

Managing and Classifying Wetlands in the Mekong River Delta

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Introduction

The Mekong Delta encompasses eleven provinces in the southernmost part of Viet Nam. The total area is about 3.9 million hectares, or 12% of the total area of the country; including areas of marine water, the depth of which at low tide does not exceed six meters. The Delta includes numerous wetlands types such as marine and coastal intertidal mudflats, the estuaries of river mouths, inland floodplains and freshwater lacustrines or palustrines. Wetlands not only provide various types of foodstuff but also play an important role in conserving biodiversity and maintaining environmental balance. They create buffer zones between land and ocean, accumulate fertile silt from the Mekong River, reduce erosion and buffer against harmful effects of typhoons and other forces in the coastal zone, and provide habitats for aquatic organisms and wildlife. For these reasons, the need to find appropriate measures for conservation and wise use of wetlands are priority tasks in establishing a development strategy in the Mekong Delta.

Classification and mapping are the initial steps in the inventory and management of wetlands. There are many wetlands classification systems available. A good system should be suitable for creating wetlands maps at various scales and should also be flexible for application to economic and technological purposes.

In 1993, the Mekong River Commission Secretariat held a meeting to discuss a classification system for the Lower Mekong River Basin. A system was developed from that meeting and applied to inventory and mapping. Some categories were revised after viewing satellite color

prints, agriculture ecology, geomorphology, flooding and land use. Wetland classification maps were established for the Mekong Delta and two study sites.

In order to link the “Inventory and Management of Wetlands in the Mekong Delta” project with national wetlands management, the classification system is being revised and refined. This report discusses how to revise the wetlands classification system in the Mekong Delta.

Wetlands Definitions in International Literature

There are about 50 definitions of wetlands in the world (Dugan 1990). Wetlands classification requires three attributes:

- (i) the transient land is suitable for most aquatic flora;
- (ii) the soil substratum is not almost dried; and
- (iii) the soil stratum is not clear saturated or inundated sometime during the growing season.

Almost all definitions consider wetlands as transitional ecological zones (ecotones), i.e. transitional areas between aquatic and dry environments. In these areas, inundated lands provide suitable environments for particular flora (Cowardin et al. 1979).

According to the Ramsar Convention (1971), wetlands are “areas of marsh fen, peatland or water, either 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” (UNESCO 1994).

The U.S National Wetlands Inventory defines wetlands as “land transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or land covered by shallow water”. Wetlands must have one or more of the following three attributes:

- at least periodically, the land supports predominantly hydrophytes;
- the substrate is predominantly undrained hydric soil; and
- the substrate is non-soil and is saturated with water or covered by shallow water at sometime during the growing season of each year.

The Canadian Wetlands Registry defines wetlands as “land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to a wet environment” (National Wetlands Working Group 1988). The New Zealand Department of Conservation defines wetlands as “a collective term for permanently or temporarily wet areas, shallow water and land margins. In Australia, wetlands are defined as “areas of marsh, fen, peatland or water, whether natural or artificial, permanent, seasonal or cyclical, with water that is static or flowing, fresh brackish or salt including mudflats and mangrove areas exposed at low tide” and also as; “an area of permanent, seasonal or intermittent inundation, whether natural or otherwise;

fresh brackish or saline, static or flowing” ; “areas of seasonally, intermittently water-logged soil or inundated land, whether natural or artificial, with water that is static or flowing , fresh brackish or saline, where inundation by water affects the type of biota present”.

Typical Wetlands Classification Systems

According to Handbook 7 of the Ramsar Handbooks for the Wise Use of Wetlands (Ramsar Convention Bureau 2000), 41 wetlands types can belong to one of three classes: Category 1: Marine/Coastal Wetlands, 11 types; Category 2: Inland Wetlands, 20 types; and Category 3: Artificial Wetlands, 10 types.

Wetlands types are based on water quality (salt, fresh), inundation levels, vegetation and landform. This is a very simple system with two levels (non-hierarchical) but it is not easy to determine wetlands boundaries on maps.

