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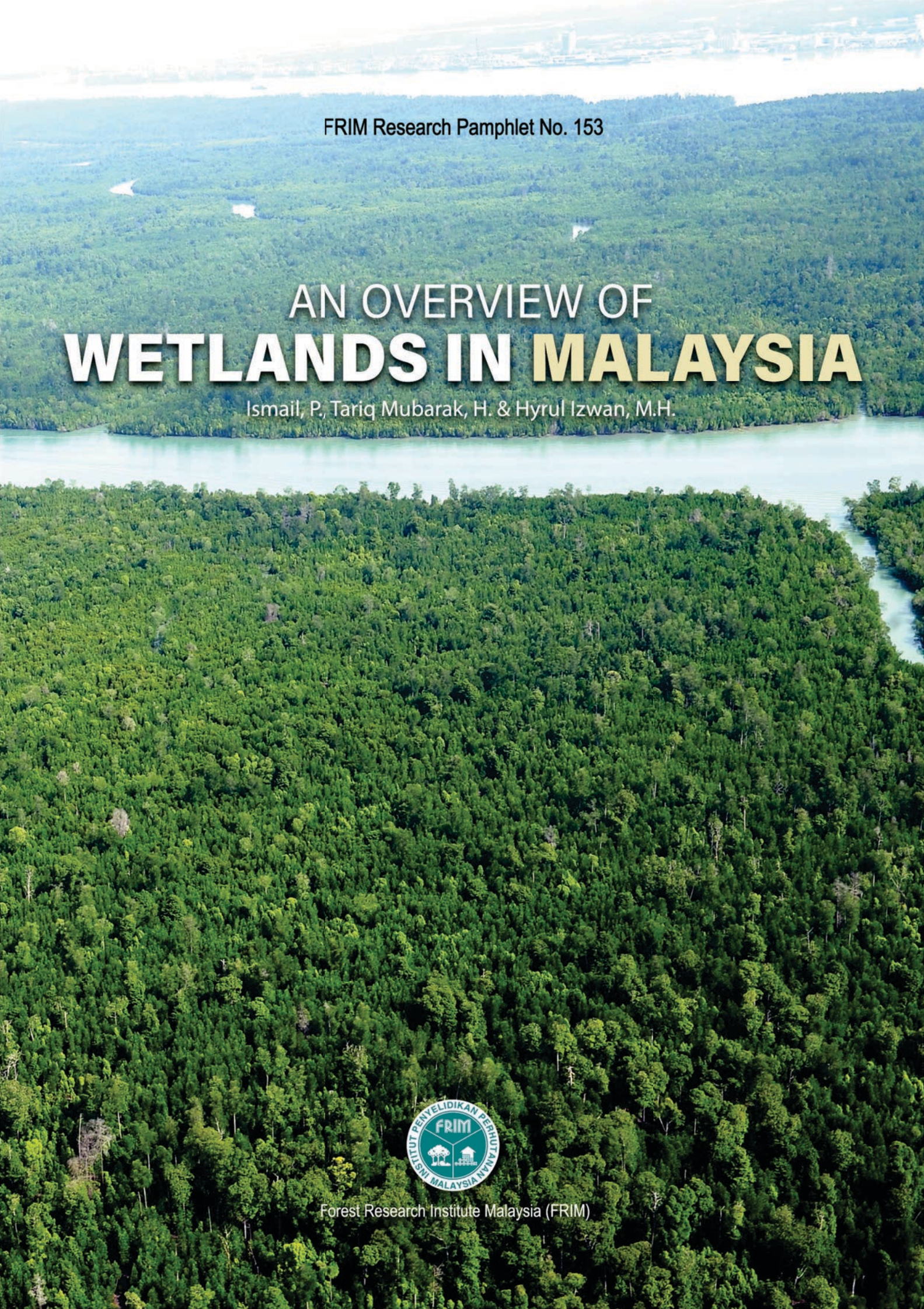
AN OVERVIEW OF WETLANDS IN MALAYSIA

Ismail, P., Tariq Mubarak, H. & Hyrul Izwan, M.H.



Forest Research Institute Malaysia (FRIM)

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ISMAIL PARLAN
TARIQ MUBARAK HUSIN
HYRUL IZWAN MOHD HUSIN

FOREST RESEARCH INSTITUTE MALAYSIA (FRIM)
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Director- General
Forest Research Institute Malaysia
52109 Kepong
Selangor Darul Ehsan
Malaysia

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Tel : +603-6279 7000
Fax : +603-6273 1314
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AN OVERVIEW OF WETLANDS IN MALAYSIA

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ACKNOWLEDGEMENTS

The Ministry of Energy and Natural Resources (KeTSA) undertook an initiative to produce the Overview of Wetlands in Malaysia, also known as Wetlands Compendium as it is important to have baseline information on our wetlands. This is to be in line with the requirement under the National Policy on Wetlands. With the assistance from Forest Research Institute Malaysia (FRIM), efforts were made to update and publish the Wetland Compendium. High appreciation goes to all respective agencies that provided useful and updated data and information to be compiled in this document.

EXECUTIVE SUMMARY

Wetland can be defined as land that is submerged or inundated by water, permanently or seasonally. The Ramsar Convention defines wetlands under Article 1.1 as areas of marsh, fen, peatland of 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 tides does not exceed six metres. Wetlands cover a small percentage of the earth's surface, yet they are essential as they are rich in nature and vital to human life. A world without wetland is like a world without water as they act as our water sources and purifiers. Wetlands as a buffer zone also protect our coastline and are crucial to agriculture and fisheries.

Natural wetlands in Malaysia cover a vast area of which only about 5.1 million ha been accounted. In addition, there are 90 major lakes and nearly 100 river systems in Malaysia. Geographically, natural wetlands cover areas of peat swamp, mangroves, rivers, lakes, and coral reefs, and they are a habitat for flora and fauna. Meanwhile, there are also man-made wetlands such as lakes and paddy fields. The paddy fields in Malaysia cover an area of about 699,980 ha.

Overall, there are 31 types of wetlands in Malaysia; natural and man-made wetlands. Nonetheless, some of the wetlands are small by land area and not covered in this document. There are 16 major types of wetlands that have been selected based on information and data availability.

Malaysia has been a Party to the Convention on Wetlands or the Ramsar Convention since 10 March 1995 and has legal obligations to conserve and use its wetlands wisely. The Convention requires the country to at least protect those wetlands of significance as Ramsar Sites and manage them in accordance with the standards set. The federal government has a constitutional responsibility to coordinate the efforts of all states within the country to conserve the wetlands and to fulfil its obligations under Ramsar Convention. At present, Malaysia have seven designated wetland sites for Ramsar, mainly mangrove areas, covering an area of 134, 182 ha.

At the national level, it is recognised that Malaysia has already put in place a policy direction in regard to the use of its natural resources. Nonetheless, the National Wetlands Policy has been developed in recognition of the need to harmonise with all relevant existing policies and to ensure wetlands are managed in accordance with the principles of sustainable development.

INTRODUCTION

Wetlands refer to areas where water is the primary factor controlling the environment and the associated plant and animal life. They occur where the water table is at or near the land surface, or where the land is covered by shallow water. The Ramsar Convention takes a broad approach in determining the wetlands which come under its aegis. Under the text of the convention (Article 1.1), 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".*

In addition, for the purpose of protecting coherent sites, the Article 2.1 provides that wetlands to be included in the Ramsar List of internationally important wetlands:

> "*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*"

The classification system of wetland type is based on the Ramsar Convention as in **Annex I**. Five major wetland types are generally recognised as follows:

i. Marine (coastal wetlands including coastal lagoons, rocky shores, and coral reefs);
ii. Estuarine (including deltas, tidal marshes, and mangrove swamps);
iii. Lacustrine (wetland associated with lake);
iv. Riverine (wetlands along rivers and streams); and
v. Palustrine (marshes, swamps, and bogs).

Table 1 and **Figure 1** show the extensive area of natural wetlands in Malaysia. Mangroves, river systems, tropical peat swamp forests, and nipa swamps constitute the main wetlands ecosystem found in Malaysia which is located along the coastline. Mangroves occur primarily in the state of Perak, Selangor, and Johor in Peninsular Malaysia, along the east coast of Sabah and in northern and south-western Sarawak with acreage of about 630,000 ha.

Intertidal mud and sand flats are extremely important wetland habitats in Malaysia. They fringe the majority of Malaysia's coastlines, and may in certain places be several kilometres wide at low tide. Mudflats that are associated with major mangrove forest support the very rich benthic fauna and represent the richest feeding grounds for migratory shorebirds and resident water birds such as herons, egrets, and storks, e.g. Matang Mangroves in Perak and Rajang Delta in Sarawak.

Freshwater swamp forest occurs on permanently or seasonally flooded soils with over 35% mineral content, normally in zone along the lower reaches of certain rivers. They also occur

around freshwater system such as Tasek Bera. Nipa swamp is tidal, monospecific stand of the palm *Nypa fruticans*. Nipa mainly occurs in Sabah and Sarawak.

Peat swamp forest reaches its optimal stage of development in Malaysia, and in Sarawak in particular, where the formation and structure of peat swamp forest has been well studied. Some 1.54 million ha remain in Malaysia, of which 72% is in Sarawak, about 20% in the Peninsular Malaysia (mainly in South-eastern Pahang, Johor, and Selangor) and the remaining 8% occurs in Sabah.

Few natural lakes occur in Malaysia, the lake system of Tasek Bera and Tasek Chini in Pahang and Loagan Bunut in Sarawak being a major example. Lakes provide an important fishery resource for local inhabitants. Tasek Bera was designated Malaysia's first Ramsar site in 1994 and Tasek Chini was designated as Malaysia's first Man and Biosphere (MAB) site in 2009. Oxbow lakes occur mainly in Sabah and Sarawak along the meandering lower reaches of major rivers such as the Baram and Limbang in Sarawak and the Kinabatangan, Sugut, and Segama in Sabah. There are nearly 100 river systems in Malaysia, the largest being the Rajang in Sarawak. Among others, there are Sungai Pahang, Kinabatangan, and Baram.

In Malaysia, wetland areas have been set aside for conservation and protection under a number of different laws, depending on which legislation is used; there will be differences in the level of protection achieved and the agency responsible for its management. Some relevant acts are the Environment Quality Act 1974, National Forestry Act 1984 (Amended 1993), Fishery Act 1985, National Parks Act 1980, and National Land code 1965. Sabah and Sarawak have their own state legislation for the establishment of parks and reserves such as Forest Enactment 1968 and Forest Ordinance 2015 (Cap. 71). Current list of acts and ordinances related to wetlands as in **Annex II**.

Table 1. Estimated total natural wetland area in Malaysia by state and wetland type (excluding lakes, oxbow lakes, river systems and coral reefs)

State/Wetland Types	Mangroves	Mudflats	Freshwater Swamp	Peat Swamp Forest	Marshes	Nipa Swamp	Melaleuca Swamp	Sandy Beaches	Rocky Shores	Total (ha)
Kedah	7,725	1,483	0	0	n.a	n.a	n.a	181	195	**7,920**
Kelantan	422	n.a	0	0	11,020	1,020	6,350	n.a	n.a	**23,482**
Johor	26,818	16,586	11,900	13,000	n.a	n.a	415	285	33	**59,412**
Melaka	1,241	1,012	0	0	600	n.a	626	381	1	**4,635**
Negeri Sembilan	1,557	301	0	0	n.a	n.a	217	816	48	**2.722**
Pahang	3,759	1,777	330,890	200,000	20,350	n.a	n.a	n.a	n.a	**504,360**
Perak	44,990	7,797	1,967	0	1,967	n.a	n.a	734	87	**153,542**
Perlis	49	n.a	0	0	n.a	n.a	n.a	343	12	**404**
Pulau Pinang	1,967	4,189	0	0	n.a	n.a	n.a	390	58	**6,704**
Sabah	378,195	n.a	152,702	120,000	721,216	758,770	n.a	n.a	n.a	**2,075,883**
Sarawak	139,890	n.a	28,907	1,120,000	n.a	869,700	n.a	n.a	n.a	**2,178,497**
Selangor	20,853	20,806	0	76,000	n.a	n.a	521	4767	n.a	**122,560**
Terengganu	1,571	n.a	10,433	13,000	n.a	24,100	14,748	n.a	n.a	**78,964**
Total	**629,037**	**53,951**	**536,799**	**1,542,000**	**755,153**	**1,653,590**	**22,877**	**7,897**	**434**	**5,201,738**

