ADB

Regional Flyway Initiative · Site Study

January 2026

RFI Priority Site · Bang Pu coast and fishponds

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Asian Development Bank

General Site Information

Country	Thailand			
RFI Site Name	Bang Pu coast			ID138
City/ Municipality, Province, Region	Bang Pu Mai subdistrict, Mueang district, Samut Prakan Province			
Geographical coordinates	13.50º N, 100.74º E		Area (has)	385 has
Key species	Black-tailed Godwit and Brown-headed Gull			
Key habitats (biomes)	Mangrove forests and intertidal mudflats.			
Key ecosystem services	Regulating and provisioning services			
Key drivers of change	Pollution arising from aquaculture and industries upstream of, and in the landscapes immediately surrounding the site. Coastal erosion, accelerated by sea-level rise in the Gulf of Thailand.			
Conservation status (mark all that applies)	■	Protected Area	■	Flyway Network Site
		Ramsar Site		Others _____
IBA/ KBA name (and number) and other designations	Inner Gulf of Thailand			
Management Stakeholders	Royal Thai Army, Bang Pu Mai subdistrict government, Department of Marine and Coastal Resources			
With management plan?				
Project concept themes	Improved site management and restoration. Biodiversity-friendly aquaculture			
Length of project	5 years			
Sector/s	Aquaculture, pollution management			
No. of potential beneficiaries				
Indigenous Peoples	■	No		Yes _____
Anticipated Implementation Risks	Potential disturbance to biodiversity if further infrastructure is built at the site, and if mangrove restoration poorly planned.			
Estimated Project Budget (US$)	10,600,000			
Potential Source/s of Financing	■	Loan (to be identified)		Private Sector
	■	Grant (to be identified)		Public-Private Partnership

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Acronyms

ADB	Asian Development Bank
AWC	Asian Waterbird Census
BNEC	Bang Pu Nature Education Center
CSR	Conservation Status Review
DOF	Department of Fisheries
DMC	Developing Member Country
DWNP	Department of Wildlife, National Parks and Plant Resources
DWR	Department of Water Resources
EAAFP	East Asian-Australasian Flyway Partnership
FEED	Foundation of Environmental Education for Sustainable Development
IBA	Important Bird and Biodiversity Area
IUCN	International Union for the Conservation of Nature
MNRE	Ministry of Natural Resources and Environment (Thailand)
NGO	Non-governmental Organisation
ONEP	Office of Natural Resources and Environmental Policy
RID	Royal Irrigation Department
RFI	Regional Flyway Initiative
TAO	*Tambon* Administrative Organisation
TESSA	Toolkit for Ecosystem Services Assessment
USD	United States Dollars

Executive summary

The Bang Pu coast is a compact and fairly well-protected wetland located along the Inner Gulf of Thailand coast in Samut Prakan province. Despite its size (<400 ha), Bang Pu comprises diverse estuarine and intertidal mudflats, mangrove forests, fishponds and brackish marshes, and annually supports globally significant numbers of the Black-tailed Godwit *Limosa limosa* (NT) as well as large congregations of the Red-necked Stint *Calidris ruficollis* (NT) and the Brown-headed Gull *Larus brunnicephalus*, with Bang Pu being possibly the most important wintering site for the latter in Southeast Asia. An additional 15 globally threatened or Near Threatened migratory waterbird species have been recorded at the site. Key ecosystem services provided by the site as identified by stakeholders, includes regulating services such as flood protection, water quality and salinity control.

Unlike most other wetlands in the Gulf of Thailand, Bang Pu is exceptional because the Royal Thai Army provides direct jurisdiction over the site (>200 ha), which is well delineated and is effectively its main management authority. As a result, Bang Pu is among the best protected wetlands in the Inner Gulf. An established nature education centre is managed by WWF Thailand in collaboration with FEED and WWF Thailand. The site received international recognition in 2025 and recently became Thailand's fourth EAAFP Flyway Network Site; it is currently under assessment as an ASEAN Heritage Park. While Bang Pu remains relatively undisturbed, much of the landscape surrounding it is dominated by aquaculture ponds, alongside residential, industrial and tourism development alongside strips of coastal mangroves, and there is increasing pressure on the site as a result of developments such as large-scale industrial development. Industrial and residential activity upstream from the site (along the Chao Phraya) has resulted in increased water pollution from effluent and wastewater. As with most sites in the Gulf of Thailand, Bang Pu site is low-lying and very vulnerable to sea-level rise.

Important interventions to improve the management of the Bang Pu wetlands is to strengthen its management through the establishment of a comprehensive site management plan (which it currently lacks), alongside co-management frameworks that include stakeholders in the surrounding landscape and volunteers. There are also major opportunities to improve the site's resilience by engaging local communities in Bang Pu Mai and other subdistricts. This may focus on biodiversity-friendly aquaculture practices (fish and shellfish farming are major land uses around Bang Pu) through incentives and capacity building programmes, while improving pollution management along this intensively used sector of the Gulf coastline. This can be further complemented by targeted and carefully planned wetland restoration work (which is ongoing as an initiative of the Bang Pu Nature Education Center) and implementation of nature-based solutions to strengthen shoreline stability at vulnerable areas.

