ADB

Regional Flyway Initiative · Site Study

January 2026

RFI Priority Site · Prek Toal (part of Tonle Sap Biosphere Reserve)

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General Site Information

Country	Cambodia			
RFI Site Name	Prek Toal			ID009
City/ Municipality, Province, Region	Aek Phnum and Sangkae Districts, Battambang Province (access from Siem Reap City, Siem Reap Province)			
Geographical coordinates	13.12º N, 103.65º E		Area (has)	21,348 has
Key species	Spot-billed Pelican, Greater Adjutant, Masked Finfoot, and Painted Stork. Fishing Cat			
Key habitats (biomes)	Seasonally flooded grassland, and swamp forest			
Key ecosystem services	Provisioning services (fisheries and various NTFPs), regulating services (flood hazard regulation), cultural services (through tourism and recreation)			
Key drivers of change	Encroachment and land use change, dry-season fires, invasive species, water pollution			
Conservation status (mark all that applies)		Protected Area		Flyway Network Site
		Ramsar Site		Others _____
IBA/ KBA name (and number) and other designations	Prek Toal			
Management Stakeholders	Ministry of Environment, Provincial Department of Environment, Battambang and Siem Reap, Ministry of Agriculture, Forestry and Fisheries, MOWRAM			
With management plan?				
Project concept themes	Strengthen fisheries management and alternative livelihoods, nature-based tourism, improved site protection, exploring carbon financing			
Length of project	5-8 years			
Sector/s	Fisheries and aquaculture, tourism			
No. of potential beneficiaries	Approximate total of direct and indirect beneficiaries is 182,238 people (44,926 households), based on the 2019 census population in Aek Phnum and Sangkae districts.			
Indigenous Peoples		No		Yes _____
Anticipated Implementation Risks	Interventions to improve the quality of fish habitat may cause short-term disturbance to wetlands			
Estimated Project Budget (US$)	16,850,000			
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
CFi	Community fishery
CPA	Community protected areas
CSR	Conservation Status Review
DoFWC	Department of Freshwater Wetlands Conservation
DoF	Department of Fisheries
DMC	Developing Member Country
EAAFP	East Asian-Australasian Flyway Partnership
FiA	Fisheries Administration
IBA	Important Bird and Biodiversity Area
IUCN	International Union for the Conservation of Nature
LCG	Local conservation group
MAFF	Ministry of Agriculture, Forestry and Fisheries
MOE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
NLC	NatureLife Cambodia
NGO	Non-governmental Organisation
PDoE	Provincial Department of Environment
RFI	Regional Flyway Initiative
TESSA	Toolkit for Ecosystem Services Assessment
TSBR	Tonle Sap Biosphere Reserve
USD	United States Dollars
WCS	Wildlife Conservation Society
WWT	Wetlands and Wildfowl Trust

Executive summary

Cambodia's Tonle Gap Great Lake and its diverse wetland habitats such as seasonally flooded grasslands and swamp forests support Southeast Asia's largest congregations of waterbirds including large breeding colonies of nearly 20 species of storks (5 species), herons, cormorants and pelicans (e.g. Spot-billed Pelican), together with wintering congregations of migratory ducks such as Garganey and shorebirds. The Prek Toal Ramsar Site (21,348 ha) is situated in the northwest of Tonle Sap Great Lake in Battambang Province (and is one of three core areas in the Tonle Sap Biosphere Reserve). The site falls largely within Ek Phnom and Sangkae Districts. Prek Toal is globally important for five migratory waterbird species, namely Masked Finfoot *Heliopais personatus* (CR), Spot-billed Pelican *Pelecanus philippensis* (NT), Painted Stork *Mycteria leucocephala* (LC), Greater Adjutant *Leptoptilos dubius* (NT), and Asian Openbill *Anastomus oscitans* (LC). As with Cambodia's Ramsar Sites, Prek Toal's management authority is the Ministry of Environment, together with the provincial department of environment in Battambang. Prek Toal contains some of the most undisturbed floodplain habitats in the Tonle Sap, including gallery and (seasonally flooded) swamp forest, and extensive areas of seasonally flooded grassland and herbaceous vegetation. Aquatic productivity is very high, and Prek Toal has yielded some of the largest fish harvests from the Tonle Sap. Fishing (including harvesting of water snakes), aquaculture, and agriculture constitute the main economic activities across the site and wider area. Due to Prek Toal's proximity to Siem Reap, a key gateway to tourism and a major transport hub, ecotourism in the Tonle Sap landscape is mostly concentrated in and around Prek Toal, and there are many initiatives to promote and expand tourism here.

As one of the largest wetlands in Cambodia, Prek Toal provides significant ecosystem services for communities around the plains of the Tonle Sap and especially regulating services such as flood hazard regulation. The wetlands here play an important role in floodwater storage during the wet season. Prek Toal's wetlands alone are conservatively estimated to hold 479,000 to 583,000 tonnes of carbon, and the annual carbon sequestration rate is estimated at 18,800 tonnes per year. The principal drivers impacting the site and its biodiversity are long-term changes to the hydrology, land use change, poaching, and unsustainable fishing practices. Dry-season fires have degraded parts of Prek Toal and thinned some swamp forest areas, while invasive plants such as water hyacinth have established throughout much of the site.

To strengthen management and conservation of Prek Toal and its adjacent wetlands, there is a clear need to continue the integration of an ecosystem approach to fishery management (EAFM) to current and future interventions. Therefore, there is a need to strengthen management and legal protection of the wetlands through improved site management by addressing dry-season fires, encroachment, illegal fishing, and controlling invasive species. In addition, interventions proposed under this project aim to improve and scale-up the sustainable management of community fisheries with several villages, building upon existing fisheries and conservation projects, while expanding on alternative sources of livelihoods for local people through tourism, which has benefited from its proximity to Siem Reap as a major source of international tourists.

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 Cambodia, a total of 15 wetland sites, including several Asian Waterbird Census (AWC) count sites, were initially assessed through data analysis and expert consultation, of which 12 were short-listed for assessment based on the available (recent) data. Of this pool of sites, nine (9) 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. Eight (8) of the RFI sites identified are inland wetlands, most notably a cluster of sites around the Tonle Sap Great Lake, such as Prek Toal, Ang Tropeang Thmar and Boeng Tonle Chhmar. A single coastal site was identified, i.e. Koh Kapik Ramsar Site where there have been extensive surveys of its biodiversity to date, including surveys led by NatureLife Cambodia. 11 EAAF species exceeded the 1% threshold at the site level in Cambodia, with species such as the Masked Finfoot, Greater Adjutant and Sarus Crane (ssp. *sharpii*) at their highest congregations in Southeast Asia. Other species

with important populations and/or congregations in Cambodia includes Spotted Greenshank, Black-headed Ibis and Painted Stork.

2. Site profile of Prek Toal (part of Tonle Sap Biosphere Reserve)

Location: Prek Toal Ramsar Site is situated in the northwest of Tonle Sap Lake floodplain, within the catchments of the Cardamon Mountains lying to the southwest and the Dong Rek Mountains to the north. It is roughly circular in shape, with its eastern boundary bordering the dry season (low water) edge of the lake and in the northwest, it roughly follows the rivers Prek Mous and Prek Da. It is located in Aek Phnum and Sangkae Districts in Battambang Province, and the nearest towns are Bak Prea (in Prey Chas Commune) and Siem Reap (in Siem Reap Province), which are approximately 50 km and 40 km distant respectively.

Area: The Prek Toal RFI covers an area of 21,348 ha

Altitude: 1-10 m asl.

Geographical coordinates: 13.12º N, 103.65º E

Description of site: Prek Toal contains some of the most pristine floodplain habitats in the Tonle Sap Lake ecosystem. In the dry season, permanent water remains only in the major streams, ponds and creek systems where the water depth ranges between 0.5 to 1.5 m, and Prek Toal is mostly covered with freshwater swamp forest. The area is annually flooded in the wet season with water depths of about 7-8 m and only the canopy of the tall trees remaining above water. Three main vegetation types can be distinguished: 1) gallery forest located along waterways, and around seasonal ponds and lakes; 2) dense swamp forests dominated by *Barringtonia* sp. and shrubs, which covers most of the site; and 3) dense mats of grassland and herbaceous vegetation, covering extensive areas primarily in the southwest and eastern parts of Prek Toal. Aquatic productivity is very high, and Prek Toal has yielded some of the best fish harvests from Tonle Sap Lake.

