

Darwin Initiative Innovation Annual Report

To be completed with reference to the "Project Reporting Information Note":
(<https://www.darwininitiative.org.uk/resources/information-notes/>)

It is expected that this report will be a maximum of 20 pages in length, excluding annexes)

Submission Deadline: 30th April 2024

Submit to: BCF-Reports@niras.com including your project ref in the subject line

Darwin Initiative Project Information

Project reference	DARNV015
Project title	Risk reduction of Highly Pathogenic Avian Influenza in Cambodia's wetlands
Country/ies	Cambodia
Lead Partner	Wildlife Conservation Society (WCS)
Project partner(s)	Ministry of Environment
Darwin Initiative grant value	200,000 GBP
Start/end dates of project	April 2023 – March 2025
Reporting period (e.g. Apr 2023 – Mar 2024) and number (e.g. Annual Report 1, 2, 3)	April 2023 – March 2024 (Annual report 1)
Project Leader name	Emily Denstedt
Project website/blog/social media	
Report author(s) and date	Emily Denstedt, Vor Sina, Chea Sokha, Sours Sreyem April 30, 2024

1. Project summary

Cambodia supports populations of some of the most threatened species of waterbirds in the world, such as Giant Ibis, Sarus Crane, and Spot-billed Pelican. Just as many populations of these threatened species are beginning to recover, the expansion of agriculture and communities into waterbird habitat poses increased disease threats, particularly from Highly Pathogenic Avian Influenza (HPAI). Globally, HPAI is now impacting both domestic and wild birds on an unprecedented scale in terms of mortality, economic and livelihood losses, and geographic spread. Several wild bird species have been affected including wildfowl, waders, cranes, grebes, herons, pelicans, corvids, and raptors. Multiple mortality events have also been documented in several wild mammal species across the globe, highlighting the breadth of ecological impacts and the potential for complex cascading effects.

In 2021, conservation partners in Cambodia responded to outbreaks of HPAI in two key nesting sites which ultimately killed over 1,700 Asian Openbill Storks (*Anastomus oscitans*), as well as egrets, pond-herons, and cormorants primarily in Boeung Sne wetland, the main field site for this project (Figure 1).

Then, in 2022 and 2023, mass mortality events in wild birds recurred in these very same locations as well as additional sites, including in some of the most threatened waterbird colonies across the country.

Domestic duck farms and flocks are situated within or near where wild birds nest or feed in Boeung Sne wetland, creating an interface where HPAI and other diseases circulate. Small to medium scale duck farming is a major livelihood source to many communities around Cambodia's wetlands, and domestic birds at this project site have been succumbing to HPAI outbreaks. The loss of these birds due to HPAI and other infectious diseases has severe consequences, both in terms of economic hardship and food security. Additionally, over the last five years, multiple documented cases of avian influenza virus spillover from domestic birds into humans have occurred with some human mortality in communities across Cambodia, highlighting the real public health threat posed by this virus.

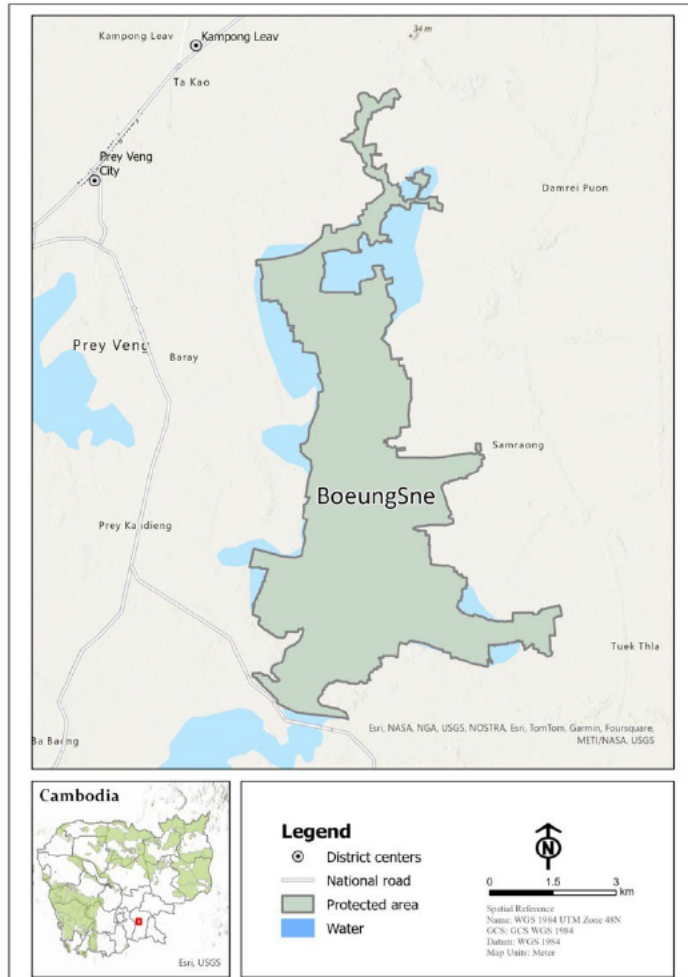


Figure 1: Boeung Sne wetland, Prey Veng province, Cambodia.

This Darwin Initiative Innovation project began in April 2023, on the heels of the most recent outbreaks among nesting waterbirds. Through partnerships between the Wildlife Conservation Society (WCS) and the Royal Government of Cambodia's Ministry of Environment, this project will improve our understanding of how HPAI circulates in one high-risk pilot wetland (Boeung Sne wetland) and implement spillover risk reduction measures to safeguard waterbird colonies, smallholder farmers, and their domestic poultry. The project team is gathering important ecological data using innovative technology while collaborating with a network of duck farmers who operate in and around the target area. Wildlife health surveillance will be operationalised across multiple vulnerable field sites (including Boeung Sne wetland), leveraging the progress and capacity developed through previous efforts. By adopting a One Health approach, this project will also equip and empower communities living next to these wetlands to protect their own health, the health of their domestic poultry, and the wetland ecosystem from the impacts of HPAI. Practical, low-cost, and culturally acceptable measures for improving farm biosecurity, poultry husbandry, and livelihood security will be co-designed with communities, strengthening the physical and natural barriers to pathogen sharing between wild waterbirds and poultry coexisting in these sites.

Disease transmission between and among domestic animals, wild animals, and humans is most likely to occur at the interface between areas of natural habitat and human or farming landscapes. Despite great efforts around the world, knowledge of predictive factors for where and when the next HPAI outbreak is likely to occur remain scarce, hindering preparation measures. It is unknown to what degree improved animal management practices in smaller farms will prevent HPAI spillover/spillback specifically, however we can be confident that establishing a stronger barrier between livestock and wildlife while conserving biodiversity is necessary to prevent pathogen transmission between them broadly and to protect public health.

2. Project stakeholders/partners

This project leverages the strong, long-standing relationship between the Royal Government of Cambodia and WCS, building on nearly 20 years of support to communities and the Ministry of Environment (MoE). Since 2021, WCS has collaborated closely with MoE, the Ministry of Health (MoH), the General Directorate of Animal Health and Production (GDAHP), and the National Animal Health and Production Institute (NAHPRI) at the national level, the Provincial Department of Environment (PDoE) at the subnational level, and district veterinarians and community members on the ground in Boeung Sne wetland and other vulnerable wild bird nesting sites which have been impacted by HPAI (Annex A, zip folder). This project and its partnerships were based on Cambodia's identified need for continued support in mitigating ongoing and worsening HPAI threats in Boeung Sne and more widely across the country.

Partners on this project have supported and participated in the implementation of this project's activities and continue to do so. These partners include:

The Provincial Department of Environment under the MoE continues to conserve the Boeung Sne wetland and the waterbird colonies which inhabit this project site. PDoE is the primary force working at the frontlines during HPAI outbreaks, and leading the response efforts (including early reporting, data collection, site quarantine, and carcass removal) alongside other supporting One Health partners. PDoE also actively participates in all activities conducted to understand the project site (e.g. biodiversity monitoring with drone surveys) and is a key stakeholder in all surveys and interventions involving the duck farming community under this project.

Communities: Small-holder duck farmers and flock owners are active partners on this project. Eight key farms for action were selected and these farm/flock owners participate in the relevant surveys and workshops paving the way towards piloting interventions around Boeung Sne wetland. They are also key resources of historical knowledge around the wetland, making significant contributions towards understanding how HPAI circulates in this ecosystem. The

community has a close relationship with PDoE, and several of the farmers were sensitized to the work under this project long before it began given the historical presence of WCS and PDoE during outbreak events around their farms since 2021.

3. Project progress

3.1 Progress in carrying out project Activities

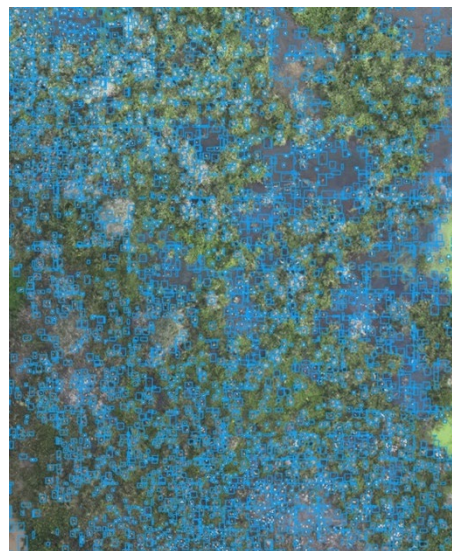
Output 1: At interfaces between poultry farming and waterbird habitat, longitudinal risk factors which may contribute to HPAI outbreaks and spillover are quantified and key sites for action are selected in and around one critical protected area.