Note: n.a = data not available

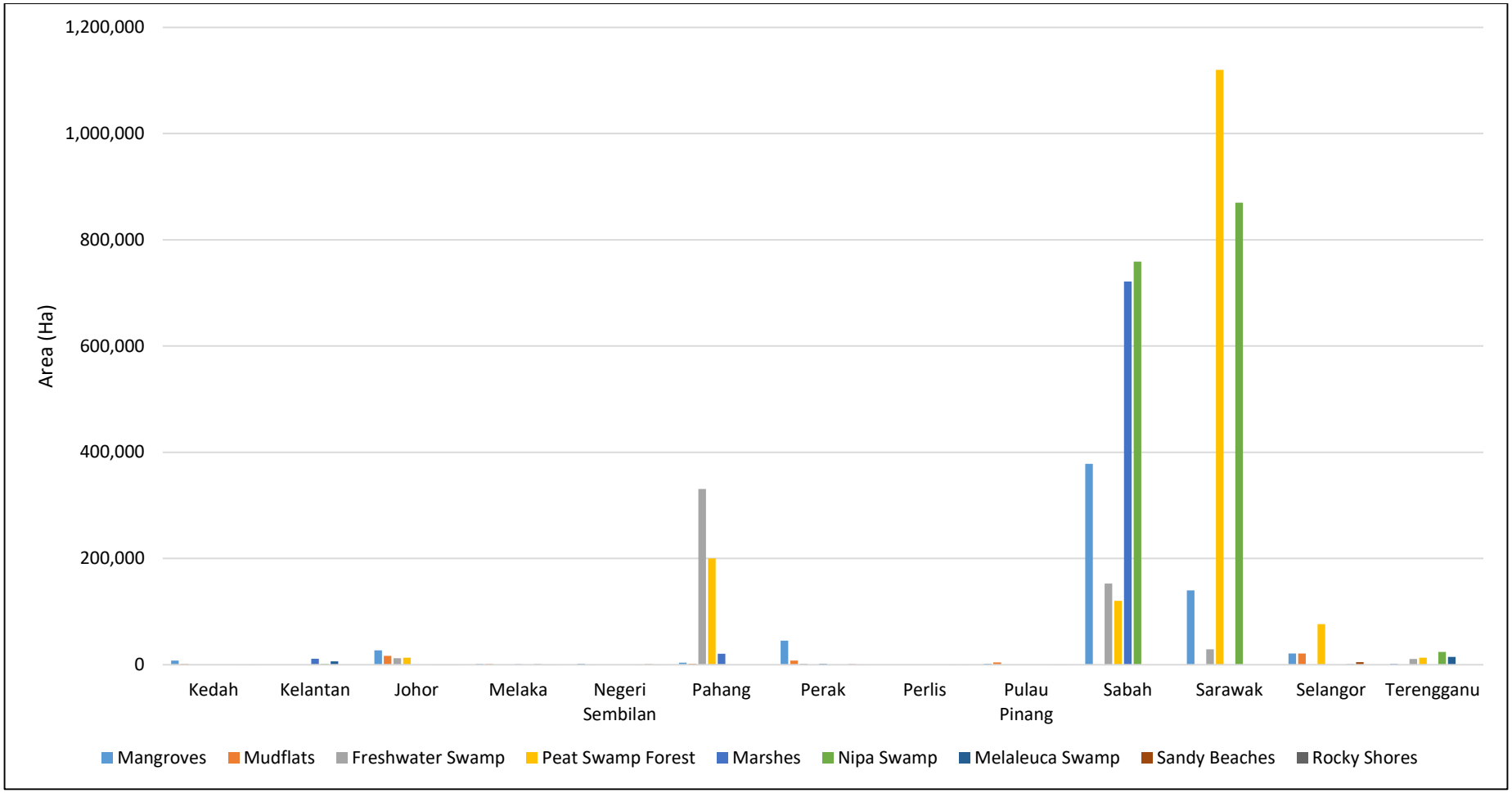
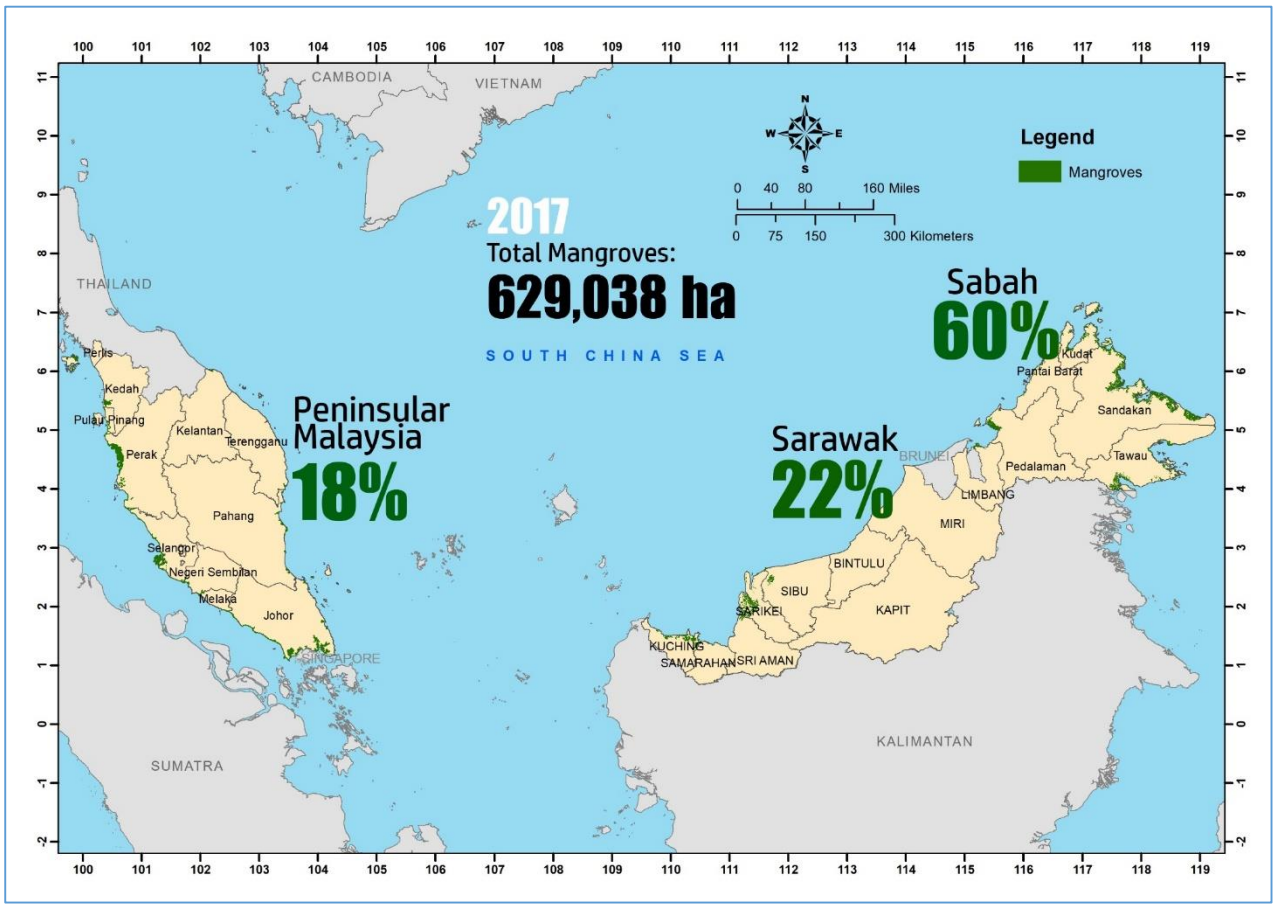


Figure 1. The estimated total natural wetland area in Malaysia (excluding lakes, oxbow lakes, river systems and coral reefs)

NATURAL WETLANDS

1. Mangroves

Mangroves are well developed in sheltered estuaries where water is brackish, and waves as well as tidal conditions are conducive for mud accumulation. Mangroves cover about 3% (629,038 ha) of the total land area in Malaysia of which 60% is in Sabah, 22% in Sarawak, and the remaining 18% in Peninsular Malaysia (**Figure 2**). About 70% of the total mangrove area has been gazetted as a forest reserve with the remainder being state land.



Source: Hamdan et al. (2019)

Figure 2. Mangroves in Malaysia

Mangroves occur primarily in the state of Perak, Selangor, and Johor in Peninsular Malaysia, along the east coast of Sabah, and in northern and southwestern Sarawak (**Plate 1**). Bakau minyak (*Rhizopora apiculata*) is the most commercial timber species in the mangroves. It is characterised as leaf blades elliptic, tiny black-spotted below, leaf stalks, stipules often tinged red, and tree up to 20 m tall (**Plate 2**).

Plate 1. Mangrove forests ecosystem in the coastal of Klang, Selangor

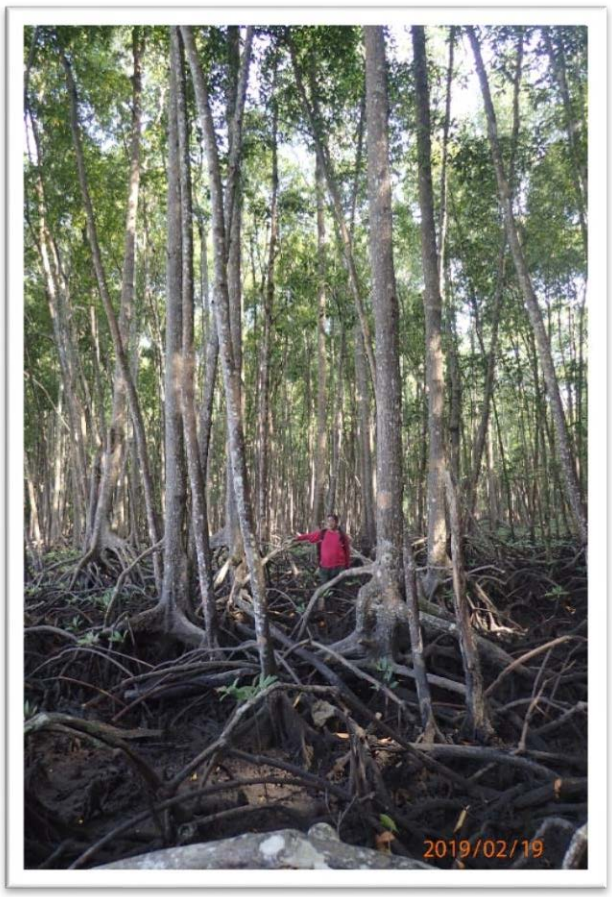


Plate 2. Bakau minyak (*Rhizophora apiculata*) is the main commercial species in mangroves with stilt roots

State	Mangroves (ha)
Kedah	7,725
Kelantan	422
Johor	26,818
Melaka	1,241
Negeri Sembilan	1,557
Pahang	3,759
Perak	44,990
Perlis	49
Pulau Pinang	1,967
Sabah	378,195
Sarawak	139,890
Selangor	20,853
Terengganu	1,571
Total	**629,038**

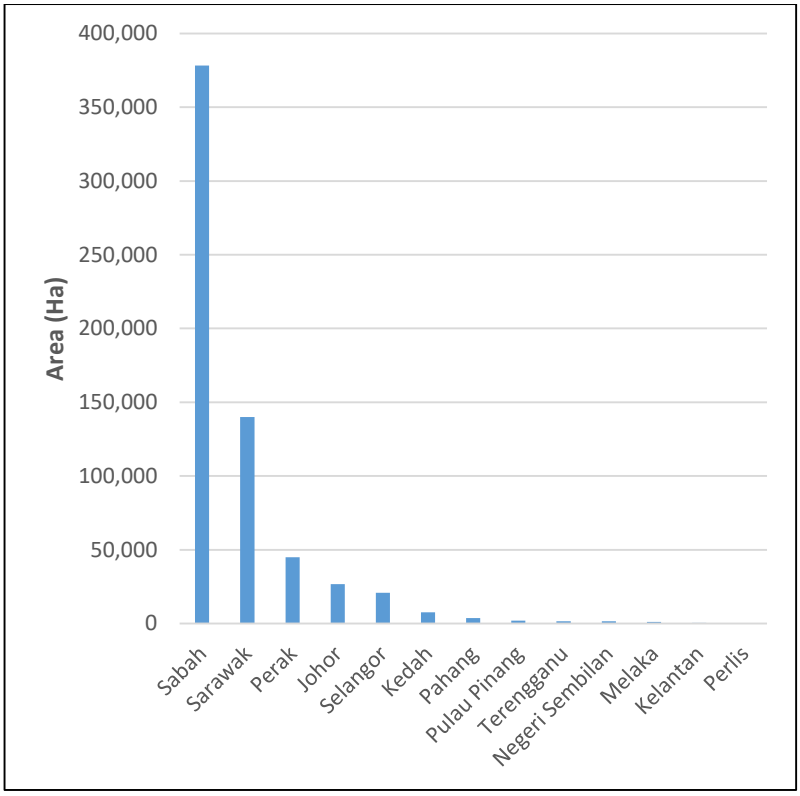


Figure 3. Total mangrove areas in Malaysia

2. Mudflats

Mudflats also known as tidal flats are coastal wetlands that form when mud is deposited by tides or rivers. They are found in sheltered areas where the tidal waters flow slowly such as bays, lagoons, and estuaries (**Plate 3**). A mixture of very fine silts from tidal waters and alluvium from rivers dropping their load as they reach the sea is deposited, resulting a build-up of mud layers, called mudflats. Mudflats are covered at high tide and exposed as the tide drops. Mudflats are often found in the remains of the valleys that were tributaries to the main submerged river. In such areas, remains of the original watercourses can sometimes be seen as channels carved out of the mud, down which little fresh water may be seen flowing at low tide. All mudflats are usually crisscrossed by winding channels that are kept open by tidal action. Unless these channels are fed by active water sources, such as streams and rivers, they will usually dry out at low tide and contain no water.

Intertidal mud and sand flat are extremely important wetland habitats in Malaysia. They fringe the majority of Malaysia's coastlines, and may in certain places be several kilometres in width at low tide. Mudflats that are associated with major mangrove forests, and especially accreting, mangrove forest support the richest benthic fauna (organisms that are either attached or living within the bottom sediments), e.g. Matang in Perak, the Klang Island in Selangor, and Rajang Delta (including Pulau Bruit) in Sarawak. These areas, therefore, represent the richest feeding grounds for migratory shorebirds and resident water birds such as herons, egrets, and storks. These areas are also important as nursey, breeding ground, and feeding areas for large number of bivalves (i.e. cockles, crustaceans, and prawns) and fish species that are important for coastal fisheries activities. Based on available data, there are 53,951 ha of estimated tidal mudflats area in this country (**Figure 4**).

Plate 3. Condition of mudflats during low tide

State	Mudflats (Ha)
Kedah	1,483
Kelantan	n.a
Johor	16,586
Melaka	1,012
Negeri Sembilan	301
Pahang	1,777
Perak	7,797
Perlis	n.a
Pulau Pinang	4,189
Sabah	n.a
Sarawak	n.a
Selangor	20,806
Terengganu	n.a
Total	**53,951**