The wetlands classification system of IUCN (Fig. 5) (Dugan 1990) can be summarized as a hierarchical system of four levels as follows:

This system is more comprehensive than the Ramsar system. Information on geology (coastal, estuary) is included in Level 2. Information on hydrology

Figure 4. Wetlands classification system proposed for mapping in the Mekong Delta

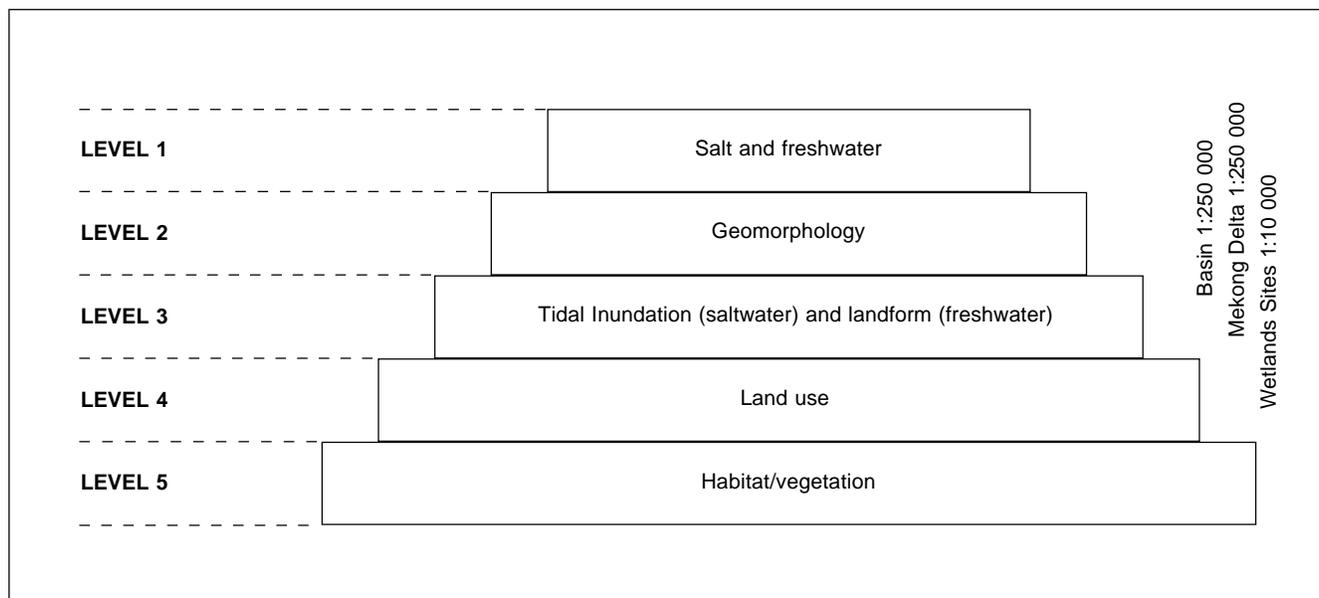


Figure 5. IUCN wetlands classification system (Dugan 1990)

LEVEL 1	Saltwater						Freshwater						Artificial						
LEVEL 2	Marine			Estuary			Lagoon	Salt pans	Rivers		Lacustrine		Palustrine		Aquaculture	Agriculture	Salt Pans	Urban/Industry	Reservoir
LEVEL 3	Tidal	Intertidal		Tidal	Intertidal					Perennial	Temporary	Permanent	Seasonal	Emergence					
LEVEL 4	Combines 39 wetlands types, identified by geomorphology, soil types, land use, vegetation etc.																		

(inundation and inundated duration) is added in Level 3. However, artificial wetlands are grouped in a single category. Applied to the Mekong River Delta, all wetlands can be brought together in this category; more or less all wetlands are artificial or impacted by human activities.

Mekong River Basin Wetlands Classification

The system proposed in 1993 by the MRCS (Fig. 6) does not classify artificial wetlands as a separate group. Instead, it is made up of five hierarchical levels.

