ADB

Regional Flyway Initiative · Site Study

January 2026

RFI Priority Site · Krabi River Mouth

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General Site Information

Country	Thailand			
RFI Site Name	Krabi River Estuary			ID131
City/ Municipality, Province, Region	Mueang Krabi, Krabi Province			
Geographical coordinates	8.02 N, 98.93 E		Area (has)	133,199 ha
Key species	Spotted Greenshank and Chinese Egret			
Key habitats (biomes)	Mangrove forests, intertidal mudflats and seagrass beds.			
Key ecosystem services	Provisioning services and regulating services			
Key drivers of change	Tourism, especially of industrial, aquaculture and housing areas (from Krabi Town)			
Conservation status (mark all that applies)		Protected Area		Flyway Network Site
		Ramsar Site		Others forest reserve
IBA/ KBA name (and number) and other designations	Na Muang Krabi			
Management Stakeholders	Department of Aquatic Resources, Department of Marine and Coastal Resources, ONEP, Krabi Provincial Government and Mueang Krabi (district) Government. Department of Fisheries. Royal Forest Department.			
With management plan?	Yes			
Project concept themes	Wetland management, small-scale fisheries, sustainable aquaculture and sustainable tourism			
Length of project	10 years			
Sector/s	Fisheries and aquaculture. Tourism.			
No. of potential beneficiaries				
Indigenous Peoples		No		Yes _____
Anticipated Implementation Risks	Construction of water and ecotourism infrastructure may impact wildlife.			
Estimated Project Budget (US$)	46,000,000			
Potential Source/s of Financing		Loan (to be identified)		Private Sector
		Grant		Public-Private Partnership

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Acronyms

ADB	Asian Development Bank
AWC	Asian Waterbird Census
BCST	Bird Conservation Society of Thailand
CSR	Conservation Status Review
DOF	Department of Fisheries
DMC	Developing Member Country
DMCR	Department of Marine and Coastal Resources
DWNP	Department of Wildlife, National Parks and Plant Resources
DWR	Department of Water Resources
EAAFP	East Asian-Australasian Flyway Partnership
ECA	Ecologically Critical Area
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
RFI	Regional Flyway Initiative
TAO	*Tambon* Administrative Organisation
TESSA	Toolkit for Ecosystem Services Assessment
USAID	United States Agency for International Development
USD	United States Dollars

Executive summary

The wetlands of the Krabi River Estuary and Bay (30,745 ha) is located along the west coast of peninsular Thailand in Krabi Province, approximately 650 km south of Bangkok. This site overlaps with the estuary of the Krabi River immediately downstream of Krabi town and extend south-east to the rocky headland of Khao Laem Nang. Krabi Estuary covers one of the largest extents of mangrove forests in Peninsular Thailand but also overlaps with a diversity of wetlands including intertidal mudflats, seagrass beds and sandy beaches. The Krabi Estuary is currently recognised as a Ramsar Site and EAAFP Flyway Network Site, although not all key areas of wetlands of migratory waterbirds fall within the boundaries of the designated area. As a whole, the Krabi Estuary is known to be important for the Spotted Greenshank *Tringa guttifer* (EN) and Tibetan Sandplover *Anarhynchus atrifrons* (LC), alongside historical records of the Masked Finfoot *Heliopais personatus*. In addition, a further 14 globally Near Threatened or Threatened species have been recorded, although in smaller numbers.

Krabi's wetlands support diverse regulating and provisioning (ecosystem) services. For example, the estuarine and coastal waters within the site support a major fishery, with the majority of households living in the coastal villages dependent on fishing as a source of livelihood. The mudflats are harvested by the local communities for molluscs, prawns, crabs and mussels. In many of the coastal villages (*muban*) in Mueang Krabi, 70-90% of households are involved in small-scale fishing. There has been considerable development of aquaculture ponds, and numerous fish cages have been established. Mangroves in the Krabi Estuary are cut for charcoal production and pole wood. Modelling remotely sensed data shows that the site stores from 1,170,000 to 5,600,000 tonnes of carbon and offers >$4.1m USD of coastal protection under some extreme weather event scenario. Tourism is a major contributor to the Krabi economy, and the coastal zone around Krabi town draws a high volume of domestic and international tourists annually. As a direct consequence of the pressures from heavy human use from tourism, the site faces diverse threats ranging from habitat disturbance and pollution to overfishing.

RFI interventions at this site should aim to address key threats to the site, including solid and water pollution in Krabi Bay by improving the sustainability of tourism activities. This may include but not limited to interventions to strengthen the capacity of tourist operators, guidance on wastewater and solid waste management, and guidance on best practices from the tourism industry. Local fishing communities should be supported to adopt better fishing practices, whilst the Krabi Estuary Ramsar Site's management is strengthened to address. As with most coastal sites in Peninsular Thailand, Krabi is vulnerable to sea-level rise and climate change. Targeted interventions can be implemented through improved land-use planning, mangrove and seagrass restoration, and various nature-based solutions to protect highly vulnerable (non-vegetated) coastlines, while continuing work to improve the resilience of local communities.

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 more than 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). 15 EAAF species exceeded the 1% threshold at the site level in Thailand, with species such as Spotted Greenshank 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, Great Knot, and Sarus Crane.

