of at least 66 species of fish (Choosakul et al., n.d.).

Bung Kong Long is a habitat of the vulnerable *Clarias batrachus.* Nong Bong Khai is a habitat of Thailand's endemic fish species being threatened in the wild *Betta splendens* and *Badis badis*, and endangered *Albulichthys albuloides, Osteochilus schlegeli, Pangasianodon gigas, Pangasius sanitwongsei,* and *Ceratoglanis scleronema*.

Reservoirs such as Nam Phrom, Ubonratana, Nam Un, Huai Luang have at least 9-19 aquatic plant species, 26-52 fish species (NIFI, 1978; Duangsawasdi et al., 1980).

Village ponds of marsh type have at least 3-11 fish species (Chookajorn, Chantsavang and Setkit, 1982).

(12) Harvestable resources

Wetlands provide various products with great socio-economic values. Most wetlands are important in augmenting the diet and, through the harvest and sale of wetland produce, the income of rural inhabitants and households in the Mekong River Basin.

(a) Forest resources

Direct harvest of forest resources from wetlands yields a wide variety of important products, ranging from timber and non-timber products; firewood and charcoal; fencing, housing, thaching and roofing materials; fibers; resins; dyes; raw materials for cottage industries, handicrafts, and compost. Choosakul (2001) reported that in flooded forests of the middle Mun River basin, fuelwoods e.g. *Phyllanthus collinsae*, *Artabotrys spinosus*, *Hymenocardia wallichii* were collected and charcoal was produced at a rate of 4-5 bags/time/household, valued at 100-200 baht/bag or 400-1,000 baht/time/household.

(b) Wildlife resources

Wild foods are harvestable from wetlands and vital for local nutritional status and sources of augmented diets and income. Wetland wildlife such as several species of amphibians e.g. frogs *Rana tigrina, R. vittigera, R. limnocharis, Kaloula pulchra*; paddy rats *Rattus rattus*; molluscs and pond snails e.g. *Filopaludina doliaris, Vicisara doliaris*; crabs, snakes, insects, birds, soft-shelled turtles, and ant eggs are important sources of supplementary protein and are not only consumed domestically but also sold in local markets providing an additional household income source. Choowaew et al. (1994) reported that the daily intake of wetland wildlife in the vicinity of Huai Nam Un wetlands, Songkhram River basin was 34.8 g/person compared to 142.0 g/person of normal animal protein consumption rate. The prices of some wild food products from wetlands as recorded from village markets indicated their relative values e.g. 40 baht/bag of 6 frogs, 20 baht/row of 5-6 dried and grilled Ueng (*Kaloula pulchra*), and 1 baht/each fried crispy Mang Da Na (*Letbocerus indicus*). Amphibians, reptiles and birds are also vital to agro-ecosystems and to rural economy as they play an important role in rodent and insect control. Some animals such as crocodiles and snakes are exploited for food and skins.

(c) Flora resources

Aquatic plants and vegetables such as morning glory *Ipomoea aquatica,* Neptunia *Neptunia natans,* Lotus or Tropical water-lily *Nymphaea lotus,* Asiatic Pennywort *Centella asiatica, Limnocharis flava, Colocasia esculenta* are harvested from wetlands for food. Sacred Lotus *Nelumbo nucifera* is harvested and used in religious and cultural activities. Several kinds of aquatic plants are grown in wetlands for animal feed and for sale. Through the harvest and sale of wetland produce such as morning glory *Ipomoea aquatica,* duckweed *Lemna sp.,* and water hyacinth *Eichhornia crassipes*, wetlands also provide daily income and economic opportunities for many unemployed and the under-employed inhabitants. Choosakul et al. (n.d.) reported that from flooded forests of the middle Mun River, income from gathering and selling various varieties of mushrooms was 3,000-4,000 baht/yr/household; income from fruits gathered, preserved and sold was 1,000-2,000 baht/yr for harvestible period of only 2 months.; and income from bamboo shoots was 2,000-3,000 baht/yr for harvestible period of only 3 months. Wetland plants such as water hyacinth *Eichhornia crassipes*, Cypress species e.g. *Scirpus grossus*, Typha species e.g. *Typha angustifolia* are harvested and used as raw materials for cottage industries. Mat production using plant materials from flooded forests of the middle Mun River provides an annual income of at least 1,500 baht/household/yr (20-50 mats/household/yr and sale price 35-50 Baht/mat) (Choosakul, 2001).

(d) Medicinal resources

Over 100 species of medicinal plants were found in flooded forests of the middle Mun River basin, of which over 80 species were used by communities for traditional medicines. List of products harvestable from flooded forests is presented in Choosakul (2001).

(e) Agricultural resources

Wetlands can be used for agriculture and yield substantial benefits to rural communities. Rice which is a staple food and major export of Thailand is grown in wetlands. Rice cultivation can adapt to the annual flood. Choosakul (2001) reported that due to the natural fertility of alluvial soils and riverine sediments, no insect pests, high biodiversity, appropriate and unique native rice varieties, average rice productivity grown in Pa Tham or riverine flooded forests can be as high as 400-500 kg/rai/yr (maximum 684.6 kg/rai/yr), compared to 250 kg/rai/yr (or 350-400 kg/rai/yr) average rice productivity from rainfed ricefields of the Northeast. Department of Land Development (1993) reported that rice productivity was average at 296 kg/rai in 7 villages in the vicinity of Huai Nam Un wetlands in Amphoe Sri Songkhram of the Songkhram River basin. Cash crops e.g. many varieties of vegetables, chilli, and tobacco can be grown along the river banks using natural fertile alluvium soils.

(f) Forage resources

Wetlands contain grasslands and trees that can be grazed by livestock which are important to pastoral communities. Fodder can be collected for sale or use as a dry-season animal feed. Livestock and poultry production depends very much on wetlands.

(g) Fisheries

Wetlands are nutrient-rich, sheltered habitats for fish and aquatic species, and are important to their life cycles as feeding, spawning, hatching and nursery areas. Wetlands is the main source of low-cost and high quality animal protein for rural populations. In the Mekong River Basin of Thailand, fish and aquatic animals are major daily protein intake in the diet, accounting for over 60% (Choowaew et al., 1994). Consumption of fish and aquatic animals is estimated at 20-35 kg per capita per year (ICLARM, 1999).

Fisheries is significant to the local as well as national economies, providing occupation and income-earning opportunities, particularly for the unemployed or under-employed. The Mekong River and its associated wetlands support one of the largest inland fisheries in the world. The majority of rural families are either part- or full-time fishermen or fish farmers.

It is estimated that capture fisheries constitutes 90% and culture fisheries constitutes 10% of the total fish production in the Lower Mekong Basin (Mekong River Commission, 1997). Small-scale and subsistent capture fisheries is believed to be much more important to rural nutrition. Major capture fishery systems in Thailand include the mainstream of the Mekong River and its major tributaries, riverine flooded forests, lakes, marshes, reservoirs, and ricefields during flooding. Types of fish culture include traditional pond culture, usually of household-scaled size for supplementing the family's diet and income; pen and cage culture on the main tributaries; non-intensive rice-fish or rice-shrimp culture; and semi-intensive or intensive culture from household to commercial scales (Department of Fisheries, n.d.).

There are various estimates and reports on fish yields and socio-economic values derived from different wetland types, sizes and locations.

For example, in the lower Songkhram River basin, the Department of Fisheries of Thailand (n.d.) reported that the average annual fishery yield was estimated at 13,000-18,000 tons. Household fish and aquatic animal product consumption rate was 29.56 kg/capita/yr. Average household annual fish catch by habitats of 12 wetland types was estimated as follows : from natural lakes (highest at 168.67 kg), rivers (125.11 kg), floodplain swamps/marshes (117.44 kg), reservoirs (84.48 kg), rainfed wet rice (78.05 kg), natural swamps/marshes (73.26 kg), streams (66.73 kg), floodplain grassland (50 kg), seasonal irrigation canals (30 kg), inundated lowland wet rice (19.9 kg), floodplain trees/shrubs (14 kg), and aquaculture ponds (2 kg). Habitat yield assessment revealed 83.0 kg/rai/yr for closed habitats such as natural lakes, natural swamps/marshes, reservoirs and aquaculture ponds; 2,590.2 kg/km/yr for rivers, streams and canals; 1.7 kg/rai/yr or 43.39 kg/rai/3-months inundated period of floodplain grassland, swamps/marshes, trees/shrubs; and 2.0 kg/rai/yr or 50.47 kg/rai/3-months inundated period for rainfed wet rice.

The National Inland Fisheries Institute (n.d.) reported that Tung Kula Rong Hai, floodplain area with many rivers and streams, had high fish productivity of 5,179 tons/yr, average fish catch of 3 kg/day/household, and average income from capture fisheries of 1,827.92 baht/month/household in 1984. For culture fisheries, Techapeowlert (1991) found that the average productivity of fish polyculture was 50-4500 kg/rai/yr; of fish monoculture 1800-3053 kg/rai/yr; of rice-fish fields 45-200 kg/rai/yr along with triple rice productivity compared to rice monoculture; of school fish ponds is 200 kg/rai; and of village fish ponds 5-152 kg/rai.

Average standing crop or fish productivity per unit area of rivers in the Northeast of Thailand was estimated at 13.76 kg/rai. Considering 6 major rivers, namely Mun, Chi, Kam, Songkhram, Loei, and Pong, having a total surface area of 304,613 rais, the total freshwater fishery resources from these rivers was 4,191.47 tons/yr. The Mekong River has a standing crop 5.17 kg/rai; the Mun 14.28 kg/rai; the Chi 19.58 kg/rai; Nam Un 16.52 kg/rai (Office of Agricultural Economics, 1985 and Duangsawasdi and Duangsawasdi, 1992).

Average standing crop or fish productivity per unit area of natural and semi-natural lakes and ponds such as Nong Han Sakhon Nakhon was estimated at 11.58 kg/rai (ranging from 5.5 – 21.55 kg/rai) during 1964-75 (Office of Agricultural Economics, 1985). In 1993-94, average standing crop of Nong Han Sakhon Nakhon was 9.74 kg/rai, with 289 fishing households having an average total catch of 596-916 kg/day or 4.8 kg/fisherman/day and average income of 102.65 baht/fisherman/day (Duangsawasdi et al., 1994).

Average standing crop of reservoirs having surface area <5,000 rai was 9.36 kg/rai and of reservoirs having surface area >5,000 rai was 17.64 kg/rai during 1968-71 (Office of Agricultural Economics, 1985).

(h) Clay/sand/salt/mineral resources

Clay pottery using clay from Pa Tham or riverine flooded forests provides an annual income of 8,000-10,000 baht/month or 48,000-60,000 baht/yr (for 6 months production period from November to April) to Ban Go Pottery Community (comprising 3 villages in Sri Saket) with over 4 generations of pottery skills of at least 6 households (Choosakul, 2001).

The Korat Plateau is underlain by evaporite rock salt which leaches into the soils and is raised to the surface by rock salt mining. Salt production using saline soil from Pa Tham or flooded forests in the middle Mun River basin, e.g. a community of 16 villages in Tambon Don Rad, Amphoe Ratanaburi, Surin, provides an annual income of 1,000-4,000 baht/yr (for 4 months production period from February to May) (Choosakul, 2001).

(13) Water transport

Wetlands have been important routes for transportation since the ancient time. Wetlands may serve as a convenient alternative to normal forms of road transport with effective, low cost and less environmental effects. The Mekong River and its tributaries are the lifelines and also important means of transportation. Major inland ports on the Mekong River include one in Nong Khai. Other smaller and less developed ports include one at Chiang Saen and Chiang Khong.

(14) Recreation and tourism

Rivers and streams especially ones with rapids, waterfalls and beaches, such as Kaeng Sa Phue and Kaeng Ta Na (Ubonratchathani), and Kang Kud Ku (Loei), are prime tourism spots. At least 140,000 tourists visited Kaeng Sa Phue in 1999 (World Commission on Dams, 2000). Wetland recreation and tourism include water sports, swimming, diving, canoeing, fishing, birdwatching, nature photography, sailing, etc..

(15) Importance to history/culture/heritage

Wetlands are involved with Thai history, legends, culture, traditions, national identity, religion, and way of life. Settlements, floating markets, temples and religious establishments can be seen along waterways and on riverbanks. Many wetlands are religious sites or highly respected or have spiritual values according to the local beliefs (e.g. Don Pu Ta). Some wetlands are archaeological sites. Many Thai traditions, culture and festivals in the North and Northeast are centered on wetlands, such as Loy Kratong, Festival of Lights, Illuminated Boats Procession, Rockets Festival, and Boat Racing.

(16) Importance to nature education

All wetland types are natural laboratories for all groups, levels, and all walks of life.

(17) Parts of landscape and natural processes and balance

Wetlands stabilise local climate conditions, hydrological, nutrient, and material cycles.

7.0 PRESENT USES OF WETLANDS

Uses of wetlands differ according to wetland types and sizes. All cases contribute substantially to the national and local economies. Uses of many wetlands in the Mekong River Basin of Thailand are of marginal value but for significant subsistence.

Rivers and streams are used mainly for fisheries, water supply for domestic consumption, agriculture and livestock, transportation, recreation and tourism. Many rivers contribute to hydropower generation.

Riverine floodplains are used mainly for agriculture, livestock grazing, and fisheries.

Flooded forests in northeastern Thailand are public lands traditionally used all year round for over 100 years for rice planting (from January to August for lowland rice, from February to September for upland rice), cultivating upland crops (February –August), growing vegetables (December-January), firewood collection (January-September), animal raising during dry season, and wild products gathering throughout the year. Mushrooms are collected between late April-May to September (5 months). ManSang starts growing from late April-May and is collected for domestic food and sale in August-September. Rattan is harvested during January-April. Reeds is collected between February-April. Fruits and bamboo shoots are collected in 3 months during May-August. Medicinal plants are available during dry season. From September to November, floodwater starts. Fish and molluscs are collected year round. Average estimated values from flooded forest is 38,906 baht/household/year. Average income from fisheries alone is 9,284 baht/household/year (Tham Mun Project, 1995).

Marshes and swamps are used for domestic water supply, for agriculture in the seasonally inundated peripheral areas, and for fisheries in the central perennially-inundated areas. Harvesting of natural products, such as woods, edible plants, plants of medicinal value, and utilizing peripheral areas for grazing, livestock and cattle, besides being habitats for animals and birds, are major uses.

Lakes and reservoirs are mainly used for water supply and storage, flood prevention, fisheries, irrigation, agriculture and livestock, transportation, recreation and tourism.

8.0 ECONOMIC VALUATION OF WETLANDS

Conceptually, total economic value of wetlands consists of use value and non-use value (Pearce and Moran, 1994; Barbier, Acreman and Knowler, 1997).

A use value is a value arising from an actual use made of a given resource. This might be the use of flooded forest for timber, or the use of a lake for fisheries or recreation, and so on. Use values are further divided into **direct use values**, **indirect use values** and **option values**.

Direct use values refer to actual uses in which outputs are directly consumable such as fishing, timber harvesting, wildlife gathering, water extraction, agriculture, transportation, etc..

Indirect use values refer to the functional benefits deriving from wetland ecosystem functions such as water purification, flood prevention, groundwater recharge, climate stabilisation, etc..

Option values refer to values approximating individuals' willingness to pay to safeguard wetlands and wetland resources for the option of using them directly or indirectly in the future which are like insurance values such as habitats and biodiversity conservation.

A non-use value is divided into **bequest values** and **existence values**.

Bequest values refer to use and non-use values of wetland resource legacy, the benefits accruing to any individual from the knowledge that others or future generations might benefit from a resource in the future.

Existence values are unrelated to current use or option values, deriving simply from the knowledge of existence of any particular wetlands and wetland resources. An individual's concern to protect the Mekong Giant Catfish although he or she has never seen one and is never likely to, is an example of existence value.

A common taxonomy for economic valuation of wetlands is presented in Table 5.

So far, there has been very few studies and research on economic valuation of wetlands and wetland resources. Approaches taken and available results, have been involved only with some particular types of direct use values which are more tangible and easier to quantify.

Table 5 Categories of economic values of wetlands.

