

CAMBODIA PARTICIPATORY PLANNING USING OUTCOME MAPPING : Summary Report



Cambodia country team

December 2022

STOP Spillover

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STOP SPILLOVER

Strategies to Prevent (STOP) Spillover enhances global understanding of the complex causes of the spread of a selected group of zoonotic viruses from animals to humans. The project builds government and stakeholder capacity in priority Asian and African countries to identify, assess, and monitor risks associated with these viruses and develop and introduce proven and novel risk reduction measures.

Through Outcome Mapping (OM), a structured participatory tool that uses a bottom-up collaborative process, spillover ecosystem stakeholders (both traditional and non-traditional) will be empowered to identify and reduce zoonotic spillover risks at human-animal-environment interface and develop an outcome-oriented project action plan. This report outlines the details of the OM workshop activities in Cambodia.

Acronyms

CAMBOHUN	Cambodia One Health University Network
CCDC	Cambodia Communicable Disease Control
CTO	country technical officer
FA	Forestry Administration
FAO	Food and Agriculture Organization
FWA	Food, Water, Air, Climate, Livelihoods and Economics, and Policy and Security Resources
GDAH	General Directorate of Animal Health and Production
HC	health center
IPC	Institute Pasteur du Cambodge
JSI	JSI Research & Training Institute, Inc.
KNIA	Kampong Cham National Institute of Agriculture
MOE	Ministry of Environment
MOH	Ministry of Health
NaVRI	National Veterinary Research Institute
NIPH	National Institute of Public Health
OD	operational district
OM	Outcome Mapping
PDA	provincial department of agriculture
PDE	provincial department of environment
PHD	provincial health department
RAC	risk analysis and communication
SEAOHUN	Southeast Asia One Health University Network
SMM	surveillance, mapping, and modeling
STOP Spillover	Strategies to Prevent Spillover
USAID	United States Agency for International Development
WHO	World Health Organization
WLE	Wildlife, Livestock, Epidemiology, Behavior Change, and Gender
Z-TWG	Zoonosis technical working group

Key Terms

Critical (boundary)¹ partner: In OM, these are social actors with whom a project will work or whom the project will support or influence to achieve its vision. These may be individual organizations, groups, or institutions (e.g., local cultural or religious leaders, government agents, partner organizations, business entities). It is through them that the project expects to influence change in the wider society toward the OM vision.

High-risk interface: A socio-economic, environmental, and biological area in which the transmission of infectious agents across species (human, livestock, and/or wildlife) is known to occur. This may include bat guano collection sites, wet markets, wildlife farms and restaurants, and tourist areas. Human behaviors in these zones are driven by livelihood and economic needs, cultural traditions, and norms that cause contact and thus transmission risk. Each STOP Spillover intervention focuses on a specific high-risk interface relevant to a targeted zoonotic disease.

High-risk interface node: A particular interactive space in an interface where there is potential for transmission of infectious agents across species (human, livestock, and/or wildlife).

Intervention: Action taken by the project or other organizations to help critical partners achieve their outcome targets.

Outcome Mapping: A program design and implementation strategy that targets transformation in stakeholders to guide implementation, adaptive management, and evaluation. It is guided by how targeted ecosystem actors react to a project's interventions.

Outcome target (the challenge):¹ An outcome target is a statement of change that describes how the behaviors, relationships, activities, or actions of each critical partner will change if the project achieves its vision. Outcome targets capture partner behavior as anticipated in the vision.

Spillover: For the purposes of this project, spillover is defined as an event in which an emerging zoonotic virus is transferred from one animal host species (livestock or wildlife) to another, or to humans.

Vision: Conveys the large-scale development-related changes that a project hopes to encourage in a given context. It is one or several statements that describe the economic, political, social, environmental, and relevant broad behavioral changes in selected critical partners.

¹ For STOP Spillover, we are replacing the term 'boundary partner' with 'critical partner' and 'outcome challenge' with 'outcome target.' 'Boundary' and 'challenge' were the technical words for those concepts in the original OM manual.

Introduction

Cambodia has been confronted with both non-communicable and communicable diseases. USAID PREDICT undertook activities in Cambodia from 2009 to 2020 and focused on the live field rat market and fruit bat guano (urine and feces) beneath roosting sites. PREDICT found that 15 documented outbreaks of highly pathogenic avian influenza occurred in Cambodia between 2004 and 2020. Reynes *et al.* (2005) reported that Nipah virus was detected in a *Pteropus lylei* fruit bat in Western Cambodia.

On September 30, 2020, the United States Agency for International Development (USAID) awarded STOP Spillover to a Tufts University-led consortium. The five-year project supports Cambodia in strengthening its capacity to reduce the risk of viral spillover from animal hosts to humans. Specifically, STOP Spillover will collaboratively design, implement, and assess risk reduction interventions by empowering local stakeholders to understand better and act to reduce key risks. STOP Spillover’s scope is limited to the following priority viruses: Ebola; Marburg; Lassa, Nipah; animal-origin coronaviruses (including SARS-CoV, SARS-CoV-2, and MERS-CoV); and animal-origin zoonotic influenza viruses (such as highly pathogenic H5N1 avian influenza).

A core component of STOP Spillover is OM, a process that uses a collaborative, stakeholder-driven approach to engage a broad range of traditional and non-traditional stakeholders to identify and map desired outcomes. OM focuses on changes in targeted actors and in the spillover ecosystem as project outcomes to be influenced by a combination of interventions. Through participatory workshops, stakeholders identify and prioritize high-risk interfaces, describe current opportunities and knowledge gaps in zoonotic spillover risk pathways, and identify potential activities to reduce related risks.

Outcome Mapping Process

In Cambodia, one-on-one stakeholder engagements at the national level preceded the OM kick-off workshop. Fourteen national consultative meetings were conducted virtually and in person between March and April 2022 to introduce the project, discuss opportunities for geographical and high-risk interfaces (bat-human, rodent-human, livestock production), and prepare for the national kick-off and stakeholder engagement meetings (see Annex A1). The meetings also secured participants’ willingness to collaborate with STOP Spillover.