Activity 1.1 Identification of key breeding and foraging areas for migratory and resident threatened waterbirds and their temporal use

In the first year, two key breeding and foraging areas for waterbirds were identified and assessed - Boeung Sne (BS) in Prey Veng province and Boeung Prek Lapouv (BPL) in Takeo province. Wild bird species present at these sites were documented. At the project outset, both sites were considered high-risk for viral spillover and disease outbreaks in both wild and domestic birds. The BPL site, however, has undergone changes to its landscape since this project commenced making some project activities no longer appropriate for this site. As such, a Change Request approval was made by the Darwin Committee to restrict most project activities to Boeung Sne only.



Historical wild bird count data collected at BS by MoE partners using traditional bird counting methods was assessed. It was determined traditional methods (i.e. manual counting) was extremely challenging due to the density of the nesting colonies, and accurate counts were nearly impossible to gather. To improve biodiversity monitoring in this key breeding area, and to better evaluate temporal fluctuations in population numbers, the project team began piloting innovative drone and Artificial Intelligence (AI) technology in November 2023. Images were also gathered in February and March 2024. The AI programming process is still being refined to ensure monthly counts can be done efficiently and accurately (Figures 2 & 3). Aerial footage will continue to be gathered throughout the year to trend waterbird population numbers, particularly in relation to HPAI mortality events.



Figures 2 & 3: An aerial image taken from a drone of the nesting colonies in Boeung Sne wetland (left) and snapshot of the current programming to determine wild bird numbers using AI (right).

Activity 1.2 *Gather and analyse existing and new ecological, temperature, weather, water parameter, and HPAI outbreak data around Boeung Sne*

To identify the potential role of climate/environmental factors in HPAI outbreaks in wild birds over the last 5 years at BS, the project team gathered both new and existing data. Historical data sets collected around BS by the MoE and the Department of Water Resource Management (DoWRM) from 2018 until present were evaluated. As these were not complete data sets, the project team explored other more robust sources of climate and environmental data including ERA5 daily raster data (the fifth-generation atmospheric reanalysis of the global climate produced by the Copernicus Climate Change Service, [REDACTED]) and the Mekong River Commission (MRC). Mean temperature, accumulated precipitation, mean lake depth, mean lake temperature, accumulated solar radiation, and open water evaporation from December 1st, 2018, up to April 30th, 2023, were obtained from the Copernicus Climate Change Service. A single daily tile was needed to cover the BS area (see Annex 4 below). Daily rainfall data was obtained from Neak Luong weather station (MRC). “HPAI outbreak seasons” from December 1st of the previous year until April 30th of the following year were created (five seasons in total; 2019 – 2023). At the same time, daily wild bird morbidity and mortality data from these “seasons” (collected by WCS and PDoE from BS in 2021-2023) were cleaned and collated. Epidemic curves were generated and were plotted together with each environmental variable. Data from 2019 and 2020 were included as “control” of the environmental variables as these years preceded the first recorded HPAI outbreaks at BS. See Figures 4 and 5 below, and Annex 4 for additional results. Ecological data and HPAI outbreak data was gathered and analysed in the time planned. Currently, there are no obvious differences in the environmental variables between pre- and post- outbreak years, or obvious observable trend differences in the variables pre- and post- outbreak beginning within and across seasons. However, the plots validate community knowledge which report that wild bird mortalities reduce and eventually cease once the rains arrive.

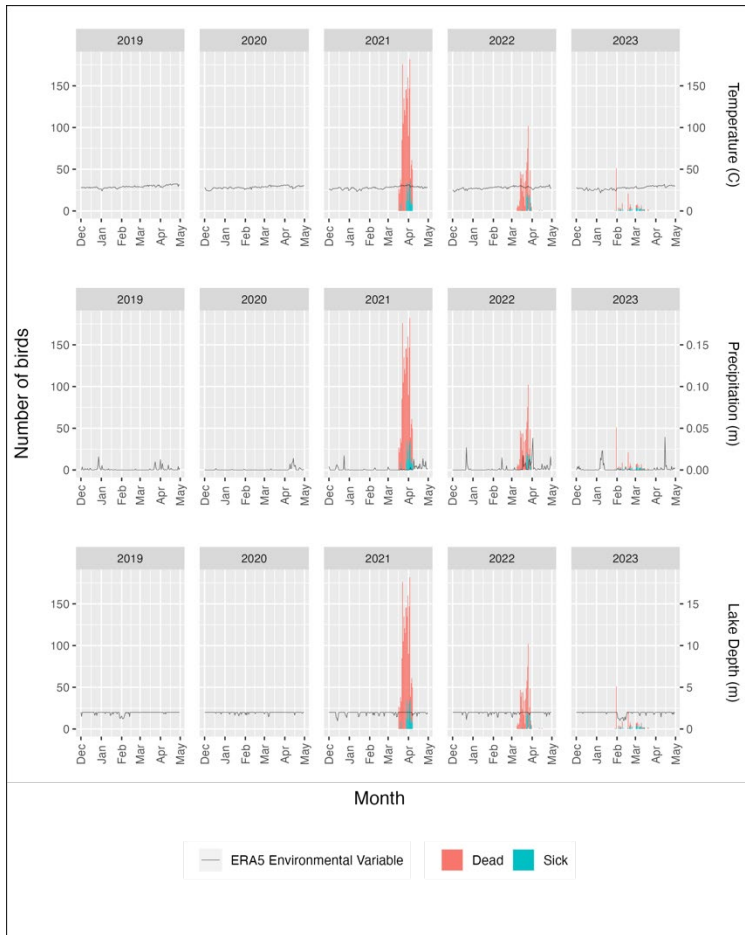


Figure 4: Epidemic curves showing the number of dead, sick and healthy birds found daily during the outbreak seasons of 2021 – 2023 and the daily values for mean temperature, precipitation, and mean lake depth according to ERA5 (<https://climate.copernicus.eu/>)

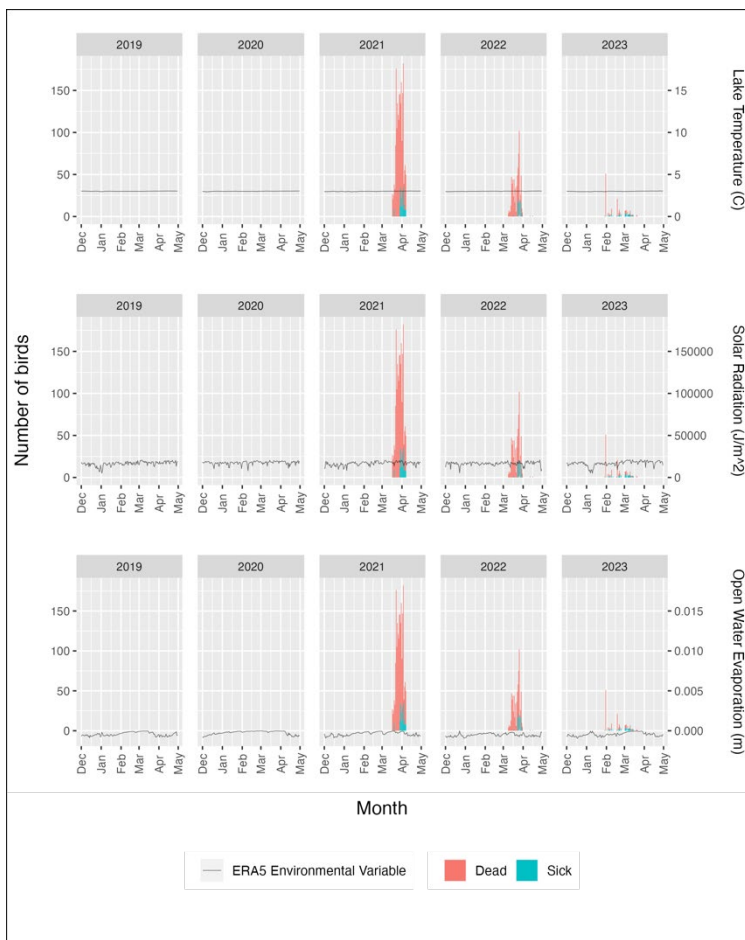


Figure 5: Epidemic curves showing the number of dead, sick and healthy birds found daily during the outbreak seasons of 2021 – 2023 and the daily values for lake temperature, solar radiation, and open water evaporation according to ERA5 (<https://climate.copernicus.eu/>)

The project team also began gathering water parameters such as pH, turbidity (PPM), temperature, and conductivity (mS/cm) around BS beginning in January. These data points will continue to be collected and analysed for temporal trends later in the project.

Activity 1.3 *Spatial and temporal mapping of poultry farming and methods through participatory consultation, particularly use of waterbodies by domestic ducks.*

Spatial and temporal mapping of poultry farming, farming methods, and use of the waterbody were completed as planned through participatory consultation. All poultry farm locations have been mapped across the waterbody (Annex B, zip folder provided), with data gathered on farming methods (Annex C & D, zip folder provided).