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 Thailand, a total of 36 wetland sites, including several Asian Waterbird Census (AWC) count sites, were initially assessed through data analysis and expert consultation, of which 18 were short-listed for assessment. Of this pool of sites, twelve (12) were defined and identified to be RFI priority sites on the basis that they support over 1% the flyway population of at least one EAAF migratory waterbird species. Nine (9) of the RFI sites identified are coastal wetlands, a consequence of the country's long coastline along the Gulf of Thailand and Peninsular Thailand, with the largest cluster of priority sites concentrated in the Inner Gulf of Thailand (four: Pak Thale-Laem Pak Bia, Khok Kham, Bang Pu, Khlong Tamru). Three inland (freshwater) wetlands are distributed in Nakhon Sawan and Buri Ram provinces, identified for their important to species such as Baer's Pochard (CR) and Sarus Crane (VU). 15 EAAF species exceeded the 1%

threshold at the site/landscape level in Thailand, with species such as the Spotted Greenshank (EN) exceeding 10% of the estimated population in just one site (Laem Pak Bia) on a regular basis. Other species with important non-breeding populations in Thailand includes Spoon-billed Sandpiper (CR), Great Knot (EN), and Sarus Crane (VU).

2. Profile of Bang Pu coast and fishponds

Location: Bang Pu is a coastal wetland site situated near the mouth of the Chao Phraya River. It is located in Bang Pu Mai Subdistrict, Mueang Samut Prakan District, Samut Prakan Province, in the south of Greater Bangkok.

Area: The Bang Pu coast and fishponds RFI site covers an area of 385 ha.

Altitude: Sea level

Geographical coordinates: 13.50º N, 100.74º E

Description of site: The Bang Pu Recreation Centre was built in the 1930s for military recreational purposes. At present, the site is a fragmented area of office buildings, ponds, mudflats, mangroves and scrubland. The 102 ha of mangroves, brackish marshes and the associated mudflats are notable remnants of these habitats within the Inner Gulf of Thailand, and they support significant numbers of migratory waterbirds. The centre is a popular destination for local people as a seaside resort, and several hides have been constructed for viewing the waterbirds in the wetlands.

Site administration, management and land tenure: Bang Pu's land tenure lies with the Royal Thai Army and the site is managed in partnership with WWF Thailand, with support from the corporate sector. It was officially declared as a nature reserve in 2003 and subsequently managed as the WWF Nature Education Centre (Thailand's first urban nature education centre), which welcomes thousands of visitors each year. Bang Pu became formally recognised as the 4th EAAFP Flyway Network Site for Thailand on 28 March 2025, in addition to Pak Thale-Laem Pak Bia, Khok Kham and the Krabi Estuary, with an area of 201 ha defined within this area.

Social and economic values: Bang Pu is popular with domestic visitors, including large numbers of students and educators who visit the Bang Pu Nature Education Center each year. The education centre represents a partnership between three different stakeholders, with different mandates. The Royal Thai Army utilises its development mandate in the construction and maintenance of the wildlife observation infrastructure (including the boardwalk, nature trail, bird observation tower and canopy observation bridge), and its profile and connections to heighten public and media interest in the site. WWF Thailand uses its strengths in environmental awareness promotion to provide quality nature education for schoolchildren, and corporate sector organisations finance the education programme as part of their Social Corporate Responsibility (CSR) programmes.

Figure 1. Map of Bang Pu coast and fishponds, showing its boundary (in blue) and location within Thailand (in pink) (data from EAAFP Site Information Sheet; map: Evelyn Pina Covarrubias).

3. Biodiversity value of Bang Pu coast and fishponds

3.1. Key habitats

The site is a fragmented area of office buildings, ponds, mudflats, mangroves, and scrubland. The 102 ha of mangroves, brackish marshes, and the associated mudflats are notable remnants of these habitats within the Inner Gulf of Thailand.

3.2 Importance of Bang Pu coast and fishponds for migratory waterbird species

The Bang Pu coast and surrounding fishponds supports a high diversity of migratory waterbird species, notably shorebirds, gulls and terns. Count data from the 2017 and 2018 Asian Waterbird Census (AWC) was averaged in the RFI analysis for Bang Pu coast and fishponds and then compared to the Conservation Status Review (CSR1) 1% population estimates to calculate a score for each species. Black-tailed Godwit was found to regularly exceed the 1% population estimate during counts over these two years (see Table 1).

Table 1. List of migratory species (based on the EAAFP list of species) with globally significant congregations in Bang Pu.

Scientific name	IUCN	Average count	CSR1	CSR1 score
Black-tailed Godwit *Limosa limosa*	NT	1,694	1,600	1.1

The Bang Pu coast and fishponds is also known to support significant numbers of the near-threatened Red-necked Stint *Calidris ruficollis* (NT) and Brown-headed Gulls. Each winter, 6,000–8,000 Brown-headed Gulls *Larus brunnicephalus* (4.3-5.7% of the CSR1 population estimate) feed and roost on the mudflats and the water's surface at Bang Pu, as well as significant numbers of the Painted Stork *Mycteria leucocephala* (Parr et al. 2022). In addition, 15 globally Near threatened or Threatened migratory waterbird bird species have been observed at the site in smaller numbers, including Grey Plover *Pluvialis squatarola* (VU), Eurasian Curlew *Numenius arquata* (NT), Bar-tailed Godwit *Limosa limosa* (NT), Asian Dowitcher *Limnodramus semipalmatus* (NT), Spotted Greenshank *Tringa guttifer* (EN), Ruddy Turnstone *Arenaria interpres* (NT), Great Knot *C. tenuirostris* (EN), Red Knot *C. canutus* (NT), Broad-billed Sandpiper *C. falcinellus* (VU), and Curlew Sandpiper *C. ferruginea* (VU)

3.3 Other notable biodiversity

Bang Pu supports notable populations of mangrove flora and fauna, including a high diversity of intertidal marine species (see Parr et al. 2012).