2. Site profile of Krabi River Mouth

Location: Krabi town, in Mueang Krabi District is the capital of Krabi Province, on the west coast of Peninsular Thailand, where the Krabi River flows into Phang Nga Bay, about 650 km south of Bangkok. The site comprises the estuary of the Krabi River, immediately upstream and downstream of Krabi town, extending from the rocky headland of Khao Laem Nang, east past the complex of rivers which open to the sea at Pak Nam Krabi, to the Khlong Yuan and Khlong Taling Chan, and south to Ban Laem Hin.

Area: The Krabi River Mouth RFI site covers an area of 133,199 ha.

Altitude: 0-30 m asl., with some isolated hills that rise to above 100 m.

Geographical coordinates: 8.02 N, 98.93 E

Description of site: The Krabi River Mouth RFI site is dominated by mangrove forest (estimated to cover 7,303 ha in the Ramsar site) and mudflats (estimated at 2,259 ha). The other wetland habitats include sandy beaches, estuarine waters, seagrass beds and small areas of *Melaleuca* swamp forest, and the adjacent terrestrial habitats include limestone karst forest (often on steep wooded cliffs and outcrops), beach forest, areas of plantation agriculture (rubber and oil palm), rice fields, and towns and villages. The western-facing coast of the site is dominated by sandy beaches with 1-2 km wide sandy inter-tidal zones, and immediately offshore is a 6 km wide, shallow (< 5m) inshore shelf with some isolated islets. The coastline has three major river estuaries which empty into Krabi Bay and the Andaman Sea, including the combined estuary of the Khlong Chilat and Pak Nam Krabi, the Khlong Yuan and the Khlong Phela, and a much smaller inlet (Khlong Thalu).

Site administration, management and land tenure: The Krabi Estuary was designated as a Ramsar site by the Government of Thailand in 2001, although some important areas of sandflats and some shorebird roost sites excluded from the boundary of the site. The current management authority for Ramsar sites in Thailand is the Department of Aquatic Resources. Some of the western parts of the Krabi Estuary are included in Had Nopparat Tara Pi Pi Island Marine National Park, including the 45-million-year-old fossil mollusc beach at Laem Pho, and most of the intertidal and marine parts of this site are included in Krabi Environmental Protected Area, which was designated in 2016 (WDPA). These protected areas are state-owned, and the surrounding community areas are privately owned. The mangrove forests in the Krabi Estuary site are state-owned and were previously under concession for charcoal production, but this ended in 2001, and since then, the forests have been largely unmanaged and have reverted to community forestry and for biodiversity conservation. The Management Authorities for the Krabi Estuary are the Mangrove Forest Management Unit 3 and Unit 4 of the Royal Forest Department, and Krabi Municipality.

Social and economic values: Krabi is a major fishing port, and the mudflats are harvested by the local communities for molluscs, prawns, crabs, mussels and fish, which are an important source of income (minimum daily wage is 300 THB). In many of the coastal villages (*muban*) in Mueang Krabi, 70-90% of households are involved in small-scale fishing in some way, and especially for households not involved in agricultural activities (per 2024 RFI workshop data). There has been considerable development of aquaculture ponds, and numerous fish cages have been established (some of which are used as roost sites by waterbirds). Mangroves are cut for charcoal production and pole wood, and the fruits of the *Nypa* palms are harvested for food and the fronds used for thatching. Areas around the wetlands are used as rubber and oil palm plantations. The local economy of Krabi is centred largely on tourism, and infrastructure has been developed to provide tourists with accommodation and food. Krabi municipality has constructed the Krabi Mangrove Nature Trail, which is located near the centre of the town and is one of the longest mangrove walkways in the region.

Figure 1. Map of Krabi River Mouth, 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 Krabi River Mouth

3.1. Key habitats

The Krabi River Mouth RFI site is dominated by mangrove forest (estimated to cover 7,303 ha in the Ramsar site) and mudflats (estimated at 2,259 ha). The other wetland habitats include sandy beaches, estuarine waters, seagrass beds and small areas of Melaleuca swamp forest, and the adjacent terrestrial habitats include limestone karst forest (often on steep wooded cliffs and outcrops), beach forest, areas of plantation agriculture (rubber and oil palm), rice fields, and towns and villages. The western-facing coast of the site is dominated by sandy beaches with 1-2 km wide sandy inter-tidal zones, and immediately offshore is a 6 km wide, shallow (< 5m) inshore shelf with some isolated islets.

3.2. Importance of Krabi River Mouth for migratory waterbird species

The Krabi Estuary regularly supports several thousand migratory waterbirds on passage and over-wintering. Count data from the 2017 and 2018 Asian Waterbird Census (AWC) and the Thailand Shorebird Survey 2021-2022), supplemented by data on Spotted Greenshank from Zöckler et al. (2018), was averaged in the RFI analysis for Krabi River Mouth, and then compared to the Conservation Status Review (CSR1) 1% population estimates to calculate a score for each species. Two species were found to regularly exceed the 1% population estimate during these three years (Table 1). Counts of Spotted Greenshank remain significant, reaching 1.5% of the global population, though reduced compared to historical counts of [3] to 40 individuals.