These were followed by a **project kick-off meeting** on June 1 in Phnom Penh. The primary objective was to introduce STOP Spillover to key stakeholders. The national-level stakeholder engagement determined the priority pathogen(s), interface(s), and stakeholders that will work with Cambodia’s STOP Spillover country team. The national kick-off meeting a combined “Kick-off” and one-day national stakeholder engagement meeting was organized on June 1, 2022 in Phnom Penh. The primary objective of the Kick-off meeting was to formally launch STOP Spillover in Cambodia, introducing STOP Spillover to key national stakeholders including line ministries, NGOs and academic institutions. The objective of the one-day national stakeholder engagement meeting was to determine the priority pathogen(s), interface and potential stakeholders to engage for STOP Spillover activities. The combined meeting was attended by 38 people (excluding STOP Spillover personnel), of whom five were female and 33 were male. Participants were drawn from the USAID Mission, Tufts University, government, non-governmental organizations (NGOs), and academic institutions that are members of Cambodia One Health University Network (CAMBOHUN), and Southeast Asia One Health University Network (SEAOHUN). See Annex B1 for the detailed participant list.

Figure 1. OM-Related Activities in Cambodia



1 Pham, T. T., Trần, Y. L., Nguyễn Thị, K. N., Tăng Thị, K. H., & Đặng, H. P. (2021, July). The economic value of the wildlife trade in Viet Nam. CIFOR infobriefs, 336, 1–6. https://www.cifor.org/publications/pdf_files/infobrief/8098-infobrief.pdf. Some sources estimate it closer to \$1 billion per year. Southerland, D. (2020, June 9). Can Viet Nam stop its trade in endangered wild animals? Radio Free Asia. <https://www.rfa.org/english/commentaries/Viet-Nam-wildlife-06092020160820.html>.



Bat guano farm, Kampong Cham Province

Photo: Cambodia country team

After the kick-off/one-day national stakeholder engagement meeting, the Cambodia country team organized one-on-one meetings with the Kampong Cham provincial department of agriculture (PDA) and provincial health department (PHD) on June 8 and with the district governor and director of operational district (OD) on June 9. The agenda included an introduction to STOP Spillover, a high-level assessment of the current knowledge of zoonotic disease risk related to bat guano production, and identification of key stakeholders. Through these meetings, the country team identified the location and number of bat guano productions and the benefits of bat guano for vegetable production and fertilizer for horticultural crops and family income. The foundation for future stakeholder collaboration was laid, and their participation in the interface OM workshop confirmed (see Annex A2).

The country team organized a community visit to understand local practices in guano harvesting and better prepare for the interface OM. The final step was the interface OM workshop in Kampong Cham July 4–8, attended by national, provincial, and district participants and community members engaged in bat guano harvesting. The purpose of this workshop was to identify the risks associated with direct bat-human

interactions, opportunities, gaps, barriers and risk-reduction research and interventions. National, provincial, and district level stakeholders were engaged from July 5-6, while community-level stakeholders were invited on July 7-8. The first two days of the interface OM workshop were attended by 55 people (excluding STOP Spillover personnel). These included government and funder organizations, representatives from General Directorate of Animal Health and Production (GDAHP), Cambodia Communicable Disease Control (CCDC), National Institute of Public Health (NIPH), PHD, PDA, Forestry Administration (FA), provincial department of environment (PDE), district administration, OD, district veterinarian, and Kampong Cham National Institute of Agriculture (KNIA), and bat guano harvesters. Twenty-four community members attended the last two days of the workshop. The workshop was also attended by 10 CAMBOHUN team members, two people from USAID Washington, and three technical advisors from STOP Spillover. Annex B2 is a complete list of participants.

After these meetings, STOP Spillover prioritized the program's interventions for implementation in Year 3 during an internal meeting dubbed the Intervention/Study Selection Process. Figure 1 illustrates the OM activity sequence.

OM OUTPUTS

Interface and Pathogen Prioritization

STOP Spillover’s assessment of current and prior work on zoonotic viruses in Cambodia led to the pre-selection of three potential interfaces and associated pathogens: rodent-human interface (coronaviruses) in Kandal Province; bat-human interface (coronaviruses and Nipah virus) in Kampong Cham Province; and the poultry-human interface (highly pathogenic avian influenza) in peri-urban regions of Phnom Penh. In the national stakeholder engagement meeting, participants were presented with these three potential interfaces and three criteria (Figure 2). Using the rubric method, the total score for each criterion was summed to rank the interfaces.

The group discussion and scoring results ranked the bat-human interface in Kampong Cham Province as the program’s top priority. To confirm that this selected interface was appropriate, the country team conducted two additional consultative meetings with FA and Institute Pasteur du Cambodge (IPC) for supporting information on bat species, density, and viral spillover risk to humans. Following these additional engagements, the bat-human interface in Kampong Cham Province was confirmed as the interface to focus STOP Spillover’s initial activities. However, stakeholders noted the presence of bats in Kampot and Battambang Provinces. Key stakeholders promised to provide more information about the bat populations in those other provinces for further consideration by STOP Spillover.

Figure 2. Prioritization Criteria

	Impact Risk to humans and other animals and environmental health and well-being
	Ease of implementation Technical availability of candidate interventions that can reduce the risk of impact
	Participation Feasibility of taking action based on stakeholders’ social and economic interests

Identification of Opportunities, Gaps, and Barriers

Farmers build artificial bat roosts close to their houses, resulting in regular exposure to the animals and their secretions. Bat guano is collected daily and weekly by farmers without personal protective equipment. The self-reported reasons why farmers engage in bat guano production were: 1) requires a relatively small investment and can be used in agriculture and/or to earn an income by selling to traders from Tbong Khmum and Kratie Provinces; 2) does not take much technical skill; 3) does not require much labor input and maintenance costs are minimal. Bat guano harvesters may provide other ecosystem services (e.g., reducing crop pests and mosquitos due to bat predation).

At the interface OM workshop, stakeholders identified the following opportunities, gaps, and barriers (Table 1) and discussed their understanding, experiences, and inputs related to spillover risk at the bat-human interface.