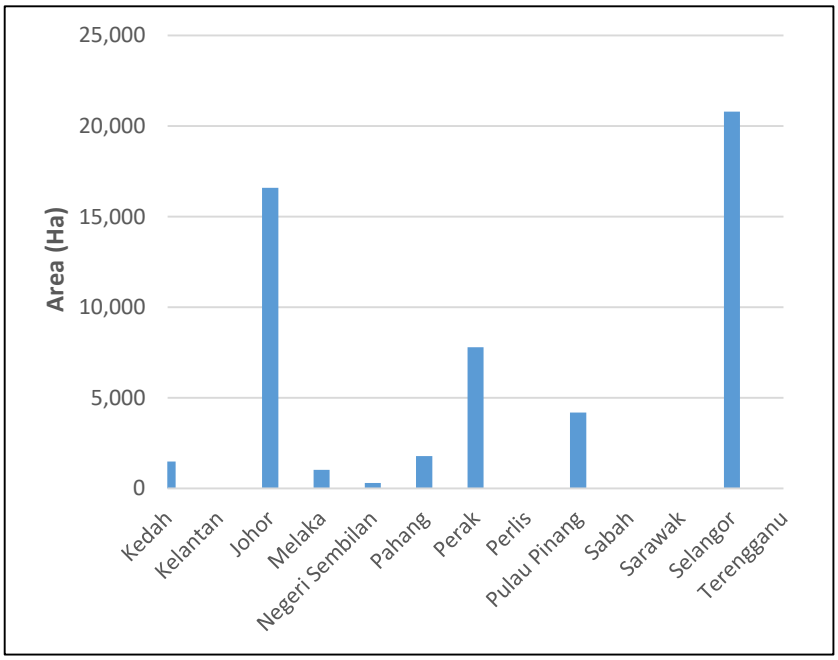


Figure 4. Total land area of mudflats in Malaysia

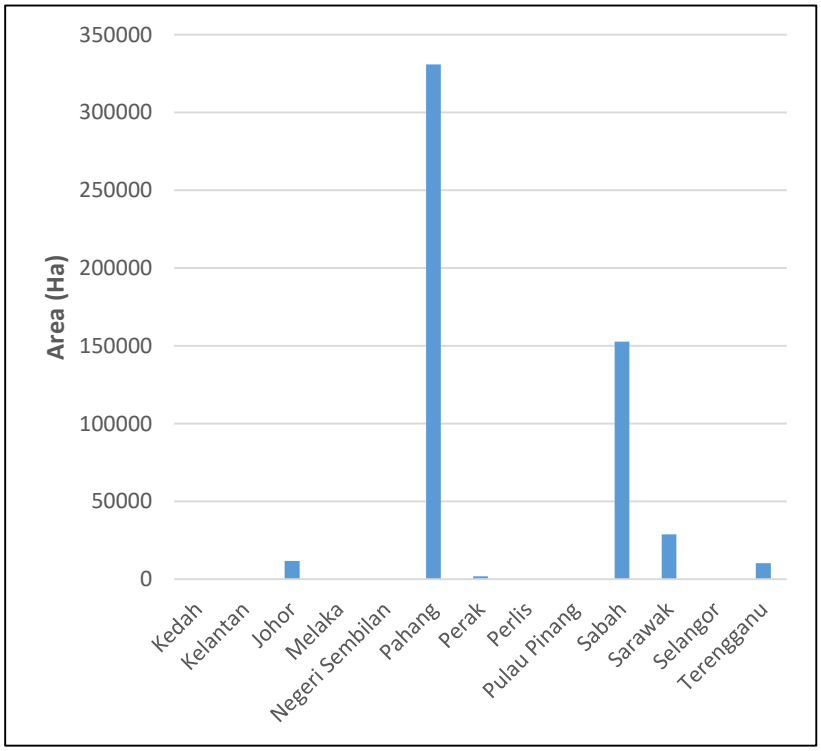
3. Freshwater Swamp

Freshwater swamp occurs on permanently or seasonally-flooded soil with over 35% mineral content, normally in a zone along the lower reaches of certain rivers. It also occurs around freshwater lake system such as Tasek Chini and Tasek Bera (**Plate 4**) in Pahang, Sungai Sedili in Johor. It is also found along some of the river systems along Sabah's east coast and along the lower reaches of a certain river in Sarawak. This wetland type is species-rich compared to mangrove with over 120 canopy tree species recorded at Sedili in Johor. The forest type is also characterised by having a high diversity of understory species including rattan and palm species.

As a result of biogeographic, microclimatic, and soil factor, the species composition and relative dominance of the tree flora varies greatly between areas. The main remaining freshwater swamps are at Sedili Kecil in Johor, along the lower reaches of major rivers and at Tasek Bera and Tasek Chini in Pahang, along Sabah's east coast and along the lower reaches of certain rivers in Sarawak. Based on available data, there are estimated about 536,799 ha of freshwater swamps in this country (**Figure 5**).

Plate 4: Freshwater swamp at Tasek Bera, Pahang

State	Freshwater Swamp (Ha)
Kedah	0
Kelantan	0
Johor	11,900
Melaka	0
Negeri Sembilan	0
Pahang	330,890
Perak	1,967
Perlis	0
Pulau Pinang	0
Sabah	152,702
Sarawak	28,907
Selangor	0
Terengganu	10,433
Total	**536,799**



Source: DANIDA (2007)

Figure 5. Total land area of freshwater swamps in Malaysia

4. Peat Swamp Forest

Tropical peat swamp forest grows on peatland (organic soils) in the harsh waterlogged environment. The tropical climate and high annual rainfall in Malaysia have resulted in the formation of peat swamp forest. When anaerobic and waterlogged conditions occur simultaneously over a long period of time, decomposition of plant material partially inhibited and resulted in accumulation of organic soil over thousands of years. The organic matter that makes up the peat will release tannins and organic acids into the water which will cause the peat water to look almost black in appearance, but is clear when held up against the light. This habitat reaches its optimal stage of development in Malaysia, and in Sarawak particularly, where the formation and structure of peat swamp forest has been well studied.

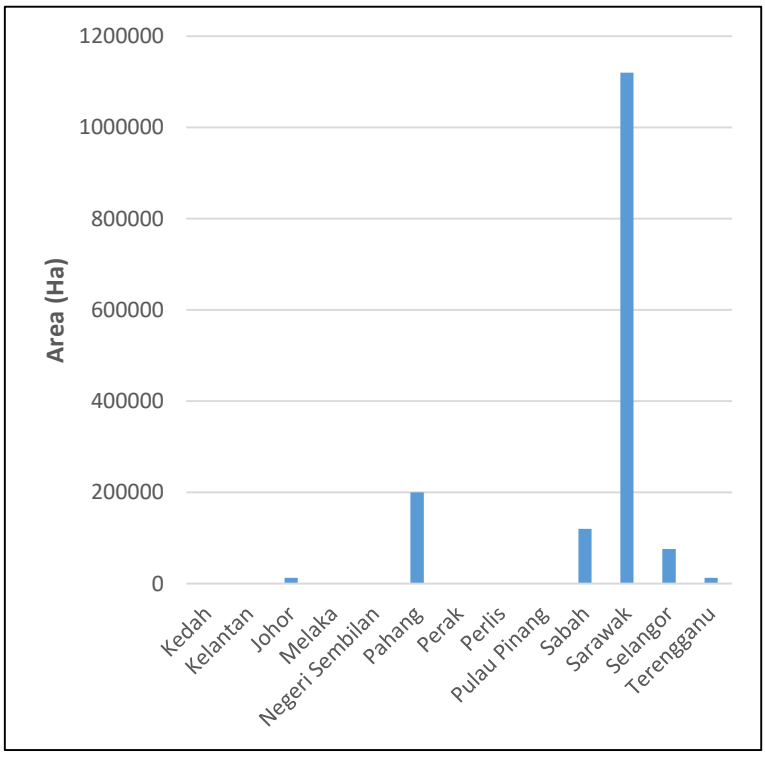
Approximately 1.5 million ha remain in Malaysia, which accounts for about 5% of the total land area of Malaysia. Less than 20% of this wetland type is present in the Peninsular (mainly in southeastern Pahang and Selangor) (**Plates 5 & 6**), while another 72% in Sarawak (mainly in the First, Second, Third, and Sixth Division), and the remaining 8% is in Sabah (**Figure 6**). Peat swamp forests are critical habitat for a significant number of threatened and endangered species for both flora and fauna such as the Sumatran Rhinoceros *(Dicerorhinus sumatrensis),* Orangutan (*Pongo* spp.), and Proboscis Monkey (*Nasalis larvatus)*. Main commercial and most popular timber species in peat swamp forest is Ramin melawis (*Gonystylus bancanus*) due to its special characteristics for furniture.

Last but not least, peat swamp forests are an important component in the world of wetlands. The correlation between land and water where a transition zone within the flow of water with the cycling of nutrients and the energy of the sun are combined to produce a unique ecosystem of hydrology, soils, and vegetation. This type of wetland provides a variety of benefits in the form of forestry and fisheries products, energy, flood mitigation, water supply, and groundwater recharge. The peat swamp forest is also a very important ecosystem in storing and absorbing carbon, thus it plays a critical role in climate change mitigation.

Plate 5. Raja Musa Forest Reserve, Selangor has been accredited and approved as Queen's Commonwealth Canopy (QCC) in September 2017

Plate 6. Peat swamp forest in Pekan Forest Reserve, Pahang

State	Peat Swamp Forest (Ha)
Kedah	0
Kelantan	0
Johor	13,000
Melaka	0
Negeri Sembilan	0
Pahang	200,000
Perak	0
Perlis	0
Pulau Pinang	0
Sabah	120,000
Sarawak	1,120,000
Selangor	76,000
Terengganu	13,000
Total	**1,542,000**



Source: UNDP (2006)

Figure 6. Total land area of peat swamp forests in Malaysia

5. Lakes

Lakes consist of natural and man-made (**Table 2**). In Malaysia, it is mostly for reservoir and hydroelectric power generation. Lakes also play an important role in agricultural purpose, flood control, navigation, and also recreational purposes. They are also home to diverse biological species and provides breeding areas for many species, in particular water birds.

Few natural lakes occur in Malaysia, the lake system of Tasek Bera and Tasek Chini (**Plate 7**) in Pahang and Loagan Bunut in Sarawak being the only major examples. A number of large reservoirs have been constructed, such as the Kenyir Dam in Terengganu (**Plate 8**) and Batang Ai in Sarawak. On the other hand, Oxbow lakes occur mainly in Sabah and Sarawak along the meandering lower reaches of major rivers such as Baram and Limbang in Sarawak and the Kinabatangan, Sugut, and Segama in Sabah. They support rich freshwater fish populations, and may be fringed with thick floating mats of vegetation.

Table 2. Major lakes in Malaysia

No.	State	Name	Purposes	Area of Water Body (km ^{2})
1	Perak	Air Kuning (Perak)	W	n.a
2	Perak	Bersia	H,F	5.7
3	Perak	Bukit Merah	I,W	41
4	Perak	Chendroh	H,F	25
5	Perak	Gopeng	SR	n.a
6	Perak	Jor	H	0.5
7	Perak	Kenering	H,F	60
8	Perak	Mahang	H	0.1
9	Perak	Temenggor	H,F	152
10	Perak	Kinta	Exm	n.a
11	Perak	Tasik Raban	Re	0.375
12	Selangor	Air Kuning (Selangor)	Re	0.004
13	Selangor	Batu	F,W	2.5
14	Selangor	Klang Gates	W,F	2.25
15	Selangor	Langat	W	1.75
16	Selangor	Meru	W	1
17	Selangor	Semenyih	W	2.5
18	Selangor	Sungai Baru	Re	0.05
19	Selangor	Sungai Tinggi	W	n.a
20	Selangor	Sg. Selangor	W	n.a
21	Selangor	Tasik The Mines	Exm,Re	n.a
22	Selangor	Tasik Titiwangsa	Re	0.125
23	Selangor	Tasik Kundang	Re	n.a
24	Selangor	Tasik Aman	Re	0.0224
25	Selangor	Damansara	W	0.04

No.	State	Name	Purposes	Area of Water Body (km^2)
26	Selangor	Sg Batu	F,W	1.1
27	Pahang	Anak Endau	I,W	7.2
28	Pahang	Sq Pontian	I,W	20
29	Pahang	Repas baru	SR	0.05
30	Pahang	Repas Lama	SR	n.a
31	Pahang	Sultan Abu Bakar	H	0.5
32	Pahang	Chereh Dam	W	54
33	Pahang	Tasik Chini	N	2
34	Pahang	Tasik Bera	N	6
35	Pahang	Ulu Lepar	N	4.69
36	Pahang	Bintau	N	0.25
37	Kelantan	Bukit Kuang	I,W	4.04
38	Kelantan	Pergau (Kuala Yong)	H,F	4.3
39	Kelantan	Rantau Panjang	W	3
40	Johor	Bekok	F,W	8.75
41	Johor	Congkok	W	0.5
42	Johor	Gunong Ledang	W	0.75
43	Johor	Juaseh	W	n.a
44	Johor	Lobong	I,W	4.25
45	Johor	Layang(Lower)	W	n.a
46	Johor	Layang(Upper)	W	n.a
47	Johor	Lebam	W	n.a
48	Johor	Linggui	W	50
49	Johor	Machap	F,W	9.09
50	Johor	Sembrang	F,W	8.5
51	Johor	Pontian Kecil	W	1.75
52	Johor	Pulai Besar	W	0.625
53	Kedah	Ahning	W,I	n.a
54	Kedah	Malut	W	0.5
55	Kedah	Muda	I	26
56	Kedah	Padang Saga	I,W	0.05
57	Kedah	Pedu	I	65
58	Kedah	Dayang Bunting	N	0.375
59	Kedah	Beris	W	13.7
60	Labuan	Bukit Kuda	W	n.a
61	Labuan	Kerupang	W	n.a
62	Labuan	Pagar	W	n.a
63	Melaka	Air Keruh	Re	0.5
64	Melaka	Asahan	W	0.75
65	Melaka	Durian Tunggal	W	3.5

No.	State	Name	Purposes	Area of Water Body (km ^{2})
66	Melaka	Jus	W	4
67	Negeri Sembilan	Kelinci	W	n.a
68	Negeri Sembilan	Pedas	W	n.a
69	Negeri Sembilan	Sungai Terip	W,I	2.25
70	Negeri Sembilan	Upper Muar	W	n.a
71	Negeri Sembilan	Gemencih	W	n.a
72	Pulau Pinang	Air Hitam	W	0.25
73	Pulau Pinang	Mengkuang	W	0.625
74	Pulau Pinang	Teluk Bahang	W	n.a
75	Pulau Pinang	Bukit Pancur	N	0.061
76	Perlis	Timah Tasuh	I,W,F	13.33
77	Perlis	Tasik Melati	Re	n.a
78	Sabah	Babagon	W	n.a
79	Sabah	Pinangsoo	W	n.a
80	Sabah	Sepagaya	W	n.a
81	Sabah	Tenom	H	n.a
82	Sabah	Timbangan	W	n.a
83	Sabah	Ox-bow	N	n.a
84	Sarawak	Batang Ai	H	n.a
85	Sarawak	Sika (Bintulu)	W	n.a
86	Sarawak	Loagan Bunut	N	n.a
87	Sarawak	Tasik Biru	Exm	n.a
88	Terengganu	Kenyir	H,F	369
89	Terengganu	Puteri/Bukit Besi	Exm,Re	1.8
90	Wilayah Persekutuan	Tasik Putrajaya	Re	7.5

Notes:

W-water supply, I-irrigation, H-hydropower, F- Flood Control, Re-Recreation, SR-Silt Retention, N-Natural, Exm-Ex Mining Pool, F-Forested, Agr-Agricultural, R-Range, Cu-Cleared Unproductive

Source: NAHRIM (2005)