Activity 1.4 *Analysis of combined data from 1.1 – 1.3 above used to inform selection of key sites for action.*

Key sites (duck farms/flocks across one wetland) were identified as planned. Eight duck flocks/farms and one abattoir have been selected for activities under Outputs 2-4 based on the data and assessments described above (see Annex E, zip folder). These farms were selected based on multiple criteria such as location relative to the HPAI outbreak site, permanence of their farming operations, spillover risk behaviours, and previous mortalities noted in their domestic ducks.

Output 2: A profile of poultry farmers and economic comparison of farming practices is completed, coupled with an identification of entry points for awareness raising, dialogue, and management interventions.

Activity 2.1 *Assessment of ownership patterns (including gender roles), buyers/offtakes, buying terms and identification of where demand originates.*

Each of the eight duck farms/flocks were assessed and data has been successfully collected on ownership patterns, gender roles in duck farming and trading, and trade dynamics (Annex C, zip folder).

Activity 2.2 *Cost-benefit-loss assessment of status quo farming methods is conducted, with projections of financial losses due to disease outbreak events.*

Data was successfully collected from each farmer/flock owner (Annex C, zip folder). A formal analysis of this data has been delayed due to the need to re-hire a consultant, however we anticipate this to be completed within quarter 5 of the project.

Activity 2.3 - *Participatory assessment of current/future poultry-raising practices, including risk factors which may be associated with spillover/spillback, motivations behind these practices, and health issues in fowl to date.*

Progress is moving well ahead on assessing and understanding points of HPAI spillover risk in duck farming settings around BS wetland. Current/future poultry-raising practices have been documented for each participating farmer through formal interviews. Risk factors associated with HPAI spillover/spillback have been identified, including nodes of risk along poultry trade chains suggested and highlighted by communities. Health issues in domestic ducks to date have been recorded. See Annex D for a preliminary report and Annex C for data collected (in provided zip folder).

Output 3: Early detection, reporting, & response mechanisms to domestic and wild bird morbidity and mortality events due to HPAI are formalized and scalable so mitigation measures reducing risk of disease spillover and spread can be activated with haste and prompt coordination is ensured.

Activity 3.1 Provide training of trainers to animal health authorities on detecting and responding to morbidity/mortality events in domestic poultry and wild birds.

This activity is planned for the second year.

Activity 3.2 Train rangers to assist in detecting, reporting, and responding to wild bird morbidity/mortality events, and to collect data using SMART for Health tool.

In the first year, 153 community rangers and 61 rangers from the PDoE have been trained in *Wildlife Morbidity and Mortality Event Reporting and Response* across 6 protected areas and one additional wetland (not considered formally “Protected”). Three of these sites have experienced mass mortality events in wild waterbirds since the project began. See Annex 5 below for a training report as an example in Boeung Prek Lapouv.

SMART for Health training is planned for the second year. Currently, the project team is re-evaluating its proposed target user (community rangers) to determine if this technology is the most appropriate for gathering wildlife health data in the context of these outbreaks based on recent trials in other countries.

Activity 3.3 - Perform active surveillance for AIV in domestic and wild birds during select times of year.

BS began experiencing mass mortality events in wild waterbirds one month earlier (December 2023) than was recorded in past years. Most surveillance conducted thus far has been throughout the course of this outbreak, and all samples (223 swab samples and 24 carcasses from a total of 860 dead wild birds) gathered since December by the project team have been from wild birds. Wild bird mortalities continue to be detected by rangers into the month of April but in reduced numbers. Wild birds have been confirmed positive for HPAI H5N1 by the National Animal Health and Production Research Institute (NAHPRI).



Figure 6: PDoE, WCS, and other One Health partners respond to the first mass mortality event in wild birds nesting in Boeung Sne (2023).

Mortality events are being recorded in both duck and chicken farms around BS, but the sampling of these animals has been led by government partners due to the heightened sensitivity around the disease in the domestic animal sector.

Wildlife health surveillance continues at BPL as well, and multiple mortalities in wild birds (n=5) have been reported by conservation partners since the beginning of the project. The cause of death for these cases has yet to be determined.

Activity 3.4 - Finalize and implement Cambodia’s Wildlife Health Surveillance SOP at key sites to ensure outbreaks are investigated quickly by appropriate stakeholders and response measures are taken.

When the project began, the WHSN Working Group resumed its quarterly meetings for the first time in more than a year. Three meetings were held by the end of quarter 4 to finalize the *Standard Operating Procedure (SOP) for Wildlife Health Surveillance in Cambodia* (June, September, and December 2023; see Annex F in zip folder). In December 2023, the SOP was endorsed and signed by GDAHP, the Forestry Administration, and the General Directorate of Natural Protected Areas (Annex 6 below). The signed SOP was then officially introduced to relevant government and non-government One Health colleagues through the WHSN Working Group meetings, and informally at relevant multistakeholder One Health forums including national workshops dedicated to the development of specific African Swine Fever and Avian Influenza Virus SOPs, and at the annual Joint External Evaluation in Cambodia under the World

Health Organization's International Health Regulations and Global Health Security Agenda. The mechanisms for outbreak response following this SOP are now rolled out in multiple protected areas, including Boeung Sne, and stakeholders are actively reporting and investigating outbreak events. These activities have been carried out in the manner and time planned under the project.

Output 4: Practical, low-cost, and culturally acceptable measures that improve farm biosecurity, fowl husbandry, and livelihood security, are designed and implemented.

Activity 4.1 *Co-develop with communities simple, low-cost biosecurity measures and farming practices that reduce pathogen spillover/spillback risk (including HPAI) between domestic fowl and threatened waterbirds, ensuring equal gender contributions.*

The project team and the community surrounding BS wetland are currently working towards co-designing interventions on duck farms and around the protected wetland to improve biosecurity. Feedback was gathered through discussions with each farmer and the project team, and one workshop was held bringing farmers, PDoE rangers, and other stakeholders together to begin this process (Annex H, zip folder). A consultant was hired to provide expertise in terms of designing interventions, but the project team was required to recruit for this position again near the end of Year 1, resulting in a delay of activities under Output 4.

Activity 4.2 *Conduct training for poultry farmers on the measures designed above.*

We are planning to conduct these trainings beginning in quarter 5 but anticipate additional trainings will be required throughout Year 2.

Activity 4.3 *Establish a gender-balanced Committee who promotes the measures from 4.1 within their community encouraging broad adoption, and who monitor their uptake using a simple framework.*

Although duck farmers/flock owners have begun to co-design interventions (Activity 4.1), a formal Committee is not yet defined for monitoring and evaluation of these interventions. We plan for this to be formalized and an evaluation framework to be designed during quarter 5, which is slightly later than previously planned.

Activity 4.4 *Co-design livelihood safeguards (e.g. insurance funds) with priority communities to lessen economic impacts of domestic fowl disease events on farmers contingent on good farming practices.*

The co-design process under Activity 4.1 has begun with priority duck farmers/flock owners, however economic safeguard plans have not yet been designed and rolled out. We expect this to take place during quarters 5 and 6, which is later than previously planned.

3.2 Progress towards project Outputs

Output 1: At interfaces between poultry farming and waterbird habitat, longitudinal risk factors which may contribute to HPAI outbreaks and spillover are quantified and key sites for action are selected in and around one critical protected area.

There has been substantial progress in achieving this output. Data on key waterbird breeding and foraging areas have been gathered and evaluated, including wild bird species data and original counts collected pre-project. At the outset of this project, due to challenges in counting birds using traditional methods, it was unknown whether wild bird numbers were being negatively impacted over time due to repeated HPAI outbreak events. To improve accuracy of monitoring the large colonies of waterbirds, innovative biodiversity monitoring technology was introduced in November 2023 using drone surveys and deep learning algorithms (Artificial Intelligence). This will continue to be implemented throughout the project duration. This method of biodiversity monitoring is likely to be fully refined and ready for scaling up to other wild bird nesting colonies

in other locations by project end. We hope this monitoring method will provide insights into how disease outbreaks are impacting waterbird numbers over time, as this was difficult to estimate from traditional baseline counting methods.

Ecological/climate data were successfully gathered from nearby weather stations and geospatial modelling sources, and these data were analyzed for longitudinal risk factors associated with HPAI outbreak events (see Activity 1.2 above). We can conclude that there are no ecological/climate factors associated with outbreak events based on this available data. HPAI outbreaks in Boeung Sne wetland are most likely associated with the influx and movement of domestic ducks, with simultaneous nesting of waterbirds in dense colonies, during the December-April period.

Poultry farms and farming methods around the project wetland were gathered and mapped successfully. Eight target farms were selected for participatory co-design of farm interventions, a process which is now underway.

Output 2: A profile of poultry farmers and economic comparison of farming practices is completed, coupled with an identification of entry points for awareness raising, dialogue, and management interventions.

By the end of Year 1, a profile of each target farm has been produced with data gathered from each farmer through one-on-one surveys. Gender-sensitive entry points for awareness raising, dialogue, and management interventions to improve biosecurity around the farms and wetland have been identified. Risk factors for HPAI spillover/spillback, including live bird transportation methods, carcass disposal practices, and lack of quarantine, have been assessed. Health issues noted in domestic ducks to date have been documented on each farm. The next step in this process is to co-design and implement risk-reduction practices with the community, which has begun over the last two months. This process will likely require more consultations with the community and stakeholders than previously thought to reach a successful outcome.

Raw economic data has been gathered; however, the former analysis will extend into the next quarter due to the unexpected re-hiring of a new consultant to support the project team in this task.