Bat guano farm in Kampong Cham Province

Photo: Cambodia country team

Table 1. Interface Opportunities, Gaps, by Level

Opportunities	Gaps
National	
<ul style="list-style-type: none"> • Zoonosis Technical Working Group (Z-TWG) at the central level, with reps from CCDC, GDAH, NIPH, and FA. • Joint Avian Influenza Surveillance group, with reps from Food and Agriculture Organization (FAO), IPC, and CCDC. • Passive surveillance monthly report by GDAH. • Availability of national laboratory institutes: NIPH, IPC, and National Veterinary Research Institute (NaVRI) • Availability of guidelines and standard operating procedures of zoonotic disease from WHO, FAO, and CCDC. • CCDC, FA, GDAH, NaVRI and other NGOs such as IPC, FAO have experience implementing human and animal health projects. • The PREDICT project improved the capacity of technical staff at GDAH, CCDC, NIPH, IPC, PHDs, and PDAs. 	<ul style="list-style-type: none"> • Lack of collaboration, coordination, and communication between national and sub-national level related to zoonotic surveillance. • No integration of lab results of human and animal surveillance. • Inadequate supporting materials, equipment, and protocols on zoonotic disease. • Limited scientific research on bat-human interface knowledge, attitudes, and practices among local people and stakeholders. • Limited knowledge and capacity on zoonotic disease, especially at the bat-human interface among some technical staff and focal persons. • Limited budget for implementing interventions, capacity building, and promotion on zoonotic disease. • No formal One Health policy. • Inadequate office space, focal person(s), and supporting materials and equipment.
Provincial	
<ul style="list-style-type: none"> • Government departments working on human and animal health include PDA, PHD, and PDE, • KNIA promotes One Health and zoonotic disease. 	<ul style="list-style-type: none"> • Provincial level has not been involved with Z-TWG. • Limited human resources dedicated to One Health. • Lack of interdepartmental coordination and communication on zoonotic diseases, interventions, and prevention. • Limited supporting laboratory, materials, equipment, and technology for surveillance. • Limited budget to control zoonotic diseases, or support capacity building and health promotion.
District	
<ul style="list-style-type: none"> • Government structures working on human and animal health: <ul style="list-style-type: none"> - District administration - Sangkat FA - DOE - OD - District referral hospital 	<ul style="list-style-type: none"> • Inadequate knowledge and capacity on bat-human interface, zoonotic disease, and promotion. • Lack of communication and connection with provincial level on zoonotic disease risks at the bat-human interface.

Table 2. Community-Level Opportunities, Gaps, and Barriers

Opportunities	Gaps	Barriers
<ul style="list-style-type: none"> • Government structures working on human and animal health: <ul style="list-style-type: none"> - Local authorities (village and commune chief) - Health centers - Commune veterinarians - Village animal health workers • Bat guano is beneficial and can replace chemical fertilizer. • Increases cropping products • Increases family income (first main income for some bat guano harvesters) • Bat guano harvesters are willing to practice good hygiene and biosafety measures. 	<ul style="list-style-type: none"> • Lack of understanding and capacity on zoonotic disease and case reporting. • Bat guano harvesters lack understanding and knowledge on zoonotic disease, bat-human interface, and self-protection. • Bat guano harvesters have no representative to share information or support each other. • Bat guano harvesters do not regularly practice biosafety measures. 	<ul style="list-style-type: none"> • Bat guano harvesters are occupied by other priority tasks, such as livelihood and family responsibilities. • Neighbors may become upset when they realize there is risk from bats.

Table 3. Vision Statements

Category	Vision Statement (Bat guano harvesters community live safer and better)
Capacity	<ul style="list-style-type: none"> Bat guano harvesters have appropriate knowledge and capacity to self-protect and reduce and prevent zoonotic virus spillover in their communities. All stakeholders and communities have adequate knowledge on bat-human interface and practice safe bat guano farming.
Biosafety practice and safe value chain	<ul style="list-style-type: none"> Community members understand and sustainably implement appropriate biosafety practices for zoonotic disease prevention in bat guano farming.
Benefits	<ul style="list-style-type: none"> Stakeholders and farmers are aware of and leverage the benefits of bat guano farming.
Surveillance	<ul style="list-style-type: none"> A functional bat-human surveillance system is established with full engagement of provincial technical staff and bat guano harvester communities. Sentinel surveillance system at provincial level is developed with the involvement of pertinent focal persons.
Provincial technical working group	<ul style="list-style-type: none"> Z-TWG is expanded sub-nationally to communities where bat-human interface exists, and their capacity in surveillance and interventions to prevent and reduce zoonotic virus spillover is strengthened. Coordinating and technical staff at the provincial level prioritize their duties and capacities in One Health national surveillance system for animal-human spillover risk prevention and reduction.

Define Interface Vision

OM workshop participants agreed on an interface vision informed by five different situational categories for identifying critical partners and outcome targets (Table 3).

Identification of Critical Partners

The vision-setting discussion identified 25 key stakeholders from three subgroups who could be targeted for behavior change, risk awareness, social learning, capacity building, and other intervention outcomes. These included: 1) Government institutions (GDAH, FA, NaVRI, MOE, CCDC, NIPH, PHD, PDA, PDE, OD, health centers (HCs), DOA, DOE, Sangkat FA); 2) community representatives (commune and village chiefs, village health support groups, village animal health workers, bat guano harvesters, traders, and consumers, farmers, neighbors); 3) NGOs and development agencies (FAO, WHO, U.S. CDC, Wildlife Conservation Society, Wildlife Alliance). All these are significant for achieving the proposed OM visions and STOP Spillover objectives due to their roles (or potential roles) in prevention of bat-human spillover. The list was narrowed to a few critical partners, defined as social actors through whom the project expects to influence change in the wider society. The critical partners proposed are described in Figure 3.

Defining Outcome Targets and Progress Markers

The country team started this session with a presentation on the definitions of outcome progress markers, describing them as a gradual progression of partner behavioral change leading to the project vision status. The team also presented a guide on how to develop these progress markers.