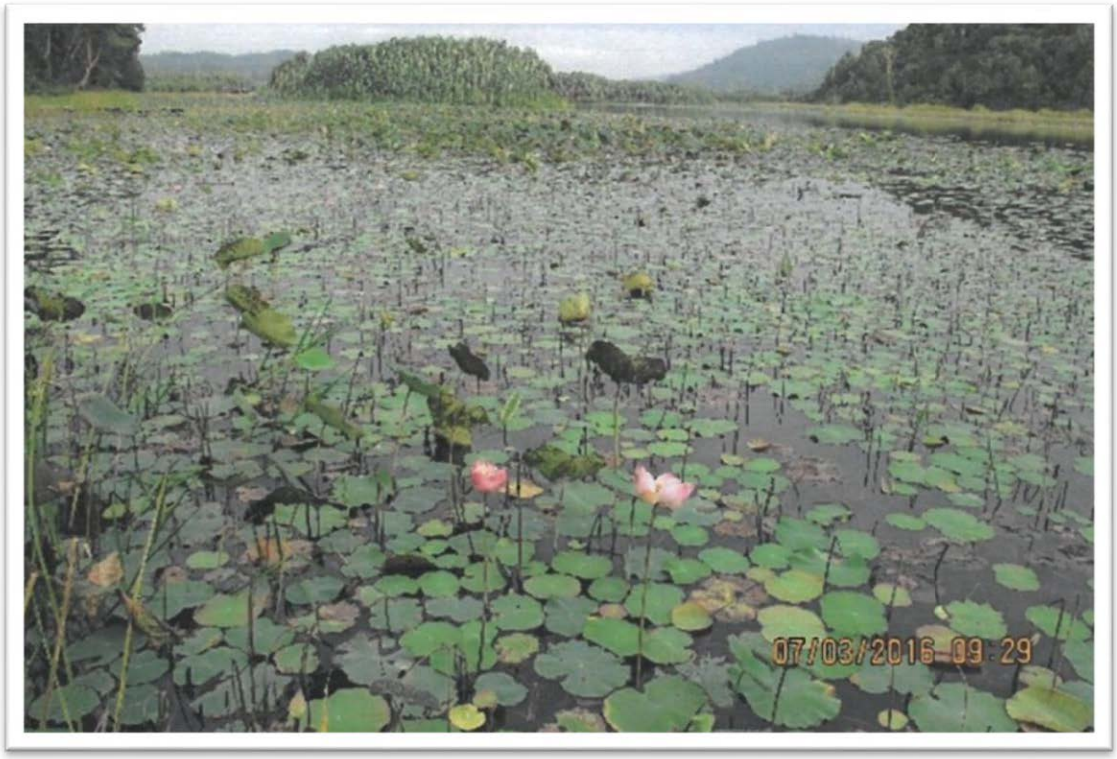


Plate 7. Tasek Chini, Pahang is a famous ecotourism site for lotus-watching

Source: http://tourism.terengganu.gov.my

Plate 8. Kenyir Lake in Terengganu, one of important lakes for water catchment and hydro project

6. River Systems

There are nearly 100 river systems in Malaysia, the largest being the Rajang in Sarawak with a catchment area of 51,000 km^2 (**Table 3**). The Pahang, Kinabatangan, and Baram are among major rivers (**Plate 9**). Ecologists have recognised six types of rivers in Malaysia: montane streams, upland (Saraca) streams, lowland (Neram) rivers, lowland slow flowing streams, freshwater tidal (Rasau) rivers, and brackish-water or mangrove estuaries. 'Rasau' rivers are important breeding areas for estuarine fish and carp, but few intact examples remain in Malaysia. The highly endangered False gharial (*Tomistoma schlegelii)* has been recently confirmed to breed along the Ensengei Baki River in Sarawak.

Land and water are ecologically linked in a natural system called a catchment, drainage basin, or watershed. From the smallest droplet to the mightiest river, water works to shape the land, taking with it sediment and dissolved materials that drain to watercourses, and in most cases, eventually to the sea. Type of rock and soil, the shape of the land, the amount of rainfall, and type of vegetation are some of the factors that determine the river's shape, size and flow. River basin is an area of land from which all surface run-off flows through a sequence of streams, rivers, and possibly, lakes into the sea at a single river mouth, estuary, or delta.

Table 3. River basins in Malaysia

Area	No. of Basin	Main Basin (>80 km^2)	Small Basin
Peninsular Malaysia	1,235	74	1,161
Sabah	1,468	75	1,393
Sarawak	283	40	243
Total	2,986	189	2,797
Total Area	327,897.031	31 2,863.7 13	15,033.858
% Total Area	-	**95%**	**5%**

Source: Official website DID (2018)

Plate 9. Example of river system

7. Marshes

Marshes have a number of specific characteristics. Among its main visible characteristics are frequently or continually inundated with shallow depth of water and usually dominated by aquatic herbaceous vegetation such as reeds, rushes, grasses, and sedges (**Plate 10**). The vegetation grows on marshes are commonly referred to as emergent since they grow with their stems partly in and partly out of the water. Marshes rely on water sources and include some of the most productive ecosystem in the world. In Malaysia, marshes are normally found in area where the original freshwater swamp forest has been cleared or burnt. They are stages of ecological succession and not normally a permanent vegetation type. Dominant plant includes species of reeds, reedmace, club rush, sedges, and spike rushes.

There are relatively few open marsh areas in Malaysia. Kota Belud Bird Sanctuary, on Tempasuk plain in Northwestern Sabah, consists of freshwater marshes, together with a complex of other wetland habitats. It is important to resident and migratory water birds and has good tourism potential. Another marsh in Sabah, Padas Damit, supports waterfowl and Estuarine crocodile. **Figure 7** shows marshes areas in Malaysia with estimated land area of 755,153 ha.

Plate 10. Marshes swamp habitat in Merchang, Terengganu

State	Marshes (Ha)
Kedah	n.a
Kelantan	11,020
Johor	n.a
Melaka	600
Negeri Sembilan	n.a
Pahang	20,350
Perak	1,967
Perlis	n.a
Pulau Pinang	n.a
Sabah	721,216
Sarawak	n.a
Selangor	n.a
Terengganu	n.a
Total	**755,153**

Source: DANIDA (2007)

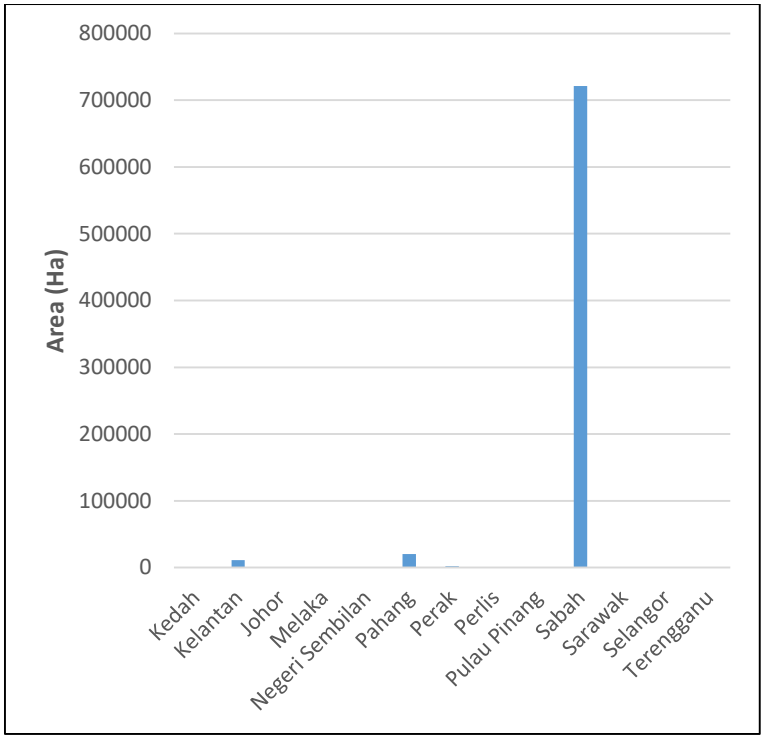


Figure 7. Total land area of marshes in Malaysia

8. Nipa Swamps

Nipa swamps are tidal, monospecific stands of the Nipa Palm (*Nypa fruticans*). Nipa occurs in association with mangroves and extent further into brackish water, often lining the tidal reaches of rivers and forming huge swamp in delta areas such as mangrove in Sarawak and Klias Peninsula in Sabah. Overall estimation total area of nipa swamp in Malaysia is about 1,653,590 ha (**Figure 8**).

These are refuges for the Estuarine crocodile (*Crocodylus porosus*) and provide roosting areas for water birds, e.g. the egret roost at Sungai Padas Damit in Sabah. Nipa provides traditional attap roofing for local inhabitant, and in Sarawak, sugar is extracted from the nipa and then refined and distilled into alcohol. **Plates 11 & 12** show examples of nipa stands in Pahang and Selangor.

State	Nipa Swamps (Ha)
Kedah	n.a
Kelantan	1,020
Johor	n.a
Melaka	n.a
Negeri Sembilan	n.a
Pahang	n.a
Perak	n.a
Perlis	n.a
Pulau Pinang	n.a
Sabah	758,770
Sarawak	869,700
Selangor	n.a
Terengganu	24,100
Total	**1,653,590**

Source: DANIDA (2007)

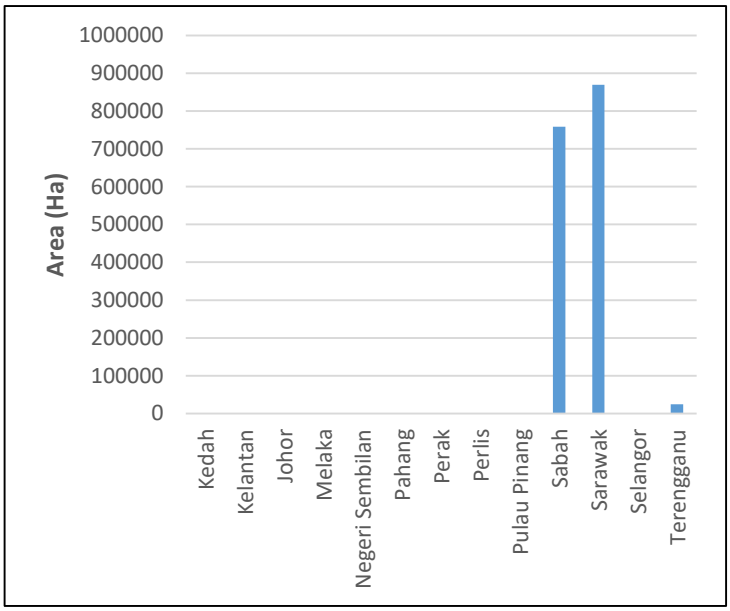


Figure 8. Total land area of nipa swamps in Malaysia

Plate 11. Nipa clumps in Nenasi, Pahang

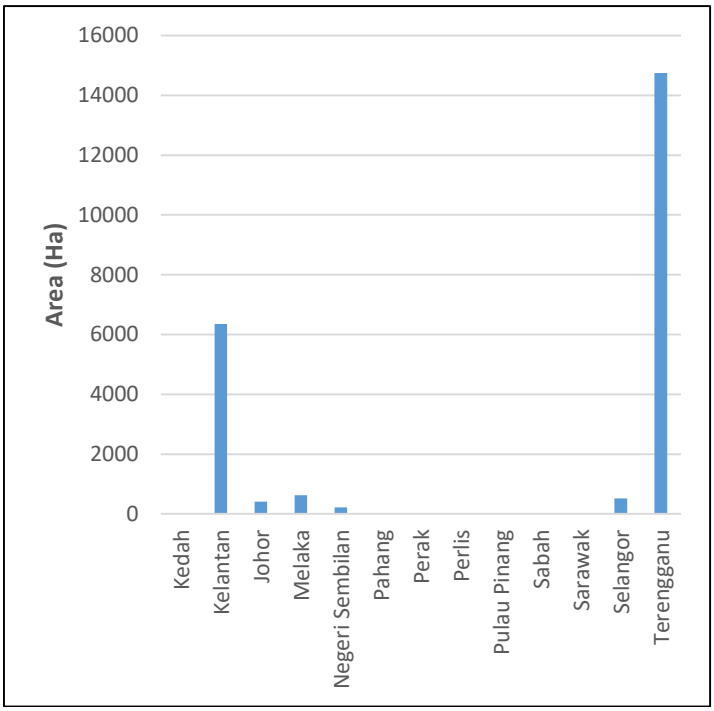
Plate 12. Nipa swamps in Kuala Selangor

9. Melaleuca Swamp

Melaleuca swamp, or locally known as 'gelam' forest is actually freshwater swamp forest, however the vegetation is almost exclusively for *Melaleuca cajuputi.* The forest replaces the original freshwater swamp forest after it has been burnt as Melaleuca are more resistant to fire. These forests occupy extensive areas of alluvial flats along the east coast of Peninsular Malaysia, mainly in Terengganu and Kelantan (**Plate 13**). There are about 41,520 ha Melaleuca swamp in this country, however, the figure might be significantly reducing due to rapid development in this type of wetlands (**Figure 9**).

Plate 13. *Melaleuca cajuputi* stand exclusively dominated the Melaleuca swamps

State	Melaleuca Swamp (Ha)
Kedah	n.a
Kelantan	6,350
Johor	415
Melaka	626
Negeri Sembilan	217
Pahang	n.a
Perak	n.a
Perlis	n.a
Pulau Pinang	n.a
Sabah	n.a
Sarawak	n.a
Selangor	521
Terengganu	14,748
Total	**22,877**



Source: Hamdan et.al. (2020)

Figure 9. Total land area of Melaleuca swamps in Malaysia

10. Sandy Beaches

In Malaysia, sandy beaches occur largely along the east coast of Peninsular Malaysia, Sabah and Sarawak, with estimated coverage of 7,897 ha (**Figure 10**). Plants in this habitat have to anchor themselves deeply in the shifting sands and find enough freshwater between the loose sand and mineral grains. Animal are found mostly in the tidal zones with bivalve mollusks being the most common. Sandy beaches are also important as turtle landing and nesting sites. Large beaches are attractive recreational areas for people, hence capitalised for tourism (**Plate 14**).

