ADB

Regional Flyway Initiative · Site Study

May 2026

RFI Priority Site · North Manila Bay (Pampanga)

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Asian Development Bank

General Site Information

Country	Philippines			
RFI Site Name	Manila Bay (Pampanga), including Sasmuan Ramsar Site			ID120
City/ Municipality, Province, Region	Sasmuan, Batang, Almacen, Baruya, Sta Teresa, Bangcal, Pugad, Pampanga River, Westbank, Malauli, Consuelo, Eastbank-Sapang Kawayan and San Roque municipalities, Pampanga			
Geographical coordinates	14.83 N, 120.59 E		Area (has)	3,664 has
Key species	Whiskered Tern and Black-headed Gull			
Key habitats (biomes)	Mangrove forests and intertidal flats (among the largest in North Manila Bay)			
Key ecosystem services	Provisioning services, regulating services (e.g. storm hazard and flood protection)			
Key drivers of change	Aquaculture expansion, climate change			
Conservation status (mark all that applies)		Protected Area		Flyway Network Site
	■	Ramsar Site		Others _____
IBA/ KBA name (and number) and other designations	North Manila Bay			
Management Stakeholders	DENR, PENRO Pampanga, Sasmuan Municipal Government			
With management plan?	Yes, under the Manila Bay Sustainable Development Master Plan			
Project concept themes	Wetland restoration, ecotourism			
Length of project	Five years			
Sector/s	Tourism, fisheries and aquaculture			
No. of potential beneficiaries	Approximately 6,262 direct and 30,000 indirect beneficiaries			
Indigenous Peoples	■	No		Yes, _____
Anticipated Implementation Risks	Potential reduction of wildlife habitat if mangrove restoration poorly managed. Increased tourism impact expected to cause disturbance.			
Estimated Project Budget (US$)	6,850,000			
Potential Source/s of Financing		Loan		Private Sector
	■	Grant (to be identified)	■	Public-Private Partnership

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Abbreviations

ADB	Asian Development Bank
AWC	Asian Waterbird Census
CSR	Conservation Status Review
DMC	Developing Member Country
EAAFP	East Asian-Australasian Flyway Partnership
ECA	Ecologically Critical Area
IBA	Important Bird and Biodiversity Area
IUCN	International Union for the Conservation of Nature
LGU	Local Government Unit
NGO	Non-governmental Organisation
NT	Near Threatened
RFI	Regional Flyway Initiative
SBMCHEA	Sasmuan Bangkung Malapad Critical Habitat and Ecotourism Area
SLR	Sea Level Rise
TESSA	Toolkit for Ecosystem Services Assessment
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USAID	United States Agency for International Development
USD	United States Dollars

Executive summary

Manila Bay covers more than 1,900 km^2 and encloses a low-lying coastline of around 196 km spanning Cavite in the south to Bataan, Pampanga and Bulacan in the north. As a whole, Manila Bay is rich in intertidal wetlands and contains significant intertidal areas with patches of mudflats, mangroves, and *nipah* swamps, although the extents of these wetlands are very much reduced presently. The Sasmuan (Pampanga) sector of Manila Bay is located in the northwestern part of Bay and includes the intertidal foreshore in Pampanga which overlaps with extensive coastal wetlands such as mangroves, estuarine mudflats and fishponds along the Pampanga River mouth. The coastline in this part of Manila Bay is known to be internationally important for waterbirds, including very large congregations of terns, gulls, shorebirds and egrets. The Sasmuan Ramsar site sits on public land that is owned by the local and national governments. The management authorities with jurisdiction over the site are the Department of Environment and Natural Resources (DENR) and the Local Government Unit of Sasmuan, Pampanga.

Presently, wetland ecosystems across much of Manila Bay are highly fragmented, degraded are under significant anthropogenic pressure from reclamation, solid waste pollution and coastal development with the expansion of Manila's urban sprawl. In Pampanga especially, the tidal foreshore areas, riverine habitats (e.g. Pampanga River Estuary) and the remaining patches of mangroves continue to be converted to aquaculture and polyculture which is evident from the extensive areas of fishponds, fish pens, and shellfish pens. Yet wetlands in the Bay continue to provide valuable provisioning, regulating and cultural ecosystem services. Regulating services, for instance, flood hazard, storm hazard, and erosion regulation, remain important to the communities living in Pampanga's coastal zone. Pampanga's coastal wetlands in Sasmuan ranks well above both the national RFI and overall country averages in terms of its total annual benefits per ha of mangroves (estimated at 1,160 USD/ha).

The coastal wetlands in Sasmuan Ramsar Site currently supports limited infrastructure such as boardwalks targeted at domestic tourists but given the size of the site and its proximity to Manila, there is considerable scope and opportunity for ecotourism development and expansion, through the creation of new infrastructure managed by the Sasmuan Municipal Government and barangays, including more access boardwalks, observation towers, signages and shelters. Small-scale restoration of mangrove forests has been carried out in Sasmuan by DENR and PENRO Pampanga, while the natural regeneration of mangroves against an accreting coastline means that mangrove forest cover has increased in the Ramsar site. However, there is scope and opportunity for further restoration at disused fishponds along in the Pampanga estuary while strengthening the management of existing areas of mudflats through (mangrove regeneration management) and monitoring; this needs to be underpinned by further scoping studies to identify the best areas for successful restoration. Furthermore, there is an opportunity to strengthen the resilience of coastal communities and improve livelihoods through the creation of local financing initiatives, capacity building, and awareness programmes (on sustainable fishing practice, wildlife-friendly aquaculture, product development) to disburse small loans and grants to small-scale fishers and aquaculture operators.

1. Background of the Regional Flyway Initiative

In July 2021, the Asian Development Bank made a commitment to develop a long-term Regional Flyway Initiative (RFI) in the East-Asian Australasian Flyway (EAAF) (Sovereign Project 55056-001) to protect and restore priority wetland ecosystems and the associated ecosystem services they provide in the EAAF, the most threatened migratory bird flyway globally. The Initiative is slated for implementation in nine ADB developing member countries (DMCs) in East, South and Southeast Asia: Mongolia, People's Republic of China (PRC), Bangladesh, Viet Nam, Cambodia, Philippines, Thailand, Malaysia and Indonesia. In 2023, the geographic scope of the RFI was further extended to two DMCs in Southeast Asia and the Pacific respectively, Lao PDR and Papua New Guinea.

The primary aim of the RFI is to enhance and expand the existing efforts in conserving and managing wetlands of the highest priority for migratory birds within the EAAF through innovative loan and grant financing, and at scale. Consultations and analyses over the development period help identify key interventions to strengthen the management of wetlands, enabling the implementation of nature-based solutions while strengthening biodiversity protection. Over time, the RFI seeks to leverage collaborative opportunities by developing partnerships among important stakeholders including national governments, civil society organizations, communities, regional organizations like the East Asian-Australasian Flyway Partnership (EAAFP), development agencies, the private sector, and other relevant entities.