Figure 3. Critical Partners

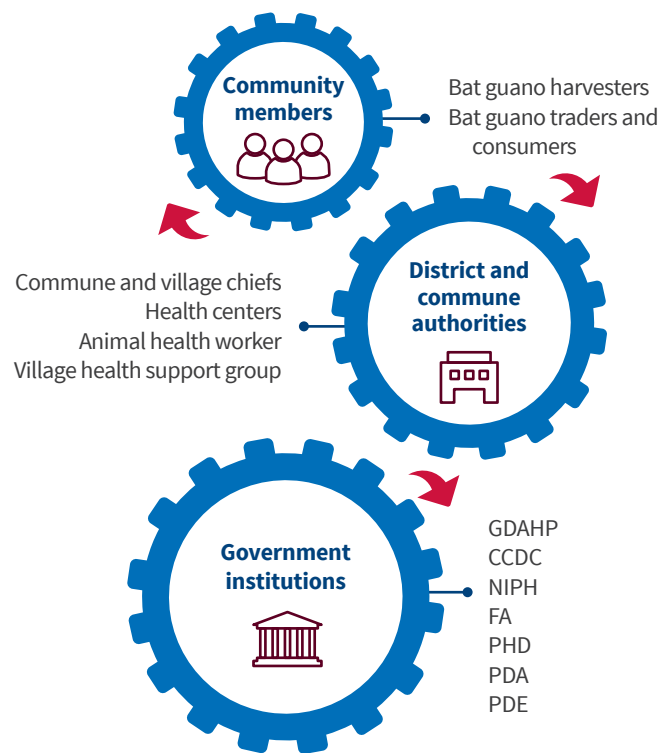


Table 4. Outcome Targets and Progress Markers

Outcome target	Expect to see	Like to see	Love to see
Critical partners: GDAH, FA, CCDC (Z-TWG) and NIPH			
<ul style="list-style-type: none"> Z-TWG develops sentinel surveillance that fully involves key local partners within the bat-human interface. Technical staff have capacity to train sentinel surveillance focal persons on zoonotic disease. 	<ul style="list-style-type: none"> Technical staff of Z-TWG attend training on zoonotic disease and pathogens related to bat-human interface technical staff conduct assimilation exercise: where key roles and responsibilities and effective outbreak response are laid out. Technical staff of Z-TWG has improved understanding of and skills in laboratory diagnosis and sampling and report cases on time. Z-TWG involves key stakeholders in surveillance. Z-TWG identifies potential pathogens at selected site 	<ul style="list-style-type: none"> Technical staff understand zoonotic disease and pathogens related to bat-human interface Z-TWG staff practice bat-human surveillance: sampling, diagnosis, and case reporting. Z-TWG builds network and team at provincial and sub-national levels for surveillance. Z-TWG develops national research agenda. Z-TWG sets up reinforcement guideline for national zoonotic disease surveillance. 	<ul style="list-style-type: none"> Integration of One Health surveillance system at national and sub-national levels. Z-TWG Technical staff use surveillance systems and provide training on zoonotic disease.
Critical partner: PDA			
<ul style="list-style-type: none"> Conduct training and capacity-building program on zoonotic disease and safe bat production techniques. Share information about bat guano production and investigation and other interventions. Develop materials for training, awareness, and intervention. Assign province-based technical experts. 	<ul style="list-style-type: none"> Participate in the training of zoonotic disease and biosafety and biosecurity practice in surveillance activities. Identify key stakeholders to involve in surveillance. 	<ul style="list-style-type: none"> Have knowledge and capacity on zoonotic disease and how to perform surveillance activities using biosafety and biosecurity practices. Have capacity to form a sentinel team and coordinate key stakeholders to conduct zoonotic surveillance. 	<ul style="list-style-type: none"> Participate in bat-human surveillance at the provincial level. Conduct training and awareness on the zoonotic disease and bat-human interface. Practice and promote biosafety and biosecurity in surveillance to subordinate levels.
Critical partner: PHD			
<ul style="list-style-type: none"> Collaborate and coordinate with Z-TWG on bat-human surveillance. Expand training and awareness on zoonotic disease and bat-human interface. 	<ul style="list-style-type: none"> Participate in the training on zoonotic disease and surveillance. Identify key stakeholders to involve in surveillance. 	<ul style="list-style-type: none"> Have knowledge and capacity on zoonotic disease and how to conduct surveillance. Form a sentinel team and coordinate key stakeholders to conduct zoonotic surveillance. 	<ul style="list-style-type: none"> Participate in provincial bat-human surveillance. Conduct training and awareness on zoonotic disease and bat-human interface.
Critical partner: PDE			
<ul style="list-style-type: none"> Actively raise awareness on hygiene and environmental impact of bat guano production. Gain capacity and reinforce guidelines on good bat guano production practices. 	<ul style="list-style-type: none"> Participate in capacity building program on zoonotic disease. Join other departments and stakeholders on environmental improvement in bat guano harvester communities. 	<ul style="list-style-type: none"> Gain knowledge and skills on zoonotic disease and how to integrate hygiene with environment improvement practices. Increase awareness of hygiene and the environment. 	<ul style="list-style-type: none"> Introduce good hygiene practices to bat guano harvesters to ensure a good/clean environment in bat guano farm communities. Investigate, monitor, and evaluate environment in bat guano farms.

Table 4. Outcome Targets and Progress Markers cont'd

Outcome target	Expect to see	Like to see	Love to see
Critical partners: District and commune authorities			
<ul style="list-style-type: none"> District administration authorizes and engages OD and district agriculture office to join sentinel surveillance and intervention activities. 	<ul style="list-style-type: none"> District administration and local authorities participate in learning events (training, workshops, and meetings) on zoonotic disease and bat-human surveillance. 	<ul style="list-style-type: none"> District administration and local authorities have capacity for zoonotic disease and bat-human surveillance. 	<ul style="list-style-type: none"> District administration and local authorities engage and assign subordinate levels to participate in sentinel surveillance and interventions.
Critical partners: OD and HC			
<ul style="list-style-type: none"> Have capacity to train on zoonotic disease and surveillance. Coordinate and participate in sentinel surveillance. 	<ul style="list-style-type: none"> Join trainings, workshops, and meetings on zoonotic disease and bat-human surveillance. 	<ul style="list-style-type: none"> Increase comprehension of and knowledge on zoonotic disease and surveillance. 	<ul style="list-style-type: none"> Engage and assign subordinate levels to participate in sentinel surveillance and interventions.
Critical partner: Bat guano harvesters			
<ul style="list-style-type: none"> Apply good hygiene and biosafety practices on bat guano farms (e.g., use safety protection equipment, especially during collection, storage, and transportation of guano. Improve design and structures of bat guano farms for long-term use and a safer way of bat roost replacement. Participate in preventive events and surveillance. 	<ul style="list-style-type: none"> Participate in zoonotic disease awareness and training programs on safe bat production techniques. Facilitate collaboration and discussion on potential zoonosis risk within their communities. 	<ul style="list-style-type: none"> Are aware of zoonotic diseases related to the bat-human interface. Practice good hygiene and sanitation in the bat guano value chain. 	<ul style="list-style-type: none"> Practice good hygiene and safe techniques in guano production, apply self-protection, and work to prevent zoonotic spillover. Share knowledge of safe bat guano production practices with their communities.