4. Ecosystem services

The Bang Pu coast overlaps with diverse coastal habitats along the Inner Gulf of Thailand, offering valuable regulating and cultural ecosystem services (Figure 2). The results from the RFI workshop[1] highlight the top ecosystem services provided by the site, emphasising their essential and non-substitutable nature (Table 2). Regulating services such as global climate regulation and erosion regulation benefit communities adjacent to and distant from the site. Both services have seen an increase in the past and are expected to continue increasing in the future, highlighting their growing significance for regional and global environmental health. Cultural services, particularly recreation ecotourism, knowledge systems and education, and cognitive development for psychological and physical health, significantly benefit communities at all distances. These services have all experienced an increase in the past and are projected to continue rising, reinforcing Bang Pu's importance to both local and broader populations.

4.1. Ecosystem services provided by Bang Pu coast and fishponds

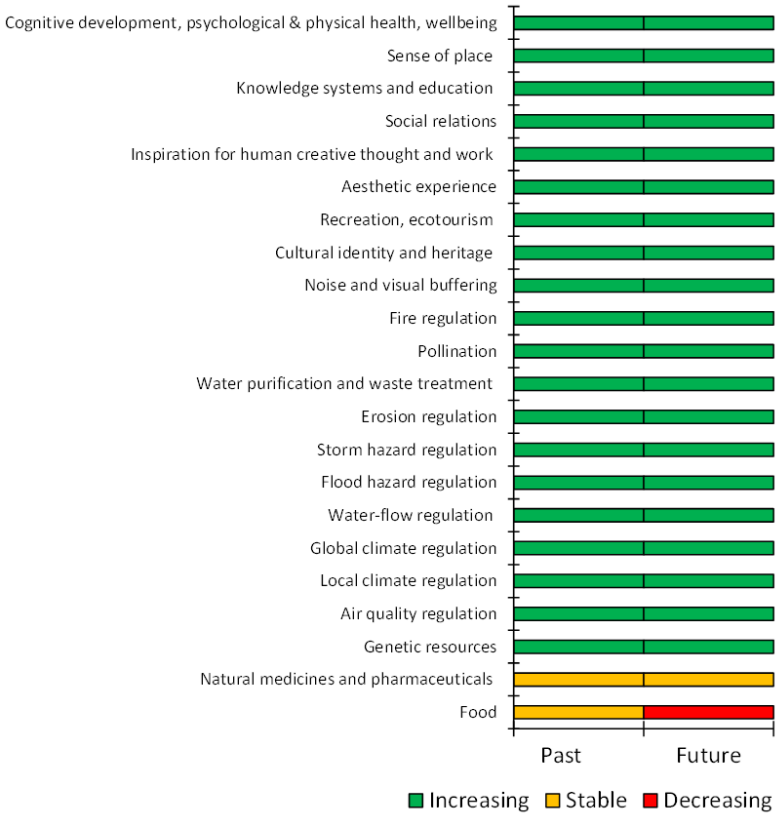

Figure 2. List of ecosystem services provided by Bang Pu coast and fishponds, as identified through stakeholder consultation at the Regional Flyway Initiative workshop.

[1] Asian Development Bank. (2023, November 27-29). Thailand: Wetland Ecosystem Services Workshop [Workshop]. Thailand. https://events.development.asia/learning-events/thailand-wetland-ecosystem-services-workshop

Table 2. List of top ecosystem services provided by Bang Pu coast and fishponds.

Ecosystem services	Essential or non-substitutable	Benefits to communities			Change	
		Within the site	Adjacent to the site	Distant to the site	Past	Future
Regulating services						
Global climate regulation		✓	✓	✓	Increase	Increase
Erosion regulation		✓	✓		Increase	Increase
Cultural services						
Recreation, ecotourism		✓	✓	✓	Increase	Increase
Knowledge systems and education		✓	✓	✓	Increase	Increase
Cognitive development, psychological & physical health, wellbeing		✓	✓	✓	Increase	Increase

4.2. Global climate regulating services

Based on systematic reviews (Chen & Lee, 2022; Stankovic et al., 2023), the amount of carbon stored in Bang Pu coast and fishponds is estimated to range from 6,640 to 36,900 tonnes, while the annual carbon sequestration rate is estimated at between 103 and 1,010 tonnes per year.

4.3. Coastal protection services

The coastal protection services provided by the Bang Pu coast and fishponds were assessed using both biophysical indices and monetary values (see Tables A1 and A2, and Annex 1 for details). Unfortunately, Bang Pu coast and fishponds cannot be compared to the average risk levels of either the nine RFI coastal sites or of all other coastal areas in Thailand because no biophysical data were available for this site due to its relatively small size (Table A3 in Annex 1).

In monetary terms (Table A4 in Annex 1), the Bang Pu coast and fishponds rank below the national RFI average (985 vs. 1,987 USD/ha) in terms of total annual benefits per ha of mangroves. At the same time, while these benefits for the total area of the Bang Pu coast and fishponds are also below the average of all RFI sites in Thailand (724 vs. 1,804 thousand USD), they are closer to the average of all other coastal sites in the country (724 vs. 789 thousand USD).