Output 3: Early detection, reporting, & response mechanisms to domestic and wild bird morbidity and mortality events due to HPAI are formalized and scalable so mitigation measures reducing risk of disease spillover and spread can be activated with haste and prompt coordination is ensured.

Great progress has been made towards Output 3. The mechanisms and procedures for early detection, reporting, and investigating unusual wildlife morbidity and mortality events have been formalized through the approval of Cambodia's *Standard Operating Procedure (SOP) for Wildlife Health Surveillance* and introduced to five wetlands through training exercises. Provincial rangers under the MoE detected the first signs of an HPAI outbreak beginning in BS wetland in December 2023, and followed protocol to facilitate a fast response by One Health stakeholders including responders from the US CDC, Ministry of Health, Ministry of Agriculture, Forestry, and Fisheries. GDAHP, NAHPRI, the United States Defense Threat Reduction Agency, and others. Samples were collected from wild birds (Figure 7 below) and HPAI H5N1 was confirmed to be the cause of the outbreak. It was determined that multiple domestic poultry outbreaks were also occurring concurrently. Soon after, multiple cases of human infection were confirmed. All data on wild bird morbidity and mortality detected at the project site is recorded and managed in the Wildlife Health Intelligence Platform.

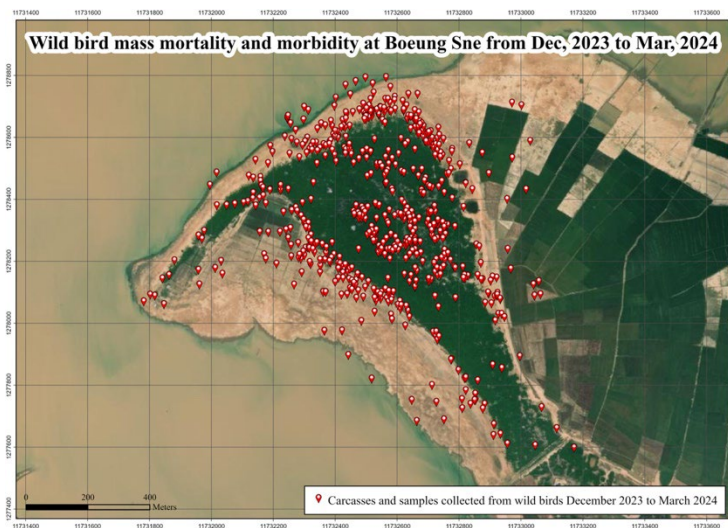


Figure 7: Cases of wild bird morbidity and mortality in 2024 are mapped across the nesting colony peninsula in Boeung Sne wetland

In Year 1 of the project, the situation of H5N1 outbreaks in wild birds and poultry worsened across the country, with suspected HPAI outbreaks detected in wild waterbird colonies across several other wetlands in Cambodia. Wildlife morbidity and mortality response trainings have now been scaled beyond the target project site to reach community and provincial ranger groups protecting these other at-risk wetlands. Matched-funding was mobilized to conduct these trainings, ensuring effective capacity building and safe outbreak response while operationalizing the SOP.

Additionally, through quarterly meetings held by the Wildlife Health Surveillance Network Working Group (WHSN WG), efforts have been made to improve communication and coordination plans for future outbreaks in response to lessons learned during these events in Year 1 (Annex F, zip folder). There are ongoing difficulties with transparency and data sharing among sectors and with effective coordination during events which involve wild and/or domestic animals and/or human cases. These challenges will continue to be addressed through these quarterly meetings.

Output 4: Practical, low-cost, and culturally acceptable measures that improve farm biosecurity, fowl husbandry, and livelihood security, are designed and implemented.

The project team began working closely with communities in Year 1 to understand the context and practices around duck farming (see Output 2) to co-design and pilot meaningful and impactful interventions under Output 4. Duck farmers are now engaged in a participatory process with support from WCS and MoE to agree on simple, low-cost biosecurity and animal management improvements in order to reduce risk of disease circulation around the project wetland (Annex G photo 5, zip folder). Interventions being considered by the community include strategic land use around the wetland during high-risk times of year, on-farm biosecurity improvements, quarantine procedures for newly-introduced and sick domestic birds, and a common trade location outside the wetland itself.

Trainings to implement the new interventions will take place in Year 2. Frameworks for evaluation of these interventions and livelihood safeguard plans are still in early discussions. We anticipate there may be a lower level of motivation for implementing safeguards around duck-farming livelihoods this year given other more pressing constraints and challenges in the area (e.g. drought).

3.3 Progress towards the project Outcome

Outcome: Threats to waterbird biodiversity from HPAI are reduced through increased understanding of risk factors, improved poultry management, wildlife health surveillance, and strengthened agriculture and livelihood resilience around critical protected areas

The project has made good progress towards achieving the project outcome in Year 1, particularly regarding understanding risk factors for HPAI in the project site and scaling up wildlife health surveillance. Baseline data for waterbird population numbers was previously sporadic and difficult to gather accurately. However, the implementation of innovative monitoring tools is improving data quality. Environmental factors associated with outbreaks had not been analysed previously but are now assessed in detail. All detected events involving ill or dead wild birds around the project site are now reported through the wildlife health surveillance network as early

as possible, and weak points in this coordination are identified for future improvement. Other critical wetlands are also reporting wild bird morbidity and mortality events as a direct result of training stakeholders to implement the SOP across several protected areas in the country.

Progress was made in Year 1 in understanding farming methods, gathering data to inform the design and implementation of improved farming practices, and identifying and introducing key farmers to the initiative. The co-design process has begun with local communities around BS wetland, albeit later than originally planned, and this process will continue into Year 2 along with subsequent implementation of these interventions and associated livelihood safeguards for the first time in this site.



Figure 8: A duck farmer gathers his flock from a rice paddy field in Boeung Sne wetland. *Photo credit – Eleanor Briggs*

The incidence of both wild and domestic bird illness and death have increased in BS wetland since the 2022-2023 nesting season, which may be in part due to increased successful event reporting during Year 1 of project implementation. However, increases in wild bird and poultry mortality are being reported more often this year across the country concurrently, and so it may be that there is worsening circulation of this virus in wild and domestic birds overall. Several documented cases of human infection with H5N1 occurred across Cambodia during the first year of the project, including near the project site. Globally, HPAI is decimating wildlife and domestic poultry. The project identified the very real risk at the outset of this

initiative that despite best efforts at mitigating disease transmission at the project site, this virus may continue to spill over and spread. By 2025, we may not observe a reduced incidence of bird illness or death, however prevention and risk reduction interventions are still imperative to preserve the overall health of the wetland, its biodiversity, and the communities surrounding it.

3.4 Monitoring of assumptions

Outcome Assumptions

1. *Stakeholders are willingly and consistently collecting data on bird morbidity/mortality* – This assumption remains true for MoE partners and small-holder duck farmers, however sensitivities around domestic bird sample testing and results sharing from laboratories have become increasingly challenging.
2. *Wild bird mortalities may go undetected within wetlands despite best efforts* – This assumption remains reasonable. This year, outbreaks of HPAI began earlier (December) than previously recorded (typically January or February) and began when water levels were still high. Bird mortalities were noted in the water itself, and we expect a certain number of wild bird carcasses went undetected simply due to being lost under the water.
3. *Communities are willing to implement new farming practices* – This assumption remains reasonable. Currently, communities remain motivated to work towards risk-reduction solutions with the project team and partners. We learned, however, that uptake of other farming-related interventions in communities in this area have not always been strong. So we may face some challenges in this regard.
4. *Outbreaks of HPAI may still occur despite project interventions, as it is realistic to assume only risk reduction can be achieved and not complete prevention* – This assumption remains reasonable.
5. *Wild birds continue to use Boeung Sne as a nesting site* – This assumption holds true.

Output 1 Assumptions

1. *Poultry will continue to be raised in these areas* – This assumption holds true.

Output 2 Assumptions

1. *Stakeholders are willing to participate in assessments* – This assumption holds true.
2. *Stakeholders provide accurate and true information* – This assumption remains reasonable, however as previously stated there is increasing sensitivity around sharing information particularly regarding HPAI in poultry.
3. *Results of assessments conclude that implementing interventions which may prevent HPAI spillover are more cost effective than maintaining status quo methods while facing mass mortality events* – This assumption remains reasonable, given the level of effort and funds which have been mobilized thus far responding to HPAI outbreaks in both wild and domestic birds across the country.

Output 3 Assumptions

1. *Government, rangers, and communities are willing to receive training* – This assumption holds true, and partners trained thus far have been willing to participate.
2. *Farmers are willing to have technical teams sample poultry* – This assumption remains reasonable, however there have been increasing levels of sensitivity around surveillance in domestic poultry. As such, government partners have led the sampling efforts in domestic poultry flocks and this has not been conducted by the project team.
3. *Cambodia's government approves the final Wildlife Health Surveillance SOP into national policy* – This assumption holds true, and the SOP has now been approved.