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

Scientific name	IUCN	Average count	CSR1	CSR1 score
Tibetan Sandplover *Anarhyncus atrifrons*	LC	773	300	2.6
Spotted Greenshank *Tringa guttifer*	EN	15	10	1.5

The area supports significant numbers of the Bar-tailed Godwit *Limosa lapponica NT*. In addition 14 globally Near Threatened or Threatened migratory waterbird species have been observed in smaller numbers; Christmas Island Frigatebird *Fregata andrewsi* VU, Chinese Egret *Egetta eulophotes* VU, Black-faced spoonbill *Platalea minor* EN, Eurasian Curlew *Numenius arquata* NT, Curlew Sandpiper *Calidris ferruginea* VU, Great Knot *Calidris tenuirostris* EN, Grey Plover *Pluvialis squatarola* VU, Ruddy Turnstone *Arenaria interpres* NT, Black-tailed Godwit *Limisa limosa* NT, Asian Dowitcher *Limnodromus semipalmatus*

NT, Red Knot *Calidris canutus* NT, Red-necked Stint *Calidris ruficollis* NT, Broad-billed Sandpiper *Calidris falcinellus* VU and Far Eastern Curlew *Numenius madagascariensis* EN

Until the mid-2000s, mangrove creeks in the Krabi River estuary used to be a reliable site for Masked Finfoot *Heliopais personata* (CR), but it has not been recorded there for more than a decade.

3.3. Other notable biodiversity

Numerous globally threatened (resident) bird, mammal and reptile species are recorded from Krabi River Mouth, including; Great Hornbill *Buceros bicornis* VU, Wreathed Hornbill *Rhythiceros undulatus* VU, Sperm Whale *Physeter macrocephalus* VU, Indo-Pacific Finless Porpoise *Neophocaena phocaenoides* VU, Indo-Pacific Humpback Dolphin *Sousa chinensis* VU, Dugong *Dugong dugon* VU, Smooth-coated Otter *Lutrogale perspicillata* VU, Asian Small-clawed Otter *Aonyx cinereus* VU, Fishing Cat *Prionailurus viverrinus* VU, Long-tailed Macaque *Macaca fascicularis* EN, Hawksbill Turtle *Eretmochelys imbricata* CR, Green Turtle *Chelonia mydas* EN and Olive Ridley Turtle *Lepidochelys olivacea* VU.

Figure 2. Map of Krabi River Mouth showing the extent and distribution of intertidal mudflats as of 2020 (Map: Radhika Bhargava).

4. Ecosystem services

4.1. Ecosystem services provided by Krabi River Mouth

Krabi River Mouth encompasses diverse habitats, providing valuable provisioning, regulating, and cultural ecosystem services (Figure 3). Provisioning services, such as food and ornamental resources, mainly benefit communities adjacent to the site (Table 2). Food provision has increased in the past and is expected to remain unchanged in the future. Ornamental resources have also seen an increase but are projected to decrease in the future, indicating potential concerns for sustainability. Regulating services, particularly global climate regulation, benefit adjacent communities. This service has remained stable in the past and is expected to increase in the future, highlighting its growing importance. Cultural services, including cultural identity and heritage and aesthetic experience, provide significant value to adjacent communities. Cultural identity and heritage have increased in the past but are expected to decrease moving forward, while aesthetic experience has remained stable with no change projected for the future, reinforcing the area's cultural significance.

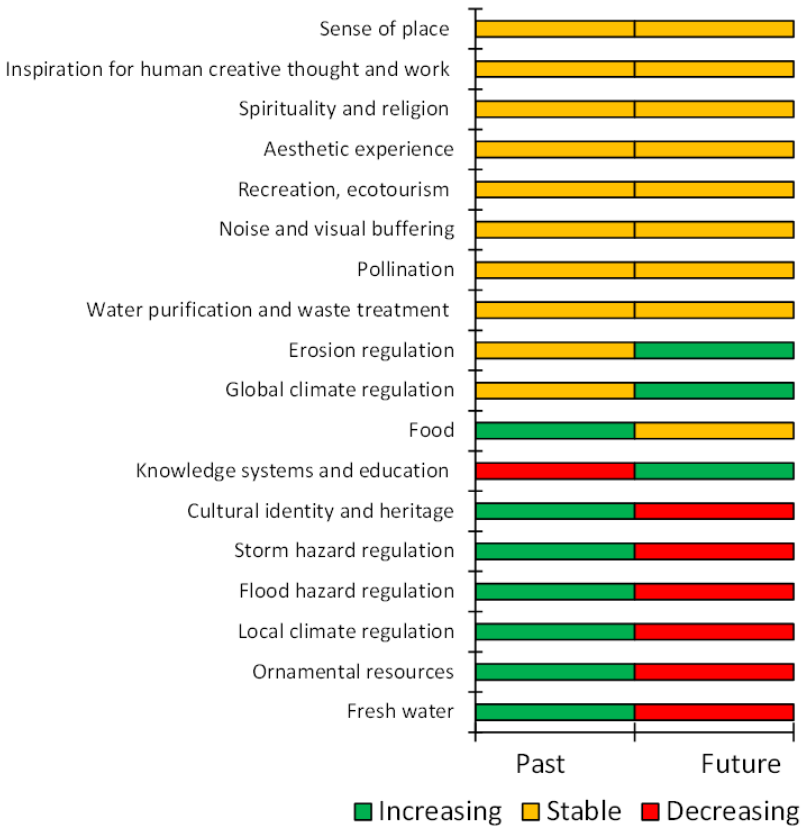

Figure 3. List of ecosystem services provided by Krabi River Mouth, as identified through stakeholder consultation at the Regional Flyway Initiative workshop.

Table 2. List of top ecosystem services provided by Krabi River Mouth.