5. Drivers of change and their potential impacts on Bang Pu coast and fishponds

5.1. Current drivers of change and their level of impact

Stakeholders at the RFI workshop[2] identified several drivers of change impacting Bang Pu. Table 3 highlights these key drivers of change and their corresponding levels of impact on the wetland site. High-impact drivers include invasive plant species, which significantly disrupt the native ecosystem and affect biodiversity. Restoration for conservation efforts, although aimed at preserving the wetland, have also notably altered its natural state. Temperature extremes pose further threats to the wetland's ecological balance.

Medium-impact drivers encompass activities of site managers, which have moderately modified the site. Dams within or upstream of the wetland alter the hydrological regime, affecting water flow and habitat conditions. Other medium-impact factors include fishing, killing, and harvesting of aquatic resources, garbage and solid waste accumulation, household sewage and urban wastewater, invasive animal species, loss of hydrological connectivity, and the development of tourism and recreation infrastructure.

Low-lying coastal sites across the Inner Gulf of Thailand and the Lower Chao Phraya Basin are at risk from the effects of climate change, particularly sea-level rise. Chaiyarak et al. (2019) projected that sea levels will increase by 0.2 m by 2049, whereas Norris et al. (2024) indicated increases by up to 0.3 m to 2050 and 0.7 m by the late century under a high emissions scenario. In either case, there is expectedly an increased vulnerability to flooding, increased saline intrusion, and changes to the extent of mangroves and associated intertidal areas such as mudflats.

[2] Asian Development Bank. (2023, November 27-29). Thailand: Wetland Ecosystem Services Workshop [Workshop]. Thailand. https://events.development.asia/learning-events/thailand-wetland-ecosystem-services-workshop

Table 3. Drivers of change and their potential impact on the integrity of Bang Pu coast and fishponds based on consultations with stakeholders.

Driver of change	Impact
Invasive plant species	High
Restoration for conservation	
Temperature extremes	
Activities of site managers	Medium
Dams within or upstream of the wetland site, which alter the hydrological regime	
Fishing, killing and harvesting of aquatic resources	
Garbage and solid waste	
Household sewage and urban wastewater from outside the wetland site	
Invasive animal species	
Loss of hydrological connectivity	
Tourism and recreation infrastructure	Low
Habitat shifting and alteration	
Industrial, mining and military effluents	
Loss of keystone species	
Other 'edge effects' that degrade the wetland site values	
Recreational activities and tourism	
Research, education and other work-related activities	
Sewage and wastewater from wetland site facilities	
Utility and service lines	

Figure 3. Land cover types in the Bang Pu Nature Education Center based on remotely-sensed data (Map: Radhika Bhargava)

5.2. Potential alternative state of Bang Pu coast and fishponds under current drivers of change

Stakeholders at the RFI workshop[3] 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.

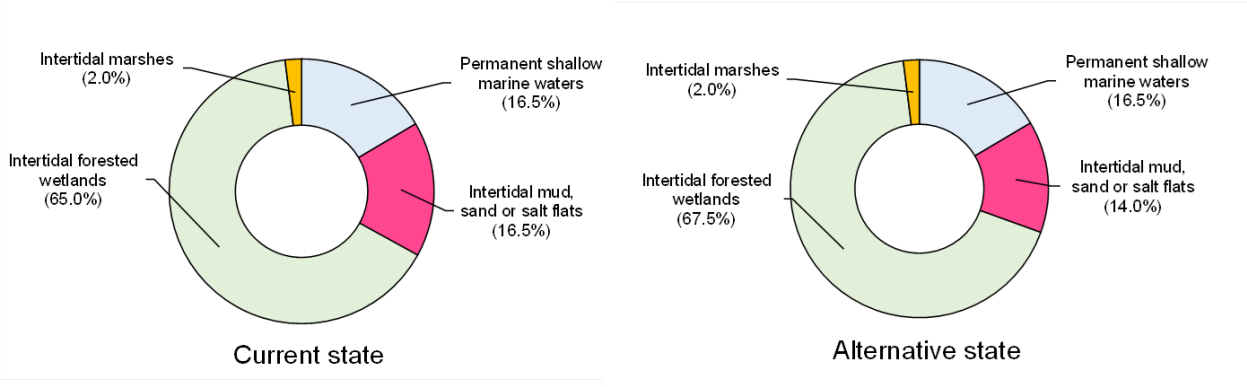

Figure 4. The proportional change in the extent of different habitat types between the current and alternative states of Bang Pu coast and fishponds.

5.3. Expected changes in the ecosystem services of Bang Pu Coast and Fishponds

Stakeholders at the RFI workshop[4] documented the future trends in the provision of ecosystem services in Bang Pu Coast, indicating if the ecosystem services provided by this site (to 2035) will increase, decrease, or will remain stable if the current drivers of change impacting this site will continue in their present condition, with the intervention remains unchanged.

Provisioning services, particularly food provision, are expected to increase in Bang Pu's wetlands in the long term (Figure 2, Table 2). However, there is concern that regulating services, such as air quality and global climate regulation, as well as flood and storm hazard regulations may decrease in the long term, while cultural services, particularly recreation and tourism, remain stable.