Classifying and Mapping Wetlands in the Mekong Delta

Fundamental Principle

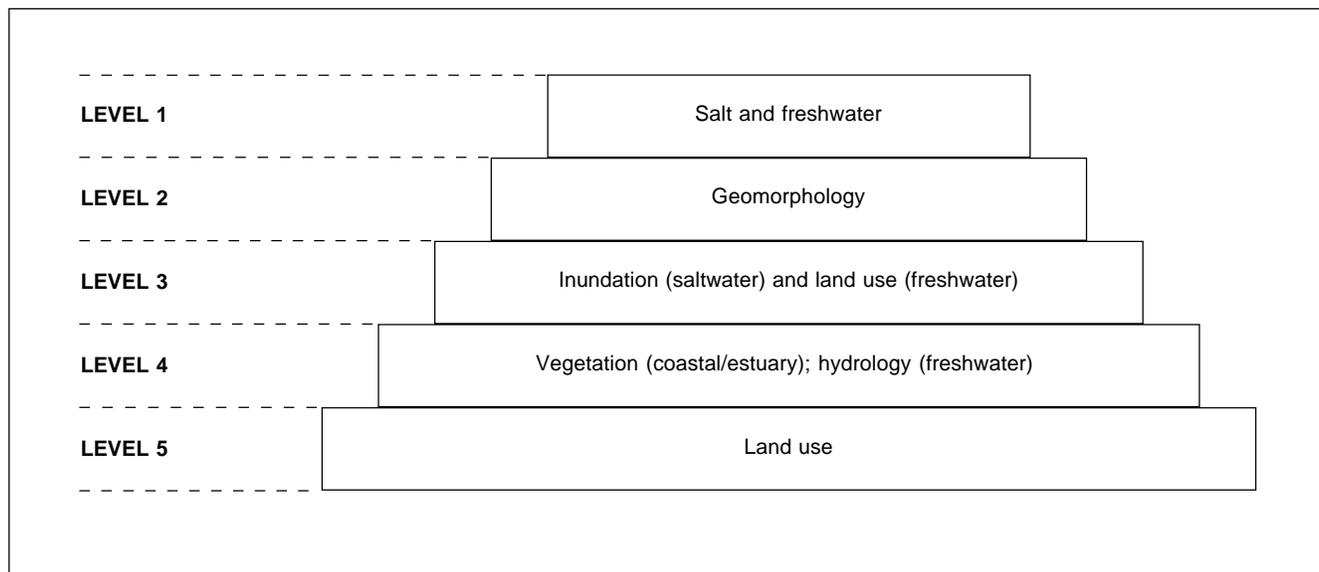
To develop the wetlands classification for the Mekong Delta, the following rules were approved by the wetlands team:

- Wetlands terminology is rooted in the Ramsar Convention. The convention recognizes the

interdependence of people and their environment and the ecological function of wetlands. Article 2.1 of the Convention states that “The boundaries of each wetland shall be precisely described and also delimited on a map and they 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, especially where these have importance as waterfowl habitat” (UNESCO 1994). In so doing, the classification must be measurable in accordance with the objectives of the Convention.

- As indicated in Article 2.2, the importance of wetlands will be defined in terms of “ecology, botany, zoology, limnology or hydrology” (UNESCO 1994). Two concepts very clearly pointed out in the Ramsar Convention are conservation and wise use. Hence, the classification of wetlands should reflect this point of view. They should not be based on sectoral aspects such as fishery, agriculture or forestry management.
- As agreed by the wetlands team, the classification system in the Mekong Delta has to reflect the Ramsar approach. The wetlands classification should not only fit international classification systems but also the national classification system. The system should be simple and easy to adapt for use in mapping at

Figure 6. MRCS wetlands classification system (MRCS 1993-1999)



various scales by satellite photo interpretation and GIS techniques.

Wetland Classification

Based on the above points and in reference to other international wetlands classification systems, the wetland classification system proposed by MRCS in 1993, and after making 3 different wetlands classification maps (scale 1:250,000 – for the whole delta – and at 1:25,000) of the Mekong Delta, the following was agreed:

- For maps using 1:250 000 scale, four hierarchical levels are used.
 - Level 1: Based on water quality (2 groups)
 1. Saltwater wetlands
 2. Freshwater wetlands
 - Level 2: Based on geomorphology (5 classes)
 1. Coastal and marine
 2. Estuarine
 3. Freshwater rivers
 4. Freshwater lacustrine
 5. Freshwater palustrine
 - Level 3: Based on geomorphology (11 sub-classes)
 1. Tidal (coastal/marine)
 2. Intertidal (coastal)
 3. Nontidal (coastal)
 4. Lagoon (coastal)
 5. Tidal (estuarine)
 6. Intertidal (estuarine)
 7. Nontidal (estuarine)

