CEPF Final Completion and Impact Report

Organization's Legal Name:	Wildlife Conservation Society - HQ
Project Title:	Pragmatic protocols for restoration of ecosystem processes in Cambodia's wild.
Grant Number:	CEPF-110356
Hotspot:	Indo-Burma III
Strategic Direction:	6 Demonstrate scalable approaches for integrating biodiversity and ecosystem services into development planning in the priority corridors
Grant Amount:	$179,949.64
Project Dates:	July 01, 2020 - December 31, 2022
Date of Report:	June 13, 2023

IMPLEMENTATION PARTNERS

General Directorate of National Protected Areas (GDNPA – formerly the General Directorate of Administration for Nature Conservation (GDANCP)). As the General Directorate is responsible for the management of protected areas and natural resources, the Department of Freshwater Wetlands Conservation were instrumental in the setting up of the Technical Working Group (Advisory Committee) on the project. Although meetings were not as frequent as planned (due to Covid-19 restrictions in place locally), constant communication was possible using online resources. Field trips were conducted to project sites on a number of occasions and feedback provided on project activities. Provincial Departments of Environment (PDOE) (Kompong Thom and Preah Vihear). Through participation with membership of the TWG and with collaboration on the activities in the field, PDOE were actively involved in the design, and the implementation of the project. PDOE were the main partner for work at the provincial level and in particular with permissions and support for surveys – especially aerial photography using drones. Community Protected Area (CPA) Committees. CPA members were the key partner in the project. The majority of the project work was carried out with the collaboration and support of the CPA committees and the CPA members. CPA members were actively involved in buffalo husbandry, and restoration activities at forest ponds. In addition, CPA members were the recipients of training on husbandry and veterinary care, assisted with vaccination schemes and conducted surveys using techniques taught by WCS Biodiversity Team.

CONSERVATION IMPACTS

Planned Long-Term Impacts: 3+ years (as stated in the approved proposal)

Impact Description	Impact Summary
By 2025, populations of at least five globally threatened species (e.g. Giant Ibis, White-shouldered Ibis, Bengal Florican, Sarus Crane, Eld's Deer), are stable or increasing within the target protected areas (KPWS, CWS, ATT and NTSPL), through restoration and enhancement of ecosystem function by means of restoring populations of keystone species, or suitable proxies, by community action.	From results of censuses for White-shouldered Ibis, and Sarus Cranes, it can be seen that populations are stable. From nest protection efforts of Giant Ibis, numbers are also stable.

Planned Short-Term Impacts: 1 to 3 years (as stated in the approved proposal)

Impact Description	Impact Summary
By the end of the project, the wetland restoration pilots using free-ranging domestic and feral animals managed by local communities have improved habitat quality at least 15 trapeangs within KPWS, CWS, and ATT, plus 100 hectares of grassland habitat at the NTSLPL.	In addition to the 3 experiment ponds in KPWS and the 4 experiment ponds in CWS, domestic and feral buffalo have been actively visiting and restoring 20 ponds in KPWS and 11 ponds in CWS. In total, 38 ponds have benefited from buffalo restoration. The overall estimation for the Northern Tonle Sap Protected Landscape is approximately 500 hectares of natural grassland were grazed by the project buffalo and around 1,500 hectares were used by community buffalos/livestock. There are 10 trapeangs used for wallowing and restoring by buffalos in Stoung and Chikreng Bengal Florican Conservation Area.
By the end of the project, pragmatic protocols for wetland ecosystem restoration, based on demonstration projects, are accepted and supported by government (through ministerial decision (prakas)) and local community (through integration into CPA management plans).	Whilst much of the groundwork has been set for pragmatic protocols to be produced, this was not possible during the project timeframe. In part there remains work to be done on defining what a restored pond is. There are many factors to take into account, and whilst this project focused on substrate type, that too depended on starting conditions. Covid-19 prevented the Technical Working Group from regular meetings during much of the project and so ministerial prakas was not possible. Local communities are using buffalos, and will continue to do so into the next project where we plan to drill down more into what a restored pond is and how to achieve that.

