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Vietnam Rapid Biosafety Assessment Activity Report

March 2023



(Activity 1.3.1.1)

Rapid Assessment of Prior Biosafety Training Programs Completed at the Stakeholder Level and Related Primary Knowledge, Attitudes, and Practices (KAP) on Wildlife Farms in Dinh Quan District, Dong Nai Province

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ACRONYMS

CDC	Centers of Disease Control and Prevention
CIRAD	The French Agricultural Research Centre for International Development
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
DAH	Department of Animal Health
DARD	Department of Agriculture and Rural Development
FAO	Food and Agriculture Organization of the United States
FAO ECTAD	FAO Emergency Centre for Transboundary Animal Diseases
FGD	Focus Group Discussion
INGO	International Nongovernmental Organization
IRB	Institutional Review Board
KAP	Knowledge, Attitudes, and Practices
KII	Key Informant Interview
MARD	Ministry of Agriculture and Rural Development
OH	One Health
OH-DReaM	One Health Design, Research, and Mentorship (working groups)
OM	Outcome Mapping
PPE	Personal Protective Equipment
SBC	Social and Behavior Change
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TIPs	Trial of Improved Practices
TOT	Training of Trainers
VietGAP	Vietnamese Good Agricultural Practices
WCS	Wildlife Conservation Society
ZD	Zoonotic Disease

STOP Spillover

Strategies to Prevent Spillover (or 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. Spillover refers to an event in which an emerging zoonotic virus is transferred from a non-human animal host species (livestock or wildlife) to another, or to humans.

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Within Dinh Quan district and Cao Cang, Dinh Quan town, La Nga, Phu Tuc, Suoi Nho, Phu Ngoc, Phu Tan, Gia Canh and Thanh Son communes, we thank leaders of the Health Centers, the Department of Natural Resources and Environment, the Department of Agriculture and Rural Development, Animal Husbandry and Veterinary Medicine Station, and Forest Protection County for providing your support and sharing essential information for our research.

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EXECUTIVE SUMMARY

The Rapid Biosafety Assessment was conducted from July-September 2022 and was divided into two parts for different target groups: (1) a Biosafety Training Assessment focused on establishing an understanding of the existing capacity of 29 government officers working on agriculture and forest protection from national to commune levels; and (2) a Biosafety-related Knowledge, Attitudes, and Practices (KAP) assessment of 66 wildlife farmers in Dinh Quan district. The KAP assessment completed questionnaires with 66 individuals and held two focus group discussions (FGDs) with 20 wildlife value chain actors. The key enumerators for both were the leaders and staff from the human health, veterinary, environment, agricultural, rural development, and forest protection subsectors from provincial to commune levels.

Key findings:

Overall, there was insufficient training on biosafety and zoonotic diseases for both government officers and wildlife farmers. There were large gaps in KAP relating to zoonotic disease prevention and biosafety/biosecurity standards among both target groups. The most important reasons identified for these gaps were:

- A lack of enforcement of existing regulations
- Unclear regulations for wild animal health monitoring, food safety, and wildlife value chain inspection
- A lack of mechanisms to promote capacity strengthening among government staff
- A lack of mechanisms to promote compliance by wildlife farm owners.

Insufficient foundational information about potentially zoonotic pathogens on wildlife farms and inadequate instructional materials were widely cited as barriers to government officers' training. Additional issues included the following:

- There is a critical lack of information on pathogens known or suspected to be present in farmed wildlife, as well as the potential risks to humans and other animals. There is a shared recognition among government officers and wildlife farmers about this critical knowledge gap and the need to address it.
- There are limited One Health-relevant mechanisms for coordination and information sharing among domestic animal health, wildlife health, human health, and environmental health sectors
- Training documents/curricula were identified as the lowest barrier among the government management staff

- Although government staff reported a lack of funding for training, the leadership indicated that there was a training budget available.
- Government agency leadership indicated that biosafety training needs were not identified as priorities by the management agencies for the annual work planning.

Most wildlife management staff reported that they had never or rarely been trained on biosafety and biosecurity in general or specifically on wildlife-specific biosafety and biosecurity issues. Most government officers have good basic knowledge of biosafety practices, with more than 70% providing appropriate answers. The following list summarizes zoonotic disease knowledge among government officers and attitudes toward increasing training.

- 100% of respondents considered training on biosafety and biosecurity in wildlife farming as necessary, with one third considering it extremely necessary.
- Government officers were divided in their assessment of the risk of zoonotic diseases in Vietnam, with 52% considering the risk serious or very serious, but 48% considering the risk somewhat or not serious.
- Only 63% of respondents reported using one or more kinds of personal protective equipment (PPE) during their contact with wildlife. The most commonly used types of PPE reported by respondents were masks and gloves. Fewer people mentioned other PPE such as dedicated clothing or boots.
- Most government officers chose all four suggested content categories for additional training, including: (1) basic biosecurity practices, (2) technical solutions for breeding and facilities, (3) biosecurity practices for wildlife farms, and (4) bio-risk reduction measures. Some requested additional content more relevant to their work or personal needs.
- Most high-ranking officers preferred formal training with certificates, while short courses are preferred by officers at lower levels. Both groups were enthusiastic about the option of creating online access to self-study training.

Most wildlife farmers have never been trained on biosafety and biosecurity practices.

Although the level of knowledge of the biosafety requirements was high, the rate of adoption and frequencies of practice or success were much lower for almost all criteria. The main knowledge of and attitudes toward biosafety on farms included the following:

- 60% of farm owners reported having a good and stable livelihood from wildlife farming
- 76% of farmers did not think their current farm could cause zoonotic disease outbreaks
- 76% of farm owners stated that they need biosafety and biosecurity training
- 80% of farmers believed that they could or might be able to adopt required biosafety and biosecurity practices with their current resources
- Biosafety and biosecurity practices are considered socially acceptable

- There are strong interactions among wildlife value chain actors, but the capacities for wildlife production, biosafety, biosecurity, and prevention of diseases that can be transmitted from animals to humans are still limited.

The **wildlife farmers' top three priorities** for improved biosecurity/biosafety were:

- Better use of PPE
- Improved disease control
- Enhanced waste management

When directly asked, most farmers downplayed biosafety, biosecurity, and zoonotic disease risks and stated that there are no diseases transmitted among their captive wildlife. However, in the Behavioral Risk Analysis (activity 1.2.6.1), wildlife producers expressed biosafety concerns regarding the risk of personal illness resulting from their exposure to their wildlife. *This suggests that wildlife farmers are aware of biosafety, biosecurity, and zoonotic disease risks, but that they view the topic as a sensitive subject and are reluctant to discuss the topic openly.*

Breeding practices, farming techniques, and methods for treatment of sick animals are learned from other wildlife farmers who successfully rear each respective species. This indicates that **peers influence behavior. This influence can be leveraged for social and behavior change (SBC) interventions.** There is a wide range of biosafety and biosecurity levels across operations. Most are cleaned daily, but PPE use in waste handling is limited. To store wastewater and excrement from wildlife production, farmers use both open and covered pits. These waste products are also used for plant fertilizer, biogas, or spread in fishponds.

The farmers reported that they treat sick animals by administering medications according to cattle or poultry dosages, adjusted for the weight of the animal. This is understandable as most medications are not labeled for use in wildlife. Farmers did not keep medical records of wildlife or of people on the farm. Most farmers have not been trained on biosafety and biosecurity practices and there is a lack of knowledge on zoonotic disease transmission. The most important barriers to implementing biosafety and biosecurity measures as reported by wildlife farmers are as follows:

- Cost of measures
- Discomfort of wearing PPE
- The lack of information on biosafety and biosecurity practices for wildlife

While the farmer attitudes toward PPE could be addressed by farmers themselves, the lack of information and the financial barriers would need to be addressed by higher-level stakeholders from agriculture, human, and animal health sectors. Biosafety and biosecurity-related veterinary and wildlife health extension services were limited. Most recent capacity building activities were *ad hoc* cooperation activities related to the COVID-19 pandemic or other health emergencies and have not been institutionalized as regular, recurring programs.

Recommendations from the research findings:

STOP Spillover research and intervention recommendations:

- Farmers are aware of biosafety, biosecurity, and zoonotic disease risks, but they view those topics as sensitive and are reluctant to openly discuss risks and gaps. Qualitative and discussion-based methods to build trust with respondents are recommended to understand their knowledge and perceptions regarding the presence and mitigation of biosafety and biosecurity risks.
- Pilot implementation to test and refine biosafety and biosecurity practices on selected farms before introducing them more broadly should be supported. This can be accomplished using the Trials of Improved Practices¹ (TIPs) methodology.
- An SBC approach that builds appropriate conditions for adoption of new practices for wildlife farmers and related stakeholders in the wildlife value chain in Dong Nai and throughout Vietnam is needed. Incentives and mechanisms to encourage farmers to voluntarily comply with on-farm biosafety and biosecurity measures should be put in place.
- One Health volunteers/collaborators in the community should be identified and established to support farmers' access to wildlife healthcare and disease reporting in collaboration with appropriately trained animal health professionals.
- Urgently addressing the lack of foundational information about potential zoonotic pathogens in farmed wildlife will improve the abilities of all stakeholders to accurately assess risk and act to mitigate it.

Other recommendations

- Raising awareness about the benefits of biosafety and biosecurity measures for wildlife farms should be prioritized among decision makers and annual planners.
- Training to improve KAP and general capacity for biosafety, biosecurity, and zoonotic diseases for managers in One Health relevant agencies at all levels is recommended. Communication materials, manuals on farm biosafety and biosecurity, communities, health staff (human health and wildlife health care/veterinary functions, wildlife farm oversight functions), and informal local peer-education networks are needed to support improved biosafety/biosecurity capacity.

¹ Trials of Improved Practices is a formative research technique that program planners use to pretest the actual practices that a program will promote.

PART I: INTRODUCTION

1.1 Background

Wildlife farms and associated value chains are recognized as high-risk interfaces for zoonotic disease emergence. Live wild animals, wildlife products, livestock, poultry, and humans interact in diverse ways on farms, during transport, in markets, in restaurants, and in consumers' homes, creating myriad opportunities for zoonotic infectious agents to be shared among species. While the risk remains difficult to quantify, especially in comparison to highly regulated livestock value chains, even a single emergence event can have devastating consequences.² In the Southeast Asia region, wildlife value chains have been implicated in the recent zoonotic emergence of *Streptococcus suis*,³ highly pathogenic avian influenza,⁴ SARS-CoV-1,⁵ and the ongoing SARS-CoV-2 pandemic.^{6,7}

In Vietnam specifically, more than 180 species of wildlife are farmed for food, medicine, and other products, supplying both domestic and export markets.⁸ Some species are sourced from the wild and legally or illegally enter the value chain through wildlife farms. Although commercial wildlife farming is longstanding and widespread, both wildlife farming and the associated value chains have evolved rapidly ahead of effective regulation.