Total economic values

Use values			Non-use values	
Direct use values	Indirect use values	Option values	Bequest values	Existence values
➢ Fish ➢ Wildlife ➢ Forest ➢ Non-wood products ➢ Traditional medicines ➢ Agriculture ➢ Water supply ➢ Navigation / transportation ➢ Energy ➢ Recreation / tourism ➢ Research / education	➢ Nutrient retention ➢ Flood mitigation ➢ Salinity control ➢ Water treatment ➢ Climate stabilization ➢ Erosion control ➢ Maintenance of ecosystem and biological diversity ➢ Surface water discharge ➢ Groundwater recharge	➢ Biological diversity ➢ Conserved habitats ➢ Medicinal values ➢ Eco-tourism ➢ Wilderness	➢ Habitats ➢ Prevention of irreversible change ➢ Ecological process	➢ Habitats ➢ Endangered species ➢ Genetic pool ➢ Aesthetics ➢ Cultural assets

Sources : Pearce and Moran, 1994; Barbier, Acreman and Knowler, 1997.

Choosakul et al. (n.d.) studied resource use values of flooded forests (ca. 180 sqkm) of 11 communities, 366 households in 3 sub-districts along the middle part of the Mun River. Resource uses calendar was made for 18 activities found in flooded forests for all year round. Commercial direct use values or income from wetland products sale were analysed and calculated. Results revealed that the total annual benefits derived from this wetland was 14,239,637 baht or 38,906 baht/household/yr, consisting of commercial use value from agricultural resources (including rice, kenaf, watermelon, groundnut, corn) was 6,445,477 baht/yr; from flora resources (fuel, charcoal, potatoes, mushrooms, bamboo shoots, vegetables, fruits, timber, reeds, rattan and other non-timber products) was 3,033,815 baht/yr; and from fauna resources (fish, mollusks, frogs, ant's eggs and animal dung) was 4,760,285 baht/yr (Tham Mun Project, 1995).

Department of Land Development (n.d.) reported that there were 11,700 fishermen living around Nong Han (Sakhon Nakhon). The net annual income from fisheries was estimated at 11,200 baht/household. Average daily total catch was estimated at 1,794 kg of which 39% were consumed locally.

Department of Land Development (2001) monitored the socioeconomic conditions at Huai Nam Un wetlands, Amphoe Sri Songkhram, Nakhon Phanom and reported that inhabitants had an annual income of 17,250 baht from rice production, 10,606 baht from fisheries, and 3,197 baht from handicrafts. Average rice yield in waterlogged area was 123 kg/rai, compared to 217 kg/rai in non-waterlogged area.

Prapamontol (2001) applied the Contingent Valuation Method to conservation of fishery resources in Bung Lahan, Chaiyaphum. Results revealed that nearly 40% of the sampled households (300 households in 20 villages of 4 sub-districts located in the vicinity of 3 km from Bung Lahan) were households having over 50% of the total income derived from fisheries in Bung Lahan. The Mean and Median value which fishery households revealed their willingness to pay for conservation of fishery resources in Bung Lahan were 417.16 and 259.04 baht/household/year respectively. The total value which 4,035 households altogether in the study area were willing to pay for conservation of fishery resources in Bung Lahan was 1,683,240.60 baht/year. In comparison, fishery households benefited 20,349.20 baht/household/year on average from capture fisheries in Bung Lahan. The total benefit which 4,035 households altogether derived from this wetland was 82,109,022 baht/year. Key factors significantly determining the economic value for conservation of fishery resources in Bung Lahan were housing location, importance of fishery resources to the households, and source of information about conservation of fishery resources.

9.0 THREATS TO WETLANDS

Despite the close dependence upon natural wetland ecosystems, several factors combine to increase pressure upon the resources and decrease the benefits obtained by local communities. Threats to wetlands in the Mekong River basin of Thailand include increased population and additional pressures on wetlands and wetland resources; infrastructure development; deforestation and degradation of watersheds; altered hydrological regimes, flow regulation, drainage, dredging, filling; salinization; reclamation schemes, irrigation, agriculture, aquaculture; hydroelectric schemes, flood control; groundwater abstraction; over-exploitation of wetland resources; water pollution from human settlements, agriculture and industries; introduction and invasion of exotic and non-native species; and global climate change.

Demand for fresh and clean water is projected to increase considerably, water scarcity and competition for freshwater resources is likely to be a problem in the Mekong River basin for the foreseeable future. Northeast Thailand's severe drought in 1993 adversely affected irrigation and water supply (Mekong River Commission, 1997). Dams construction will have major social and environmental consequences and wetland ecosystems will have to play more and better role in water supply, recharge and discharge, as water sources. Demand for hydropower will also rise, alternative energy sources are needed.

Changes in hydrological regimes or inflow reduction due to development projects e.g. construction of dams, roads or barriers encircling wetlands; withdrawal of upstream water for multiple uses; and water diversion often have impacts on wetland ecosystems by obstructing connection with adjacent wetlands and may deteriorate surface water quantity and quality, threaten wetland resources and sustainability, prevent species migration, disrupt life cycles and adversely affect their survival, and result in significant reduction of species abundance. Mekong-Chi-Mun Water Diversion Project and Songkhram River Dam Project have potentially severe impacts on wetlands and floodplain forests.

Sedimentation and erosion are problems in most major rivers e.g. Kok, Mun, Chi, and Songkhram Rivers and in various wetland sites e.g. Chiang Saen Basin, Nong Luang, Nong Hang, Nong Han Kumphawapi, and Bung Khong Long. Sedimentation may cause changes in hydrological regimes, disturb aquatic ecosystems, invertebrates and fisheries, and affects navigability.

Wetland ecosystems are vulnerable to environmental changes outside their immediate boundaries. Urban, industrial and domestic wastes pollute rivers, lakes, reducing and destroying biodiversity. Waters are also contaminated by sedimentation from forest clearance, siltation, sand mining, salt leaching, agro-chemical runoff, fertilizer, pesticide and toxic substances.

Natural wetlands in Thailand's Mekong River Basin have gone through several significant changes due to intensive use of their resources. Various wetland types are under threats from encroachment and conversion to other land uses such as for cultivation, irrigation, settlements, urbanization, industries, and development of infrastructures.

Introduction of exotic, non-native species such as Giant Mimosa, Golden Apple Snail, and alien fish is a problem in some wetland sites e.g. in Chiang Saen Basin, Nong Bong Khai, Nong Luang, Nong Hang, Lam Plai Mat and Nong Kom Ko.

Wetlands are threatened by increased exploitation of biological resources. Most wetlands in the region have suffered a marked decline in waterbird populations and associated biodiversity. Illegal hunting, collection of wildlife's eggs, and inappropriate fishing practices cause loss of endangered species and biodiversity; loss of breeding, nursing grounds and habitats for aquatic biota.

Although tourism provides economic benefits, income and occupational opportunities to local inhabitants, excessive number of tourists and recreational activities, increase of waste discharged from hotels, resorts, and restaurants contribute to deterioration of various wetlands e.g. Nong Luang, Nong Hang, Nong Leng Sai, Nong Han Kumphawapi, Nong Han Sakhon Nakhon, Kok River, and Doon Lam Pan.

10.0 WETLANDS MANAGEMENT ACTIVITIES

Thailand has began to take more holistic approaches for wetland management since January 1993 after the Royal Forest Department had organized a consultative meeting on wetland management participated by representatives from relevant agencies. The Office

of Environmental Policy and Planning was appointed by the meeting to act as the national focal point and establishment of a National Sub-committee on Wetlands Management was proposed under the National Environment Board.

On July 1, 1993, the National Environment Board agreed and appointed the National Sub-committee on Wetlands Management. This Sub-committee is chaired by the Deputy Permanent Secretary of Ministry of Science Technology and Environment with members comprising representatives from relevant government agencies (i.e. the Office of Environmental Policy and Planning; Royal Forest Department; Department of Fisheries; Royal Irrigation Department; Department of Land Development; Department of Local Administration; Department of Environmental Quality Promotion; Bureau of Budget; Department of Technical and Economic Cooperation; Department of International Organization; The Royal Navy), non-government organizations (i.e. Wildlife Fund Thailand; Bird Conservation Society of Thailand), and distinguished experts.

To assist its work, in 1999 the National Sub-committee on Wetlands Management appointed the Technical Working Group on Wetlands consisting of wetland experts and scientists from universities, relevant government agencies and non-government organizations to provide technical consultation to the Committee.

10.1 Roles and responsibilities of government agencies

Wetland management involves several government agencies. Their names, roles and responsibilities are presented in Table 6. Each agency has its own objectives, approaches, policies and operational regulations on wetland management.

Table 6 Roles, authorities and responsibilities of government agencies involved in wetland management in Thailand.

Wetland related agencies	Roles, authorities, responsibilities
The Cabinet	▪ Oversee the national natural resources and environmental policy and plans ▪ Decide and approve on key principles, measures, strategies
National Environment Board	▪ Approve on national wetland policy and key measures ▪ Provide comments and advise on national environmental strategies to the Cabinet
National Sub-committee on Wetlands Management	▪ Provide common guidelines and coordinate actions on wetland management through formulation of national policy, measures and action plan on wetland management and protection. ▪ Provide supports and monitor implementation of the national policy, support, supervise and monitor implementation of the Ramsar Convention, promote integration of wetland considerations in formulation and implementation of natural resources development and conservation plans, assist strengthening awareness, provide education and wetland related studies and research.
Technical Working Group on Wetlands Management	▪ Acts as preliminary reviewing panel for wetland management plans of each wetland site before presented to the National Sub-committee, provides technical views and

	information on issues discussed by the Scientific and Technical Panel of the Convention on Wetlands.
Ministry of Natural Resources and Environment	
Office of Environmental Policy and Planning, MOSTE (at present, Office of Natural Resources and Environmental Policy and Planning, MNRE)	▪ Formulate policies, measures, operational frameworks, management/action plans on conservation and use of wetlands at national level in accordance with the national environment plan and the National Economic and Social Development Plan and in consistence with obligations and strategic plans of the Convention on Wetlands and other related conventions. These actions are taken under the Enhancement and Promotion of Environmental Quality Act (1992). ▪ Coordinate with relevant agencies to enable implementation of the policies, measures and plans, and monitor and evaluate their implementation. ▪ Act as the national focal point for the Ramsar Convention ▪ Act as the secretariat body of the National Sub-Committee on Wetlands Management
Department of Water Resources	▪ Manage water resources ▪ Act as national coordinating body of the Mekong River Commission
Department of National Parks, Wildlife and Plants	▪ Manage and conserve wetlands within protected areas i.e. Wildlife Sanctuaries, National Parks, and Wildlife Non-Hunting Areas in accordance with the National Park Act (1961) and the Wildlife Preservation and Protection Act (1992). ▪ Regulate the use of parks and their resources; provide appropriate recreational activities and facilities; introduce and conduct interpretative programs to build visitors' understanding and appreciation of park values. ▪ Protect wildlife and increase populations; protect wildlife habitats; educate the public regarding wildlife protection.
Department of Environmental Quality Promotion	▪ Enhance and promote national environmental quality via public relations, education, awareness programmes ▪ Coordinate and support activities of NGOs ▪ Maintain environmental database and information systems
Pollution Control Department	▪ Control and prevent pollution of all forms from all sources
Provincial Natural Resources and Environment Office	▪ Oversee and coordinate provincial natural resources and environmental management strategies
Ministry of Agriculture and Cooperatives	
Department of Land Development	▪ Soil and land use survey, classification, mapping and planning nationwide ▪ Wetland classification and mapping ▪ Conduct studies, survey and research related to wetlands management
Department of Fisheries	▪ Manage and conserve fishery areas and wetlands which are habitats of aquatic animals, under the Fishery Act (1957), the Fishing Right in Thai Fishing Area Act (1959), the Thai Fishing Vessels Act (1938), the Fishing Port Act (1963), and the Wildlife Preservation and Protection Act (1993). ▪ Enhance fishery productivity, conserve and develop aquatic species, replenish natural stock and long-term use of fishery resources. ▪ Conduct studies, research, and experiments in every field

	of fisheries; explore and analyze fishing grounds beyond Thai waters and promote fisheries cooperation with other nations; develop occupations relating to fisheries.
Royal Forest Department	▪ Manage and conserve all types of forests including those associated with natural wetlands, e.g. mangrove forests, peat swamp forests, as well as streams, marshes, canals, ponds, waterfalls, under the Forest Act (1941), the Forest Preservation Act (1964). ▪ Protect and rehabilitate denuded watersheds; introduce alternative land use and agricultural practices to discourage shifting cultivation. ▪ Mangrove, Swamps and Wetlands Management Division, Forest Research Office : established on 20 October 2000, research on mangroves, swamps and wetlands, technology transfer and information service, develop action plans, protection and rehabilitation measures; established RFD's Wetlands Committee on 8 June 2001, to set up RFD's wetland management policy and action plan and to implement the Ramsar Convention. RFD developed Action Plan for Sustainable Wetland Management Phase I : 2003-2007, targeting at establishment of 22 Wetland Information Centers, survey and research on at least 2 million rais of wetland areas, set up community networks at least at 10 wetland sites, 15% of targeted population participate in wetland management, 20% of targeted communities get access to wetland information service, and participatory sustainable wetland management. (Piriyayota, n.d.).
Royal Irrigation Department	▪ Develop water resources and manage water supply for various purposes e.g. for storage, cultivation, drainage, flood prevention, and transportation under the Public and Civil Irrigation Acts (1939).
National Resources and Biodiversity Institute (NAREBI)	▪ Facilitate a new concept of ecosystem management to reduce the institutional overlap and duplication of efforts among various agencies.
Ministry of Transportation	
Habour Department	▪ Protect and maintain wetlands for use as transportation routes e.g. rivers and canals in accordance with the Maritime in Thai Water Act (1992, the 14th revision).
Ministry of Interior	
Department of Lands	▪ Determine rights, guidelines, criteria, conditions and methods of land use as well as private and public real estate by issuing land holding documents and review private land holding and land holding documents under the state's protection, all in accordance with law on land and group 4 of civil and commerce laws entitled property in management of natural wetlands.
Department of Local Administration	▪ Supervise local administration in administering local areas in accordance to government policies and in providing adequate service to local communities.
Department of Town and Country Planning	▪ Conduct studies and formulate landscape design plans in areas around and adjacent to wetlands to ensure the existence of the entire wetland ecosystems
Provincial Office	▪ Oversee and coordinate management activities in wetlands within provincial boundary.
Local Administration Organizations	▪ Local administration is the most vital part in ensuring

	wetland management and conservation is implemented in accordance to both national policies and the need of local people. The administrations have the closest association to the people, natural resources and the environment, and their action would thus have most impact to wetlands and population in the surrounded areas. ▪ Administering of wetland management is under the Sub-district Council and Sub-district Administration Organization Act (1994), especially the maintenance of natural resources and environment under the jurisdiction of sub-district council and sub-district administration organization in Article 23(4) and Article 67(7).
Ministry of Education	
Department of Education	▪ Oversee and develop educational curricula ▪ Enhance wetland education
Ministry of Tourism and Sports	
Tourism Authority of Thailand	▪ Promote appropriate tourism activities in wetlands in order to generate and enhance local occupation and income
Ministry of University Affairs	
Universities and Academic Institutions	▪ Conduct survey, studies, and research on all aspects related to wetland ecosystems management ▪ Provide technical and academic advice ▪ Serve as members in Committee, Sub-Committee, Working Group and as individual consultants ▪ Contribute to wetland management projects/programmes and activities of GOs, NGOs, and Ios ▪ Wetland education, communication, trainings and public awareness raising

10.2 Roles and activities of non-government organizations

Non-government organizations in Thailand play active roles and contribute to wetland management activities. Their names, roles and activities are presented in Table 7.

Table 7 Roles and activities of non-government organization in wetland management in Thailand.