Ecosystem services	Essential or non-substitutable	Benefits to communities			Change	
		Within the site	Adjacent to the site	Distant to the site	Past	Future
Provision services						
Food		✓			Increase	No change
Ornamental resources		✓			Increase	Decrease
Regulating services						
Global climate regulation		✓			No change	Increase
Cultural services						
Cultural identity and heritage		✓			Increase	Decrease
Aesthetic experience		✓			No change	No change

4.2. Global climate regulating services

Based on systematic reviews (Chen and Lee, 2022; Stankovic et al., 2023), the amount of carbon stored in Krabi River Mouth is estimated to range from 1,170,000 to 5,600,000 tonnes, while the annual carbon sequestration rate is estimated to be between 17,300 and 125,000 tonnes per year.

4.3. Coastal protection services

The coastal protection services provided by Krabi River Mouth 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 Thailand (Table A3 in Annex 1), Krabi River Mouth shows some only partly mixed results in terms of risk level:

(1) for the potential exposure to coastal hazards, Krabi River Mouth is just below average (index: 2.69 vs. 2.75 for RFI coastal sites and 2.70 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, Krabi River Mouth is well below average (17 vs. 63 people/ha for RFI coastal sites and 30 people/ha for all other coastal areas); but

(3) for the contribution to reducing coastal risk as a percentage of the maximum potential exposure, Krabi River Mouth is consistently above average (5.68% vs. 5.44% for RFI coastal sites and 3.92% for all other coastal areas).

In monetary terms (see Table A4 in Annex 1), the total annual benefits per hectare of mangroves at Krabi River Mouth are 0 (compared to the national RFI average of 1,987 USD/ha) because the relevant population and property are directly exposed onto the coast to experience these benefits. However, when flooding extends well inland such as in the event of 100-year return period storms, the benefits of mangrove protection from the total area of Krabi River Mouth are above the average of all RFI sites in Thailand (4.1 vs. 4.0 million USD).

5. Drivers of change and their potential impacts on Krabi River Mouth

5.1. Current drivers of change and their level of impact

Stakeholders at the RFI workshop[1] identified several drivers of change impacting the Krabi River. High-impact drivers include commercial and industrial areas, which significantly alter the natural landscape and contribute to habitat loss and degradation (Table 3). Erosion and siltation, along with housing and settlement development, disrupt the wetland's ecological balance. Loss of hydrological connectivity further affects water flow and habitat health. Other high-impact activities include recreational activities and tourism, the development of roads and railroads, tourism infrastructure, and utility and service lines, which fragment habitats and introduce disturbances.

Medium-impact drivers consist of fishing, killing, and harvesting of aquatic resources, which pose moderate threats to biodiversity. Additional medium-impact factors include garbage and solid waste accumulation, habitat shifting, increased fragmentation within the wetland, and isolation from other natural habitats. Livestock farming, marine and freshwater aquaculture, oil and gas drilling, and restoration for conservation also moderately impact the site's ecological integrity. Storm and flooding events, as well as activities of site managers, add to the cumulative medium-level impact on the wetland.

Over time, sea-level rise may further impact the site. Norris et al. (2024) estimated that sea-level at the site will increase by 0.3m up to 2050 and 0.7m by the late century under a high emissions pathway. Under various scenarios there will be increased flooding, increased saline intrusion, changes to the extent of mangroves and changes to the available habitat for shorebirds. Temperatures are also expected to increase, exacerbating heat stress. Rainfall is likely to be more variable, with larger dry periods and increased rainfall in shorter timeframes. These effects will have impacts on both the biodiversity and on the resident population and will impact on livelihoods.

[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 3. Drivers of change and their potential impact on the integrity of Krabi River Mouth based on consultations with stakeholders.

Driver of change	Impact
Commercial and industrial areas	High
Erosion and siltation/deposition	
Housing and settlement	
Loss of hydrological connectivity	
Recreational activities and tourism	
Roads and railroads	
Tourism and recreation infrastructure	
Utility and service lines	
Fishing, killing and harvesting of aquatic resources	Medium
Garbage and solid waste	
Habitat shifting and alteration	
Increased fragmentation within the wetland site	
Isolation from other natural habitats	
Livestock farming and grazing	
Marine and freshwater aquaculture	
Oil and gas drilling; extraction of sand	
Restoration for conservation	
Storm and flooding	
Activities of site managers	Low
Agricultural and forestry effluents	
Air-borne pollutants	
Dams, hydrological modification and water management/use	
Earthquakes/tsunamis	
Excess energy	
Excess ponding of water onsite	
Habitat clearing	
Household sewage and urban wastewater from outside the wetland site	
Hunting, killing and collecting of terrestrial animals	
Invasive animal species	
Loss of cultural links, traditional knowledge and/or management practices	
Natural deterioration of important cultural wetland site values	
Research, education and other work-related activities	
Sewage and wastewater from wetland site facilities	
Shipping lanes and canals	

5.2. Potential alternative state of Krabi River Mouth under current drivers of change

Stakeholders at the RFI workshop[2] 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

[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

will be no changes in the current drivers of change impacting the site, and the current management regime.