² Kock, Richard, and Caceres-Escobar, Hernan. 2022. "Situation Analysis on the Roles and Risks of Wildlife in the Emergence of Human Infectious Diseases." Gland, Switzerland: IUCN. https://web.archive.org/web/20220214083543id_/https://portals.iucn.org/library/sites/library/files/documents/2022-004-En.pdf

³ Huong, Vu Thi Lan, Hugo C. Turner, Nguyen Van Kinh, Pham Quang Thai, Ngo Thi Hoa, Peter Horby, H. Rogier van Doorn, and Heiman F. L. Wertheim. 2019. "Burden of Disease and Economic Impact of Human *Streptococcus Suis* Infection in Vietnam." *Transactions of The Royal Society of Tropical Medicine and Hygiene* 113 (6): 341–350. <https://doi.org/10.1093/trstmh/trz004>

⁴ Luk, Hayes K. H., Xin Li, Joshua Fung, Susanna K. P. Lau, and Patrick C. Y. Woo. 2019. "Molecular Epidemiology, Evolution and Phylogeny of SARS Coronavirus." *Infection, Genetics and Evolution* 71, 21–30. <https://doi.org/10.1016/j.meegid.2019.03.001>

⁵ Wang, L. F., and B. T. Eaton. 2007. "Bats, Civets and the Emergence of SARS." In *Wildlife and Emerging Zoonotic Diseases: The Biology, Circumstances and Consequences of Cross-Species Transmission*, edited by James E. Childs, John S. Mackenzie, and Jürgen A. Richt, 325–344. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-70962-6_13

⁶ Zhou, Peng, Xing-Lou Yang, Xian-Guang Wang, Ben Hu, Lei Zhang, Wei Zhang, Hao-Rui Si, et al. 2020. "A Pneumonia Outbreak Associated with a New Coronavirus of Probable Bat Origin." *Nature* 579 (7798): 270–273. <https://doi.org/10.1038/s41586-020-2012-7>

⁷ Mueller, Benjamin. 2023. "New Data Links Pandemic's Origins to Raccoon Dogs at Wuhan Market." *The New York Times*. <https://www.nytimes.com/2023/03/16/science/covid-wuhan-market-raccoon-dogs-lab-leak.html>

⁸ Food and Agriculture Organization of the United Nations (FAO). 2018. "Technical Report on Conducting Field Census Survey Using Updated Wildlife Farm Management Tool."

Dong Nai province is one of the top three provinces for wildlife farms in the country, hosting more than 800 wildlife farms as of 2021.⁹ Farmed wildlife in the province have been previously reported to carry STOP Spillover priority pathogens including Coronaviruses and Influenza viruses.^{10 11} Dong Nai also has a large, biodiverse forest zone, adjacent to districts with many farms: Dinh Quan (335 farms), Vinh Cuu (231 farms), Tan Phu (53 farms), Xuan Loc (53 farms), and Thong Nhat (46 farms). For these reasons, Dong Nai Province was identified as a high-risk interface for STOP Spillover interventions.

In consultative Outcome Mapping (OM) workshops with stakeholders from the provincial, district, and community levels held in Dong Nai Province in December 2021, the following key points were reported:

- Government agencies do not have adequate human resource capacity to guide biosafety in wildlife production, including how to raise the animals and prevent infections.
- Many wildlife farms are small-scale operations without well-developed long-term development strategies.
- Wildlife species are often mixed with domestic animals.
- Farm owners and workers are reluctant to contact or interact with relevant technical agencies for advice as agency personnel have limited knowledge of wildlife health issues and wildlife farming practices.
- Biosafety and biosecurity practices are not a priority in wildlife husbandry, which is less regulated than livestock production, and farm owners and workers lack knowledge of good biosafety and biosecurity practices.
- Actors within the wildlife value chain have limited knowledge about the potential zoonotic disease risks.¹²

The wildlife-human interface in Dong Nai province was identified as the first priority high-risk interface for STOP Spillover work in Vietnam. Capacity strengthening and biosafety/biosecurity training were recommended by many OM participants as a

⁹ FAO. n.d. Wildlife Farming in Vietnam: Southern Vietnam's Wildlife Farm Survey Report in a Glance." <https://www.fao.org/3/az118e/az118e.pdf>

¹⁰ USAID. n.d. "PREDICT Vietnam: One Health in Action 2009-2020." <https://static1.squarespace.com/static/5c7d60a711f7845f734d4a73/t/5f5945bce1e2441a7754f039/1599686094096/FINAL+REPORT+COUNTRY-VIET+NAM-FULL.pdf>

¹¹ Rabaa, Maia A., Ngo Tri Tue, Tran My Phuc, Juan Carrique-Mas, Karen Saylor, Matthew Cotten, Juliet E. Bryant, et al. 2015. "The Vietnam Initiative on Zoonotic Infections (VIZIONS): A Strategic Approach to Studying Emerging Zoonotic Infectious Diseases." *Ecohealth* 12, 726–735. <https://doi.org/10.1007/s10393-015-1061-0>

¹² STOP Spillover. 2022. "Vietnam Participatory Planning Using Outcome Mapping: Summary Report." <https://stopspillover.org/resources/viet-nam-participatory-planning-using-outcome-mapping-summary-report>

priority approach for STOP Spillover to address zoonotic spillover risks and associated gaps in Dong Nai.

Biosafety¹³ in animal production is defined by the government of Vietnam as the application of integrated and synchronous technical and management measures to prevent and limit infectious disease transmission in livestock. Sound implementation of biosafety and biosecurity practices is considered the optimal solution to prevent diseases and advance sustainable animal production. The Law on Animal Husbandry 32/2018/QH14 dated 19 November 2018, sets the framework for livestock and wildlife farming in Vietnam. Wildlife is included under the description of “other farm animal means any animal other than cattle, poultry and not on the list of endangered and rare species or the list of endangered and rare forest animals or ordinary forest animals or aqua creatures or the list of forest wild animals provided in the Appendix of Convention on international trading in endangered wild animals and plants.” Many decrees provide additional guidance, but despite the existing legal framework the application of and compliance with these measures are limited and major gaps exist for wildlife farms.

The successful application of on-farm biosafety and biosecurity strategies can prevent pathogens from entering farms or spreading once inside the farm, thus improving animal productivity and health for both animals and humans. Biosafety and biosecurity capacity building and training programs have been implemented previously. However, these programs have targeted provincial and district government management staff and have had a focus on livestock and poultry farms, **neglecting the high risk posed by wildlife and the crucial involvement at the community level in Dong Nai.**

¹³ A note on terminology: For livestock and associated value chains, *biosafety* refers to the use of specific practices, training, safety equipment, and specially designed buildings to protect the workers, community, and environment from an accidental exposure to or unintentional release of infectious agents and toxins. *Biosecurity* for livestock farming refers to protecting the farm from the introduction and spread of infectious agents. For consistency with the approved STOP Spillover Vietnam workplan, we use *biosafety* in the title of the document. Because this work addresses both biosafety and biosecurity, throughout the body of the document we will use biosafety and biosecurity as defined above.

PART 2: METHODOLOGY

2.1 Activity Description

To reduce zoonotic disease spillover risks, increased biosafety and biosecurity awareness and behavior change were identified as priority measures during stakeholder consultations. Based on discussions during OM, the STOP Spillover team and One Health Design, Research, and Mentorship (OH-DReaM) working group members developed a research study to fill critical knowledge gaps required to design interventions in this high-risk interface. Results from this and other related studies will be used to prioritize cost effective, culturally acceptable biosafety and biosecurity measures to reduce the risks of zoonotic spillover by reducing hazard exposure at the wildlife-human interface.

2.2 Objectives

The Biosafety Rapid Assessment focused on establishing an understanding of the following:

1. What is the existing biosafety/biosecurity capacity of government officers in human and veterinary health, environment, and forest protection sectors overseeing and managing wildlife farms from national to commune levels?
2. What are the current biosafety/biosecurity-related knowledge, attitudes, and practices (KAP) of wildlife farmers at the community level?

Outputs from this assessment will:

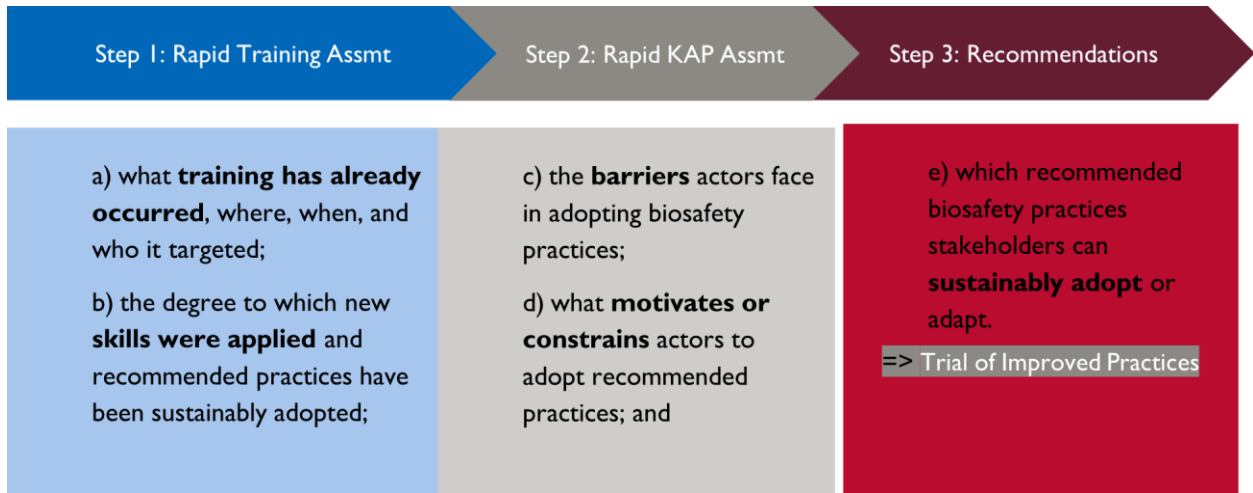
- Inform the selection of three priority biosafety/biosecurity practices for a subsequent pilot activity (activity 2.2.2.1, Biosafety TIPS);
- Inform the design of project interventions and supporting activities, including the development of training materials, community-based training, or social and behavior change (SBC) interventions; and
- Serve as baseline data for project monitoring, evaluation, and learning.