[3] Asian Development Bank. (2023, November 27-29). Thailand: Wetland Ecosystem Services Workshop [Workshop]. Thailand. https://events.development.asia/learning-events/thailand-wetland-ecosystem-services-workshop

[4] Asian Development Bank. (2023, November 27-29). Thailand: Wetland Ecosystem Services Workshop [Workshop]. Thailand. https://events.development.asia/learning-events/thailand-wetland-ecosystem-services-workshop

Bang Pu coast overlaps with diverse coastal habitats, offering valuable regulating and cultural ecosystem services (Figure 2). The results from the RFI workshop[5] highlight the top ecosystem services provided by the site, emphasising their essential and non-substitutable nature (Table 2). Regulating services such as global climate regulation and erosion regulation benefit communities adjacent to and distant from the site. Both services have seen an increase in the past and are expected to continue increasing in the future, highlighting their growing significance for regional and global environmental health. Cultural services, particularly recreation ecotourism, knowledge systems and education, and cognitive development for psychological and physical health, significantly benefit communities at all distances. These services have all experienced an increase in the past and are projected to continue rising, reinforcing Bang Pu's importance to both local and broader populations.

In the alternative state, the gain of 4% of mangrove and the loss of 15% of intertidal mudflat will result in a gain of stored carbon, estimated at 409 tonnes and an increase in carbon sequestration rate (carbon accumulation) by approximately 17 tonnes per year.

A loss of 3 ha of mangroves as presented in Table A5 is equivalent to 3% of the total land use for the site, which is expected to result in roughly a 0.4% reduction in coastal protection. This may amount to approximately three thousand USD in lost total benefits per year (based on 985 USD per hectare of mangroves) and five thousand USD in lost total benefits per 100-year return period storm (based on the same 0.4% reduction in coastal protection).

[5] Asian Development Bank. (2023, November 27-29). Thailand: Wetland Ecosystem Services Workshop [Workshop]. Thailand. https://events.development.asia/learning-events/thailand-wetland-ecosystem-services-workshop

6. Capacity needs in Bang Pu coast and fishponds

Stakeholder consultations with representatives of local governments along the Bang Pu coast identified major capacity gaps in local tourism development and in the development of businesses for smallholders engaged in community-based products. There are opportunities for stakeholder groups focused on sustainable ecotourism and educational awareness through social media.

Table 4. Capacity needs for key stakeholders involved in the management of Bang Pu, based on RFI stakeholder consultations.

Stakeholder group	Current role in wetland management	Possible future role in wetland management	Current capacity for sustainable wetland management	Capacity development needed to improve wetland management	Form of capacity development (e.g. training, organisational strengthening etc.)
Royal Thai Army: Quartermaster Department	Lawful owner of the land.	Oversee and support management and development plans for the site.	Mostly land stewardship.	Support local nature-based tourism	Training programmes and workshops. Exchange visits to other wetlands.
Foundation of Environmental Education for Sustainable Development (Thailand) FEED	Organise activities to promote environmental education and awareness.	Expand work on environmental education; content development.	Mostly on providing environmental education.	Producing content for social media.	Training workshops and programmes in content and media creation (including wildlife photography)
Tourists and visitors (including birdwatchers)	End-user (benefits from the site's ecosystem services). Contributor to pollution on-site.	Support activities to raise profile and promote awareness of the site	Mostly supporting (e.g. promoting site awareness)	Producing content for social media to promote awareness of the site.	
Local communities		Support the conservation and management of the site		Support nature-based tourism activities; waste management.	Training workshops and programmes in waste management (and sorting)

7. Opportunities for RFI interventions

7.1. Recommended Interventions

Proposed RFI interventions for Bang Pu are broadly similar to Khok Kham and Khlong Tamru, another Gulf of Thailand site located approximately 30 km to the east in the Bang Pakong Estuary, given the geographic proximity of both sites and broad similarities in landscape and biodiversity. The recent recognition of Bang Pu (Bang Pu Nature Conservation Center) as an EAAFP Flyway Network Site strengthens the case scaling up work at this site for wetland restoration and protection, and the development of a comprehensive site management plan. There are also opportunities for targeted interventions to address environmental flows, sediment transfer and wastewater / industrial pollution in the landscape matrix around Bang Pu.

To strengthen management and conservation of Bang Pu and the wider landscape, there is a need to:

(1) Sustain and improve the existing management of coastal wetlands through,
   a. Understanding future risks to the landscape and planning interventions accordingly to ensure the long-term success of interventions.
   b. Comprehensive site management plan with provisions for targeted wetland restoration work with a focus on 'mangrove zones' to strengthen shoreline stability, notwithstanding the coastal erosion challenges the site faces.
   c. Addressing wastewater and industrial pollution.
   d. Strengthen and formalise co-management structures involving the local community, volunteers and other government stakeholders.

(2) Enable, and up-scale (economic) infrastructure for compatible forms of economic activity in the landscape immediately surrounding Bang Pu by,
   a. Promoting sustainable approaches to aquaculture (for shellfish and fish) that are biodiversity-friendly.