Output 4 Assumptions

1. *Communities willingly design, adopt, and implement the measures* – This assumption holds true thus far, as communities have willingly participated in all engagements.
2. *Communities willingly and consistently implement safeguards* – This assumption remains reasonable, although we may observe challenges in the sustainability of these safeguards. Domestic bird loss is not the most severe constraint this year for small-holder farmers, and they may not want to prioritize safeguarding measures specific to duck farming due to other more severe pressures (e.g. drought).
3. *Implemented measures follow the “precautionary principle”, mitigating pathogen spillover risk even in the absence of any documented outbreaks in these locations during the life of the project* – This assumption remains reasonable.
4. *Domestic poultry farming will continue in Boeung Sne* – This assumption holds true to date.
5. *If no additional HPAI occurs during the life of the project, protection for waterbirds and agricultural livelihoods will be achieved against other infectious disease threats beyond Avian Influenza Virus (AIV)* – This assumption remains reasonable, however the project site has continued to be faced with repeated outbreaks in wild and domestic birds.

3.5 Impact: achievement of positive impact on biodiversity and poverty reduction

Project Impact: “To pilot new, scalable approaches to reduce risk of highly pathogenic avian influenza (HPAI) spillover negatively impacting globally threatened waterbird species, agricultural resilience, and local livelihoods in Key Biodiversity Areas (KBAs) in Cambodia”.

This project is contributing to a higher-level impact on **biodiversity conservation** through:

- its analysis and improved understanding of ecological/environmental variables which may influence risk of HPAI outbreaks;

- piloting innovative methods (using drone surveys and artificial intelligence bird counts) as a means of monitoring waterbird population numbers in the face of repeated mass mortality events, methods which can be scaled to other wetlands in Cambodia and further afield where dense nesting colonies of waterbirds are threatened by HPAI;
- developing and implementing effective wildlife health surveillance policy instruments across Cambodia's protected areas, which can serve as a model for other groups or countries looking to do the same;
- designing and piloting practical disease risk-reduction interventions at the interface between domestic and wild birds, using one high-risk field location to test effectiveness and uptake prior to further scaling.

This project is contributing to a higher-level impact on **human development and wellbeing (poverty reduction)** through:

- striving for improved public health by way of piloting zoonotic spillover prevention measures for small-scale duck farmers and;
- improving domestic duck farming practices to reduce disease risks, simultaneously protecting domestic animal health and community livelihoods as co-benefits to conserving waterbirds in the area.

4. Project support to the Conventions, Treaties or Agreements

In the first year of the project, through direct consultation with One Health partners and the project team, Cambodia's first *Standard Operating Procedure for Wildlife Health Surveillance* was approved and introduced into national policy. This contributes to international biodiversity and development conventions and agreements to which Cambodia is a member state including:

- Ramsar Convention on Wetlands which has published Handbooks and technical guidance specifically for wetland health and avian influenza and developed directly in line with Strategic Plan targets.
- Global Goals for Sustainable Development (SDGs), particularly Goal 3 *Good Health and Wellbeing*, Target 3.d which is to "Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks" in line with the International Health Regulations (IHR), and Goal 15 (Life on Land) Target 15.5 to halt the loss of biodiversity.

While Cambodia is not a member state on the Convention on the Conservation of Migratory Species of Wild Animals (CMS), this project's work responds to calls to address agricultural drivers of HPAI spillover and spread under the *CMS FAO Co-convened Scientific Task Force on Avian Influenza and Wild Birds* and the 14th Meeting of the Conference of the Parties (Uzbekistan, February 2024) reporting on Migratory Species and Health. The CMS acknowledges "the rapid expansion of the poultry industry in the last few decades, often in the absence of adequate biosecurity and insufficient risk assessment with conservation authorities to inform land planning, has been associated with HPAI epidemics and without reform, it is likely that further viruses will emerge".

5. Project support for multidimensional poverty reduction

This project takes place in Cambodia, currently designated as a Least Developed Country (LDC) according to the United Nations. The majority of the project activities take place in rural areas in partnership with communities who are vulnerable to economic hardship and who rely on income generated from farming ducks, chickens, and commodities. These communities have been facing ongoing threats to their health and the health of their domestic duck flocks due to circulating HPAI in the area. Loss of domestic ducks also poses a food security issue. As the price of duck feed is high, several duck farmers rely on access to the land, often land they do not own, to free-graze their domestic ducks. However, it is this very practice which is likely contributing greatly to disease spread among duck farms and between domestic and wild birds. We aim to have direct

poverty impacts on duck farmer livelihoods through improved animal health and husbandry. Given the number of human cases of avian influenza this past year in Cambodia, we also hope interventions will positively impact public health in the project site. Additionally, the project aims to establish a community-led safeguarding system to reduce the financial burden farmers may experience if their ducks succumb to disease, however this will be piloted in Year 2.

We also expect non-monetary poverty reduction through empowering community and provincial ranger empowerment and strengthened community governance. By building capacity for wildlife health surveillance (e.g. PPE use and safe sampling), rangers working on the frontlines of high-risk interfaces can respond effectively and safely to ongoing HPAI outbreaks in wild birds.

Boeung Sne wetland, where these communities reside, provides ecosystem services and is, itself, under threat. The ecosystem is facing biodiversity loss as a result of disease. The project aims to protect the wetland as a whole, including the wild birds it hosts, so its ecosystem integrity and services can be maintained.

6. Gender Equality and Social Inclusion (GESI)

Please quantify the proportion of women on the Project Board ¹ .	60%
Please quantify the proportion of project partners that are led by women, or which have a senior leadership team consisting of at least 50% women ² .	75%

GESI Scale	Description	Put X where you think your project is on the scale
Not yet sensitive	The GESI context may have been considered but the project isn't quite meeting the requirements of a 'sensitive' approach	
Sensitive	The GESI context has been considered and project activities take this into account in their design and implementation. The project addresses basic needs and vulnerabilities of women and marginalised groups and the project will not contribute to or create further inequalities.	X
Empowering	The project has all the characteristics of a 'sensitive' approach whilst also increasing equal access to assets, resources and capabilities for women and marginalised groups	
Transformative	The project has all the characteristics of an 'empowering' approach whilst also addressing unequal power relationships and seeking institutional and societal change	

¹ A Project Board has overall authority for the project, is accountable for its success or failure, and supports the senior project manager to successfully deliver the project.

² Partners that have formal governance role in the project, and a formal relationship with the project that may involve staff costs and/or budget management responsibilities.

Gender equality is a core value of WCS and the project team. We offer equal opportunity to people of all genders while delivering project activities. As reflected in the table above, gender equality is integrated throughout the project.

In the first year of project implementation, the WCS team collected relevant gender-disaggregated data to inform gender-sensitive entry points for change particularly with respect to farming practices (Annex C). Recognizing that women and men may have different perspectives and responsibilities when it comes to animal management and farming economics, the team specifically asked questions regarding gender roles.

Since the project began, 75% of the participating partners in surveys, the first co-design workshop, and quarterly WHSN Working Group meetings are women. This high level of engagement from women suggests positive progress in gender equality and allows the project team and partners to identify gender-sensitive entry points for project interventions.

Additionally, an application was submitted for an IRB (Institutional Review Board) review which was subsequently approved. The purpose of the IRB review is to ensure that research and data collection carried out by the project team does not pose more than a minimum risk to humans. This review considers the involvement of vulnerable groups such as pregnant or nursing women and indigenous peoples.

7. Monitoring and evaluation

The project is managed and monitored by a core team of expert staff from WCS in the field of One Health, with regular engagement with partners under MoE. The project team works closely together each week through direct in-person engagement, communications with teams on the ground at field sites (e.g. Telegram updates), direct updates to the WHSN Working Group via Telegram on project activities including outbreak responses, and quarterly in-person meetings with MoE and the WHSN Working group.

In Year 1, the majority of M&E and indicator tracking was managed directly by the core project team using the project's logical framework, an annual workplan, and activity reports. Data is routinely cleaned, entered, and managed comprehensively using the Wildlife Health Intelligence Platform. In Year 2 we will work with WCS Cambodia's M&E National Manager and aim to utilize *Airtable* which is an online, collaborative relational database and shared platform for activity and indicator data management, assessment, and visualization.

8. Lessons learnt

Lesson 1: Outbreaks are difficult to accurately budget for in advance. As it is difficult to predict how severe a mass mortality event will be, or if one will occur at all, this can be a difficult activity to allocate the appropriate amount of funds to. Some guesswork is required, and we learned this year that despite the predictable nature of these HPAI outbreaks in Cambodia's wild bird colonies, they are becoming increasingly more expensive to manage. In Year 2 of the project, we will anticipate this and plan accordingly.

Lesson 2: Interviews, surveys, and community consultations should be planned with sufficient time to allow for rescheduling, as farmers and other community members are often busy tending to livestock and their other primary duties, and rightfully so. In the future, we will distribute the work-planning and timeline of these consultative processes over more weeks and months than we had originally. These activities cannot and should not be rushed. Should delays in these activities be expected due to investing more time in the consultative process, a Change Request will be submitted.

Lesson 3: Animal disease data remains highly sensitive, almost increasingly so. Although mechanisms for prompt dissemination of diagnostic results to relevant stakeholders following the testing of domestic and wild animal samples is considered policy in Cambodia, this may not be the situation in practice despite good intentions. Project indicators should be designed in anticipation of this, to not rely heavily on prompt receipt of these laboratory data.

9. Actions taken in response to previous reviews (if applicable)

Feedback was responded to specifically in an Annex attached to this project's Half Year Report.

