



Regional Flyway Initiative · Site Study

January 2026

RFI Priority Site · Chi Kreng and Stoung

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General Site Information

Country	Cambodia			
RFI Site Name	Stoung - Chi Kreng	Chi Kreng: ID014	Stoung: ID017	
City/ Municipality, Province, Region	Chi Kreng: Chi Kraeng District, Siem Reap Province Stoung: Stoung District, Kampong Thom Province			
Geographical coordinates	Chi Kreng: 13.01°N, 104.42°E Stoung: 12.99°N, 104.47°E	Area (has)	Chi Kreng: 7,447 ha Stoung: 9,893 ha	
Key species	Sarus Crane, Bengal Florican			
Key habitats (biomes)	semi-natural grassland			
Key ecosystem services	Provisioning (freshwater), regulating (flood hazard mitigation, water purification) and cultural services			
Key drivers of change	Clearance of land for agriculture			
Conservation status (mark all that applies)	<input type="checkbox"/>	Protected Area	<input type="checkbox"/>	Flyway Network Site
	<input type="checkbox"/>	Ramsar Site	<input type="checkbox"/>	Others _____
IBA/ KBA name (and number) and other designations	Stoung and Chi Kraeng			
Management Stakeholders	Ministry of Environment, Ministry of Agriculture, Forestry and Fisheries, Provincial Governments of Siem Reap and Kampong Thom			
With management plan?	Yes			
Project concept themes	Biodiversity-friendly rice agriculture, nature-based tourism			
Length of project	5 years			
Sector/s	Agriculture and tourism			
No. of potential beneficiaries	Based on the 2019 census, Chi Kraeng District has 128,931 people across 29,698 households, while the Stoung District has 108,372 people across 26,547 households.			
Indigenous Peoples	<input type="checkbox"/>	No	<input type="checkbox"/>	Yes _____
Anticipated Implementation Risks	Risk for increased encroachment of conservation areas, with expansion of rice cultivation			
Estimated Project Budget (US\$)	13,700,000			
Potential Source/s of Financing	<input type="checkbox"/>	Loan (to be identified)	<input type="checkbox"/>	Private Sector
	<input type="checkbox"/>	Grant (to be identified)	<input type="checkbox"/>	Public-Private Partnership

Table of Contents

General Site Information	3
Acronyms	5
Executive summary	6
1. Background of the Regional Flyway Initiative	7
2. Site profile of Stoung and Chi Kreng	8
2.1. Chi Kreng	8
2.2. Stoung	9
3. Biodiversity value	10
3.1. Key habitats	10
3.2. Importance of Chi Kreng grasslands for migratory waterbird species	11
3.3. Other notable biodiversity in Chi Kreng grasslands	11
3.4. Importance of Stoung grasslands for migratory waterbird species	11
3.5. Other notable biodiversity in Stoung	12
4. Ecosystem services	12
4.1. Ecosystem services provided by Chi Kreng and Stoung	12
4.2. Global climate regulating services	14
4.3. Flood mitigating services	14
5. Drivers of change and their potential impacts on Chi Kreng and Stoung	15
5.1. Current drivers of change and their level of impact	15
5.2. Potential alternative state of Chi Kreng and Stoung under current drivers of change	16
5.3. Expected changes in the ecosystem services of Chi Kreng and Stoung	17
6. Capacity needs for stakeholders in Stoung and Chi Kreng	19
7. Opportunities for RFI interventions	22
7.1. Recommended Interventions	22
7.2. Potential Financing	32
7.3. Proposed Institutional Arrangements	32
7.4. Project Beneficiaries	32
7.5. Anticipated Implementation Risks	33
References	34
Annex 1. Supplementary information on flood mitigation services	36

Acronyms

ADB	Asian Development Bank
AWC	Asian Waterbird Census
BFCA	Bengal Florican Conservation Area
CMC	Community management committee
CPA	Community protected areas
CSR	Conservation Status Review
DoFWC	Department of Freshwater Wetlands Conservation
DMC	Developing Member Country
EAAFP	East Asian-Australasian Flyway Partnership
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
NLC	NatureLife Cambodia
NGO	Non-governmental Organisation
PDoE	Provincial Department of Environment
RFI	Regional Flyway Initiative
TESSA	Toolkit for Ecosystem Services Assessment
USD	United States Dollars
WCS	Wildlife Conservation Society

Executive summary

Cambodia's Tonle Sap Great Lake and its diverse wetland habitats, such as seasonally flooded grasslands and swamp forests, support Southeast Asia's largest congregations of waterbirds, including several large breeding colonies of storks, egrets, cormorants, and pelicans. The northern floodplain of the Tonle Sap is dominated by seasonally flooded grasslands and forms an important landscape for highly charismatic species such as the Bengal Florican and the Sarus Crane, with the best examples to be found in Stoung and Chi Krong. Both landscapes are also protected under Cambodian Law as Bengal Florican Conservation Areas and mandated by national decree. Currently, the most significant driver of change identified is agricultural intensification, associated with dry-season rice farming and the expansion of tree plantations. Dry season rice farming requires the construction of irrigation infrastructure such as canals, which can significantly impact the grassland's hydrology, and making it more vulnerable to bush fires.

The movement of the flagship Bengal Florican from the conservation area into the wider agricultural landscape exposes them to habitat degradation caused by agricultural intensification. As a result, there is a need for better management of unprotected areas of grasslands outside existing BFCAs, while sustaining low-intensity rice farming that is still widely practiced here. Another immediate priority for the long-term management of the Stoung and Chi Krong landscape is the strengthened implementation and enforcement of the existing site management plan for two protected areas currently designated as BFCAs to safeguard breeding populations of the endangered Bengal Florican. Existing, ongoing efforts to monitor biodiversity in both the Stoung and Chi Krong landscapes are led by MAFF, in collaboration with the Wildlife Conservation Society (WCS) and local stakeholders.

Local communities in and around both BFCAs are almost entirely dependent on rice agriculture as the major source of livelihood although that are substantial potential for nature-based tourism due to the site's proximity to major tourist centres in Siem Reap. In fact, existing tourism arrangements with conservation NGOs such as the WCS already bring small numbers of international tourists to observe the Bengal Florican, and which generates a steady source of revenue for participating villages through community funds.