Table 5. Summary of key RFI interventions proposed for Bang Pu coast and fishponds

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Component 1. Strengthening site management of the Bang Pu coastline					
Undertake an environmental and social impact assessment of project implementation in the Bang Pu coastline.	Best practices, guidelines, and standards for proposed RFI interventions	Environmental and social impact assessment report finalised and disseminated with key local stakeholders. Guidelines for evaluating	100,000	1.5 years	DMCR DWR Royal Thai Army Bang Bu Mai TAO Consultancy companies

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		proposed project components on their positive and negative impacts considering local planning regulations developed. Guidelines and standards for an iterative process on redesigning project components developed and implemented. Number of consultations conducted with local stakeholders for a participatory process in developing standard and guidelines for project interventions Number of stakeholder groups engaged in the assessment and development of project interventions' guidelines			Research institutions (e.g. Mahidol University)
Undertake a climate, topographical and hydrological survey to assess vulnerability, and determine scenarios for the site for long-term management.	Priority sites for long-term management, as well as impacts of sea-level rise and shifts in hydrology identified. Predicted sea level rise impacts at the site better assessed.	Hydrological and climate change impact assessment report finalised, presented to local stakeholders and endorsed by designated management authority.	100,000	1 year	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		Area for long-term management identified. Number of consultations conducted with local stakeholders for a participatory process in the local assessment. Number of stakeholder groups engaged in the assessment.			
Develop a comprehensive site management plan to address threats and disturbance, and strengthen long term management	Wetlands within the Bang Pu FNS site is well managed for migratory waterbirds and local stakeholders, including volunteers are regularly engaged.	An agreed long-term vision and management plan for Bang Pu. A co-management framework, with relevant stakeholders with jurisdiction over the coastal zone. Number of volunteer networks established and supported. Number of consultations conducted with key stakeholders for a participatory process. Number of stakeholder groups engaged in the site management planning Number of activities in the site	150,000	2 years	EAAFP DMCR DWR FEED Royal Thai Army Conservation organisations Research institutions (e.g. Mahidol University)

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		management implemented			
Establish a long-term biodiversity and threat monitoring framework, with a focus at sites with high waterbird concentrations.	Improved biodiversity conservation through monitoring and increased participation of local communities in protecting migratory waterbird species.	Biodiversity monitoring and adaptive management framework focusing on key species indicators and sites with high waterbird concentrations established and implemented. Indicator species identified and actively monitored. A capacity program on the developed biodiversity monitoring framework created for key stakeholders Number of people trained on biodiversity monitoring. A multi-sector biodiversity monitoring group organized. Number of biodiversity monitoring activities implemented.	30,000	5 years (and beyond).	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Component 2. Improving wastewater and pollution management in the Bang Pu coastal landscape					
Strengthen wastewater management (industrial effluents and pollutants from adjacent industries and aquaculture areas) from canals and drains draining into coast off Bang Pu wetlands.	Improved water quality in the Bang Pu coastline, alongside a significant decline in solid waste. Improved wetland management through maintained water management infrastructure such as canals and sluice gates (based on findings of hydrological report)	Number of wastewater management infrastructure (e.g., canals and sluices optimised to maintain water levels and drainage capacities, while reducing solid waste pollution and discharge) improved. Regulations and guidelines on wastewater and pollution management improved and disseminated with key stakeholders. Baseline and targets metrics on key chemical and biological contamination in water developed. Set target reduction on key chemical and biological contamination in water achieved. Number of consultations conducted with key stakeholders, ensuring a participatory process. Number of people engaged in	500,000	5 years	DMCR DWR FEED Royal Thai Army Aquaculture operators and other landowners

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		wastewater and pollution management Number people engaged in the awareness-raising activities on wastewater management.			
Improve local awareness of pollution and solid waste management.	Better wetland management through increased engagement from local communities and businesses on solid waste management.	Training program/ modules on pollution and solid waste management developed and implemented. Number of training activities (up to 2) implemented Number of stakeholders (including local communities and businesses) trained on improved waste disposal methods. Number of local businesses engaged in managing solid waste.	100,000	5 years	
Component 3. Targeted restoration of degraded mangroves in the Bang Pu coastal landscape					

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Restore degraded mangrove forests and brackish marshland in and along the Bang Pu coast.	Better wetland management through mangrove restoration. Increased mangrove forest cover in targeted degraded areas, especially disused fishponds.	Up to 15 ha of disused fishponds and degraded mangrove forest restored. Restoration plan and pilot plots identified and developed with careful consideration of important feeding areas for birds. Monitoring plan developed and actively implemented. Number of people engaged in the mangrove restoration activities. Number of activities in the restoration and monitoring plans implemented.	200,000	5 years at least (mangrove restoration work ongoing)	Royal Forest Department DMCR Royal Thai Army Bang Pu Mai TAO, Mueang district government, Samut Prakan Research institutions
Scale up nature-based solutions to address coastal erosion on the Bang Pu coast.	Better wetland management through nature-based solutions to protect the coast from erosion.	Number of nature-based solutions implemented to protect the coast from erosion, including the use of wooden structures expanded to cover at least XX m for vulnerable sites. Number of consultations conducted to plan nature-based solutions for a participatory process.	200,000	2 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		Number of people engaged in implementing nature-based solutions.			
Component 4. Upscaling of tourism infrastructure targeting nature-based activities.					
Improve and expand (as required) infrastructure for nature-based tourism, including signages, trails on boardwalks and wetland interpretation facilities, shelters and bird hides	Improved protection and management of Bang Pu coast, through nature-based tourism benefits, increased appreciation of waterbirds, and the wetlands, and expanded field infrastructure for tourist visitors.	Number of tourism infrastructure (including signage, trails on boardwalks and wetland interpretation facilities, shelters and bird hides) established and improved. Number of people benefitting from nature-based tourism. Number of nature-based trips organized in Bang Pu coast	250,000	2 years	Royal Thai Army FEED Conservation organisations
Component 5. Improve sustainable aquaculture practices in the wider Bang Pu coastline					
Promote low impact, biodiversity-friendly production processes for fish and shellfish aquaculture.	Better management for Bang Pu coast through increased capacity of local communities on biodiversity-friendly production and financial management, and microfinance mechanisms. Improved inclusivity with the engagement of	Up to 20 aquaculture operators in the area accredited to a recognised international standard (that includes a strong biodiversity component). Training programmes for biodiversity-friendly production developed, in line with Thailand	1,000,000	5 years	Department of Fisheries Bang Pu Mai TAO, Mueang district government, Samut Prakan Conservation organisations Aquaculture companies, operators and cooperatives