8. Non-regular inundated wetlands
9. Flood plain
10. Fresh lacustrine
11. Fresh palustrine

Level 4: Based on vegetation and land use (40 wetland types)

- For maps using 1:10 000 to 1:25 000 scale, five hierarchical levels are used
- At Level 5, sub-types are distinguished based on habitats (Fig. 4).

Mapping Materials and Methods

MATERIALS

Wetlands maps of the Mekong Delta were produced using the following information and data:

Maps of physical factors

- geomorphology and sediments of the Mekong Delta at 1:250 000 (1989)
- topographical, USA's UTM at 1:250 000
- soil map of the Mekong Delta at 1:250 000
- surface water resources at 1:250 000 (1986)
- hydrological at 1:250 000 (1984, 1994 and 1996)

Photos and maps of land use and vegetation:

- satellite photos, LANDSAT-5TM (1-3, 1998)
- current land use maps at 1:250 000 (1998) of whole Mekong Delta and 1:100 000 for each province
- vegetation at 1:250 000

METHODS

The methods involved were:

- Digitising maps of physical factors;
- Overlaying the available maps onto topographical maps to define the mega-classes and macro-classes to make the base map;
- Interpreting satellite photos and field checking land use types and comparing with historical land-use maps;
- Digitising land-use and vegetation information;
- Overlaying and matching the satellite information, land use and vegetation onto base maps and defining wetlands classes to make draft maps;
- Revising;
- Analysing and printing wetlands classification map and data.

Conclusion

By applying three international classification systems for mapping wetlands in the Mekong Delta, the Vietnamese wetlands team developed a system using four hierarchical levels. Particularly, land use was

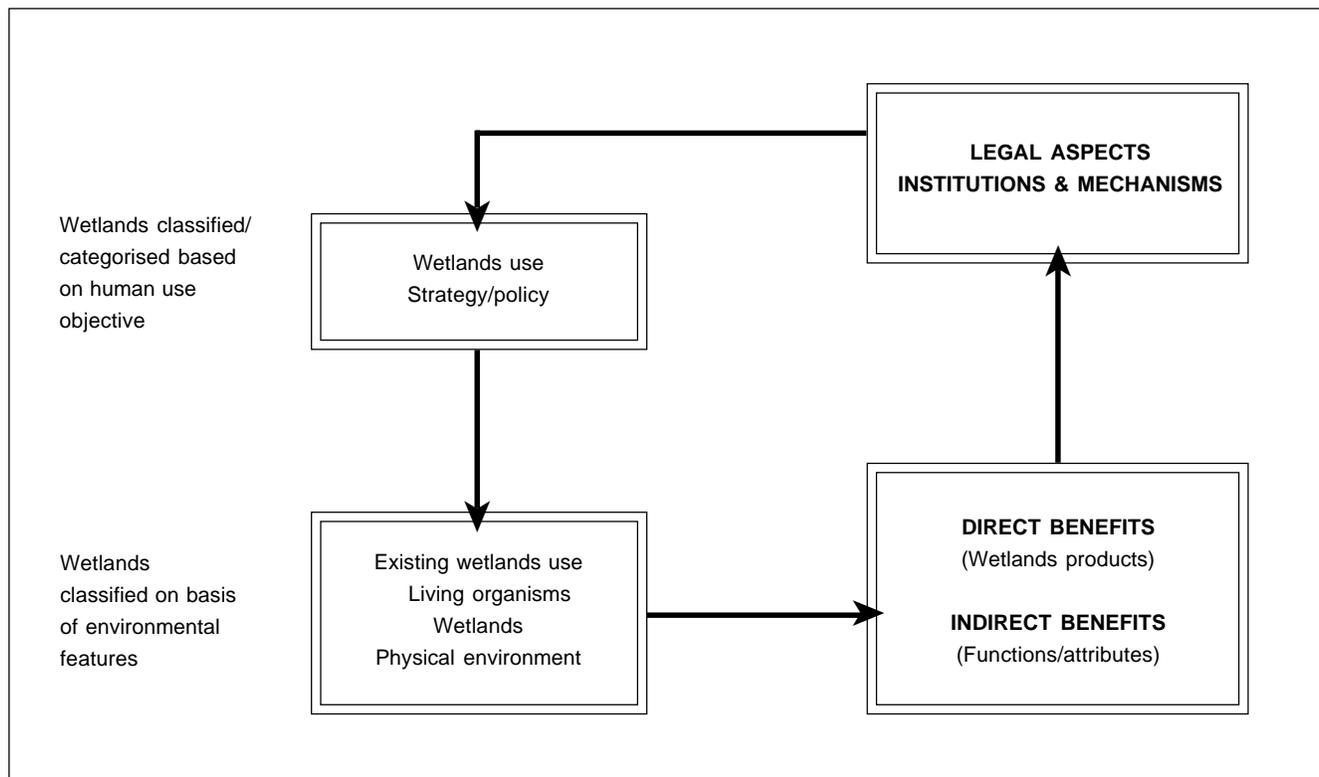
considered a factor in the classification system. The result is a detailed representation of wetland types, as shown in the map that appears on the front cover of this volume. Land use patterns clearly reflect physical characteristics of land and biological resources. This factor is easy to recognize on satellite photos.