2.3 Duration and Locations

Research Period: July–September 2022, see Timeline in Annex 2

Study Sites: Dinh Quan town; Cao Cang, La Nga, Phu Tuc, Suoi Nho, Phu Ngọc, Phu Tan, Gia Canh, and Thanh Son communes; Dinh Quan District; Dong Nai Province

Figure 1: Main Steps for Biosafety Rapid Assessment



2.4 Research Methodology

Desktop Review: To identify information gaps and to inform the development of a questionnaire for use in key informant interviews (KIs) and focus group discussions (FGDs) with government and community-level stakeholders in the wildlife value chain, STOP Spillover Vietnam Country Team identified and reviewed documents from training courses on biosafety and biosecurity offered between 2013 and July 2022 in Vietnam in general and specifically at the interface level in Dong Nai Province. The initial Tools for Biosafety Assessment at Wildlife Farms was based on the FAO Biosecurity Toolkit 2007 and Food and Agriculture Organization of the United Nations (FAO) Emergency Centre for Transboundary Animal Diseases (ECTAD) Vietnam Pig Farm checklist.

Field Data Collection: STOP Spillover technical experts and the OH-DReaM working group further refined the data collection tools, based on feedback from enumerators during their training, to ensure they were appropriate for use on current wildlife farms in Dinh Quan district. Please see Appendix I for the list of trained enumerators who participated in this activity.

We conducted the rapid assessment of prior biosafety training programs at the Dong Nai wildlife farming interface level to determine who had received biosafety/biosecurity training and what topics/content had been used. We interviewed 29 one health officials from relevant agencies at national, provincial, district, and communal levels, including those related and/or under the Division of Agriculture and Rural Development, the Sub-Division of Animal Health, the Sub-Division of Forest Rangers, Agriculture Extension, and other relevant collaborating organizations such as FAO and Wildlife Conservation Society (WCS).

Once we identified who had been trained or had experience with biosafety and biosecurity measures and how they were trained, we used barrier analysis and FGDs with actors, including

wildlife farm owners, caretakers, traders, consumers, and food suppliers, along the wildlife farming value chain to describe barriers that limit the adoption of recommended biosafety practices.

This information has been used to improve the design and rollout of appropriate and feasible biosafety recommendations using a TIPs approach on biosafety demonstration/model farms (See activity 2.2.2.1). Data collection included a questionnaire that covers various aspects such as the geographical location of wildlife farming, wildlife value chain actors, and their current biosecurity practices. Sixty-six key informant in-depth interviews and two FGDs with 20 wildlife value chain actors were conducted in nine communes in Dinh Quan district to complement and enrich the findings. These questionnaires and FGDs were coordinated with STOP Spillover activity 1.2.6.1 to align the sampling strategy, optimize data collection, and avoid over-burdening actors.

PART 3: RESEARCH RESULTS

3.1 *Desktop Review*

Information on previous training courses delivered, topics, and curricula was collected from official published research and reports from previous programs and projects. Programs and projects prioritizing Southern Vietnam and/or Dong Nai (e.g., National Institute of Hygiene and Epidemiology, National Agriculture Extension Center, Dong Nai Agriculture Extension Center), or trainings at the regional or global level (e.g., by FAO,¹⁴ WCS/PREDICT, Vietnam OH University Network, The French Agricultural Research Centre for International Development [CIRAD]) were identified.

Through discussion with FAO representatives in Ha Noi after reviewing FAO's prior training reports, we confirmed that biosafety/biosecurity training courses conducted by FAO were focused on livestock (cattle, pigs) and poultry. Very few biosafety/biosecurity training courses specifically for wildlife have been developed or delivered by FAO Vietnam. The team also confirmed with the National Wildlife Coordinator at FAO ECTAD Vietnam that efforts for wildlife farms and associated value chain TIPs, interventions, and training development would address significant acknowledged gaps for wildlife farming that FAO Vietnam could not cover and that FAO Vietnam is ready to support and follow up with STOP Spillover, if needed.

¹⁴ FAO ECTAD Vietnam is currently expanding the project to seven other models in Northern Vietnam and training more poultry production training experts in Southern Vietnam. FAO ECTAD Vietnam aims to effectively prevent avian influenza at source and improve livelihoods at the same time.

3.2 Rapid Assessment on Prior Biosecurity Training Programs

The KIIs were conducted with leaders, managers, and staff in OH-relevant agriculture and health institutions at five levels, from central (national) to communal. Within the agriculture sector, interviews were focused on sectors related to wildlife farming, including livestock/animal health and forest protection entities. Table I lists the agencies with personnel that participated in the rapid assessment.

Table I: Representative Agencies that Participated

Central	District
<ul style="list-style-type: none"> • Livestock Department, Ministry of Agriculture and Rural Development (MARD) 	<ul style="list-style-type: none"> • Dinh Quan Forest Protection
<ul style="list-style-type: none"> • Vietnam Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) management authority 	<ul style="list-style-type: none"> • Dinh Quan Health Center
<ul style="list-style-type: none"> • United Nations Forestry and Agriculture Organization – FAO Vietnam 	<ul style="list-style-type: none"> • Centre of Agriculture services
<ul style="list-style-type: none"> • DEEP VZN project – PATH 	<ul style="list-style-type: none"> • Division of Agriculture & Rural Development
Regional	
<ul style="list-style-type: none"> • Ho Chi Minh City Forest and Agriculture University 	<ul style="list-style-type: none"> • Environmental Protection Division
Provincial	Communal
<ul style="list-style-type: none"> • Planning and Financial Division, Department of Agriculture and Rural Development (DARD) 	<ul style="list-style-type: none"> • Forest ranger station in Dinh Quan town
<ul style="list-style-type: none"> • Sub-Division of Provincial Animal Husbandry & Veterinary, DARD 	<ul style="list-style-type: none"> • Forest ranger station in La Nga
<ul style="list-style-type: none"> • Forest Protection, DARD 	<ul style="list-style-type: none"> • Forest ranger station in Thanh Son
<ul style="list-style-type: none"> • Provincial Centers of Disease Control and Prevention (CDC) 	<ul style="list-style-type: none"> • Forest ranger station in Cao Cang
<ul style="list-style-type: none"> • Sub-Division of ARD for Forest and Water products 	<ul style="list-style-type: none"> • Forest ranger station in Suoi Nho – Phu Tuc
<ul style="list-style-type: none"> • Environmental Protection Division 	
<ul style="list-style-type: none"> • Provincial Centre of Agriculture services 	

3.2.1 Interviewee Groups by Stakeholder Level and Education Background

Table 2: Classification of Interviewees by Representative Level and Education Background

Representative Level	No. of Interviewees	%	Educational Background	No. of Interviewees	%
National	1	3.5	Forestry	13	44.8
Regional	1	3.5	Veterinary medicine/livestock husbandry	10	34.5
Provincial	11	37.9	Environment	2	6.9
District	9	31.0	Biology	1	3.5
Commune	5	17.2	Human health	2	6.9
International nongovernmental organizations (INGOs)	2	6.9	Economics	1	3.5
<i>Male 23 (79%)</i> <i>Female 6 (21%)</i>	29	100		29	100

3.2.2 Biosafety and Biosecurity Training

To determine whether government officers had prior training as of the date of the survey, we selected eight most common basic training topics to use as a checklist. This helped ensure that once the question was asked, if a person had participated or been trained in one of those areas, they should be able to easily respond “YES” or “NO.”

Less than a third (27.6%) of respondents answered YES to the first question on prior biosafety and biosecurity training on general threats, regardless of their position. Local officers reported that they have never or rarely been trained on biosafety/biosecurity in general or in these topics related to wildlife specifically. Most of the courses mentioned were delivered in the last 10 years, following the emergence of H5NI, other pig/poultry diseases, or SARS-CoV-2/ COVID-19. Only 48% of participants reported that they had been trained once on any topic, while the remaining 52% reported they had never been trained on any of the eight basic topics. Only personnel working for international organizations such as FAO (one person) and PATH (one person) reported that they had been trained more than once on any of the topics listed in Table 3.

Table 3: Summary of Training Contents of Courses Attended

#	Have you ever been trained on:	# (%) Yes
1	General biological threats and benefits of biosafety and biosecurity?	8/29 (27.6%)
2	General biosafety and biosecurity issues in animal husbandry?	11/29 (37.9%)
3	General biosafety and biosecurity issues related to wildlife?	4/29 (13.8%)
4	Biosafety and biosecurity measures in livestock farming?	12/29 (41.4%)
5	Biosafety and biosecurity measures in wildlife farming?	4/29 (13.8%)
6	Biosafety and biosecurity in zoonosis prevention related to husbandry?	11/29 (37.9%)
7	Biosecurity in zoonosis prevention related to wildlife?	5/29 (17.2%)
8	Bio-risks classification and response?	4/29 (13.8%)

The most common topics for which government staff said they had received training were all targeted at domestic animal husbandry (#2, #4, and #6), not wildlife. No training topic received a majority positive response. Topic #4 (Biosafety and biosecurity measures in livestock farming) was most reported, with 12 respondents (41.4%). Only 4 respondents had been trained at least once on a wildlife-related topic (#3 or #5), and the same 4 respondents reported that they had been trained on both topics.

3.2.3 Basic Biosecurity Knowledge and the Most Common Practices

To measure basic knowledge and the most common practices related to biosafety and biosecurity among the government staff, nine questions evaluating basic knowledge were asked. Most of the local staff indicated they had not had opportunities to work with wildlife as directly as farmers, except for occasional field visits. Pre-testing of the assessment tools during enumerator training highlighted that government officers had very limited interactions with wildlife and could not provide valid answers based on their actual practice on wildlife farms. Accordingly, respondents were only asked to answer one question about their use of personal protective equipment (PPE) from the list of topics in the questionnaires. The few field activities that were carried out were mainly focused on the livestock or poultry where PPE use was only one of major biosecurity practices required for outsiders.