Unexpected impacts (positive or negative)?

Establishing a feral herd of buffalo proved to be more complicated than expected. Shortly after fitting the feral herd with GPS tags, it became clear that the GSM network was not as extensive as cell companies had claimed. This part of the project had been experimental, however we worked with a company that was designing these tags for cattle. Despite this, tracking the buffalo was unsuccessful, given the lack of service coverage and the tendency for the buffalo to remove the tags during their natural behaviour. Without tags, the feral population were difficult to manage, and on two occasions were found to be crop-raiding. Whilst their behaviour did indicate that they were becoming wilder, this only made their actions more uncontrollable. In addition, as these were previously domestic buffalo, they

tended to prefer ponds that were closer to villages. It is highly likely that over a longer period of time the buffalo could be persuaded to use more remote ponds. During the project period, an outbreak of lumpy skin disease (LSD) occurred in the domestic cattle population. While disease outbreaks were expected, it was interesting to note that buffalo appeared to be more resistant to LSD. When LSD was prevalent in village cattle, the majority of project buffalo showed no clinical signs. In fact, only one female buffalo was suspected of having contracted LSD (note that she had not been vaccinated against LSD as she was heavily pregnant at the time). Clinical signs only indicated that it might have been LSD, the animal showed no signs of weakness and improved rapidly without treatment. There were observations made by community members directly involved at site level. There appeared to be an increase in the leech population within experiment ponds, an increase that the community believed can be attributed to the presence of buffalo attracting leeches, and perhaps also transferring them from pond to pond. The communities do use leeches in traditional medicine and so the increase was seen as positive, and it may also have further positive implications for biodiversity if they are found to be prey items for species such as Ibis who frequent the ponds. Additionally, community members noted an increase in wildlife seen at ponds used by buffalo, anecdotal changes that perhaps would be more difficult to ascertain with project indicators over such a short project. Community members noticed that birds in particular were more often seen when buffalo were in the ponds. Lastly, the communities involved in buffalo herding are keen to expand restoration efforts and expand activities beyond those beneficial for biodiversity. WCS and the communities are interested in expanding buffalo projects to include a community livelihood initiative in the form of community buffalo dairies. Buffalos will be owned by CPAs with financial gains to be made from sales of buffalo meat and sale of buffalo milk. The project has successfully received funding from the Darwin Initiative to investigate ways of reducing poverty and tackling malnutrition through this innovative project.

PROJECT RESULTS/DELIVERABLES

Overall results of the project:

Following the kick-off of the project, a Technical Working Group was established consisting of members from Ministry of Environment and relevant Provincial Department of Environments, WCS and also other NGOs known to be working on wetland projects. The project purchased a total of 78 buffalo across 3 different locations (50 in Kompong Thom (KPT), 14 in Chhaeb Wildlife Sanctuary (CWS) and 14 in Kulen Promtep Wildlife Sanctuary (KPWS)). Due to improved husbandry and veterinary training and intervention, a total of 42 buffalo were born to these herds (24 in KPT, 8 in CWS and 10 in KPWS). Of these growing herds, mortality rate was very low with only 6 buffalo dying (1 in KPT, 3 in CWS and 2 in KPWS), in addition 1 buffalo in CWS is missing, presumed dead. Both domestic cows and buffalo were part of the vaccination scheme across the project sites. Vaccinations were administered for Foot and Mouth Disease, Haemorrhagic Septicaemia, Black Leg and Lumpy Skin Disease. Additionally, deworming treatments were administered across all sites. In NPL alone, 4,118 buffalo and cows received deworming and vaccines. Ad hoc trainings were conducted by project staff in addition to a more formal workshop with input from the General Department of Animal Health and Production on Veterinary and Husbandry considerations of keeping buffalo attended by 53 (4 female) community members. Seasonal ponds in the Northern Plains Landscape (NPL) were assessed for their suitability for restoration projects using buffalo. A total of 445 ponds were collated in a database and two areas (one in CWS and one in KPWS) were selected for the buffalo project following community consultations. In KPWS, 11 ponds were selected and in CWS, 10 ponds were selected. Following a workshop attended by the working group members, a monitoring protocol for seasonal ponds was produced as a working draft to be tried and tested during the course of the project. Communities and biodiversity researchers from WCS conducted

