

Characteristics, Threats and Management of Philippine Wetlands

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필리핀 습지의 특성, 위협 및 관리

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Abstract

The Philippines is a naturally water-rich archipelago capable of sustaining its ecological goods and providing services and needs of its people. Several waterbodies have been declared as natural wetlands in the country supporting the needs of community like water and food. In this study, 65 natural wetlands were considered including six sites that were identified as ‘Wetlands of International Importance’ such as Naujan Lake National Park, Agusan Marsh Wildlife Sanctuary, Olango Island Wildlife Sanctuary, Tubbataha Reefs Natural Park, Las Piñas–Parañaque Critical Habitat and Ecotourism Area and Puerto Princesa Subterranean River National Park. There are 22 wetland types presented in this research categorizing the Philippine wetlands. Philippine wetlands are now facing tremendous challenges such as land use conversion, abuse of resources, pollution coming from domestic, industrial and agricultural activities, and climate change. This paper provides an overview of Philippine wetlands in terms of their characteristics and components, impacts in the ecosystem, and the challenges they are dealing with. Moreover, the preservation measures that the government and private agencies implements to these wetlands were discussed and assessed. The enforcement of local and national laws concerning wetlands is found to be inadequate resulting in poor quality wetlands. The preservation and utilization of these wetlands can be maximized with a voluntary participation of whole Philippine community.

Key words : Ecosystem services, Management, Philippines, Threats, Wetlands

요약

필리핀은 친환경자원을 유지하고 시민들에게 서비스 및 필수품을 제공할 수 있는 수자원이 풍부한 열도이다. 지역 사회가 필요로 하는 물과 식량을 제공하는 일부 수역은 자국 내 자연습지로 선정된다. 본 연구에서는 ‘국제적으로 중요한 습지’로 선정된 Naujan Lake National Park, Agusan Marsh Wildlife Sanctuary, Olango Island Wildlife Sanctuary, Tubbataha Reefs Natural Park, Las Piñas–Parañaque Critical Habitat and Ecotourism Area and Puerto Princesa Subterranean River National Park의 6개 지역을 포함한 총 65개의 습지를 조사하였다. 이들 습지는 22개의 유형으로 분류되었다. 필리핀 습지는 현재 습지의 전용, 자원의 남용, 생활 및 산업과 농업활동에 따른 오염, 그리고 기후변화와 같은 수많은 위협에 직면해있다. 본 논문은 습지의 특성 및 구성요소, 생태계에 미치는 영향, 습지가 직면한 위기에 대한 개관을 제공한다. 또한 정부와 민간기관에서 시행하고 있는 습지 보존 대책이 토의되고 평가되었다. 습지에 대한 지자체 및 국가차원의 법령이 부족한 것으로 판단되었으며, 이는 습지의 질적 하락으로 이어진다. 이러한 습지의 보존 및 활용은 필리핀 전체 지역사회의 자발적인 참여로부터 극대화될 수 있다.

핵심용어 : 생태계서비스, 유지관리, 필리핀, 위협, 습지

1. Introduction

Wetlands are known to support biodiversity as a biological

system. It is where a number of microorganisms, reptiles, amphibians, fish, birds and mammals that live within or near waters are found. Wetlands play a critical role in providing several natural processes, products and services to the human communities for its development and survival (PAWB–DENR, 2013). The Ramsar Convention, an intergovernmental treaty about the conservation and wise

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use of wetlands and its resources, defines wetlands as the “areas of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including area of marine water the depth of which at low tide does not exceed six meters.” (DENR, 2011; PAWB–DENR, 2013). As stated in the Ramsar Convention, wetlands can be identified into three broad categories: inland, coastal/marine and human-made. Inland wetlands include freshwater inland waters/waterbodies and brackish water that are situated within land boundaries. Coastal/marine wetlands are referring to the wetlands that are found within coastal watersheds; while, fish and shrimp ponds, farm ponds, irrigated agricultural land, salt pans, dams and reservoirs, gravel pits, sewage farms and canals are classified under the human-made wetlands (PAWB–DENR, 2013).

Wetlands are also considered as one of the world’s most productive and valuable ecosystems that provides a great number of foods that categorizing it as a “biological supermarket” (US EPA, 2016) Conserving and providing water is said to be its basic function establishing economic, scientific, cultural and recreational value for the community (DENR, 2011). Table 1 summarizes the services and benefits that the wetlands provide to the people. The goods or products that are directly harvested from wetlands are observed under the provisioning. For the Regulating, the functions or services that are performed by wetlands are

enumerated. Ecosystem scale attributes of wetlands is presented under the cultural; whereas, the additional services are considered under the supporting section. Unfortunately, people took advantage of the resources that the wetlands provide and focus only its benefits. This leads wetlands to continuously deal with threats of being transformed, destroyed and irreversibly changed (PAWB–DENR, 2005).

Philippines are endowed with a numerous bodies of water such as rivers, bays, gulfs, waterfalls, lakes and swamps. These water bodies, referred to as surface water, have been the country’s source of water along with the rainfall and groundwater resources. The freshwater storage capacity and the high rate of precipitation has been the country’s assurance of sufficient supply of water for its agricultural, industrial and domestic uses (Greenpeace, 2007). In terms of the quality and quantity of water, there are areas in the Philippines that are critical. Merely less than half of the rivers in the Philippines are identified as a good source of public water supply (Gorme et al., 2009). Philippines, as a part of the Ramsar Convention, is also responsible for the conservation of its wetlands of international importance (Wetlands International, 2002). The importance of wetlands in the Philippines has received increasing recognition partly because of the government agencies responsibilities in the conservation of natural resources (PAWB–DENR, 1993). Philippine wetlands are also facing a threatening situation

Table 1. Ecosystem services provided by or derived from wetlands. Adapted from PAWB–DENR, 2013.