State	Sandy Beaches (Ha)
Kedah	181
Kelantan	n.a
Johor	285
Melaka	381
Negeri Sembilan	816
Pahang	n.a
Perak	734
Perlis	343
Pulau Pinang	390
Sabah	n.a
Sarawak	n.a
Selangor	4,767
Terengganu	n.a
Total	**7,897**

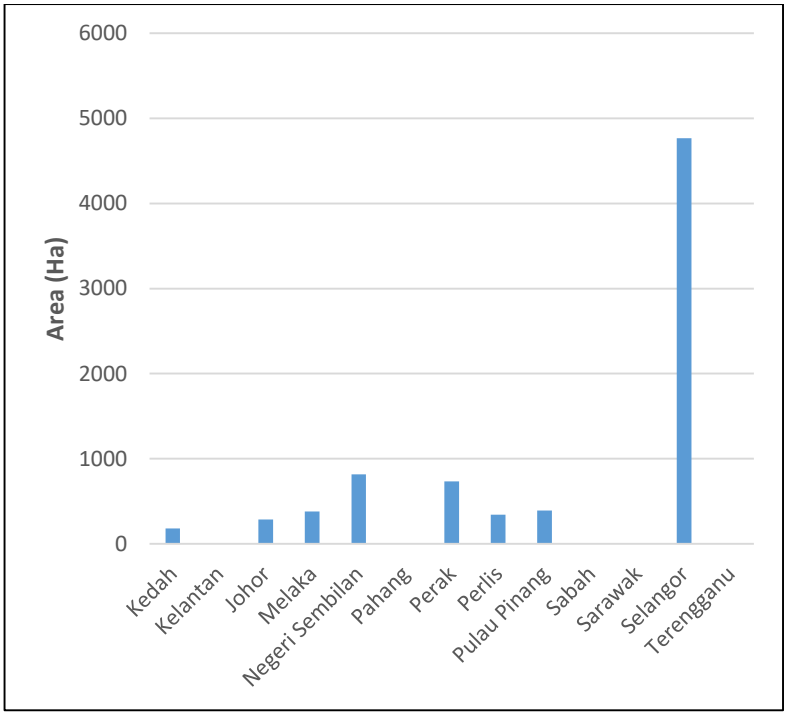


Figure 10. Total land area of sandy beaches in Malaysia

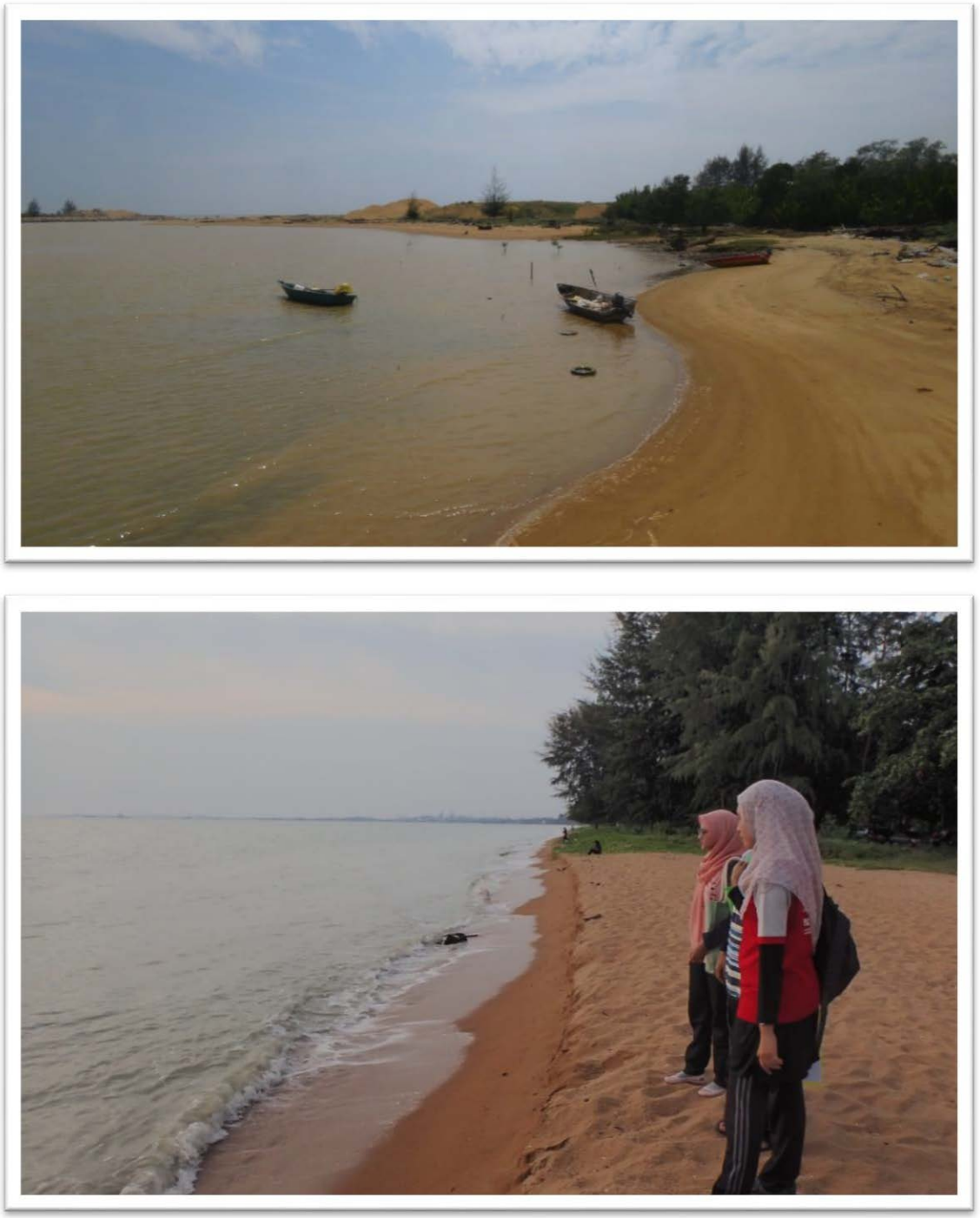


Plate 14. Sandy beaches in Kemaman, Terengganu (upper) and Pangkalan Balak, Melaka (below)

11. Rocky Shores

Rocky shores are rare habitats in Malaysia. Isolated rocky headlands and island occur at the many offshore islands along the west and east coast of Peninsular Malaysia and in Sabah and Sarawak. Few prominent places such as Tanjung Tuan, Melaka, and Penang National Park (**Plate 15**) are best examples for this type of wetland. Overall, total area for rocky shores in Malaysia is estimated about 434 ha (**Figure 11**). Rocky shore ecosystems support animals and endemic plants in Malaysia. However, ecological information on this unique habitat is scarce.

Plate 15. Rocky shores at Penang National Park, Penang

State	Rocky Shores (Ha)
Kedah	195
Kelantan	n.a
Johor	33
Melaka	1
Negeri Sembilan	48
Pahang	n.a
Perak	87
Perlis	12
Pulau Pinang	58
Sabah	n.a
Sarawak	n.a
Selangor	n.a
Terengganu	n.a
Total	**434**

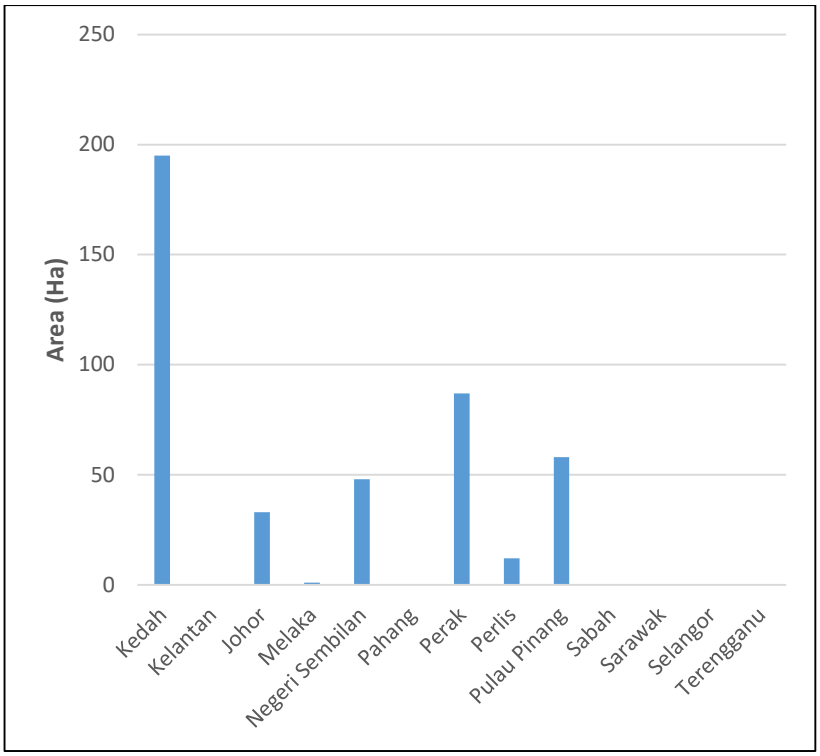
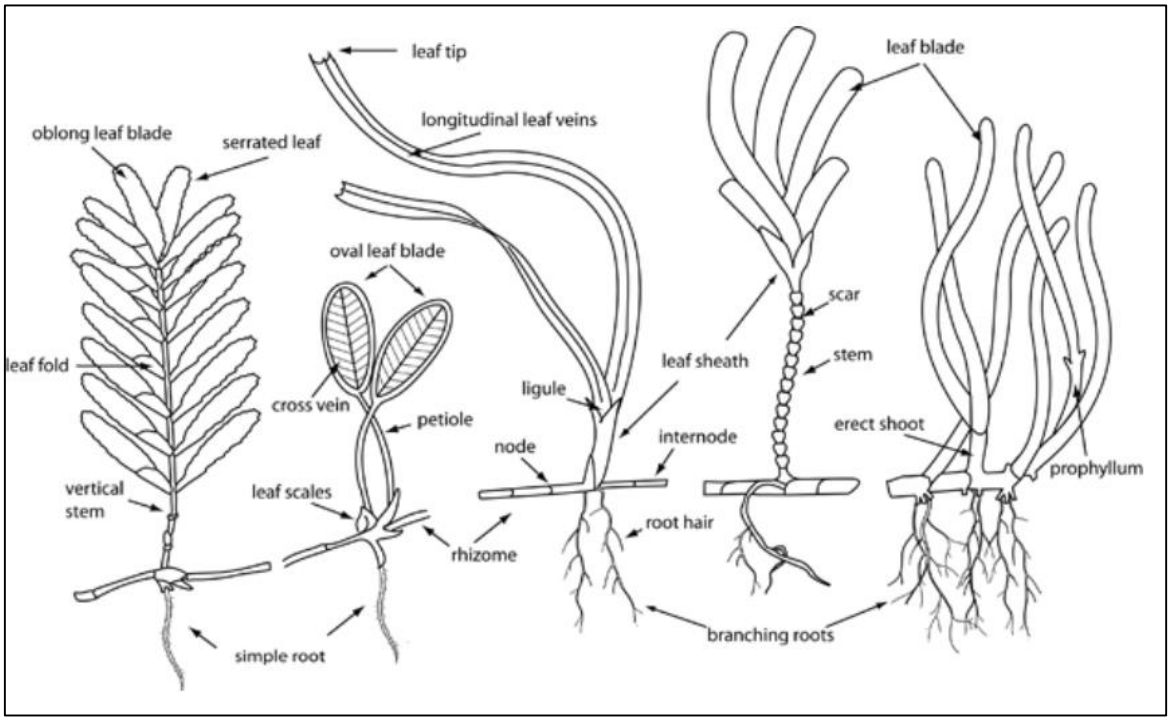


Figure 11. Land area of rocky shores in Malaysia

12. Seagrass

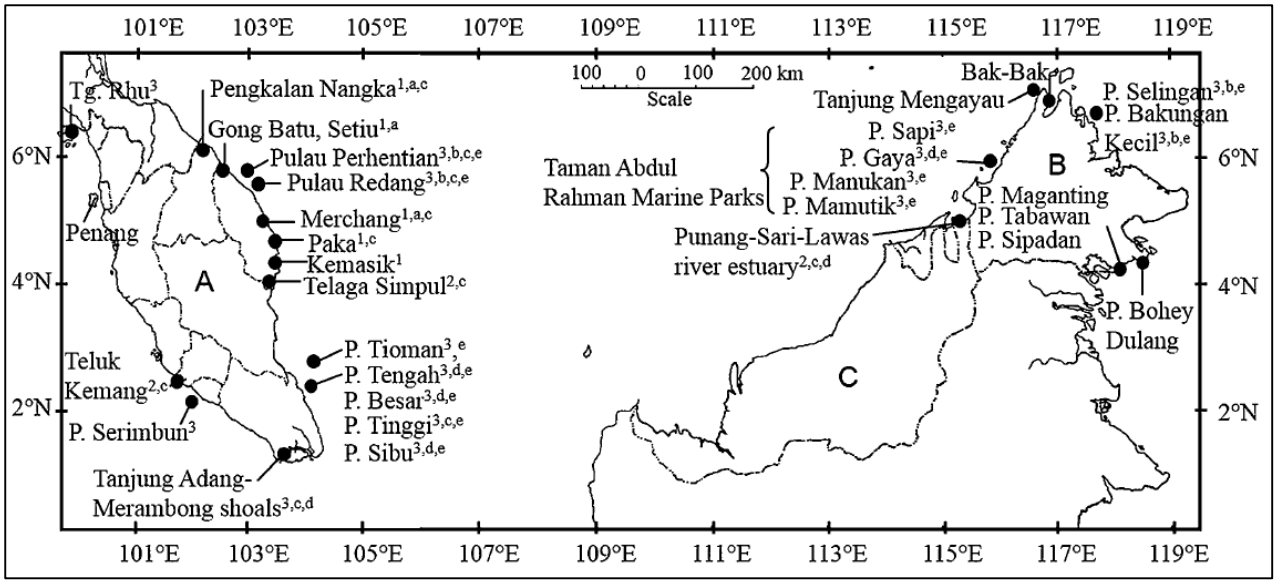
Seagrasses are submerged monocotyledonous angiosperms living in marine and estuarine habitats. **Figure 12** shows an illustration to demonstrate the morphological features of main seagrass taxonomic groups. Seagrasses vary in morphology and size, ranging from strap-like leaves that reach 1 m or more in height to shorter ovate leaved that grows to only a few centimetres tall. Malaysia has about 16 species of seagrasses from a total of 20 species recorded in Southeast Asia. It has been considered as the most diverse seagrass flora in the world with 7 dominant genera. The generic richness of both mangrove and seagrasses show a similar global pattern. Although the number of seagrasses species is relatively small in comparison to other groups, their number are no means proportional to their ecological and economic importance.

Healthy seagrasses may grow dense and form an extensive beds or meadows. Their characteristics and interactive community within and from outside account for the high diversity and enable survival of diverse invertebrates (shrimps, sea cucumbers, starfishes, bivalves, gastropods), vertebrates (dugongs, green turtles, fishes), and macro algae, indirectly helping the survival of local coastal communities that depend solely on fisheries activities. **Figure 13** shows the major and important seagrass areas, associated habitats, utilisation by coastal communities, and other users in Malaysia. **Plate 16** shows example of seagrass meadow in Johor.