Table 4: Key Biosecurity Knowledge and Practice Assessment

	Questions	% YES	% NO	% DON'T KNOW
1.	'Biosecurity' refers to actions that reduce the risk of disease spread on a farm?	86.21	3.44	10.34
2.	Regular vaccination can prevent animals from getting infectious diseases?	100	0	
3.	It is important to separate sick animals from healthy animals to prevent disease spread?	100	0	
4.	Good management of animal waste can prevent disease spread?	100	0	
5.	If sick and healthy livestock drink from the same water source there is a risk of disease spread?	82.14	3.44	10.34
6.	Selling sick animals will spread infectious disease to areas outside of the source farm?	68.97	20.69	10.34
7.	Are there many domestic and wild animal diseases that pose an infection risk to humans?	75.86	17.24	6.90
8.	From your point of view, should zoonotic spillover be considered as a threat to national/local security?	65.52	17.24	17.24
9.	Does your work involve direct contact with wildlife?	68.97	31.03	0
10.	Do you use protective equipment during your contact with wildlife?*	58.63	37.93	3.44

*If respondents answered YES, they were asked to list the types of PPE used.

Knowledge was particularly strong with 100% correct answers for three key issues, specifically (1) the necessity of vaccination, (2) the importance of separating sick from healthy animals, and (3) proper management of animal waste. Whether or not the officers reported attending training, having been trained or not, most officers demonstrated a basic knowledge of good animal health management biosecurity practices. A slightly lower level of knowledge was indicated by fewer correct answers to questions about (1) the definition of biosecurity (89%) and (2) the risk of use of the same water between sick and healthy animals (82%).

However, the lowest correct answer score was on the practice question: only 63% of staff said they have used protective equipment during their contact with wildlife. The most common PPE reported were masks and gloves. Fewer people mentioned the remaining items such as dedicated clothing or boots. Disinfectant sprays (though not strictly PPE) were mentioned occasionally by participants.

3.2.4 Attitude on Zoonotic Diseases and Training Needs

To understand the attitude on zoonotic diseases and training needs among the government management staff involved, we used 4- and 5-point scales to assess their attitude on the related issues as follows:

1. *The risk of the zoonosis spread and amplification in Vietnam:* Responses were almost evenly divided, with 52% considering it a very serious/serious risk, 41% as somewhat serious, and 7% considered it not serious at all.
2. *The necessity of training on biosecurity for government management staff:* All participants agreed that training is needed, and either extremely necessary (35%), very necessary (45%), or necessary (21%).

Table 5: Attitude on Zoonotic Diseases and Training Necessity

From your point of view, how serious is the issue of zoonosis spread and amplification currently in Vietnam?	No.	%	According to you, is it necessary to strengthen training and knowledge about biological risks for officers/farmers?	No.	%
Not serious	2	6.9	Unnecessary	0	0
Somewhat serious	12	41.4	Somewhat necessary	0	0
Serious	13	44.8	Necessary	6	20.7
Very serious	2	6.9	Very necessary	13	44.8
Total	29	100	Extremely necessary	10	34.5
			Total	29	100

3.2.5 Training Topics and Type Preference

To better understand the officers' preference on the training topics and duration, four main groups of training topics and two types of time duration were offered. Basic biosafety practice being the most preferred option at 86.2%. Training topics on (2) biosafety practice at the wildlife farms and (3) technical solutions on breeds and barns were also popular choices, with 62.1% and 58.6% of officers, respectively. The demand for bio-risks reduction measures was lower with 48.3% of officers selecting it. Additional topics were added by 10.7% and were more relevant to their specific work or personal needs needs (i.e., enforcement measures, necessary equipment for wildlife farming, and diseases related to livestock and wildlife farming and prevention methods). The findings suggest that officers recognize the importance of biosecurity training and prefer training programs that focus on the fundamentals of biosecurity management.

In terms of training time, formal training (with certificates) was preferred by most high-ranking officers, while short courses were preferred by officers at lower levels. Both highly appreciated the self-study training online.

Table 6: Training Content and Type Preference

What training contents would you select if offered free bio-risks training programs?	No.	%
1. Basic biosafety practice	25	86.2
2. Biosafety practice at the wildlife farms	18	62.1
3. Some technical solutions on breeds, barns	17	58.6
4. Bio-risks reduction measures	14	48.3
5. Other topics (Enforcement measures, necessary equipment for wildlife farming, diseases related to livestock and wildlife farming and prevention methods)	3	10.7
What training type would you select if offered free bio-risks training programs?		
Formal Training	16	55.2
Short Training Course/Self-Study	13	44.8
Total	29	100

3.2.6 Training Source and Cooperation Activities

Table 7: Training Sources and Cooperation

<ul style="list-style-type: none"> ● Ministry of Agriculture ● Institute of Livestock ● Department Veterinary Medicine Vietnamese Good Agricultural Practices (VietGAP) ● Forest and Agriculture University ● National Centre of Agriculture Services ● Provincial Centre of Agriculture Services ● Dong Nai Veterinary Medicine ● Different projects and programs ● FAO ● NIHE ● WCS ● STOP Spillover ● The Vietnam One Health University Network ● APCOVE CIRAD ● The Canadian International Development Agency and World Bank Lipsap (Livestock & Food Safety 2010–18) ● Universities

The biosafety and biosecurity training courses that respondents reported attending were organized and offered by different agencies under MARD, DARD (national and provincial levels), INGOs, and various projects or programs during the past 10 years. Many were *ad hoc* and offered in response to a specific disease issue, and thus not institutionalized and offered on a regular or recurring basis.

Regarding the stakeholder in charge of biosafety and biosecurity, there was an opinion from a Dong Nai Sub-DARD representative that biosafety should be independently inspected by a third party and recommended to improve disease control and improve commodity production.

VietGAP¹⁵ is a standards and certification program for plants and livestock products in agriculture and offers one example of third party inspection and certification. Through our survey, VietGAP was described as the main provider of biosafety and biosecurity capacity-building programs to date, well-staffed with expert trainers and curricula. As the Department of Animal Health (DAH) leader mentioned, VietGAP has 150 livestock farms and 40 crop farms established in certification programs in Dong Nai. Although animal husbandry following the VietGAP standards is not required by the Ministry of Agriculture, it has a full manual for solving practical problems (seeds, feed, waste treatment) and has a policy to support participants in the development of the VietGAP process (30% for households who can participate according to Decision 31/2021). VietGAP has a budget and annual plan that includes training activities.

It was recommended that in addition to the VietGAP experts, the core trainers for future biosafety and biosecurity programs should be invited from the Livestock Department. The VietGAP available database, procedures, and documents can be used as reference for the wildlife biosecurity training development, if needed.

3.2.7 Barriers to Biosafety and Biosecurity Training Reported by Officers

Barriers to government officers' biosafety and biosecurity training were divided into five groups: (1) governance, (2) finance, (3) human resources, (4) information and instruction materials, and (5) infrastructure and supplies. Each barrier under each group was evaluated using a five-point scale for degrees of agreement as follows: strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree. Results are in Table 8 below.

Among the five groups of barriers, information was identified as a problem by the highest percentage of respondents. The category of 'no biosafety curriculum and no documentation' was the least commonly identified barrier (38%), though may have lacked specificity about wildlife content. 'Lack of information on suspected pathogens' scored highest (80% agreed) and 'limited evidence or information shared' scored second highest (76% agreed) as barriers for training, specifically related to farmed wildlife.

¹⁵ VietGAP includes standards/regulations on good agricultural practices for agricultural products (cultivation, livestock, aquaculture) in Vietnam. This includes principles, order, and procedures to guide organizations and individuals to produce, harvest, and preliminarily process products to ensure safe products; improve product quality; ensure social welfare and health of producers and consumers; and ensure environmental protection and product traceability.

VietGAP standards/regulations are compiled based on the provisions of Vietnamese laws (Law on Food Safety, Law on Standards and Technical Regulations, Law on Environmental Protection, Law on Water Resources) and guidelines of FAO, and refer to regulations in ASEANGAP, GlobalGAP, EurepGAP, and HACCP standards.

Table 8: Barriers to Officers' Biosecurity Training, % of Respondents by Degree of Agreement

	Barriers to Biosafety and Biosecurity Training	% Strongly Agree	% Agree	% Neither Agree/ Disagree	% Disagree	% Strongly Disagree
1.	Governance					
	No policy guidelines	13.8	37.9	13.8	31.0	3.4
	Poorly formulated guidelines	6.9	58.6	13.8	20.7	0.0
	Poor guideline dissemination	13.8	51.7	17.2	17.2	0.0
	Not adhering to laws	13.8	51.7	13.8	17.2	3.4
2.	Financial Barriers					
	Biosafety/biosecurity program poorly financed	60.7	10.7	25.0	3.6	0.0
	No finances for training	3.6	39.3	10.7	39.3	7.1
3.	Human Resources					
	No trained personnel	10.7	39.3	10.7	32.1	7.1
	Inadequate numbers trained	0.0	42.9	10.7	39.3	7.1
	Heavy workload	3.6	57.1	28.6	7.1	3.6
	Lack of training of trainers (TOT) teams	17.9	50.0	3.6	25.0	3.6
4.	Information and Instructional Materials					
	Limited database	10.3	65.5	6.9	13.8	0.0
	No biosafety and biosecurity literature	6.9	41.4	24.1	27.6	0.0
	Lack of information on suspected pathogens	6.9	72.4	10.3	10.3	0.0
	No curriculum on biosafety and biosecurity	6.9	31.0	24.1	37.9	0.0
	No instructional materials	6.9	31.0	20.7	41.4	0.0
5.	Infrastructure and Supplies					
	Inadequate infrastructure	3.4	41.4	27.6	24.1	3.4
	Lack of equipped laboratories	13.8	44.8	20.7	17.2	3.4
	Lack of provision of PPE	10.3	31.0	20.7	34.5	3.4

“Actually, we are not worried much about our training capability, but the formal information for development of training contents related to the evidence of zoonotic risks from wildlife... We need a trusted source of scientific information to persuade our trainees/farmers about any potential risk caused by their cultivation/farming.” Trainer from the Animal Health subdivision

The concern quoted above from the trainer was reflected in the fact found later when many farmers did not believe that their animals could cause any diseases (see farmers' KAP survey).