Through the RFI Technical Assistance (TA) implemented over the RFI's development phase from 2021 to 2024, BirdLife International takes the lead in providing and coordinating technical support for development of the RFI. This is carried out in collaboration with the EAAFP and a consortium of international non-governmental organizations including Wetlands International and the Paulson Institute, as well as two universities, namely the University of Southampton, UK and the National University of Singapore. Over the development phase, the TA team undertook a site selection analysis to identify priority wetland sites in all 10 countries based on recent bird data benchmarked against internationally accepted criteria under the Convention on Wetlands of International Importance (or Ramsar Convention), EAAFP Flyway Network Sites and Important Bird and Biodiversity Areas (IBAs). The team further developed ecosystem services profiles for prioritised wetlands using a multi-pronged approach used the TESSA ecosystem services assessment tool, and data-driven modelling of water-based ecosystem services and stored carbon.

In the Philippines, a total of 20 wetland sites, including many Asian Waterbird Census (AWC) count sites, were initially assessed through data analysis and expert consultation, of which twelve (12) were defined and identified to be RFI priority sites on the basis that they support more than 1% the flyway population of at least one EAAF migratory waterbird species. The majority of the RFI wetlands prioritised for the Philippines are coastal wetlands, a consequence of the country's long coastline, with the largest cluster of priority sites being North Manila Bay, which constitutes three sites across the provincial jurisdictions of Bataan, Pampanga and Bulacan. 28 EAAF species exceeded the 1% threshold at the site level, with species such as Chinese Crested Tern, Chinese Egret and the Tufted Duck.

2. Site profile of North Manila Bay (Pampanga)

Location: This RFI site is located in the northwestern part of Manila Bay and includes the intertidal foreshore in Pampanga Province and overlaps with the extensive wetlands (estuarine mudflats and fishponds) along the Pampanga River mouth. The locations in this part of Manila Bay that are known to be internationally important for waterbirds (exceeding 1% of flyway population thresholds) are in the following municipalities: (1) Sasmuan – Barangay Batang, (2) Lubao – Barangays Almacen, Baruya, Sta. Teresa, Bancal Pugad, (3) Macabebe – Barangays Pampanga River Westbank, Pampanga River Eastbank, (4) Masantol – Barangays Malauli, Sapang Kawayan, (5) Floridablanca – Barangay Consuelo, and (6) Mexico – Barangay San Roque.

Area: The North Manila Bay (Pampanga) RFI site has an area of 3,664 ha

Altitude: 0-3 m asl.

Geographical coordinates: 14.83 N, 120.59 E

Description of site: Manila Bay covers more than 1,900 km^2 and spans a coastline of around 196 km from Cavite City to Bataan Province, including the coastline in Pampanga Province. It is a large semi-enclosed bay fringed by shallow intertidal areas with relicts of mudflats, mangroves, and nipa swamps. The status and distribution of remaining habitats in Manila Bay was assessed and mapped during a series of rapid surveys in 2016-2018 (Jensen 2018). This found that the largest foreshore areas are located in Bulacan Province (6,425 ha), followed by Bataan (4,962 ha) and Pampanga (3,562 ha), although large areas of this habitat have been converted to fishponds. Mudflat is the single most important habitat for a large diversity of migratory waterbirds, notably shorebirds, but it has been greatly reduced in area in Manila Bay, although important areas of semi-permanent mudflat are found scattered in drained fishponds and saltpans. Mangroves have also been greatly reduced in extent, with remaining areas in Bataan (37.4%), Pampanga (15.3%) and Bulacan (11.1%). Pampanga Province also retains some relict stands of Nipa *Nypa fruticans* swamps, in patches of a few hectares. Fragmented and degraded areas of seagrass survive, mostly offshore in Bataan and Bulacan provinces, a habitat that is the main growth areas for a large number of fish species vital for the local economy. The internationally important waterbird sites in Pampanga Province include the Pasac River (Sasmuan, Barangay Batang and adjacent tidal mudflats), Lubao Fishponds (Almacen-Baruya-Sta Teresa and Bangcal Pugad), and the Pampanga River (0-5.5km Westbank - Malauli, Consuelo, Eastbank-Sapang Kawayan and San Roque, or Hagonoy).

Site administration, management and land tenure: The definition of the North Manila Bay (Pampanga) RFI site follows that of a new Ramsar site that was designated in February 2021, the Sasmuan Pampanga Coastal Wetlands, by the Department of Environment and Natural Resources (DENR) Biodiversity Management Bureau which is the National Ramsar Administrative Authority for the Philippines. The Ramsar site includes a mangrove islet that was recently designated as the Sasmuan Bangkung Malapad Critical Habitat and Ecotourism Area (SBMCHEA), where a view deck and boardwalk have been constructed. The Ramsar site is public land (defined as 'Forest Land') that is owned by the local and

national governments. The management authorities are the DENR and the Local Government Unit of Sasmuan, Pampanga. A management plan is being drafted for the area.[1]

Manila Bay is recognised as an Important Bird and Biodiversity Area (Mallari et al. (2001) and a Key Biodiversity Area (Conservation International 2006, IUCN 2014) because it supports internationally important populations of migratory waterbirds, including several globally threatened species.

Social and economic values: Manila Bay is very important for its fisheries and aquaculture production which supports the large urban population around the periphery of the Bay, with important species such as Milkfish *Chanos chanos*, tilapia (various species), shrimp and crab. There are high concentrations of various fish trapping devices, and extensive areas with fishpens in the open sea area, as well as aquaculture along the shorelines (Mialhe et al. 2015, BirdLife International 2017a). Aquaculture may account for nearly two thirds of the total economic value of Manila Bay (PEAMSEA, 2006).

The wetland ecosystems in Manila Bay are under significant anthropogenic pressure. Tidal foreshore areas, riverine habitats (especially in the Pampanga River Estuary) and the remaining patches of mangroves continue to be converted to aquaculture (UNEP-TEEB 2017) and polyculture (Mialhe et al. 2015) which is evident from the extensive areas of fishponds, fish pens, and shellfish pens throughout the bay. Other important issues affecting the wetlands include large-scale development projects and sea-level rise.

The Manila Bay Sustainable Development Master Plan (MBSDMP) was formulated through a bilateral project between the Governments of the Philippines and the Netherlands in 2019 to provide an overarching framework for development across all of Manila Bay. There are however major gaps in the development of the MBSDMP, including in the protection of critical habitats and the provisions for the management of biodiversity and ecosystems (Lopez 2019).