Site administration, management and land tenure: Prek Toal is a part of the Core Area of Tonle Sap Biosphere Reserve (the other two core areas being Boeng Tonle Chhmar and Stoung Sen). It was designated as a Ramsar site in 2015, with the same boundary as the Prek Toal Core Area of Tonle Sap Biosphere Reserve, and as an IBA in 2003. Prek Toal Ramsar Site and its surrounding areas was designated as Tonle Sap Multiple Use Area in 1993. Battambang provincial authority has territorial jurisdiction over Prek Toal Ramsar site, and the Ministry of Environment has functional jurisdiction in supervising resource management activities in the area, but the Fisheries Administration is responsible for managing the fish sanctuary (designated to increase fish stocks in the lake) that overlaps with the Ramsar site. Prek Toal Ramsar site is state-owned, and the Management Authority is the Director of Prek Toal Core Area and

Tonle Sap Multiple Use Area. The areas of flooded forest and grassland surrounding Prek Toal are owned by the state, and the rice fields further south are privately owned.

Social and economic values: Khmer people, who mostly engage in subsistence fishing and aquaculture, make up the majority of the (70%) local communities at Prek Toal. The other 30% are ethnic minorities, including Cham and Vietnamese, who are mostly engaged in fishing and aquaculture in floating villages. In the past, most fishermen used traditional gear which did not lead to overfishing, but most now use modern gear that is less sustainable and more destructive. A few families earn their living from boat manufacturing and construction. The people live in floating villages, which are concentrated along major rivers and do not damage the wetlands. In the past, the wetlands were divided into fishing lots, which restricted access into the site, but in 2012 the fishing lots were cancelled and replaced by fish sanctuaries.

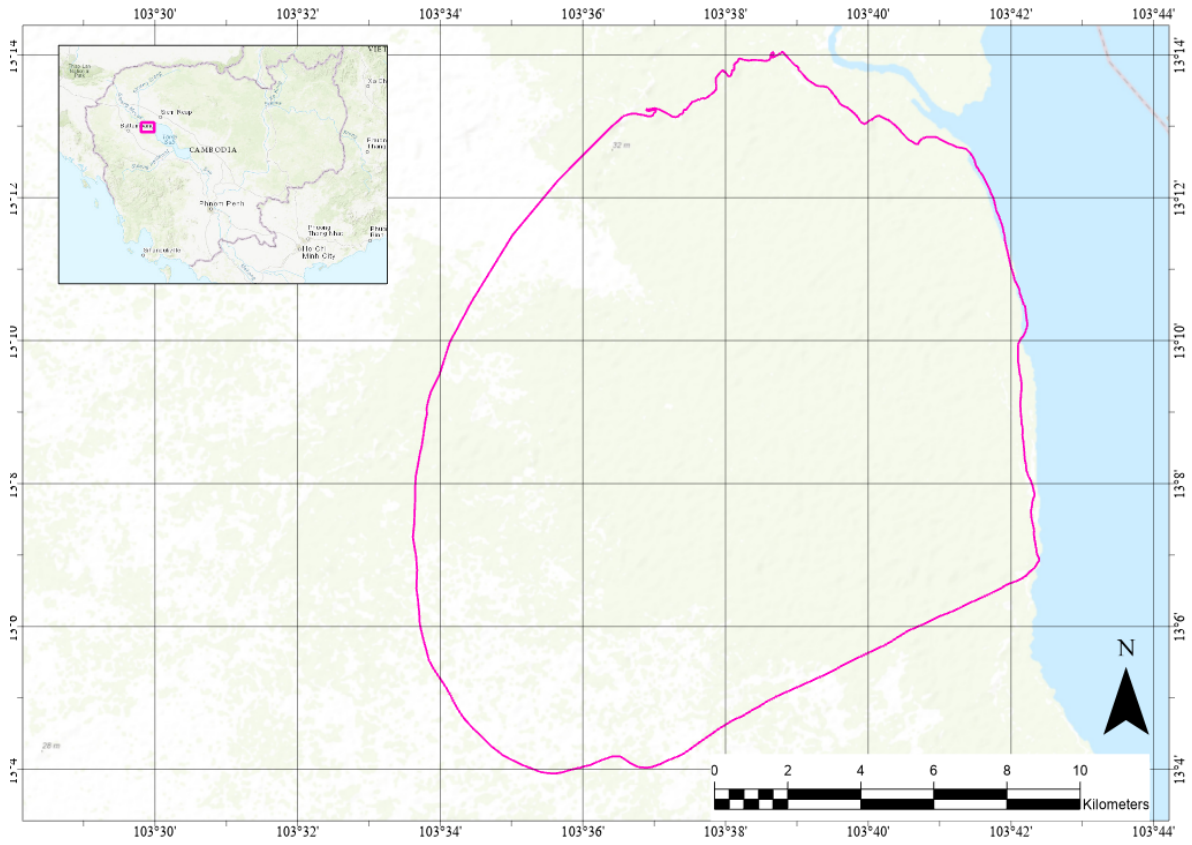

Figure 1. Map of the Prek Toal Ramsar Site, showing its location in the Tonle Sap Great Lake and Cambodia (Map: Evelyn Pina Covarrubias)

3. Biodiversity value of Prek Toal (part of Tonle Sap Biosphere Reserve)

3.1. Key habitats

Prek Toal contains some of the most pristine floodplain habitats in the Tonle Sap Lake ecosystem. Three main vegetation types can be distinguished: 1) gallery forest located along waterways, and around seasonal ponds and lakes; 2) dense swamp forests dominated by *Barringtonia* sp. and shrubs, which covers most of the site; and 3) dense mats of grassland and herbaceous vegetation, covering extensive areas primarily in the southwest and eastern parts of Prek Toal.

3.2. Importance of Prek Toal for migratory waterbird species

In the dry season (January to May), the large trees at Prek Toal support the largest remaining colonies of storks, pelicans, and ibises (anywhere) in mainland Southeast Asia. When first discovered in the mid-1990s, the colonies were heavily threatened by annual harvesting of the eggs and chicks by nearby villagers, mainly for trade and local consumption. This led to the establishment of the Prek Toal conservation team, which has conducted annual monitoring and protection of the breeding bird colonies since 2001. This conservation action has been remarkably effective, and since 2004, all species have bred successfully.

Count data from the 2022 Asian Waterbird Census (AWC) was used in the RFI analysis for Prek Toal. Only a single AWC count was conducted in that year, and the results of this count were compared against the Conservation Status Review (CSR1) 1% population estimates to calculate a score for each species (see Mundkur & Langendooen 2022). Five migratory waterbird species were found to exceed the 1% population estimates during the 2022 AWC, and the CSR1 scores for these species were summed to produce the overall site score (Table 1).

Table 1. List of migratory species (based on the EAAFP list of species) with globally significant congregations in Prek Toal Ramsar Site.

Species name	IUCN	Average count	CSR1	CSR1 score
Spot-billed Pelican *Pelecanus philippensis*	NT	4786	55	87.0
Painted Stork *Mycteria leucocephala*	LC	6843	70	97.8
Greater Adjutant *Leptoptilos dubius*	NT	445	8	55.6
Asian Openbill *Anastomus oscitans*	LC	18,808	3,000	6.3
Masked Finfoot *Heliopais personatus*	CR	12	3	4

Prek Toal also supports populations of numerous near threatened or threatened waterbirds, including; Lesser Adjutant *Leptoptilos javanicus* (NT), Milky Stork *Mycteria cinerea* (EN), Little Cormorant *Microcarbo nige*r (LC), Indian Cormorant *Phalacrocorax fuscicollis* (LC), Sarus Crane *Antigone antigone* (VU), River Lapwing *Vanellus duvaucelii* (NT), Black-tailed Godwit *Limosa limosa* (NT) Bar-tailed Godwit *Limosa lapponica* (NT), Red-necked Stint *Calidris ruficollis* (NT), Asian Woolly-necked Stork *Ciconia episcopus* (NT), Black-necked Stork *Ephippiorhynchus asiaticus* (NT), Grey-headed Fish Eagle *Icthyophaga ichthyaetus* (NT), and Oriental Darter *Anhinga melanogaster* (LC).