monitoring of both control and experiment ponds in order to gather as much data as possible to formulate criteria that could be used to gauge restoration activities. A total of 294 surveys were conducted across all 21 ponds, providing just over a year of data. It was not always possible to access every pond in succession and so data gaps were present – particularly in the wet season. During the wet season months of June and July, invariably every pond was inundated with water, meaning a comparison of substrate types was not relevant. The surveys consisted of general observations of human and wildlife activity, and pond descriptors (name, UTM etc). Soil penetrability was also assessed through use of a basic penetrability meter that could be fabricated locally. Substrate classification took place for each of the eight substrates (covering dry mud, wet mud, saturated mud and water – with a scale of low and high vegetation cover for each substrate) that were categorised by the working group and an attempt to identify the dominant vegetation type in each category. Depth of the deepest part of the pond was measured and finally an assessment of buffalo wallows was made. This survey technique was complemented by a sketch map; hand drawn to scale on graph paper using the techniques described in the Monitoring of Seasonal Forest Ponds – a Tool for Community Researchers (attached). The data was collated using KoboCollect, with the sketch maps being photographed allowing the GIS team to digitise them as they received them from the field. In addition to the surveys that were led by the community teams, the GIS team consisting of WCS and PDOE also used aerial (drone) photography to complement the hand drawn sketch maps with 280 drone images taken and georeferenced. Results were positive with a strong correlation between the photograph and the sketch map. The community could be relied upon for accurate sketching and monitoring of the ponds.

In addition to the surveys of ponds, camera traps were installed at a limited number of ponds in both sites to assess presence/absence of birds and mammals. Finally, herdsmen at both locations were required to complete a daily diary of buffalo attendance at project ponds.

Results from this extensive work are promising. There appears to be a clear pattern of change in ponds that are utilised by buffalos. Substrate change was most notable. In both control and experiment ponds, wet season was dominated by high coverage of water with control ponds showing high vegetation cover of the water. This is to be expected with the absence of browsing by buffalo - the vegetation dominated the water. With experiment ponds, water coverage was still high, but the vegetation cover was lower as the buffalo feeding kept this under control. A starker change occurred with the end of the wet season, as the rains subsided so too did the water cover, giving way to dry mud that was of varying vegetative cover. By January, control ponds were dominated by dry mud – in some cases it was the only substrate found. Conversely, in experiment ponds, coverage of pond area was a mix of wet mud and water at a ratio of 50:50. As the rains returned at the start of the wet season, experiment ponds had a water substrate much sooner than control ponds, some up to three months earlier.

As expected, the water depth increases gradually for all ponds during the wet season, and then decreases during the dry season. The first results during the project period suggest that the presence of buffalos have an effect on the water depth in experiment ponds. Indeed, the water depth increases faster during the wet season and then appears to decrease slower during the wet season. From January 2022, 9 months since the start of the restoration, the average water depth for experiment ponds is constantly higher than the one for control ponds. Therefore, the contrast between the wet and dry season appears less pronounced for experiment ponds, suggesting that the passage of buffalos regulate the high variation of the water depth between seasons. The higher water depth in experiment ponds may allow a reduction in water evaporation during the dry season, the ponds becoming dryer slower during the dry season.