Participants were divided into four groups to develop progress markers for partners identified in the previous exercise. They presented their findings, summarized in Table 4.

Proposed Risk-reduction Interventions

From plenary discussion with the bat guano harvesting-community, activities considered to represent a high risk of spillover were identified, including 1) collecting, packaging, and transporting bat guano; 2) replacing bat roost materials; 3) hunting, preparing, and cooking bats; and 4) consuming water contaminated by bat guano/urine. In addition, bat guano is most frequently collected by women, leading to a potential gender disparity in risk exposure. To achieve the outcome targets and minimize spillover risk, participants proposed a list of project interventions supporting the 10 (priority) critical partners. Table 5 provides a consolidation of proposed interventions from all the critical partners.



Group work discussion during the interface OM workshop in Kampong Cham

Photo: Cambodia country team

Intervention/Study Selection Process

The purpose of the Intervention/Study Selection Process (ISSP), is to engage and leverage the technical expertise across STOP Spillover to make informed programmatic decisions regarding selected interventions – and studies – that emerge from OM. Because the proposed interventions were numerous (and some beyond STOP Spillover’s mandate and scope), the country team and lead advisors synthesized information from OM stakeholder engagement activities to prioritize interventions and studies using the following criteria:

- Alignment with local customs needs and priorities.
- Alignment with project intervention.
- Level of impact on risk reduction.
- Feasibility 1: cost, time, joint resources.
- Feasibility 2: willingness of key stakeholders and local beneficiaries to conduct.
- Leading to sustainable risk management (e.g., shared policy, institutions).

Beyond the intervention/study selection process, the country team refined the interventions and research activities into the following four activities to be prioritized for implementation.

1. Research on bat ecology and prevalence of pathogens carried by these species

This activity will seek to fill knowledge gaps identified during the interface OM about bat species, pathogens, distribution, and scale of guano farms in Kang Meas District of Kampong Cham Province. The activity will inform previous data, including from USAID PREDICT, that have documented coronaviruses in bats sampled at a small number of artificial-roost guano harvest sites.

2. Inclusive national risk assessment focusing on bat-human interfaces

While national stakeholder engagement identified the artificial roost bat guano harvest as the priority interface for STOP Spillover, substantial scientific evidence supports the existence of other high-risk bat-human interfaces in Cambodia. We will explore and map these other interfaces and assess the risk of spillover of priority pathogens to target future STOP Spillover work in Cambodia. We seek to gather, synthesize, and interpret these data through a national-level risk assessment process.



3. Community-level risk-reduction interventions

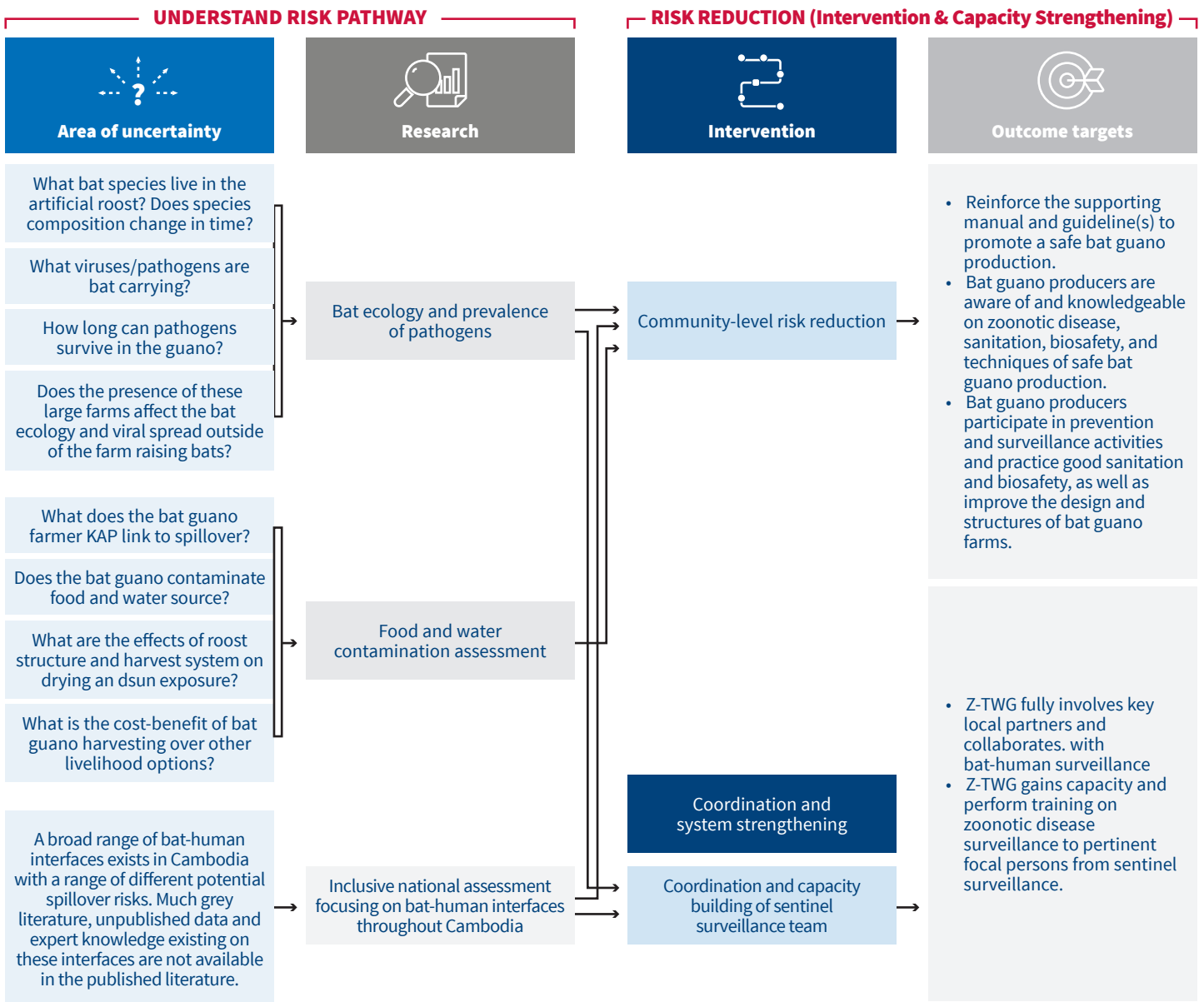
The majority of bat guano harvesters at the interface level OM directly collect guano at the farms next to their houses without wearing protective clothing, hats, gloves, or facemasks. There is a low apparent risk perception. Additionally, women are mainly engaged in collecting and packaging guano, as social norms dictate that they stay at home and such work is their responsibility. Therefore, this intervention aims to implement practical interventions and social behavior change activities to improve biosafety and risk reduction practices among bat guano harvesters and their communities.