3.3. Other notable biodiversity

The site also holds populations of several near threatened and threatened terrestrial bird species including Alexandrine Parakeet *Psittacula eupatria* (NT), Red-breasted Parakeet *Psittacula alexandri* (NT), Manchurian Reed Warbler *Acrocephalus tangorum* (VU) and Yellow-breasted Bunting *Emberiza aureola* (CR).

Additional to birds, the site holds significant populations of numerous globally threatened mammal, reptile and fish species, including; Hairy-nosed Otter *Lutra sumatrana* (EN), Fishing cat *Prionailurus viverrinus* (VU), Long tailed Macaque *Macaca fascicularis* (EN), Indochinese Silvered Langur *Trachypithecus germaini* (EN), Siamese Crocodile *Crocodylus siamensis* (CR), Burmese Python *Python bivittatus* (VU), Tonle Sap Water snake *Enhydris longicauda* (VU), Northern River Terrapin *Batagur baska* (CR), Asiatic Softshell Turtle *Amyda cartilaginea* (VU) and Yellow-headed Temple Turtle *Heosemys annandalii* (CR)

Fish species of conservation concern with significant populations here include Mekong Giant Catfish *Pangasianodon gigas* (CR), Giant Carp *Catlocarpio siamensis* (CR), Flying Minnow *Laubuka caeruleostigmata* (EN), Jullien's Golden Carp *Probarbus jullieni* (CR), Mekong herring *Tenualosa thibaudeaui* (VU), Bala Shark *Balantiocheilos melanopterus* (VU), and *Scleropages formosus* (EN).

4. Ecosystem services

4.1. Ecosystem services provided by Prek Toal (part of Tonle Sap Biosphere Reserve)

The Prek Toal area overlaps with diverse wetland habitats, providing valuable provisioning, regulating, and cultural ecosystem services (Fig. 2). The results from the RFI workshop[1] highlight the top ecosystem

[1] Asian Development Bank. (2023, September 13-14). Cambodia: Wetland Ecosystem Services Workshop [Workshop]. Phnom Pehn, Cambodia. https://events.development.asia/learning-events/cambodia-wetland-ecosystem-services-workshop

services provided by the site, emphasising their essential and non-substitutable nature (Table 2). Provisioning services, such as fresh water and food provision, benefit communities both within, adjacent to, and, in the case of food, distant from the site. Regulating services, particularly erosion regulation, benefit adjacent and distant communities. Cultural services, including recreation ecotourism and aesthetic experience, significantly benefit communities at all distances.

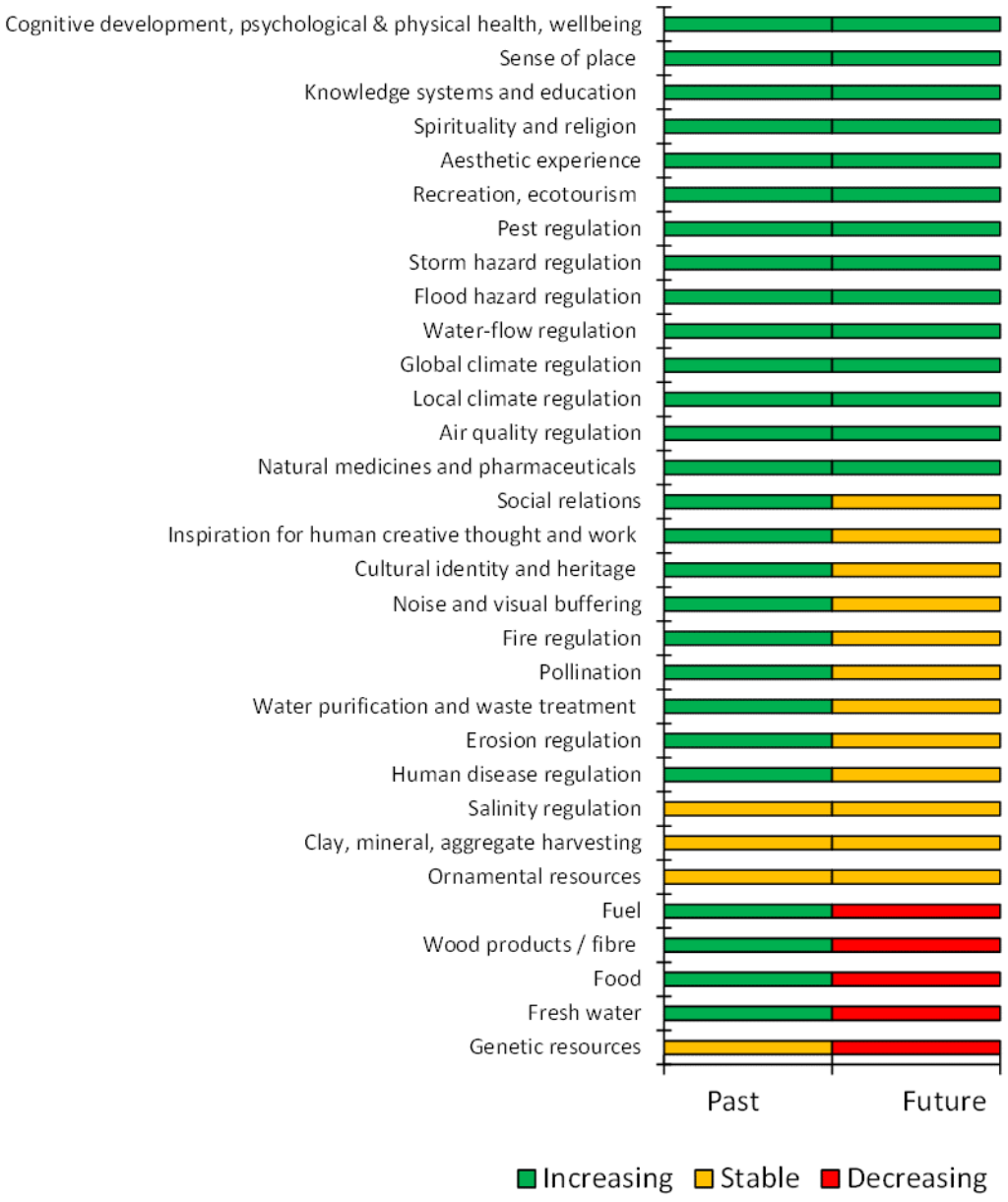

Figure 2. List of ecosystem services provided by Prek Toal (part of Tonle Sap Biosphere Reserve), as identified through stakeholder consultation at the Regional Flyway Initiative workshop.

Table 2. List of top ecosystem services provided by Prek Toal (part of Tonle Sap Biosphere Reserve).

Ecosystem services	Essential or non-substitutable	Benefits to communities			Change	
		Within the site	Adjacent to the site	Distant to the site	Past	Future
Provisioning services						
Fresh water	Yes	✓	✓		Increase	Decrease
Food	Yes	✓	✓	✓	Increase	Decrease
Regulating services						
Erosion regulation	Yes		✓	✓	Increase	No change
Cultural services						
Recreation, ecotourism	Yes	✓	✓	✓	Increase	Increase
Aesthetic experience	Yes	✓	✓	✓	Increase	Increase

4.2. Global climate regulating services

Based on the look-up values from a FAO report (Dondini et al. 2023) and IPCC (2006), the amount of carbon stored in Prek Toal is estimated to range from 479,000 to 583,000 tonnes, while the annual carbon sequestration rate is estimated at 18,800 tonnes per year.