The second highest ranked barrier was finance, with strong agreement that biosecurity programs receive insufficient funding and 43% indicated that there were no financial resources for training. However, there was variation in the response to the second question (no = 46%) and provincial leaders did not agree that lack of finance was the main barrier. There was also an opinion from the leader of DARD (with a similar opinion from the leader of DAH) that:

“Money really is not a barrier as the budget is always available for training or communication. The main reason was due to the HR capacity to develop the right training plans as well as to conduct such kind of training. If the staff are capable enough, they can propose a budget from the State.” Leader at DARD

Public sector governance and management was the third ranked barrier with an average of 65% of all interviewees indicating the three criteria were barriers. ‘No policy guidelines’ scored the lowest, with 52% agreed and 34% disagreed, but is still at a level that indicates concern. Those that did not agree felt that Dong Nai province already had many policies to encourage biosecurity.

“Dong Nai has proposed the policy allowing the Wild animals (bears) to be released into the forest and captive wildlife are still allowed to be raised normally but are not encouraged for being slaughtered nor commercialized. When there is an epidemic (rabies), dogs are banned from slaughter, and can only be raised.”
Leader, Dong Nai Provincial Forest Protection Sub-Department

Table 9: Ranking Summary of Barrier Groups among Officers

Ranking Barriers	Description	%
1. Barriers to Information	<ul style="list-style-type: none"> Lack of information on suspected pathogens Limited evidence or information shared 	79.3% 75.6%
2. Financial barriers	<ul style="list-style-type: none"> Biosecurity programs receive little funding No financial resources for training 	71.3% 43.0%
3. Regulation barriers	<ul style="list-style-type: none"> The content of the guideline has many shortcomings Inadequate propaganda and dissemination of instructions Not tied to regulations/sanctions 	65.5%
4. Other barriers	<ul style="list-style-type: none"> Infrastructure and supplies only scored 50% on average and had the highest number of disagreements and no objections No biosafety curriculum and no documentation was the lowest barrier group 	< 50% 38%

Human resources received the highest score as a barrier, due to the reported lack of TOT teams (68%), followed by heavy workload of concerned personnel (61%). The rankings for ‘inadequate numbers trained’ and ‘no trained personnel’ received a mixed score with 43–50% agreeing and 46–40% disagreeing. Some indicated that not enough people were trained because sometimes after invitations were sent, the owners of the farm did not participate due to fear of being infected from other farms, or they could not organize the training because there were not enough trainees and they had to change training locations. Concern about exposure to personnel from other farms or visiting other farms is positive and reflects an awareness of biosecurity.

The lowest ranked barrier was infrastructure and supplies; fewer than 50% agreed that this was a barrier, and this had the highest number of disagreements and no objection (more than 50%). Among the lowest ranked barriers was the lack of provisioning of PPE. Only 41% agreed that the lack of PPE provision was a barrier and 38% disagreed.

3.2.8 Analysis of Strengths, Weaknesses, Opportunities, and Threats

Based on the above-mentioned analysis, Dong Nai currently has a lot of good conditions and opportunities for developing capacity building programs on wildlife biosecurity. The strengths, weaknesses, opportunities, and threats (SWOT) are summarized in Table 10.

Table 10: SWOT Analysis of the Biosecurity Capacity Building Program

STRENGTHS

- In line with the strategic directions of the sector/government.
- Aligns with the priorities of donors, OH programs, and networks.
- Consistent across basic infrastructure and state budget.
- All units have staff with high levels of education and practical experience.
- Officials and residents both highly appreciate the importance of biosafety and the need to raise public awareness and capacity of officials.

WEAKNESSES

- Contains only short-term priorities of units, localities, programs, and projects.
- Lacks specific long-term training strategies/support programs specifically for biosafety and wildlife.
- Lacks needs assessment and prioritization in capacity building planning.
- Lacks lessons learned and extensive needs assessment and training for OH officers at all levels.

OPPORTUNITIES

- There are several training programs and a full set of biosafety standards for livestock and poultry farming (FAO).
- Training programs and projects and basic programs have been scattered over the years, especially in the past 10 years.
- Experienced in cross-sector cooperation and coordination through many epidemics.
- The trained and current OM staff could be the key trainer/core group.

CHALLENGES

- Lacks international and domestic experience in both resources and training programs directly related to wildlife.
- Lacks resources of trainers/experts with direct experience in wildlife.
- Lacks practical experience on biosafety/wildlife tests.
- Lack of lessons learned and needs assessment from the community.

Conclusions Related to Government Officers:

Government staff all have backgrounds, qualifications, and practical experience with livestock rather than with wildlife. They had very limited opportunities to be trained and to work with wildlife management and to practice biosafety or biosecurity. However, most of them are aware of the risk of zoonotic diseases, have adequate knowledge about basic requirements of biosafety and biosecurity, and strongly emphasize the necessity of biosecurity training.

Dong Nai currently contains many favorable conditions for capacity building related to OH, wildlife biosafety and biosecurity, and SBC programs. Dong Nai province already has many policies to encourage wildlife protection, biosafety, and biosecurity, and prioritizes these areas within government agencies. The government and various donor programs have conducted some related training and intervention programs. However, most of them were donor driven, of short durations, and not articulated in the context of institutional change. They lacked a

systematic or strategic focus of financial and human resources as most were initiated and implemented by external donors and organizations.

The greatest barriers identified for training among the government officers were the lack of information on known or suspected pathogens in farmed wildlife and the limited evidence or information shared among human, domestic animal, and wildlife health sectors. Funding was the second highest ranked barrier, and was thought to be mainly due to a lack of planning and advocacy, instead of a lack of financial resources for training (as many personnel claimed). Several barriers related to organization and dissemination of information were frequently raised, such as shortcomings in the contents of the specific guideline on recommended domestic animal and wildlife farm biosafety and biosecurity practices, inadequate promotion and dissemination of instruction, and training being optional or not tied to regulations or/sanctions. The lowest ranked barriers were related to infrastructure and supplies.

Training and Capacity Building Recommendations Related to Government Officers:

- To sustainably and effectively develop the kind of support described above, internal capacity must be built for wildlife-related management staff at all levels. Staff can continue the capacity building for those who work with wildlife and wildlife farmers who can act as wildlife peer educators who network with other farmers. In this role, they can also coach and counsel their community with their own knowledge and experience.
- The evidence base on pathogens known or suspected to be present on wildlife farms, as well as the potential risks to humans and other animals, must be improved. There is a shared recognition among government officers and wildlife farmers about this critical knowledge gap and the need to address it.
- The TOT core training groups should be prepared for delivering training that could be raised or developed from community needs.
- The TIPs could be piloted as soon as the rapid assessment is finished.

3.3 KAP Regarding Zoonotic Diseases and Biosecurity

3.3.1 Demographic Information on Wildlife Farmers



Dinh Quan is a mountainous district, only about 100 km from Bien Hoa city. This proximity allows for similar economic and social development conditions. General education qualifications are fairly good among wildlife farmers. Most are young and motivated to actively learn new knowledge to run their own business and expand their market.

High education levels were found among farmers who

were former agriculture or animal health officers and who raised wildlife as a hobby after they retired, or among young university graduates who recently started wildlife farming. With good education, these people became the core group of both the most experienced and some of the youngest pioneering wildlife farmers who are eager to learn and share their own experience and information with others in the network and community.

Table II: General Information of Wildlife Farmers in Dinh Quan District

General Information	N	%
Gender		
● Male	38	57.5
● Female	28	42.4
	66	
Education		
● Primary School	7	10.6
● Secondary School Level 1 (5–9 grades)	29	43.9
● Secondary School Level 2 (10–12 grades)	25	37.9
● Above College/University	5	7.6

The participants on surveyed farms were nearly gender balanced with male owners representing a little over half the sample. Education level was moderate— of the 66 farmers interviewed, only 8% had college or university level education, but more than 80% had at least a secondary school education (Table II).

3.3.2 Classification of Wildlife Herd and Farm Sizes by Species

Most farms raise wildlife together with other livestock or pet animals, such as pigs, poultry, goats, dogs, and cats. Among the selected farms, 52 (79%) farms raise only one wildlife species, and 14 (21%) farms raise multiple species.

On the 66 farms, a total of 17,280 individual wild animals of various species were held, with the greatest number of individual animals being pythons and other snakes concentrated on a small number of farms (Table 12). Species considered most likely to host STOP Spillover priority pathogens, especially coronaviruses (civet, bamboo rat, and porcupine) are referred to as key species. Among these, the most frequently held species (but not the most numerous in terms of numbers of individual animals) was the palm civet (41% of farms), followed by bamboo rats (24% of farms) and porcupines (14% of farms).

Table 12: General Information of Wildlife Farms by Respondent-Identified Primary Species in Dinh Quan Survey Area.

Species	Number of Farms	Mean Animals per Farm	Area (m ²)	Stocking Rate (m ² /head)
Bamboo rat	20	56	53.6	1.2
Civet	27	17	55.6	4.0
Porcupine	9	25	53.6	2.6
Snake, multiple species	6	2108	724.2	0.3
Earth python	2	910	175.0	0.2
Boar	1	7	24.0	3.4
Freshwater crocodile	1	500	200.0	0.4

3.3.3 Key Findings from Rapid Assessment of the Wildlife Farmers

Key Findings Related to General Wildlife Farmers

Based on the modified FAO checklist of biosecurity criteria, each wildlife farm owner was asked to indicate the following: (1) Did they already know the criteria for requirements? (2) Have they followed/tried to do as required? (3) If they followed/tried, did they succeed or follow it properly/regularly as required?

Most farmers were cooperative in answering all the questions related to their knowledge and current practices. Overall, most of the wildlife farmers have good knowledge of biosafety and biosecurity requirements (87%), but only 59% among them have attempted or succeeded in performing the practice as required. Only 39% of farmers confirmed they have practiced biosafety and biosecurity regularly or properly as required. The detailed results related to three main categories for rapid assessment as knowledge – practice performance and success rates for each of the 34 main and 3 sub-criteria of biosafety and biosecurity requirements could be

seen at the following summary of the most prominent key findings for each of above-mentioned questions.

Table 13: Levels of Knowledge, Compliance and Success in Adoption of Biosafety and Biosecurity Practices at 66 Wildlife Farms in Dinh Quan District.