Source: https://www.seagrasswatch.org/idseagrass/

Figure 12. Morphological structure of seagrasses



Note: Peninsular Malaysia (A), east Malaysia-Sabah (B), Sarawak (C).
Lagoon [1], intertidal [2], subtidal [3], Aquaculture [a], turtle sanctuary [b], traditional capture fisheries [c], dugong feeding ground [d], and marine park [e].
Source: Japar Sidik (2012)

Figure 13. Seagrass distribution in Malaysia

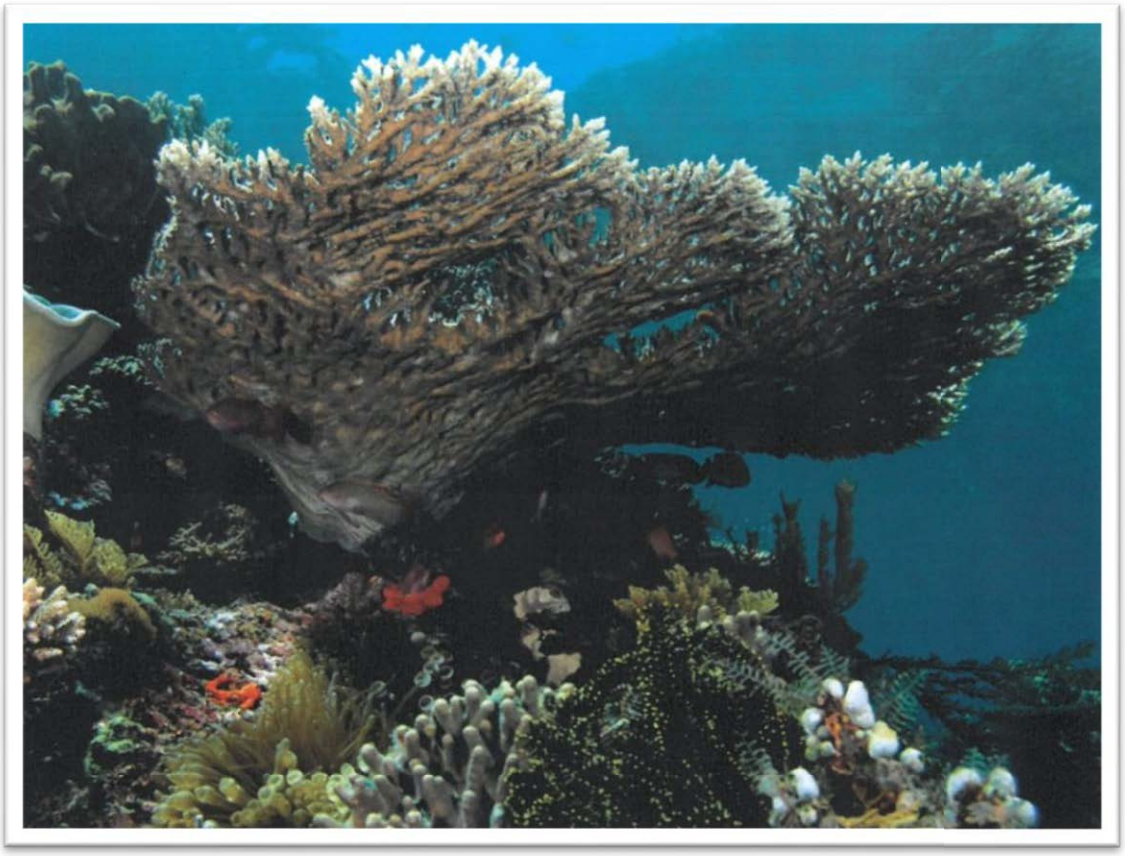
Source: https://theiskandarian.com/when-tides-are-low-follow-and-explore/

Plate 16. A local fisherman harvesting molluscs (snails) during low tides from the seagrass meadow in Tanjung Kupang, Johor

13. Coral Reefs

A coral reef is an assembly of many types of plants and animals of which corals form one of the dominant components. Reefs are essentially massive deposits of calcium carbonate that have been produced by corals with major additions from calcareous algae and other organisms that secrete calcium carbonate. The coral reefs are sensitive and easily destroyed because they need specific conditions such as water temperature above 18°C, water depth shallower than 50 m, low sedimentation rates and sufficient circulation of pollution-free water to grow and survive. **Plates 17 & 18** show coral reef areas in Redang, Terengganu and Sabah.

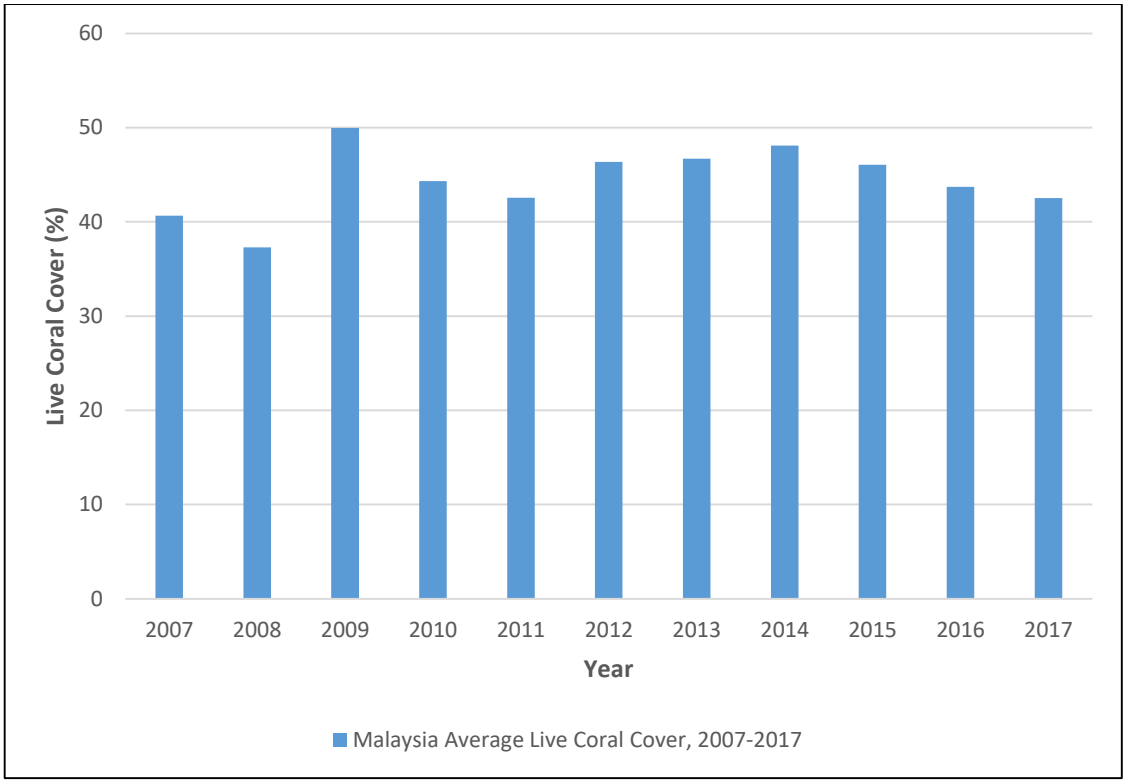
Plate 17. Popular coral reefs site in Redang Marine Park, Terengganu



Source: inhabit.com

Plate 18. Coral reefs in Tun Mustapha Park, Sabah

Coral reefs are distributed mainly around the offshore islands in three regions, which is east and west coast regions in Peninsular Malaysia, Sabah, and Sarawak. Largely the marine waters of offshore islands where the corals occur are protected as marine parks or areas prohibited from fishing. Marine parks are a protected area which extends for a distance of two nautical miles seaward from the most outer point of the island. However, the land areas of these islands are not protected as part of marine park. Estimated coral reef coverage in Malaysia at about 4,006 km^2 and support almost 700 species of fish (5^{th} National report to Convention on Biological Diversity). **Figure 14** shows the average living coral cover in Malaysia for 2007–2017.



Source: Reef Check Survey Report Status of Coral Reefs in Malaysia (2017)

Figure 14. Malaysia's average living coral cover

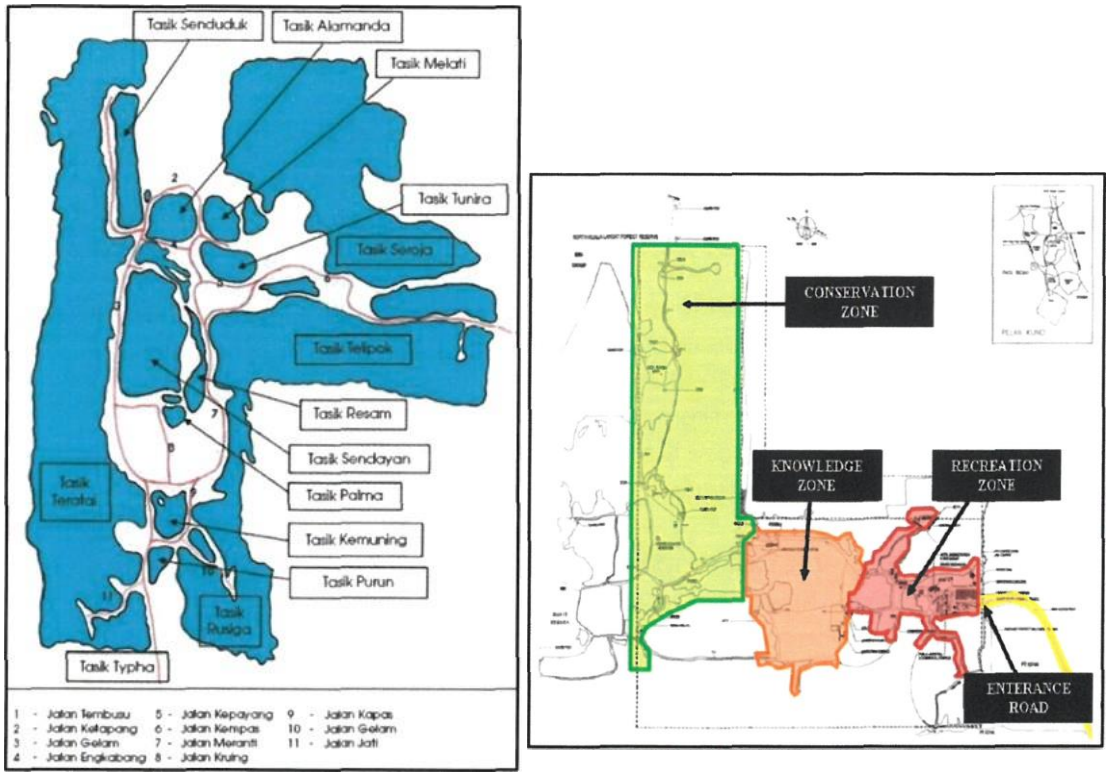
MAN-MADE WETLANDS

14. Paya Indah Wetlands

Paya Indah Wetlands is located in Dengkil, Kuala Langat District in the state of Selangor, about 50 km from Kuala Lumpur (**Plate 19**). Covering about 3,100 ha, out of which 450.76 ha are under the administration of Department of Wildlife and National Parks (DWNP) Peninsular Malaysia. The wetlands encompass a myriad of ecosystems including abandoned mining land, peat swamp forest, and large open lakes (**Figure 15**).

Paya Indah Wetlands has approximately 244 species of residential and migratory birds, 12 species of mammal, including Nile hippopotamus (*Hippopotamus amphibious*) and at least 20 species of amphibians and reptiles, including dozens of Estuarine crocodile (*Crocodylus porosus*) (**Plate 20**). Paya Indah Wetlands is envisaged to be unique eco-tourism destination and invaluable source of educational experience.

Plate 19. Paya Indah Wetlands in Dengkil, Selangor



Source: Official Website Department of Wildlife and National Park (2018)

Figure 15. The layout of Paya Indah Wetlands

Plate 20. The crocodiles and hippo are among the attractions in the Paya Indah Wetlands

15. Putrajaya Wetlands

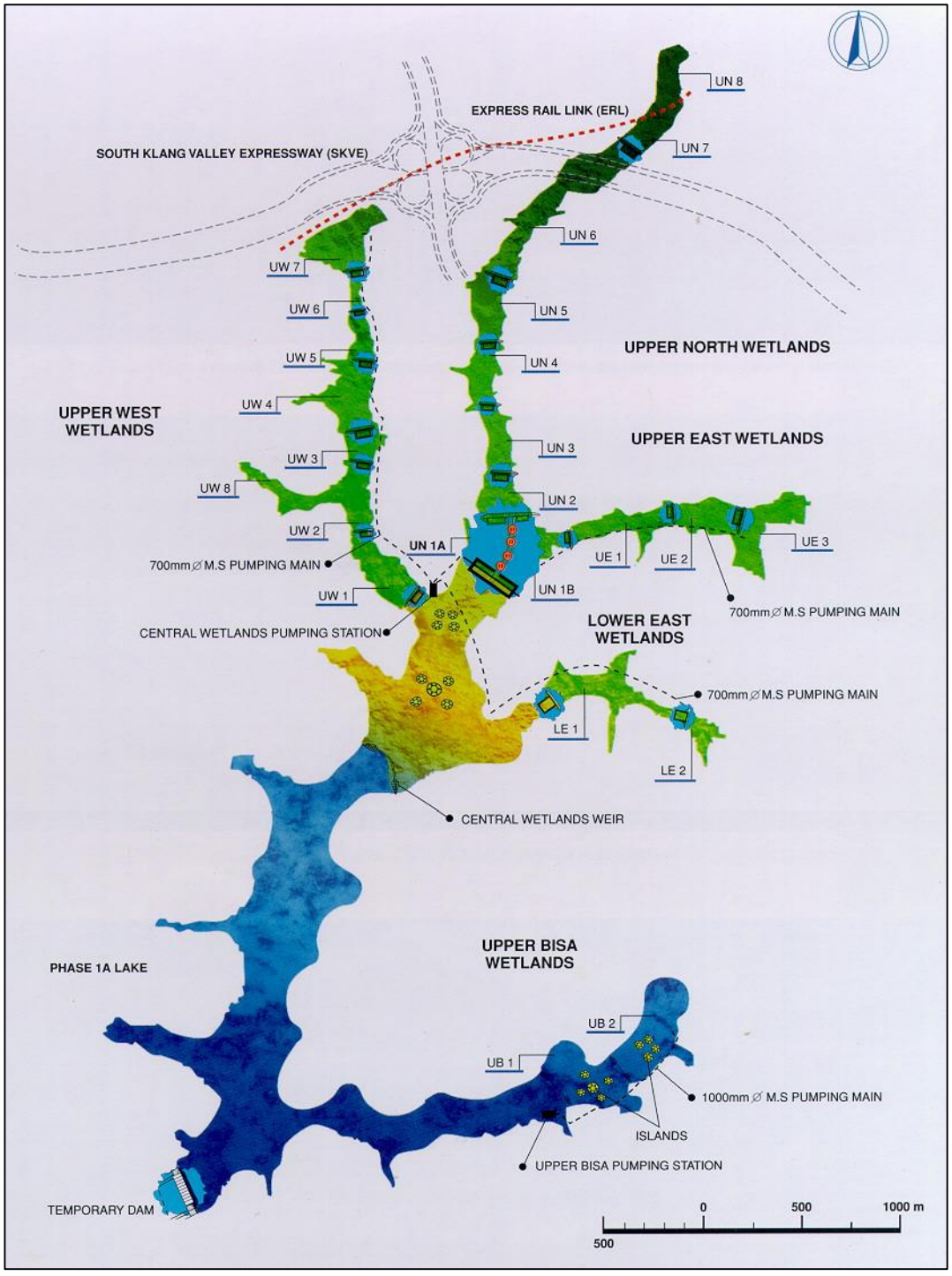
The 400 ha Putrajaya Lake was created by inundating the valleys of Sungai Chuau and Sungai Bisa. The lake has been primarily designed to enhance the aesthetic appeal of Putrajaya, as a sport and recreation attraction as well as a tourist attraction. The wetland is to be complemented by riparian park and gross pollutant traps. Putrajaya wetland is the first man-made wetland in Malaysia and one of the largest fully constructed freshwater wetland in the tropics. The project has transformed an oil palm site into wetland ecosystem with the help of modern technology and stringent environmental management method in design and construction.