4.3. Flood mitigating services

The flood mitigation services provided by Prek Toal (part of Tonle Sap Biosphere Reserve) were assessed using biophysical values only (see Table A1 and Annex 1 for details). When compared to both the average of the eight RFI inland sites and the average of all other inland wetlands in Cambodia (Table A2 in Annex 1), Prek Toal shows some consistent results in terms of benefits and beneficiaries:

(1) for the average green storage capacity per sq. km of wetland, Prek Toal is above average (486 Giga Litres or GL of water per km^2 vs. 382 GL/km^2 for RFI inland sites and 458 GL/km2 for all other inland wetlands);

(2) for the average population uniquely benefitting from influential green storage upstream per sq. km of wetland, Prek Toal is also above average (112 vs. 80 people/km2 RFI inland sites and 110 people/km^2 for all other inland wetlands); and

(3) for the average built-up area uniquely benefitting from influential green storage upstream per sq. km of wetland, Prek Toal is again well above average (7.19 ha/km^2 vs. 4.89 ha/km^2 for RFI inland sites and 3.92 ha/km^2 for all other inland wetlands).

5. Drivers of change and their potential impacts on Prek Toal (part of Tonle Sap Biosphere Reserve)

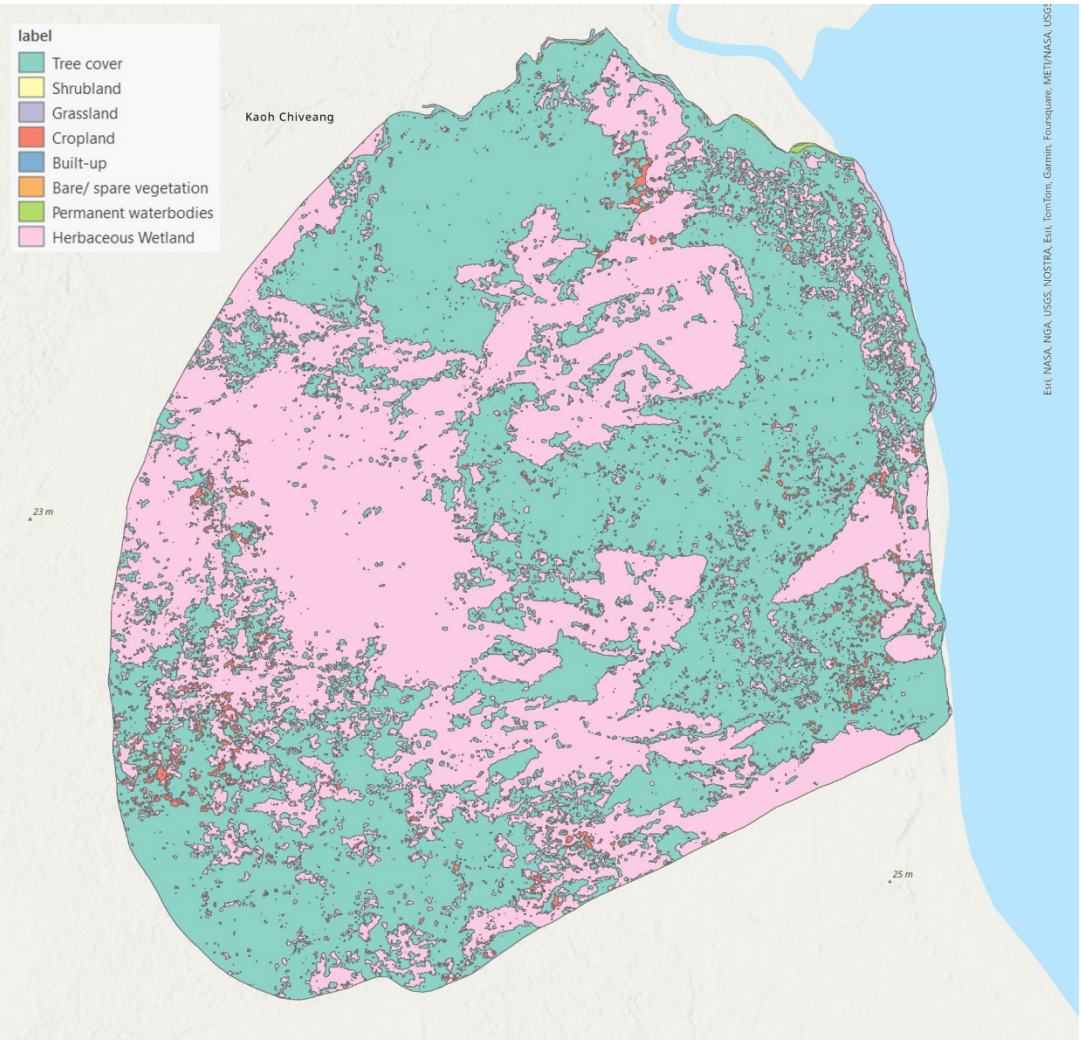

Figure 3. Map of the Prek Toal Ramsar Site, showing vegetation types (Map: Radhika Bhargava)

5.1. Current drivers of change and their level of impact

Stakeholders at the RFI workshop[2] identified several drivers of change impacting Prek Toal, and their corresponding levels of impact on the wetland site (Table 3). High-impact drivers include dams within or upstream of the wetland, which significantly alter the hydrological regime, affecting water flow and habitat conditions. Housing and settlement developments pose substantial threats by modifying the landscape and contributing to habitat fragmentation. Hunting, killing, and collecting terrestrial animals further threaten the site's biodiversity.

Medium-impact drivers encompass air-borne pollutants and annual and perennial non-timber crop production, which degrade air and soil quality. Other medium-impact factors include the destruction of cultural heritage buildings, droughts, erosion, and siltation/deposition, all of which contribute to habitat loss. Fishing, garbage and solid waste, habitat shifting, household sewage, and invasive plant species affect the wetland's ecological balance. Additional pressures include the loss of cultural links, marine and freshwater aquaculture, natural deterioration of cultural wetland values, roads and railroads, sewage and wastewater from facilities, shipping lanes, and temperature extremes.

More broadly, Cambodia is particularly vulnerable to the effects of climate change in the long term (World Bank 2023, Norris et al. 2024)

- Daily temperatures are predicted to rise by 0.9-1.7 °C by 2040-2059.
- A reduction in rice crop yield of 5-10% by the 2050s due to rising temperatures
- Increased freshwater contamination due to increased flash flooding resulting from heavier rains.
- Stress on the Mekong River system and likely increased flooding (frequency and scale) by the 2050s. Greater need to maintain sediment flow and prevent salinization of the delta.
- Increased heat-stress for the human populace and ecological systems.
- Likely wetter, mainly due to increased rain in the southwest monsoon (July-October)

[2] Asian Development Bank. (2023, September 13-14). Cambodia: Wetland Ecosystem Services Workshop [Workshop]. Phnom Pehn, Cambodia. https://events.development.asia/learning-events/cambodia-wetland-ecosystem-services-workshop

Table 3. Drivers of change and their potential impact on the integrity of Prek Toal (part of Tonle Sap Biosphere Reserve) based on consultations with stakeholders.

Driver of change	Impact
Dams within or upstream of the wetland site, which alter the hydrological regime	High
Housing and settlement	
Hunting, killing and collecting of terrestrial animals	
Air-borne pollutants	Medium
Annual and perennial non-timber crop production	
Destruction of cultural heritage buildings, gardens, sites, etc.	
Drought conditions	
Droughts	
Erosion and siltation/deposition	
Fire and fire suppression	
Fishing, killing and harvesting of aquatic resources	
Garbage and solid waste	
Habitat shifting and alteration	
Household sewage and urban wastewater from outside the wetland site	
Invasive plant species	
Loss of cultural links, traditional knowledge and/or management practices	
Marine and freshwater aquaculture	
Natural deterioration of important cultural wetland site values	
Roads and railroads	
Sewage and wastewater from wetland site facilities	
Shipping lanes and canals	
Temperature extremes	
Activities of site managers	Low
Agricultural and forestry effluents	
Collecting terrestrial plants or plant products (non-timber)	
Drug cultivation	
Energy generation, including from hydropower dams, wind farms and solar panels	
Excess energy	
Flight paths	
Habitat clearing	
Invasive animal species	
Pathogens	
Recreational activities and tourism	
Research, education and other work-related activities	
Storm and flooding	
Tourism and recreation infrastructure	
Utility and service lines	

5.2. Potential alternative state of Prek Toal (part of Tonle Sap Biosphere Reserve) 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.