A private-public partnership covering an area of about 18,000 ha in Manila Bay is being assessed for implementation by the Department of Public Works and Highways (DPWH 2016, PPP Center 2016). It is named the Manila Bay Integrated Flood Control and Coastal Defence and Expressway Project, and it aims to reclaim coastal areas from Navotas City in Metro Manila to Bataan Province. The design includes the creation of five artificial islands in the habitats of commercially important fish species and areas where migratory waterbirds congregate (Daily Economic 2014, Mooyart et al. 2015, DA-BFAR 2015b, and this study).

[1] Ramsar Site Information Sheet: *Sasmuan Pampanga Coastal Wetlands*. Available at https://rsis.ramsar.org/ris/2445

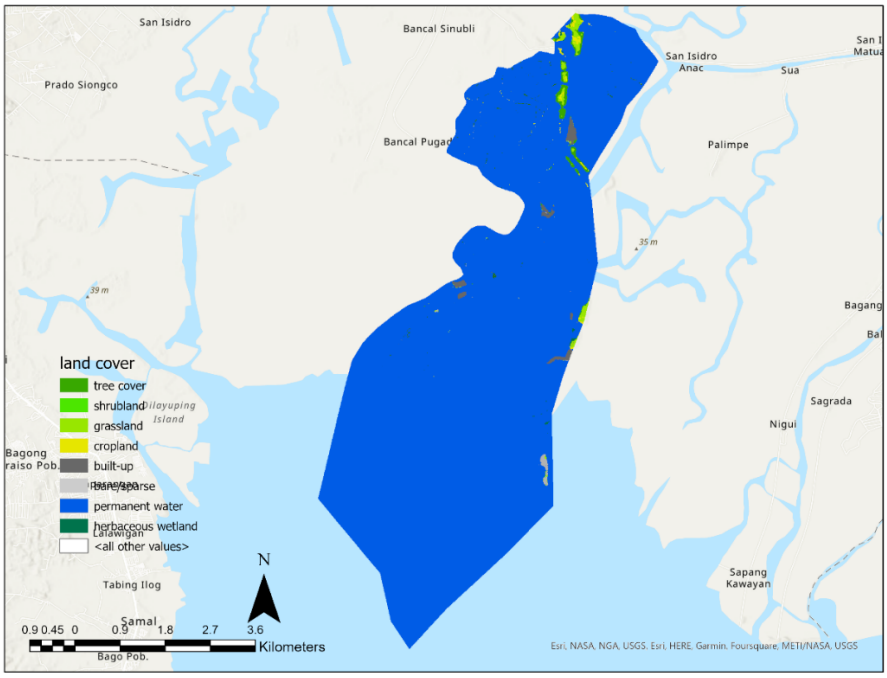

Figure 1 Map of the Pampanga sector of North Manila Bay, showing the distribution of vegetation cover across the coastal zone. Bulacan holds the largest areas of coastal wetlands in North Manila Bay. The inshore waters of Manila Bay still form more than half of the area of this site (Map: Radhika Bhargava)

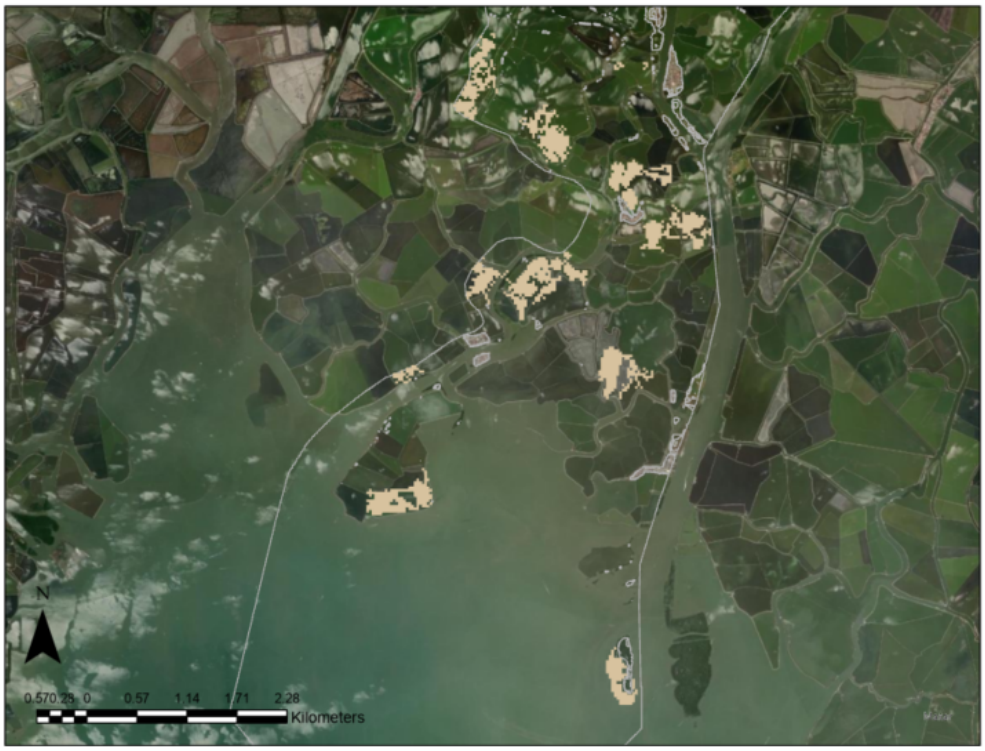

Figure 2 Coastal fishponds and intertidal flats at the estuary of the Pampanga River.

3. Biodiversity value of North Manila Bay (Pampanga)

3.1. Key habitats

Manila Bay is a large semi-enclosed bay fringed by shallow intertidal areas with relicts of mudflats, mangroves, and nipa swamps. Mudflat is the single most important habitat for a large diversity of migratory waterbirds, notably shorebirds, but it has been greatly reduced in area in Manila Bay, although important areas of semi-permanent mudflat are found scattered in drained fishponds and saltpans.

Mangroves have also been greatly reduced in extent, with remaining areas in Bataan (37.4%), Pampanga (15.3%) and Bulacan (11.1%). Pampanga Province also retains some relict stands of Nipa *Nypa fruticans* swamps, in patches of a few hectares. Fragmented and degraded areas of seagrass survive, mostly offshore in Bataan and Bulacan provinces, a habitat that is the main growth areas for a large number of fish species vital for the local economy. The internationally important waterbird sites in Pampanga Province include the Pasac River (Sasmuan, Barangay Batang and adjacent tidal mudflats), Lubao Fishponds (Almacen-Baruya-Sta Teresa and Bangcal Pugad), and the Pampanga River (0-5.5km Westbank - Malauli, Consuelo, Eastbank-Sapang Kawayan and San Roque, or Hagonoy).