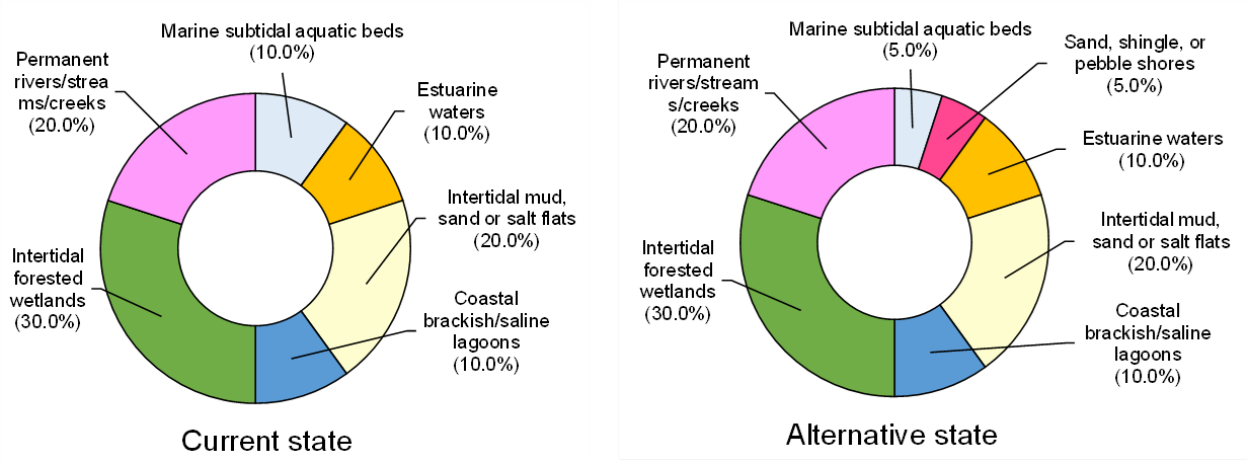

Figure 4. The proportional change in the extent of different habitat types between the current and alternative states of Krabi River Mouth.

5.3. Expected changes in the ecosystem services of Krabi River Mouth

Stakeholders at the RFI workshop[3] documented the future trends in the provision of ecosystem services in Krabi River Estuary, 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.

Figure 3 and Table 2 highlight that provisioning services, particularly food provision, are expected to increase in the long term. 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.

The Krabi River Estuary encompasses diverse habitats, providing valuable provisioning, regulating, and cultural ecosystem services (Figure 3). The results from the RFI workshop[4] highlights the top ecosystem services provided by the site, emphasising their essential and non-substitutable nature (Table 2). Provisioning services, such as food and ornamental resources, mainly benefit communities adjacent to the site. Food provision has increased in the past and is expected to remain unchanged in the future. Ornamental resources have also seen an increase but are projected to decrease in the future, indicating potential concerns for sustainability. Regulating services, particularly global climate regulation, benefit adjacent communities. This service has remained stable in the past and is expected to increase in the

[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

future, highlighting its growing importance. Cultural services, including cultural identity and heritage and aesthetic experience, provide significant value to adjacent communities. Cultural identity and heritage have increased in the past but are expected to decrease moving forward, while aesthetic experience has remained stable with no change projected for the future, reinforcing the area's cultural significance.

In the alternative state, the 50% loss of seagrass will result in a loss of stored carbon, estimated to be between 26,700 and 334,000 tonnes, and a decrease in carbon sequestration rate (carbon accumulation) by approximately 46 and 48 tonnes per year.

A loss of 0 ha of mangroves as presented in Table A5, is not expected to result in any reduction in coastal protection as estimated in 4.3.

6. Capacity needs in Krabi River Estuary

Stakeholder consultations with representatives of local agencies in Krabi identified major capacity gaps for local tourism development and the development of businesses for smallholders involved in community-based products. Local stakeholders highlighted knowledge gaps in ecotourism practices, and the development of itineraries for visitors. There are also opportunities for stakeholder groups focused on sustainable ecotourism to be established to promote capacity building for the local community.

Table 4. Capacity needs for key stakeholders involved in the management of the Krabi River Estuary.

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.)
Fishing cooperatives (for fishermen)	Management, maintenance, and protection of the mangroves and wetlands.	Support fishery programmes to increase fish productivity (and address fish declines in the coastal waters off Krabi)	Mostly to raise awareness and increase publicity of wetlands.	Learning processes/programmes about the Krabi estuary ecosystem. Wetland awareness workshops for the local community.	Training/field visits, within the community and other sites.
Local communities	Management, maintenance, and protection of the area.	Campaign and support nature conservation and the management of local resources.	Strengthen community and promote education on local culture and nature conservation	Coaching programmes for the local youths to promote community awareness	Training/field visits, within the community and other sites.
Ecotourism operators	Provide ecotourism services for local and international tourists.	Promoting collaboration and joint initiatives across community groups for ecotourism and environmental protection.		Sustainable ecotourism training activities, with targeted awareness of the wetlands and biodiversity in Krabi.	Field visits to ecotourism features in the site organised by technical experts

7. Opportunities for RFI interventions

7.1. Recommended Interventions

The Krabi River estuary supports considerable tourism infrastructure developments (hotels, lodgings, roads) and is a key site for tourism in Peninsular Thailand (Janekarnkij 2010). Tourism in Krabi is driven by domestic and international tourists visiting coastal resorts, beaches and other natural attractions. Krabi also support a sizeable aquaculture sector (including oyster and mussel farms) and major fishery (estimated at more than 2,400 fishermen, in 2004) and shellfishery. Janekarnkij (2010) estimated the net provisioning benefits of Krabi estuary (from mangrove forests) at, at least $1,428,270/year at the time of assessment. There are strong opportunities to develop tourism products around biodiversity and to improve capacity and knowledge in the tourism sector. Stakeholders identified tourism as one of the major threats to the landscape, especially through water pollution (see Tanyaros 2009; Obpat & Worachananant 2022). In addition, the residential areas, commercial centres and fishing operations around Mueang Krabi town, contribute to increased solid waste and wastewater pollution entering the estuary, and has driven increases in bacterial contamination. Environmental flows into the estuary have been altered leading to habitat change, and some coastal mangroves have been cleared. Cheewinsiriwat et al. (2024) found that the Krabi coast is among the most vulnerable sites in Krabi to climate change. Based on various stakeholders consulted, improved management of the Krabi Estuary for biodiversity needs to benefit the wider end-users (e.g. tourism sector and fishing communities) and requires the site to be managed in a way to expand restorative work for mangroves, introducing sustainable fishing methods, promoting more sustainable tourism and making efforts to reduce waste water pollution and other upstream factors affecting the site.