Provisioning	
Food	Production of fish, wild game, fruits and grains
Freshwater	Storage and retention of water for domestic, industrial, and agricultural use
Fiber and fuel	Production of logs fuelwood, peat and fodder
Biochemical	Extraction of medicines and other materials from biota
Genetic Materials	Genes for resistance to plant pathogens, ornamental species
Regulating	
Climate regulation	Source of and sink for greenhouse gases, influence local and regional temperature, precipitation, and other climatic processes
Water regulation (Hydrological flows)	Groundwater recharge/discharge
Water purification and waste treatment	Retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	Retention of soils and sediments
Natural hazard regulation	Flood control, storm protection
Pollination	Habitat for pollinators
Cultural	
Spiritual and inspirational	Source for inspiration, many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	Opportunities for recreational activities
Aesthetic	Many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	Opportunities for formal and informal education and training
Supporting	
Soil formation	Sediment retention and accumulation of organic matter
Nutrient cycling	Storage, recycling, processing and acquisition of nutrients

caused mainly by the drainage and reclamation activities (DENR and UNEP, 1997). Some other threats that are also issues of concern in the Philippines are exotic species introductions, over-exploitation, pollution and siltation (DENR and UNEP, 1997). There are some regulations concerning wetlands that don't directly applied to them but are distributed to natural resources, jurisdictions over territory and management, or the prohibition of certain acts bound to site specific areas (PAWB-DENR, 2013).

The objective of this paper was to assess the status of wetlands of international importance and other wetlands present in the Philippines, in terms of its characteristics and components, the ecosystem services it provides, challenges that they're dealing with, and the laws, policies, programs, and the community response to its way of conserving and managing wetlands.

2. Wetlands in the Philippines

2.1 Description and types of natural wetlands

The Philippines are known to have extensive wetland areas

such as lakes, rivers, ponds, inland and coastal marshes and swamps, estuaries and mangrove swamps. The estimated total area of freshwater lakes, swamps and estuaries, brackish ponds and man-made reservoirs, is around 114,000 ha, 527,000 ha, 176,000 ha and 130,000 ha, respectively. The Philippines is consists of 216 lakes, 421 principal rivers, and 22 marshes, swamps and reservoirs according to the Philippine Biodiversity Conservation Priorities (Scott, 1989). Among these waterbodies, 65 Philippine wetlands were considered in this study.

Wetlands considered in this study were characterized depending on its wetland type as shown in Fig 1. In Fig 1(a), it shows the distribution of wetland types in the Philippines used in this study. The five major wetland types that exist in the country are intertidal mudflats and sand flats (type 6), mangrove swamps and forest (type 7), shallow sea bays and straits (type 1), estuaries and deltas (type 2) and lastly, freshwater lakes and associated marshes (type 14). The two most common types of wetlands in the country, intertidal mudflats, sand flats (type 6) and mangrove swamps and forests (type 7), comprise 30% of the entire wetlands

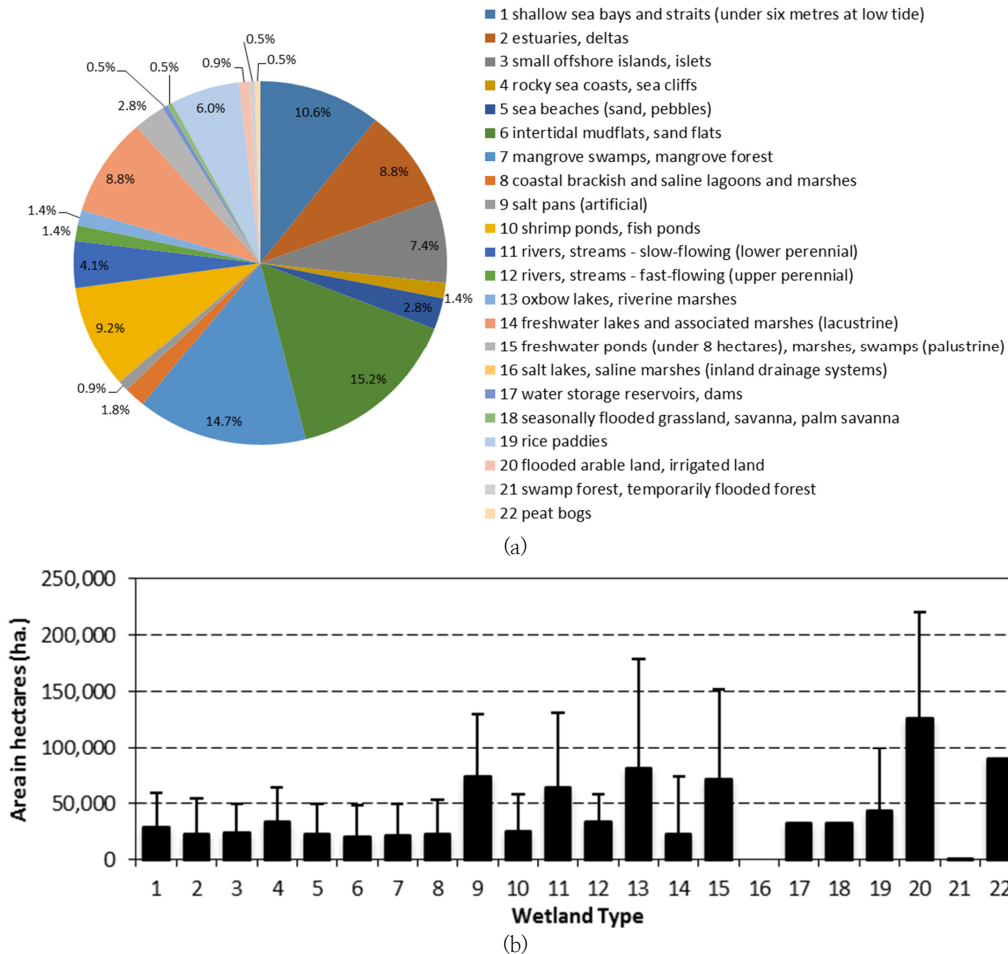


Fig. 1. Characteristics of Wetland Types in the Philippines (a) Distribution (b) Average area (Scott, 1989; PAWB- DENR 2005).

considered in this study. Only few salt lakes and saline marshes (type 16), water storage reservoirs and dams (type 17), grassland and savanna (type 18), swamp forest (type 21) and peat bogs (type 22) are in the Philippines. Shallow sea bays and straits (type 1), estuaries and deltas (type 2), shrimp ponds and fish ponds (type 10), and freshwater lakes and associated marshes (type 14) have similar distribution having approximately 10% among the wetland types in the country. There were no salt lakes, saline marshes (type 16) type of wetlands that was considered in this study.