While average soil penetrability follows the same trend for control and experiment ponds, in general, the average soil penetrability for experiment ponds is higher or equivalent to the

control ponds during the project period. It increases faster and higher than control ponds during the wet season and decreases slower during the dry season. Soil penetrability has a positive impact on the feeding habits of birds such as the Giant Ibis, which probe the mud for invertebrates and eels.
The passage of buffalos seems to have an effect on the physical characteristics of seasonal ponds. To better quantify this effect, this study should be continued, and the methodology standardized, to reduce to a minimum certain bias. For example, the same number of ponds should be selected in each category, experiment and control ponds. Furthermore, the size of each pond should be carefully monitored, and ponds of similar size should be selected in the two categories. The number of buffalo visiting experiment ponds should be strictly regulated and monitored, to be able to better understand the impact of different numbers of buffalos on the physical characteristics of seasonal ponds.

Results for each deliverable:

Component		Deliverable		
#	**Description**	**#**	**Description**	**Results for Deliverable**
1.0	Restore foraging habitat of waterbirds through increasing populations of free-ranging and feral domestic water buffalo	1.1	List of target villages and households	Five villages in the Northern Plains and the the Tonle Sap areas were engaged on the project activities, the village lists are attached under the Other information tab.
1.0	Restore foraging habitat of waterbirds through increasing populations of free-ranging and feral domestic water buffalo	1.2	Veterinary records showing reduction in mortality rate of free-ranging domestic buffalo	From the veterinary records of the Provincial Department of Agriculture, Forestry and Fisheries (PDAFF) for the years 2020 and 2022 showed a reduction in reported illness in domestic buffalo (from 208 animals in 2020 to only 10 in 2022). Similarly, treatments followed the same trend. In these two years, the number of deaths reported in buffalo was zero. Vaccinations of buffalo showed that there was a reduction in buffalo vaccination overall, perhaps due to reduced numbers of buffalo being raised in the province as a whole. See "Veterinary Records from Provincial Dept of Agriculture", "2022 Annual Report PDAFF" and "2020 Annual Report PDAFF".
1.0	Restore foraging habitat of waterbirds through increasing populations of free-ranging and feral domestic water buffalo	1.3	Database of free-ranging domestic and feral water buffalo, including, location, ownership, health status of all animals	Database of buffalos within the Kampong Thom Buffalo bank can be found in the attachment "Buffalo Bank Member". For Preah Vihear Province, the attachments "Buffalo Inventory Kham Keut" and "Buffalo Inventory Sambour" contain the database of buffalos in those locations.

Component		Deliverable		
#	Description	#	Description	Results for Deliverable
1.0	Restore foraging habitat of waterbirds through increasing populations of free-ranging and feral domestic water buffalo	1.4	Up-to-date database of trapeangs, including details of location and status	The attachment "2023-03_NPL_Trapeang_List" is the working database for trapeangs in the Northern Plains Landscape. Each time a patrol is completed, new trapeangs are added to the database.
2.0	Develop standardized protocols for ecosystem restoration based on demonstration projects	2.1	Terms of reference for expert advisory panel and minutes of meetings	Whilst the terms of reference and the establishment of the working group was completed, the capacity of the working group to meet was severely limited due to Covid-19. Communication often switched to Telegram for the group discussions.
2.0	Develop standardized protocols for ecosystem restoration based on demonstration projects	2.2	Minutes of panel meetings and field visits	Meetings and field visits were impacted by covid-19 restrictions. A report of a field visit can be found in the attachments.
2.0	Develop standardized protocols for ecosystem restoration based on demonstration projects	2.3	Pragmatic ecosystem restoration protocols in draft form	The protocols for using buffalo to restore ponds was not completed, however a comprehensive monitoring document was produced. The draft protocols are included as an attachment.
2.0	Develop standardized protocols for ecosystem restoration based on demonstration projects	2.4	Ministerial decree on protocols for ecosystem restoration	This deliverable was not completed during the grant period. The Department of Wetlands was engaged with the project, however the protocols themselves were not advanced enough to warrant presentation to the Ministry of Environment. As more data is collected, this will be possible in the near future.
2.0	Develop standardized protocols for ecosystem restoration based on demonstration projects	2.5	Compliance with CEPF Social and Environmental Safeguards monitored and reported to CEPF	CEPF Social and Environmental Safeguards were monitored and reported to CEPF biannually, see attachments.