[3] Asian Development Bank. (2023, September 13-14). Cambodia: Wetland Ecosystem Services Workshop [Workshop]. Phnom Pehn, Cambodia. https://events.development.asia/learning-events/cambodia-wetland-ecosystem-services-workshop

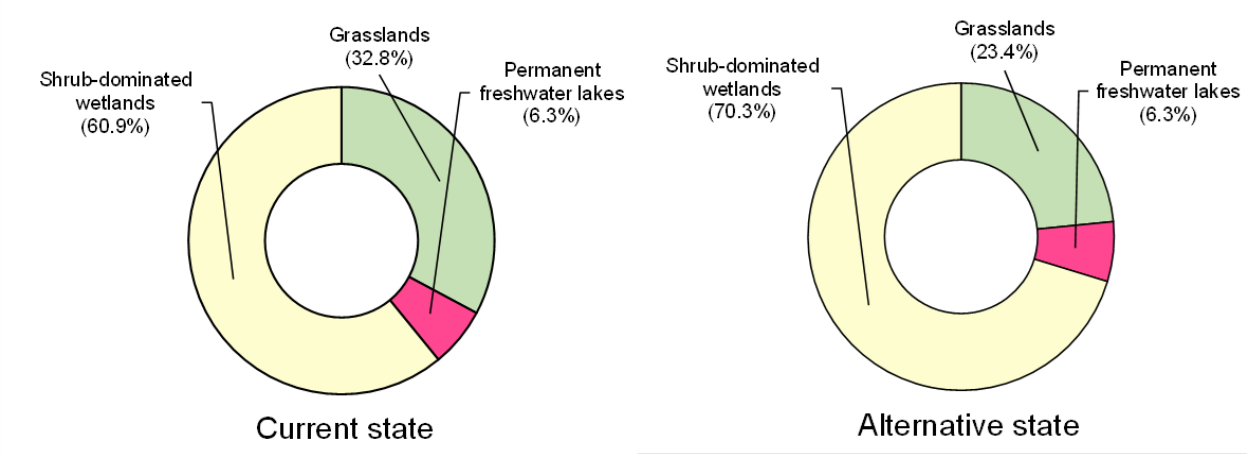

Figure 4. The proportional change in the extent of different habitat types between the current and alternative states of Prek Toal (part of Tonle Sap Biosphere Reserve).

5.3. Expected changes in the ecosystem services of Prek Toal (part of Tonle Sap Biosphere Reserve)

Stakeholders at the RFI workshop[4] documented the future trends in the provision of ecosystem services in Prek Toal, 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.

Freshwater provision has seen an increase in the past but is expected to decrease in the future (Figure 2 and Table 2). Food provision has also increased historically but is projected to decline moving forward. Erosion regulation has experienced an increase in the past and is expected to remain unchanged in the future. Cultural services, recreation ecotourism and aesthetic experience, have seen an increase in the past and are anticipated to continue growing in importance.

In the alternative state, the loss of 29% of grassland and the gain of 15% of wetland will result in a nett loss of stored carbon. estimated to be between 34,000 and 18,000 tonnes, and an increase in carbon sequestration rate (carbon accumulation) by approximately 1,870 tonnes per year.

No net change in the area of green water habitats is expected as presented in Table A5. Despite a shift in composition from grasslands to shrub-dominated wetlands, the total green water habitat area remains unchanged. Consequently, the green storage capacity per km² of wetland is expected to remain stable at 486 Giga Litres, and no change in flood mitigation benefits for the downstream population and built-up areas per km² of wetland is anticipated.

[4] Asian Development Bank. (2023, September 13-14). Cambodia: Wetland Ecosystem Services Workshop [Workshop]. Phnom Pehn, Cambodia. https://events.development.asia/learning-events/cambodia-wetland-ecosystem-services-workshop

6. Capacity needs in Prek Toal (part of Tonle Sap Biosphere Reserve)

The stakeholder consultation and analyses with government and civil society stakeholders identified at least seven stakeholder groups with clear roles in the long-term sustainable management of Prek Toal (part of Tonle Sap Biosphere Reserve). Table 4 summarizes the current and potential roles of these stakeholder groups in relation to the management of Prek Toal. There are opportunities to strengthen biodiversity monitoring, patrolling and law enforcement, tourism, and livelihood development.

Table 4. Capacity needs for key stakeholders involved in the management of the Tonle Sap Biosphere Reserve, as identified from stakeholder consultations at the RFI workshop in Phnom Penh in 2023.

Stakeholder Group	Current role in the wetland management	Possible Future role in wetland management (in 10 years)	Current capacity for sustainable wetland management	Capacity Development support needed to improve wetland management	Form of capacity development
Cambodian National Mekong Committee (CNMC)	International cooperation and coordination Site management and conservation Development of water policy and other related legal frameworks in the Mekong River Basin	Remain the same	N/A	N/A	N/A
Tonle Sap Authorities (MoWRAM)	Coordinating ministries' interventions on the lake, research, assessment, and recommendations to agencies	Remain the same	N/A	N/A	N/A
Tonle Sap BR authorities (MoE)	Coordinating ministries' interventions on the lake, Management & Research	Remain the same	N/A	N/A	N/A

Stakeholder Group	Current role in the wetland management	Possible Future role in wetland management (in 10 years)	Current capacity for sustainable wetland management	Capacity Development support needed to improve wetland management	Form of capacity development
MoE & PDoE	Guidelines, legal and institutional frameworks Technical support Promoting cooperation across agencies Administration	Maintain the current role and might have more authority in decision-making for site management	GIS SMART Patrols Bird and wildlife monitoring Reporting Communication channels Coordinating skills Development and implementation legal framework Management & action plan development and implementation Site assessment tools on the site (R-METT)	GIS mapping Bird monitoring Apply wetland Assessment Tools Ecosystem services assessment SMART Patrols Coordination skills	Funding support Training on key skill sets Site visit (local & overseas) Coaching & demonstration of assessment tools
Ministry of Agriculture (MoA)& FiA	Law and guidelines Legal and institutional frameworks Technical support, cooperation Administration	Remain the same	GIS mapping Bird monitoring Reporting Communication channels Coordinating skills Development and	N/A	N/A

Stakeholder Group	Current role in the wetland management	Possible Future role in wetland management (in 10 years)	Current capacity for sustainable wetland management	Capacity Development support needed to improve wetland management	Form of capacity development
			implementation legal framework Management & action plan development and implementation Fish Inventories		
CPA (MoE)	Participation in conservation, monitoring, restoration, awareness raising, livelihood, tourism	Maintain the current role and will have better engagement in decision-making processes	GPS skills Use SMART devices Reporting and coordination skills Ecotourism operation Geographic knowledge Bird monitoring	Ecotourism, site management and monitoring, action plan and management plan development, livelihood, fishery products and value chain, fire forest control	Financial and technical support Training Feasibility study on alternative livelihood Network building Equipment and tool for forest fires control
Cfi (MoA)	Participation in conservation, monitoring, restoration, awareness raising, livelihood, tourism	Remain the same	Kubo device Reporting & monitoring Ecotourism Operation Forest fire control Coordination skills	Ecotourism Site management & monitoring, restoration Biodiversity monitoring Livelihood improvement opportunities Fisheries products	• Training • Financial and technical support • Site visit

Stakeholder Group	Current role in the wetland management	Possible Future role in wetland management (in 10 years)	Current capacity for sustainable wetland management	Capacity Development support needed to improve wetland management	Form of capacity development
				Forest fire management	
Agricultural Cooperatives (AC)	Water management Crop and livestock Poultry production Chemical Inputs Land expansion	Remain the same	N/A	N/A	N/A
Local authorities	Administration Coordination, cooperation Community Investment Plan	Maintain the current role and will have active participation in conservation & PA Management	Coordination and reporting CIP Administration	Understanding the negative impact on ecosystem services and biodiversity CIP allocation for conservation and site management	Training Financial and technical support Awareness raising on ecosystem services and biodiversity, value and Impacts
Private sectors (Rice millers, fish processors, handicrafts)	Price regulation Collector & buyer Market access networking & processing products	Maintain current role and have more investment & contribution in conservation & PA management)	N/A	N/A	N/A
Tour Operators	Promote tourism (for domestic and international tourists)	Maintain the current role and have more investment & network for	N/A	N/A	N/A