To strengthen management and conservation of Stoung and Chi Krong, there is a clear need to strengthen management and legal protection of both sites through improved zonation, and the establishment of site management plans that address key threats such as agricultural encroachment, dry-season fires and invasive species. In addition, interventions proposed under this project aims to improve and scale-up alternative sources of livelihoods for local people through biodiversity-friendly rice agriculture through initiatives such as Ibis rice and Crane rice. Doing so will require minimally medium-term investments into building community capacity in best practices in rice agriculture, creation of local financing mechanisms to support participating households given likely high levels of local debt, and associated compliance and validation mechanisms for rice products.

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 Stoung and Chi Kreng

2.1. Chi Kreng

Location: Chi Kreng is located in Siem Reap Province, northwestern Cambodia. It lies in the eastern part of the Tonle Sap Lake inundation zone, adjacent to the Stoung RFI site.

Area: The Chi Kreng RFI site covers an area of 7,447 ha

Altitude: Approximately 10 m asl.

Geographical coordinates: 13.01°N, 104.42°E

Description of site: Chi Kreng comprises one of the largest remnant tracts of contiguous semi-natural grassland within the Tonle Sap Lake inundation zone. These grassland-dominated landscapes are now extremely rare in Southeast Asia and have been disappearing rapidly in Cambodia in recent years. The grasslands are essentially man-made, having formed over long periods of low intensity use and they continue to play an important role in sustaining local livelihoods. The vegetation at Chi Kreng is characterised by a mosaic of tall and short grass swards, mixed with some patchy, dense scrub, limited deepwater rice fields and small, scattered wetlands. Wet season rice is cultivated along the site's northern fringe adjacent to Provincial Road Number 6.

Site administration, management and land tenure: Chi Kreng was designated as a Bengal Florican Conservation Area (BFCA) in 2010 by the Department of Agriculture, Forestry and Fisheries, to be protected and managed for biodiversity conservation and sustainable use by local communities. The Forestry and Fisheries Administrations are the main government agencies involved in the management of the conservation area, with participation of local government and community stakeholders. Five Non-Governmental Organizations are collaborating in the effort to strengthen natural resource management in the protected areas: the Wildlife Conservation Society (WCS), the Centre d'Etude et de Développement Agricole Cambodgien (CEDAC), the Sam Veasna Center (SVC), BirdLife International in Indochina and the Angkor Center for Conservation of Biodiversity (ACCB). Engagement with local communities have been carried out at Srolay, Trea, Kampong Chen Cheung communes in Kampong Thom, and Lveang Russei and Spean Tnoat communes in Stoung.

Social and economic values: During the dry season, as floodwaters recede, large numbers of people move into the Chi Kreng area to fish, harvest grasses, gather brushwood and wetland plants, and graze domestic

livestock in herds that can number several hundred animals. Deepwater rice is cultivated in patches of the northern parts of the site, and a potential future threat to biodiversity there is large-scale conversion of grassland areas to rice cultivation.

2.2. Stoung

Location: Stoung is located in Kampong Thom Province, northwestern Cambodia. It lies in the eastern part of the Tonle Sap Lake inundation zone, immediately adjacent to the Chi Kreng RFI site.

Area: The Stoung RFI site has an area of 9,893 ha

Altitude: Approximately 10 m asl.

Geographical coordinates: 12.99°N, 104.47°E

Description of site: The Stoung RFI site comprises one of the largest remnant tracts of contiguous semi-natural grassland within the Tonle Sap Lake inundation zone. This grassland dominated landscapes are now extremely rare in Southeast Asia and have been disappearing rapidly in Cambodia in recent years. The grasslands are essentially man-made, having formed over long periods of low intensity use and they continue to play an important role in sustaining local livelihoods. The vegetation at Stoung is characterised by a mosaic of tall and short grass swards, mixed with some patchy, dense scrub, limited deepwater rice fields and small, scattered wetlands. Wet season rice is cultivated along the northern fringe of the site.

Site administration, management and land tenure: Stoung was designated as a Bengal Florican Conservation Area (BFCA) in 2010 by the Department of Agriculture, Forestry and Fisheries, to be protected and managed for biodiversity conservation and sustainable use by local communities. The Forestry and Fisheries Administrations are the main government agencies involved in the management of the conservation area, with participation of local government and community stakeholders. Five Non-Governmental Organizations are collaborating in the effort to strengthen natural resource management in the protected areas: the Wildlife Conservation Society (WCS), the Centre d'Etude et de Développement Agricole Cambodgien (CEDAC), the Sam Veasna Center (SVC), BirdLife International in Indochina and the Angkor Center for Conservation of Biodiversity (ACCB).

Social and economic values: During the dry season, as floodwaters recede, large numbers of people move into the Stoung area to fish, harvest grasses, gather brushwood and wetland plants, and graze domestic livestock in herds that can number several hundred animals. Deepwater rice is cultivated in patches of the northern parts of the site, and a potential future threat to biodiversity there is large-scale conversion of grassland areas to rice cultivation.