To strengthen management and conservation of the wider Krabi Estuary wetlands, 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.
    b. Strengthened management of the Krabi River Estuary, with targeted interventions to address wastewater and solid waste pollution.
    c. Expansion of wetland restoration work with a focus on ‘mangrove zones’ to strengthen shoreline stability at suitable areas, notwithstanding the coastal erosion challenges the site faces.
    d. Strengthen and formalise co-management structures involving the local community and government agencies
(2) Improve the sustainability of tourism activities in the area
    a. Improve revenue generation from tourism to support environmental management
    b. Improve access and infrastructure at key biodiversity sites for ecotourism and education.
    c. Manage and restrict access to sensitive sites.
    d. Develop and build capacity for more sustainable tourism operators.

(3) Enable, and up-scale (economic) infrastructure for compatible forms of economic activity for local communities
    a. Promoting sustainable approaches to fisheries (fish and shellfish) that are biodiversity friendly.
    b. Capacity building and improved access to finance for local small scale fishing communities.

Table 5. Summary of key RFI interventions proposed for Krabi River Mouth

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Component 1. Strengthening landscape management in Krabi River Estuary					
Conduct an assessment and scoping study of past and existing interventions implemented in the Krabi Estuary area. Identify, successes failures, gaps and lessons for RFI interventions.	Best practices, guidelines, and standards for proposed RFI interventions	Assessment report with key threats identified and recommendations for improved management published and disseminated to key stakeholders. Number of consultations conducted with local stakeholders for a participatory process in the scoping study Number of stakeholder groups engaged in the scoping study	100,000	1 year	ONEP DMCR Consultancy companies
Undertake an environmental and project social impact assessment.	Best practices, guidelines, and standards for proposed RFI interventions	Environmental and social impact assessment report finalized and disseminated with key local stakeholders. Guidelines for evaluating proposed project components on	100,000	Up to 1.5 years.	ONEP DWR DMCR Mueang Krabi district (*amphoe*) government

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		their positive and negative impacts 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			Krabi provincial government
Undertake hydrological and climate change impact assessment.	Best practices, guidelines, and standards for proposed RFI interventions	Hydrological and climate change impact assessment report with site identification for mangrove restoration, impacts of sea-level rise and shifts in hydrology to guide proposed interventions, and proposed guidelines for land use planning and further stages of	100,000	Up to 1.5 years.	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		intervention, finalized, and disseminated with key stakeholders. Number of consultations conducted with local stakeholders for a participatory process in the impact assessment study Number of stakeholder groups engaged in the impact assessment study			
Review and update site management plan for the Krabi River Estuary Ramsar Site.	Improved management and conservation of Krabi River Estuary Ramsar Site through updating the site management and zonation plans, possible expansion of the area of the Ramsar Site to include crucial habitat used by shorebirds, and identification of important and sensitive shorebird areas.	Site management and zonation plans that take into account emerging threats, and sea-level rise over appropriate timeframes, developed, disseminated with key stakeholders and endorsed by the management authority (expected to be DWR). Number of consultations conducted with key stakeholders for participatory process in the development of the site management and zonation plans, Number of stakeholder groups engaged in the	150,000	2 years	DWR ONEP DNP EAAFP Krabi Provincial Government Consultancy companies Research institutions BCST

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		development of the site management and zonation plans			
Restore critical mangrove forests (and back-mangrove), seagrass beds and degraded areas (including ex-aquaculture areas), within, and outside the Krabi River Estuary Ramsar Site.	Improved site management through the identification and restoration of degraded areas of wetlands including aquaculture ponds Ecological connectivity strengthened with mangrove restoration	At least 10 plots identified for mangrove or back-mangrove restoration.	100,000	1 year	DWR ONEP Royal Forest Department
		At least 100 ha of degraded lands restored with suitable mangrove species. Number of stakeholder groups engaged in the mangrove restoration activities.	200,000	5 years	
Biodiversity monitoring plans for the site established and strengthened	Improved biodiversity conservation through a robust biodiversity monitoring plan focused on migratory waterbirds, fish, mangrove species, and seagrass beds	A biodiversity monitoring plan focused on migratory waterbirds, fish, mangrove species, and seagrass beds co-developed with key stakeholders and integrated to the site's management cycle. Number of people engaged in biodiversity monitoring. A biodiversity monitoring group established.	50,000	10 years	DWR ONEP Research institutions BCST
Component 2. Exploring the feasibility of carbon financing for mangrove conservation in Phang Nga Bay					