Stakeholder Group	Current role in the wetland management	Possible Future role in wetland management (in 10 years)	Current capacity for sustainable wetland management	Capacity Development support needed to improve wetland management	Form of capacity development
	Capacity Building Tourism regulation	conservation & PA management			
Local communities	Access to natural resources and ecosystem services	Maintain the current role and have better understanding and knowledge to less harm in exploitation and accessibility	Bird monitoring Geography Fishing	Fish production Alternative livelihood Marketing & communication	Awareness raising Campaign Site exchange visits Forming local groups and clubs
Conservation NGOs	Funding projects in conservation and management Technical support Capacity building Awareness raising Livelihood and tourism development	Remain the same	SMART patrol GIS skills Bird monitoring Coordinating and implementing projects	N/A	N/A

7. Opportunities for RFI interventions

7.1. Recommended Interventions

Prek Toal is the most important and largest of three core areas of the Tonle Sap Biosphere Reserve (TSBR) designated for biodiversity conservation and fishery management. The site protects some of the largest remaining areas of floodplain wetland such as seasonally inundated swamp forest (flooded forest) on the Tonle Sap, used by the largest waterbird colonies in Southeast Asia. There are at least four villages (mostly floating villages) across two districts near the boundary of the core area with local communities here largely dependent on small-scale fishing and fish processing as the main source of livelihood, together with tourism activities. The proposed interventions at Prek Toal form part of a wider, landscape level intervention for the sustainable management of Tonle Sap, focusing on fisheries, tourism, and underpinned by improved landscape-level management with participation of local communities.

At Prek Toal, RFI interventions:

- Strengthen site management and enforcement. The site can benefit from improved community conservation management, this will require community training, an improved management plan, training and resources for patrols and to explore and develop alterative finance mechanisms (carbon, biodiversity bonds).
- Scale up habitat restoration work with a focus on swamp forest. Parts of the site have become degraded as a result of deforestation, drying, dry-season fires and invasive species such as giant mimosa.
- Enhance sustainable management of fisheries. Fish (and water snakes of several species) are harvested regularly the Tonle Sap. The project aims to protect biodiversity and improve livelihoods through micro-finance tied to the adoption of sustainable fishing practices, alongside there is improved provision of storage and processing capacity to help maximise revenue for the local communities.
- Sustain livelihoods through ecotourism. Livelihoods for communities around the core area has benefitted from a fair and sustainable approach to tourism since the early 2000s through measures including, infrastructure for biodiversity tourism, benefits-sharing to assist community protected area management will be improved. In addition, the project is expected to continue work to build local capacity (through training of local guides and tour operators) to use the site sustainably.

Table 5. Summary of key RFI interventions proposed for Prek Toal Ramsar Site

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Component 1. Strengthening site management of Prek Toal Ramsar Site					
Conduct a scoping study of existing interventions (and projects) and threats and drivers of change at Prek Toal, including targeted work on long-term threats (from climate change, damming, sedimentation, and invasive species).	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.	50,000	1 year	MOE (and department of freshwater conservation, and Tonle Sap) MAFF; fisheries administration MOWRAM Consultancy companies
Strengthen, update and expand site management plan in Prek Toal Ramsar Site (there are already several cycles of management plans)	Improved management of PTRS through participatory planning and co-management with key stakeholders. Establishment of a co-management framework, with continued involvement of local stakeholders Mitigation measures to address and	Site management and zonation plans over short to medium-term for PTRS developed, in consultation with key stakeholders, and agreed by key stakeholders and endorsed by MOE Number of consultations conducted to strengthen engagement of local stakeholders for participatory process. and engage national stakeholders for mandates on zonation.	100,000	5 years	MOE (and department of freshwater conservation, and Tonle Sap) MAFF (and provincial department of agriculture) Battambang Provincial department of environment MOWRAM Conservation organisations Community groups (including LCGs)

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	mitigate fire risk at flooded forests during the dry season defined and actively implemented. Improved management of PTRS through increased enforcement patrols focused on illegal bird hunting and land clearance at the fringes of the PTRS and sustained water and nutrients flow through the site at critical times of year to maintain ecological function.	Number of implemented activities in the developed site management plan. Co-management framework developed and piloted. Number of stakeholder groups engaged in the development of site management plan. Number of mitigation measures to address fire risks at flooded forests during the dry season implemented. Number of patrolling activities focused on illegal bird and land clearances at the fringes of the PTRS Number of consultations related to sustaining water and nutrients flow at a critical time of the year.			

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Designate more community protected areas (CPAs) with the local communities in and around PTRS	Improved management of PTRS through participatory planning and co-management with key stakeholders.	Number of CPA designations (target of up to three CPAs) facilitated, with boundaries well-defined. Number of consultations implemented with key stakeholders for participatory processes.	150,000	2 years	
Improve water management infrastructure (including canals and ditches) at forest and scrubby areas vulnerable to dry season fires to ensure water supply to PTRS for vulnerable areas during the dry season and to minimize the risk of fires.	Mitigation measures for forest and scrub fire risk during dry season are in place through better water management infrastructure	Number of water management infrastructure (including drainage canals and clearance of vegetation) repaired and improved. Number of facilitated localized dredging works to address siltation of water channels and vegetation. Recorded forest and scrub fire incidents reduced substantially against baselines. Number of consultations organized with concerned communities.	500,000	Up to 3 years	MOE MAFF MOWRAM Battambang and Siem Reap provincial governments

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Strengthening legal protection of Prek Toal	Increased wildlife protection and management of PTRS through sustained patrol and enforcement efforts for wildlife protection and encroachment activities, including at major streams and channels in the swamp forest, reduced incidences of illegal cases, and increased enforcement capacity of rangers (and management board)	Number of patrolling activities, using SMART approach against baselines implemented in PTRS. Number of enforcement materials (including boundary markers and signage on illegal activities around the edges of PTRS) developed, installed, and maintained. Capacity program on enforcement and patrolling developed and implemented. Number of training activities for enforcement and patrolling developed and implemented. Number of trained people on enforcement and patrolling. Number of reported illegal cases (of fishing and encroachment, including use of fish traps on	100,000	5 years	MOE (department of freshwater conservation) and Battabang department of environment MOWRAM Conservation and academic organisations (including bird and community-focused NGOs)