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	women in the workforce.	Marine Fishery Management Strategy. Number of training activities implemented for local communities. Number of people, with a representative % of women) trained on biodiversity-friendly fish and shellfish aquaculture and financial management trained. Microfinance mechanism established. Number of local fisherfolk benefitting from the established microfinance mechanism. Number of community cooperatives supported.			
Total investment for 5 years			**USD 10,600,000**		

7.2. Potential Financing

The estimated project cost is USD 10,600,000 for five years. This budget supports environmental and social impact assessments; the development of a comprehensive site management plan; wastewater and pollution management; the expansion of nature-based tourism; mangrove restoration; nature-based solutions; financial management; and capacity-building for local stakeholders in biodiversity-friendly production, biodiversity monitoring, wastewater and solid waste management, and financial

management. Table 5 summarizes the projected budget distribution across the proposed project components.

If the proposed USD 200,000 investment over at least five years is allocated to restoring degraded mangrove forests and brackish marshlands along the Bang Pu coast, it could enable the rehabilitation of up to 15 hectares of disused fishponds and degraded mangroves. With estimated coastal protection benefits of USD 985 per hectare annually (see Section 5.3), this intervention could yield approximately USD 14,775 in annual benefits – amounting to around USD 73,875 over five years. This suggests a benefit–cost ratio of around 0.4:1 for the restoration component alone, indicating limited direct financial returns from coastal protection but underscoring important ecological and co-benefits, including the restoration of critical bird feeding habitats. When paired with complementary investment in scaling up nature-based solutions – such as installing wooden structures to mitigate coastal erosion at vulnerable sites – this integrated approach supports long-term coastal resilience, habitat recovery, and biodiversity conservation. Forgoing these interventions would risk further habitat loss, continued shoreline erosion, and reduced ecosystem services for communities and wildlife depending on the Bang Pu wetland landscape.

There are potential for co-financing with existing projects, and ongoing work to recognise the site as an ASEAN Heritage Park.

7.3. Proposed Institutional Arrangements

The project is expected to be facilitated by the Royal Thai Army and the DMCR, with support from FEED and conservation organisations operating in the Bang Pu area. The project is expected to take place over a 5-year period, with targeted work to develop a comprehensive site management plan and implement it. Other targeted interventions at the site includes mangrove and wetland restoration, biodiversity monitoring, expansion of nature-based solutions to protect vulnerable areas of coastline, and pollution management.

7.4. Project Beneficiaries

There are no indigenous people in this landscape. Interventions at the site will involve local communities in Bang Pu Mai subdistrict.

7.5. Anticipated Implementation Risks

Stakeholder engagement: Proposed interventions rely on support from local communities, particularly for supporting biodiversity-friendly production and co-management. Establishing strong stakeholder buy-in from local leaders and community engagement will facilitate better implementation of the proposed interventions.

Environment: Most proposed interventions are relatively soft and have a low environmental impact, but it may be necessary to consider the effects of expanding tourism in Bang Pu coast, which could increase

anthropogenic pressures and lead to greater disturbance of wildlife. Planning with stakeholders to reduce noise pollution during the construction of ecotourism facilities and during ongoing ecotourism activities, as well as managing waste pollution associated with increased tourist traffic, is essential.

The installation of nature-based solutions (e.g. bamboo and wooden coastal protection structures such as fences) to protect vulnerable coastlines along Bang Pu needs to take into account key areas of habitat for migratory waterbirds.

References

Asian Waterbird Census (AWC): Thailand data for 2017-2018. See https://eaaflyway.net/asian-waterbird-census

BirdLife International Important Bird Area factsheet: Inner Gulf of Thailand (Thailand). Available at: https://datazone.birdlife.org/site/factsheet/inner-gulf-of-thailand-iba-thailand

Chaiyarak, B., Tattiyakul, G., & Karnsunthad, N. (2019). *Climate Change Vulnerability Assessment Bang Pakong River Wetland, Thailand*. Bangkok, Thailand: IUCN. X + 73pp.IUCN Red List of Threatened Species. Available at: www.iucnredlist.org

Mundkur, T. & Langendoen, T. (2022) *Report on the Conservation Status of Migratory Waterbirds of the East Asian – Australasian Flyway Partnership.* First Edition. Draft Report to the East Asian – Australasian Flyway Partnership. Wetlands International, Ede, The Netherlands. Available at: https://www.wetlands.org/publication/eaaf-conservation-status-review1/

Norris, L. et al. (2024) *Climate risk report for the Southeast Asia region*, Met Office, Overseas Development Institute (ODI), Foreign, Commonwealth and Development Office. https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/services/government/climate-risk-report-for-sea---v6-final-updated.pdf

Parr, J.W.K., Pukotchasarnseen, T., & La-orphanphol, T. (2012) Bang Pu: Thailand's First Urban Nature Education Centre. *Natural History Bulletin of the Siam Society* 58: 7–17.