The wetland straddles the water courses of Sungai Chuau, Sungai Bisa, and three tributaries. Their primary function is to ensure that the water entering the lake meets the standard set by Perbadanan Putrajaya. To achieve this, the wetland has been planted with a variety of aquatic plants that act as a natural filtration system, removing nutrient and pollutants from the catchment water. They treat natural run-off from the 50.9 km^2 of Sungai Chuau catchment (**Plates 21 & 22**).

Plate 21. End point of Putrajaya Wetlands

Plate 22. Upper side of Putrajaya Wetlands

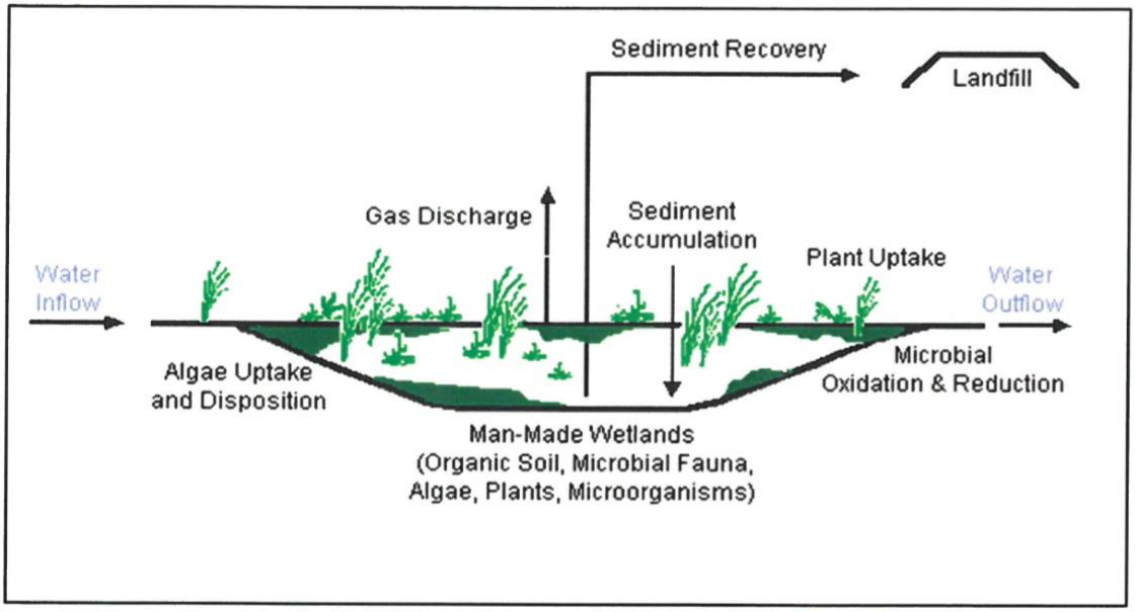
The 197.2 ha wetland system comprises of six arms with 23 cells (**Figure 16**). All the arms (except of Upper Bisa) eventually discharge to the central wetland, which make the 24 cells in total, before the water flows down into the Putrajaya Lake. A series of rock filled weirs was constructed along the six arms of the wetland to divide the 24 cells. Although all six arms are connected, they differ in size, depth, plant communities, and pollutant loads that it is designed to handle.



Source: PLWMOS (Putrajaya website on lake & wetland)

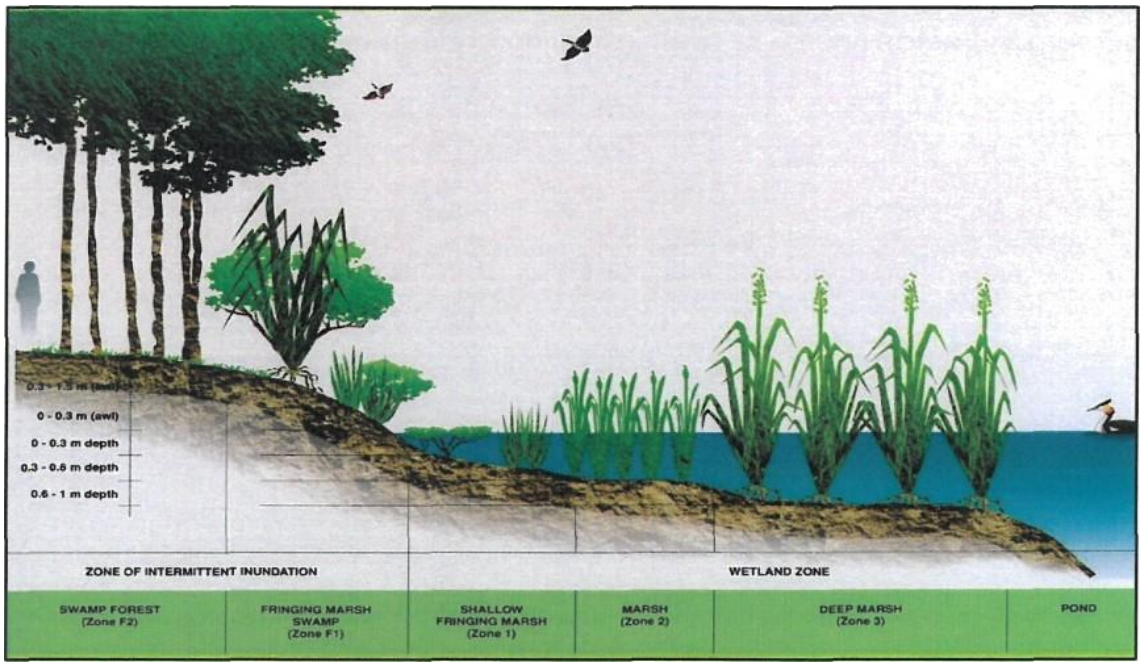
Figure 16. The Putrajaya Wetland cells and its location

The basic process occurring in the cell zones are illustrated in **Figure 17**. Typical longitudinal cross-section and typical layout of wetland cell are show in **Figures 18 & 19,** respectively.



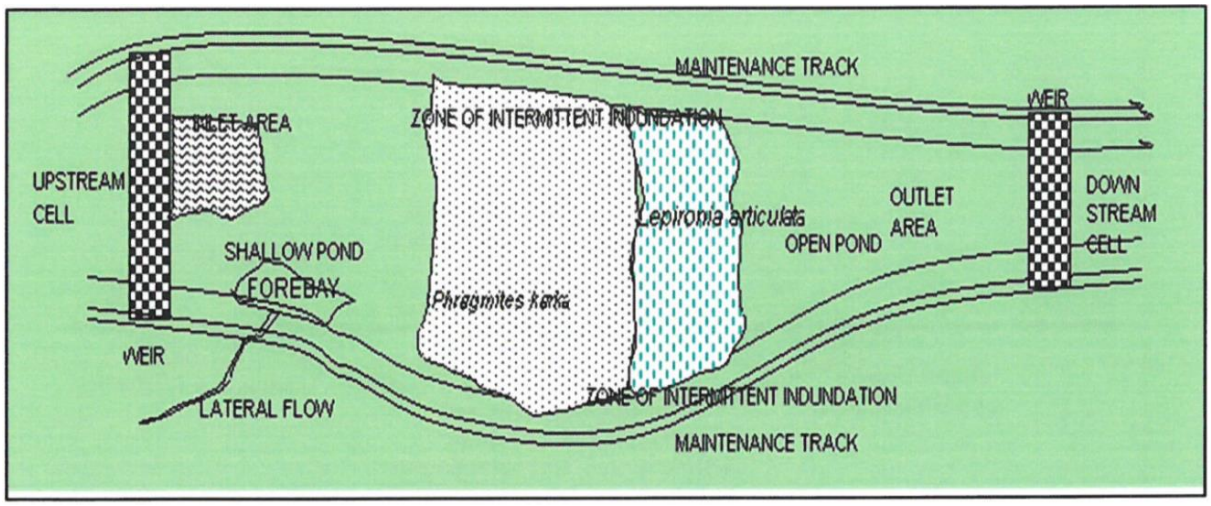
Source: Bioremediation website on constructed wetlands

Figure 17. Various processes occurring in the wetland cells



Source: PLWMOS (Putrajaya website on lake & wetland)

Figure 18. Longitudinal section of a typical wetland cell showing the Zone of Intermittent Inundation (F2 and F1), Wetland Zone (Zone 1, 2 and 3), and the open pond



Source: PLWMOS (Putrajaya website on lake & wetland)

Figure 19. Typical layout of a wetland cell

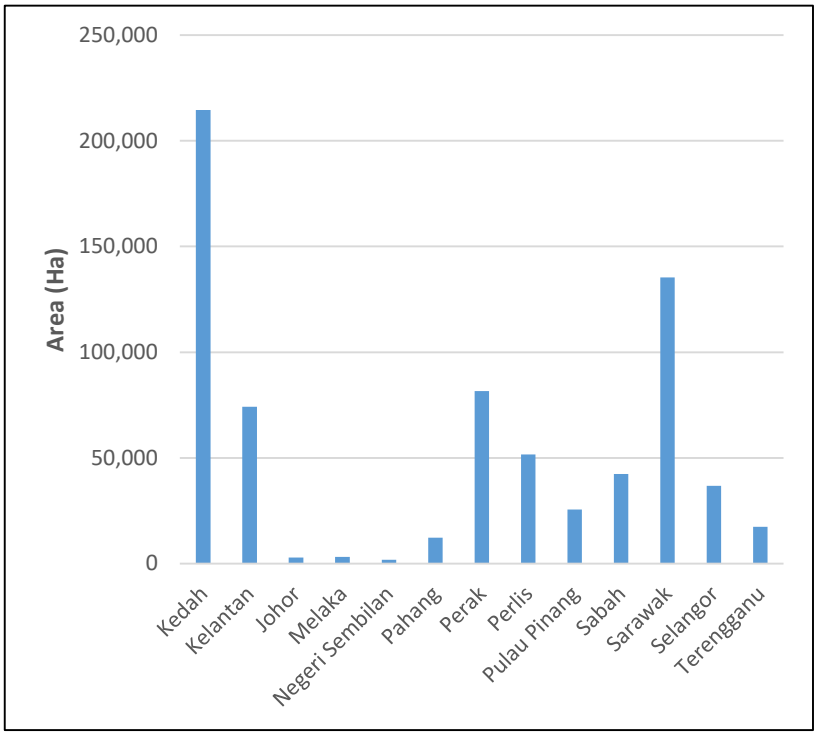
The design features a multi-cell multi-stage system with flood retention capability to maximise the space available for colonisation by aquatic plant. The roles of the plants are to intercept pollutants and to provide a root zone where bacteria and microorganisms can flourish to assist in filtering and removing water pollutants.

16. Paddy Fields

Paddy field is a flooded field used to cultivate rice. Most paddies are flooded with water sourced from river and rainfall during monsoon season, while other must be irrigated (**Plate 23**). The paddies have impermeable subsoil and bordered by earth bunds to hold an average of 10–15 cm of water in the field for three-quarters of the growing season. In Southern and Eastern Asia, wet-rice cultivation is the most prevalent method of farming in the Far East, where it utilises a small fraction of the total land yet feeds the majority of the rural population. Rice was domesticated as early as 3,500 Before Century, and by about 2,000 years ago it was grown in almost all of the present day cultivation areas, predominantly deltas, floodplains and coastal plains, and some terraced valley slopes. Based on record by DOA (2020), Malaysia has an area of 699,980 ha of paddy fields (**Figure 20**).

Plate 23 Paddy field in Sekinchan, Selangor

State	Paddy Field (Ha)
Kedah	214,592
Kelantan	74,149
Johor	2,866
Melaka	3,135
Negeri Sembilan	1,896
Pahang	12,300
Perak	81,699
Perlis	51,612
Pulau Pinang	25,564
Sabah	42,442
Sarawak	135,426
Selangor	36,868
Terengganu	17,431
Total	**699,980**



Source: DOA (2020)

Figure 20. Paddy fields in Malaysia

CONVENTION ON WETLANDS

The Ramsar Convention

The Convention on Wetlands is an intergovernmental treaty adopted on 2 February 1971 in the Iranian city of Ramsar, whose mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". The official name of the treaty is "The Convention on Wetlands of International Importance especially as Waterfowl Habitat", which reflects its original emphasis on the conservation and wise use of wetlands primarily to provide habitat for water birds. Over the years, the convention has broadened its scope to cover all aspects of wetland conservation and wise use recognising wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well-being of human communities.

The broad aim of the Convention on Wetlands is to halt the worldwide loss of wetlands and to conserve those that remain through wise use and management. This requires international cooperation, policy-making, capacity building, and technology transfer. The Convention on Wetlands provides framework for national action and wise use of wetlands and their resources. **Table 4** shows a glance of the information in Ramsar Convention.