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		channels such as bamboo fence traps) especially in key streams and channels			
Component 2. *Scaling up invasive species management and swamp forest restoration in Tonle Sap Biosphere Reserve*					
Survey and identify key sites for restoration in PTRS and in abutting landscapes. Clarify land tenure	Improved management of PTRS with effective invasive species management through suitability assessment for site restoration	At least xx sites suitable for restoration in PTRS, taking into account long-term changes, identified. A restoration plan with prioritized plots for restoration and management activities developed and consulted with key stakeholders. Number of consultation meetings implemented to assess site restoration suitability within PTRS. Number of stakeholder groups involved in the site restoration plan development.	100,000	1 year	MOE and provincial department of environment (Battambang, Siem Reap) MAFF and provincial department of forestry Community groups Conservation organisations, including WCS Research institutions
Manage water hyacinth (in community	Improved management of PTRS with	Area (target of ip to 200 has) cleared and/or managed of	100,000	5 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
fisheries) and giant mimosa.	effective invasive species management through the sustained clearance of invasive species such as the water hyacinth and giant mimosa, and the effective management of impacted areas.	water hyacinth and other invasive plants, with participation from local community groups. Number of stakeholder groups involved in invasive species management			
Restore degraded areas of swamp (flooded) forest and scrub during the dry season.	Improved management of PTRS through the restoration of degraded areas of swamp forest and scrub during the dry season Mitigation measures for forest and scrub fire risk during dry season are in place through the restoration of impacted areas and water management at restoration sites.	Number of nurseries with native swamp forest species such as *Barringtonia* spp. established. At least 200 ha of degraded (flooded) forest restored over a five-year period. Number of stakeholder groups involved in restoration activities.	200,000	5 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Component 3. Wildlife protection and monitoring, with a focus on breeding waterbirds and other flagship species of the Tonle Sap Biosphere Reserve					
Strengthen and sustain biodiversity monitoring, with a focus on breeding waterbirds such as storks, pelicans and raptors.	Improved waterbird conservation through biodiversity monitoring Increased awareness of waterbirds amongst local communities.	Number of awareness-raising activities (including WMBD activities) implemented on the importance of protecting waterbirds and wetlands for villages Number of stakeholder groups engaged in awareness-raising activities Biodiversity monitoring program, linked to management cycle, developed and implemented. Number of biodiversity monitoring activities implemented.	100,000	5 years	MOE and provincial department of environment MOWRAN Conservation organisations Research institutions
Component 4. Strengthen the management of community fisheries in Prek Toal					
Strengthen management of site fisheries, with a focus on small-scale artisanal fishers at community fisheries (Cfi) at (Prek Toal/Piak Kantel, Anlong	Improved management of PTRS through the protection of fish breeding areas, regulation of fishing activities, and	A co-management framework and plan for small-scale fishers developed and approved by Fisheries Administration and Provincial Fisheries Office.	500,000	5 years	MAFF Fisheries Administration (FiA) MOWRAM Battambang provincial government

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Ta Oor, Kampong Prahok, Thvang).	strengthened fishery management system. Fishery resources are better managed and conserved	Number of identified activities in the co-management plan implemented. Number of consultations to engage local stakeholders, including Cfi representatives for participatory processes, implemented. A licensing framework for fishers established and actively implemented. Number of fisherfolk benefitting from activities to promote fishery management. Number of patrol activities, using SMART approach against illegal fishing implemented. Fishery monitoring framework in place. Number of community-led agreements on sustainable fishing			Community fisheries (Cfi) Conservation organisations (including rural development NGOs) Fishing operators

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		practices facilitated and supported.			
Conduct education and awareness activities around sustainable fisheries management and fishing practices.	Improved management of PTRS through increased awareness around sustainable fisheries management and fishing practices for all villages in PTRS.	An awareness-raising plan on sustainable fisheries developed and implemented. Number of education and awareness-raising activities implemented (target to have at least one per year) for all villages. Number of local stakeholders involved in awareness-raising events, including World Migratory Bird Day activities organised annually	100,000	5 years	MAFF Fisheries Administration (FiA) Community fisheries (Cfi) Conservation organisations
Improve the conditions and quality of key fish-breeding areas (i.e. fish sanctuaries) in PTRS (dependant on scoping work)	Fishery resources conserved and sustained through deepening of key water pools used by breeding fish during the dry season. Mitigation measures to address local impacts of dry season in place.	At least three (3) inundated areas dredged and deepened. Recorded fishing output at deepened areas known to be important for breeding fish populations increased by xx% against baselines	500,000 (for dredging in first 2 years)	5-8 years	Provincial department of fisheries for Battambang (and Siem Reap) Fisheries Administration (FiA) MOWRAM Community fisheries

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Strengthen the capacity and resilience of small-scale fishers (and snake harvesters) in villages around the Prek Toal core area (Prek Toal/Piak Kantel, Anlong Ta Oor, Kampong Prahok, Thvang)	Fishery resources conserved and sustained through increased adoption of sustainable fishing practices, and better access to livelihood opportunities and microfinancing mechanisms.	A capacity building program on sustainable fishing practices and financial management developed and implemented. Number of small-scale operators and fishers (target of at least 100) adopting sustainable fishery management. Number of people from local fishing communities of 5-6 villages including Prek Toal (with a representative % of women) trained on sustainable fishery management. Small loan scheme in place for small-scale fishers. Number of fishing cooperatives established and supported. Number of people benefitting from the microfinance mechanism.	200,000	5 years	MAFF Fisheries Administration Community groups (and Community fisheries) Conservation organisations
Component 5. *Strengthen alternative livelihoods for local communities (in selected villages) for value-added products*					

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Develop capacity for alternative livelihood opportunities, including value-add livelihood activities (Prek Toal/Piak Kantel, Anlong Ta Oor, Kampong Prahok, Thvang)	Improved management of PTRS through alternative livelihood, market access, and engagement of vulnerable groups. Improved engagement of women and minority groups (e.g. Cham, Vietnamese communities) in the workforce.	Number of consultations conducted with local stakeholders in the development of the capacity-building program. Training program for communities in four villages on the development and production of selected aquaculture products (e.g. processing of dried and smoked fish, fish pastes and sauce), and business planning developed and implemented. Number of livelihood activities supported through small-scale financing opportunities Number of people (target of at least 100 households, xx% of women) benefitting from grants and microloans. Number of markets established to support local livelihood.	200,000	8 years	Fisheries administration Battambang and Siem Reap Provincial department of fisheries Village community groups Conservation organisations and rural development NGOs Community groups of key communes and villages

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Improved fish storage and processing facilities.	Fishery resources conserved and sustained through livelihood support for villages. Installation of new infrastructure for storage, processing and package of fish-based products at participating villages	Number of consultations conducted with local stakeholders in planning livelihood support in target villages. Number of supporting infrastructures (target is storage and processing facility installed in at least 2 villages) for storage, processing, and package of fish-based products at participating villages, installed. Number of people benefitting from the installed infrastructure.	200,000	2 years	Fisheries administration Battambang and Siem Reap Provincial department of fisheries Village community groups
Component 6. Sustained work to upscale tourism infrastructure and strengthening sustainable ecotourism targeting international tourists from Siem Reap					
Improve, expand tourism, and maintain infrastructure at Phnom Krom and at other key sites including signages, jetties and viewing structures. Exchange visits to other popular tourism spots.	Improved protection and management of PTRS through ecotourism benefits and increased appreciation of waterbirds and flooded forest wetland habitats.	Number of tourism infrastructure (including signage, jetties, and viewing structures) improved and installed. Number of households benefitting from ecotourism (target of at least 200 households)	250,000	2 years	MOE; Battambang and Siem Reap provincial department of environment Provincial Department of tourism Conservation and academic organisations (including bird and

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
					community-focused NGOs)
Strengthen the capacity of local communities and businesses for nature-based tourism. Establish a development plan for nature-based tourism in Prek Toal	Improved protection and management of PTRS through nature-based tourism and increased capacity (including nature guiding) of local communities to support domestic and limited volumes of international tourists.	An ecotourism strategy and business plans and packages with a focus migratory waterbirds and flooded forests developed and tested with tourism operators in Siem Reap. Number of stakeholder groups engaged in the development of the ecotourism strategy and plan. A training program for ecotourism developed. Number of trained people from target communities. Number of people benefitting from ecotourism activities	200,000	3 years	Community groups of key villages Sam Veasna Centre for Conservation
Improve the access to finance for local tourism operators Strengthen benefits-sharing from tourism revenue for local communities	Improved access to microfinance for boat and small-scaled tour operators based around sustainable practices.	At least 50 ecotourism operators supported through small grants and loans. At least 4 villages are actively involved and	200,000	3 years	Siem Reap Provincial Department of Tourism Siem Reap provincial government Community groups

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	Benefit-sharing mechanism maintained at key villages at Prek Toal.	benefitting from ecotourism-based livelihoods.			
Component 7. Exploring the feasibility of carbon financing for forest conservation in the Tonle Sap Biosphere Reserve, building on experience from forest conservation (e.g. Cardamoms, Eastern Plains)					
Assess the feasibility of carbon financing for the site, and other wetlands with swamp forest cover on the Tonle Sap	Improved management of PTRS through innovative financing mechanisms.	Feasibility and suitability report of carbon financing for Tonle Sap Biosphere Reserve, with a focus on the core areas, developed and presented to key stakeholders. Investment guidelines for carbon financing from mangrove conservation drafted and endorsed by government agencies. Number of consultations conducted with local stakeholders for a participatory process in the development of the feasibility and suitability report of carbon financing.	100,000	2 years	MOE Battambang Provincial Government (including Battambang Provincial department of environment) Consulting companies
Total investment for 5-8 years			**USD 16,850,000**		

7.2. Potential Financing

The estimated project cost is USD 16,850,000 over 5-8 years. This budget supports the development of the site management plan, assessment of carbon financing, swamp forest restoration, capacity-building of local stakeholders on patrolling, enforcement, biodiversity monitoring, sustainable fisheries, tourism, waterbird conservation, and alternative livelihood, establishment of ecotourism and water management infrastructure, microfinancing mechanisms for local communities, and invasive species management. Table 5 summarizes the projected budget distribution across the proposed project components.