4. Coordination and capacity building of the sentinel surveillance team.

This activity will seek to enhance the coordination and capacity building of Z-TWG and the development of sentinel surveillance teams. It is designed to detect the spillover of coronaviruses and other bat-transmitted pathogens to humans and livestock. Sampling will target people geographically, followed by wildlife and livestock based on human cases for monitoring spillover in bat guano production farms. Figure 4 Below shows the risk pathways and corresponding risk reduction actions i.e., interventions and research activities.

Figure 4. Prioritized Interventions and Research Activities



Conclusion and Next Steps

The OM process in Cambodia provided a roadmap for STOP Spillover to develop and implement risk-reduction interventions in Cambodia. The national stakeholder engagement meeting prioritized the bat-human interface for STOP Spillover’s initial work in Cambodia, with coronaviruses and Nipah virus prioritized as the focus pathogens. Kampong Cham was selected as the initial implementation geographic location due to community exposure to bats stemming from the bat guano harvesting industry. Key stakeholders at the center of national and sub-national implementing units

were identified as critical partners who will act to effect change in bat guano harvesting communities. From their defined outcome targets, four packages of activities have been developed to meet the main objectives of the project: 1) expand and sustain the capacity and functions of the Z-TWG to the provincial level; 2) fill key knowledge gaps related to bat guano harvesting; 3) increase zoonotic and bat-human surveillance activities; and 4) strengthen sanitation and safety practices among bat guano communities involved in harvesting of bat guano.

Annex A1. National One-on-One Consultative Meeting

	DATE	NAME	POSITION	ORGANIZATION	LOCATION
1	2 March 2022	Dr. Nop Sotheara	Project management specialist	USAID Mission	Phnom Penh
2	2 March 2022	Dr. Hak Makara	Senior technical advisor, animal health	FAO	Virtually
3	7 March 2022	Dr. Anne-Laure Banuls	Principal coordinator, PREZODE project	IPC	Phnom Penh
4	7 March 2022	Dr. Ly Sowath	Deputy director	IPC	Phnom Penh
5	7 March 2022	Dr. Vincent Herbreteau	Surveillance and modeling specialist	IPC	Phnom Penh
6	22 March 2022	Mr. Sokkung Sou	Head of programs	WaterAid	Virtually
7	31 March 2022	Mr. Chuop ChanSopha	Deputy director of Wetland Conservation Department	MOE	Phnom Penh
8	31 March 2022	H.E. Dr. Ly Sovann	Director	CCDC	Virtually
9	1 April 2022	Dr. Um Bunna	Veterinary, health specialist	U.S. CDC, Defense Threat Reduction Agency	Virtually
10	2 April 2022	Dr. Chheang Dany	Deputy director	FA	Phnom Penh
11	4 April 2022	Mr. Chhoeung Sovannarith	Resource mobilization manager	Heifer International	Virtually
12	5 April 2022	Dr. Sorn San	Deputy director general	GDAHP	Virtually
13	11 April 2022	Dr. Doung Veasna	Head of Virology Unit	IPC	Virtually
14	22 April 2022	Mr. Lon Sayteng	Director of Health and Sanitation Department	Ministry of Rural Development	Virtually

Annex A2. Provincial One-on-One Consultative Meetings

	DATE	NAME	POSITION	ORGANIZATION	LOCATION
1	8 June 2022	Mr. Sim Thavirak	Director	PDA	Kampong Cham
2	8 June 2022	Dr. Seng Sopharun	Deputy director	PHD	Kampong Cham
3	9 June 2022	Mr. Ouk Savuth	Governor	District authority	Kang Meas
4	9 June 2022	Mr. Ing Chiheang	Director	OD	Kang Meas

Annex A3. Distribution of OM Participants, by Level

CATEGORY	DATE	NAME	VIRTUAL	IN PERSON	TOTAL
National	8	37	3	42	45
Provincial	2	21	0	23	23
District	1	1	0	2	2
Community	5	19	0	24	24
Total	16	78	3	91	94