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Assess the feasibility of carbon financing for the site, and other wetlands with high mangrove cover in the Thai Peninsula (e.g. Phang Nga, Krabi, Satun, Ranong)	Feasibility and suitability of carbon financing established to assess its viability as a financing mechanism for wetland conservation in Thailand.	Feasibility study report for carbon financing for Krabi River Estuary and other mangrove sites in Peninsular Thailand. Investment guidelines for carbon financing from mangrove conservation drafted and endorsed by government agencies. Number of consultations conducted with key stakeholders, for a participatory process. Number of stakeholder groups engaged in the feasibility study for carbon financing in the site.	100,000	2 years	MNRE ONEP Krabi provincial government Consulting companies
Component 3. Addressing water (and plastic) pollution and strengthening wastewater management from villages and ecotourism areas in Krabi River Estuary					

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Assess the extent of water and associated pollution in Krabi River Estuary and the associated coastal waters (e.g. point source discharges from tourist sites, aquaculture and factories entering the waters off the Krabi Estuary)	Improved site management in Krabi River Estuary through assessing current water conditions, and possible causes of water pollution.	Assessment study to determine the main causes and impact of pollution and methods to address wastewater management. Guidelines and recommendations for businesses, especially aquaculture and tourism operators developed and promoted. Number of consultations conducted with key stakeholders, for a participatory process. Number of stakeholder groups engaged in the water pollution assessment.	100,000	1 year	ONEP DWR DMCR Department of Fisheries Mueang Krabi district (*amphoe*) government Krabi provincial government Tourism businesses Aquaculture businesses
Implement the pollution reduction plan, with a focus on wastewater (sewage) and solid waste from industries and tourism operations.	Improved site management through the implementation of the pollution reduction plan with a focus on wastewater and solid waste from industries and tourism operations.	Strategy for wastewater management and pollution reduction plan developed, with a focus on tourism developments such as resorts and hotels along Krabi Town. Number of consultations conducted with key stakeholders, particularly industries and	1,500,000	10 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		tourism operators, for a participatory process. Number of activities in the pollution reduction plan implemented. Number of target group (target of up to 300 businesses (including aquaculture) and tourism operators engaged on water pollution) engaged in the pollution reduction plan implementation. Metrics and baselines on key chemical and biological contaminations in coastal waters established. Measured reduction in key chemical and biological contamination in the coastal waters off Krabi Estuary; and sampled shellfish, based on the established baselines.			
Component 4. Upscaling of tourism infrastructure and capacities, with a focus on sustainable and/or nature-based tourism (e.g. mangrove boat tours, wildlife-watching tours)					
Strengthen local capacity for nature-based tourism	Improved site management and protection through nature-based tourism	Training programme established for nature-based tourism focusing on	150,000	3 years	Department of Tourism Mueang Krabi

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	benefits and increased capacity of local stakeholders on nature-based tourism focusing on nature trails, birdwatching and boat tours.	nature trails, birdwatching and boat tours Number of training activities implemented to target participants Number of people trained from target participants, including women, (target of up to 100 local guides trained in nature-interpretation skills and techniques)			district (*amphoe*) government Krabi provincial government Conservation organisations
Build local capacity (for local operators) to support tourism		Sustainable tourism code of conduct developed and disseminated to key stakeholders Number of consultations conducted with key stakeholders, ensuring a participatory process. Training programme established focused on the sustainable code of conduct for businesses. Number of tourism operators (target of up to 100 local tourism operators, including resort managers) trained on sustainable best-practices in tourism.	150,000	3 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		Number of businesses (hotels and tourism operators) compliant to the sustainable tourism code of conduct			
Expand and maintain the infrastructure for ecotourism, including signage, trails on mangrove boardwalks and wetland interpretation facilities, shelters and bird hides away from sensitive areas.	Improved site management and protection through nature-based tourism benefits and expanded ecotourism infrastructure for ecotourism.	Number of nature-based tourism infrastructure (i.e. signage, up to 1 km trails on mangrove boardwalks with extensions of 0.5 km, wetland interpretation facilities) established and improved. Number of people benefitting from ecotourism activities.	1,000,000	2 years	DWR Department of Tourism Mueang Krabi district (*amphoe*) government Krabi provincial government
Component 5. Strengthening the livelihoods and resilience of fishing and aquaculture communities.					
Improve and renovate water management infrastructure such as canals and sluice gates based on findings of hydrological assessments conducted.	Strengthened site management through improved water and solid waste management systems	Assessment report on the solid waste and water conditions in Krabi Estuary and adjacent coastal waters. Metrics and baselines for healthy water conditions established. Water conditions substantially reduced against baselines, based on the metrics established.	1,000,000	5 years	DMCR Mueang Krabi district (*amphoe*) government Krabi provincial government

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		Number of water infrastructure (i.e. drainage canals between villages and the bay) established and improved. Number of stakeholder groups engaged in water and solid waste management.			
Develop a co-management system for small-scale fisheries (to strengthen value chains) – as a contribution to the existing large sustainable fisheries and coastal management program for Thailand as a contribution to Thailand's Marine Fishery Management Plan.	Improved site management through better fishery management, access to livelihood opportunities, inclusive engagement, and microfinance mechanisms. Fishery resources are better managed and conserved. Improved local livelihoods Improved provisioning services (for food resources, e.g. fish)	Number of community-led agreements on sustainable fishing practices, supported with improved storage and processing capability to increase market access and reduce wastage. Small loan scheme in place for small-scale fishers. Number of small-scale fishing operators (target of at least 100 across two districts) engaged in sustainable fishing practices. Number of fishing cooperatives established and supported. Capacity building for local fishing communities (with a representative %	500,000	10 years	Department of Fisheries MAC Mueang Krabi district (*amphoe*) government *Tambon* administration offices Fisheries and shellfishery cooperatives Conservation NGOs Fishing cooperatives