There is a potential for co-financing from a planned IUCN freshwater adaptation project, supported by AFD and the Green Climate Fund, as well as ongoing projects by several NGOs such as the Wildlife Conservation Society and the Sam Veasna Centre for Conservation.

7.3. Proposed Institutional Arrangements

The proposed project is expected to be implemented over a period of at up to eight (8) years, with main project components focusing on improved site management for Prek Toal Ramsar Site (led by the Ministry of Environment, and Provincial Department of Environment for Siem Reap) and scaling up sustainable fisheries and the development of alternative livelihoods (with the Ministry of Agriculture, Forestry and Fisheries, and its Fisheries Administration) and sustained efforts to scale up tourism (with the Siem Reap Provincial Department of Tourism and Ministry of Tourism). Conservation organisations and rural development NGOs are well established in the Tonle Sap and are expected to play a major supporting and technical role in the project by supporting project activities focused on biodiversity monitoring of waterbirds, driving community engagement and capacity building for nature-based tourism.

7.4. Project Beneficiaries

Based on the 2019 National Institute of Statistics of Cambodia population census, Aek Phnum district has 71,120 people in 15,632 households across 7 communes. Sangkae district, on the other hand, has 111,118 people in 29,294 households across 10 communes. This brings the approximate total direct and indirect beneficiaries to 182,238 people (44,926 households).

This proposed project is expected to undertake activities to promote gender inclusion and participation in livelihood activities, through capacity building activities for alternative livelihoods (e.g. fish processing and development of fish-based products), small-scale fisheries and nature-based tourism.

There are no indigenous communities in the project landscape. Most households are ethnically Khmer but there are a few Vietnamese and Cham households, mostly in the floating villages outside the Prek Toal core area.

7.5. Anticipated Implementation Risks

Stakeholder engagement: Proposed interventions rely on support from local communities, particularly in adopting sustainable fishing practices, patrolling, 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 PTRS, 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.

It is also important to assess how the construction of water infrastructure and digging (and dredging) works to deepen inundated parts of the site may cause short-term disturbance to wildlife.

References

Asian Waterbird Census (AWC): Cambodia data for 2022. See https://eaaflyway.net/asian-waterbird-census

BirdLife International Important Bird Area factsheet: Prek Toal (Cambodia). Available at: https://datazone.birdlife.org/site/factsheet/prek-toal-iba-cambodia in September 2024.

Clements, T., O'Kelly, H. and Sun V. (2007) *Monitoring of Large Waterbirds at Prek Toal, Tonle Sap Great Lake 2001–2007.* WCS Cambodia Program. Available at: https://s3.amazonaws.com/WCSResources/file_20120710_004515_Prek-Toal-Report_udxyFt.pdf

IUCN Red List of Threatened Species. Available at: www.iucnredlist.org

Mulligan, B., Rours V., Sun V., Sam H. and Goes, F. (2012) Status of the masked finfoot in Cambodia. *Cambodian Journal of Natural History* 2012: 13–28. Available at: https://www.fauna-flora.org/our-work/publications/cambodian-journal-natural-history/

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

Ramsar Site Information Sheet: Prek Toal. Available at: https://rsis.ramsar.org/ris/2245

Ramsar Management Plan (2007-2011): Prek Toal Core Area Tonle Sap Biosphere Reserve. Plan prepared by the Tonle Sap Conservation Project in association with Ministry of Environment and Ministry of Agriculture, Forestry and Fisheries. Available at: https://rsis.ramsar.org/RISapp/files/31383985/documents/KH2245_mgt1511.pdf

Seng Kim Hout, Pech Bunnat, Poole, C.M., Tordoff, A.W., Davidson, P. and E. Delattre (2003) *Directory of Important Bird Areas in Cambodia: key sites for conservation.* Phnom Penh, Cambodia: Department of Forestry and Wildlife, Department of Nature Conservation and Protection, BirdLife International in Indochina, and the Wildlife Conservation Society Cambodia Program.

Sun Visal and Allebone-Webb, S. (2009) *Monitoring of large waterbirds at Prek Toal, Tonle Sap Great Lake, pp.1-19 in: Biodiversity monitoring in the floodplain of the Tonle Sap in 2008-2009.* Wildlife Conservation Society Cambodia Program, Phnom Penh. Available at: https://s3.amazonaws.com/WCSResources/file_20120710_041420_Monitoring-Report_cShlxp.pdf

World Bank (2023) *Cambodia Country Climate and Development Report*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/099092823045083987/P17887106c6c2d0e909aa1090f3e10505c1

Annex 1. Supplementary information on flood mitigation 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 flood mitigation were spatially inferred in QGIS from a selection of metrics expressing different biophysical values modelled online by the Water World component of this tool. Equivalent data to assess monetary values similarly to coastal protection were not available for the RFI region.

The key metrics selected for biophysical values (Table A1) were the average green storage capacity, which is the volume of water stored by each square kilometre of wetland itself as well as its soil and vegetation, and the direct influence of this storage capacity on beneficiaries found downstream of the wetland, both as the average number of people and the average built-up area that are uniquely benefitting from the resulting flood mitigation (and not from other green storage found upstream).

Table A1. Contribution of the wetland habitats to flood mitigation in Prek Toal (part of Tonle Sap Biosphere Reserve) based on site-level (biophysical) values inferred from Mulligan (2022) and expressed as ranges to represent the resulting uncertainty.

Influence of the wetland on flood mitigation (metrics)	**Benefit/Beneficiaries**
Average green storage capacity per sq. km of wetland in million cubic metres (GigaLitres/km2)	456 – 515
Average population uniquely benefitting from influential green storage upstream per sq. km of wetland (n/km2)	106 – 112
Average built-up area uniquely benefitting from influential green storage upstream per sq. km of wetland (ha/km2)	6.77 – 7.62

Table A2. Biophysical benefits from and beneficiaries of RFI inland wetland sites (expressed as ranges to represent the resulting uncertainty) and at the national level.

Site name	**Green storage capacity (GigaLitres/km^2)**	**Downstream population (n /km^2)**	**Downstream built-up area (ha /km^2)**
Prek Toal Core Area	486 (±29)	112 (±7)	7.19 (±0.42)
Ang Tropeang Thmor	411 (±38)	73 (±7)	3.84 (±0.36)
Boeung Prek Lapouv	448 (±37)	139 (±12)	8.40 (±0.71)
Anlung Pring	264 (±63)	0 (±0)	1.22 (±0.29)

Boeng Chhmar	406 (±27)	102 (±7)	6.57 (±0.43)
Chikraeng / Stoung	206 (±23)	45 (±5)	2.84 (±0.32)
Kulen Promtep WS	456 (±6)	87 (±1)	4.20 (±0.05)
Cambodia RFI average	382	80	4.89
Cambodia national average	458	110	3.92

Table A5. Key habitat types in Prek Toal (part of Tonle Sap Biosphere Reserve) based on stakeholder-based assessment at the Regional Flyway Initiative workshop in September 2023.

Habitat type	Current state		Alternative state (2035)	
	Area (ha)	Cover (%)	Area (ha)	Cover (%)
Grasslands	7002.0	32.8	5001.5	23.4
Permanent freshwater lakes	1342.4	6.3	1342.4	6.3
Shrub-dominated wetlands	13003.8	60.9	15004.4	70.3
Total	21348.2	100.0	21348.2	100.0