Tools, products or methodologies that resulted from the project or contributed to the results:
The main tool that resulted from this project was to standardise the way that seasonal forest ponds are monitored, and by whom. Efforts were made to standardise a set of protocols that would allow community members (after receiving some basic classroom training and repeated field trainings) to conduct surveys of ponds and fully understand the effects that buffalo were having on them. During the course of the project, these protocols were refined, and improved with the end result being a tool for community-based researchers that is being translated to Khmer language and can be used to roll out monitoring (and therefore restoration) of ponds in other landscapes. The survey protocol is a step-by-step guide to restoration monitoring, including selection of ponds, data collection and guides on sketch mapping and conservation technology. Additionally, following the husbandry workshop, a list of husbandry guidelines (in Khmer language) were provided to farmers and community members involved in pond restoration.

PORTFOLIO INDICATORS

Portfolio Indicator Number	Portfolio Indicator Description	Expected Numerical Contribution	Expected Contribution Description	Actual Numerical Contribution	Actual Contribution Description
4.2	Number of priority corridors with biodiversity and ecosystem service values integrated into land-use and/or development plans.	1	Demonstration projects for ecological restoration developed in at least 1 priority corridor (Northern Plains Seasonally Inundated Forests).	1	Demonstration projects for ecological restoration were developed in 1 priority corridor (Northern Plains Seasonally Inundated Forests).
1	Number of civil society organizations, including domestic organizations, that actively participate in conservation actions guided by the ecosystem profile.	1	One civil society organization (WCS) actively participates in conservation actions guided by the ecosystem profile	1	One civil society organization (WCS) actively participated in conservation actions guided by the ecosystem profile
3	Number of key biodiversity areas	4	At least 4 KBAs targeted by the grant	3	3 KBAs targeted by the grant have new or

Portfolio Indicator Number	Portfolio Indicator Description	Expected Numerical Contribution	Expected Contribution Description	Actual Numerical Contribution	Actual Contribution Description
	targeted by CEPF grants that have new or strengthened protection and management.		have new or strengthened protection and management		strengthened protection and management (KMH37 Upper Stung Sen Catchment and KMH08 Chhep in the Northern Plains Dry Forest Priority Landscape, and KH16 Stung/Chi Kreng/Kampong Svay in the Tonle Sap Lake and Inundation Zone Prioritry Landscape).

GLOBAL INDICATORS

Protected Areas

Protected areas that have been created and/or expanded as a result of the project. Protected areas may include private or community reserves, municipal or provincial parks, or other designations where biodiversity conservation is an official management goal.

Name of Protected Area	WDPA ID*	Latitude	Longitude	Country	Original Total Size (Hectares) **	New Protected Hectares ***	Year of Legal Declaration or Expansion

*World Database of Protected Areas

**If this is a new protected area, 0 should appear in this column

*** This column excludes the original total size of the protected area.

Key Biodiversity Area Management

Key Biodiversity Areas (KBAs) under improved management—where tangible results have been achieved to support conservation—as a result of the project.

KBA Name	KBA Code	Size of KBA	Number of Hectares with Improved Management

Production Landscapes

Production landscapes with strengthened management of biodiversity as a result of the project.

A production landscape is defined as a site outside a protected area where commercial agriculture, forestry or natural product exploitation occurs.

Name of Production Landscape	Latitude	Longitude	Hectares Strengthened	Intervention

Benefits to Individuals

- **Structured Training:**

Number of Men Trained	Number of Women Trained	Topics of Training
63	5	Buffalo Husbandry and Basic Veterinary Procedures: Workshop with field visits and exercises on buffalo husbandry to cover general buffalo biology, habitat type, feed and supplement, abnormality examination, pregnancy observation, vaccination and deworming recommendation, animal house management and cleanliness. Community Monitoring of Restoration Ponds: Classroom training and field exercises on survey techniques for monitoring restoration activities.