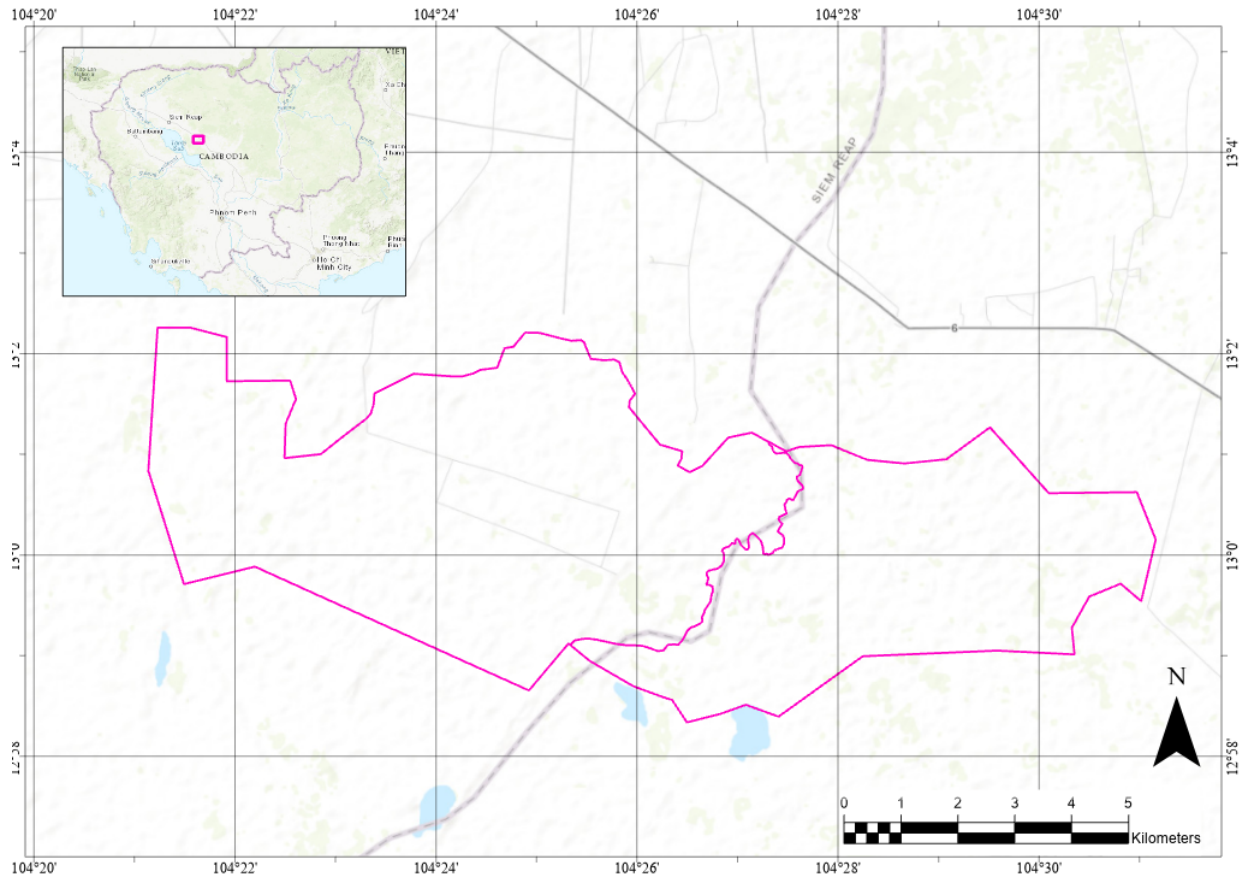


Figure 1. Map of the Chi Kreng (west) and Stoung (east) RFI sites, showing its location in the northern floodplain of the Tonle Sap Great Lake and Cambodia (Map: Evelyn Pina Covarrubias)

3. Biodiversity value

3.1. Key habitats

The Chi Kreng and Stoung RFI sites comprise one of the largest remnant tracts of contiguous semi-natural grassland within the Tonle Sap Lake inundation zone. These grassland-dominated landscapes are now extremely rare in Southeast Asia and have been disappearing rapidly in Cambodia in recent years. The grasslands are essentially man-made, having formed over long periods of low-intensity use, and they continue to play an important role in sustaining local livelihoods. The vegetation at Chi Kreng and Stoung is characterised by a mosaic of tall and short grass swards, mixed with some patchy, dense scrub, limited deepwater rice fields, and small, scattered wetlands.

3.2. Importance of Chi Kreng grasslands for migratory waterbird species

The small, seasonally-flooded pools at Chi Kreng are used as feeding areas by large waterbirds dispersing from the Tonle Sap Lake breeding colonies, including large numbers of Painted Stork *Mycteria leucocephala* and Lesser Adjutant *Leptoptilos javanicus* (NT).

Count data from the 2022 Asian Waterbird Census (AWC) was used in the RFI analysis for Chi Kreng. Only a single AWC count was conducted in that year, and the results of this count were compared to the Conservation Status Review (CSR1) 1% population estimates to calculate a score for each species. Two 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 Chi Kreng.

Species name	IUCN	Average count	CSR1	CSR1 score
Painted Stork <i>Mycteria leucocephala</i>	NT	275	70	3.9
Sarus Crane <i>Antigone antigone sharpii</i>	VU	3	2	1.5

3.3. Other notable biodiversity in Chi Kreng grasslands

The seasonally inundated grasslands at Chi Kreng support an important breeding population of Bengal Floricans *Houbaropsis bengalensis* (CR), possibly the largest for the species in Southeast Asia. There is also a substantial non-breeding population of Manchurian Reed-warbler *Acrocephalus tangorum* (VU), as well as small numbers of non-breeding Greater Spotted Eagle *Clanga clanga* (VU) which occur during the dry season. Grassland habitat all across the Tonle Sap landscape is used by globally significant congregations of the Yellow-breasted Bunting *Emberiza aureola* (CR), although much of this occur outside of existing protected areas (Ly et al. 2023).

3.4. Importance of Stoung grasslands for migratory waterbird species

The small pools at Stoung are used as feeding areas by large waterbirds dispersing from the Tonle Sap Lake breeding colonies, including Painted Stork *Mycteria leucocephala* and Lesser Adjutant *Leptoptilos javanicus* (NT).

Count data from the 2022 Asian Waterbird Census (AWC) was used in the RFI analysis for Stoung. Only a single AWC count was conducted in that year, and the results of this count were compared to the

Conservation Status Review (CSR1) 1% population estimates to calculate a score for each species. The Sarus Crane was the only migratory waterbird species found to exceed the 1% population estimates during the 2022 AWC (Table 2), and the CSR1 score for this species provided the overall site score.

Table 2. List of migratory species (based on the EAAFP list of species) with globally significant congregations in Stoung.

Species name	IUCN	Average count	CSR1	CSR1 score
Sarus Crane <i>Antigone antigone sharpii</i>	VU	2	2	1

3.5. Other notable biodiversity in Stoung

The seasonally inundated grasslands at Stoung support an important breeding population of Bengal Floricans *Houbaropsis bengalensis* (CR). There is also a substantial non-breeding population of White-browed Reed-warbler (VU) and Yellow-breasted Bunting (CR), as well as small numbers of non-breeding Greater Spotted Eagle *Clanga clanga* (VU).