Question No.	Checklist Criteria	Knows the Practice	Has Attempted to Follow	Successfully Adopted
1.1	Distance to industrial water treatment	94%	92%	88%
1.2	Distance to schools/hospitals	94%	94%	89%
2	Water source	98%	91%	89%
3	Waste management area	97%	73%	70%
4	Walls	97%	58%	48%
5	Isolation area	94%	55%	47%
6	Barn cleaning	94%	47%	39%
7	Food placement	100%	80%	74%
8	Vermin risks	67%	27%	21%
9	Vermin entry ban	91%	62%	52%
10	Vermin protect net/cover	76%	52%	30%
11	Breed certification	100%	100%	97%
12	Isolation before combination	91%	30%	21%
13	Food source identified	95%	74%	68%
14	Water source	94%	76%	70%
15	Records/log book	50%	30%	21%
16	Farming techniques	58%	33%	26%
17.1	Use PPE: boots, shoes	82%	50%	26%
17.2	Gloves	86%	71%	62%
17.3	Masks	95%	83%	71%
17.4	PPE clothes	76%	38%	5%
18	PPE changes and hand wash	73%	27%	11%
19	Sterilization spray	76%	42%	29%
20	Sterilization food/water trays	95%	83%	79%
21	Diseases control prevention	82%	23%	12%
22	Reproduction hygiene	86%	27%	21%
23	Clean the farming devices	89%	42%	38%
24	Separate room and device per ages	89%	68%	64%
25	Solid waste treatment	88%	58%	47%
26	Liquid waste transport	85%	48%	41%
27	Liquid waste treatment	76%	23%	15%

Question No.	Checklist Criteria	Knows the Practice	Has Attempted to Follow	Successfully Adopted
28	Vaccination	47%	11%	5%
29	Animal health profile	39%	17%	12%
30	Sick animal protection	94%	55%	52%
31	Animal health reporting	88%	12%	9%
32	Zoning for diseases control	95%	32%	27%
33	Training for farmers	71%	20%	8%
34	Traceability profiles	97%	94%	91%
	Average	84%	53%	44%

On average, 84% of respondents reported knowledge of the biosafety and biosecurity requirements. (Table 13). The level of self-reported knowledge of biosafety requirements/regulations was quite high, ranging from 94–100% for the first seven criteria related to location of the facility and standard of the enclosures.

All respondents reported knowledge of the breed origin requirement due to strict wildlife regulations of the forest protection local office. The second highest score was on knowledge of the need to ensure the hygiene of food placement and water sources (100% and 98% respectively). The lowest score was on knowledge concerning animal health profile (39%) and vaccination (47%) requirements. The records and log books (50%) scored third lowest, emphasizing that documentation and record-keeping requirements are not well recognized by most farmers.

Although the level of knowledge of biosafety requirements/regulations was reported as high (87%), only 53% of farmers had attempted to implement the requirements. The gap between knowledge and practice was substantial in many cases.

Farmers exhibited high knowledge of PPE requirements, but typically less than half of farmers had attempted to implement them. Respondents appear to know that it is required but do not want to use available PPE frequently as it is heavy, hot, and uncomfortable. Other practices with a large gap between knowledge and attempts to implement were cleaning, waste management, vermin control, and animal health reporting.

The interviews and site visits revealed a wide range of standards in physical facilities in wildlife farming operations. Many respondents reported that they take advantage of pre-existing livestock/poultry barns. Some households have constructed purpose-built barns out of bricks or wood that are usually 5–20m away from the family residence. Some farmers clean their barns daily and spray insecticide, typically once a month, and wastewater and excrement are generally washed into a covered manure cellar or cesspit. Manure may be applied to gardens or fishponds, and in some cases biogas is harvested from anaerobic fermentation of manure. Very few people mentioned management of visitors with one exception—most households raising

porcupines and civets are cautious about allowing guests to enter, especially during breeding time because the animals are scared and bite their newborns.

Unsurprisingly, the rate of regular successful adoption was lower than attempted compliance—44% on average. In most criteria, the rate of successful adoption was only slightly lower than for “attempt to follow,” but there were some exceptions, especially in PPE. Many farmers had evidently tried using various forms of PPE and abandoned the practice or continued to follow the requirements only infrequently. Very high levels of compliance and successful implementation were seen on breed certification, citing rules (in relation to water sources, hospitals, schools, etc.) and traceability profiles.

Key Findings Classified by Wildlife Species

The team also stratified data on knowledge and attempted compliance and successful adoption of the 34 selected biosafety and biosecurity requirements by the three key species (bamboo rats, civets, and porcupines). Overall, most metrics were similar across species (Table A3, Table A4, and Table A5), but a few notable differences among species were observed.

Although they did not exhibit the greatest knowledge of required practices, bamboo rat farmers were somewhat more likely to have tried or succeeded in successfully adopting them (Table A4 and Table A5). These differences were not consistent across metrics—most of the differences in the means were accounted for by large discrepancies on a handful of practices. Bamboo rat farmers were much more likely to have attempted (50%) or succeeded (35%) in applying the isolation requirement for new stock compared with civet (22%, 19%) or porcupine farmers (11%, 11%). Bamboo rat farmers also scored much higher on vermin management and most types of PPE use, though civet and porcupine farmers were more likely to wear masks than bamboo rat farmers. A much higher proportion (85%) of bamboo rat farmers isolated sick animals from conspecifics than civet (33%) or porcupine (44%) farmers. Civet and porcupine farmers also generally scored lower for both attempted and successful compliance on most record-keeping measures, though they were more likely than bamboo rat farmers to have documented the food and water sources for their animals.

Among key species, the biosafety-required criteria seemed to have been known more among the civet farmers (88%) than the other two who shared almost the same percentage (84% for porcupine and 83% for bamboo rat farmers). It may reflect the fact that the civet was the newest and not as well known or traditional as the two other species. Therefore, most of the civet farmers were also the newer and younger generation who had to learn how to raise and save their expensive wildlife species via the internet or by self-study. Meanwhile, the farmers of bamboo rats or porcupines learn on their own or through experience from previous experienced farmers, requiring less updated information than those raising newer and rarer species like civets.

Non-key species farmers were not greatly different in their practices compared to farmers of the key species. They demonstrated slightly higher levels of knowledge, attempted compliance, and successful adoption on average, though only by small margins. Most practices were similar, but non-key species farmers showed higher compliance in some basic husbandry areas such as using gloves, cleaning food and water dishes, and vermin control. Animal health records and reporting remained poor, but records of food and water sources as well as traceability profiles were somewhat more likely to be kept by these farmers (mostly snake farmers).

3.4 Priorities of the Biosecurity Practices

Based on the results from all three above checklists related to the knowledge, attempted compliance, and successful adoption, the final short list of five has been chosen by discussion among the survey team.

The goal was to select practices that had poor compliance, high potential impact, and high implementation feasibility. Practices that are highly dependent on outside factors or actors were not considered good implementation targets as they could not necessarily be influenced by the project. Vaccination (5%) and training for farmers (8%) were discussed and have high potential impact, but they were considered to have low implementation feasibility due to reliance on outside factors such as vaccine availability and rollout of structures for development and delivery of farmer extension training.

The remaining three practices from the shortlist were therefore selected as the most promising areas for immediate intervention implementation.

Table 14: Shortlist of Five Priority Gaps for Farmers (%)

#	Criteria	Knows the Practice	Has Tried to Practice	Successfully Adopted	Priority Ranking
17.4	PPE clothes	76	38	5	1
21	Diseases control and prevention	82	23	12	2
27	Liquid waste treatment	76	23	15	3
28	Vaccinations for wildlife	47	11	5	4
33	Training for farmers	71	20	8	5
	Total average for all 34 criteria	84	53	44	

Priority #1. Enhanced PPE Use

Our data indicated high levels of knowledge around PPE practice (60–100% depending on species and specific criteria), but much lower compliance. Use of dedicated footwear, clothing, masks, and gloves were the most frequently reported PPE type used, and these were reportedly used more often by civet and porcupine farmers than bamboo rat farmers.

Through our direct observation at farm visits, we noted that most farmers did not use any PPE, even when they sprayed water for cleaning the floors under the civet cages or when they fed the bamboo rats. Some civet farmers even hug and hold their civets with their bare arms, as they did with their cats or dogs.

Figure 2: Some observations at the Dinh Quan farms. Photo on the left shows a farmer handling a civet without PPE. The photo on the right shows a farmer hosing waste from under a civet cage without PPE.



These results were comparable to those from Risk Assessment where moderate levels of use of PPE were reported. The respondents in that survey reported that dedicated shoes or boots were commonly used when feeding (55%), cleaning cages (65%), and handling animals (36%). Gloves were reportedly often used when cleaning the barn (67%) and handling animals (43%). Masks were frequently used during feeding (70%), cleaning of cages (72%), and velveting (40%). Protective clothes/gowns/aprons were rarely used (less than 20%) in most animal care and handling operations. There are still farmers who do not use any PPE in livestock production activities (accounting for 11–28%). A minority (10%) of respondents do not use any PPE in feeding (14%) and handling (10%) animals at sambar deer farms.

Priority # 2. Disease Control

One of the most significant challenges for wildlife farmers was caring for sick animals. The need to care for sick animals is well understood, and although the farmers often call a veterinarian for sick livestock (including poultry), they often do not request treatment for captive wildlife—generally because they are aware veterinarians do not have much wildlife-related experience. More commonly, they will consult friends or peers from informal wildlife farming networks who do have in-depth experience with the areas of concern. Farmers related previous difficulties they had encountered due to a lack of available expert animal health services. For example,

civets have gastrointestinal disease that appears to respond to treatment, but the animals die shortly after they appear to have recovered and returned to their normal diet. Farmers expressed frustration at the lack of good animal and health and nutrition information to deal with health issues on wildlife farms.

Farmers generally described diseases based solely on the observed symptoms, and animals generally did not have any form of veterinary examination. Treatment of sick animals was based on previous experience with livestock, using medications according to cattle or poultry dosage, adjusted for weights. No medical records were typically kept for wildlife at the farm. Farmers reported buying breeding stock based on peer suggestions.

Some concerns have been raised regarding declining reproductive success or infertility, which may be caused by inbreeding and limited genetic diversity of the captive stock in some species. It is also frequently reported that civet mothers tend to kill or eat their newborns when they are disturbed, such as seeing unfamiliar people. In addition to being an observed health problem for wildlife farmers, the fact that this species is highly subject to disturbance during the breeding season should be considered in scheduling any intervention or research activity on civet farms. Farmers expressed a desire to be instructed in better reproductive techniques.