The average area of wetland types in the Philippines is shown in Fig 1(b). Flooded arable land, irrigated land type of wetland, type 20, is the largest among the wetlands considered in this study having a 126,000 ha average area and a 94,000 ha standard deviation. This is followed by peat bogs having 90,000 ha, and oxbow lakes and riverine marshes having approximately 82,000 ha. Wetland type 2, 3, 5, 6, 7, 8, and 14 has close values of average area ranging from approximately 20,000 ha up to 25,000 ha. Excluding wetland types 16 and 17, which are the salt lakes, saline marshes and water storage reservoirs and dams, the smallest average area among the wetland type is intertidal mudflats and sand flats, type 6, considering that it has the most number of wetlands studied.

These different types of wetlands serve as a habitat to several species of wildlife and it shows a significant effect to waterfowl. Migratory water birds throughout East Asia made its way to the Philippine wetlands as it becomes their important wintering grounds. Six of the country's wetland area have been recognized and declared by the Ramsar Convention as wetlands of international importance. These six wetlands receive protection under this treaty upon its declaration because of its importance to migratory waterfowl and endemic Philippine species (Jonas, 2012).

2.1.1 Some Philippine wetlands and wetlands of international importance

Philippines is approximately consists of 7,100 islands lying in the three major island division, namely Luzon, Visayas and Mindanao (PAWB-DENR, 2005; Scott, 1989). The location of the wetlands considered in this study is plotted in Fig 2. Since the Philippines are surrounded with a large extent of water bodies, it is evident that the wetlands are mostly found around the perimeter of the country. Out of the 65 wetlands considered in this study, 18 wetlands are located in Luzon, 33 wetlands in Visayas and 14 wetlands in Mindanao. The total area of wetlands that are considered in this study is 442,864 ha in Luzon, 453,171 ha in Visayas and 575,082 ha in

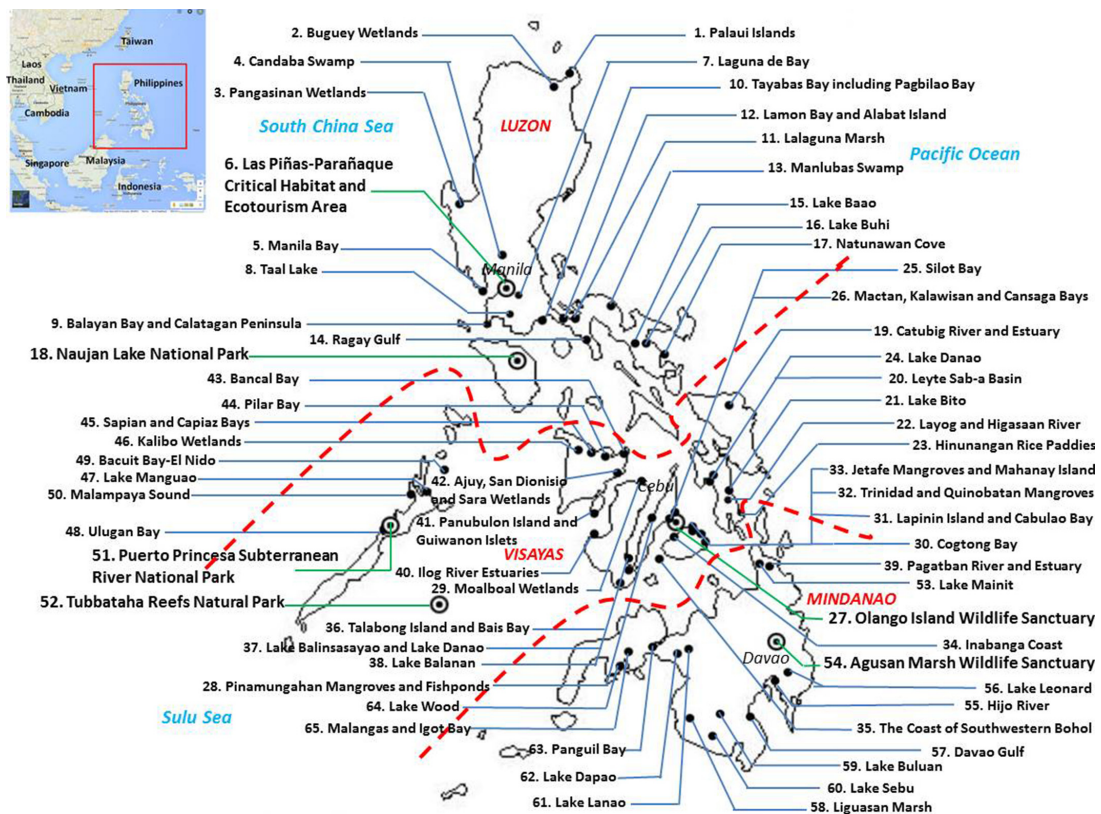


Fig. 2. Location of 65 Philippine wetlands considered in this study (PAWB- DENR 2005; Scott, 1989).

Mindanao. Visayas has the most number of wetlands that were used in this study but its wetland total area was the smallest among the three islands. As for Mindanao, having the least number of wetlands considered, it has the largest total area of wetlands.