Wetland related agencies	Roles, authorities, responsibilities
NGOs	▪ Enhance incentives and awareness to the population around wetlands on values and importance of wetlands and mobilize local efforts to enable conservation of wetlands with wise use by building pride and incentives for conservation and sustainable use. ▪ Launch complaints on inappropriate development projects which potentially have negative impacts on wetlands
Wildlife Fund Thailand Under the Royal Patronage of HM the Queen	▪ Conserve natural resources and environment ▪ Study wildlife ▪ Operate conservation networks ▪ Provide the local people with knowledge and understanding of nature conservation ▪ Wetland education and awareness at various sites

	▪ Wetland management planning at Khan Thu Li Peatswamp ▪ Serve as a member of National Sub-Committee on Wetland management
Bird Conservation Society of Thailand	▪ Survey, study and monitor bird habitats, populations, migratory patterns, status ▪ Provide the public with knowledge and understanding about birds, and their relations and importance to overall ecosystems ▪ Public education and awareness ▪ Regular bird-watching activities ▪ Provide technical advice, data and information ▪ Serve as a member of National Sub-Committee on Wetland management
Green World Foundation	▪ Environmental education ▪ Development of environmental education materials ▪ River SPY or Stream Investigation Project
Tham Mun Project (29 Wiphat Anuson Rd., Tambon Nai Muang, Amphoe Muang, Surin 32000)	▪ Promote people's participation in natural resource management ▪ Support and disseminate information on the models of natural resources recovery and conservation by community organizations ▪ Coordinate and cooperate with various agencies on natural resource management ▪ Organize meetings and training sessions; youth camps; promote supplementary occupations ▪ Rehabilitation of Flooded Forests of The Mun River Project, supported by Thailand Environment Fund
Project for Ecological Recovery (PER)	▪ Campaigns for Songkhram River conservation ▪ Operate Songkhram River conservation ▪ Campaigns against pollution of the Nam Pong River ▪ Organize meetings, trainings, and activities at grassroots level
Wetlands International – Thailand Programme	▪ Wetland education, public awareness ▪ Schools, teachers and youth networks ▪ Organize meetings, trainings, wetland site visits ▪ Development of Regional Environmental Education Programme in the Lower Mekong Basin

10.3 Roles and activities of International and UN organizations

International and UN organizations contribute, support, and play important roles in various wetland management activities, projects and programmes in Thailand. Their names, counterpart agencies, and activities are presented in Table 8.

Table 8 Roles and activities of International and UN organizations related to wetland management in Thailand.

Organizations / Counterparts	Project Title	Duration
DANCED-OEPP	▪ Implementation of Ramsar Convention :	2002-2006

	Management and Protection of Wetland Areas	
UNEP/GEF/Kasetsart University	▪ Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand – Wetland Sub-component	2002-present
UNDP/GEF/IUCN	▪ Mekong River Basin Wetland Biodiversity Conservation and Sustainable Use Programme	1999-present
Wetlands International	▪ Asian Wetland Inventory (AWI) Objective : To standardize wetland inventory approaches across Asia by emphasizing on core data collection Output : A Manual for an Inventory of Asian Wetlands Version 1.0	1999-present
ICLARM-AIT/MRC	▪ Legal and Institutional Framework and Economic Valuation of Resources and Environment in the Mekong River Region : A Wetlands Approach Objective : To improve the national legal and institutional framework and to increase local capacity to manage wetlands, wetland resources and the environment	1999-present
Mekong River Commission (MRC)	▪ Environment (Aquatic Habitats) Programme	present
Swedish International Development Agency (SIDA)/MRC	▪ Inventory and Management of Wetlands in the Lower Mekong Basin	1990-2001
European Community / Royal Forest Department	▪ Sustainable Management of Phu Khiew Wildlife Sanctuary through Community Participation	1997-2004
DANCED-OEPP	▪ National Wetland Inventory of Thailand	1995-1999
Canadian International Development Agency (CIDA)	▪ The Restoration of forests with Cultural Importance in Maha Sarakham Province ▪ Canada-Thailand Trilateral Environment (to strengthen the capacity of national institutions to plan and implement sustainable natural resource management, focusing on the environmental impact of energy development sector)	1996
ASEAN	▪ ASEAN – Mekong Basin Development Cooperation Objectives : To stimulate sustainable economic growth of the Mekong Basin; and to encourage a process of dialogue and common project identification which can result in firm economic partnerships for mutual benefit	1995-present
Asian Development Bank (ADB)	▪ Regional technical assistance to facilitate, promote and support sub-regional economic cooperation among the countries in the Greater Mekong Sub-region (GMS). Among the identified projects are 11 environment and natural resource management projects. ▪ Greater Mekong Subregional Environmental Monitoring and Information System (SEMIS)	1992-present
Japan International Cooperation Agency (JICA)	▪ Mekong International Bridge Construction Project (Mukdahan-Thailand and Sawannakhet-Laos)	From 1998
Southeast Asia Rivers Network (SEARIN)	▪ Campaigns on river and dam issues ▪ Support local community rights to rivers ▪ Oppose threats to rivers and riverine ecosystems.	present
Towards Ecological Recovery and Regional Alliance (TERRA)	▪ Focus on issues concerning natural environment and local communities within the Mekong region	present

10.4 Major achievements

10.4.1 National wetland policy and plans on wetland management

The National Wetland Policy, Measures and Action Plan on Wetland Management prepared for 1997-2002 was endorsed by the Cabinet on September 23, 1999. This first national action plan for wetland management consists of 43 projects, 28 work plans to be carried out by 14 agencies with a total budget of 472.5 million baht. Key measures include enhancing awareness on wetland importance and values; wetland management and coordinating cooperation for wetland conservation; capacity building and human resources development; promotion and support for basic research and studies; establishment of conditions on wise uses and wetland rights; development of legal instruments and enhancing efficiency of wetland related agencies; and promotion of international cooperation on wetland conservation. However, the plan did not well succeed due to the economy stagnation, limited budget, and problems with budget allocation for implementation.

The Work Plan on Wetland Management for 2003-2007 was prepared and integrated into the National Policy, Strategies and Action Plan on Conservation and Sustainable Use of Biodiversity. This Plan consists of 168 activities, 4 sub-work plan to be carried out by 41 agencies with a total budget of 2,600.56 million baht. Key measures include wetland education, public awareness, capacity building and staff development on sustainable use of wetlands; wetland management, rehabilitation and protection; wetland research; and promotion of international cooperation on wetland conservation. The Plan was endorsed by the Cabinet on June 11, 2002.

10.4.2 National wetland inventory

National wetland inventory was initiated in 1995 and completed in 1999. See also 4.0. Key outputs are 5 publications in a series of Wetlands in Thailand :

(1) An Inventory of Wetlands of International and National Importance in Thailand
(2) Wetlands of Northern Thailand
(3) Wetlands of Northeastern Thailand
(4) Wetlands of Central and Eastern Thailand
(5) Wetlands of Southern Thailand

10.4.3 International cooperation

On August 26, 1997, the Cabinet endorsed the ratification of the Ramsar Convention and the ratification instrument was submitted on May 13, 1998. Thailand became the 110th Contracting Party to the Ramsar Convention with the nomination of Phru Khuan Khi Sian Wetland in Thale Noi Wildlife Non-Hunting Area as the first Ramsar Sites. Based on the National Wetland Inventory, 9 more sites of international importance were

nominated. At present, Thailand has 10 Ramsar Sites as presented in Table 9. At least 2 sites locate in the Mekong River basin : Nong Bong Khai Wildlife Non-Hunting Area in Chiang Rai and Bung Khong Long Wildlife Non-Hunting Area in Nong Khai.

Table 9 List of Thailand's Ramsar Sites.

No.	Name of Sites	Types	Province(s)	River Basin	Date of designation
1	Phru Khuan Khi Sian	Peatswamp, melaleuca forests	Phatthalung	Rivers of Southern Thailand	13 May 98
2	Bung Khong Long Wildlife Non-Hunting Area	Lake, associated marshes	Nong Khai	Mekong	5 July 01
3	Don Hoi Lot Wetlands	Estuaries, intertidal mudflats	Samut Songkhram	Mae Klong	5 July 01
4	Krabi River Estuary	Estuaries, mangroves, shallow sea bays	Krabi	Rivers of Southern Thailand	5 July 01
5	Nong Bong Khai Wildlife Non-Hunting Area	Lake, associated marshes	Chiang rai	Mekong	5 July 01
6	Princess Sirindhorn Wildlife Sanctuary (Phru To Daeng Peatswamp Forest)	Peatswamp forests	Narathiwat	Rivers of Southern Thailand	5 July 01
7	Hat Chao Mai Marine National Park – Libong Islands Wildlife Non-Hunting Area – Trang River Estuary	Estuaries, mangroves, shallow sea bays sea beaches, offshore islands	Trang	Rivers of Southern Thailand	14 August 02
8	Wetlands of Laemson National Park – Kapoe Estuary – Kra Buri River Estuary	Estuaries, mangroves, shallow sea bays sea beaches	Ranong	Rivers of Southern Thailand	14 August 02
9	Ang Thong Islands Marine National Park	Offshore islands sea beaches	Surat Thani	Rivers of Southern Thailand	14 August 02
10	Phang Nga Marine National Park	Offshore islands sea beaches, estuaries, mangroves	Phang Nga	Rivers of Southern Thailand	14 August 02

10.4.4 Specific wetland site management plans

Since 1994, at least 8 priority sites with critical status were selected for contracted studies to formulate specific wetland site management plans. Those sites include :

(1) Sam Roi Yot wetlands in Prachuap Khirikhan
(2) Wetlands of Saiburi River basin in Pattani

(3) Phru Ban Mai Khao peatswamp forests in Phuket
(4) Pa Bung Pa Tham riverine flooded forests in Si Saket
(5) Phru Khan Tulee peatswamp forests in Surat Thani
(6) Bung Khong Long Wildlife Non-Hunting Area in Nong Khai
(7) Thale Noi Wildlife Non-Hunting Area in Phatthalung
(8) Hat Chao Mai Marine National Park – Libong Islands Wildlife Non-Hunting Area – Trang River Estuary in Trang

At least 2 sites within the Mekong River Basin, namely Pa Bung Pa Tham riverine flooded forests in Si Saket and Bung Khong Long Wildlife Non-Hunting Area in Nong Khai, have baseline information and management plans.

10.4.5 Protected areas

In 1996, a wetland site in the Mekong River Basin of Thailand, Doon Lampan Forest in Maha Sarakham was declared as environmentally protected area under the Enhancement and Promotion of National Environmental Quality Act (1992).

Besides, results of the national wetland inventory revealed that, within the Mekong River Basin of Thailand, at least 7 sites of international importance and 34 sites of national importance were under the protected areas system as National Parks, Wildlife Sanctuaries and Wildlife Non-Hunting Areas (Office of Environmental Policy and Planning, 2002).

10.4.6 The Cabinet's Resolution on the National List of Wetlands

On August 1, 2000 the Cabinet endorsed the National List of wetlands and 13 conservation measures. The List includes 61 wetlands of international importance, 48 wetlands of national importance, 19,295 wetlands of local importance, 9 wetlands qualified for Ramsar Site nomination, and 28 priority wetlands for study, survey, protection and rehabilitation.

Among wetlands on the National List, there are wetland sites locating within the Mekong River Basin as follows :

<u>15 wetlands of international importance</u>

- Chiang Saen Basin (including Nong Bong Khai Wildlife Non-Hunting Area)
- Nong Leng Sai
- Kwan Phayao
- Nong Han Sakhon Nakhon
- Nong Han Kumphawapi

- Bung Lahan
- Bung Khong Long Wildlife Non-Hunting Area
- Huai Chorakhe Mak Reservoir Wildlife Non-Hunting Area
- Huai Talat Reservoir Wildlife Non-Hunting Area
- Sanambin Reservoir Wildlife Non-Hunting Area
- Mekong River
- Songkhram River
- Lam Plai Mat
- Lam Dome Yai and Wetlands of Pa Yot Dome Wildlife Sanctuary
- Wetlands of Phu Khieo Wildlife Sanctuary

15 wetlands of national importance

- Nong Luang
- Nong Hang
- Kok River
- Doon Lam Pan Wildlife Non-Hunting Area
- Nong Kom Ko
- Nong Pla Koon
- Bung Klua / Bo Kae
- Nong Sam Muen
- Kaeng La Wa
- Huai Sua Ten
- Lower Nam Mong Basin
- Nong Hua Khu Wildlife Non-Hunting Area
- Mun River and Flooded Forests
- Confluence of the Mun and Chi Rivers
- Nong Waeng Wildlife Non-Hunting Area

2 wetlands qualified for Ramsar Site nomination

- Nong Bong Khai Wildlife Non-Hunting Area
- Bung Khong Long Wildlife Non-Hunting Area

4 priority wetlands for protection

- Nong Hang
- Nong Leng Sai
- Nong Han Kumphawapi
- Bung Lahan

6 priority wetlands for rehabilitation

- Nong Hang
- Nong Leng Sai
- Kwan Phayao
- Nong Kom Ko
- Nong Waeng Wildlife Non-Hunting Area

- Nong Hua Khu Wildlife Non-Hunting Area

2 priority wetlands for further detailed inventory

- Wetlands of Phu Khieo Wildlife Sanctuary
- Wetlands of Pa Yot Dome Wildlife Sanctuary

The 13 conservation measures are :

(1) nomination of Ramsar Sites
(2) increase number and area of wetlands under protected areas system
(3) declare wetlands of importance as public lands and define their boundaries to prevent encroachment
(4) rehabilitation of degraded wetlands
(5) formulation of wetland management plans and zonation of land use activities
(6) environmental impact assessments of all development projects likely to have negative changes on important wetlands
(7) wetland education and public awareness
(8) wetland studies and research
(9) identify indicators and criteria and monitor wetland changes
(10) surveys of wetland biodiversity
(11) pollution prevention and control from all sources
(12) forest fire prevention and control
(13) landscape design plans to ensure the conservation of entire wetland ecosystems

10.4.7 Wetland Education and Awareness

Since 1994, the annual wetland conference has been held by the Office of Environmental Policy and Planning in order to provide the public with knowledge on wetlands and wetland management activities and to celebrate the World Wetland Day on February 2 every year. Wetland publications of all forms e.g. reports, proceedings, books, folders, leaflets, pamphlets, posters, and bimonthly newsletters have been produced and distributed to wide public continuously.

10.4.8 Studies, Surveys and Research

There is a number of studies and research for wetland management planning and research on mangrove forests, wetland biodiversity, wetland ecosystems, wetland monitoring, wetland resource uses, economic valuation, wetland classification and delineation, wetland related laws and legal instruments, and wetland institutions.

11.0 APPLICATIONS OF GIS AND REMOTE SENSING IN WETLAND RESEARCH AND MANAGEMENT

LANDSAT-1 imageries (1 : 500,000) were used by Land Classification Division for natural and man-made water bodies survey in the northeastern Thailand during August-September 1976 (Department of Land Development, 1978). The results show that the

LANDSAT-1 imageries could be used for surveying of both natural and man-made water bodies, especially water quantity, water shortage and flood problems, overall conditions and resource uses. At least 110 man-made water bodies or reservoirs and 242 natural water bodies were recorded. The 12 frames of LANDSAT-1 imageries from Multispectral Scanner used in this survey are listed below.

NASA ERTS-1	THAI ID.	DATE
NASA E-1200-02492-7	1-5	8 Feb 1973
NASA E-1200-02494-7	1-6	8 Feb 1973
NASA E-1147-02543-7	2-4	17 Dec 1972
NASA E-1147-02550-7	2-5	17 Dec 1972
NASA E-1147-02552-7	2-6	17 Dec 1972
NASA E-1148-02595-7	3-3	18 Dec 1972
NASA E-1148-03002-7	3-4	18 Dec 1972
NASA E-1148-03004-7	3-5	18 Dec 1972
NASA E-1220-03012-7	3-6	28 Feb 1973
NASA E-1221-03062-7	4-4	1 Mar 1973
NASA E-1167-03061-7	4-5	6 Jan 1973
NASA E-1221-03071-7	4-6	1 Mar 1973

Wannapiyarat and Trakooldit (n.d.) of the Land Use Planning Division, Department of Land Development, studied, analyzed and evaluated the potential use of the data from multidated JERS-1 Optical Sensor (OPS) and Synthetic Aperture Radar (SAR) in monitoring wetlands and land use changes in Bung Lahan, one of the richest wetlands in Chaiyaphum Province of the northeastern Thailand. The data used were JERS-1 OPS dated 28/12/95 and JERS-1 SAR dated 15/5/95 and 7/11/95. Data processing and analysis was carried out using EASI/PACE. Results from the study during October 1995 – September 1997 revealed that very high accuracy of the performance could be obtained from digital analysis of the OPS data to classify water bodies, marshlands, ricefields, perennial trees, shrubs, and mixed fieldcrops. Visual interpretation of SAR images was suitable for delineation of water bodies, marshlands, and urban areas. Data fusion techniques could be effectively used to enhance several land cover types as well as land cover changes in wetland areas.