Overwhelmingly, respondents believed that captive wildlife have very few diseases due to the closed breeding system and predominantly home-grown feed. Most farmers said that there are no diseases seen on their farms or in their captive wildlife and that they catch diseases from wildlife. They rely upon their experience in livestock husbandry and on advice or information from other farmers who are successful in wildlife production. Wildlife farmers in our survey displayed a low level of awareness of biosecurity principles and had a low zoonotic disease risk perception. Most farmers reported low PPE use, and little or no PPE use was observed by survey teams on farms (see Figure 2 above). Biosecurity and zoonotic disease communication materials are generally not available for farmed wildlife in Vietnam, and farmers report that no communication campaign for zoonotic disease prevention in the wildlife value chain has occurred to date in Dong Nai province.

A related issue that needs addressing is the lack of targeted health services and health surveillance for wildlife farmers. Although most respondents did not think they were likely to get sick from their animals, when we asked for more details, some declared that they do experience flu-like illnesses, though they regarded this as normal and are not concerned by it.

Priority #3. Waste Treatment and Environment Management

Waste management was another area identified for improvement. The most basic criterion—existence of a designated location for waste—was well known (97%) and successfully adopted by 70% of farmers. In general, sound waste management practices were much less common. Though requirements for effective management of solid and liquid wastes were fairly well known (76–88%), less than 50% of farmers had successfully adopted sound practices for

managing solid wastes and only 15% for liquid waste (typically washdown water from cleaning enclosures). Porcupine farmers had the lowest rate of successful adoption of sound liquid waste management practices at 11%. This was reflected in the direct observation during our field trips that most farms raising porcupines seemed dirtier and smellier than those of other species. Civets, by contrast, generally lived in the better high and dry barns. The team observed that the waste treatment at some farms seemed very poor and was even left mixed at the same feeding areas of porcupine cages.

Many farmers clean their barns daily and the washdown water is generally drained into a covered manure cellar or cesspit. Manure may be applied to gardens or fishponds and in some cases, biogas is harvested from anaerobic decomposition of manure. A wide range of standards in hygiene, biosafety, and biosecurity practices was observed, which suggests that positive deviance approaches may be effective in spreading sound practices that have already been developed in situ.

Many farmers voiced ideas for better treatment methods for wastewater and animal waste. They expressed interest in suitable probiotic fermentation to treat manure, wastewater, and other animal waste to reduce odor and prevent environmental contamination. Some indicated that they are considering building gutters to drain wastewater from barns to manure cellars or build biogas harvesting systems. Some farmers also expressed an interest in provided, suitable disinfectants and disinfecting their farms.

3.5 Farmers' Self-Assessment

Disease control was identified as the top priority (30% of respondents) for improvement by farmers and also their self-assessed weakest area (33%). Locations and barn hygiene (which includes waste management) was the second priority (23%) for improvement for farmers, though it was the self-identified strongest practice (38%). Similarly, caring and feeding was identified as the third priority for improvement even though it was self-identified as one of the strongest practices (38%).

Table 15: Farmers' Self-Assessment on Biosecurity Practices

Common Practice Groups	Strongest Area	Weakest Area	Top Priority for Improvement	Priority #
Disease control	2%	33%	30%	1
Location and barns	38%	17%	23%	2
Caring and feeding	38%	30%	21%	3
Breeding	6%	9%	12%	
PPE	16%	11%	14%	

The Farmers' Self-Assessment showed that the farmers could not identify true priorities by themselves or focused on big/general areas instead of small/specific things such as PPE. Though

farmers did not consider PPE to be their worst area, we have included results for PPE in Table 15 for comparison due to our observations together with the output of the KAP assessment in Section 3.3.

3.5.1 Farmers’ Self-Assessment on Biosafety and Biosecurity Perspectives

Table 16: Farmer Perceptions about Biosafety and Biosecurity

Area	Yes	Maybe	No	Don’t Know
Current practices of farmers can lead to zoonotic disease	8%	9%	76%	8%
Applying all required biosafety and biosecurity practices helps prevent zoonotic diseases	33%	58%	5%	5%
Farmers risk zoonotic disease infections by not following biosafety and biosecurity practices	29%	59%	3%	9%
Friends, family, and community support adoption of biosafety and biosecurity practices	49%	29%	3%	20%
Able to adopt all necessary biosafety and biosecurity practices with current knowledge and skills	9%	65%	14%	12%
Need biosafety and biosecurity training	76%	-	2%	23%
Able to adopt the necessary biosafety and biosecurity practices in wildlife farming with the time, money and other resources currently available	14%	65%	6%	15%

To understand wildlife farmer perspectives on biosafety, biosecurity, and zoonotic disease, nine priority issues were probed in a self-evaluation survey. Respondents were asked to classify the perception of seven issues based on their level of agreement (high, medium, low, or don’t know). Results for those issues are shown in Table 16 above.

Critically, of the farmers surveyed, 76% did not believe that their current wildlife farming practices could lead to zoonotic diseases. In a separate YES/NO question, 62% of respondents did not know the specific dangers of zoonotic diseases. Given that knowledge gap, it is not surprising that only 33% responded that following required biosafety and biosecurity practices helped prevent zoonotic disease risks, and that only 29% thought that farmers are at risk of zoonotic disease infections if they do not follow required biosafety and biosecurity practices. These results reflected similar findings to the Behavioral Risk Assessment conducted in Tan Phu and Vinh Cuu districts of Dong Nai province.

Although most farmers did not know about the risks of zoonotic diseases, they responded that biosafety and biosecurity practices were socially accepted (49%) or might be socially accepted (29%). It is important that 76% identified that they need biosafety and biosecurity training. Farmers thought they would have trouble (11%) or might have trouble (64%) remembering all the biosafety and biosecurity procedures, using a YES/NO/MAYBE scale. Despite that concern,

most also believed they could adopt the required biosafety and biosecurity practices with their current resources (15% YES, 65% maybe).

3.5.2 Farmers' Assessment on Barriers for Biosecurity Practices

Farmers were requested to share their opinions on the likelihood of success, timeframe, and locus of responsibility for each of the 11 previously self-identified barriers.

The score is calculated as the sum of highly likely, likely, medium-term, and short-term, standardized to a maximum possible score of 1.0, which indicates 100% of respondents scored this item as either likely or highly likely AND either medium- or short-term impact timeframe,

Table 17: Perceived Barriers to Implementation of Improved Biosecurity and Biosafety Practices on Wildlife Farms.

	Likelihood			Timeframe				Score
	Highly Likely	Likely	Not Likely	Long-Term	Medium-Term	Short-Term	No Answer	
Cost to make changes (n=62)	14.5%	82.3%	3.2%	14.5%	71.0%	12.9%	1.6%	0.90
Attitude to biosafety (n=61)	11.5%	83.6%	4.9%	11.5%	73.8%	11.5%	3.3%	0.90
Legislative uncertainty (n=62)	14.5%	82.3%	3.2%	39.3%	42.6%	16.4%	1.6%	0.78
Comfort of PPEs (n=61)	42.6%	50.8%	6.6%	11.5%	60.7%	24.6%	3.3%	0.89
Changes restrict innovation (n=61)	32.8%	62.3%	4.9%	25.0%	56.7%	16.7%	1.7%	0.84
Lack of access to information (n=61)	36.1%	62.3%	1.6%	13.1%	49.2%	36.1%	1.6%	0.92
Administrative burden (n=60)	6.7%	86.7%	6.7%	26.3%	59.6%	10.5%	3.5%	0.82
Hassle of making changes (n=61)	32.8%	63.9%	3.3%	23.3%	63.3%	11.7%	1.7%	0.86
Turnover of staff (n=61)	3.3%	83.6%	13.1%	6.7%	65.0%	20.0%	8.3%	0.86
Training costs (n=61)	6.6%	86.9%	6.6%	6.7%	73.3%	16.7%	3.3%	0.92
Time to make changes (n=61)	8.9%	82.1%	8.9%	25.0%	53.6%	19.6%	1.8%	0.82

Most farmers believed that removal of the identified barriers would be likely (75%) or highly likely (20%) to result in them being able to implement better biosafety and biosecurity practices. Only a few people (5%) doubted the success of biosafety and biosecurity practices when barriers were removed.

Most barriers were evaluated by farmers as having a medium-term timeframe for impact (61%), with the remainder approximately evenly split between short- and long-term timeframes. The composite scoring metric based on combined likelihood of impact and short or medium impact timeframes placed lack of information, training cost, cost of change, and attitudes as the most promising areas.

Table 18: Farmer Beliefs on Locus of Responsibility for Addressing Perceived Barriers to Implementation of Improved Biosecurity and Biosafety Practices on Wildlife Farms

Barrier	Farmer	Government	Both
Cost to make changes (n=62)	<u>82.3%</u>	-	17.7%
Attitude towards biosafety and biosecurity (n=61)	<u>85.2%</u>	-	14.8%
Legislative uncertainty (n=61)	3.3%	77.0%	19.7%
Comfort of PPE (n=61)	<u>78.7%</u>	1.6%	19.7%
Changes restrict innovation (n=60)	78.3%	1.7%	20.0%
Lack of access to information (n=61)	23.0%	11.5%	<u>65.6%</u>
Administrative burden (n=59)	10.2%	64.4%	25.4%
Hassle of making changes (n=61)	57.4%	3.3%	39.3%
Turnover of staff (n=60)	90.0%	8.3%	1.7%
Training costs (n=61)	23.0%	27.9%	<u>49.2%</u>
Time to make changes (n=56)	80.4%	1.8%	17.9%
Mean	56%	18%	26%

Farmers generally took responsibility for making these changes upon themselves (mean of 56% for all perceived barriers). One woman at Dinh Quan town noted during the first FGD that

“Biosecurity is more likely related to changing our daily habits or improvement of environment hygiene rather than investing in or buying new equipment, neither to change or upgrade too much of our available facilities.” Woman, Dinh Quan town, FGD at Phu Ngoc commune

Farmers did not assign responsibility to government for addressing most of the barriers (mean of 18% across all perceived barriers). The only areas where respondents felt that most of the responsibility rested with the government were legislative uncertainty (77%) and administrative burden (64%). Respondents identified the lack of information (66%) and the cost of training (49%) as areas of shared responsibility between farmers and the government.