Annex B1. Kick-off and National Stakeholder Engagement Meeting Participants

DATE	NAME	POSITION	ORGANIZATION	LOCATION
1	Ms. Stephanie Martz	Infectious disease project manager, Emerging Threats Division	Office of Infectious Disease, Bureau for Global Health USAID	Virtual USAID
2	Ms. Lenna Neat Arango	Infectious disease team lead	USAID Mission/Cambodia	In person USAID
3	Dr. Nop Sotheara	Project management specialist	USAID Mission/Cambodia	In person USAID
4	Prof. Deborah Kochevar	Project director	Tufts University	In person STOP Spillover
5	Dt. Paul Monaghan	Project manager	Tufts University	Virtual STOP Spillover
6	Dr. Jeff Mariner	Hub co-lead Wildlife, Livestock, Epidemiology, Behavior Change, and Gender (WLE)	Tufts University	In person STOP Spillover
7	Mr. Julius Nyangaga	Consultant	Right Track Africa	Virtual STOP Spillover
8	Dr. Elaine Faustman	Hub lead risk analysis and communication (RAC)	University of Washington	Virtual STOP Spillover
9	Ms. Kristin Cabrera	WLE/Food, Water, Air, Climate, Livelihoods and Economics, and Policy and Security Resources (FWA) hub administrator	Tufts University	Virtual STOP Spillover
10	Dr. Saul Tzipori	Hub co-lead surveillance, mapping, and modeling (SMM)	Tufts University	Virtual STOP Spillover
11	Dr. Shibani Ghosh	Faculty expert (Friedman School)- WFA	Tufts University	Virtual STOP Spillover
12	Ms. Elizabeth Creel	Senior technical advisor/operational lead	JSI	Virtual STOP Spillover
13	Ms. Esther Kihoro	Consultant	RTA	Virtual STOP Spillover
14	Dr. Vipat Kuruchittham	Executive director	SEAOHUN	In person STOP Spillover
15	Mr. Rabindra Khaniya	Regional lead	SEAOHUN	In person STOP Spillover
16	Ms. Ratsuda Poolsuk	Operation manager	SEAOHUN	Virtual STOP Spillover
17	Ms. Juthamaneey Areeya	Senior public engagement officer	SEAOHUN	Virtual STOP Spillover
18	Dr. Vattana Thun	Chairperson	CAMBOHUN	In person STOP Spillover
19	Dr. Vutha Pheng	Coordinator	CAMBOHUN	In person STOP Spillover
20	Mr. Sambath Chann	Country team lead	CAMBOHUN	In person STOP Spillover
21	Ms. Malen Ken	Country technical officer (CTO)-SMM	CAMBOHUN	In person STOP Spillover
22	Mr. Dou Sok	CTO-RAC	CAMBOHUN	In person STOP Spillover
23	Ms. Phanet Mean	Admin and finance officer	CAMBOHUN	In person STOP Spillover
24	Ms. Bonary El	CTO- FWA	CAMBOHUN	In person STOP Spillover
25	Ms. Dom Peou	CTO- WLE	CAMBOHUN	In person STOP Spillover
26	Mr. Thea Sive	Project officer	CAMBOHUN	In person STOP Spillover
27	Ms. Tran Kim Ngan	WLE lead	VOHUN	Virtual STOP Spillover
28	Dr. Sovann Ly	Director	Cambodia CDC	In person National

DATE	NAME	POSITION	ORGANIZATION	LOCATION
29	Dr. Seng Doeun Yi	Deputy director	Cambodia CDC	In person National
30	Dr. Heng Meng	PHD staff	Kampong Cham	In person Provincial
31	Dr. Sopharun Seng	Head deputy PHD	Kampong Cham	In person Provincial
32	Dr. Piseth Keam	PHD staff	Kandal	In person Province
33	Dr. Sothyra Tum	Director	National Animal Health and Production Research Institute	Virtual National
34	Dr. Dany Chheang	Deputy director general	Forestry Administration, MAFF	Virtual National
35	Mr. Mongkulrengsey Bou	FA officer	Forestry Administration, MAFF	In person National
36	Dr. San Sorn	Deputy director general	GDAPH	In person National
37	Mr. BunsongUng	Office chief	Office of investigation, surveillance and animal disease control, GDAHP	In person National
38	Mr. Mengheang Nong	Technical staff	Kampong Cham PDA	In person Province
39	Mr. Dorin Ul	Office chief	Kandal PDA	In person Province
40	Mr. Chan Sophal Chuop	Deputy director	Wetland Conservation Department, MOE	In person National
41	Dr. Sayteng Lun	Director	Department of Health and Sanitation, Ministry of Rural Development	In person National
42	Dr. Vincent Herbreteau	Specialist on surveillance and modeling	PreZode	In person National
43	Dr. Anne-Laure Banuls	Principal coordinator	PreZode	In person National
44	Mr. Naisim Sum	WASH and health project coordinator	WaterAid	In person National
45	Dr. Bettina Ruehe	One Health advisor	Deutsche Gesellschaft für Internationale Zusammenarbeit Cambodia	In person National
46	Mr. Sopheavuthtey Borin			Virtual National
47	Dr. Makara Hak	Technical advisor for animal health	FAO	In person National
48	Dr. Sareth Nhem	Country director	Heifer International	In person National
49	Mr. Saiyann Thong	Program manager, livestock technology and One Health	Heifer International	In person National
50	Dr. Bunna Um	Veterinary-health specialist	U.S. CDC Defense Threat Reduction Agency	In person National
51	Mr. Sophoan Min	Country coordinator	Agronomes et Vétérinaires Sans Frontières (AVSF)	In person National
52	Ms. Leroux Nicole	Research biologist	Wildlife Alliance	In person National
53	Ms. Leroux Nicole	Research biologist	Wildlife Alliance	In person National
54	Mr. Paglia Steven	Conservation program director	World Wildlife Fund	In person National
55	Mr. Navven Hon	Program manager	Conservation International	In person National
56	Dr. Veasna Duong	Head of virology	Institut Pasteur du Cambodge	In person National
57	Dr. Karlsson Erik	Deputy head of virology	Institut Pasteur du Cambodge	In person National
58	Dr. Kroesna Kang	Dean	Royal University of Agriculture	In person National

DATE	NAME	POSITION	ORGANIZATION	LOCATION
59	Dr. Sovatha Mam	Vice-rector	University of Health Sciences	In person National
60	Dr. Sophat Seak	Dean	Faculty of Development Studies, RUPP	In person National
61	Ms. Thary Dy	Administrative staff	Kampong Cham National Institute of Agriculture	In person National
62	Mr. Borin Sear	Lecturer	Prek Leap National Institute of Agriculture	In person National
63	Dr. Sarin Neang	Researcher	Agro-industrial Department, Ministry of Agriculture, Forestry and Fisheries	In person National
64	Dr. Bunna Chea	Lecturer	Royal University of Agriculture	In person National