- **Cash Benefits:**

Number of Men – Cash Benefits	Number of Women – Cash Benefits	Description of Benefits
3	2	Buffalo herdsmen were employed in KPWS and CWS to monitor the buffalo herds and maintain their schedules of visiting project

Number of Men – Cash Benefits	Number of Women – Cash Benefits	Description of Benefits
		ponds. For this they received a daily allowance for the life of the project.

Benefits to Communities

View the **characteristics** column below with the following corresponding codes:	View the **benefits** column below with the following corresponding codes:
1- Small Landowners	a. Increased Access to Clean Water
2- Subsistence Economy	b. Increased Food Security
3- Indigenous/ Ethnic Peoples	c. Increased Access to Energy
4- Pastoralists / Nomadic Peoples	d. Increased Access to Public Services
5- Recent Migrants	e. Increased Resilience to Climate Change
6- Urban Communities	f. Improved Land Tenure
7- Other	g. Improved Use of Traditional Knowledge
	h. Improved Decision-Making
	i. Improved Access to Ecosystem Services

Community Name	**Community Characteristics**							**Type of Benefit**								**Country**	**Number of Males Benefitting**	**Number of Females Benefitting**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**			

Characteristics of "Other" Communities:

Policies, Laws and Regulations

View the **topics** column below with the following corresponding codes:			
A- Agriculture	E- Energy	I- Planning/Zoning	M- Tourism
B- Climate	F- Fisheries	J- Pollution	N- Transportation
C- Ecosystem Management	G- Forestry	K- Protected Areas	O- Wildlife Trade
D- Education	H- Mining and Quarrying	L- Species Protection	P- Other

No.	**Name of Law**	**Scope**	**Topics**														
			A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**

"Other" Topics Addressed by the Policy, Law or Regulation:

No.	Country/ Countries	Date Enacted/ Amended	Expected impact	Action Performed to Achieve the Enactment/ Amendment

Companies Adopting Biodiversity-friendly Practices

A company is defined as a for-profit business entity. A biodiversity-friendly practice is one that conserves or uses natural resources in a sustainable manner.

Name of Company	Description of Biodiversity-Friendly Practice	Country/Countries where Practice was Adopted

Networks and Partnerships

Networks/partnerships should have some lasting benefit beyond immediate project implementation. Informal networks/partnerships are acceptable.

Name of Network/Partnership	Year Established	Country/ Countries	Established by Project?	Purpose

Sustainable Financing

Sustainable financing mechanisms generate funding for the long-term (generally five or more years). These include, but are not limited to, conservation trust funds, debt-for-nature swaps, payment for ecosystem services (PES) schemes, and other revenue, fee or tax schemes that generate long-term funding for conservation.

Name of Mechanism	Purpose	Date Established	Description	Country/ Countries	Project Intervention	Delivery of Funds?
Buffalo Bank	The Kompong Thom part of the project provided a traditional buffalo banking scheme to individuals who signed a contract to receive a buffalo which would visit wetland areas defined by the project team. The income that they received from the buffalo scheme was in part a payment for the	2021	Buffalo banking scheme	Cambodia	Supported an existing mechanism	No

Name of Mechanism	Purpose	Date Established	Description	Country/ Countries	Project Intervention	Delivery of Funds?
	ecosystem services they were providing. In the NPL, buffalos are part of CPA committees and sales of meat (and in the future, buffalo milk) will directly support patrolling and other CPA activities.					

Globally Threatened Species

Globally threatened species (CR, EN, VU) on the IUCN Red List of Threatened Species, benefitting from the project.