It should be recognized that the natural (or original) wetlands have almost disappeared in the Delta. Even though some areas of *Melaleuca* forest in the inland swamps and some plots of mangrove have naturally regenerated in the new land along the coast, they are more or less disturbed by agriculture or aquaculture.

The classification system should be hierarchical and quantifiable. It should be flexible so that it can be linked to regional systems and made more detailed for smaller sites.

Wetlands classifying and mapping provides basic information for inventory and management of wetlands in the Delta. The connection between wetlands classification and other components in the management process is illustrated in Fig. 7.

Figure 7. Wetlands classification in the Mekong Delta management process



ANNEX 1

Ramsar Classification System for Wetlands Types

Marine/Coastal Wetlands

- A Permanent shallow marine water
- B. Marine sub-tidal aquaculture beds
- C. Coral reefs
- D. Rocky marine shore
- E. Sand shingle or pebble shores
- F. Estuarine waters
- G. Intertidal mud, sand or salt flats
- H. Intertidal marshes
- I. Intertidal forested wetlands
- J. Coastal brackish/saline lagoons
- K. Coastal freshwater lagoons
- K(a) Karst and other subterranean hydrological systems

Inland Wetlands

- L Permanent inland deltas
- M Permanent rivers/streams/creeks
- N Seasonal/intermittent/irregular rivers/streams/creeks
- O Permanent freshwater lakes
- P Seasonal/intermittent freshwater lakes
- Q Permanent saline /brackish alkaline lakes
- R Seasonal intermittent saline/brackish/alkaline lakes and flats
- Sp Permanent saline/brackish/alkaline marshes/pools
- Ss Seasonal/intermittent saline/brackish/alkaline marshes/pools
- Tp Permanent freshwater marshes/pools
- Ts Seasonal intermittent freshwater marshes/pools
- U Non-forested peatlands
- Va Alpine wetlands
- Vt Tundra wetlands
- W Shrub-dominated wetlands
- Xf Freshwater, tree dominated wetlands
- Xp Forested peatlands
- Y Freshwater springs, oases
- Zg Geothermal wetlands
- Zk(b) Karst and other subterranean hydrological systems, inland

Artificial Wetlands

- 1. Aquaculture ponds
- 2. Ponds
- 3. Irrigated lands
- 4. Seasonally flooded agriculture land
- 5. Salt exploitation sites

- 6. Water storage areas
- 7. Excavations
- 8. Wastewater treatment areas
- 9. Canals and drainage channels, ditches
- Zk(c) Karst and other subterranean hydrological systems

ANNEX 2

IUCN Wetlands Classification (Dugan 1990)