4. Ecosystem services

4.1. Ecosystem services provided by Chi Kreng and Stoung

The Chi Kreng and Stoung landscape encompasses diverse wetland (including seasonally inundated grassland) habitats, providing valuable provisioning, regulating, and cultural ecosystem services (Figure 2) for adjacent communes and their local communities. The results from the RFI workshop¹ highlights the top ecosystem services provided by the site, emphasising their essential and non-substitutable nature (Table 3). Regulating services, such as local climate regulation, water purification, and pollination, benefit communities within, adjacent to, and distant from the site. Local climate regulation has remained unchanged in the past but is projected to decrease in the future. Water purification and pollination have both experienced a decline in the past and are expected to continue decreasing, indicating potential challenges for ecosystem health and community well-being. Cultural services, particularly recreation ecotourism and knowledge systems and education, significantly benefit communities at all distances. Both

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 have remained stable in the past, and they are expected to increase in the future, reinforcing the wetland's importance to both local and broader populations.



Figure 2 List of ecosystem services provided by Chi Kreng and Stoung, as identified through stakeholder consultation at the Regional Flyway Initiative workshop.

Table 3. List of top ecosystem services provided by Chi Kreng and Stoung.

Ecosystem services	Essential or non-substitutable	Benefits to communities		Change	
		Adjacent to the site	Distant to the site	Past	Future
<i>Regulating services</i>					

Ecosystem services	Essential or non-substitutable	Benefits to communities			Change	
		Within the site	Adjacent to the site	Distant to the site	Past	Future
Local climate regulation	Yes	✓	✓		No change	Decrease
Water purification and waste treatment	Yes	✓	✓	✓	Decrease	Decrease
Pollination	Yes	✓	✓	✓	Decrease	Decrease
<i>Cultural services</i>						
Recreation, ecotourism	Yes	✓	✓	✓	No change	Increase
Knowledge systems and education	Yes	✓	✓	✓	No change	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 Chi Kreng and Stoung is estimated to range from 141,000 to 145,000 tonnes, while the annual carbon sequestration rate is estimated at 1,870 tonnes per year.

4.3. Flood mitigating services

The flood mitigation services provided by Chi Kreng and Stoung 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), Chi Kreng and Stoung shows some consistent results in terms of benefits and beneficiaries:

- (1) for the average green storage capacity per sq. km of wetland, Chi Kreng and Stoung is below average (206 Giga Litres or GL of water per km² vs. 382 GL/km² 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, Chi Kreng and Stoung is also below average (45 vs. 80 people/km² RFI inland sites and 110 people/km² 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, Chi Kreng and Stoung is again below average (4.89 ha/km² vs. 3.92 ha/km² for RFI inland sites and 5.24 ha/km² for all other inland wetlands).

5. Drivers of change and their potential impacts on Chi Kren and Stoung

5.1. Current drivers of change and their level of impact

Stakeholders at the RFI workshop² identified 39 drivers of change impacting Chi Kren & Stoung, and their corresponding levels of impact on the wetland site (Table 4). High-impact drivers include agricultural and forestry effluents, which significantly degrade water quality and habitat health (of water bodies that feed into the Tonle Sap). Annual and perennial non-timber crop production alters land use, while habitat clearing contributes to the loss of natural vegetation. Other high-impact, substantial threats involve fishing, killing, and harvesting of aquatic resources, increased fragmentation within the wetland, drought conditions, and other 'edge effects' that degrade the wetland's ecological values.

Medium-impact drivers consist of air-borne pollutants, which affect the ecosystem's health, and collecting terrestrial plants, which can disturb native vegetation. Additional medium-impact factors include dams within or upstream of the wetland, which alter the hydrological regime, as well as droughts, excess ponding of water, and fire suppression activities. Garbage and solid waste, housing and settlement developments, hunting terrestrial animals, invasive plant species, livestock farming, and loss of cultural links contribute to moderate habitat and cultural value degradation. The loss of hydrological connectivity, keystone species, and deterioration of cultural wetland values further moderately impact the site's integrity. Recreational activities, research, temperature extremes, utility lines, water extraction, and wood pulp production also add to the medium-level impacts on the wetland.

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 4. Drivers of change and their potential impact on the integrity of Chi Kreng and Stoung based on consultations with stakeholders.

Driver of change	Impact
Agricultural and forestry effluents	High
Annual and perennial non-timber crop production	
Drought conditions	
Fishing, killing and harvesting of aquatic resources	
Habitat clearing	
Increased fragmentation within the wetland site	
Other 'edge effects' that degrade the wetland site values	
Air-borne pollutants	Medium
Collecting terrestrial plants or plant products (non-timber)	
Dams within or upstream of the wetland site, which alter the hydrological regime	
Droughts	
Excess ponding of water onsite	
Fire and fire suppression	
Garbage and solid waste	
Housing and settlement	
Hunting, killing and collecting of terrestrial animals	
Invasive plant species	
Livestock farming and grazing	
Loss of cultural links, traditional knowledge and/or management practices	
Loss of hydrological connectivity	
Loss of keystone species	
Natural deterioration of important cultural wetland site values	
Recreational activities and tourism	
Research, education and other work-related activities	
Temperature extremes	Low
Utility and service lines	
Water extraction/diversion within the wetland site or catchment	
Wood pulp and plantations	
Commercial and industrial areas	
Drug cultivation	
Excess energy	
Habitat shifting and alteration	
Household sewage and urban wastewater from outside the wetland site	
Logging and timber harvesting	
Marine and freshwater aquaculture	
Sewage and wastewater from wetland site facilities	
Shipping lanes and canals	
Storm and flooding	
Tourism and recreation infrastructure	

5.2. Potential alternative state of Chi Kreng and Stoung under current drivers of change

Stakeholders at the RFI workshop³ 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 3). 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>

5.3. Expected changes in the ecosystem services of Chi Kreng and Stoung

Stakeholders at the RFI workshop⁴ documented the future trends in the provision of ecosystem services in Chi Kreng and Stoung, 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 2 and Table 3 highlight that local climate regulation has remained unchanged in the past but is projected to decrease in the future. Water purification and pollination have both experienced a decline in the past and are expected to continue decreasing. Cultural services, particularly recreation, ecotourism, knowledge systems, and education, have remained stable in the past, and they are expected to increase in the future.

In the alternative state, the loss of 28% of mangrove and the gain of 9% of wetland will result in a loss of stored carbon, estimated to be between 35,100 and 35,500 tonnes, and a decrease in carbon sequestration rate (carbon accumulation) by approximately 285 tonnes per year.