10. Risk Management

Please refer to section "3.1 Progress in carrying out project Activities". Due to changes in the landscape, wild bird nesting behaviours, and reduced duck farming, certain project interventions were no longer as urgent or relevant in the Boeung Prek Lapouv wetland. This was not an anticipated or documented risk in our project's Risk Registrar; however a project design adaptation was made in response to reallocate certain resources and activities away from Boeung Prek Lapouv which was approved via a Change Request.

The risk of poor transparency and timely release of official diagnostic results when bird samples are tested holds true and was documented originally in the project's Risk Registrar. The project team has and continue to face this particular risk, perhaps more than expected at the project outset. Discussions with laboratories to ensure all results are officially reported and fed back to wildlife health surveillance network stakeholders are ongoing, and the project team will continue to encourage prompt publication of testing results particularly those which deemed bird samples to be positive for avian influenza virus.

11. Sustainability and legacy

Throughout Year 1, despite increasing political sensitivities in Cambodia around H5N1 detections particularly in domestic birds, there has been increasing interest among partners in the project activities and the long-term need of the work carried out by this project. Quarterly, the project team has facilitated a WHSN Working Group meeting where the activities, findings, and plans under this project are shared with direct (MoE, GDAHP, NAHPRI) and indirect or external partners (including the Forestry Administration, US CDC, Institut Pasteur du Cambodge, FAO, WHO, US Embassy) and other concerned One Health stakeholders. There is increasing interest in investing in this ongoing threat.

There is increasing capacity resulting from this project, beyond what was originally intended. Since the first report of wild birds dying in the project site in December of 2023, several other protected areas which host waterbird colonies (e.g. Prek Toal in the Tonle Sap Lake) have begun reporting similar events across the country. The project team expanded their capacity building trainings to reach other MoE rangers across more sites to ensure effective reporting and safe investigation of these events.

It is evident that there is a rapidly increasing demand for scaling out activities under this project, and an urgent country-wide situation regarding the circulation of H5N1 in both domestic and wild birds, and in communities. WCS intends to continue to build on the foundation this project has developed to other at-risk landscapes it supports in partnership with MoE, expanding and mainstreaming activities such as biodiversity monitoring using innovative AI should it prove effective during this Darwin Innovation project. The uptake of risk reduction measures on domestic duck farms will need to be evaluated over the coming year, but should these interventions be deployed successfully then the intended benefits are expected to be scaled to additional farms beyond the life of this project.

12. Darwin Initiative identity

- This project published in the **Darwin Initiative's January newsletter** (ed. "*Food for Thought: Paving the Way to Food Sustainability*").
- The Darwin Initiative logo and branding has been included in all community meeting presentations, workshops with partners, and related reports.
- WCS also released a **WildAudio podcast** episode in March 2024 which interviewed the project's Principal Investigator and other project contributors on the HPAI threat in Cambodia. Activities under this project were highlighted.

- Direct project partners and indirect project collaborators are all aware of this Darwin Initiative. Some components of this project are distinct, while others (e.g. SOP implementation, wildlife health surveillance training of rangers) are part of a larger national effort.

13. Safeguarding

Has your Safeguarding Policy been updated in the past 12 months?	Yes/No
Have any concerns been reported in the past 12 months	Yes/No
Does your project have a Safeguarding focal point?	Yes/No
Has the focal point attended any formal training in the last 12 months?	
What proportion (and number) of project staff have received formal training on Safeguarding?	100% [n = 4]
<p>Has there been any lessons learnt or challenges on Safeguarding in the past 12 months? Please ensure no sensitive data is included within responses.</p> <p>None to date.</p>	
<p>Does the project have any developments or activities planned around Safeguarding in the coming 12 months? If so please specify.</p>	
<p>Please describe any community sensitisation that has taken place over the past 12 months; include topics covered and number of participants.</p> <p>Community sensitisation was conducted early in the project with target farms (n = 8) and community members regarding project objectives, upcoming collaborative activities, and anticipated partnership. Informed consent was ensured and documented throughout Year 1.</p>	
<p>Have there been any concerns around Health, Safety and Security of your project over the past year? If yes, please outline how this was resolved.</p> <p>None. All anticipated Health and Safety concerns regarding infectious disease are mitigated as much as possible with trainings and refresher trainings, PPE use, and other biosafety practices.</p>	

14. Project expenditure

Table 1: Project expenditure during the reporting period (1 April 2023 – 31 March 2024)

Project spend (indicative) since last Annual Report	2023/24 Grant (£)	2023/24 Total Darwin Initiative Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)				
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				A project Workshop was booked in March 2024, however the expenses did not get successfully entered into WCS's global finance system until early April. As such, the cost of the workshop could not be included here. This has resulted in Operating Costs appearing underspent, although the money has indeed been spent.
Capital items (see below)				This purchase of one laptop was made in USD which was <10% variance, however when converted to GBP the variance exceeded 10% slightly. Due to inflation, we are experiencing higher costs of most types of equipment across the region and the laptop consequently was more expensive than budgeted for. Multiple quotes were obtained, and the least expensive option was selected.
Others (see below)				
TOTAL	82,451.91	82,451.90		

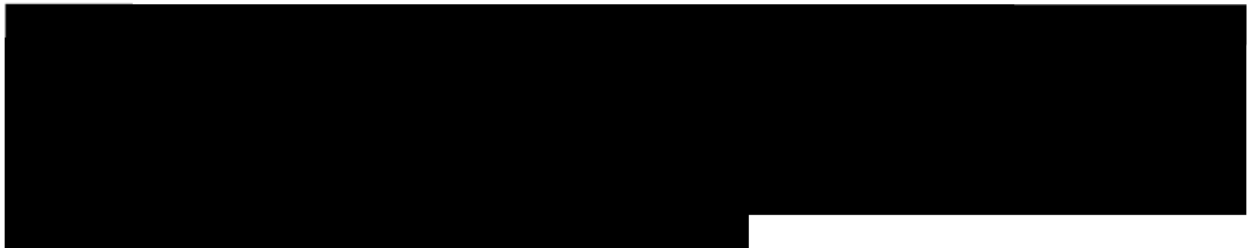
Table 2: Project mobilised or matched funding during the reporting period (1 April 2023 – 31 March 2024)

	Secured to date	Expected by end of project	Sources
Matched funding leveraged by the partners to deliver the project (£)			World Health Organisation (WHO)
Total additional finance mobilised for new activities occurring outside of the project, building on evidence, best practices and the project (£)			World Health Organisation (WHO)

15. Other comments on progress not covered elsewhere

Project design enhanced: Please see Activity 1.1 for use and leveraging of innovative technology to enhance biodiversity monitoring beyond what was proposed in the original project submission. AI-generated wild bird counts is novel to the country and with few examples globally of its use especially with respect to disease impacts on wildlife populations. We aim to utilize this innovative monitoring method to trend wild bird populations over time in the face of repeated mass mortality events and scale this technology to other protected wetlands experiencing similar outbreaks of disease on an annual basis.

Human and animal research ethics: The project team submitted its activities and methods to WCS's Institutional Animal Care & Use Committee (IACUC) to ensure that the highest animal welfare standards are maintained during the sampling of wild or domestic birds. The IACUC approved the proposed methods and will require periodic updates from the project team to ensure standards are maintained. Additionally, the project and data collection instruments (e.g. surveys) were reviewed and approved by the IRB to ensure protection of project participants welfare, rights, and privacy.



Annex 1: Report of progress and achievements against logframe for Financial Year 2023-2024

Project summary	Progress and Achievements April 2023 - March 2024	Actions required/planned for next period
<p>Impact</p> <p>“To pilot new, scalable approaches to reduce risk of highly pathogenic avian influenza (HPAI) spillover negatively impacting globally threatened waterbird species, agricultural resilience, and local livelihoods in Key Biodiversity Areas (KBAs) in Cambodia.”</p>	<ul style="list-style-type: none"> Improved understanding of ecological/environmental variables during HPAI outbreaks; Innovative, scalable methods piloted to monitor waterbird population numbers in the face of repeated mass mortality events; Developed and currently implementing effective wildlife health surveillance policy instruments across Cambodia’s protected areas; In early design and piloting phase of practical disease risk-reduction interventions at the interface between domestic and wild birds. 	
<p>Outcome: Threats to waterbird biodiversity from HPAI are reduced through increased understanding of risk factors, improved poultry management, wildlife health surveillance, and strengthened agriculture and livelihood resilience around critical protected areas.</p>		
<p>Outcome indicator 0.1 Incidence of both wild and domestic bird illness and death are reduced around one critical wetland (Boeung Sne) by 2025.</p>	<ul style="list-style-type: none"> Incidence has not been reduced thus far, but reporting of detected cases has become more effective. 	<ul style="list-style-type: none"> Incidence of wild bird illness and death will continue to be tracked until project end.
<p>Outcome indicator 0.2 All detected events involving ill or dead wild birds around one wetland are reported through the wildlife health surveillance network throughout project lifetime.</p>	<ul style="list-style-type: none"> All detected events involving ill or dead wild birds around the project site have been successfully reported through the wildlife health surveillance network (Section 3.2, Figure 7). 	<ul style="list-style-type: none"> Continue to scale up and reinforce effective wildlife health surveillance into Year 2.
<p>Outcome indicator 0.3 Improved farming practices are designed, implemented, and evaluated by local committees around one wetland by project end.</p>	<ul style="list-style-type: none"> Enhanced understanding of duck farming practices. Improved practices are in the design phase. 	<ul style="list-style-type: none"> See relevant output indicators below.
<p>Outcome indicator 0.4 Livelihood safeguards are designed and implemented around one wetland by project end.</p>	<ul style="list-style-type: none"> Expected in Year 2. 	<ul style="list-style-type: none"> See relevant output indicators below.
<p>Output 1. At interfaces between poultry farming and waterbird habitat, longitudinal risk factors which may contribute to HPAI outbreaks and spillover are quantified and key sites for action are selected in and around one critical protected area.</p>		
<p>Output indicator 1.1</p>	<ul style="list-style-type: none"> Historical data on bird counts were obtained and evaluated. Collection of new data began November 2023 using innovative tools for bird colony counting and 	<ul style="list-style-type: none"> Drone images will continue to be gathered over time and deep learning algorithms will