1. Saltwater

1.1 MARINE

- 1. Sub-tidal
 - i) Permanent unvegetated shallow waters less than 6 metres depth at low tide, including seabay, straits
 - ii) Sub-tidal aquatic vegetation, including kelp beds, sea grasses, tropical marine meadows
 - iii) Coral reefs
- 2. Intertidal
 - i) Rocky marine shores including cliffs and rocky shores
 - ii) Shores of mobile stones and shingle
 - iii) Intertidal mobile unvegetated mud, sand or salt flats
 - iv) Intertidal vegetated sediments, including salt marshes and mangrove, on sheltered coasts

1.2 ESTUARINE

- 1. Sub-tidal
 - i) Estuarine water; permanent water of estuaries and estuarine systems of deltas
- 2. Intertidal
 - i) Intertidal mud, sand or salt flats, with limited vegetation
 - ii) Intertidal marshes, including salt-marshes, salt meadow, saltings, raised salt marshes, tidal brackish and freshwater marshes
 - iii) Intertidal forested wetlands, including mangrove swamp, nipa swamp, tidal freshwater swamp forest

1.3 LAGOON

- i) Brackish to saline lagoons with one or more relatively narrow connections with the sea

1.4 SALT LAKE

- i) Permanent and seasonal, brackish, saline or alkaline lakes, flats and marshes

2. Freshwater

2.1 RIVERINE

1. Perennial
 - i) Permanent rivers and streams, including waterfalls
 - ii) Inland Delta
2. Temporary
 - i) Seasonal and irregular rivers and streams
 - ii) Riverine floodplains, including river flats, flooded river basins, seasonally flooded grasslands

2.2 LACUSTRINE

1. Permanent
 - i) Permanent freshwater lakes (>8 hectares), including shore subject to seasonal or irregular inundation
 - ii) Permanent freshwater ponds (<8 hectares)
2. Seasonal
 - i) Seasonal freshwater lakes (>8 hectares), including floodplain lakes

2.3 PALUSTRINE

1. Emergent
 - i) Permanent freshwater marshes and swamps on inorganic soils with emergent vegetation whose bases lie below the water table for at least most of the growing season
 - ii) Permanent peat-forming freshwater swamps including tropical upland valley swamps dominated by *Papyrus* or *Typha*
 - iii) Seasonal freshwater marshes on inorganic soil, including sloughs, potholes, seasonal flooded meadows, sedge marshes, and dambos
 - iv) Peatlands, including acidophilous, ombrogenous, or soligenous mires covered by moss, herb or dwarf shrub vegetation, and fens of all types
 - v) Alpine and polar peatlands, including seasonally flooded meadows, moistened by temporary water from snowmelt
 - vi) Freshwater springs and oases with surrounding vegetation
 - vii) Volcanic fumaroles continually moistened by emerging and condensing water vapour
2. Forested
 - i) Shrub swamps, including shrub-dominated fresh marsh, shrub carr and thickets
 - ii) Freshwater swamp forest including seasonally flooded forest, wooded swamp on inorganic soil
 - iii) Forested peatlands, including swamp forest

3. Artificial Wetlands

3.1 AQUACULTURE AND MARICULTURE

- i) Aquaculture ponds, including fish ponds and shrimp ponds

3.2 AGRICULTURE

- i) Ponds including farm ponds, stock ponds, small tanks
- ii) Irrigated lands and irrigation channels, including rice fields, canals and ditches
- iii) Seasonally flooded arable land

3.3 Salt Exploitation

- i) Salt pans and salines

3.4 Urban/Industrial

- i) Excavations, including gravel pits, borrow pits and mining pools
- ii) Wastewater treatment areas, including sewage farms, settling ponds and oxidation basins

3.5 Water-storage areas

- i) Reservoirs holding water for irrigation and /or human consumption with pattern of gradual, seasonal, draw down of water level
- ii) Hydro-dams with regular fluctuation in water level on weekly or monthly basis