Among the 65 Philippine wetlands considered in this study, there are six declared wetlands of international importance that includes Agusan Marsh Wildlife Sanctuary, Naujan Lake National Park, Tubbataha Reefs Natural Park, Olango Island Wildlife Sanctuary, Puerto Princesa Subterranean River National Park and Las Piñas-Parañaque Critical Habitat and Ecotourism Area. The characteristics of each wetlands of international importance are summarized in Table 2. Considering that Tubbataha Reefs Natural Park is situated in the middle of Sulu Sea, it has the biggest area among the six wetlands and also has a huge number of fish species, corals and algae. Las Piñas-Parañaque Critical Habitat and Ecotourism Area, popular for bird watching and has the smallest area of wetland among the six, joined the Ramsar sites in 2013 being the latest declared wetland of international importance. Tubbataha Reefs Natural Park, Naujan Lake National Park and Agusan Marsh Wildlife Sanctuary have joined Ramsar Convention on the same date, November 12, 1999. Naujan Lake National Park is known for its fishing site while trapping of crocodiles for sale is a very famous activity in Agusan Marsh Wildlife Sanctuary.

Naujan Lake National Park is known to be the fifth largest lake in the Philippines. Fishing is also known to be the main livelihood of the community living around the lake (Ramsar, 2016). Naujan Lake National Park, together with Agusan Marsh Wildlife Sanctuary and Puerto Princesa

Subterranean River National Park, are considered as an important source of water for domestic and agricultural uses, particularly in irrigation (BirdLife International, 2016; PAWB-DENR, 2013; Ramsar, 2016). Agusan Marsh Wildlife Sanctuary is considered as the country's most ecologically significant wetlands acting as a "giant sponge" since it has been a storage for the 15% of the Philippines' fresh water resources (Jonas, 2012). Its main economic activities, aside from fishing, are aquaculture and agriculture (BirdLife International, 2016). Puerto Princesa Subterranean River National Park, having unique biogeographic region, is also a popular ecotourism destination along with the Tubbataha Reefs Natural Park's popularity amongst fishermen and scuba divers (Ramsar, 2016; SCPW, 2016). Tubbataha Reefs Natural Park is a state-owned wetland where there are no inhabitants living around the boundaries of the site (PAWB-DENR, 2013). Olango Island Wildlife Sanctuary is surrounded by a reef flat lagoon which is well-known most extensive reef areas in the Central Visayas (PAWB-DENR, 2013). Most of the people in the area depends on the sanctuary's coastal resources for their livelihood such as harvesting sea urchins, fish and commercial shells, farming corn, cassava and coconut, and lastly, raising livestock (Ramsar, 2016). The first wetland in the Philippines to have been entitled as a critical habitat under the Presidential Proclamation 1412 and 1412-A is the Las Piñas-Parañaque Critical Habitat and Ecotourism Area (PAWB-DENR, 2013).

Enumerated in Table 3 are the 65 Philippine wetlands considered in this study, including the six wetlands of international importance. Among these wetlands, Liguasan

Table 2. Wetlands of international importance (Birdlife International, 2016; Jonas, 2012; PAWB-DENR, 2005; Ramsar, 2016; SCPW, 2016).

Parameters	Agusan Marsh Wildlife Sanctuary	Naujan Lake National Park	Tubbataha Reefs Natural Park	Olango Island Wildlife Sanctuary	Puerto Princesa Subterranean River National Park	Las Piñas-Parañaque Critical Habitat and Ecotourism Area
Location	Agusan del Sur (Mindanao)	Oriental Mindoro (Luzon)	middle of Sulu Sea (Visayas)	Cebu (Visayas)	Palawan (Visayas)	Manila (Luzon)
Size	14836 ha	14568 ha	96828 ha	5800 ha	22202 ha	175 ha
Species	14 freshwater fishes, 127 birds, 21 amphibians, 39 reptiles, 14 mammals, 112 trees	5 amphibians, 12 reptiles, 13 mammals, 14 fishes, 70 birds, 600 flowers	359 corals, 600 fishes, 7 seagrass, 66 algae, 13 sharks, 2 marine turtles, 13 cetaceans	33 mangroves, 8 seagrasses, 72 macrobenthic algae, 97 birds, 4 non-scleractinian, 4 soft coral, 49 resident birds, 48 migratory birds	800 plant, 233 animal, 15 endemic species of birds	82 birds (47 migratory), 11 mangroves
Well-known characteristics	Trapping of crocodiles for sale on commercial farms	popular for fishing	home to largest coral atoll	major stopover for migratory waterfowl	connects a range of important ecosystems from the mountain-to-the-sea	popular for bird watching
Date of joining	1999 November 12	1999 November 12	1999 November 12	1994 July 01	2012 June 30	2013 March 15

Marsh has the largest size having a 220,000 ha followed by the Manila Bay having 130,000 ha and Tubbataha Reefs Natural Park with a 96,828 ha in size. Palau Island, Las Piñas-Parañaque Critical Habitat and Ecotourism Area, Lalaguna Marsh, Lake Baao, Lake Bito, Lake Danao, Silot Bay, Pinamungahan

Mangroves and Fishponds, Moalboal Wetlands, Lake Balinsasayao and Lake Danao, Lake Manguao, Lake Leonard, Lake Sebu, and Lake Wood are wetlands having an area smaller than 1000 ha. Lake Lanao, considered as the largest lake in Mindanao, is known to be one of the 17 ancient lakes on

Table 3. 65 Philippine wetlands considered in this study (PAWB- DENR 2005; Scott, 1989).