3.2 Importance of North Manila Bay (Pampanga) to migratory waterbird species

Waterbird count data from the 2019, 2020 and 2021 Asian Waterbird Census (including datasets from two different areas in the site in 2021) was used in the RFI priority sites analysis for North Manila Bay (Pampanga). The four datasets from these three years were averaged and then compared to the CSR1 1% population estimates to calculate a score for each species. Five species were found to exceed the 1% population estimates (see Table 1), and the scores for these species were summed to produce the overall site score for North Manila Bay (Pampanga).

Table 1 List of migratory species (based on the EAAFP list of species) with globally significant congregations in the coastal wetlands in Pampanga Province.

Scientific name	IUCN	Average count	CSR1	CSR1 score
Kentish Plover *Charadrius alexandrinus*	LC	2,961	700	4.2
Intermediate Egret *Ardea intermedia*	LC	3,962	1,000	4.0
Whiskered Tern *Chlidonias hybrida*	LC	18,188	10,000	1.8
Great White Egret	LC	1,217	1,000	1.2

Scientific name	IUCN	Average count	CSR1	CSR1 score
Ardea alba				
Black-headed Gull *Larus ridibundus*	LC	18,659	20,000	1.0

North Manila Bay (Pampanga) supports important populations of several globally threatened and near-threatened species, including Black-faced Spoonbill *Platalea minor* (EN), Chinese Egret *Egretta eulophotes* (VU), Far Eastern Curlew *Numenius madagascariensis* (EN), Curlew Sandpiper *Calidris ferruginea* (NT), Red-necked Stint *Calidris ruficollis* (NT), Grey-tailed Tattler *Tringa brevipes* (NT) and Spotted Greenshank *Tringa guttifer* (EN).

3.3 Other notable biodiversity

Avicennia rumphiana (VU), a mangrove species of conservation concern, is reported to thrive in the Sasmuan Bangkung Malapad Critical Habitat and Ecotourism Area (SBMCHEA), which now receives further protection as a Ramsar Site.

4. Ecosystem services

4.1. Ecosystem services provided by North Manila Bay (Pampanga)

The North Manila Bay (Pampanga) region overlaps with diverse habitats that provide essential provisioning, regulating, and cultural ecosystem services (Figure 3). The results from the RFI workshop[2] highlights the top ecosystem services provided by the site, emphasising their essential and non-substitutable nature (Table 2). Provisioning services, particularly food provision, benefit communities at all distances. Regulating services, such as flood and storm hazard regulation, are crucial for community resilience. Flood hazard regulation benefits all communities, whereas storm hazard regulation benefits both within and adjacent communities only. Cultural services, including recreation ecotourism and knowledge systems and education, are essential and benefit communities across all distances.

[2] Asian Development Bank. (2023, June 27–30). *Philippines: Wetland Ecosystem Services Workshop* [Workshop]. Asian Development Bank Headquarters, Manila, Philippines. https://events.development.asia/learning-events/philippines-wetland-ecosystem-services-workshop

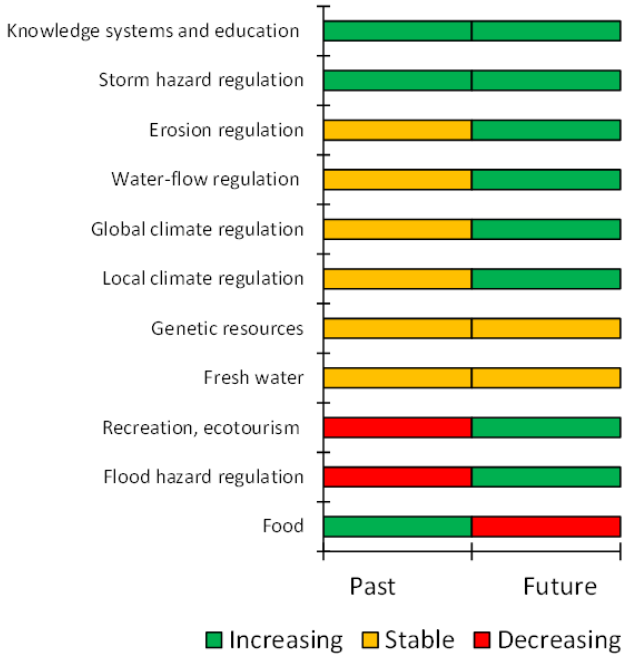

Figure 3 List of ecosystem services provided by North Manila Bay (Pampanga), as identified through stakeholder consultation at the Regional Flyway Initiative workshop.

Table 2 List of top ecosystem services provided by North Manila Bay (Pampanga).

Ecosystem services	Essential or non-substitutable	Benefits to communities			Change	
		Within the site	Adjacent to the site	Distant to the site	Past	Future
Provisioning services						
Food	Yes	✓	✓	✓	Increase	Decrease
Regulating services						
Flood hazard regulation	Yes	✓	✓	✓	Decrease	Increase
Storm hazard regulation	Yes	✓	✓		Increase	Increase
Cultural services						
Recreation, ecotourism	Yes	✓	✓	✓	Decrease	Increase
Knowledge systems and education	Yes	✓	✓	✓	Increase	Increase

4.2. Global climate regulating services

Based on systematic reviews (Chen and Lee, 2022; Stankovic et al., 2023), the amount of carbon stored in North Manila Bay (Pampanga) is estimated to range from 114,000 to 230,000 tonnes, while the annual carbon sequestration rate is estimated to be between 1,720 and 1,950 tonnes per year.

4.3. Coastal protection services

The coastal protection services provided by the Pampanga sector of North Manila Bay were assessed using both biophysical indices and monetary values (see Tables A1 and A2, and Annex 1 for details). When compared to both the average of the nine RFI coastal sites and the average of all other coastal areas in the Philippines (Table A3 in Annex 1), Pampanga shows mixed results in terms of risk level:

(1) for the potential exposure to coastal hazards, Pampanga is consistently above average (index: 2.99 vs. 2.70 for RFI coastal sites and 2.36 for all other coastal areas);

(2) for the contribution to reducing coastal risk as a proportion of population density with 2.5 km of the coast, Pampanga is well below the average (18 vs. 117 people/ha for RFI coastal sites and 122 people/ha for all other coastal sites); and

(3) for the contribution to reducing coastal risk as a percentage of the maximum potential exposure, Pampanga is equal to the average of RFI coastal sites (5.28%) but below average compared to all other coastal sites (6.60%).

In monetary terms (Table A4 in Annex 1), Pampanga is below the average of all RFI coastal sites in the Philippines regarding both total annual benefits (3.6 million vs. 16.4 million USD) and total benefits against 100-year return period storms (0.6 vs. 2.4 million USD). However, Pampanga ranks well above both the national RFI and overall country averages in terms of total annual benefits per ha of mangroves (28,002 vs. 14,895 or 11,160 USD/ha).