Data on key breeding and foraging areas for threatened waterbirds and their temporal use are gathered between the months of January to May.	monitoring (Evidence provided in Section 3.1, Figures 2 & 3; and eBird assessments in HYR).	continue to be refined to improve AI precision and trend bird numbers. If successful, this innovative biodiversity monitoring method is to be scaled to other sites in Cambodia facing disease outbreaks in wild birds.
Output indicator 1.2 Ecological and climate data is gathered and analysed for trends associated with HPAI outbreaks in Boeung Sne area, between the months of January to May.	<ul style="list-style-type: none"> Data on precipitation, lake depth, water and air temperature, and other variables have been gathered and analysed against HPAI outbreak data from 2019 to 2023 (Evidence provided in Section 3.1, Figures 4 & 5; Annex 4 & 5 below). No obvious trends between environmental/climate parameters and outbreak events were observed. 	<ul style="list-style-type: none"> Additional analyses will be completed with updated 2024 data and additional parameters will be evaluated (e.g. water pH).
Output indicator 1.3 By Q3, poultry farm locations and methods are mapped across the waterbody through participatory engagement with farmers.	<ul style="list-style-type: none"> Completed (Evidence provided in Section 3.1, Annex B-D). 	
Output indicator 1.4 Analysis of data collected from 1.1-1.3 above is conducted and at least 5 farms for action are selected based on this data by Q3.	<ul style="list-style-type: none"> Completed for 8 farms (Evidence provided in Section 3.1, Annex E). 	
Output 2. A profile of poultry farmers and economic comparison of farming practices is completed, coupled with an identification of entry points for awareness raising, dialogue, and management interventions.		
Output indicator 2.1. Economic assessments of buyers/offtakes/demand and ownership patterns (including gender roles) conducted at each selected farm by Q4 by a contracted economist.	<ul style="list-style-type: none"> Data has been successfully collected on ownership patterns, gender roles in duck farming and trading, and trade dynamics from 8 duck farms/flocks (Annex C, zip folder). Raw economic data has been gathered (Annex C), however the former analysis will extend into Year 2. 	<ul style="list-style-type: none"> A formal analysis of the economic data will be conducted following the hiring of a new consultant.
Output indicator 2.2. By Q4, a cost-benefit-loss assessment of status quo farming methods vs. projections of financial losses due to outbreak events (based on past losses) is completed for each selected farm by a contracted economist.	<ul style="list-style-type: none"> Raw economic data has been gathered (Annex C), however the former analysis will extend into Year 2. 	<ul style="list-style-type: none"> A formal analysis of the economic data will be conducted following the hiring of a new consultant.
Output indicator 2.3.	<ul style="list-style-type: none"> Completed (Evidence provided in Annexes C & D). 	

<p>By Q4, a participatory assessment on current and future poultry raising practices (including gender roles) and respective motivations, risk factors for spillover/spillback, and health issues noted in fowl to date is conducted with each selected farmer.</p>		
<p>Output 3. Early detection, reporting, & response mechanisms to domestic and wild bird morbidity and mortality events due to HPAI are formalized and scalable so mitigation measures reducing risk of disease spillover and spread can be activated with haste and prompt coordination is ensured.</p>		
<p>Output indicator 3.1. Training of trainers provided to at least 10 animal health authorities on domestic and wild bird morbidity and mortality reporting and response.</p>	<ul style="list-style-type: none"> • Training has not yet been conducted. 	<ul style="list-style-type: none"> • Training is planned for Year 2.
<p>Output indicator 3.2. Provide training to at least 20 rangers to assist in detecting, reporting, and responding to wild bird morbidity/mortality events in key protected areas, and at least 2 rangers to collect data using SMART for Health, by Q7.</p>	<ul style="list-style-type: none"> • Completed. 153 community rangers and 61 rangers from the Provincial Department of Environment have been trained in <i>Wildlife Morbidity and Mortality Reporting and Response</i> across 6 protected areas and one additional high-risk wetland (Evidence provided in Annex 5 below for example report). • SMART for Health training not yet conducted. 	<ul style="list-style-type: none"> • Refresher trainings will be provided to rangers in Year 2 for <i>Wildlife Morbidity and Mortality Reporting and Response</i>. • Novel data collection tool (SMART for Health) to be piloted in Year 2.
<p>Output indicator 3.3. Collect at least 50 samples per farm from domestic poultry and at least 50 from wild birds in Boeung Sne to test for AIV throughout each year.</p>	<ul style="list-style-type: none"> • Samples gathered since December 2023 by the project team have been from wild birds during outbreak response at Boeung Sne (223 swab samples and 24 carcasses from a total of 860 dead wild birds). HPAI H5N1 confirmed as the cause of the outbreak. • No samples from domestic poultry were collected by WCS. Sampling of domestic birds has been led by government partners due to the heightened sensitivity around the disease in the domestic animal sector. 	<ul style="list-style-type: none"> • Sampling will continue to be done in colonies during reported events of sick or dead wild birds. • Some surveillance during “non-outbreak” season will be conducted. • Limited to no sampling by WCS is anticipated in domestic birds, but government partners will be encouraged to continue doing so.
<p>Output indicator 3.4. Hold at least two final workshops by Q4 with One Health partners to finalize Cambodia’s Wildlife Health Surveillance SOP and introduce it formally to at least two wetlands by December 2023.</p>	<ul style="list-style-type: none"> • Completed. SOP is now finalized and approved (Annex 6 below). Mechanisms have been introduced to five wetlands through trainings. 	<ul style="list-style-type: none"> • Continue to refresh SOP protocols at the project site and others to scale up this policy instrument.
<p>Output 4.</p>		

<p>Output indicator 4.1.</p> <p>Work with priority communities to develop and promote simple low-cost biosecurity and animal management measures by end of Q4 that reduce the risk of spillover of HPAI from domestic fowl to threatened waterbirds. WCS will facilitate a process whereby communities design the activities themselves, ensuring equal contribution from women.</p>	<ul style="list-style-type: none"> • One co-design workshop with farmers/flock owners and community members completed (Evidence in Section 3.2, Annex H). • Individual interviews with each farmer completed • Co-design phase of improved biosecurity and animal management practices is ongoing. • Consultant successfully re-recruited to assist the project team with recommendations for interventions at the farm level and across the wetland broadly. Field visit and additional surveys with partner communities completed. 	<ul style="list-style-type: none"> • Tailored, farm-level recommendations will be discussed with community and agreed upon. • Wider-scale recommendations for the wetland and surrounding area to be discussed and agreed upon with MoE and community members.
<p>Output indicator 4.2.</p> <p>Conduct 2 trainings by Q5 for all selected poultry farms on the measures designed above.</p>	<ul style="list-style-type: none"> • Not yet conducted. 	<ul style="list-style-type: none"> • Trainings to be designed and implemented.
<p>Output indicator 4.3.</p> <p>One committee will be formed by Q4 and a simple framework for evaluation of interventions will be co-created.</p>	<ul style="list-style-type: none"> • Evaluation framework not started. 	<ul style="list-style-type: none"> • Evaluation framework to be co-designed with community with their consent and willingness.
<p>Output indicator 4.4.</p> <p>Work with the above priority community to design livelihood safeguards (e.g. community insurance funds contingent on good farming practice) and roll out in each village by Q5.</p>	<ul style="list-style-type: none"> • Not started. 	<ul style="list-style-type: none"> • To be co-designed with community with their consent and willingness.