No net change in the area of green water habitats is expected as presented in Table A5. Despite shifts in composition between grasslands, planted/cultivated areas, shrub-dominated wetlands, and permanent freshwater lakes, the total green water habitat area remains unchanged. Consequently, the green storage capacity per km² of wetland is expected to remain stable at 206 Giga Litres, and no change in flood mitigation benefits for the downstream population and built-up areas per km² of wetland is anticipated.

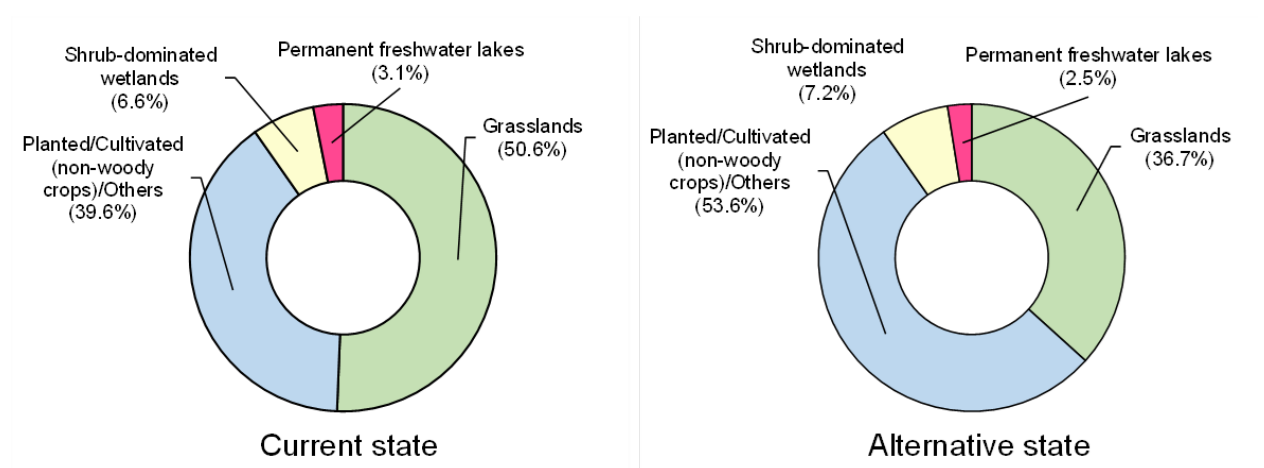


Figure 3. The proportional change in the extent of different habitat types between the current and alternative states of Chi Kreng and Stoung.

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>

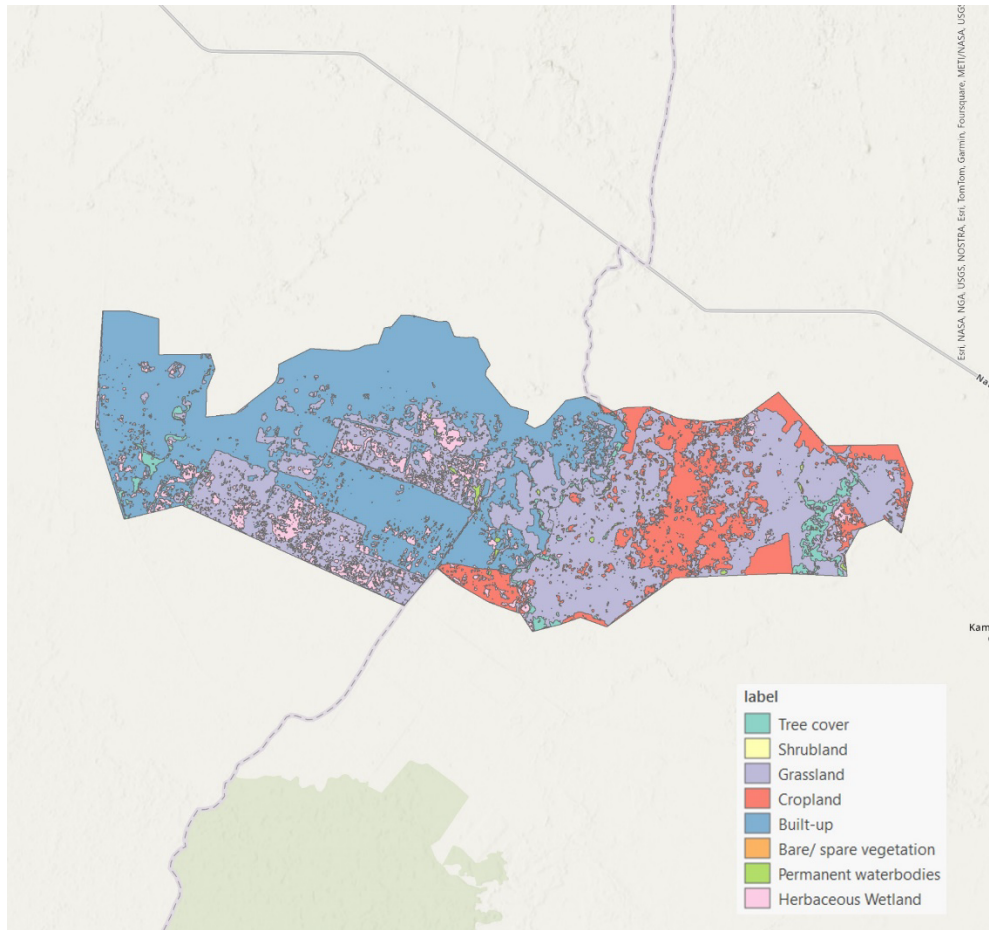


Figure 4. Major land cover types in Chi Krong and Stoung grasslands based on remotely sensed data (Map: Radhika Bhargava)

6. Capacity needs for stakeholders in Stoung and Chi Kreng

The stakeholder consultation and analyses with government and civil society stakeholders identified ten stakeholder groups with clear roles in the long-term sustainable management of the Stoung – Chi Kreng wetlands. Table 5 summarizes the current and potential roles of these stakeholder groups in relation to the management of the Stoung – Chi Kreng wetlands. There are opportunities to strengthen wetland assessment, patrolling and law enforcement, tourism, site management, livelihood development, and biodiversity monitoring.