5. Drivers of change and their potential impacts on North Manila Bay (Pampanga)

5.1. Current drivers of change and their level of impact

Stakeholders in the RFI workshop[3] identified 16 drivers of change impacting North Manila Bay (Pampanga) and their corresponding levels of impact on the wetland site (Table 3). High-impact drivers include commercial and industrial areas, which pose substantial threats to the wetland by contributing to habitat degradation and pollution. Other significant high-impact activities are fishing, killing, and harvesting of aquatic resources, as well as marine and freshwater aquaculture, which threaten the biodiversity and disrupt the ecosystem balance. Recreational activities and tourism further add to the high impact, potentially leading to habitat disturbance. Additionally, ports with large-scale loading and unloading of goods significantly modify the wetland environment. Medium-impact drivers include shipping lanes and canals, which affect habitat connectivity and potentially disturb wildlife.

Table 3 Drivers of change and their potential impact on the integrity of North Manila Bay (Pampanga) based on consultations with stakeholders.

Driver of change	Impact
Commercial and industrial areas	High
Fishing, killing and harvesting of aquatic resources	
Marine and freshwater aquaculture	
Recreational activities and tourism	
Ports with large scale loading and unloading of goods	Medium
Annual and perennial non-timber crop production	Low
Collecting terrestrial plants or plant products (non-timber)	
Dams within or upstream of the wetland site, which alter the hydrological regime	
Drug cultivation	
Housing and settlement	
Hunting, killing and collecting of terrestrial animals	
Increased fragmentation within the wetland site	
Isolation from other natural habitats	
Research, education and other work-related activities	
Shipping lanes and canals	
Tourism and recreation infrastructure	

[3] Asian Development Bank. (2023, June 27–30). *Philippines: Wetland Ecosystem Services Workshop* [Workshop]. Asian Development Bank Headquarters, Manila, Philippines. https://events.development.asia/learning-events/philippines-wetland-ecosystem-services-workshop

5.2. Potential alternative state of North Manila Bay (Pampanga) under current drivers of change

Stakeholders in the RFI workshop[4] defined the most plausible future alternative state (to 2035), and how this will translate to a net change in the cover of different types of wetland habitat types within this site (current habitat cover vs future alternative cover; Figure 4). The alternative state of the site assumes there will be no changes in the current drivers of change impacting the site, and the current management regime.

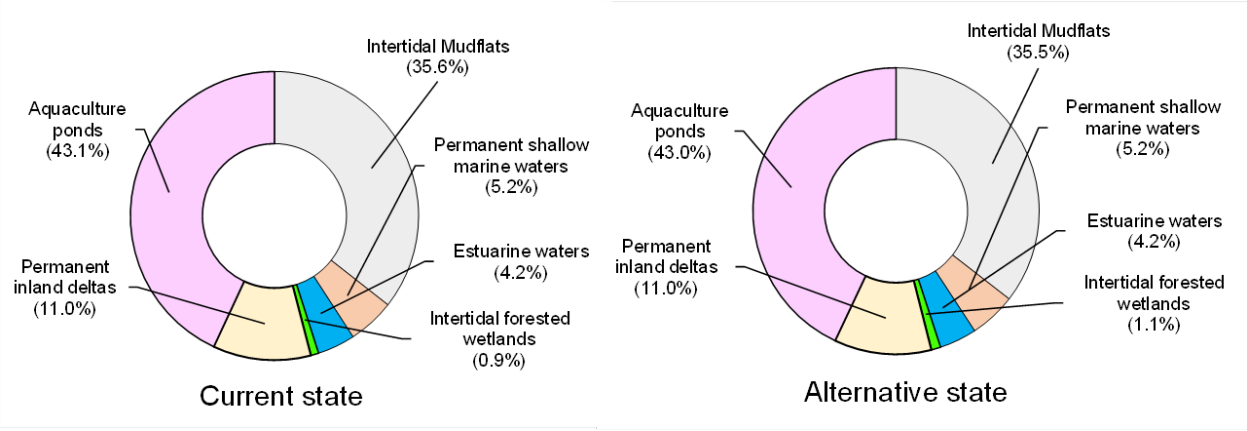

Figure 4 The proportional change in the extent of different habitat types between the current and alternative states of North Manila Bay (Pampanga).

5.3. Expected changes in the ecosystem services of North Manila Bay (Pampanga)

Stakeholders in the RFI workshop[5] documented the future trends in the provision of ecosystem services in North Manila Bay (Pampanga), indicating if the ecosystem services provided by this site (to 2035) will increase, decrease, or will remain stable, assuming that the current drivers of change impacting this site will continue in their present condition, with the intervention remains unchanged.

Figure 3 and Table 2 highlight an increase in food provision in the past and an anticipated decrease of that provisioning service in the future. Flood hazard regulation experienced a decline in the past but is expected to increase in the future. Storm hazard regulation has shown and is projected to continue increasing. Recreation and ecotourism saw a decrease in the past but are anticipated to increase moving

[4] Asian Development Bank. (2023, June 27–30). *Philippines: Wetland Ecosystem Services Workshop* [Workshop]. Asian Development Bank Headquarters, Manila, Philippines. https://events.development.asia/learning-events/philippines-wetland-ecosystem-services-workshop

[5] Asian Development Bank. (2023, June 27–30). *Philippines: Wetland Ecosystem Services Workshop* [Workshop]. Asian Development Bank Headquarters, Manila, Philippines. https://events.development.asia/learning-events/philippines-wetland-ecosystem-services-workshop

forward. Knowledge systems and education have experienced an increase in the past and are expected to continue this positive trend.

In the alternative state, the gain of 20% mangrove is expected to result in a gain of stored carbon estimated to be between 22 and 8,330 tonnes and an increase in caron sequestration (carbon accumulation) by approximately 2 and 50 tonnes per year.

A gain of 6.5 ha of mangroves as presented in Table A5 is equivalent to only 0.2% of the total land use for the site, which is expected to result in roughly a 5% increase in coastal protection. This may amount to roughly 182 thousand USD in gained total benefits per year (based on 28,002 USD per hectare of mangroves) and 31 thousand USD in gained total benefits per 100-year return period storm (based on the same 5% increase in coastal protection).

6. Capacity needs in North Manila Bay (Pampanga)

The stakeholder consultation and analyses with stakeholders representing government and civil society identified at least 5 major stakeholder groups with clear roles in the long-term sustainable management of wetlands in North Manila Bay (Pampanga). Current role and opportunities for building local capacity on wetland management are summarized in Table 4.

Table 4. Capacity needs for improved management of North Manila Bay wetlands, identified at the stakeholder level.

Table 4 Capacity needs for improved management of North Manila Bay wetlands, identified at the stakeholder level.