Wetland Name	Location	Size	Wetland Type
1. Palau Island	Cagayan	several 100 ha.	03,06
2. Buguey Wetlands	Cagayan	14,400 ha.	06,07,08,10,19
3. Pangasinan Wetlands	Pangasinan	3,000 ha.	06,10,19
4. Candaba Swamp	Pampanga	32,000 ha.	11,15,17,18,19,20
5. Manila Bay	Manila	130,000 ha.	01,02,06,07,09,10
6. Las Piñas-Parañaque Critical Habitat and Ecotourism Area	Manila	175 ha.	-
7. Laguna de Bay	Laguna	91,136 ha.	11,14
8. Taal Lake	Batangas	23,424 ha.	14
9. Balayan Bay and Calatagan Peninsula	Batangas	75,000 ha.	01, 04, 05, 06, 07, 08 & 10.
10. Tayabas Bay including Pagbilao Bay	Quezon Province	50,000 ha.	01, 02, 03, 06, 07, 10 & 19.
11. Lalaguna Marsh	Quezon Province	500 ha.	15
12. Lamon Bay and Alabat Island	Quezon Province	9,150 ha.	01, 02, 03, 06, 07 & 10.
13. Manlubas Swamp	Camarines Norte	-	15
14. Ragay Gulf	Bicol	-	01, 02, 06, 07 & 10.
15. Lake Baao	Camarines Sur	177 ha.	14 & 21.
16. Lake Buhi	Camarines Sur	1,707 ha.	14
17. Natunawan Cove	Albay		01, 06 & 07.
18. Naujan Lake National Park	Oriental Mindoro	10,875 ha.	14
19. Catubig River and Estuary	Northern Samar	-	02, 06, 07, 11 & 12.
20. Leyte Sab-a Basin	Leyte	90,000 ha.	11, 15, 19 & 22.
21. Lake Bito	Leyte	126 ha.	14
22. Layog and Higasaan Rivers	Leyte	10,500 ha.	11, 12 & 13.
23. Hinunangan Rice Paddies	Leyte	5,000 ha.	19
24. Lake Danao	Cebu	260 ha.	14
25. Silot Bay	Cebu	100 ha.	06, 07 & 08.
26. Mactan, Kalawisan and Cansaga Bays	Cebu	18,000 ha.	01, 02, 06, 07, 09 & 10.
27. Olango Island	Cebu	5,800 ha.	03, 05, 06 & 07.
28. Pinamungahan Mangroves and Fishponds	Cebu	800 ha.	04, 06, 07 & 10.
29. Moalboal Wetlands	Cebu	300 ha.	06, 07 & 10.
30. Cogtong Bay	Bohol	2,000 ha.	01, 02, 03, 06, 07 & 10.
31. Lapinin Island and Cabulao Bay	Bohol	37,500 ha.	01, 03, 06, 07 & 10.
32. Trinidad and Quinobatan Mangroves	Bohol	10,500 ha.	02, 06 & 07.
33. Jetafe Mangroves and Mahanay Island	Bohol	9,000 ha.	03, 06 & 07.
34. Inabanga Coast	Bohol	-	01, 02, 06, 07 & 10.
35. The Coast of Southwestern Bohol	Bohol	12,600 ha.	01, 02, 06, 07 & 10.
36. Talabong Island and Bais Bay	Negros Oriental	6,400 ha.	01, 02, 03, 06 & 07.
37. Lake Balinsasayao and Lake Danao	Negros Oriental	76 ha 28 ha.	14
38. Lake Balanan	Negros Oriental	-	14
39. Pagatban River and Estuary	Negros Oriental	2,500 ha.	01, 02, 05, 06, 07, 11 & 19.
40. Ilog River Estuaries	Negros Occidental	5,000 ha.	02, 06, 07, 10 & 19.
41. Panubulon Island and Guiwanon Islets	Guimaras	14,000 ha.	03, 06 & 07.
42. Ajuy, San Dionisio and Sara Wetlands	Iloilo	45,000 ha.	10 & 19.

Wetland Name	Location	Size	Wetland Type
43. Bancal Bay	Iloilo	7,700 ha.	01, 02, 03, 06, 07 & 10.
44. Pilar Bay	Capiz	52,000 ha.	01, 03, 06, 07 & 19.
45. Sapián and Capiz Bays	Capiz	3,000 ha.	01, 02, 05, 06, 07 & 08.
46. Kalibo Wetlands	Aklan	25,000 ha.	01, 02, 04, 05, 06, 07 & 19
47. Lake Manguao	Palawan	643 ha.	14
48. Ulugan Bay	Palawan	1,880 ha.	01, 03, 07 & 10
49. Bacuit Bay–El Nido	Palawan	35,284 ha.	01, 03
50. Malampaya Sound	Palawan	30,000 ha.	01, 02, 03, 06, 07
51. Puerto Princesa Subterranean River National Park	Palawan	22,202 ha.	–
52. Tubbataha Reefs Natural Park	Zamboanga	96,828 ha.	03
53. Lake Mainit	Surigao del Norte	13,836 ha.	14
54. Agusan Marsh Wildlife Sanctuary	Agusan del Sur	89,359 ha.	10, 11, 13, 14, 15 & 19
55. Hijo River	Davao	58,200 ha.	11 & 12.
56. Lake Leonard	Davao	6 ha.	14
57. Davao Gulf	Davao	–	01, 02, 05, 06, 07 & 10
58. Liguasan Marsh	Cotabato	220,000 ha.	11, 13, 14, 15, 19 & 20
59. Lake Buluan	Maguindanao	6,500 ha.	14
60. Lake Sebu	South Cotabato	350 ha.	14
61. Lake Lanao	Lanao del Sur	34,700 ha.	14
62. Lake Dapao	Lanao del Sur	1,011 ha.	14
63. Panguil Bay	Lanao del Norte	19,500 ha	01, 06 & 07
64. Lake Wood	Zamboanga del Sur	792 ha.	14
65. Malangas and Igot Bay	Zamboanga del Sur	34,000 ha.	01, 02, 03, 06 & 07

earth (Environmental Management Bureau, 2006; Greenpeace, 2007). Palauí Island and Buguey wetland have been identified as the two important wetland sites in the northern part of Luzon. Additionally, Buguey wetland has been recognized to be an Important Bird Area but protected status is not yet been formally established there (Mallari et al., 2001).

2.2 Characteristics and components

One way to determine the wellness of wetlands is through the presence and conditions of its floras and faunas that are very important aspects of any ecosystem (CEF, 2016). The total biodiversity of Philippine wetlands is comprised of 1,616 species of aquatic plants and 3,675 species of aquatic fauna (DENR, 1997). Also, the country has a rich water bird fauna; 115 species of waterfowl have been noted including 20 species of *Ardeidae*, 14 species of *Anatidae*, 17 species of *Rallidae* and 46 species of shorebirds (Scott, 1989).