Annex B2. Interface OM Workshop Participants

DATE	NAME	POSITION	ORGANIZATION	LOCATION
1	Ms. Stephanie Martz	Infectious disease project manager, Emerging Threats Division	Office of Infectious Disease, Bureau for Global Health USAID	In person USAID
2	Dr. Ian Mendenhall	Senior infectious disease advisor	USAID Mission/ Washington	In person USAID
3	Dr. Deborah Kochevar	Project director	Tufts University	Virtual STOP Spillover
4	Ms. Kristin Cabrera	USAID STOP Spillover Hub Administrator	Tufts University	Virtual STOP Spillover
5	Dr. Felicia B. Nutter	Co-lead of STOP Spillover's WLE Hub	Tufts University	Virtual STOP Spillover
6	Dr. Jeff Mariner	Hub co-lead WLE	Tufts University	In person STOP Spillover
7	Ms. Esther Kihoro	Consultant	RTA	In person STOP Spillover
8	Dr. Tristan Burgess	Consultant	Center for Wildlife Studies	In person STOP Spillover
9	Mr. Rabindra Khaniya	Regional lead	SEAOHUN	In person STOP Spillover
10	Dr. Vutha Pheng	Coordinator	CAMBOHUN	In person STOP Spillover
11	Ms. Malen Ken	CTO-SMM	CAMBOHUN	In person STOP Spillover
12	Mr. Dou Sok	CTO-RAC	CAMBOHUN	In person STOP Spillover
13	Ms. Phanet Mean	Admin and finance officer	CAMBOHUN	In person STOP Spillover
14	Ms. Bonary EL	CTO-FWA	CAMBOHUN	In person STOP Spillover
15	Mr. Dom PEOU	CTO-WLE	CAMBOHUN	In person STOP Spillover
16	Mr. Thea Sive	Project officer	CAMBOHUN	In person STOP Spillover
17	Dr. Sarin Neang	Project assistant	CAMBOHUN	In person STOP Spillover
18	Dr. Bunna Chea	Lecturer	Royal University of Agriculture	In person National
19	Mr. Borin Sear	Lecturer	Prek Leap National Institute of Agriculture	In person National
20	Mr. Virac Hem	Director	KNIA	In person Provincial
21	Mr. Sokkheng Khun	Officer	KNIA	In person Provincial
22	Mrs. Limkhuoch Hov	Officer	KNIA	In person National

DATE	NAME	POSITION	ORGANIZATION	LOCATION
23	Dr. Makara Hak	AH-technical advisor	FAO	In person National
24	Mr. Savoeurn Meang	Project manager	AVSF	In person National
25	Mr. Daraden Vang	Staff	NIPH	In person National
26	Ms. Bunnary Seng	Virologist	NIPH	In person National
27	Ms. Samnang Um	Staff	NIPH	In person Provincial
28	Mr. Seanheng Cheab	Officer	CCDC	In person National
29	Mr. Sovan Sao	Officer	CCDC	In person National
30	Mr. Bunsong Ung	Office deputy chief	GDAHP	In person National
31	Mr. Kosal Han	Deputy of provincial governor	Kampong Cham province	In person Provincial
32	Dr. Phirun Kimsour	Director	Kampong Cham PHD	In person Provincial
33	Mr. Ra Hay	Technical staff	Kampong Cham PHD	In person Provincial
34	Mr. Kongsal Nhung	Director	Kampong Cham PDE	In person Provincial
35	Mr. Pen Toum	Office chief	Kampong Cham PDE	In person Provincial
36	Mr. Socheat Larch	Officer	Kampong Cham PDE	In person Provincial
37	Ms. Sony Serey	Officer	Kampong Cham PDE	In person Provincial
38	Mr. Navuth Phuong	Deputy director	Kampong Cham PDA	In person Provincial
39	Mr. Sonavan Katoun	Deputy director	Kampong Cham PDA	In person Provincial
40	Mr. Sophal Lorn	Office deputy chief director	Kampong Cham PDA	In person Provincial
41	Ms. Linda Sreang	Officer	Kampong Cham PDA	In person National
42	Mr. Phearun Tich	Officer	Kampong Cham PDA	In person Provincial
43	Mr. Phanit Pang	Chief officer	Kampong Cham PDA	In person Provincial
44	Mrs. Muyleng Roth	Officer	Kampong Cham PDA	In person Provincial
45	Mr. Daravuth Chin	Agriculture officer	Kong Meas district	In person District
46	Mrs. Mony Phan	Deputy of district governor	Kong Meas district	In person District
47	Mr. Darakrapum Seng	Director	OD Kang Meas	In person Provincial
48	Mr. Vuthy Sao	Technical staff	OD Kang Meas	In person Provincial
49	Mr. Seakleng Kong	Commune chief	Khchau commune	In person Community
50	Mr. Sophal Sun	Commune councilor	Khchau commune	In person Community
51	Mr. Sokchea Mao	Veterinarian	Khchau commune	In person Community
52	Mr. Mao Bun	Veterinarian	Khchau commune	In person Community
53	Mr. Somearn Hor	Technical staff	Khchau Health Center	In person Community
54	Mr. Njib Sing	Village chief, Varint 1	N/A	In person Community
55	Mr. Kimni Luk	Village chief, Varint 2	N/A	In person Community
56	Mr. Chub Chim	Village chief, Varint 3	/N/A	In person Community
57	Mrs. Sokny Chub	Village health support group, Varint 3	N/A	In person Community
58	Mr. Bunthan Va	Bat guano harvester, Varint 3	N/A	In person Community
59	Mrs. Hongnghan Pich	Bat guano harvester	Varint 3	In person Community
60	Mr. Oun Heng	Bat guano harvester	Varint 3	In person Community

	DATE	NAME	POSITION	ORGANIZATION	LOCATION
61	Mr. Tha Sut	Bat guano harvester	Varint 3	In person	Community
62	Mr. Seakchay Kong	Bat guano harvester	Varint 2	In person	Community
63	Mr. Phalla Teck	Bat guano harvester	Varint 2	In person	Community
64	Mr. Oun Thai	Bat guano harvester	Varint 2	In person	Community
65	Mrs. Muy Pha	Bat guano harvester	Varint 2	In person	Community
66	Mr. Kimsin San	Bat guano harvester	Varint 1	In person	Community
67	Mrs. Vuchey Sab	Bat guano harvester	Varint 1	In person	Community
68	Mr. Try Mao	Bat guano harvester	Varint 1	In person	Community
69	Mr. Yousreng Huy	Bat guano harvester	Varint 1	In person	Community
70	Mrs. Chansony Lang	Bat guano harvester	Varint 1	In person	Community
71	Mr. Kimlean Leng	Bat guano harvester	Varint 1	In person	Community
72	Mr. Vengsear Huy	Bat guano harvester	Varint 1	In person	Community



Tufts University



Africa One Health University Network



Southeast Asia One Health University Network



icddr,b



Right Track Africa



JSI Research & Training Institute, Inc.



Tetra Tech



University of Washington



University of Glasgow



University of California, Los Angeles



Broad Institute



University of Nebraska Medical Center



Humanitarian OpenStreetMap Team



Internews