Stakeholder	Current Role in wetland management	Future role	Form of capacity development
NGA - DENR	Technical assistance Personnel & support Provide funding for rehabilitation and improvement of infrastructure in the area	Capacity building (completion of requirements and data information, training of stakeholders)	Bird and biodiversity monitoring training (bird ID/counting)
NGA - POT TIEZA			Training workshops
NGA - DA-BFAR			Capacity development for tourism
Local Government Units	Promotion, management, monitoring of safety and security	Formulation/updating of an integrated management plan for wetland Involvement of other NGAs (DPWH)	Community-based product development
Community(s), visitors, SMEs	Direct beneficiaries of fishery and livelihood and recreational activities	Expected to play a more active role in wetland activities, advocacy building, training other community members.	Business development for local smallholders
Local/international CSOs		Technical support for site management.	Financial and project management support

7. Opportunities for RFI interventions

7.1 Recommended Interventions

The largest protected area of coastal wetlands and mangrove forest in North Manila Bay falls within the Sasmuan Ramsar site and there is ongoing work to restore degraded areas of mangroves. For instance, Sasmuan's LGU has forged partnerships with the private sector, under the "Connected Mangrove Project", a reforestation project which leverages connected technologies such as solar-powered sensors and real-time camera footage to collect critical data.

Table 5 List of proposed interventions for the Pampanga sector of North Manila Bay, and the expected output and timeframes for project implementation.

Intervention	Outcome	Indicators	Cost	Timeframe	Potential Stakeholders
Component 1. Enhancement of sustainable wetland-based ecotourism for the Sasmuan Ramsar Site (and SBMCHEA)					
Develop a coordinated wetland-based tourism plan for Manila Bay	Cohesive and inclusive wetland-based tourism implementation for Manila Bay Wetland-based tourism strategy and plan developed with inputs from key stakeholders	Feasibility studies related to wetland-based tourism completed. One wetland-based tourism plan developed for Manila Bay and disseminated to key stakeholders Number of stakeholders engaged for the development of the wetland -based tourism plan for Manila Bay	200,000	1.5 years	Department of Environment and Natural Resources Department of Tourism People Organisations Concerned local government units Conservation organisations (including bird and community-focused NGOs) Tourism operators
Build the capacity of small-scale tourism operators on wetland-based tourism	Training and capacity needs for wetland-based tourism assessed Relevant training modules developed and implemented with	Training Needs Assessment on wetland-based tourism completed and disseminated to concerned stakeholders Number of training	500,000	2 years	

Intervention	Outcome	Indicators	Cost	Timeframe	Potential Stakeholders
	key stakeholders (e.g., DENR, LGUs, provincial government, DoT, tourism operators) Improved capacity of key stakeholders about wetland-based tourism	modules developed based on the results of training needs assessment Number of capacity-building activities administered with concerned stakeholders Number of small-scale tourism operators (target of up to 20) benefitting from the capacity-building activities			
Improve ecotourism infrastructure including viewing platforms, access roads, boardwalks, and signages in least sensitive areas	Stronger (and functional) infrastructure to host tourists, including platforms, boardwalks, and signage in least sensitive areas	Scoping map for appropriate areas for wetland-based tourism development created and presented to key stakeholders Number of infrastructure established/ improved (i.e., at least 0.5 km boardwalks and hides) constructed	100,000	3 years	
Component 2. Improvement of wetland site management					
Establish a local-led biodiversity and wetland (mangrove) monitoring scheme	Biodiversity and wetland (mangrove) monitoring framework and mechanism for the site established. Improved local biodiversity and wetland (mangrove)	Biodiversity and wetland (mangrove) monitoring framework identified and used for site monitoring Number of monitoring reports on the biodiversity and wetland (mangrove) status generated, especially during the	100,000	5 years	DENR PENRO Pampanga Universities Conservation organisations LGUs

Intervention	Outcome	Indicators	Cost	Timeframe	Potential Stakeholders
	information for better site management. Formation of a locally led conservation monitoring group led by concerned LGUs	migration season A locally led conservation monitoring group organized			
Develop and capacitate key stakeholders on the Sasmuan Ramsar site management plan	Cohesive and integrated management implemented for Sasmuan Ramsar site Site management strategy and plan developed with inputs from key stakeholders Boundaries are delineated and secured. Key stakeholders are equipped to technically implement the developed Sasmuan Ramsar site management plan	Baseline studies completed to guide site management planning for Sasmuan Ramsar site management plan Number of stakeholders engaged for the development of the site management plan for the Sasmuan Ramsar site management plan Number of capacity-building activities conducted to technically equipped key stakeholders, including the vulnerable groups, in the management plan implementation Boundary map finalized, presented with key stakeholders, and secured.	50,000	5 years	
Component 3. Improvement of local livelihood opportunities through microfinance mechanisms					
Establish financing instruments, including through	Improved capacity for financial management of	Financial mechanism and management board established to	200,000	5 years	BFAR

Intervention	Outcome	Indicators	Cost	Timeframe	Potential Stakeholders
microfinance for fishers, aquaculture operators, and tourism operators	local communities Financial mechanism and management board established to manage disbursement of small loans and grants relevant to site management Better fishing practices documented in the areas covered by the capacity-building activities	manage disbursement of small loans and grants. Microfinancing mechanism for small grants/loans to fishers strengthened or established to at least 2 barangays. Number of small loans for fisherfolk disbursed.			Provincial Government of Pampanga concerned LGUs Existing fishing and aquaculture cooperatives Conservation organizations
Build institutional capacity for small-scale fisheries through strengthening existing cooperatives.	Improved capacity for sustainable fishing practices of local communities Training and capacity needs for fisherfolk assessed Relevant training modules developed and implemented with key stakeholders (e.g., DENR, concerned LGUs, provincial government, DA) Improved capacity of key stakeholders about sustainable fishing practices	Training Needs Assessment on sustainable fishing practices completed and disseminated to concerned stakeholders Number of training modules developed based on the results of training needs assessment Number of capacity-building activities administered with concerned stakeholders Number of people benefitting from the capacity-building activities, especially those from the vulnerable groups	100,000	5 years	

Intervention	Outcome	Indicators	Cost	Timeframe	Potential Stakeholders
Build institutional capacity for aquaculture operators (and fishpond owners) for 'wildlife-friendly' fish and shrimp farming.	Improved capacity for aquaculture management, and 'biodiversity-friendly' aquaculture among aquaculture operators Training and capacity needs for aquaculture operators assessed Relevant training modules developed and implemented with key stakeholders (e.g., DENR, concerned LGUs, provincial government, DA) Improved capacity of key stakeholders about aquaculture management and 'biodiversity-friendly' aquaculture	Training Needs Assessment on aquaculture management and 'biodiversity-friendly' aquaculture completed and disseminated to concerned stakeholders Number of training modules developed based on the results of training needs assessment Number of capacity-building activities administered with concerned stakeholders Number of people, with target of at least 30 aquaculture operators, benefitting from the capacity-building activities	100,000	5 years	
Establish incentives for the development of wildlife-friendly aquaculture products; creation of markets for products	Aquaculture operators and fishpond owners actively trained on biodiversity-friendly fishpond and shrimp pond management approaches. Training	Number of 'biodiversity-friendly' aquaculture products, with target of up to 10, developed. Number of business plans and trade networks mapped and established for aquaculture operators,	100,000	5 years	BFAR Provincial Government of Pampanga Sasmuan LGU Aquaculture operators