Annex 2: Project's full current logframe as presented in the application form (unless changes have been agreed)

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Impact: To pilot new, scalable approaches to reduce risk of highly pathogenic avian influenza (HPAI) spillover negatively impacting globally threatened waterbird species, agricultural resilience, and local livelihoods in Key Biodiversity Areas (KBAs) in Cambodia.			
Outcome: Threats to waterbird biodiversity from HPAI are reduced through increased understanding of risk factors, improved poultry management, wildlife health surveillance, and strengthened agriculture and livelihood resilience around critical protected areas.	0.1 Incidence of both wild and domestic bird illness and death are reduced around one critical wetland (Boeung Sne) by 2025 0.2 All detected events involving ill or dead wild birds around one wetland are reported through the wildlife health surveillance network throughout project lifetime 0.3 Improved farming practices are designed, implemented, and evaluated by local committees around one wetland by project end 0.4 Livelihood safeguards are designed and implemented around one wetland by project end	0.1 Data shows a decreasing incidence of morbidity and mortality rates among domestic and wild birds 0.2 All events are entered into the Wildlife Health Intelligence Platform and cross-checking the numbers with farmers and rangers is performed monthly 0.3 Target farms demonstrate modified farming practices consistently following implementation 0.4 Communities agree on safeguard design and roll out implementation	<ul style="list-style-type: none"> • Stakeholders are willingly and consistently collecting data on bird morbidity/mortality • Wild bird mortalities may go undetected within wetlands despite best efforts • Communities are willing to implement new farming practices • Outbreaks of HPAI may still occur despite project interventions, as it is realistic to assume only risk reduction can be achieved and not complete prevention • Wild birds continue to use Boeung Sne as a nesting site
Output 1 At interfaces between poultry farming and waterbird habitat, longitudinal risk factors which may contribute to HPAI outbreaks and spillover are quantified and key sites for action are selected in and around one critical protected area.	1.1 Data on key breeding and foraging areas for threatened waterbirds and their temporal use are gathered between the months of January to May 1.2 Ecological and climate data is gathered and analysed for trends associated with HPAI outbreaks in Boeung Sne area, between the months of January to May 1.3 By Q3, poultry farm locations and methods are mapped across the waterbody through participatory engagement with farmers 1.4 Analysis of data collected from 1.1-1.3 above is conducted and at least 5 farms for action are selected based on this data by Q3	1.1 Data is collated into a data management platform (e.g. Excel) 1.2 Data is collated and analyzed to produce a report 1.3 A map is produced indicating locations of each farm, area of coverage, and farming methods 1.4 Target farms are listed for action	<ul style="list-style-type: none"> • Poultry will continue to be raised in these areas

<p>Output 2</p> <p>A profile of poultry farmers and economic comparison of farming practices is completed, coupled with an identification of entry points for awareness raising, dialogue, and management interventions.</p>	<p>2.1 Economic assessments of buyers/offtakes/demand and ownership patterns (including gender roles) conducted at each selected farm by Q4 by a contracted economist</p> <p>2.2 By Q4, a cost-benefit-loss assessment of status quo farming methods vs. projections of financial losses due to outbreak events (based on past losses) is completed for each selected farm by a contracted economist</p> <p>2.3 By Q4, a participatory assessment on current and future poultry raising practices (including gender roles) and respective motivations, risk factors for spillover/spillback, and health issues noted in fowl to date is conducted with each selected farmer</p>	<p>2.1 A profile of poultry farmers is produced in the form of a report, with entry points for interventions identified and gender data disaggregated</p> <p>2.2 A comparison between status quo farming methods and projections of losses due to HPAI outbreaks is produced in the form of a report</p> <p>2.3 A report is produced to inform gender-sensitive entry points for interventions/activities</p>	<ul style="list-style-type: none"> • Stakeholders are willing to participate in assessments • Stakeholders provide accurate and true information • Results of assessments conclude that implementing interventions which may prevent HPAI spillover are more cost effective than maintaining status quo methods while facing mass mortality events
<p>Output 3</p> <p>Early detection, reporting, & response mechanisms to domestic and wild bird morbidity and mortality events due to HPAI are formalized and scalable so mitigation measures reducing risk of disease spillover and spread can be activated with haste and prompt coordination is ensured.</p>	<p>3.1 Training of trainers provided to at least 10 animal health authorities on domestic and wild bird morbidity and mortality reporting and response</p> <p>3.2 Provide training to at least 20 rangers to assist in detecting, reporting, and responding to wild bird morbidity/mortality events in key protected areas, and at least 2 rangers to collect data using SMART for Health, by Q7</p> <p>3.3 Collect at least 50 samples per farm from domestic poultry and at least 50 from wild birds in Boeung Sne to test for AIV throughout each year</p> <p>3.4 Hold at least two final workshops by Q4 with One Health partners to finalize Cambodia's Wildlife Health</p>	<p>3.1 List of attendees by gender with signatures</p> <p>3.2 Written guidance is made available to stakeholders and records of reminders (emails, messages) are available</p> <p>3.3 Sample data and diagnostic results are available on Wildlife Health Intelligence Platform</p> <p>3.4 Ministry signature on SOP is obtained. Target farms/wetlands sign off on having received a copy with information disseminated</p>	<ul style="list-style-type: none"> • Government, rangers, and communities are willing to receive training • Farmers are willing to have technical teams sample poultry • Cambodia's government approves the final Wildlife Health Surveillance SOP into national policy

	Surveillance SOP and introduce it formally to at least two wetlands by December 2023		
<p>Output 4</p> <p>Practical, low-cost, and culturally acceptable measures that improve farm biosecurity, fowl husbandry, and livelihood security, are designed and implemented.</p>	<p>4.1 Work with priority communities to develop and promote simple low-cost biosecurity and animal management measures by end of Q4 that reduce the risk of spillover of HPAI from domestic fowl to threatened waterbirds. WCS will facilitate a process whereby communities design the activities themselves, ensuring equal contribution from women</p> <p>4.2 Conduct 2 trainings by Q5 for all selected poultry farms on the measures designed above</p> <p>4.3 One committee will be formed by Q4 and simple framework for evaluation of interventions will be co-created</p> <p>4.4 Work with the above priority community to design livelihood safeguards (e.g. community insurance funds contingent on good farming practice) and roll out in each village by Q5</p>	<p>4.1 Designs for interventions are created</p> <p>4.2 Training record complete with attendee signatures</p> <p>4.3 Committee lists are available disaggregated by gender; evaluation survey is designed and used to assess target farms</p> <p>4.4 Livelihood safeguard plan is produced and signed by all participating communities; record evidence of safeguards practice is available</p>	<ul style="list-style-type: none"> • Communities willingly design, adopt, and implement the measures • Communities willingly and consistently implement safeguards • Implemented measures follow the “precautionary principle”, mitigating pathogen spillover risk even in the absence of any documented outbreaks in these locations during the life of the project • Domestic poultry farming will continue in Boeung Sne • If no additional HPAI occurs during the life of the project, protection for waterbirds and agricultural livelihoods will be achieved against other infectious disease threats beyond Avian Influenza Virus (AIV)
<p>Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)</p> <p>Activities towards Output 1:</p> <p>1.1 Identification of key breeding and foraging areas for migratory and resident threatened waterbirds and their temporal use</p> <p>1.2 Gather and analyse existing and new ecological, temperature, weather, water parameter, and HPAI outbreak data around Boeung Sne</p> <p>1.3 Spatial and temporal mapping of poultry farming and methods through participatory consultation, particularly use of waterbodies by domestic ducks</p> <p>1.4 Analysis of combined data from 1.1 – 1.3 above used to inform selection of key sites for action.</p> <p>Activities towards Output 2:</p> <p>2.1 Assessment of ownership patterns (including gender roles), buyers/offtakes, buying terms and identification of where demand originates</p> <p>2.2 Cost-benefit-loss assessment of status quo farming methods is conducted, with projections of financial losses due to disease outbreak events</p>			

2.3 Participatory assessment of current/future poultry-raising practices, including risk factors which may be associated with spillover/spillback, motivations behind these practices, and health issues in fowl to date

Activities towards Output 3:

3.1 Provide training of trainers to animal health authorities on detecting and responding to morbidity/mortality events in domestic poultry and wild birds

3.2 Train rangers to assist in detecting, reporting, and responding to wild bird morbidity/mortality events, and to collect data using SMART for Health tool

3.3 Perform active surveillance for AIV in domestic and wild birds during select times of year

3.4 Finalize and implement Cambodia's Wildlife Health Surveillance SOP at key sites to ensure outbreaks are investigated quickly by appropriate stakeholders and response measures are taken.

Activities towards Output 4:

4.1 Co-develop with communities simple, low-cost biosecurity measures and farming practices that reduce pathogen spillover/spillback risk (including HPAI) between domestic fowl and threatened waterbirds, ensuring equal gender contributions

4.2 Conduct training for poultry farmers on the measures designed above

4.3 Establish a gender-balanced Committee who promotes the measures from 4.1 within their community encouraging broad adoption, and who monitor their uptake using a simple framework

4.4 Co-design livelihood safeguards (e.g. insurance funds) with priority communities to lessen economic impacts of domestic fowl disease events on farmers contingent on good farming practices

Annex 3: Standard Indicators

Table 1 Project Standard Indicators

DI Indicator number	Name of indicator	Units	Disaggregation	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned during the project
DI-A01	Number of people in eligible countries who have completed structured and relevant training	People	Men	208			208	No set number
DI-A01	Number of people in eligible countries who have completed structured and relevant training	People	Women	6			6	No set number
DI-C01	Number of best practice guides and knowledge products published and endorsed	Number	New	1			1	1
DI-B10	Number of individuals / households reporting an adoption of livelihood improvement practices as a result of the project activities	Number	Improved	0			0	8

Checklist for submission

	Check
Different reporting templates have different questions, and it is important you use the correct one. Have you checked you have used the correct template (checking fund, type of report (i.e. Annual or Final), and year) and deleted the blue guidance text before submission?	Y
Is the report less than 10MB? If so, please email to BCF-Reports@niras.com putting the project number in the Subject line.	N
Is your report more than 10MB? If so, please discuss with BCF-Reports@niras.com about the best way to deliver the report, putting the project number in the Subject line.	Y
Have you included means of verification? You should not submit every project document, but the main outputs and a selection of the others would strengthen the report.	Y
If you are submitting photos for publicity purposes, do these meet the outlined requirements (see section 16)?	n/a
Have you involved your partners in preparation of the report and named the main contributors	N
Have you completed the Project Expenditure table fully?	Y
Do not include claim forms or other communications with this report.	