2.2.1 Fauna

In Table 4, some birds, fishes, reptiles, amphibians and mammals species that are found in the Philippine wetlands are enumerated. The exotic species in the Philippines that consist of 93% fish, 2.67% mollusks and 4.33% crustaceans, frogs and turtles, are mainly used for ornamental, food

and biological control (PAWB–DENR, 2013). Naujan Lake is known having a rich fish fauna including some species that are protected (BirdLife International, 2016). Tubbataha Reefs Natural Park has been recognized as a site that has the most number of white–tip sharks and known to be supporting threatened fish such as the endangered humphead wrasse and the vulnerable giant grouper (Ramsar, 2016).

The Philippines has been a major migration route for East Asian shorebirds. Consequently, the Philippine wetlands have been important wintering areas for several migratory waterfowl (Scott, 1989). Olango Island Wildlife Sanctuary and Agusan Marsh Wildlife Sanctuary have been a major stopover for migratory birds and waterfowl for breeding or escaping the harsh North Asia winters. Among the common species are Chinese egrets, Asiatic dowitchers, Eastern curlews, plovers, and sandpipers (Jonas, 2012; Ramos, 2011; SCPW, 2016). The rare plain swampphen is a resident–breeding species found in Naujan Lake National Park, along with *Ninox Mindorensis*, *Sarcops Calvus*, *Penelopides Panini Mindorensis*, Philippine duck (*Anas luzonica*) and Brown–banded rail (*Rallus mirificus*) that are bird (sub) species endemic to the island (PAWB–DENR, 2013). Christmas Island Frigatebird is a threatened species

Table 4. Various fauna species that can be found in the selected Philippine wetlands (Birdlife International, 2016; Jonas, 2012; PAWB-DENR, 2005; Ramsar, 2016; SCPW, 2016).

Type	Description
Fish	common carp (<i>Cyprinus carpio</i>), gourami, grunt* (<i>Leiopotherapon plumbeus</i>), mangrove red snapper (<i>Lutianus argentimaculopus</i>), milkfish (<i>Chanos Chanos</i>), mudfish (<i>Ophicephalus striatus</i>), mullet (<i>Mugil macrolepis</i>), white goby (<i>Glossogobius giuris</i>)
Birds	blue-headed racquet-tail (<i>Prioniturus platenae</i>), blue paradise-flycatcher (<i>Terpsiphone cyanescens</i>), Chinese egrets, Palawan blue-flycatcher (<i>Cyornis lemprieri</i>), Palawan flowerpecker (<i>Prionochilus plateni</i>), Palawan hornbill (<i>Anthracoceros marchei</i>), Palawan peacock pheasant* (<i>Polyplectron emphanum</i>), Palawan tit (<i>Parus amabilis</i>), Philippine cockatoo (<i>Cacatua haematuropygia</i>), Philippine duck (<i>Anas luzonica</i>), Philippine hawk eagle (<i>Spizaetus philippensis</i>), white-vented shama (<i>Copsychus niger</i>), yellow-threatened leafbird, sandpipers, egrets, tern, plovers, herons
Reptiles	freshwater crocodile*, green sea turtle (<i>Chelonia mydas</i>), hawksbill turtle (<i>Eretmochelys imbricata</i>), olive ridley turtle (<i>Lepidochelys olivacea</i>), salt water crocodile (<i>Crocodylus porosus</i>), Philippine crocodile* (<i>Crocodylus mindorensis</i>), estuarine crocodile* (<i>Crocodylus porosus</i>)
Amphibians	brown-striped tree frog* (<i>Polypedates macrotis</i>), everett's tree frog (<i>Rhacophorus everetti</i>), giant visayan frog*, mary's frog* (<i>Micrixalus mariae</i>), Mindoro tree frog* (<i>Philautus schmackeri</i>), Philippine discoglossid frog* (<i>Barbourula busuangensis</i>), rough-skinned tree frog* (<i>Philautus longicrus</i>), South-East Asian wood frog* (<i>Rana sanguinea</i>)
Mammals	bottlenose dolphin (<i>Tursiops truncatus</i>), Palawan stink badger* (<i>Mydaus marchei</i>), Palawan porcupine* (<i>Hystrix pumila</i>), Palawan flying fox* (<i>Acerodon leucotis</i>)

*endemic species

Table 5. Various flora species found in selected wetlands in the Philippines (Birdlife International, 2016; Jonas, 2012; PAWB-DENR, 2005; Ramsar, 2016; SCPW, 2016)

Type	Description
Mangrove	deliuari, holly mangrove, <i>Aegiceras Corniculatum</i> , <i>Aegiceras floridum</i> , <i>Avicennia lanata</i> , <i>Avicennia Marina</i> , reflexed orange mangrove, large-leaved orange mangrove, red mangrove, oriental mangrove, rib-fruited yellow mangrove, <i>Excoecaria agallocha</i> , <i>Heritiera littoralis</i> , red-flowered black mangrove, white-flowered mangrove, sea teak, tall-stilt mangrove, asiatic mangrove, stilt mangrove, mangrove apple, cannonball mangrove, cedar mangrove
Flowering Plant, Aquatic Plant and Tropical Plant	<i>Caesalpinia crista</i> , <i>Dracontemelon dao</i> , <i>Hydrilla</i> , <i>Scyphiphora hydrophyllacea</i> , portia tree, eelgrass, <i>Pometia pinnata</i>
Ferns and Grasses	golden leather fern, mangrove fern, ground ferns, cogon grass/lalang grass, grass, bulrush
Coral	staghorn coral, dana staghorn coral
Tree	<i>Cerbera manghas</i> , <i>Cynometra ramiflora</i> , <i>Diospyrus sp</i> , <i>Hibiscus tiliaceus</i> , nipa, tropical almond
Flower and Shrub	<i>Derris trifoliata</i> , Benguet lily/ Philippine lily, arius

that breeds in Tubbataha Reefs Natural Park that also serves as its feeding grounds. Tubbataha Reefs Natural Park is known for being the only breeding area for the endemic subspecies of black noddy (Ramsar, 2016).