Genus	Species	Common Name (English)	Status	Intervention	Population Trend at Site
Thaumatibis	gigantea	Giant Ibis	CR	Restoration of ponds, improving feeding grounds, monitoring habitat and habitat protection all took place under this CEPF grant.	Stable
Pseudibis	davisoni	Black Ibis	CR	Restoration of ponds, improving feeding grounds, monitoring habitat and habitat	Stable

Genus	Species	Common Name (English)	Status	Intervention	Population Trend at Site
				protection all took place under this CEPF grant.	
Grus	antigone	Sarus Crane	VU	Restoration of ponds, improving feeding grounds, monitoring habitat and habitat protection all took place under this CEPF grant.	Stable
Houbaropsis	bengalensis	Bengal Bustard	CR	Species habitat protection though community agreements on wetland use by buffalo bank scheme beneficiaries.	Increasing
Rucervus	eldii	Brow-antlered Deer	EN	Restoration of ponds, improving feeding grounds, monitoring habitat and habitat protection all took place under this CEPF grant.	Unknown
Leptoptilos	dubius	Greater Adjutant	EN	Restoration of ponds, improving feeding grounds, monitoring habitat and habitat protection all took place under this CEPF grant.	Unknown
Leptoptilos	javanicus	Lesser Adjutant	VU	Restoration of ponds, improving feeding grounds, monitoring habitat and habitat protection all took place under this CEPF grant.	Increasing

LESSONS LEARNED

The project was ambitious, and may have created more questions than it could answer. One of the fundamental questions is "what is a restored tropeang". This project focused on some aspects of a seasonal pond; namely the substrate type, vegetation cover and water depth. It also touched on species biodiversity in terms of birds and mammals (or anything large enough to be captured on a camera trap). However, it was not possible to dig deeper into the ecosystem of a seasonal pond. While we drew a lot on previous studies, and literature available, the ponds themselves are not one standard pond. The characteristics of a pond vary incredibly, with respect to almost every feature. For instance a pond may be predominantly fed by seasonal streams, or it may be fed only by rainwater. It may also be fed by rising groundwater – it could also be fed by a combination of those three, or more. For every pond a new combination of factors is present so when looking at restoration activities and their success, it may serve better to compare ponds individually and for that a much longer study would be required. Since the ponds are so precariously affected by water, seasonal changes can be skewed instantly by unseasonable weather. In 2021 there was an unseasonable bout of rainfall in March which filled many ponds just as the buffalo were starting their activities in what should have been dry ponds. That being said, the pond surveys were able to build an excellent base for changes that did occur within the factors that we deemed important following meetings with the Technical Advisory Panel. This gave a solid understanding of what effect the buffalo could be having on ponds, and will also lead to further exploration on some of the factors that we did not assess. A key lesson learned on this part was that the sketch maps produced by the communities was incredibly useful for assessing substrates, yet could be improved with some species identification of vegetation. Restoration activities were scheduled by project staff, however working with animals is not an easy task – buffalo in particular can be stubborn, but this could also be built upon. The buffalo themselves were a key indicator of when 'restoration processes' were complete. If the conditions at the pond were not suitable, they would move on. For example, when vegetation in the form of grasses was exhausted, the buffalo would move on, the pond that they left behind improved by its ability to grow new grasses and avoid succession. A greater understanding of this would improve the study remarkably, unfortunately the component of the project that would have gone someway to tracking this (GPS/GSM) was not functioning in the landscape. We attempted to replicate this with observations in the form of diaries kept by herdsmen, and more work should be done on this to improve their data collection skills.