A joint study between the Mekong River Commission and the Japanese Institute for Irrigation and Drainage, to map inundated areas using Radarsat imageries, has been initiated in 1997 (Mekong River Commission, 1997). The product of the inundation mapping was provided for use in the land resources information system.

Four LANDSAT 5 TM images, path-row : 127-48 (19/10/91); 127-49 (17/9/91); 127-49 (17/9/91); and 128-49 (17/10/91), PROCOMP-11, and SPANS GIS software were used for flood-risk zoning analysis in the Mun and Chi watershed in the northeastern Thailand (Yaovanit, 1998).

Sombutputorn (1998) established methodology for wetland ecosystem mapping and analysis using remotely sensed data (LANDSAT 5 TM, bands 2, 3, 4, dated 3/12/90, 26/12/90 and 01/95, 1:50,000) and Geographic Information System to design spatial data

structure and associated attributes. The study area was 1,308,147 ha of the Songkhram watershed in Nongkhai, Udonthani, Sakon Nakhon and Nakhon Phanom. Using the wetland classification system modified from Dugan (1990), wetlands were classified into Type, System, Subsystem and Class. Visual interpretation was carried out using Procom-II and data processing was carried out using PAMAP GIS. The data was organized by themes into layers. There were 23 wetland units resulting from the overlay analysis of the defined theme layers. Each unit has a range of information on which the detailed study was based. Selected sites of important wetland units were studied in terms of water quality, physical and biological components. The establishment of spatial database and its associated attributes was carried out. The developed database provides a tool for formulating spatial model for wetland ecosystems.

Sritumboon (2000) carried out a study on changes and distribution of riparian forest areas in floodplain of the Songkhram River using aerial photographs and geographic information systems. The study area covers 3 villages : Ban Pak Yam and Ban Dong Nong Bua, Amphoe Sisongkhram, Nakhon Phanom and Ban Tha Kon, Amphoe Akat Amnuay, Sakon Nakhon. Relationship between riparian forest and landform, changes and distribution of riparian forest areas in floodplain of the Songkhram River, and accuracy of the map generated using 1:50,000 aerial photographs and a geographic information system were studied and analysed. The result revealed that the riparian forest areas were limited only in the floodplain. The 1:15,000 aerial photographs were good enough to be used for mapping riparian forest areas.

The drought risk area in northeast Thailand was evaluated by Mongkolsawat et al. (2000) using remotely sensed data (Landsat TM data of December 1998) and GIS. The study enhanced drought risk area mapping and indicated that high drought risk areas found in the Southwest and extended to the Northwest of the region. The low risk areas are located along the Mekong River.

Chansaku (2002) applied the Remote Sensing Technique and Geographic Information System for wetland classification and mapping in Tung Kula Ronghai (2.1 million rais), northeastern Thailand. Wetland types in Tung Kula Ronghai were classified according to Thailand Wetland Classification System. Data were derived from visual interpretation of satellite imageries of bands 4, 5, 3 (Red, Green, Blue). Image unsupervised classification was carried out via computer processing using band 5 satellite images, Landsat 5-TM (287000E,1741000N; 445000E, 1687000N), taken on February 14 and October 27, 2000. The analysing model was created from 9 data layers by the Arc/Info Version 7.2 and Erdas Imagine Programme Version 8.4 via the Model Maker module, to divide and classify wetlands within the study area. The results showed that wetlands of Tung Kula Ronghai could be classified into 22 types, comprising an area of 3,168.43 sqkm, which was 88.9% of the total area. Majority is ricefields (66.37%). The applications of remote sensing and geographic information system could facilitate the classification of wetlands of all existing classes. The minimum area which could be classified from the satellite image was 25x25 sqm. This study recommends that 2 more types should be added : perennial floodplain lakes (FRF6) and perennial floodplain ponds (FRF7).

MODIS Level 1B 250 m data of the year 2000 of Thailand-Laos flood retreat were used for detection of land cover changes by Zhan et al. (2002).

At present, the Environmental Information Center, Department of Environmental Quality Promotion is implementing projects "Subregional Environmental Monitoring and Information System Phase II (SEMIS II)" and "Environmental Atlas of the Greater Mekong Subregion" in collaboration with other 5 countries in the MRB, supported by ADB and UNEP – Regional Resource Center for Asia and the Pacific (UNEP RRC.AP). Topographic maps (1:250,000) and Landsat-7 Enhanced Thematic Mapper plus (ETM+) imageries are used to form GIS. Greater Mekong Subregional Environmental Monitoring System Phase II (SEMIS II) also includes within core dataset : water related entity; water lines (rivers, streams); water bodies (lakes, reservoirs, wetlands, etc.); and Ramsar sites.

http://www.hatfieldgroup.com/feature/mek.htm
http://www.hatfieldgroup.com/feature/radarsat.htm
RADARSAT-1 imagery is used for assisting fisheries management and wetland habitat assessment in the Mekong River watershed, Southeast Asia. Results show that the multi-date analysis of RADARSAT imagery provides a practical tool for fisheries habitat and wetland mapping. The extent and duration of seasonal flooding in the Lower Mekong River Basin can be clearly identified. RADARSAT data were found to be effective for delineating permanent and seasonal water bodies, wetlands and other sensitive ecosystems, extent of inundation at different flooding levels, land uses, fishing structure and fishing activities, some vegetation classes.

12.0 THE WAY FORWARD

12.1 Wetland types assessment and prioritization

Wetlands within the Thai Mekong River basin are mostly of freshwater type. There is no marine/coastal and estuarine wetlands. Only exception is that saline wetlands can be found and classified into inland saltlake (SI) or another type of manmade wetlands. Thus, wetland types assessment is focused on freshwater wetland types.

According to Thailand's Wetland Classification System (Table 1), existing wetland types in the Mekong River Basin of Thailand are simplified and re-grouped into 12 types (Table 10) for further discussion and prioritization. They are as follows.

(1) Saline lakes/ponds/marshes/swamps
(2) Rivers, streams
(3) Rivers, streams with pools, rapids, waterfalls
(4) Floodplain grasslands
(5) Floodplain lakes/ponds
(6) Floodplain marshes/swamps
(7) Flooded forests
(8) Lakes, ponds
(9) Marshes, swamps
(10) Ricefields
(11) Fish ponds, aquaculture
(12) Reservoirs

Rapid Valuation of these 12 simplified wetland types can be carried out based on their values, functions, products and attributes (Dugan, 1990) via ranking and scoring processes. Table 11 and Table 12 are resulted from the preliminary findings of the researcher incorperated with the opinions and suggestions of experts and stakeholders in the national meeting on inventory of wetland/aquatic ecosystems (March 25, 2003).

Table 10 Simplified Wetland Classification System of Thailand.

L-I	L-II	L-III	L-IV	L-V	Simplified Types
Salt water (s)					
	Marine/Coastal (SM)				Not found in the Mekong River Basin of Thailand.
		Subtidal (SMS)			
			non-vegetated (SMS1)		
				rocky beds (SMS1a) unconsolidated beds (SMS1b)	
			vegetated/coral (SMS2)		

				natural coral reefs (SMS2a) artificial coral reefs (SMS2am) natural seagrass beds (SMS2b) natural seaweed beds (SMS2c) seaweed farms (SMS2cm) mariculture (SMS2dm)	
		Intertidal (SMI)			
			non-vegetated (SMI1)		
				coastal beaches (SMI1a) artificial coastal salt works (SMI1am) coastal mudflats (SMI1b) coastal culture (SMI1bm) coastal cliffs (SMI1c) coastal saltflats (SMI1d) coastal tide pools (SMI1e)	
			vegetated/coral (SMI2)		
				intertidal coral reefsSMI2a) coral farms (SMI2am) intertidal seagrass beds (SMI2b) intertidal seaweed beds (SMI2c) seaweed farms (SMI2cm) coastal mangroves (SMI2d) coastal mangrove plantation (SMI2dm)	
		Nontidal (SMN)			
			non-vegetated (SMN1)		
				nontidal mariculture (SMN1am) nontidal salt works (SMN1bm)	
	Estuarine (SE)				Not found in the Mekong River Basin of Thailand.
		Subtidal (SES)			
			non-vegetated (SES1)		
				rocky beds (SES1a) unconsolidated beds (SES1b)	
			vegetated/coral (SES2)		
				estuarine subtidal corals (SES2a) estuarine subtidal coral farms (SES2am) estuarine subtidal seagrass beds (SES2b) estuarine subtidal seaweed beds (SES2c) estuarine subtidal seaweed farms (SES2cm) estuarine subtidal mariculture (SES2dm)	
		Intertidal (SEI)			
			non-vegetated (SEI1)		
				estuarine beaches (SEI1a) estuarine mudflats (SEI1b) estuarine cliffs (SEI1c) estuarine salt flats (SEI1d)	
			vegetated/coral (SEI2)		
				estuarine intertidal corals (SEI2a) estuarine intertidal coral farms (SEI2am) estuarine intertidal seagrass beds (SEI2b) estuarine intertidal seaweed beds (SEI2c) estuarine mangrove swamp (SEI2d) estuarine intertidal mangrove plantations (SEI2dm) estuarine salt marshes (SEI2e)	
	Coastal lagoon(SC) / Inland saltlake(SI)				
		Coastal/inland saline/brackish lagoons/lakes/marshes			• Saline lakes/ponds/marshes/swamps

L-I	L-II	L-III	L-IV	L-V	Simplified Types
Fresh water (F)					
	Riverine (FR)				
		River (FRR)			• Rivers/streams
			perennial rivers (FRR1)		

				pools in perennial rivers (FRR1a) channels in perennial rivers (FRR1b) artificial perennial canals (FRR1bm) perennial rapids (FRR1c) perennial waterfalls (FRR1d) perennial hot springs/streams (FRR1e) perennial underground/subterrain streams (FRR1f)	• Rivers/streams with pools/rapids/waterfalls
			seasonal rivers (FRR2)		
				pools in seasonal rivers (FRR2a) channels in seasonal rivers (FRR2b) artificial seasonal canals (FRR2bm) seasonal rapids (FRR2c) seasonal waterfalls (FRR2d) seasonal hot springs/streams (FRR2e) seasonal underground/subterrain streams (FRR2f)	
		River Banks/Beaches/Bars (FRB)			
		Riverine Floodplains (FRF)			• Floodplain grasslands • Flooded forests • Floodplain lakes/ponds • Floodplain marshes/swamps • Ricefields • Fish ponds/aquaculture
			floodplain grassland (FRF1)		
				natural floodplain grassland (FRF1a) floodplain wet rice (FRF1am) floodplain crops, other than rice (FRF1bm)	
			floodplains trees/shrubs (FRF2)		
				seasonally flooded trees/shrubs/forest (FRF2a) (artificially) seasonally flooded plantations (FRF2am)	
			seasonal floodplain lakes (FRF3)		
			seasonal floodplain ponds (FRF4)		
			seasonal backswamp/marshes (FRF5)		
				natural seasonal backswamp/marshes (FRF5a) artificial seasonal wet rice (FRF5am) artificial seasonal wet plantations (FRF5bm)	
	Lacustrine (FL)				
		Lakes (>8 ha) (FLL)			• Lakes/ponds • Fish ponds/aquaculture • Reservoirs
			permanent lakes (FLL1)		
				natural permanent freshwater lakes (FLL1a) artificial permanent freshwater lakes (FLL1am)	
			seasonal lakes (FLL2)		
				natural seasonal freshwater lakes (FLL2a) artificial seasonal freshwater lakes (FLL2am)	
		Ponds (<8 ha) (FLP)			
			permanent ponds (FLP1)		
				natural permanent freshwater ponds (FLP1a) freshwater aquacultural ponds (FLP1am) sewage treatment ponds (FLP1bm) farm ponds (FLP1cm) cooling ponds (FLP1dm) borrow pits, excavated ponds (FLP1em) others (FLP1fm)	
			seasonal ponds (FLP2)		
				natural seasonal freshwater ponds (FLP2a) artificial seasonal ponds (FLP2am)	

L-I	L-II	L-III	L-IV	L-V	Simplified Types
	Palustrine (FP)				• Marshes/swamps

		Permanent (FPP)		
			(grass) permanent flooded grassland (FPPa) (sedges) permanent freshwater marshes (FPPb) (trees/shrubs) permanent swamps (FPPc)	
		Seasonal (FPS)		
			(grass) seasonal flooded grassland (FPSa) (grass) artificially seasonally flooded plantation (FPSam) (sedges) seasonal flooded marshes (FPSb) (trees/shrubs) seasonal flooded swamps (FPSc) (trees/shrubs) artificially seasonally flooded plantation (FPScm)	

Source : Simplified from Table 1.

Table 11 Rapid valuation of wetland types : ranking process.

Wetland Types	Saline lakes / ponds / marshes / swamps	Rivers, streams	Riverine pools, rapids, waterfalls	Floodplain grasslands	Floodplain lakes/ponds	Floodplain marshes/swamps	Flooded forests	Lakes, ponds	Marshes, swamps	Ricefields	Fish ponds / aquaculture	Reservoirs
Values												
Products												
♦ Forest resources	μ	λ	μ	μ	μ	λ	ν	μ	λ	λ	μ	μ
♦ Wildlife resources	λ	λ	λ	ν	λ	ν	ν	λ	ν	λ	μ	λ
♦ Fisheries	λ	ν	ν	λ	ν	ν	ν	ν	ν	ν	ν	ν
♦ Forage resources	λ	μ	μ	ν	μ	λ	ν	μ	ν	ν	μ	μ
♦ Flora resources	μ	λ	λ	λ	μ	λ	ν	λ	λ	λ	λ	μ
♦ Agricultural resources	μ	λ	μ	λ	λ	λ	λ	λ	λ	ν	λ	μ
♦ Water supply	μ	ν	λ	μ	ν	λ	λ	ν	λ	μ	μ	ν
♦ Energy supply	μ	ν	μ	μ	μ	λ	λ	μ	μ	λ	μ	ν
♦ Clay/sand/salt resources	λ	ν	μ	μ	μ	λ	λ	μ	μ	λ	μ	μ
♦ Medicinal resources	μ	μ	μ	λ	μ	λ	ν	λ	λ	λ	μ	μ
Functions												
♦ Groundwater recharge	ν	ν	λ	λ	ν	ν	λ	ν	ν	λ	μ	ν
♦ Groundwater discharge	λ	ν	λ	λ	λ	λ	ν	λ	ν	μ	μ	λ
♦ Flood control/protection	ν	ν	ν	λ	ν	ν	ν	ν	ν	λ	μ	ν
♦ Shoreline stabilization / Erosion control	μ	μ	λ	λ	μ	λ	ν	μ	ν	λ	μ	μ
♦ Sediment/toxicant retention	ν	ν	ν	ν	ν	ν	ν	ν	ν	λ	μ	ν
♦ Nutrient retention	λ	λ	ν	λ	ν	ν	ν	ν	ν	λ	μ	λ
♦ Biomass export	λ	ν	λ	λ	λ	ν	ν	λ	λ	λ	μ	λ
♦ Storm protection/windbreak	μ	μ	μ	μ	μ	μ	λ	μ	μ	μ	μ	μ
♦ Micro-climate stabilization	λ	ν	λ	λ	λ	λ	ν	λ	λ	λ	μ	λ
♦ Water transport	μ	ν	μ	μ	μ	μ	μ	λ	λ	μ	μ	λ
♦ Recreation/tourism	μ	ν	ν	λ	λ	λ	λ	ν	ν	λ	μ	ν
♦ Education/research	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν
Attributes												
♦ Biological diversity	λ	ν	ν	λ	ν	ν	ν	ν	ν	λ	μ	λ
♦ Uniqueness to culture / heritage	μ	ν	λ	μ	λ	λ	λ	λ	λ	ν	μ	μ
♦ Trans-boundary significance	μ	ν	μ	μ	μ	λ	λ	λ	λ	λ	μ	λ

Source : Modified from Dugan (1990).