An endangered and endemic species, the Philippine crocodile, occurred in Naujan Lake National Park but may now be extinct (BirdLife International, 2016). Rare and endangered species like the fresh water crocodile, salt water crocodile, oriental darter, and Philippine sailfin lizard are to be found in Agusan Marsh Wildlife Sanctuary (DENR, 2016). Hawksbill turtle, a threatened species, breeds on Tubbataha Reefs Natural Park that also serves as its feeding grounds (Ramsar, 2016). In Puerto Princesa Subterranean River National Park, species like the critically endangered Philippine cockatoo, hawksbill turtle, endangered green sea turtle and Nordmanns greenshank are living in the area (Ramsar, 2016).

2.2.2 Flora

In Naujan Lake National Park, the dense growth of *Scirpus sp.* serves as habitat to resident and migratory fowls and it also adds recreational value to the lake and it can also be used for weaving baskets (PAWB-DENR, 2013; SCPW, 2016). Olango Island Wildlife Sanctuary, largely characterized by mangrove forests and large beds of sea along tidal flats, consists of 33 species of true mangroves, which is the primary vegetation in the sanctuary associated by the most dominant species such as *Rhizophora*, *Avicennia*, *Lumnitzera* and *Osbornia*. *Cymodocea* and *Thalassia* are the most abundant species found in the sanctuary (Jonas, 2012; PAWB-DENR, 2013). Tubbataha Reefs Natural Park, having pristine coral reefs with high diversity, is one of the highest coral diversity in the world being the apex of the Coral Triangle. The threatened species such as staghorn coral (*Acropora Abrolhosensis*) and dana staghorn coral (*Acropora aculeus*) are harvested in the site (Ramsar, 2016). Some mangroves,

plants, flowers, corals, ferns, grasses, trees and shrubs species that exist in Philippine wetlands are presented in Table 5.

3. Threats in Philippine wetlands

3.1 Land use conversion

Wetlands conversion into other land uses is one of the threats that the wetlands are dealing with. Wetlands that are converted to aquaculture farms, resorts and reclamation areas will lead to further destruction due to the indiscriminate use of artificial feeds and overstocking (PAWB-DENR, 2005). For the Agusan Marsh Wildlife Sanctuary, there is a threat to convert the marshland to paddy cultivation and palm oil plantation. Same with Las Piñas-Parañaque Critical Habitat and Ecotourism Area, being a peri-urban wetland, it is now facing a threat of developing the area for commercial interest (PAWB-DENR, 2013).

3.2 Resource use and exploitation

Over fishing, over harvesting of forest and freshwater product are under this threat (PAWB-DENR, 2005). Naujan Lake National Park, known for its freshwater fishing site, is dealing with intensive fishing which comes in conflict between preserving the National Park for wildlife and development of the area for commercial and subsistence level activities by the local residents (SCPW, 2016). The small population of crocodiles, although protected by law, continues to be exploited: fishermen catch young crocodiles on fishing lines and large animals are killed in nets (PAWB-DENR, 2013). Agusan Marsh Wildlife Sanctuary is also dealing with illegal destructive activities such as hunting, trapping wildlife species and timber poaching (PAWB-DENR, 2013). Illegal harvesting of top shell has been a problem for Tubbataha Reefs Natural Park (Ramsar, 2016).

3.3 Domestic, industrial and agricultural pollution and climate change

Water quality problems such as massive algal blooms and oxygen depletion may occur to wetlands because of the domestic, industrial and agricultural pollution (PAWB-DENR, 2005). Heavy metals and other organic contents coming from residential and industrial effluents affect the surroundings of Las Piñas-Parañaque Critical Habitat and Ecotourism Area. The site is located near populated area resulting wastes coming from the surrounding cities accumulate along the coast affecting birds by the contamination of water as they have been dependent

in the site for their food (Mayuga, 2016; Ramsar, 2016). Agusan Marsh Wildlife Sanctuary is also affected by the pollution coming from mining operation upstream (PAWB-DENR, 2013). The three connected wetlands such as Manila Bay, Laguna Lake and the Pasig River are dealing with a drainage, run-off and sewerage problems around the Metropolitan Manila Area (Mendoza, 2009).

Sea-level rise, coral bleaching, changes in hydrology and in the temperature of water bodies are caused by climate change. Climate change has a large impact to wetlands as it can affect the ability of the wetlands to provide its benefits. It can lead to the reduction in the goods and services provided by these wetlands (PAWB-DENR, 2013). Weather patterns, also caused by climate change, make it difficult for the people to decide when to plant and to predict and adapt to flooding in the marsh (PAWB-DENR, 2013).

It was stated in the report on impacts, adaptation, and vulnerability to climate change by the International Panel on Climate Change in 2007 that over the last century, it has been observed that the species extinction rates increased by a factor of 1,000 making its greatest wave of mass extinction of animal species in 65 million years. By 2100, the Earth's remaining species may likely be extinct according to their prediction (PAWB-DENR, 2013). According to David Quimpo from the Haribon Foundation, there were a thousands of black-winged stilts during the migration period Las Piñas-Parañaque Critical Habitat and Ecotourism Area but as years passed by it turns out to be just hundred. Also, he observed the number of bird species went to 50 from 70 to 100 (Mayuga, 2016). In Tubbataha Reefs Natural Park, there was a decline of about 80% in the population of *Trochus Niloticus*, a protected shell species, from 2006 to 2008. Between 1998 and 1999, there was also a decline in coral cover of about 18% as a result of the El Niño phenomenon which ravaged coral reefs around the world. In 2007 up until now, an introduction of invasive plants and exotic species has been observed in Tubbataha Reefs Natural Park. To control the exotic species population, namely the crown-of-thorns starfish, manual removal and sodium bisulfate injections were used. Agusan Marsh Wildlife Sanctuary is also experiencing the introduction of exotic and invasive species such as janitor fish, the golden apple snail and water hyacinth (PAWB-DENR, 2013; Ramsar, 2016).