Table 5. Capacity needs for key stakeholders involved in the management of Stoung and Chi Kreng wetlands.

Stakeholder	Existing role in management	Priority for capacity development	Means of building capacity
Ministry of Environment and Provincial Department of Environment (for Kompong Thom and Siem Reap)	Strengthening regulations, and law enforcement Developing guidelines, legal and institutional frameworks Technical support Coordination and site administration	Spatial analyses (GIS) Biodiversity monitoring Wetland Assessment Tools and ecosystem services assessment Site enforcement through patrols (SMART) and strengthening multi-stakeholder coordination	Funding support Training and site visits for knowledge exchange Direct coaching/training & demonstration of assessment tools
Ministry of Agriculture (Agriculture and Forestry Administration)	Strengthening regulations, and law enforcement Developing guidelines, legal and institutional frameworks for improved management Technical support Coordination and site administration	NA	Same as above
Community Protected Area (CPA) management	Participation in conservation, monitoring, wetland restoration, awareness	Ecotourism development and support	Financial and technical support

Stakeholder	Existing role in management	Priority for capacity development	Means of building capacity
(Ministry of Environment)	activities livelihood, tourism. May play a bigger role in decision-making processes for site management	Site management and monitoring, action plan and management plan development, livelihood, fishery products and value chain, fire forest control	Training programmes on site management, including managing of bush fires; removal of invasive species Feasibility studies on alternative livelihood Strengthen networking and coordination with other stakeholders
Community Forestry (Ministry of Agriculture, Forestry and Fisheries)	Participation in conservation, monitoring, restoration, awareness raising, livelihood, tourism	Ecotourism Site management & monitoring, restoration Bird and Fish ID livelihood improvement Fisheries products	Training programmes Financial and technical support Site visits
Agricultural cooperatives (for rice farmers)	Water management Crop and livestock Poultry production Prepare and coordinate the distribution and use of agro-chemicals Land planning		Training programmes Financial and technical support Site visits
Local government authorities	Administration Coordination across the different stakeholders Community Investment Plan but bigger role over time on management of site	Understanding the negative impact on ES and Biodiversity CIP allocation for conservation and site management	Training Financial and technical support Raising awareness of ecosystem services, biodiversity value and Impacts
Private sector (agriculture)	Price regulation (for rice products)	-	-

Stakeholder	Existing role in management	Priority for capacity development	Means of building capacity
	Middleman role (collection and resale). Market networking & processing		
Private sector (eco-tourism operators)	Promote international and domestic tourism Building local capacity for nature-based tourism Tour regulation Livelihood support	-	-
Local community groups	Accessing to natural resources and ES	Fish production Alternative livelihood Marketing & communication	Awareness raising Support conservation activities
Conservation organisations	Funding projects in conservation and management Provide other stakeholders with technical support Capacity building Awareness raising Livelihood Ecotourism	-	-

7. Opportunities for RFI interventions

7.1. Recommended Interventions

The northern floodplain of the Tonle Sap forms an important landscape for biodiversity conservation, with its large colonies of breeding waterbirds, and also several highly charismatic species such as the Bengal Florican and the Sarus Crane. The expansion of rice cultivation and dry-season fires have reduced natural, seasonally-flooded grasslands to a few small patches, the best examples which can now be founded in Stoung and Chi Krong, both landscapes also protected under Cambodian Law as Bengal Florican Conservation Areas. An immediate priority for the long-term management of the Stoung and Chi Krong landscape is the strengthened implementation and enforcement of the existing site management plan for two protected areas currently designated as BFCAs to safeguard breeding populations of the endangered Bengal Florican (Mahood et al. 2019). The movement of this flagship species from the protected areas into the wider agricultural landscape exposes them to habitat degradation as a result of agricultural intensification. As a result, there is a need for better management of unprotected areas of grasslands outside existing BFCAs, while sustaining low-intensity rice farming that is still widely practiced. Currently, the most significant driver of change identified is agricultural intensification, associated with dry-season rice farming and the expansion of tree plantations. Dry season rice farming requires the construction of irrigation infrastructure such as canals, which can significantly impact the grassland's hydrology, and making it more vulnerable to bush fires.

Existing, ongoing efforts to monitor biodiversity in both the Stoung and Chi Kraeng landscapes are led by MAFF, in collaboration with the Wildlife Conservation Society and local stakeholders. There is opportunity for this to be scaled up more widely across the northern Tonle Sap landscape, which retains some of the large seasonally inundated grassland landscapes in Southeast Asia.

Strengthening management efforts for this sensitive wetland landscape is a priority intervention and is expected to involve strengthening local communities' capacity to implement biodiversity-friendly rice agriculture, while sustaining low intensity, traditional management approaches that is practiced in the seasonally inundated grassland landscapes of the Tonle Sap. There is also scope for invasive species management, especially the rapidly invading *Mimosa pigra*, which alters habitat structure for several species, while impacting rice farming efficiency. This is needed alongside strengthened field monitoring of biodiversity (with a particular focus on charismatic species such as Sarus Crane and Bengal Florican) and threats by patrol teams to address encroachment.

Table 6. Summary of key RFI interventions proposed for Stoung - Chi Kreng wetlands.

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
<i>Component 1. Strengthening site management and protection of Chi Kreng and Stoung grasslands</i>					
Conduct a scoping study of existing interventions and threats and disturbance at both Chi Kreng and Stoung grasslands, including targeted work on long-term threats (from climate change, dry-season fires, encroachment and invasive species management).	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.	100,000	1 year	MOE (MAFF) Siem Reap and Kampong Thom Provincial Government Management boards of both Stoung and Chi Kreng BFCAs Conservation organisations (WCS, SVCC) ADB
Strengthen and expand site management of Chi Kreng and Stoung BFCAs, including, potentially designation of a buffer zone.	Strengthened management of the Stoung- Chi Kreng wetlands, through participatory planning and co-management with key stakeholders. Establishment of a co-management framework, with stronger involvement of local stakeholders. Mitigation measures to address and mitigate fire risk during the dry season defined	Site management plan over short to medium-term for both sites developed, in consultation with key stakeholders, including villages in the boundary and within the protected area through participatory mapping. Number of consultations conducted to strengthen engagement of local stakeholders for participatory processes, understand local needs, and engage national stakeholders for	200,000	2 years	MOE Siem Reap and Kampong Thom Provincial Government Chi Kraeng and Stoung district government Conservation organisations Community groups (including LCGs) from communes engaged so far)