ANNEX 3

MRC Wetlands Classification System for the Lower Mekong Basin

Salt Water	Codes
MARINE/COASTAL (M)	
Subtidal	MS
1. Non-vegetated	MSI
Natural Subtidal Bare Marine	MS1
Subtidal Mariculture	MS1m
2. Vegetated/Coral	MS2
3. Subtidal Marine Coral	MS2a
4. Subtidal Marine Seagrass	MS2b
5. Subtidal Marine Seaweed	MS2c
Natural Subtidal Marine Seaweed	MS2c
Subtidal Marine Seaweed Farm	MS2cm
Intertidal	MI
1. Non-vegetated	MI1
Natural	MI1
a) Intertidal Coastal Beach	MIa
b) Intertidal Coastal Mudflat	MIb
c) Intertidal Coastal Cliff	MIc
d) Intertidal Coastal Saltflat	MIId
Artificial	MI1m
a) Intertidal Coastal Salt Works	MI1d
b) Intertidal Coastal Aquaculture	MI1md

2.	Vegetated/Coral	MI2
	a) Intertidal Marine Coral	MI2a
	b) Intertidal Marine Seaweed	MI2b
	c) Intertidal Marine Seaweed	MI2c
	Natural Intertidal Marine Seaweed	MI2c
	Intertidal Marine Seaweed Farm	MI2cm
	d) Trees/Shrubs	MI2d
	Coastal Mangrove Swamp	MI2d
	Coastal Mangrove Plantation	MI2
	e) Forbs/Coastal Saltmarsh	MI2e
	Nontidal	MN
	Nonvegetated	
	Nontidal Mariculture	MNm
ESTUARINE		E
	Subtidal	ES
1.	Nonvegetated	ES1
	Natural Subtidal Bare Estuarine	ES1
	Subtidal Estuarine Aquaculture	ES1m
2.	Vegetated /Coral	ES2
	a) Subtidal Estuarine Coral	ES2a
	b) Subtidal Estuarine Seagrass	ES2b
	c) Subtidal Estuarine Seaweed	ES2c
	Natural Subtidal Estuarine Seaweed	ES2
	Intertidal Estuarine Seaweed Farm	ES2cm
	Intertidal	EI
1.	Nonvegetated	EI1
	Natural	EI1
	a) Intertidal Estuarine Beach	EI1a
	b) Intertidal Estuarine Cliff	EI1b
	c) Intertidal Estuarine Saltflat	EI1c
	Artificial	EI1m
	a) Intertidal Estuarine Salt Works	EI1ma
	b) Intertidal Estuarine Aquaculture	EI1mb
2.	Vegetated/Coral	EI2
	a) Intertidal Estuarine Coral	EI2a
	b) Intertidal Estuarine Seagrass	EI2b
	c) Intertidal Estuarine Seaweed	EI2c
	Natural Subtidal Estuarine Seaweed	EI2c
	Intertidal Estuarine Seaweed Farm	EI2cm
	d) Trees/Shrubs	EI2d
	Estuarine Mangrove Swamp	EI2d
	Estuarine Mangrove Plantation	EI2dm
	e) Forbs/Estuarine Saltmarsh	EI2e
	Nontidal	EN
	Nonvegetated	
	Nontidal Estuarine Aquaculture	ENm

Coastal Lagoon	ML
Inland Salt Lake	MSL

Freshwater

RIVERINE	R
River	
1. Perennial River	RR1
a) Pool in perennial river	RR1a
b) Channel in Perennial River	RR1b
Natural Channel in Perennial River	RR1c
Perennial Canal	RR1bm
c) With Perennial Rapid	RR1c
d) With Perennial Waterfall	RR1d
2. Seasonal River	RR2
a) Pool in Seasonal River	RR2a
b) Channel in Seasonal River	RR2b
Natural Channel in Seasonal River	RR2b
Seasonal Canal	RR2bm
c) With Seasonal Rapid	RR2c
d) With Seasonal Waterfall	RR2d
Riverine Banks/Beaches/Bars	RB
Riverine Floodplain	RF
1. Floodplain Grassland	RF1
Natural Floodplain Grassland	RF1
Man-Made Floodplain Grassland	RF1m
Floodplain Wet Rice	RF1ma
Other Floodplain Crops	RF1mb
2. Floodplain Trees/Shrubs	RF2
Natural Seasonally Flooded Trees/Shrubs	RF2
Man-made Seasonally Flooded Crops/Orchards	RF2m
3. Seasonal Floodplain Lake	RF3
4. Seasonal Floodplain Pond	RF4
5. Seasonal Backswamp/Marsh	RF5
Natural Seasonal Backswamp/Marsh	RF5
Man-made Seasonal Backswamp/Marsh	RF5m
Wet Rice in Seasonal Backswamp/Marsh	RF5ma