4. Management of natural wetlands

Wetlands should be restored and rehabilitated as its deterioration will lead to a serious environmental damage

to the ecosystem. The Ramsar Convention on Wetlands defines the conservation of wetlands through 'wise-use' as the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development (DENR, 2011).

4.1 Laws, policies, programs/projects and community involvement

Only few laws were legislated that regulate access to natural resources, jurisdictions over territory and management, and prohibition of certain acts in Philippine wetlands. The impacts of these legislations are greatly dependent on its iron-hand implementation by which the non-enforcement of laws was found to be one of the biggest challenges in managing these wetlands. This might not be a problem itself, as the legislators and policy-makers might be at fault in not considering the realistic capacity of the implementing agency to enforce them at the time the policy was being made and by failing to provide the appropriate resources, such as funding for its enforcement (PAWB- DENR, 2005).

In the Philippines, wetlands policy includes the national inventory of wetlands, identification of the benefits and values of wetlands, effective public information, awareness and participation, wise use that ensures sustainable utilization of wetland resources through appropriate and effective regulation (Tolentino, 2014). Mendoza (2009) stated that projects that affect the wetlands preservation can be questioned under any number of regulatory laws from the Environmental Impact Assessment System to the water code, local government requirements and many other laws, by which he reiterated that community involvement and meta-legal strategies may play an important role in protecting wetlands. The establishment of Marine Protected Areas, Key Biodiversity Area, and Tubbataha Management Office: conservation activities as provided by the Agusan del Sur Environment Code of 2007 and the Agusan Marsh Wildlife Sanctuary Management Plan for 2005-2010 and the annual ecosystem research and monitoring, are one of the policies and activities developed in identifying the priority areas of conservation and rehabilitation for the preservation of marine life and biodiversity (PAWB-DENR, 2013).

Overall, the successes of these laws are greatly dependent on the implementation capacity of the government and local units, and also with the active participation of local communities.

4.2 Management in other developed countries

In United States, Wetlands Reserve Program (now known

as the Wetland Reserve Easement Program) is a voluntary program for landowners which takes cropped wetlands permanently out of production and restores them back to their original function. Their high priority is to restore wetlands on marginal agricultural lands prohibiting agriculture and development of structures. On the other hand, it permits hunting and other activities that will help improve the value of wildlife. This kind of program has shown a positive effect resulting to the slowing down of deterioration of wetlands and observing an increase in wetland acres in some states (Marks and Sucik, 2010).

China has a National Wetland Conservation Program that established a goal during the year 2005 to 2010 to effectively protect 50% of natural and 70% of important wetlands. The program also included to stop shrinkage and degradation, and develop monitoring, management, research and the wise use of wetlands (Madden et al., 2012). Wetland Reserve Construction Program, the Degraded Wetland Restoration Program, the Sustainable Use Pilot Program, and the Management Capacity Building Program are the sub-programs that helped to achieve these goals. As a result, China declared 316 new wetlands by August 2011 (Wetland Conservation and Management Center of State Forestry Administration, 2011). Additionally, China also has 37 wetlands that are recognized as wetlands of international importance by the Ramsar Convention (Ramsar, 2011).

Another notable advancement in wetland management can be observed in South Korea where substantial shift in its wetland policies are noticeable in the recent years, canceling the massive Yeongsan Reclamation Project in 1998, and responding to the demands of international conventions such as Ramsar and the Convention on Biological Diversity. Furthermore, Korean government has voiced their opposition to coastal reclamation and participated in bilateral bird conservation talks with neighboring Japan. Recent moves have also been made at local sites towards altering management regimes in individual rice-fields allowing some to remain flooded in winter for water bird use (Birds Korea, 2002). In Gyeongsangnam Province in South Korea, there were projects that are implemented for wetland conservation including wetland infrastructure, wetland conservation and wise use, education and awareness and conservation framework. The budgets were solely spent for wetland project of cities and counties. These projects may greatly have positive effects on wetlands but it is still incomprehensible to determine its effectiveness in the society. The various ways of wetland management in Gyeongsangnam Provincial Government have accumulated practices and knowledge throughout the time resulting to an effective way of conservation (Kim et al., 2015).

5. Conclusions and recommendations

Wetlands provide people many services and benefits such as production of food, storage of water, extraction of medicines, source of fiber and fuel, etc., These things are very critical in our lives as these are part of the people's survival in this world. Not only people depend on wetlands to survive but also animals since it serve as their habitat and most importantly, as their feeding grounds. Since Philippines is surrounded by large bodies of water, there are many wetlands found in the country. Wetlands have been the country's source of needs like water and food. But unfortunately, these benefits and services that people obtain in wetlands are all being taken for granted. People do not value these things much and just acquire resources as long as they can that makes wetlands being threatened by economical and human activities in the Philippines. These threats include conversion of land use, overused of its resources, domestic, industrial and agricultural pollution and climate change. All of these threatening situations happen to wetlands because of people's lack of concern towards the preservation and conservation of our wetlands and insufficient enforcement of laws. The management measures implemented are all very helpful to wetlands and the first priority should be the proper enforcement of laws. Nonetheless, community involvement in taking care of wetlands will be of great help in its preservation and conservation. Community involvement incorporated with proper enforcement of laws will achieve these goals more effectively. United States, China and South Korea have all established particular projects and programs to properly conserve and improve their wetlands. As for the Philippines, the programs and projects implemented are in general for the environment and not solely focus on wetlands. Establishing programs and projects should be the next priority as it focuses merely on how to improve and maintain the wetlands. These threats and management measures also exist and applicable in other countries' wetlands. Looking forward to the world's improvement in implementing rules and laws might lead to more declared wetlands around the world and be used for recreational purposes and tourism. Displaying wetlands' beauty and maintaining its genuineness to the people will open their awareness to the natural attraction of the earth.

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