Intervention	Outcome	Indicators	Cost	Timeframe	Potential Stakeholders
	programmes for certification, and business development for aquaculture operators are created for possible scale up Increased practice of wildlife-friendly aquaculture reduces pressure on Manila Bay Demand for wildlife-friendly aquaculture products is created, driving shift from operators	with target of up to 10 operators Number of adopters of 'biodiversity-friendly' aquaculture			Private sector (seafood production companies)
Component 4. Improving wetland management through mangrove and mudflat restoration, and strengthened landscape connectivity at Sasmuan Ramsar Site (SBMCHEA)					
Expand mangrove restoration plots at degraded areas of mangroves within and surrounding the Sasmuan Ramsar Site, including disused aquaculture	Wetland under sustainable management scaled up; degraded mangrove areas restored and more resilient to coastal action.	Area of restored mangrove areas, with a restoration target of up to 300 ha at identified plots (of the site's total area of 3,500 ha)	200,000	5 years	DENR Provincial Government PENRO Pampanga concerned LGUs local communities Conservation organisations
Implement sustainable management initiatives for mudflats	Important areas of mudflats are identified, mapped, and constantly monitored, which can be used to influence use of	Baseline information and map of existing mudflats generated and presented to key stakeholders Area of mudflats, especially those known	200,000	5 years	

Intervention	Outcome	Indicators	Cost	Timeframe	Potential Stakeholders
	wetland use. Appropriate nature-based solutions are identified and possibly implemented to manage erosion and loss of mudflat areas.	to be important for shorebirds, identified, restored, and sustainably managed. Area of mudflats, especially those known to be important for waterbirds, monitored. A locally led group tasked for monitoring identified mudflats and the implemented interventions			
Total investment for five years			**6,850,000**		

7.2 Potential Financing

The estimated project cost is USD 6,850,000 for five years. This project budget supports the strengthening of local nature-based tourism, the restoration of degraded areas, the capacity-building activities for key stakeholders on sustainable fishing practices, microfinancing, and site management, and the institutionalization of a biodiversity monitoring system.

If the proposed USD 200,000 investment over five years is directed toward expanding mangrove restoration in North Manila Bay (Pampanga), it could support the rehabilitation of up to 300 hectares of degraded mangroves within and around the Sasmuan Ramsar Site, including disused aquaculture ponds. With estimated coastal protection benefits of USD 28,002 per hectare annually (see Section 5.3), this intervention could generate approximately USD 8.4 million in annual benefits—equivalent to over USD 42 million over five years. This results in an exceptional benefit–cost ratio of over 200:1, highlighting the remarkable value of restoring mangroves in this ecologically and socially significant area. Beyond strengthening coastal protection, the intervention would enhance biodiversity, support the ecological integrity of the Ramsar site, and reinforce long-term climate resilience for communities along Manila Bay. Forgoing restoration in these areas would result in substantial lost benefits and weaken the protective and ecological functions of one of the Philippines' key coastal wetlands.

Co-financing for this project is feasible as a result of an existing ADB project for flood control of the Pampanga River. The project is expected to involve the construction of dykes to manage water by the enhancement of combination of green and grey infrastructure.

7.3 Proposed Institutional Arrangements

The Municipal Government of Sasmuan and key barangays around the Ramsar site are expected to be key implementing partners.

The Provincial Environment and Resources Office (PENRO) for Pampanga has played a major role in promoting wetland conservation and is expected to be a key partner for the development and implementation of this project, together with the Department of Tourism (DOT) and Department of Environment and Natural Resources (DENR), and the provincial tourism offices.

7.4 Project Beneficiaries

It is estimated that there will be about 6,262 direct and 30,000 indirect beneficiaries for any interventions implemented for the Sasmuan Ramsar site.[6]

Proposed interventions are expected to involve the participation of LGUs and stakeholder groups from the local communities in the barangays around the Sasmuan Ramsar Site, with strong representative of women and disadvantaged groups. This includes fisherfolk, small aquaculture businesses (production of seafood-based food products) and representatives from tourism guide cooperatives. There are no indigenous or minority peoples in this landscape.

7.5 Anticipated Implementation Risks

Environment: Wetland-based tourism has been identified as a key project concept theme. The proposed interventions include new infrastructure, possibly shelters and boardwalks, that would enhance the tourism experience in the Sasmuan Ramsar site. Building these infrastructures, however, would induce noise that may disturb the wildlife in the area. Planning with the stakeholders is critical before any infrastructure development.

Poorly planned establishment of mangrove plantings may lead to loss of foraging habitat for some waterbirds and is a known issue in many parts of the Philippines where coastal restoration is being implemented. Evidence-based scoping needs to be carried out to identify key restoration plots.

Feasibility studies on the impact of expanding large-scale tourism are also necessary (rather than specialized ecotourism), and it is important that development that can drive mangrove loss must be averted – further safeguarding is needed to ensure the integrity of the mangroves is not impacted by proposed development.

[6] Ramsar Site Information Sheet: *Sasmuan Pampanga Coastal Wetlands*. Available at https://rsis.ramsar.org/ris/2445

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Annex 1. Supplementary information on coastal protection services

To further validate the identification of the top ecosystem services by means of stakeholder consultation, an expectedly essential or non-substitutable regulating service across all RFI sites, namely coastal protection and flood mitigation (i.e., storm and flood hazard regulation), was assessed based on a combination of globally available datasets supplemented by web-based tool Co$tingNature (Mulligan, 2022). Estimates for coastal protection by mangroves (after the effects of coral reefs) were spatially inferred in QGIS from a selection of metrics expressing different biophysical and monetary values modelled by Chaplin-Kramer et al. (2023) and Menéndez et al. (2020), respectively.

The key metrics selected for biophysical values (Table A1) were current maximum potential exposure to coastal hazards, which is a vulnerability risk index calculated in InVEST[1] for several hazard variables (i.e., wind, waves, sea level rise, geomorphology, and bathymetry) in the hypothetical absence of current mangrove extent, and nature's (i.e., the mangroves') contribution to reducing this coastal risk, both as an absolute value multiplied by the local population affected and a percentage of the maximum potential exposure.