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	<p>and actively implemented.</p> <p>Improved management of the Stoung- Chi Kreng grasslands through increased enforcement patrols focused on illegal encroachment, wildlife trapping, and land clearance.</p>	<p>mandates on zonation.</p> <p>Number of implemented activities in the developed site management plan.</p> <p>Co-management framework developed and piloted.</p> <p>Number of stakeholder groups engaged in the development of site management plan.</p> <p>Number of mitigation measures to address fire risk during the dry season implemented.</p> <p>Number of patrolling activities focused on illegal encroachment, land clearance, and trapping of wildlife.</p> <p>Number of boundary markers established and installed in BFCAs.</p>			
<p>Strengthen the invasive species management with a focus on Giant Mimosa infestation in Stoung-Chi Kreng (BFCAs) and</p>	<p>Invasive Giant Mimosa at Stoung and Chi Kraeng (and surrounding landscapes) effectively</p>	<p>Invasive species monitoring and management plan developed and actively implemented by management board.</p>	<p>150,000</p>	<p>5 years</p>	<p>MOE (and MAFF)</p> <p>Provincial Departments of Environment of Kampong Thom and Siem Reap.</p>

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
surrounding rice farming landscapes.	managed and no longer affecting sections of the BFCA Core Zone.	<p>Management plan contributes to a part of the overall site management and zonation plan.</p> <p>Number of activities implemented in the invasive species management plan.</p> <p>Area (target of at least 20 ha of both BFCA's core zones) of the wetlands with controlled number of invasive species including Giant Mimosa</p> <p>At least one experimental plot for Giant Mimosa removal established.</p> <p>Number of stakeholder groups involved in the implementation of the invasive species management plan.</p>			<p>Provincial Agricultural Departments of Kampong Thom and Siem Reap.</p> <p>BFCA management boards</p> <p>Conservation and academic organisations (including bird and community-focused NGOs, Wildlife Conservation Society)</p> <p>Research institutions (e.g. RUPP)</p> <p>Community groups</p>
<i>Component 2. Wildlife protection and monitoring, with a focus on the Sarus Crane, Bengal Florican, Yellow-breasted Bunting and waterbird species</i>					
Strengthen legal protection and enforcement in Stoung and Chi Kreng	Increased wildlife protection and management of the Stoung – Chi Kreng grasslands through co-management with local	<p>Number of increased legal protection for the Stoung- Chi Kreng grasslands facilitated.</p> <p>Number of patrolling activities using SMART</p>	200,000	3 years	<p>MOE</p> <p>BFCA management boards</p> <p>Stoung and Chi Kraeng district government</p>

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	stakeholders and increased patrolling and enforcement efforts.	<p>approach against baselines implemented in the BFCAs.</p> <p>Co-management framework developed with existing community management committees (CMSs) in reserve and conservation organisations, with at least village communities from two communes engaged.</p> <p>Capacity program on enforcement and monitoring developed and implemented.</p> <p>Number of capacity-building activities implemented</p> <p>Number of trained people on enforcement and monitoring.</p>			<p>Local community management committees at villages</p> <p>Conservation and academic organisations (including WCS and SVCC)</p>
Strengthen biodiversity monitoring, with a focus on the Bengal Florican Sarus Crane, (Yellow-breasted Bunting), and	Increased awareness for Bengal Florican, Sarus Crane and large waterbird conservation amongst local people.	Number of awareness-raising activities implemented to preserve the Bengal Florican, cranes and wetlands.	100,000	5 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
other waterbird species.	Improved waterbird conservation through biodiversity monitoring	<p>Number of stakeholder groups engaged in the awareness-raising activities</p> <p>Biodiversity monitoring program developed, synergized with the management plans and frameworks, and implemented.</p> <p>Number of biodiversity monitoring activities implemented.</p>			
Component 3.					
<i>Upscaling tourism infrastructure and strengthening nature-based tourism in Chi Kreng and Stoung BFCA</i>					
Improve and expand tourism infrastructure at Stoung and Chi Kreng, including signages and shelters.	Improved protection and management of the Stoung- Chi Kreng wetlands through ecotourism benefits and increased appreciation of Bengal Florican, Sarus Cranes, other waterbird species, and wetlands.	<p>Number of tourism infrastructure (including signage and shelters) improved and installed.</p> <p>Number of households benefitting from ecotourism (target of at least 100 households in at least two villages)</p>	1,000,000	2 years	<p>MOT</p> <p>ATT management board</p> <p>Stoung and Chi Kraeng district government</p> <p>Conservation organisations (including bird and community-focused NGOs, such as SVCC)</p>
Strengthen the capacity of local communities and	Improved protection and management of	An ecotourism strategy and plan, focused on Bengal	200,000	3 years	Tourism operators in Siem Reap

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
<p>businesses for nature-based tourism.</p> <p>Establish a short-term development plan for nature-based tourism in Stoung and Chi Kreng BFCAs.</p>	<p>the Stoung- Chi Kreng wetlands through nature-based tourism benefit – sharing and increased capacity of local stakeholders to support domestic and international tourists.</p>	<p>Florican, Sarus Crane, and other waterbird species, developed and tested with tourism operators</p> <p>Number of provincial and district level tourism plans and strategies updated, in coordination with MOT and relevant tourism stakeholders.</p> <p>Number of stakeholder groups engaged in the development of the ecotourism strategy and plan.</p> <p>A training program for ecotourism developed.</p> <p>Number of trained people from target communes</p> <p>Number of people benefitting from ecotourism activities</p>			

Component 4. Strengthening sustainable and organic rice farming (on Jasmine rice, or other native Tonle Sap rice varieties) and a livelihood alternative for local people