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		of women) in cooperatives and sustainable fishery management. Number of people benefitting from the capacity-building activities and microfinance mechanism established.			
Strengthen sustainable and environmentally friendly practices in aquaculture, with a focus on shellfish (e.g. oysters, mussels, crabs)	Improved site management through better aquaculture management, access to livelihood opportunities, inclusive engagement, and microfinance mechanisms. Fishery resources are better managed and conserved. Improved local livelihoods Improved provisioning services (for food resources, e.g. fish)	One training and awareness programme focused on sustainable production practices in shellfish aquaculture, including certification processes and exchange visits developed and implemented Number of aquaculture operators (target of up to 100 aquaculture including shellfish operators) engaged in the sustainable aquaculture practices. Small loan scheme in place for shellfish-aquaculture operators. Number people benefiting from the	1,500,000	10 years	Krabi Provincial Government (provincial office for fisheries) Fisheries and shellfishery cooperatives Mueang Krabi district (*amphoe*) government *Tambon* administration offices Aquaculture operators

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		established loan scheme.			
Strengthen the enforcement of local fisheries.	Improved site management through increased law enforcement and patrol against illegal fishing practices. Fishery resources are better managed and conserved.	Law enforcement and patrol plan, integrated into the updated site management plan, and co-developed with key stakeholders Number of consultations conducted with key stakeholders, ensuring a participatory process. Number of reported encroachment and illegal fishing incidents reduced substantially against baselines. A patrol and enforcement committee created. Number of stakeholder groups engaged in enforcing law against illegal fishing practices.	100,000	5 years	DAR DMCR Krabi Provincial Government
Total investment for 10 years			**46,000,000 USD**		

7.2. Potential Financing

The estimated project cost is USD 46,000,000 over 10 years. This budget supports the development of site management and a co-management framework, the promotion of sustainable fishing and aquaculture practices, water and solid waste management, nature-based tourism infrastructure, the establishment of a microfinancing mechanism, the assessment of carbon financing, and capacity-building for local stakeholders on biodiversity monitoring, patrolling, enforcement, nature-based tourism, and financial

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

With coastal protection benefits recorded as USD 0 per hectare annually, it is not possible to calculate a meaningful benefit–cost ratio for this intervention. This reflects the absence of directly exposed population or infrastructure in the area, rather than a lack of ecological value.

7.3. Proposed Institutional Arrangement

The proposed project is expected to be implemented over a period of up to 10 years, with specific project components focusing on improved site management for Krabi River Estuary Ramsar Site (led by the Department of Aquatic Resources, ONEP), tourism operators in Mueang Krabi and various *tambons*, and improved fishery management (with Department of Fisheries and local fishing cooperatives)

7.4. Project Beneficiaries

Initiatives to promote gender inclusion and the vulnerable (immigrant workers in the fishery and shellfishery industry) and participation in livelihood activities. Limited women involvement at present. Develop and organise training programmes for community members focused on women in artisanal fisheries (or cottage industries).

7.5. Anticipated Implementation Risks

Stakeholder engagement: Proposed interventions rely on support from local communities, particularly in adopting sustainable fishing practices, solid waste management, 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 Krabi River Mouth, 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 ongoing ecotourism activities, as well as managing waste pollution from increased tourist traffic, is essential.

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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 the Krabi River Mouth 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)	112 – 116
Current maximum coastal risk to be mitigated, or potential exposure to coastal hazards (unitless index)	*2.59 - 2.78*
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)	2.91 - 3.13
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)	3.12- 3.34
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)	3.39- 3.64
Current proportional risk reduction, nature's contribution to reducing coastal risk as a proportion of maximum coastal risk (unitless index)	0.15- 0.16
Nature's contribution to reducing coastal risk as a proportion of population density within 2.5 km of the coast (# of people per hectare)	*17 – 18*
Nature's contribution to reducing coastal risk as a percentage of the maximum potential exposure (%)	*5.41 - 5.96*

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 the Krabi River Mouth 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$)**
Mangrove extent (hectares)[2]	9,296 – 17,315
Annual expected flood protection benefits to people (number of people)	0
Annual expected flood protection benefits to Industrial Stock (US$)	0
Annual expected flood protection benefits to Residential Stock (US$)	0
Annual expected flood protection benefits to Total Stock (US$)	*0*
Annual expected flood protection benefits to Industrial Stock per hectare of mangroves (US$ per hectare)	*0*
1-in-100-year return period damage in terms of area flooded (number of hectares)	985 – 1.007
Total expected flood protection benefits of mangroves per 100-year return period storms (US$)	*4,104,881 – 4,195,520*

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)
Koh Kham	3.02 (±0.09)	0 (±0)	5.18 (±0.16)
Ta 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 Krabi River Mouth 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 (%)
Marine subtidal aquatic beds	3077.0	10.0	1538.5	5.0
Sand, shingle, or pebble shores	0.0	0.0	1538.5	5.0
Estuarine waters	3077.0	10.0	3077.0	10.0
Intertidal mud, sand or salt flats	6154.0	20.0	6154.0	20.0
Coastal brackish/saline lagoons	3077.0	10.0	3077.0	10.0
Intertidal forested wetlands	9231.0	30.0	9231.0	30.0
Permanent rivers/streams/creeks	6154.0	20.0	6154.0	20.0
Total	30770.1	100.0	30770.1	100.0