Pimathi, R., Jukmongkol, R., Round, P. D. and Tordoff, A. W. (eds) (2004) *Directory of Important Bird Areas in the Kingdom of Thailand: key sites for conservation.* Bangkok, Thailand: Bird Conservation Society of Thailand and BirdLife International.

Scott, D.A. (1989) *A Directory of Asian Wetlands.* IUCN: Gland, Switzerland & Cambridge, U.K. Available at: https://portals.iucn.org/library/node/5933

Thaibirding.com: Bang Poo. Available at: https://www.thaibirding.com/locations/central/bang_poo.htm
Thai.It: Bang Pu Recreation Center – Seaside Resort near Bangkok. Available at: https://www.thai.lt/blog/848-bang-pu-recreation-center-seaside-resort-near-bangkok

Wickramasinghe, S., Borin, M., Kotagama, S.W., Cochard, R., Anceno, A.J. & Shipin, O.V. (2009) Multi-functional pollution mitigation in a rehabilitated mangrove conservation area. *Ecological Engineering* 35(5): 898-907. https://doi.org/10.1016/j.ecoleng.2008.12.021.

10000birds: 24 Hours in Bangkok, Bang Poo and Muang Boran. Available at: https://www.10000birds.com/24-hours-in-bangkok-bang-poo-and-muang-boran.htm

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 Bang Pu coast and fish ponds 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)	No Data
Current maximum coastal risk to be mitigated, or potential exposure to coastal hazards (unitless index)	*No Data*
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)	No Data
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)	No Data
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)	No Data
Current proportional risk reduction, nature's contribution to reducing coastal risk as a proportion of maximum coastal risk (unitless index)	No Data
Nature's contribution to reducing coastal risk as a proportion of population density within 2.5 km of the coast (# of people per hectare)	*No Data*
Nature's contribution to reducing coastal risk as a percentage of the maximum potential exposure (%)	*No Data*

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 Bang Pu coast and fish ponds 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$)**
Mangrove extent (hectares)[2]	30 – 65
Annual expected flood protection benefits to people (number of people)	(274) – 1,595
Annual expected flood protection benefits to Industrial Stock (US$)	(191,041) – 1,113,324
Annual expected flood protection benefits to Residential Stock (US$)	(131,563) – 766,704
Annual expected flood protection benefits to Total Stock (US$)	*(299,776) – 1,746,993*
Annual expected flood protection benefits to Industrial Stock per hectare of mangroves (US$ per hectare)	*(408) – 2,377*
1-in-100-year return period damage in terms of area flooded (number of hectares)	0 – 400
Total expected flood protection benefits of mangroves per 100-year return period storms (US$)	*(58) – 2,504,230*

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)**
Bang Pu	No Data	No Data	No Data
Khlong Tamru (Bang Pakong)	3.22 (±0.17)	147 (±39)	4.87 (±0.25)
Khlong Yai	2.15 (±0.07)	59 (±16)	7.27 (±1.91)
Khok Kham	3.02 (±0.09)	0 (±0)	5.18 (±0.16)
Ko Libong	2.63 (±0.07)	21 (±1)	6.21 (±0.34)
Krabi Estuary	2.69 (±0.07)	17 (±1)	5.68 (±0.28)
Pak Nam Prasae	2.63 (±0.20)	53 (±1)	5.94 (±0.44)
Pak Thale	3.23 (±0.08)	28 (±8)	3.36 (±0.85)
Ao Phang Nga	2.45 (±0.10)	12 (±1)	6.02 (±0.35)
Thailand RFI average	2.75	63	5.44
Thailand national average	2,70	30	3.92

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$)
Bang Pu	723,608 (±1,023,384)	985 (±1,393)	1,252,086 (±1,252,144)
Khlong Tamru (Bang Pakong)	4,064,792 (±101.810)	1,698 (±43)	1,028,638 (±46,938)
Khlong Yai	299,013 (±35,045)	37 (±4)	0 (±0)
Koh Kham	9,699,944 (±5,444,336)	12,815 (±7,193)	17,562,472 (±14,369473)
Ta Libong	0 (±0)	0 (±0)	3,564,916 (±55,274)
Krabi Estuary	0 (±0)	0 (±0)	4,150,201 (±45,319)
Pak Nam Prasae	557,410 (±3,584,456)	300 (±1,929)	1,464,757 (±2,408,230)
Pak Thale	806,609 (±1,685,154)	1,967 (±4,109)	962,707 (±1,130,299)
Ao Phang Nga	81,744 (±96,861)	86 (±102)	5,723,399 (±12,351,015)
Thailand RFI average	1,803,680	1,987	3,967,686
Thailand RFI total	16,233,119	Not Applicable	18,146,703
Thailand national average	789,242	2,702	9,197,142
Thailand national total	85,257,773	Not Applicable	377,082,842

Table A5. Key habitat types in Bang Pu coast and fishponds based on stakeholder-based assessment at the Regional Flyway Initiative workshop in November 2023.

Habitat type	Current state		Alternative state (2035)	
	Area (ha)	Cover (%)	Area (ha)	Cover (%)
Permanent shallow marine waters	19.7	16.5	19.7	16.5
Intertidal mud, sand or salt flats	19.7	16.5	16.7	14.0
Intertidal forested wetlands	77.7	65.0	80.7	67.5
Intertidal marshes	2.4	2.0	2.4	2.0
Total	119.6	100.0	119.6	100.0