Key : μ = Absent or exceptional; λ = Present; ν = Common and important value of that wetland type

Table 12 Rapid valuation of wetland types : scoring process.

Wetland Types	Saline lakes / ponds / marshes / swamps	Rivers, streams	Riverine pools, rapids, waterfalls	Floodplain grasslands	Floodplain lakes/ponds	Floodplain marshes/swamps	Flooded forests	Lakes, ponds	Marshes, swamps	Ricefields	Fish ponds / aquaculture	Reservoirs
Values	**Scores :** $\mu = 0$; $\lambda = 5$; $\nu = 10$											
Products												
♦ Forest resources	0	5	0	0	0	5	10	0	5	5	0	0
♦ Wildlife resources	5	5	5	10	5	10	10	5	10	5	0	5
♦ Fisheries	5	10	10	5	10	10	10	10	10	10	10	10
♦ Forage resources	5	0	0	10	0	5	10	0	10	10	0	0
♦ Flora resources	0	5	5	5	0	5	10	5	5	5	5	0
♦ Agricultural resources	0	5	0	5	5	5	5	5	5	10	5	0
♦ Water supply	0	10	5	0	10	5	5	10	5	0	0	10
♦ Energy supply	0	10	0	0	0	5	5	0	0	5	0	10
♦ Clay/sand/salt resources	5	10	0	0	0	5	5	0	0	5	0	0
♦ Medicinal resources	0	0	0	5	0	5	10	5	5	5	0	0
scores	**20**	**60**	**25**	**40**	**30**	**60**	**80**	**40**	**55**	**60**	**20**	**35**
Functions												
♦ Groundwater recharge	10	10	5	5	10	10	5	10	10	5	0	10
♦ Groundwater discharge	5	10	5	5	5	5	10	5	10	0	0	5
♦ Flood control/protection	10	10	10	5	10	10	10	10	10	5	0	10
♦ Shoreline stabilization / Erosion control	0	0	5	5	0	5	10	0	10	5	0	0
♦ Sediment/toxicant retention	10	10	10	10	10	10	10	10	10	5	0	10
♦ Nutrient retention	5	5	10	5	10	10	10	10	10	5	0	5
♦ Biomass export	5	10	5	5	5	10	10	5	5	5	0	5
♦ Storm protection/windbreak	0	0	0	0	0	0	5	0	0	0	0	0
♦ Micro-climate stabilization	5	10	5	5	5	5	10	5	5	5	0	5
♦ Water transport	0	10	0	0	0	0	0	5	5	0	0	5
♦ Recreation/tourism	0	10	10	5	5	5	5	10	10	5	0	10
♦ Education/research	10	10	10	10	10	10	10	10	10	10	10	10
scores	**60**	**95**	**75**	**60**	**70**	**80**	**95**	**80**	**95**	**50**	**10**	**75**
Attributes												
♦ Biological diversity	5	10	10	5	10	10	10	10	10	5	0	5
♦ Uniqueness to culture / heritage	0	10	5	0	5	5	5	5	5	10	0	0
♦ Trans-boundary significance	0	10	0	0	0	5	5	5	5	5	0	5
Scores	**5**	**30**	**15**	**5**	**15**	**20**	**20**	**20**	**20**	**20**	**0**	**10**
TOTAL SCORES	**85**	**185**	**115**	**105**	**115**	**160**	**195**	**140**	**170**	**130**	**30**	**120**

Prioritisation of wetland types derived from Table 12 is as follows.

Priority	Wetland Type(s)
1	Flooded forests
2	Rivers/streams
3	Marshes/swamps
4	Floodplain marshes/swamps
5	Lakes/ponds
6	Ricefields
7	Reservoirs
8	Rivers/streams with pools/rapids Floodplain lakes/ponds
9	Floodplain grasslands
10	Saline lakes/ponds/marshes/swamps
11	Fish ponds & aquaculture

The above list of priority wetland types is compared with the results of the NRD2C data analysis (Boonpukdee, 1998) and the results of a rapid appraisal carried out by the researcher on January 31, 2003 (Choowaew, 2003).

Results of the analysis of NRD2C data of a total of 26,168 villages in the Northeast of Thailand (Table 13) revealed that the top 3 types of wetlands which villages have the most accessibility were marshes/swamps (73.37%), ponds (72.99%), and streams/canals (68.92%), respectively (Boonpukdee, 1998). It should be noted that ricefields is not included in this data source.

Table 13 Number of villages from a total of 26,168 villages surveyed, having accessible wetlands.

Type	No. of Villages	%
Lakes	565	2.40
Rivers	1,350	5.80
Streams/canals/Khu/Klong	15,959	68.92
Marshes/swamps	16,989	73.37
Waterfalls/springs/subterrain streams	129	0.54
Ponds	16,901	72.99
Reservoirs	2,159	9.32
Barrages,viers,sluice gates	4,794	20.70
Others	806	3.48

Source : Boonpukdee (1998).

Results of a rapid appraisal carried out by the researcher on January 31, 2003 (Choowaew, 2003) indicated that of a total of 35 experts and stakeholders who were asked to prioritise wetland types of the Northeast for further inventory, priorities were given as follows : rivers (66%), lakes (49%), marshes (46%), flooded forests (31%), river basin (26%), floodplains and reservoirs (14%), ricefields (5%), and irrigated areas and saltfields (3%). The top 4 types of priority wetlands are rivers, lakes, marshes, and flooded forests, respectively. It should be noted that 26% of experts and stakeholders suggested that priority should be given to a river basin as a whole. Some experts suggested that wetlands of all types may be considered equally important and all types need further inventory. However, no matter what type is chosen, priority should be given to those with high number of wetland resource users and inhabitants.

At the national meeting on inventory of wetland/aquatic ecosystems held by the Thai National Mekong Committee Secretariat in cooperation with the Mekong River Commission Secretariat (March 25, 2003), the above preliminary findings were presented. A total of 33 participants listed wetland types which they considered important for further inventory. Results from the national meeting are conformable with the above priority listing. Only exception is that floodplain grasslands is selected instead of reservoirs.

Seven following wetland types (not in priority order) were agreed upon as prioritised wetland types in the Mekong River Basin of Thailand.

Rivers, streams
Floodplain grasslands
Floodplain marshes/swamps
Flooded forests
Lakes, ponds
Marshes, swamps
Ricefields

12.2 "Who is doing what" in prioritised wetland types

At the national meeting on inventory of wetland/aquatic ecosystems on March 25, 2003, 33 participants identified relevant organizations having mandates and activities related to each prioritised wetland types (Table 14). Those mandates and activities can be classified into the following gategories.

(1) Survey	(2) Classification	(3) Inventory
(4) Mapping	(5) Management Planning	(6) Policy Formulation
(7) Coordination	(8) Management	(9) Protection
(10) Conservation	(11) Rehabilitation	(12) Research
(13) Monitoring	(14) Development	(15) Occupation/Income Generation
(16) Education	(17) Publications	(18) Training/Capacity Building
(19) Networking	(20) Awareness Raising	(21) Database/Information

Table 14 "Who is doing what ?" in prioritised wetland types in the Mekong River Basin of Thailand.

Wetland Types	Rivers, streams	Floodplain grasslands	Floodplain marshes, swamps	Flooded forests	Lakes, ponds	Marshes, swamps	Ricefields
Relevant organizations							
Ministry of Natural Resources and Environment							
Department of Water Resources • Conservation, rehabilitation, development, management, planning, coordination, networking	3	3	3	3	3	3	3
Department of National Parks, Wildlife and Plants • Protection, conservation, rehabilitation, research, management, management planning, monitoring	3		3	3	3	3	
Office of Natural Resources and Environmental Policy and Planning • Coordination, policy formulation, inventory, management planning, management, protection, conservation, rehabilitation, database/information, publications, education, awareness raising, networking	3	3	3	3	3	3	
Department of Environmental Quality Promotion • Education, training/capacity building, awareness raising, coordination, networking, publications, database/information	3	3	3	3	3	3	3
Pollution Control Department • Protection, monitoring, database/information	3				3	3	
Regional Environmental Office • Database/information, coordination	3	3	3	3	3	3	3
Provincial Natural Resources and Environment Offices • Database/information, coordination, management, protection, conservation, rehabilitation, monitoring	3	3	3	3	3	3	3
Ministry of Agriculture and Cooperatives							
Department of Fisheries • Protection, conservation, rehabilitation,	3		3	3	3	3	3

survey, research, monitoring, management, management planning, occupation & income generation, development							
Royal Forest Department • Protection, conservation, rehabilitation, management, survey, research, monitoring, networking	3			3			3
Royal Irrigation Department • Survey, management, development	3				3		3
Department of Land Development • Survey, classification, inventory, mapping, publications, management planning, research, conservation, rehabilitation, development, database/information	3	3	3	3	3	3	3
Department of Agriculture • Research, development, publications		3					3
Department of Agricultural Extension • Database/information, publications, occupation & income generation		3					3
Ministry of Interior							
Department of Lands • Management, protection, development	3	3	3	3	3	3	3
Department of Local Administration • Networking, database/information, coordination	3	3	3	3	3	3	3
Department of Town and Country Planning • Planning, management, protection, development	3	3	3	3	3	3	3
Provincial Office • Coordination, database/information	3	3	3	3	3	3	3
Tambon Administration Organizations • Planning, management, conservation, protection, occupation & income generation	3	3	3	3	3	3	3
Ministry of Transportation							
Harbour Department • Management, protection, development	3				3		
Ministry of University Affairs							
Khon Kaen University • Inventory, research, education, training & capacity building, management planning, networking, database & information, publications	3	3	3	3	3	3	3
Kasetsart University • Inventory, research, education, training & capacity building, networking, database & information, publications	3		3		3	3	3

Mahidol University • Inventory, research, education, training & capacity building, management planning, awareness raising, monitoring, networking, database & information, publications	3	3	3	3	3	3	3
Ministry of Education							
Department of Education • Education, publications	3			3	3	3	
Ministry of Tourism and Sports							
Tourism Authority of Thailand • Development, occupation & income generation	3				3	3	
NGOs							
Wetlands International – Thailand Programme • Education,training/capacity building, awareness raising, networking, database/information, publications	3				3		
Wildlife Fund Thailand • Education, training/capacity building, research, conservation, management planning,awareness raising, networking	3	3	3	3	3	3	
Bird Conservation Society of Thailand • Survey, inventory, education, training, networking, monitoring, awareness raising, database/information, publications	3	3	3	3	3	3	3
Tham Mun Project • Rehabilitation, management, research, training, coordination, networking	3	3	3	3			3
Project for Ecological Recovery (PER) • Awareness raising, conservation, rehabilitation, networking, training	3	3	3	3			
IOs							
DANCED-OEPP • Inventory, protection, conservation, management, management planning, coordination, awareness raising, networking, training/capacity building, occupation & income generation	3	3	3	3	3	3	
UNDP/GEF/IUCN • Conservation, rehabilitation, capacity building, management planning, awareness raising, networking, publications	3	3	3	3			
ICLARM-AIT/MRC • Survey, research, capacity building, management, conservation	3	3	3	3			

12.3 Wetland sites assessment and prioritization

Important wetland sites in the Lower Mekong River Basin of Thailand have been listed earlier in Table 4 based on the results of wetland inventories of 3 major reference sources (Scott, 1989; Wolstencroft et al., 1993; and OEPP, 2002). Table 4 also presents details on provincial locations, geographic coordinates, extents, and types of those 39 important wetland sites.

The 39 important wetland sites can be grouped according to their types, significant level, management status, and the national priority (the Cabinet Resolution August 1, 2000).

Table 15 classifies 39 important wetland sites within the Mekong River basin of Thailand into :

3 Major wetland types
(1) Rivers, streams, riverine pools, rapids, flooded forests and floodplains
(2) Lakes, ponds and reservoirs
(3) Marshes and swamps

2 Significant levels
(1) International
(2) National

8 Management status categories
(1) Ramsar Site
(2) National Park
(3) Wildlife Sanctuary
(4) Wildlife Non-Hunting Area
(5) Provincial Freshwater Fishery Station (PFFS)
(6) Aquatic Flora and Fauna Conservation Area (AFFCA)
(7) Environmentally Protected Area (EPA)
(8) No management status

3 National priority categories
(1) Wetlands of priority for protection
(2) Wetlands of priority for rehabilitation
(3) Wetlands of priority for more detailed inventory

Threats to 39 important wetland sites are presented in Table 16.

Significant characteristics of 39 important wetland sites, including biodiversity, resource use values, and threats are described in Table 17.

For the purpose of monitoring changes of wetland / aquatic ecosystems and people's livelihood within the Mekong River basin of Thailand, important sites can be assessed according to the following criteria and given scores :

(1) Significance Level

Score	International	= 4
	National	= 2

(2) Management Status

Score	For each category	= 2

(3) National Priority

Score	For each category	= 2

(4) Degree of threats

Score	Low (1-5)	= 1
	Moderate (6-10)	= 3
	High (11-15)	= 5

(5) Users Dependence : Number of inhabitants and/or wetland resource users (if adequate data/information are available)

It should be noted that the criteria (5) is very important for monitoring changes in socio-economic values of wetlands and people's livelihood. However, knowledge gap exists. Data and information on this aspect is still inadequate and not always recorded or reported in available references.

Table 18 presents the wetland sites assessment.

Table 15 Wetland types and important wetland sites : significance level, management status and national priority.

Wetland Types & Sites	Significance Level	Management Status	National Priority
Rivers, streams, riverine pools, rapids, flooded forests, floodplains			
• Chiang Saen Basin including Nong Bong Khai Wildlife Non-Hunting Area	International	Wildlife Non-Hunting Area / **Ramsar site**	
• Lam Dome Yai and wetlands of Pa Yot Dome Wildlife Sanctuary	International	Wildlife Sanctuary	**For more detailed inventory**
• Wetlands of Phu Khieo Wildlife Sanctuary	International	Wildlife Sanctuary	**For more detailed inventory**
• Mekong River	International		
• Songkhram River and flooded forests	International		
• Lam Plai Mat	International		
• Mun River alongside Kaeng Tana National Park	National	National Park	
• Mun River and flooded forests	National		
• Confluence of the Mun and Chi Rivers	National		
• Kok River	National		
• Lower Nam Mong Basin	National		
• Lam Nam Chi			
Lakes, ponds, reservoirs			
• Bung Khong Long Wildlife Non-Hunting Area	International	Wildlife Non-Hunting Area / **Ramsar site**	
• Bung Lahan	International	PFFS	**For protection**
• Nong Han Kumphawapi	International		**For protection**
• Huai Chorakhe Mak Reservoir Wildlife Non-Hunting Area	International	Wildlife Non-Hunting Area	
• Huai Talat Reservoir Wildlife Non-Hunting Area	International	Wildlife Non-Hunting Area	
• Sanambin Reservoir Wildlife Non-Hunting Area	International	Wildlife Non-Hunting Area	
• Nong Han	International	PFFS / AFFCA	
• Kwan Phayao	International	PFFS / AFFCA	**For rehabilitation**
• Nong Luang	National		

• Bung Klua / Bo Kae	National		
• Kaeng La Wa	National		
• Huai Sua Ten	National		
• Goot Ting Reservoir			
• Nong Din Dam			
• Nong Bua Ban Khwao			
• Nong Tahan			
• Nong Khai Lake			
• Nong Gah Sark/Nong Lahan Key Nok			
• Nong Bung Rawee			
Marshes, swamps			
• Nong Leng Sai	International		**For protection & rehabilitation**
• Nong Hua Khu Wildlife Non-Hunting Area	National	Wildlife Non-Hunting Area	**For rehabilitation**
• Nong Waeng Wildlife Non-Hunting Area	National	Wildlife Non-Hunting Area	**For rehabilitation**
• Nong Kom Ko	National		**For rehabilitation**
• Doon Lam Pan Wildlife Non-Hunting Area	National	Wildlife Non-Hunting Area / EPA	
• Nong Hang	National		**For protection & rehabilitation**
• Nong Pla Koon	National		
• Nong Sam Muen	National		

Table 16 Threats to important wetland sites.