Table 4. Ramsar Convention information

Number of Contracting Parties	171
Number of Wetland Site (worldwide)	2,422
Estimated area (Ha)	254,590,454

Source: Ramsar Convention Official Website (2021)

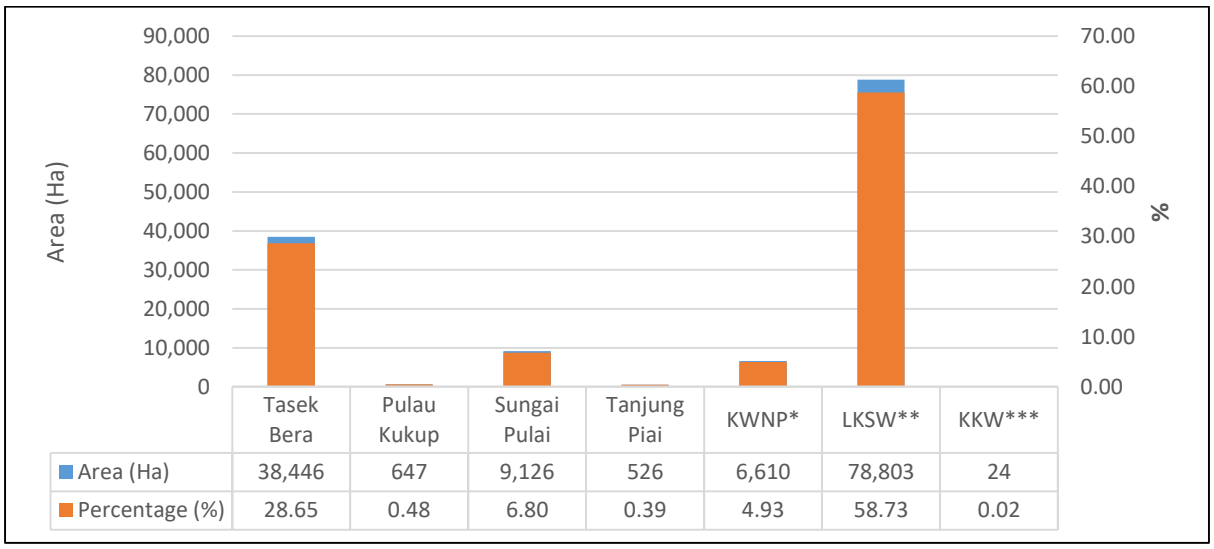
Ramsar Sites in Malaysia

Malaysia is contracting party to the Ramsar Convention. Presently, Malaysia has designated seven wetland sites for special protection as Ramsar sites, covering an area of 134,182 ha (**Table 5**) with their percentages shown in **Figure 21**.

Table 5. Ramsar sites in Malaysia

Site Name	Site Number	Administrative region	Area (Ha)	Designation date	Wetland types
Tasek Bera	712	Pahang	38,446	10-11-1994	Freshwater swamp
Pulau Kukup	1287	Johor	647	31-01-2003	Mangroves
Sungai Pulai	1288	Johor	9,126	31-01-2003	Mangroves
Tanjung Piai	1289	Johor	526	31-01-2003	Mangroves
Kuching Wetland National Park	1568	Sarawak	6,610	08-11-2005	Mangroves
Lower Kinabatangan-Segama Wetlands	1849	Sabah	78,803	08-09-2008	Mixed of mangroves, nipa & peat swamps
Kota Kinabalu Wetlands	2290	Sabah	24	22-10-2016	Mangroves

Source: Hamdan *et*.al. (2017)



* KWNP- Kuching Wetlands National Park
**LKSW- Lower Kinabatangan-Segama Wetlands
***KKW- Kota Kinabalu Wetlands

Figure 21. Total land area and percentages of Ramsar sites in Malaysia

Descriptions of the Ramsar Site in Malaysia is as follows:

Tasek Bera, Pahang - designated on 10th November 1994. Tasek Bera is a freshwater wetland system in central Peninsular Malaysia, consisting mosaic of wetland habitats dominated by peat swamp forest, extensive reed beds, Pandanus stands, and open water bodies. Lowland dipterocarp forest surrounds the wetland and the catchment has mainly been converted to oil palm and rubber plantations. The indigenous Semelai people have lived in the Tasek Bera area for more than hundreds of years, and while livelihoods are changing, natural resources still provide a source of supplementary income.

Pulau Kukup, Johor - designated on 31st January 2003. Uninhabited mangrove island located 1 km from the southwestern tip of the Malaysia Peninsula, one of the few intact sites of this type left in Southeast Asia. Pulau Kukup has been identified as one of the Important Bird Areas (IBA) for Malaysia. Apart from that, Pulau Kukup is important for flood control, physical protection, and shoreline stabilisation as it shelters the mainland town from severe storm events. The coastal straits between Pulau Kukup and the mainland are a thriving industry for marine cage culture.

Sungai Pulai, Johor - designated on 31st January 2003.The largest riverine mangrove system in the Johor State, located at estuary of the Pulai River. With its associated seagrass beds, intertidal mudflats, and inland freshwater riverine forest, the site represents one of the best examples of a lowland tropical river basin, supporting a rich biodiversity dependent on mangrove. The site fringes play a significant role in shoreline stabilisation and severe flood prevention in the adjacent 38 villages.

Tanjung Piai, Johor - designated on 31st January 2003. The site consists of coastal mangroves and intertidal mudflats located at the southernmost tip of the continental Asia, especially important for protection from sea-water intrusion and coastal erosion.

Kuching Wetlands National Park, Sarawak - designated on 8th November 2005. The site is a saline mangrove system with flora comprising predominantly the genera of *Rhizophora*, *Avicennia,* and *Sonneratia* sp., its proximity to the city of Kuching, the Damai Resort Complex, and two other national parks renders it of high potential value for tourism, education, and recreation.

Lower Kinabatangan-Segama Wetlands, Sabah - designated on 28th October 2008. The Lower Kinabatangan-Segama wetlands is of global conservation importance for its rich biodiversity: the site harbours rare, threatened, and endangered large mammal species including the world's smallest elephant. It is one of only two known sites in the world inhabited by fen species of primates, four of which are endemic to Borneo. Predominant wetland type found within the site are mangrove and brackish forest (including nipa swamps), peat swamp forest, and wet grasslands on peat, all of which are completely protected within three contiguous protected areas; Trusan Kinabatangan Forest Reserve, Kulamba Wildlife Reserve, and Kuala Maruap and Kuala Segama Forest Reserves. This 78,803 ha site is located within the largest forest-covered floodplain in Malaysia.

Kota Kinabalu Wetlands, Sabah - designated on 22nd October 2016. It is Malaysia seventh Wetland of International Importance. It supports a range of biodiversity, with 30 mangroves species and associated plants, 90 species of resident and migratory birds, and five species of reptiles. Other than that, it supports three globally threatened species, including the critical endangered mangrove *Bruguiera hainesii*, and two vulnerable water birds, the Chinese egret (*Egretta eulophotes*) and the Lesser adjutant (*Leptoptilos javanicus*).

THE WAY FORWARD FOR MALAYSIAN WETLANDS

At national level, it is recognised that Malaysia already has policy direction in regards to the use of its natural resources. The National Policy on Biological Diversity, 2016–2025, is the overarching biodiversity policy for the country that sets out strategies and actions. The policy emphasises that wetlands such as mangroves, peat and freshwater swamps, need to be adequately protected. Wetlands are further recognised as important sites for migratory birds, in regulating the hydrological regime, in supporting fisheries and unique flora and fauna, due to their distinctive characteristics at the interface of terrestrial and aquatic systems.

The National Forestry Policy 1978 (revised 1992) provides legal gazettement of all types of forests as Permanent Reserved Forest (PRF) to be conserved and managed based on the principles of sustainable forest management, as well as to conserve biological diversity, genetic resources, and to encourage research and education.

The National Physical Plan III, is a key statutory document, which provides guidelines for spatial planning and has particular relevance to the conservation of wetlands. The Plan calls for Environmentally Sensitive Areas to be integrated in the planning and management of land use and natural resources. Sensitive coastal and marine ecosystems shall be protected and managed in a sustainable manner and all surface and ground water resources shall be safeguarded and sustainably managed. In addition, other relevant policies include National Policy on Climate Change 2009, National Water Resources Policy 2012, and National Action Plan on Invasive Alien Species 2021 - 2025, and National Action Plan for Peatlands 2011.

National Wetlands Policy has been revised in recognition of the need to harmonise with all relevant existing policies. Working primarily through existing programmes and decision-making mechanisms, this Policy is designed to enhance wetland conservation and wise use. The purpose of the wetlands policy is to define and set the framework for the conservation and wise use of wetlands within the broader context of environmental management among federal and state government agencies in the country. It provides guidance in administering activities to ensure wetlands are managed in accordance with the principles of sustainable development.

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Annex I

Classification System Wetland Type (Ramsar Convention)

Wetland Type:

Marine/ coastal: A. B. D. E. F. G. H. I. J. K. Zk(a)

Inland: L. M. N. O. P. Q. R. Sp. Ss. Tp. Ts. U. Va. Vt. W. Xf. Xp. Y. Zg. Zk(b)

Human-made: 1. 2. 3. 4. 5. 6. 7. 8. 9. Zk(c)

Marine/Coastal Wetlands

A	Permanent shallow marine waters in most cases less than 6 m deep at low tide: includes sea bays and straits.
B	Marine subtidal aquatic beds; includes kelp beds, sea-grass beds, tropical marine meadows.
C	Coral reefs
D	Rocky marine shores; includes rocky offshore islands, sea cliffs.
E	Sand, shingle or pebble shores: includes sand bars, spits, and sandy islets: includes dune systems and humid dune slacks.
F	Estuarine waters; permanent water of estuaries and estuarine systems of deltas
G	Intertidal mud, sand or salt flats.
H	lntertidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes: includes tidal brackish and freshwater marshes.
I	Intertidal forested wetlands: includes mangrove swamps, nipa swamps, and tidal freshwater swamp forests.
J	Coastal brackish/saline lagoons; brackish to saline lagoons with at least one relatively narrow connection to the sea.
K	Coastal freshwater lagoons: includes freshwater delta lagoons.
Zk(a)	Karst and other subterranean hydrological system, marine/coastal

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Inland Wetlands

L	Permanent inland deltas.
M	Permanent rivers/streams/creeks: includes waterfalls
N	Seasonal/intermittent/irregular rivers/streams/creeks.
O	Permanent freshwater lakes (over 8 ha); includes floodplain lakes.
P	Seasonal/intermittent freshwater lakes (over 8 ha); includes floodplain lakes.
Q	Permanent saline/brackish/alkaline lakes.
R	Seasonal/intermittent saline/blackish/alkaline lakes and flats.
Sp	Permanent saline/brackish/alkaline marshes/pools.
Ss	Seasonal/intermittent saline/brackish/alkaline marshes/pools.
Tp	Permanent fresh water marshes/pools: ponds (below 8 ha), marshes and swamps on inorganic soils: with emergent vegetation water-logged for at least most of the growing season
Ts	Seasonal/intermittent freshwater marshes/pools on inorganic soils: includes sloughs, potholes, seasonally flooded meadows, sedge marshes.
U	Non-forested peatlands: includes shrub or open bogs, swamps, fens.
Va	Alpine wetland; includes alpine meadows, temporary waters from snowmelt.
Vt	Tundra wetland; include tundra pools, temporary waters from snowmelt.
W	Shrub-dominated wetland: shrub swamps, shrub-dominated freshwater marshes, shrub carr, alder thicket on in organic soils
Xf	Freshwater, tree-dominated wetlands: includes freshwater swamp forests, seasonally flooded forest, wooded swamps on inorganic soils.
Xp	Forested peatlands; peat swamp forest
Y	Freshwater sprints: oasis
Zg	Geothermal wetlands
Zk(b)	Karst and other subterranean hydrological systems, inland

Note: 'Floodplain' is a broad term used to refer to one or more wetland type. Which may include example from the R, Ss, Ts, W, Xf, Xp, or other wetland types. Some examples of floodplain wetlands are seasonally inundated grassland (including natural wet meadows, shrublands, woodlands and forests, Floodplain wetlands are not listed as a specific wetland type herein.

Human-made Wetlands

1	Aquaculture (e.g., fish/shrimp) ponds.
2	Ponds; includes farm ponds, stock ponds, small tank; (generally below 8 ha).
3	Irrigated land; includes irrigation channels and rice fields.
4	Seasonally flooded agricultural land (including intensively managed or grazed wet meadow or pasture).
5	Salt exploitation sites; salt pans, salines, etc.
6	Water storage areas; reservoirs/barrages/dams/impoundments (generally over 8 ha).
7	Excavations; gravel/brick/clay pits; borrow pits, mining pools.
8	Wastewater treatment areas; sewage farms, settling ponds, oxidation basins, etc.
9	Canals and drainage channels, ditches
Zk(c)	Karst and other subterranean hydrological system, human-made

Annex II

Current List of Acts and Ordinances Related on Wetlands

Federal Acts

- Drainage Act 1951
- Irrigation Act 1952
- Environmental Quality Act 1974
- Plant Quarantine Act 976
- Fisheries Act 1985
- Pesticides Act 1974
- FRIM Act 2016

Federal Acts within Peninsular Malaysia States

- Water Enactment 1920
- Aboriginal Peoples Act 1954
- Land Acquisition Act 1960
- Land Conservation Act 1960
- National Land Code 1965
- Protection of Wildlife Act 1972
- National Parks Act 1980
- National Forestry Act 1984
- Local Government Act 1976
- Town and Country Planning Act 1976
- Exclusive Economic Zone Act 1984
- Tourism Industry Act 1992
- Access Benefit Sharing 2017

Sabah Ordinances

- Land Ordinance 1956
- Conservation of Environment Enactment T996
- Fauna Conservation Ordinance 1963
- Birds' Nests Ordinance 1914
- Forest Enactment 1968
- Tourism Promotion Corporation Enactment 1981
- Parks Enactment 1984
- Water Ordinance

Sarawak

- Forests Ordinance, 2015 (Cap.71)
- National Parks and Nature Reserves Ordinance, 1956 1998 (Cap.27)
- Wildlife Protection Ordinance, 1998 (Cap.26)
- The Natural Resources and Environment (Prescribed Activities) Order, 1994
- Natural Resources and Environment Ordinance (Cap.84), Laws of Sarawak (1958 ed.)
- Tourism Board Ordinance, 1994
- Water Ordinance, 1994
- Public Parks and Greens Ordinance, 1993
- Land Code, 1958 (Cap.81)
- Sarawak Forestry Corporation Ordinance, 1995
- Sarawak Biodiversity Centre (Amendment) Ordinance, 2014
- Sarawak Rivers Ordinance, 1993 (Cap.4)

AN OVERVIEW OF **WETLANDS IN MALAYSIA**

This Wetlands Compendium provides baseline wetlands information of Malaysia, which comprises 31 types of wetland. Most of these wetlands types are small, and due to lack of information, couldn't be covered in this document. Overall, there are 16 major types of wetlands that have been selected based on information and data availability.

Natural wetlands which holds important ecosystem are estimated to be more than 5.1 million ha in Malaysia. Their natural role and functions are crucial especially in flood mitigation, maintenance of river base flows, providing habitats for the many unique flora and fauna, and serves as an essential carbon sink. In addition, there are also man-made wetlands such as man-made lakes and paddy fields which plays a crucial role in sustaining the environment and food security. Therefore, the conservation of wetlands ecosystem is of paramount importance to the country and this cannot be achieved without greater public awareness and understanding of its significance in regards to national and global contexts.