Table A1. Contribution of mangroves to coastal protection as a critical natural asset in Pampanga based on site-level (biophysical) values inferred from Chaplin-Kramer et al. (2023) and expressed as ranges to represent the resulting uncertainty. Key metrics are in italics.

Critical contribution of mangroves to coastal protection (metrics)	Risk levels
Current population density within 2.5 km of the coast (number of people per hectare)	(58) – 291
Current maximum coastal risk to be mitigated, or potential exposure to coastal hazards (unitless index)	*2.93 – 3.06*
Maximum coastal risk to be mitigated, or potential exposure to coastal hazards in 2050 according to IPCC's Shared Socioeconomic Pathway #1 'Sustainability' (unitless index)	3.29 – 3.43
Maximum coastal risk to be mitigated, or potential exposure to coastal hazards in 2050 according to IPCC's Shared Socioeconomic Pathway #3 'Regional Rivalry' (unitless index)	3.69 – 3.85
Maximum coastal risk to be mitigated, or potential exposure to coastal hazards in 2050 according to IPCC's Shared Socioeconomic Pathway #5 'Fossil-fueled Development' (unitless index)	3.83 – 4.00
Current proportional risk reduction, nature's contribution to reducing coastal risk as a proportion of maximum coastal risk (unitless index)	0.12 – 0.20
Nature's contribution to reducing coastal risk as a proportion of population density within 2.5 km of the coast (# of people per hectare)	*(10) – 46*
Nature's contribution to reducing coastal risk as a percentage of the maximum potential exposure (%)	*0.04 – 0.07*

The key metrics selected for economic values (Table A2) were the annual expected flood protection benefits to total stock, which is the monetary value of the averted damages to the industrial and residential stocks (i.e., property) in 2015 US$, the same total annual benefits expressed per hectare of mangroves, and the total benefits in the event of a 100-year return period storm, which are the rarest of cyclonic conditions but cause the most flood damages to property (i.e., maximum level of coastal protection by mangroves).

Table A2. Coastal protection benefits offered by mangroves in Pampanga based on site-level (monetary) values inferred from Menéndez et al. (2020) and expressed as ranges to represent the resulting uncertainty. Key metrics are in italics.

Benefits of mangroves in terms of coastal protection (metrics)	**Avoided costs (US$)**
Mangrove extent (hectares)[2]	2 – 257
Annual expected flood protection benefits to people (number of people)	2,367 – 2,505
Annual expected flood protection benefits to Industrial Stock (US$)	1,723,328 – 1,823,967
Annual expected flood protection benefits to Residential Stock (US$)	1,872,927 – 1,982,302
Annual expected flood protection benefits to Total Stock (US$)	3,518,854 – 3,724,348
Annual expected flood protection benefits to Industrial Stock per hectare of mangroves (US$ per hectare)	*27,207 – 28,796*
1-in-100-year return period damage in terms of area flooded (number of hectares)	5.9 – 6.3
Total expected flood protection benefits of mangroves per 100-year return period storms (US$)	*590,069 – 624,528*

Table A3. Biophysical benefits from RFI coastal wetland sites (expressed as ranges to represent the resulting uncertainty) and at the national level.

Site name	**Max pot exp (index)**	**Risk reduction (index * pop)**	**Risk reduction (% max pot exp)**
Bangrin Marine Protected Area	No Data	No Data	No Data
Kabasalan-Siay Wetland Area	2.24 (±0.03)	50 (±13)	8.2 (±0.2)
Negros Occidental Coastal Wetlands Conservation Area (NOCWCA)	2.55 (±0.04)	187 (±37)	4.8 (±0.3)
North Manila Bay (Balanga Wetlands Park)	No Data	No Data	No Data
North Manila Bay (Pampanga River East Bank)	3.16 (±0.03)	296 (±451)	3.3 (±0.6)
North Manila Bay (Sasmuan Pampanga Coastal Wetland)	2.99 (±0.06)	18 (±28)	5.3 (±1.3)
Olango Island Wildlife Sanctuary	2.77 (±0.09)	496 (±87)	7.7 (±0.2)
Panabo Coast	2.40 (±0.05)	1,537 (±617)	8.1 (±0.5)
Tubbataha Reef Natural Park	2.82 (±0.04)	Not Applicable	0.8 (±2.1)
Philippines RFI average	2.70	306	5.28
Philippines national average	2.36	122	6.60

Table A4. Monetary benefits from RFI coastal wetland sites (expressed as ranges to represent the resulting uncertainty) and at the national level.

Site name	Total annual benefits (US$)	Per mangrove area (US$/ha)	For 100-yr return period storms (US$)
Bangrin Marine Protected Area	1,045,290 (±98,880)	15,294 (±1,447)	331,327 (±31,342)
Kabasalan-Siay Wetland Area	86,324,218 (±160,880,759)	12,182 (±22,704)	1,571,774 (±3,587,626)
Negros Occidental Coastal Wetlands Conservation Area (NOCWCA)	2,511,290 (±2,318,575)	1,687 (±1,557)	5,477,498 (±5,654,072)
North Manila Bay (Balanga Wetlands Park)	1,207,200 (±572,108)	28,002 (±13,270)	202,433 (±6,784)
North Manila Bay (Pampanga River East Bank)	3,621,601 (±33,678,493)	4,200 (±39,060)	6,609,485 (±106,458,484)
North Manila Bay (Sasmuan Pampanga Coastal Wetland)	3,621,601 (±102,747)	28,002 (±794)	607,298 (±17,229)
Olango Island Wildlife Sanctuary	No Data	No Data	No Data
Panabo Coast	No Data	No Data	No Data
Tubbataha Reef Natural Park	No Data	No Data	No Data
Philippines RFI average	16,388,533	14,895	2,466,636
Philippines RFI total	98,331,201	Not Applicable	14,799,814
Philippines national average	1,849,798	11,160	4,933,082
Philippines national total	789,863,793	Not Applicable	2,136,024,319

Table A5. Key habitat types in North Manila Bay (Pampanga) based on stakeholder-based assessment at the Regional Flyway Initiative workshop in June 2023.

Habitat type	Current state		Alternative state (2035)	
	Area (ha)	Cover (%)	Area (ha)	Cover (%)
Intertidal Mudflats	1303.6	35.6	1301.2	35.5
Permanent shallow marine waters	192.3	5.2	192.0	5.2
Estuarine waters	154.8	4.2	154.6	4.2
Intertidal forested wetlands	32.3	0.9	38.8	1.1
Permanent inland deltas	403.1	11.0	402.3	11.0
Aquaculture ponds	1578.2	43.1	1575.2	43.0
Total	3664.2	100.0	3664.2	100.0

[1] https://naturalcapitalproject.stanford.edu/invest/coastal-vulnerability

[2] The reference value used by Menéndez et al. (2020) for their modelling is c. 565 ha, remote sensing data from ESA World Cover 2020 map at 10m resolution.