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
Improve water management infrastructure to ensure inundation of rice fields, without significant impact on natural areas of grasslands	Mitigation measures for fire risk during dry seasons are in place through better water management infrastructure, such as irrigation channels.	<p>Number of water management infrastructure (including drainage canals and sluice gates) repaired and improved.</p> <p>Number of facilitated localized dredging works for addressing siltation and vegetation.</p> <p>Recorded bush fires reduced substantially over baselines</p> <p>Number of consultations organized with all villages on water regime concerns on rice farming.</p>	500,000	3 years	<p>MOWRAM</p> <p>MAFF</p> <p>MOE</p> <p>Provincial Department of Water Resources</p> <p>Siem Reap and Kampong Thom Provincial Department of Agriculture, Forestry and Fisheries</p>
Pilot sustainable, regenerative rice-farming in selected communes, in the landscapes outside the protected areas (Stoung and Chi Kreng BFCA)	Improved management of Stoung – Chi Kreng wetlands through sustainable and regenerative rice production in selected communities.	<p>A capacity building (and training) program for organic and biodiversity-friendly rice farming developed and implemented.</p> <p>Number of capacity-building activities implemented.</p> <p>Number of trained rice farmers on biodiversity-friendly and/or organic farming</p>	250,000	3 years	<p>Ministry of Agriculture, Forestry and Fisheries</p> <p>Siem Reap and Kampong Thom provincial government, including provincial departments of agriculture.</p> <p>Stoung and Chi Kreng district government, and relevant district governments</p> <p>Conservation organisations</p>

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		<p>At least XX% of rice farmers in and around ATT cultivating sustainable farming.</p> <p>Number of successful rice-planting trials and experiments (on fertilizer use, soil management) in selected plots.</p> <p>Number of stakeholder consultation meetings organised with key stakeholders.</p>			<p>(including bird and community-focused NGOs)</p> <p>Agricultural banks</p>
<p>Scale up sustainable, regenerative rice-farming in the existing landscapes, using organic and/or wildlife-friendly approaches.</p> <p>Exchange visits to other wetlands to meet local communities involved in organic and wildlife-friendly rice production such as Ibis Rice.</p>	<p>Organic and biodiversity-friendly rice farming expanded and upscaled in landscapes around the BFCAs.</p> <p>Financing mechanism (for local loans and grants) created for local communities, and supported by key lending institutions for farmers.</p>	<p>Number of stakeholder consultation meetings organised with key stakeholders</p> <p>At least 10 to 15% increased on the adoption of biodiversity-friendly rice-farming against 2025 baselines in Stoung and Chi Kreng districts</p> <p>At least 30% of rice fields under organic/biodiversity-friendly cultivation.</p>	500,000	10 years	<p>Ministry of Agriculture, Forestry and Fisheries</p> <p>Siem Reap and Kampong Thom provincial government, including provincial departments of agriculture.</p> <p>Stoung and Chi Kreng district government, and relevant district governments</p> <p>Conservation organisations</p>

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	Improved management of BFCAs through the practice of biodiversity-friendly farming	<p>Number of small loans granted for marginalized communities</p> <p>Number of people who benefitted from the local financing mechanism.</p>			<p>Rural development organisations</p> <p>Fertilizer companies</p>
Improve the management of agro-chemical waste in the rice paddies.	<p>Improved management of the Stoung- Chi Kreng wetlands through the reduction of agro-chemical inflow into the wetlands and agro-chemical waste management system.</p> <p>Increase in biodiversity in rice fields against baseline metrics.</p>	<p>Agro-chemical management and disposal protocols established and strengthened for all relevant villages.</p> <p>Number of waste management storage facilities constructed.</p> <p>Metrics for agro-chemical inflow established and monitored.</p> <p>Reduced inflow of agro-chemicals into BPL wetlands against baselines and based on set metrics.</p> <p>Number of biodiversity monitoring activities</p> <p>Number of people involved in monitoring the</p>	500,000	3 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		agro-chemical inflow and biodiversity survey			
Total investment for 5-10 years			13,700,000 USD		

7.2. Potential Financing

The estimated project cost is USD 13,700,000 over 5-10 years. This budget supports the development of a site management plan that addresses zonation, fire risk during the dry season, and invasive species, implementation of enforcement and patrolling activities, biodiversity monitoring, establishment of a microfinancing mechanism, improvement of nature-based tourism infrastructure, capacity-building activities on sustainable agriculture, and piloting the transition to sustainable rice farms. Table 6 summarizes the projected budget distribution across the proposed project components.

7.3. Proposed Institutional Arrangements

The proposed project is expected to be implemented over a period of up to 10 years, with main project components focusing on improved site management of the Stoung and Chi Kreng Bengal Florican Conservation Areas, and scaling-up biodiversity-friendly rice agriculture for villages in the landscapes around the BFCAs (led by the Ministry of Environment, and Provincial Department of Environment for Kampong Thom and Siem Reap). Conservation organisations such as the Wildlife Conservation Society, which is active in this landscape, and rural development NGOs are expected to play a major supporting and technical role in the project by supporting project activities focused on biodiversity monitoring, driving community engagement, and capacity building for alternative livelihoods.

7.4. Project Beneficiaries

According to the 2019 census by the National Institute of Statistics of Cambodia, Chi Kraeng District has 128,931 people (29,698 households) distributed across 12 communes, while Stoung District has 108,372 people (26,547 households) distributed across 13 communes.

This proposed project is expected to undertake activities to promote gender inclusion and participation in livelihood activities, through capacity-building activities for alternative livelihoods focused on rice farming. There are no indigenous communities in the project landscape.

7.5. Anticipated Implementation Risks

Stakeholder engagement: Proposed interventions rely on support from local communities, particularly in adopting biodiversity-friendly and organic farming, patrolling, and co-management. Establishing strong stakeholder buy-in from local leaders and engagement from local communities 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 on the Stoung – Chi Kreng wetlands, 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 the expansion of rice cultivation and its impacts on wildlife.

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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 Chi Kreng and Stoung 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/km ²)	206 – 229
Average population uniquely benefitting from influential green storage upstream per sq. km of wetland (n/km ²)	40 – 50
Average built-up area uniquely benefitting from influential green storage upstream per sq. km of wetland (ha/km ²)	2.52 – 3.15

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 Chi Kreng and Stoung 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	3770.9	50.6	2732.2	36.7
Planted/Cultivated (non-woody crops)/Others	2949.9	39.6	3988.5	53.6
Shrub-dominated wetlands	492.2	6.6	537.4	7.2
Permanent freshwater lakes	233.9	3.1	188.8	2.5
Total	7446.9	100.0	7446.9	100.0