LACUSTRINE

Lake >8 ha

1. Permanent Lake
 - Natural Permanent Freshwater Lake
 - Man-Made Permanent Reservoir
2. Seasonal Lake
 - Natural Seasonal Freshwater Lake
 - Man-Made Seasonal Reservoir

Pond <8 ha

1. Permanent Pond
 - Natural Permanent Freshwater Pond
 - Man-Made Permanent Freshwater Pond
 - a) Freshwater Aquaculture Pond
 - b) Sewage Treatment Pond
 - c) Farm Pond
 - d) Cooling Pond
 - e) Borrow Pit, Excavated Pond
 - f) Others
2. Seasonal Pond
 - Natural Seasonal Freshwater Pond
 - Man-Made Seasonal Pond

L

LL
 LL1
 LL1
 LL1m
 LL2
 LL2
 LL2m
 LP1
 LP1
 LP1m
 LP1m
 LP1ma
 LP1mb
 LP1md
 LP1md
 LP1me
 LP1mf
 LP2
 LP2
 LP2m

PALUSTRINE

Permanent Palustrine

- a) Permanently Flooded Grassland
- b) Permanent Freshwater Marsh, with Trees/Shrubs

Seasonal Palustrine

- a) Seasonally Flooded Palustrine
 - Natural Seasonally Flooded Grassland
 - Man-Made Seasonally Flooded Plantation
- b) Seasonally Freshwater Marsh, with Sedges
- c) Seasonally Freshwater Swamp, with Trees/Shrubs
 - Natural Seasonally Flooded Swamp
 - Man-Made Seasonally Flooded Plantation

P

PP
 Ppa
 PPb
 PS
 PSa
 PSb
 PSam
 PSb
 PSc
 PSc
 PScm

ANNEX 4

Wetlands Classification of the Mekong Delta (At 1: 250 000)

Major system	Sub-system	Wetlands Class
MARINE/ COASTAL	Sub-tidal	1. Bare marine sub-tidal
	Intertidal	2. Coastal mudflat
		3. Coastal aquaculture
		4. Coastal mangrove plantation
		5. Coastal salt marsh
	Nontidal	6. Coastal nontidal multiple rained
7. Coastal nontidal single rained wet-rice		
8. Coastal nontidal other crops		
9. Coastal nontidal grassland		
Coastal lagoon	10. Coastal saline/brackish lagoon	
Sub-tidal	11. Coastal saline/brackish lagoon	
ESTUARINE	Intertidal	12. Bare estuarine sub-tidal
		13. Estuarine mudflat
14. Estuarine salt works		
15. Estuarine aquaculture		
16. Estuarine mangrove plantation		
17. Estuarine salt marsh		
RIVERINE	Nontidal	18. Estuarine sandy ridge
		19. Estuarine nontidal multiple rained crops
		20. Estuarine nontidal single rained wet-rice
		21. Estuarine nontidal other crops
		22. Estuarine nontidal grassland
		23. Estuarine nontidal aquaculture
RIVERINE	River	24. Perennial river and canal
	River banks/bars	25. Riverine banks and bars
	Riverine Floodplain	26. Floodplain grassland
27. Floodplain multiple irrigated wet-rice		
28. Floodplain single rained wet-rice		
29. Floodplain wet-rice rotated with upland crops		
30. Floodplain other crops		
31. Seasonally flooded <i>Melaleuca</i> plantation		
32. Seasonally flooded orchards/plantation		
LACUSTRINE	Lake	33. Permanent <i>Melaleuca</i> forest reservoir
		34. Seasonal reservoir
PALUSTRINE	Seasonal palustrine	35. Seasonal flooded grassland
		36. Seasonal flooded <i>Melaleuca</i> plantation
		37. Seasonal flooded single wet-rice
		38. Seasonal flooded multiple irrigated wet-rice
		39. Seasonal floodplain wet-rice rotated with upland crops
		40. Seasonal flooded other crops