	Names of Sites	THREATS															
		Encroachment, modification	Modified hydrological regimes	Development projects	Sedimentation, erosion	Pollution of all forms	Illegal hunting, harvesting	Over-exploitation of resources	Invasion of alien species	Excessive growth of aquatic plants	Water allocation	Salinity	Tourism	Deforestation, illegal logging	Management issues	Others (fire, sand mining)	TOTAL
1	Chiang Saen Basin including Nong Bong Khai Wildlife Non-Hunting Area	υ		υ	υ		υ	υ	υ						υ	υ	8
2	Nong Luang	υ	υ	υ	υ		υ		υ	υ	υ		υ		υ	υ	11
3	Nong Hang	υ	υ	υ	υ	υ	υ		υ				υ				8
4	Nong Leng Sai	υ	υ	υ		υ	υ						υ		υ		7
5	Kwan Phayao		υ	υ		υ				υ							4
6	Kok River	υ	υ		υ					υ			υ	υ		υ	7
7	Bung Khong Long Wildlife Non-Hunting Area	υ		υ	υ	υ	υ	υ		υ				υ		υ	9
8	Lower Nam Mong Basin	υ	υ	υ	υ	υ											5
9	Nong Hua Khu Wildlife Non-Hunting Area	υ		υ													2
10	Nong Han Kumphawapi	υ	υ	υ	υ	υ	υ						υ			υ	8
11	Nong Han	υ	υ	υ		υ	υ	υ					υ				7
12	Nong Waeng Wildlife Non-Hunting Area		υ	υ		υ				υ	υ	υ	υ				7
13	Bung Lahan	υ	υ	υ		υ	υ	υ		υ		υ	υ				9
14	Mun River and flooded forests	υ	υ	υ	υ	υ					υ		υ	υ	υ		9
15	Mun River alongside Kaeng Tana National Park		υ	υ				υ					υ	υ			5
16	Lam Nam Chi	υ	υ				υ										3
17	Confluence of the Mun & Chi Rivers	υ	υ	υ	υ	υ										υ	6
18	Lam Plai Mat	υ			υ		υ	υ	υ					υ			6

	Names of Sites	THREATS														
		Encroachment, modification	Modified hydrological regimes	Development projects	Sedimentation, erosion	Pollution of all forms	Illegal hunting, harvesting	Over-exploitation of resources	Invasion of alien species	Excessive growth of aquatic plants	Water allocation	Salinity	Tourism	Deforestation, illegal logging	Management issues	Others (fire, sand mining)	TOTAL
19	Huai Chorakhe Mak Reservoir Wildlife Non-Hunting Area						υ				υ						2
20	Huai Talat Reservoir Wildlife Non-Hunting Area						υ				υ						2
21	Sanambin Reservoir Wildlife Non-Hunting Area	υ					υ	υ							υ		4
22	Lam Dome Yai and Pa Yot Dome Wildlife Sanctuary	υ					υ				υ		υ			υ	5
23	Goot Ting Reservoir		υ													υ	2
24	Nong Kom Ko	υ	υ						υ		υ						4
25	Nong Din Dam		υ			υ					υ						3
26	Nong Bua Ban Khwao		υ							υ	υ						3
27	Nong Tahan		υ														1
28	Nong Khai Lake	υ						υ									2
29	Nong Gah Sark / Lahan Key Nok						υ	υ			υ						3
30	Nong Bung Rawee		υ				υ	υ									3
31	Wetlands of Phu Khieo Wildlife Sanctuary	υ					υ							υ			3
32	Mekong River		υ	υ													2
33	Songkhram River and flooded forests	υ		υ	υ			υ						υ			5
34	Doon Lam Pan Wildlife Non-Hunting Area	υ	υ	υ								υ	υ				5
35	Nong Pla Koon	υ	υ	υ	υ		υ			υ			υ				7
36	Bung Klua/Bo Kae	υ				υ	υ			υ	υ		υ				6

37	Nong Sam Muen	∪	∪		∪					∪	∪		∪				6
38	Kaeng La Wa	∪	∪			∪					∪		∪				5
39	Huai Sua Ten		∪	∪		∪				∪	∪		∪				6

Table 17 Significant characteristics of important wetland sites.

Rivers, streams, riverine pools, rapids, flooded forests, floodplains

- **Chiang Saen Basin including Nong Bong Khai Wildlife Non-Hunting Area**
  - Biodiversity : >34 plants; >121 birds; >25 fish; >3 mammals; >4 reptiles; >27 insects
  - Important bird species : Purple Heron *Ardea purpurea,* Black Stork *Ciconia nigra,* Spot-billed Duck *Anas poecilorhyncha,* Black Kite *Milvus migrans,* Baer's Pochard *Aythya baeri,* Great Cormorant *Phalacrocorax carbo,* Black-throated Robin, Great Eared Nightjar *Eurostopodus macrotis*
  - Important fish species : Badis *Badis badis,* Siamese Fighting Fish *Betta splendens*
  - Resource Use Values : water supply; fisheries (average income 100-200 baht/fisherman/day); agriculture; bird-watching; recreation
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, S
  - Transboundary significance : 3
  - Threats : sedimentation; encroachment; tourism; development; fire; over-fishing; invasion of exotic species
- **Lam Dome Yai and wetlands of Pa Yot Dome Wildlife Sanctuary**
  - Biodiversity : >188 birds; >36 fish;
  - Important bird species : White-winged duck *Cairina scutulata,* Lesser Adjutant *Leptoptilos javanicus,* Siamese Fireback *Lophura diardi,* Green Peafowl *Pavo muticus*
  - Important fish species : Featherback *Notopterus notopterus,* Barb *Barbodes gonionotus,* Smith's Barb *Puntioplites proctozysron,* Striped Snake-head *Channa striata*
  - Resource Use Values : agriculture; charcoal production; forest resources; tourism; water supply
  - Resource users : >18,000 visitors/year
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C
  - Transboundary significance : 3
  - Threats : encroachment; modified hydrological regimes; sand mining; tourism development; illegal hunting, water allocation
- **Wetlands of Phu Khieo Wildlife Sanctuary**
  - Biodiversity : >223 birds; >26 fish; >28 reptiles; >57 mammals
  - Important bird species : White-winged Duck *Cairina scutulata,* Spot-billed Pelican, Pale-capped Pigeon, White-rumped Falcon *Polihierex insignis,* Grey-sided Thursh, Masked Finfoot, Green Peafowl *Pavo muticus,* Siamese Fireback *Lophura diardi*
  - Important fish species : Walking catfish *Clarias bratrachus,* Siamese Fighting Fish *Betta splendens*
  - Resource Use Values : recreation; tourism; education; wildlife resources
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : 3
  - Threats : encroachment; deforestation; illegal hunting/harvesting; logging
- **Mekong River**
  - Biodiversity : >289 fish
  - Important bird species : Blyth's Kingfisher *Alcedo hercules,* Crested Kingfisher *Megaceryle*

lugubris, Great Thick-knee *Esacus recurvirostris*, Long-billed Plover *Charadrius placidus*, River Lapwing *Vanellus duvaucelii*, River Tern *Sterna aurantia*, Black-billed Tern *Sterna acuticauda*, Great Cormorant *Phalacrocorax carbo*, Black Stork *Ciconia nigra*, Jerdon's Buschchat *Saxicola jerdoni*, Plain Martin *Riparia paludicola*, Wire-tailed Swallow *Hirundo smithii*

- Important fish species : Mekong Giant Catfish *Pangasianodon gigas*, Blanc's Striped Featherback *Notopterus blanci*, Giant Carp *Catlocarpio siamensis*, Minnow *Albulichthys albuloides*, River Barb *Cyclocheilichthys heteronema*, Dwarf Botia *Botia sidthimunki*, *Boraras micros*, Siamese Tiger Fish *Coius undecimradiatus*
- Resource Use Values : fisheries; water supply; transportation; tourism
- Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, R, S
- Transboundary significance : 3
- Threats : modified hydrological regimes; development; water allocation; blasting and dredging of riverine rapids.

- **Songkhram River and flooded forests**
  - Biodiversity : >183 fish
  - Important fish species : Ray *Dasyatis laosensis*, Blanc's Striped Featherback *Notopterus blanci*, Siamese Giant Carp *Catlocarprio siamensis*, Golden Price Carp *Probarbus labeaminor*, Great Black Sheatfish *Wallago leerii*, Walking catfish *Clarias bratrachus*
  - Resource Use Values : fisheries; transportation; water supply; wildlife, forage, agricultural, forest, flora, medicinal resources
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : C, R
  - Transboundary significance : 3
  - Threats : encroachment; erosion; sedimentation; development; modified hydrological regimes; over-fishing

- **Lam Plai Mat**
  - Biodiversity : >16 plants; >5 birds; >37 fish
  - Important bird species : Comb Duck *Sarkidiornis melanotos*, Yellow-breasted Bunting *Emberiza aureola*, Wood Sandpiper *Tringa glareola*, Pintail Snipe *Gallinago stenura*, Richard's Pipit *Anthus novaeseelandiae*
  - Important fish species : Walking catfish *Clarias bratrachus*
  - Resource Use Values : water supply; agriculture; fisheries
  - Number of inhabitants : >8 villages
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : C
  - Transboundary significance : 3
  - Threats : encroachment; illegal logging; erosion; sedimentation; over-fishing; illegal wildlife hunting/harvesting

- **Mun River alongside Kaeng Tana National Park**
  - Biodiversity : >49 birds
  - Resource Use Values : forage, wildlife, flora, forest resources; fisheries; recreation, tourism
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C
  - Transboundary significance : -
  - Threats : over-fishing; development projects; modified hydrological regimes

- **Mun River and flooded forests**
  - Biodiversity : >100 plants; >109 fish
  - Important fish species : Golden Price Carp *Probarbus labeamajor*, Chao Phraya Giant Catfish *Pangasius santiwangsei*, Walking catfish *Clarias bratrachus*, Mud Carp *Henicorhynchus siamensis*
  - Resource Use Values : fisheries; forest, wildlife, flora, forage, medicinal resources; water supply; agriculture; recreation; tourism; energy supply

- Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C
- Transboundary significance : -
- Threats : modified hydrological regimes; sedimentation; water pollution; over-fishing; encroachment; deforestation; management issues; development projects

- **Confluence of the Mun and Chi Rivers**
  - Biodiversity : >14 plants; >3 birds; >39 fish
  - Important bird species : Brahminy Kite *Haliastur indus*, Wire-tailed Swallow *Hirundo smithii*
  - Important fish species : Featherback *Notopterus notopterus*, Eye-spot Barb *Hampala dispar*, Mud Carp *Henicorhynchus siamensis*
  - Resource Use Values : transportation; water supply; agriculture; fisheries
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, R, S
  - Transboundary significance : -
  - Threats : banks erosion; development projects; encroachment; water pollution; management issues

- **Kok River**
  - Biodiversity : > 8 fish
  - Important fish species : Walking catfish *Clarias bratrachus*
  - Resource Use Values : tourism (an income of 1,500 baht/rafting trip of 2 tourists); transportation; gravel collecting (500-1,000 baht/boat); fisheries; water supply
  - Resource users : >100-120 long boats; >20-30 gravel collecting boats
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : C
  - Transboundary significance : 3
  - Threats : tourism development; encroachment; deforestation; sand pumping; modified hydrological regimes; banks erosion, sedimentation

- **Lower Nam Mong Basin**
  - Biodiversity : >7 plants; >4 birds; >47 fish
  - Important fish species : Walking catfish *Clarias bratrachus*, Featherback *Notopterus notopterus*, Mud Carp *Henicorhynchus siamensis*
  - Resource Use Values : agriculture (100,000 baht/household/year); tourism (>100 visitirs/day)
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, R, S
  - Transboundary significance : -
  - Threats : dredging; population growth; banks erosion; deforestation; development; modified hydrological regimes; water pollution

- **Lam Nam Chi**
  - Biodiversity : >4 plants; >19 birds
  - Resource Use Values : water supply; fisheries; wildlife, flora resources
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values :
  - Transboundary significance : -
  - Threats : encroachment; over-exploitation of resources; illegal hunting

Lakes, ponds, reservoirs

- **Bung Khong Long Wildlife Non-Hunting Area**
  - Biodiversity : >24 plants; >67 birds; >61 fish; >6 amphibians; >10 reptiles; >2 mammals
  - Important bird species : Lesser Whistling-Duck *Dendrocygna javanica*, Intermediate Egret *Egretta intermedia*, Little Egret *Egretta garzetta*, Baer's Pochard *Aythya baeri*, Ferruginous Pochard *Aythya nyroca*.
  - Important fish species : Walking Catfish *Clarias batrachus*, Eye-spot Barb *Hampala dispar*, Soldier River Barb *Cyclocheilichthys enolops*, Mud Carp *Henicorhynchus siamensis*, Striped

Snake-head *Channa striata*
- Resource Use Values : fisheries; bird-watching; recreation; water supply; agriculture, cultural activities
- Resource users : >160 households; >18 villages
- Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C
- Transboundary significance : 3
- Threats : over-fishing; illegal hunting/harvesting/logging; water pollution; excessive growth of aquatic plants; sedimentation; encroachment; destructive fishing practice

- **Bung Lahan**
  - Biodiversity : >12 plants; >56 birds; >25 fish
  - Important bird species : Great thick-knee *Esacus recurvirostris,* Grey Heron *Ardea cinerea,* Purple Heron *Ardea purpurea,* River Lapwing *Vanellus duvaucelii*
  - Important fish species : Walking Catfish *Clarias batrachus,* Featherback *Notopterus notopterus,* Eye-spot Barb *Hampala dispar,* Barb *Puntius gonionotus,* Mud Carp *Henicorhynchus siamensis,* Striped Snake-head *Channa striata*
  - Resource Use Values : fisheries (20,350 baht/household/year); water supply; agriculture; livestock raising; forest, flora resources; recreation
  - Resource users : 4,035 households; >20 villages
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, R, S
  - Transboundary significance : 3
  - Threats : water pollution; insecticides discharge; salinity; development projects; tourism development; over-fishing; illegal hunting

- **Nong Han Kumphawapi**
  - Biodiversity : >15 plants; >74 birds; >39 fish
  - Important bird species : Baer's Pochard *Aythya baeri,* Black Kite *Milvus migrans,* Cotton Pygmy-goose *Nettapus coromandelianus,* Brahminy Kite *Haliastur indus*
  - Important fish species : Siamese Fighting Fish *Betta splendens,* Walking Catfish *Clarias batrachus,* Featherback *Notopterus notopterus,* Striped Snake-head *Channa striata,* Soldier River Barb *Cyclocheilichthys enolops*
  - Resource Use Values : water supply; fisheries; flora, wildlife resources; tourism
  - Number of inhabitants : >30 villages
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C
  - Transboundary significance : 3
  - Threats : modified hydrological regimes; dredging; tourism development; water pollution; sedimentation

- **Huai Chorakhe Mak Reservoir Wildlife Non-Hunting Area**
  - Biodiversity : >7 plants; >11 birds; >18 fish
  - Important bird species : Baer's Pochard *Aythya baeri,* Purple Heron *Ardea purpurea*
  - Important fish species : Transverse-bar Barb *Hampala macrolepidota,* Soldier River Barb *Cyclocheilichthys enolops,* Rohu *Labeo rohita,* Mud Carp *Henicorhynchus siamensis*
  - Resource Use Values : fisheries; water supply
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : 3
  - Threats : illegal fishing

- **Huai Talat Reservoir Wildlife Non-Hunting Area**
  - Biodiversity : >9 plants; >30 birds; >18 fish
  - Important bird species : Purple Heron *Ardea purpurea,* Eastern Marsh Harrier *Circus spilonotus,* Pied Harrier *Circus melanoleucos,* Pacific Golden Plover *Pluvialis fulva*
  - Important fish species : Red-tailed Rasbora *Rasbora borapetensis,* Rohu *Labeo rohita,* Barb *Puntius gonionotus,* Three-spot Gourami *Trichogaster trichopterus,* Featherback *Notopterus*

notopterus, Striped Snake-head *Channa striata*, Eye-spot Barb *Hampala dispar*
- Resource Use Values : water supply for agriculture, livestock; flora, wildlife resources; fisheries
- Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
- Transboundary significance : 3
- Threats : illegal fishing; water pollution