The project also aimed to release a population of domestic water buffalo to create a feral herd. Whilst this was completed to some degree (and partially successfully), in reality for a herd to become feral it may take at least a generation. Buffalo are habituated to return to villages, and are comfortable around humans as a result of many years of selective breeding for exactly this purpose. To expect to turn this breeding around in a short 2-year project is ambitious, however we did learn important things from this aspect of the project. With regard to the GPS/GSM component, the tracking of herds by GPS/GSM Trackers was not successful despite available information indicating that it should be. The GSM network required was 2G, and in the locations where we had herds we did indeed achieve this level of data transfer, yet the tags would not connect to the network. Repeated attempts to solve these issues with the supplier failed and so it was sadly abandoned as an option. In addition to this, the tags themselves were designed to attach to the ear of the buffalo, yet in all four cases the tags became detached from the buffalo in a very short time frame. Even regular ear tags used with domestic cattle did not remain in the buffalo ears for as long as expected and after discussing with cattle experts this is indeed the case in domestic cattle, with tags usually replaced annually. It is therefore unlikely that GPS/GSM tags could be used long term to locate feral herds. During the initial phase of the project, we communicated at length with a feral buffalo project in Australia that were considering use of very similar ear

tags. It may be worthwhile to reach out to this group again and see if there were similar observations from their trials – it may be that there are some solutions to the issues that we found. In the communities where we conducted this study, buffalo herding had faced a decline with preference being toward cows.
We did learn that the skills for buffalo management were to be found and largely communities were happy to work with buffalo over cows. One of the main reasons we learned as to the change in cattle preference was the level of risk involved in farming a more expensive species, with a value of a cow being less than half that of a buffalo the risk of loss was reduced and this type of farming made available to more people. The effect of cows on the natural environment needs to be examined for the Northern Plains, in particular to over-grazing and also on the use of ponds. Buffalo may have a much greater role to play in ecosystem management and if risks can be reduced through vaccination programmes and veterinary treatments, we could see a resurgence of farming of this cattle to the benefit of the local communities and also the habitats that they process. One of the greatest lessons learned was that this may just be the start of something much larger, with potential benefits in livelihood expansion that directly benefits protected area biodiversity.

SUSTAINABILITY/REPLICATION

Buffalo rearing has long been part of village life in the Northern Plains – indeed we discovered during this project that one remote village known as Sambour has another, older, name – Talat Kvay, or "Buffalo Market". Early on in the project, some community members stood out as key to the success of the project, with their knowledge and skills handling buffalo and their enthusiasm for the restoration process. This drove the project to investigate ways to expand to profit from the rearing of buffalo in ways that would then support the activities of the community in protection of their surrounding habitat. Consumption of buffalo milk is not known to occur in Cambodia, yet with its high fat content and excellent nutritional value, it would be very useful in combatting nutrition deficits in rural communities. The project has developed a proposal to continue this work with a focus on poverty reduction and habitat protection with the profit from sales of buffalo meat, and milk products being used to fund activities of the CPA committee. In this way the sustainability – and indeed upscaling - of this project is highly likely. Other programmes of WCS Cambodia have also expressed an interest in replicating this project in other landscapes – something that will require further investigation as to habitat type, but again something that is likely to occur in the near future.

ENVIRONMENTAL AND SOCIAL SAFEGUARDS/STANDARDS

Social/Environmental safeguards was listed as a deliverable under 2.5, the reports have been attached to the Other information tab.

ADDITIONAL COMMENTS/RECOMMENDATIONS

Whilst protocols for restoring a seasonal pond did not reach the level expected of the grant agreement, a solid piece of groundwork has been laid to achieve this in the near future. A successful prakas requires a committed technical working group and solid evidence-based studies. The project was plagued with issues around Covid-19 restrictions that prevented in-person meetings for the majority of the project timeframe. This stifled any constructive

meetings where a prakas formulation could have been driven to conclusion. With the continuation of the project imminent, the production of pragmatic protocols will be possible, following publication of research conducted under this CEPF grant.

ADDITIONAL FUNDING

Total Amount of Additional Funding Actually Secured (USD)	$0.00
Breakdown of Additional Funding	None

INFORMATION SHARING AND CEPF POLICY

CEPF is committed to transparent operations and to helping civil society groups share experiences, lessons learned and results. For more information about this project, you may contact the organization and/or individual listed below.

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