- **Sanambin Reservoir Wildlife Non-Hunting Area**
  - Biodiversity : >9 plants; >23 birds; >14 fish
  - Important bird species : Baer's Pochard *Aythya baeri*, White-winged Duck *Cairina scutulata*, Grey Heron *Ardea cinerea*, Purple Heron *Ardea purpurea*, Comb Duck *Sarkidiornis melanotos*, Black Kite *Milvus migrans*
  - Important fish species : Walking Catfish *Clarias batrachus*, Red-tailed Rasbora *Rasbora borapetensis*, Eye-spot Barb *Hampala dispar*, Barb *Puntius gonionotus*, Hasselt's Bony-lipped Barb *Osteocheilus hasselti*, Striped Snake-head *Channa striata*
  - Resource Use Values : tourism; bird-watching; water supply
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : C
  - Transboundary significance : 3
  - Threats : encroachment; over-fishing

- **Nong Han**
  - Biodiversity : >42 plants; >32 birds; >31 fish
  - Important bird species : Baer's Pochard *Aythya baeri*, Black Kite *Milvus migrans*, Brahminy Kite *Haliastur indus*, Lesser Whistling Duck *Dendrocygna javanica*
  - Important fish species : Walking Catfish *Clarias batrachus*, Siamese Fighting Fish *Betta splendens*, Featherback *Notopterus notopterus*, Eye-spot Barb *Hampala dispar*, River Barb *Cyclocheilicthys repasson*, Barb *Puntius gonionotus*, Striped Snake-head *Channa striata*
  - Resource Use Values : fisheries (average net annual income 11,200 baht/household); agriculture; livestock raising; tourism; water supply
  - Resource users : >11,700 fishermen
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C
  - Transboundary significance : 3
  - Threats : development projects; water pollution; encroachment; detrimental tourism; illegal hunting/fishing

- **Kwan Phayao**
  - Biodiversity : >14 plants; >14 birds; >47 fish
  - Important bird species : Barn Swallow *Hirundo rustica*
  - Important fish species : Walking Catfish *Clarias batrachus*, Climbing Perch *Anabas testudineus*, Yellow Mystus *Hemibagrus nemurus*, Striped Snake-head *Channa striata*, Barb *Barbodes gonionotus*, Spotted Featherback *Chitala ornata*, Featherback *Notopterus notopterus*
  - Resource Use Values : water supply; agriculture; fisheries (1,000 fishermen, average income 300-2,000 baht/fisherman/day); flood protection; recreation
  - Number of inhabitants : 16,964 households
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C
  - Transboundary significance : 3
  - Threats : development projects; excavation; modified hydrological regimes; aquatic plant control; over-fishing

- **Nong Luang**
  - Biodiversity : >14 plants; >4 birds; >25 fish
  - Important bird species : Lesser Whistling Duck *Dendrocygna javanica*
  - Important fish species : Walking Catfish *Clarias batrachus*
  - Resource Use Values : water supply; flood protection; agriculture; fisheries (average income 150-200 baht/fisherman/day, average income of 20,000 baht/year)

- Number of inhabitants : >4,800 households
- Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, S
- Transboundary significance :
- Threats : development projects; modified hydrological regimes; sedimentation; invasion of exotic species *Mimosa pigra*, water allocation, encroachment, illegal fishing, no clear benchmark and responsible organization dealing with threats

- **Bung Klua / Bo Kae**
  - Biodiversity : >10 plants; >28 birds; >54 fish
  - Important bird species : Brahminy Kite *Haliastur indus*, Lesser Whistling Duck *Dendrocygna javanica*
  - Importanr fish species : Great Black Sheatfish *Wallagonia sp.*, Walking Catfish *Clarias batrachus*, Featherback *Notopterus notopterus*, Freshwater Herring *Clupeichthys aesarnensis*, Barb *Puntius gonionotus*, Mud Carp *Henicorhynchus siamensis*, Hasselt's Bony-lipped Barb *Osteocheilus hasselti*, Striped Snake-head *Channa striata*, Spotted Spiny Eel *Macrognathus siamensis*
  - Resource Use Values : water supply; recreation; agriculture; flora resources
  - Number of Inhabitants : >5 villages
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : C
  - Transboundary significance : -
  - Threats : excessive growth of aquatic plants; shallowing water; land disputes; encroachment; water pollution; destructive fishing methods; illegal hunting
- **Kaeng La Wa**
  - Biodiversity : >13 plants; >36 birds; >43 fish
  - Important bird species : Brahminy Kite *Haliastur indus*, Lesser Whistling Duck *Dendrocygna javanica*
  - Importanr fish species : Walking Catfish *Clarias batrachus*, Great Black Sheatfish *Wallagonia sp.*, Mud Carp *Henicorhynchus siamensis*, Hasselt's Bony-lipped Barb *Osteocheilus hasselti*, Mystus *Mystus mysticetus*, Striped Snake-head *Channa striata*
  - Resource Use Values : fisheries; agriculture; recreation; tourism; average total income generated from Kaeng La Wa is >15,000 baht/household/year
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : C, R, S
  - Transboundary significance : -
  - Threats : modified hydrological regimes; water pollution; tourism development; encroachment; development projects
- **Huai Sua Ten**
  - Biodiversity : >8 plants; >35 birds; >24 fish
  - Important bird species : Grey Heron *Ardea cinerea*, Black Kite *Milvus migrans*, Yellow Bittern *Ixobrychus sinensis*, Streaked Weaver *Ploceus manyar*, Brahminy Kite *Haliastur indus*, Cotton Pygmy-goose *Nettapus coromandelianus*, Cinnamon Bittern *Ixobrychus cinnamomeus*
  - Important fish species : Featherback *Notopterus notopterus*, Carp *Hampala dispar*, Soldier River Barb *Cyclochcilichthys enoplos*, Mud Carp *Henicorhynchus siamensis*, Sleeping Goby *Oxyeleotris marmorata*
  - Resource Use Values : water supply; agriculture; fisheries
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : C, R, S
  - Transboundary significance : -
  - Threats : excessive growth of aquatic plants; water pollution; water allocation; development projects; dredging; modified hydrological regimes; tourism development
- **Goot Ting Reservoir**
  - Biodiversity : >6 plants; >6 birds
  - Important bird species : Baer's Pochard *Aythya baeri*

- Resource Use Values : water supply; fisheries; agriculture; livestock grazing; wildlife resources
- Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
- Transboundary significance : -
- Threats : modified hydrological regimes

- **Nong Din Dam**
  - Biodiversity : >5 plants; >15 birds
  - Resource Use Values : water supply; agriculture; recreation
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : -
  - Threats : water pollution

- **Nong Bua Ban Khwao**
  - Biodiversity : >5 plants
  - Resource Use Values : water supply; wildlife resources (invertebrates e.g. the mollusc *Pila polita* are collected by local women); livestock grazing; recreation
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : -
  - Threats :

- **Nong Tahan**
  - Biodiversity : >5 plants; >2 birds
  - Resource Use Values : sports fields, parade grounds
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : -
  - Threats :

- **Nong Khai Lake**
  - Biodiversity : >2 birds
  - Resource Use Values : fisheries; wildlife resources; water supply; livestock grazing
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : -
  - Threats : intense human use

- **Nong Gah Sark/Nong Lahan Key Nok**
  - Biodiversity : >6 plants; >17 birds
  - Resource Use Values : water supply; agriculture; wildlife, flora resources; fisheries
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : -
  - Threats : intense human use

- **Nong Bung Rawee**
  - Biodiversity : >3 plants; >6 birds
  - Resource Use Values : fisheries; water supply; agriculture; poultry raising; livestock grazing; kenaf soaking
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : -
  - Threats : intense human use; shallowing water

Marshes, swamps

- **Nong Leng Sai**
  - Biodiversity : >29 plants; >56 birds; >24 fish
  - Important bird species : Purple Heron *Ardea purpurea*, Grey Heron *Ardea cinerea*, White Cotton Pygmy-goose *Nettapus coromandelianus*, Watercock *Gallicrex cinerea*

- Important fish species : Walking Catfish *Clarias batrachus*, Barb *Barbodes gonionotus*, Yellow Mystus *Hemibagrus nemurus*, Spiny Eel *Mastacembelus armatus*, Spring Eel *Macrognathus aculeatus*, Catfish *Wallago attu*
- Resource Use Values : water supply (600 cu.m./day); agriculture; livestock production; fisheries (average income 100-200 baht/fisherman/day); recreation; bird-watching
- Number of inhabitants : 2,179 households
- Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H
- Transboundary significance : 3
- Threats : tourism development; dredging; modified hydrological regimes; destructive fishing methods; siltation; no control/organized pattern of land use; encroachment; development projects; agricultural chemicals

- **Nong Hua Khu Wildlife Non-Hunting Area**
  - Biodiversity : >9 plants; >6 birds; >28 fish
  - Important bird species : Baer's Pochard *Aythya baeri*, Lesser Whistling Duck *Dendrocygna javanica*, Common Moorhen *Gallinula chloropus*
  - Important fish species : Siamese Fighting Fish *Betta splendens*, Walking Catfish *Clarias batrachus*, Barb *Puntius gonionotus*, Common Carp *Cyprinus carpio*, Climbing Perch *Anabas testudineus*
  - Resource Use Values : water supply; agriculture; fisheries; recreation; kenaf soaking
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C
  - Transboundary significance : -
  - Threats : encroachment; water pollution; road construction; development projects
- **Nong Waeng Wildlife Non-Hunting Area**
  - Biodiversity : >8 plants; >50 birds; >5 fish
  - Important bird species : Baer's Pochard *Aythya baeri*, Purple Heron *Ardea purpurea*, Little Egret *Egretta garzetta*, Brahminy Kite *Haliastur indus*, Cotton Pygmy-goose *Nettapus coromandelianus*, Lesser Whistling Duck *Dendrocygna javanica*, Common Moorhen *Gallinula chloropus*, Garganey *Anas querquedula*
  - Important fish species : Walking Catfish *Clarias batrachus*
  - Resource Use Values : recreation; tourism; water supply
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, S
  - Transboundary significance : -
  - Threats : modified hydrological regimes; water pollution; salinity; eutrophication
- **Nong Kom Ko**
  - Biodiversity : >10 plants; >20 birds; >27 fish
  - Important bird species : Little Grebe *Tachybaptus ruficollis*, Cinnamon Bittern *Ixobrychus cinnamomeus*, Lesser Whistling Duck *Dendrocygna javanica*
  - Important fish species : Mud Carp *Henicorhynchus siamensis*, Eye-spot Barb *Hampala dispar*, Rohu *Labeo rohita*, Striped Tiger Nandid *Pristolepis fasciata*
  - Resource Use Values : water supply; agriculture; livestock grazing; fisheries; lotus cultivation
  - Number of inhabitants : >9 villages
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : -
  - Threats : shallowing water; invasion of alien species (golden apple snails); encroachment; water allocation
- **Doon Lam Pan Wildlife Non-Hunting Area**
  - Biodiversity : >50 plants; >81 birds; >9 fish; Panda Crab *Phricotelphusa sirindhorn*
  - Important bird species : Chinese Pond-Heron *Ardeola bacchus*, Cattle Egret *Bubulcus ibis*, Lesser Whistling Duck *Dendrocygna javanica*
  - Resource Use Values : fisheries; wildlife, flora resources; water supply; agriculture; education

- Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, R, S
- Transboundary significance : -
- Threats : inappropriate wetland development projects; tourism development; salinity; encroachment

- **Nong Hang**
  - Biodiversity : >4 plants; >16 fish
  - Important fish species : Walking Catfish *Clarias batrachus*
  - Resource Use Values : fisheries (100-200 fishermen/day, average income 200-500 baht/fisherman/day, average total catch 500-1,000 kg/day); water supply; agriculture (average annual income of 20,000 baht/head); wildlife resources
  - Number of inhabitants : 2,557 households
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : -
  - Transboundary significance : -
  - Threats : illegal fishing methods; bird-hunting; encroachment; modified hydrological regimes; invasion of exotic species *Mimosa pigra*

- **Nong Pla Koon**
  - Biodiversity : >12 plants; >15 birds; >51 fish
  - Important bird species : Chinese Pond-Heron *Ardeola bacchus*, Lesser Whistling Duck *Dendrocygna javanica*, Black-shouldered Kite *Elanus caeruleus*
  - Important fish species : Featherback *Notopterus notopterus*, Eye-spot Barb *Hampala dispar*, Mud Carp *Henicorhynchus siamensis*, Hasselt's Bony-lipped Barb *Osteochelus hasselti*, Yellow Mystus *Mystus nemurus*, Striped Tiger Nandid *Pristolepis fasciata*
  - Resource Use Values : water supply; agriculture; livestock raising; fisheries; flood protection; recreation; wildlife resources
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : C, R, S
  - Transboundary significance : -
  - Threats : modified hydrological regimes; dredging; excessive growth of aquatic plants; siltation; encroachment; illegal hunting

- **Nong Sam Muen**
  - Biodiversity : >5 plants; >31 birds; >22 fish
  - Important bird species : Grey Heron *Ardea cinerea*, Cinnamon Bittern *Ixobrychus cinnamomeus* Lesser Whistling Duck *Dendrocygna javanica*
  - Important fish species : Featherback *Notopterus notopterus*, Barb *Puntius gonionotus*, Striped Snake-head *Channa striata*
  - Resource Use Values : water supply; fisheries; agriculture; recreation
  - Historical (H), Cultural (C), Religious (R), Spiritual (S) values : H, C, R, S
  - Transboundary significance : -
  - Threats : encroachment; eutrophication; siltation; excessive growth of aquatic plants; dredging; tourism development; water allocation

Table 18 Wetland Sites Assessment.

Wetland Types & Sites	Significance Level	Management Status	National priority	Degree of threats	TOTAL	Users dependence
Rivers, streams, riverine pools, rapids, flooded forests, floodplains						
• Chiang Saen Basin including Nong Bong Khai Wildlife Non-Hunting Area	4	4		3	**11**	
• Lam Dome Yai and wetlands of Pa Yot Dome Wildlife Sanctuary	4	2	2	1	**9**	>18,000 visitors/year
• Wetlands of Phu Khieo Wildlife Sanctuary	4	2	2	1	**9**	
• Mekong River	4			1	**5**	
• Songkhram River and flooded forests	4			1	**5**	
• Lam Plai Mat	4			3	**7**	>8 villages
• Mun River alongside Kaeng Tana National Park	2	2		1	**5**	
• Mun River and flooded forests	2			3	**5**	
• Confluence of the Mun and Chi Rivers	2			3	**5**	
• Kok River	2			3	**5**	>100-120 long boaters, >20-30 gravel collectors
• Lower Nam Mong Basin	2			1	**3**	>100 visitors/day
• Lam Nam Chi				1	**1**	
Lakes, ponds, reservoirs						
• Bung Khong Long Wildlife Non-Hunting Area	4	4		3	**11**	>160 households
• Bung Lahan	4	2	2	3	**11**	>4,035 households
• Nong Han Kumphawapi	4		2	3	**9**	>30 villages
• Huai Chorakhe Mak Reservoir Wildlife Non-Hunting Area	4	2		1	**7**	
• Huai Talat Reservoir Wildlife Non-Hunting Area	4	2		1	**7**	
• Sanambin Reservoir Wildlife Non-Hunting Area	4	2		1	**7**	

• Nong Han	4	4		3	**11**	>11,700 fishermen >900,000 water users
• Kwan Phayao	4	4	2	1	**11**	>16,964 households
• Nong Luang	2			5	**7**	>4,800 households
• Bung Klua / Bo Kae	2			3	**5**	>5 villages
• Kaeng La Wa	2			1	**3**	
• Huai Sua Ten	2			3	**5**	
• Goot Ting Reservoir				1	**1**	
• Nong Din Dam				1	**1**	
• Nong Bua Ban Khwao				1	**1**	
• Nong Tahan				1	**1**	
• Nong Khai Lake				1	**1**	
• Nong Gah Sark/Nong Lahan Key Nok				1	**1**	
• Nong Bung Rawee				1	**1**	
Marshes, swamps						
• Nong Leng Sai	4		4	3	**11**	>2,179 households
• Nong Hua Khu Wildlife Non-Hunting Area	2	2	2	1	**7**	
• Nong Waeng Wildlife Non-Hunting Area	2	2	2	3	**9**	
• Nong Kom Ko	2		2	1	**5**	>9 villages
• Doon Lam Pan Wildlife Non-Hunting Area	2	4		1	**7**	
• Nong Hang	2		4	3	**9**	>2,557 households
• Nong Pla Koon	2			3	**5**	
• Nong Sam Muen	2			3	**5**	

Proposed important wetland sites for further detailed inventory :

Riverine type

Priority

- Lam Plai Mat (Buriram)
- Mekong River
  Songkhram River and flooded forests
  (Udorn Thani, Sakhon Nakhon, Nong Khai, Nakhon Phanom)
  Mun River and flooded forests
  Confluence of the Mun and Chi Rivers
  Kok River

Lacustrine (lakes, ponds, reservoirs) type

Priority

- Nong Han Kumphawapi (Udorn Thani)
- Bung Lahan (Chaiyaphum)
  Nong Han (Sakhon Nakhon)
  Kwan Phayao (Phayao)

Palustrine (marshes, swamps) type

Priority

ℵ Nong Leng Sai (Phayao)
ℑ Nong Hang (Chiang Rai)
ℜ Nong Kom Ko (Nong Khai)
Nong Pla Koon (Roi Et)
Nong Sam Muen (Chaiyaphum)

Results of the rapid appraisal revealed that among 35 experts and stakeholders who were asked to indicate priority wetland sites for further detailed inventory, the Mun, Songkhram, Mekong, and Chi Rivers were the top 4 priorities (37%, 31%, 23% and 20% respectively) for riverine wetland type. Bung Lahan, Nong Han Kumphawapi and Nong Han Sakhonnakhon were the first priority (26%) and Bung Khong Long was the second priority (20%) for lacustrine type. No sites were dominant for palustrine type.

12.4 Issues to be considered

12.4.1 Issues to be considered from The Workshop of Mangroves, Swamps & Wetlands Management Division (6-7 August 2001)

Piriyayota (n.d.) reported that Dr Plodprasop Surassawadi, the former Director-General of the Royal Forest Department, the present Secretary-General of Ministry of Natural Resources and Environment, presided over the Workshop held by Mangroves, Swamps and Wetlands Management Division, Forest Research Office, on 6-7 August 2001, and suggested 4 issues to be considered as follows :

(1) research on wetland ecosystem characteristics, functions and biodiversity;
(2) wetland quantitative values to people and communities;
(3) roles, authority and mandates of RFD in wetlands management; and
(4) systematic and holistic wetland research.

Results from brainstorming session also suggested that, for the Northeast, more research on wetlands of the Mun, Chi, Songkhram river basins and riverine flooded forests should be carried out.

12.4.2 Issues to be considered from the review and compilation

For each important wetland type, the following issues are recommended to be considered for further detailed inventory :

- Basin-based or sub basin-based wetland inventory
- Classification of wetland sizes and proportion of the basin (%)
- More detail on geomorphic setting and landform
- Water regime, hydroperiod and groundwater
- Degree of importance of wetland ecological functions to the Mekong River Basin or sub-basins

- Wetland ecosystems analysis, wetland dynamics, potential impacts and adaptation to climatic and hydrological changes as well as anthropological changes, consequences to local livelihood and economy
- Socio-economic values of wetland resources, list of wetland goods and services and their relative importance, economic valuation
- Demographic characteristics and trend of change, number of inhabitants, number of wetland resource users and degree of dependence
- Wetland resource use patterns and activities
- More detail on threats analysis, proximate drivers, relative importance
- Monitoring programmes and indicators
- Participatory management strategies
- Identification of wise use activities and criteria
- Alternatives for occupation and income generation

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Annex 1 : Terms of Reference for the National Wetland Expert for Classification and Inventory of Wetland/Aquatic Ecosystem. (Missing)

Annex 2 : List of contacted persons.

Name	Title	Organisation	Date
Mr Wanchai Chandrachai	Policy and Plan Analyst	Land Use Planning Division, Department of Land Development, Ministry of Agriculture and Cooperatives	October 2002
Mr Somsak Piriyayota	Forest Officer 8	Division of Mangrove Swamps and Wetland Management, Forest Research Office, Royal Forest Department, Ministry of Agriculture and Cooperatives	October 2002
Ms Sifa La-Ong	Forest Officer	Wildlife Research Division, Royal Forest Department, Ministry of Agriculture and Cooperatives	October 2002
Mr Jira Jintanugool	Director	Forest Management and Economic Research Division, Royal Forest Department, Ministry of Agriculture and Cooperatives	October 2002
Mr Samrit Pothiwat	Fisheries Officer	Fishery Resource Conservation Division, Department of Fisheries, Ministry of Agriculture and Cooperatives	October 2002
Dr Sirikul Bunpapong, Ms Nirawan Pipitsombat, Ms Nuchjarin Klaewkla	Chief of Biological Resource Section, Wetland National Focal Point	Biological Resource Section , Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment	October 2002
Ms Supawan Wongprayoon		Environmental Information Center, Department of Environmental Quality Promotion, Ministry of Science, Technology and Environment	October 2002
Ms Samang Homchuen	Assistant Professor	Department of Environmental Science, Faculty of Science, Khon Kaen University	October 2002
Mr Philip Round		Faculty of Science, Mahidol University	October 2002
Mr Uthai Treesukhon		Bird Conservation Society of Thailand	October 2002
Ms Pornpana Kuaycharoen		Project for Ecological Recovery (PER)	October 2002
Mr Hannarong Yaowalert	Assistant to Academic and Conservation Policy Unit	Wildlife Fund Thailand Under the Royal Patronage of Her Majesty the Queen	October 2002
Mr Asae Sayaka	Programme Coordinator	Wetlands International – Thailand Programme	November 2002
Mr John Parr	Director	World Wildlife Fund - Thailand	December 2002

Annex 3 : List of visited websites.

Khon Kaen University
http://rdi.kku.ac.th/journal/journal1_45/
Department of Environmental Quality Promotion (DEQP)
http://www.deqp.go.th
Office of Environmental Policy and Planning (OEPP)
http://www.oepp.go.th
Pollution Control Department (PCD)
http://www.pcd.go.th
Land Development Department (LDD)
http://www.ldd.go.th
Department of Fisheries (DoF)
http://fisheries.go.th
Royal Forest Department (RFD)
http://www.forest.go.th
Royal Irrigation Department (RID)
http://www.rid.go.th
Department of Local Administration (DoLA)
http://www.dola.go.th
Natural Resources and Biodiversity Institute (NAREBI), MoAC
http://www.narebi.or.th
Tourism Authority of Thailand (TAT)
http://www.tat.or.th
Electricity Generating Authority of Thailand (EGAT)
http://www.egat.or.th
Green World Foundation (GWF)
http://www.greenworld.or.th
Thailand Environment Institute
http://www.tei.or.th
Seub Nakhasathien Foundation
http://www.seub.or.th
Bird Conservation Society of Thailand (BCST)
http://www.bcst.org
Wildlife Fund Thailand – Under Royal Patronage of H.M.Queen
http://www.levantenet.com/wildlifefund/

http://www.terraper.org
http://www.bdmthai.com
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http://www.irn.org
http://www.rwesa.org
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http://www.watershedthai.org
http://www.probeinternational.org
http://wwwarc.murdoch.edu.au/wp/wp71.rtf
http://www.adb.org
http://www.mekonginfo.org
http://www.usyd.edu.au
http://www.sciencedirect.com
http://www.google.com
http://www.nextcity.com
http://www.mekong-protected-areas.org

UNDP
http://www.undp.or.th
UNEP
http://www.eapap.unep.org/sef-gms/lib-sef-gms-.htm
UNEP-ROAP
http://www.roap.unep.org
FAO
http://www.fao.org
Danish Cooperation for Environment and Development (DANCED)
http://www.mst.dk/danced-uk/
Japan International Cooperation Agency (JICA)
http://www.jicathai.or.th
The World Bank
http://www.worldbank.or.th
WWF-Asia Pacific
http://www.panda.org
Wetlands International (WI)
http://www.wetlands.org
ICLARM – The World Fish Center
http://www.iclarm.org

http://www.hatfieldgroup.com/feature/mek.htm

Annex 4 : List of experts and stakeholders contributed to the rapid appraisal. (January 31, 2003)

Name	Position	Office
Mr Manu Omakupt	Wetlands Expert	-
Mr Wanchai Chandrachai	Senior Policy and Plan Analyst	Soil Survey and Land Use Planning Bureau, Department of Land Development
Dr Sirikul Bunpapong	Environment Technical Officer, Chief of Biological Resources Section	Office of Natural Resources and Environmental Policy & Planning
Ms Sita Pholphoke	Environment Technical Officer	Biological Resources Section, Office of Natural Resources and Environmental Policy & Planning
Ms Pairanee Suksumek	Research Project Analyst	Biological Resources Section, Office of Natural Resources and Environmental Policy & Planning
Ms Siriwan Sa-Nguansap	Project Officer	Biological Resources Section, Office of Natural Resources and Environmental Policy & Planning
Ms Nutcharin Klaewkla	Project Officer	Biological Resources Section, Office of Natural Resources and Environmental Policy & Planning
Mr Rangsimant Buathong	Biodiversity Database Officer	Biological Resources Section, Office of Natural Resources and Environmental Policy & Planning
Ms Kalayarat Ratanachitr	Project Analyst	Biological Resources Section, Office of Natural Resources and Environmental Policy & Planning
Ms Chomphunut Songkhao	Project Analyst	Biological Resources Section, Office of Natural Resources and Environmental Policy & Planning
Ms Woranat Srithatthong	Project Analyst	Biological Resources Section, Office of Natural Resources and Environmental Policy & Planning
Ms Warinthorn Manosittisak	Environmental Officer	Office of Natural Resources and Environmental Policy & Planning
Mr Thaisak Thammakul	Environmental Officer	Office of Natural Resources and Environmental Policy & Planning
Mr Jira Jintanugool	Director	Forestry Management Development and Economic Research Division, Department of National Parks, Wildlife and Plants
Mr Pipop Chantanawaranggoon	Forestry Administration	National Parks Bureau,

	Officer	Department of National Parks, Wildlife and Plants
Ms Thiranat Muengham	Environmental Officer	Department of Environmental Quality Promotion
Mr Somsak Eng-Chuan	Administration Officer	Department of Local Administration
Mr Somboon Sonprapa	Head of Provincial Office	Nakhon Phanom Provincial Office
Mr Veerayuth	Analyst	Provincial Office
Mr Soranapong Buaroay	Agriculture Officer	Provincial Agriculture Office
Mr Kanit Waewwasit	Technical Officer	Botanical Gardens Organization
Mr Thanakhom Banditwongrat	Technical Officer	National Science Museum Organization
Mr Veera Vilasri	Technical Officer	National Science Museum Organization
Dr Sittipong Dilokwanich	Assistant Professor	Faculty of Environment and Resource Studies, Mahidol University
Mr Narong Veeravaitaya	Lecturer	Faculty of Fisheries, Kasetsart University
Ms Ruamruedee Panchan	Research Project Officer	Faculty of Fisheries, Kasetsart University
Ms Sukjai Sompongphan	Lecturer	Surin Rajabhat Institute
Ms Nantawan Prapamonthon	Lecturer	Chaiyaphum Rajabhat Institute
Mr Uthai Treesukhon	Technical Committee Member	Bird Conservation Society of Thailand
Mr Hannarong Yaowalert	Deputy Secretary	Wildlife Fund Thailand
Mr Edward G Tupacz	Project Manager	Wildlife Fund Thailand
Mr Supparerk Chanprasat	Wetlands Programme Assistant	IUCN-The World Conservation Union
Mr Rattapol Pitaktepsombat	Watershed Coordinator	IUCN-The World Conservation Union
Mr Asae Sayaka	Director	Wetlands International-Thailand Programme

Annex 5 : List of participants at the national meeting on inventory of wetland/aquatic ecosystems in Thailand (March 25, 2003).

Name	Position	Office
Mr Surachai Sasisuwan	Director-General	Department of Water Resources
Mr Anussorn Bunyaratapan	Director, Bureau of International Cooperation	Department of Water Resources
Ms Pakawan Chufamanee	Director, Mekong Affairs Division	Department of Water Resources
Mr San Kemprasit	Director, Water Resources Office Region 3 (Mekong Basin)	Department of Water Resources
Dr Sansanee Choowaew	National Wetlands Expert	Faculty of Environment and Resource Studies, Mahidol University
Dr Charoenwitt Hankaew	Technical Committee Member	Bird Conservation Society of Thailand
Mr Surapon Duangkae	Secretary General	Wildlife Fund Thailand
Mr Edward G Tupacz	Wetlands Coordinator	Wildlife Fund Thailand
Mr Asae Sayaka	Director	Wetlands International – Thailand Programme
Ms Piyathip Eawpanich	Thailand Programme Officer	IUCN – The World Conservation Union
Mr Narong Veeravaithaya	Head, Fisheries Biology Department	Faculty of Fisheries, Kasetsart University
Ms Samang Homchuen	Assistant Professor	Department of Environmental Science, Faculty of Science, Khon Kaen University
Mr Wanchai Chandrachai	Senior Policy and Plan Analyst	Soil Survey and Land Use Planning Office, Department of Land Development
Mr Phaitoon Buddhasri	Senior Policy and Plan Analyst	Soil Survey and Land Use Planning Office, Department of Land Development
Mr Pipop Chantanawarangoon	Forestry Administration Officer	National Parks Bureau, Department of National Parks, Wildlife and Plants
Dr Suchart Ingthamjitr	Fisheries Biologist	Inland Fisheries Resources Research and Development Institute, Department of Fisheries
Mr Chor Pongrungsup	Senior Forest Officer	Royal Forest Department
Mr Niwat Chankul	Environmentalist	Royal Irrigation Department
Mr Nirundorn Ritmontree	Head, Provincial Natural Resources & Environment Office	Nong Khai Provincial Natural Resources & Environment Office

Mr Pradit Wilailaksn	Head, Provincial Natural Resources & Environment Office	Udorn Thani Provincial Natural Resources & Environment Office
Mr Sawat Thanatka	Head, Provincial Natural Resources & Environment Office	Chaiyaphum Provincial Natural Resources & Environment Office
Mr Phuyot Chotikanatis	Head, Provincial Natural Resources & Environment Office	Sakon Nakhon Provincial Natural Resources & Environment Office
Mr Niran Surasawadi	Head, Provincial Natural Resources & Environment Office	Ubon Ratchathani Provincial Natural Resources & Environment Office
Mr Sompong Kanchanachinda	Head, Provincial Natural Resources & Environment Office	Buriram Provincial Natural Resources & Environment Office
Mr Manoon Bangpoophamorn	Head, Provincial Natural Resources & Environment Office	Nakhon Phanom Provincial Natural Resources & Environment Office
Ms Nirawan Pipitsombat	Senior Environmental Officer	Office of Natural Resources and Environmental Policy & Planning
Ms Pimon Jiravithayaboon	Environmental Scientist	Pollution Control Department
Ms Cheeranan Pantachak	Environmentalist	Department of Environmental Quality Promotion
Ms Orapan Payakkaporn	Senior Policy and Plan Analyst / Environment Programme Coordinator	Bureau of International Cooperation, Department of Water Resources
Ms Ruamporn Ngamboriruk	Policy and Plan Analyst	Bureau of International Cooperation, Department of Water Resources
Ms Thitima Phuavong	Assistant Environment Programme Coordinator	Bureau of International Cooperation, Department of Water Resources
Mr Hans Guttman	Environment Programme Coordinator	Environment Division, Mekong River Commission Secretariat
Mr Bountieng	JRP	Environment Division, Mekong River Commission Secretariat

Annex 6 : Wetland classification system of the Lower Mekong Basin. (Missing)