Among the top five barriers (underlined in Table 18), the most feasible barriers were prioritized to address by farmers, because they were identified as the highest personal responsibilities (i.e. cost to make changes, attitude towards biosafety and biosecurity, comfort of PPE), or those shared by farmers and government (i.e. lack access to information and training costs).

PART 4. CONCLUSIONS AND RECOMMENDATIONS

4.1 *Some Current Outstanding Biosecurity Issues in Wildlife Farms in Dong Nai*

- The most visible gap noticed by the survey team as outsiders for the priority practices among wildlife farmers was the limited to moderate use of PPE that varies by activity and species. In contrast, the most worried about and prioritized issues raised by farmers was the lack of wildlife health services leading producers to self-treat when animals are sick. Farmers also strongly lacked knowledge about zoonotic diseases.
- The highest agreed upon common priority was the existence of some unhygienic farms: mixed garbage, waste of wildlife and domestic animals, and the treatment of waste was a common dilemma for many farms of different species.
- Despite disease control and care and treatment of sick animals ranking as the most important concern among farmers, many still believe that wild animals are clean, cannot spread diseases to humans, and can't spread diseases from outside. However, there are some who are concerned about diseases they can catch from their wildlife. This reflects the conflicts/uncertainty in their knowledge and perceptions that may need to be corrected.
- Most farmers buy breeding stock based on the recommendations of friends and neighbors, test the varieties by experience, and raise them according to the experience of the breeding farm. However, using the same and nearest source of breeding can cause inbreeding or infertility or weak/sick babies.
- The role of veterinary care was quite vague, and the farmers mostly consulted with each other to find the way to take care of and treat their sick wildlife. This suggests a need for commune OH workers who can support capacity building and strengthening the peer education network on wildlife.

4.2 *Comparison of SWOT Related to Biosecurity Capacity for Officers and Farmers*

Most government officers (80%) rated biosecurity training as extremely or very necessary and 76% of wildlife farmers agreed. Common challenges included big gaps in KAP, lack of training on biosecurity and zoonotic diseases, lack of clear regulations/guidelines, and lack of mechanisms

to promote biosecurity. Each target group has their own specific gaps/challenges for both training and application of biosafety and biosecurity improvements as shown in Table 19.

Table 19: Comparison of SWOT for Officers and Farmers

Main Issues	OH Staff	Farm Owners
Common Challenges	<ul style="list-style-type: none"> ● Lack of training on biosafety and zoonotic diseases for both managers and farmers ● Huge gap in KAP in terms of zoonotic diseases and biosafety/biosecurity ● Lack of clear and detailed implementation guidance on health monitoring, food safety, and wildlife value chain inspection ● Lack of mechanisms to promote biosafety/biosecurity compliance for wildlife farm owners 	
Challenges for Each Group	<ul style="list-style-type: none"> ● 73% no/never trained (only 27% trained at least once) ● 45% rate zoonotic diseases as serious ● 41% think zoonotic disease is not serious ● Veterinary and wildlife-related services are limited 	<ul style="list-style-type: none"> ● 100% of people have never been trained on biosafety. ● 76% of people do not think their current farm can cause any zoonotic diseases. ● 40% of farmers consider biosafety to be important. Their three priorities include PPE use, disease control, and waste treatment. ● There is a strong interaction among the network of the wildlife value chain actors, but the capacity for livestock production, biosecurity, and prevention of diseases transmitted to humans is still limited.
Opportunities	<ul style="list-style-type: none"> ● 80% rated biosafety training as very or extremely necessary 	<ul style="list-style-type: none"> ● 60% of farm owners already have a good and stable livelihood from wildlife and 76% have a need for biosafety training
Barriers	<ol style="list-style-type: none"> 1. Lack of information on wildlife pathogens 2. Lack of coordination and sharing among OH relevant actors 3. Funding sources 	<ol style="list-style-type: none"> 1. Investment costs to apply biosafety and biosecurity practices 2. No clear legal regulations 3. Lack of information on biosafety and biosecurity practices for wildlife

4.3 Recommendations

- Strengthen training activities for in-service personnel and wildlife farmers to improve KAP and general capacity on biosafety, biosecurity, and zoonotic diseases for government staff in One Health relevant positions at all levels.
- Strengthen SBC interventions to raise awareness and improve KAP for wildlife farmers and the network participating in the wildlife value chain in Dong Nai.

“The awareness of people in remote areas is still poor (in some places, forest rangers have to collect thousands of forest bear traps a day until now) so mass communication is very important. It is very necessary for forest rangers to encourage/direct local farmers to go for training or SBC activities to improve their awareness and can require the licensing conditions with biosafety practice certification.” Leader, Forest Protection Sub-Department of Dong Nai

- Develop communication materials, manuals on biosafety for farmers, wildlife transporters, traders, restaurant workers and communities.
- Support pilot implementation to test and refine biosafety practices on farms before introducing more broadly, using the TIPs methodology.
- Establish groups of OH volunteers/collaborators in the community.
- Put mechanisms in place to encourage farmers to comply with on-farm biosafety measures, learning the most recent best practice available at similar Food Safety models.

“Dong Nai is the only province in the country that has 3073 safe food selling points with logos granted by the Ministry of Agriculture based on annual monitoring and evaluation. All the traders are excited to participate in this model because businesses having a logo helps the shops increase their income. That model can help to suggest the same application for the biosecurity training and certification in the long run.” Officer, Provincial Sub Department of Quality Management for Agriculture, Forest and Aquaculture Products

General Recommendations

- Biosafety and biosecurity practices should be prioritized immediately as effective measures for protecting human, wild animal, and domestic animal health in the short and long terms.
- Improving biosafety and biosecurity practices on wildlife farms and along associated value chains requires multisectoral cooperation and participatory approaches, and can start by addressing the prioritized KAPs of both government personnel and wildlife farmers.
- To promote good biosafety and biosecurity, there should be engagement of all OH-related government agencies, including animal health, human health, forest protection, environmental, and food safety, and veterinary and livestock in biosafety and biosecurity guiding development and certification.
- Besides the capacity-building program for veterinary and OH-relevant management staff, to narrow the current gaps of available services for wildlife related care and development, the capacity of community OH workers and peer network should be strengthened through the training-of-trainers, other technical training courses, and SBC interventions.

- The community is clearly more aware of the livelihoods and household economic risks and opportunities associated with wildlife farming than the disease risks. This is in part because there are no commonly reported overt signs of disease-causing great damage to farmed wildlife, livestock, or people. Therefore, bio-risk reduction interventions should use market-based incentives and incorporate awareness-raising activities.
- Communication and risk reduction interventions need to be associated with market incentives, livelihood activities, and community mobilization to improve the likelihood of success.
- The next TIPs design and extensions will be based on the main outputs of two prior risk and biosecurity assessments, a list of top 10 biosecurity issues selected by the community, and especially the direct lessons learned from the field visits—those should be synthesized and analyzed in close consultation on each step with global teams and the United States CDC in advance before implementation.

PART 6: APPENDICES

Appendix 1: List of Government Officers Attending the Training of Enumerators and Participating in the STOP Spillover Biosecurity Rapid Assessment

Appendix 2: Tables

Appendix 3: Questionnaires for the Training Rapid Assessment for Management Officers

Appendix 4: Questionnaire for KAP Rapid Assessment on Biosecurity in Wildlife Farming for Small-Scale Farms and Open Barns

Appendix 5: Guiding Questions for Focus Group Discussion

Appendix 1: List of Government Officers Attending the Training of Enumerators and Participating in the STOP Spillover Biosecurity Rapid Assessment

1.	Tran Thi Kim Ngan	WLE Vietnam Team Lead, Ha Noi University of Public Health (HUPH)
2.	Nguyen Anh Tuan	Convention on the International Trade in Endangered Species of Wild Fauna and Flora, Vietnam Ministry of Agriculture and Rural Development (CITES/MARD)
3.	Bui Van Manh	Veterinary Division Dong Nai Province
4.	Trinh Duc Duy	Centers of Disease Control and Prevention (CDC) Dong Nai Province
5.	Nguyen Thanh Binh	Forest Protection Dong Nai Province
6.	Vu Van Do	Forest Protection Dinh Quan District
7.	Khuong Ke Ha	Veterinary Office Dinh Quan District
8.	Vo Vuong Le Anh	Agriculture Office Dinh Quan District
9.	Nguyen Nhat Minh	Health Station Dinh Quan District
10.	Tran Van Huu	Veterinary Division Dong Nai Province
11.	Nguyen Thi Vieng	CDC Dong Nai Province

Appendix 2: Tables

Table A1: Timelines of Activity 1.3.1.1 Implementation

Sub Activity Code	Activity Description	2022 Date of Completion
1.3.1.1.1	One Health design, research, and mentorship (OH-DReaM) working group write concept paper + revision	May 12–4/25
1.3.1.1.2	Organize a virtual meeting among OH-DReaM working group members to finalize detailed action plan	May 13
1.3.1.1.3	Development of OH-DReaM working group task assignment	May 16–20
1.3.1.1.4	OH-DReaM working group develop the survey tools	May 23–31
1.3.1.1.5	OH-DReaM working group prepare Institutional Review Board (IRB) applications and tools for interviews and FGD, IRB forms + revisions	June 1–25
1.3.1.1.6	In-person workshop among OH-DReaM working group to discuss detailed action plan and revision of tools	July 6–7
1.3.1.1.7	Development of training content and field preparation	July 11–17
1.3.1.1.8	Organize training for assessment team (two days)	July 18–19
	IRB approval by Tufts	September 7
1.3.1.1.9	Field assessment/data collection	September 8–14
1.3.1.1.10	OH-DReaM working group write initial report	September 15–25

1.3.1.1.11	Organize a dissemination workshop	September 27
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Table A2: Top 10 Priorities of Biosafety/Biosecurity Practices Identified by the Wildlife Farmers

Question No.	Biosafety Checklist	Knowledge	Practice Performance	Practice Success	Priority Ranking
17.4	Personal protective equipment (PPE) use	76.98	44.69	7.27	# 2
21	Diseases control prevention	78.76	35.07	10.45	# 4
27	Waste treatment	72.49	30.92	12.25	# 5
28	Vaccination	44.99	22.19	4.12	(# 1)*
33	Training for farmers	59.26	28.69	7.52	(# 3)*
29	Animal health profile	41.51	24.69	12.90	# 6
18	PPE changes and hand wash	70.63	37.36	14.89	# 7
31	Animal health reporting	88.95	30.92	15.22	# 8
22	Reproduction hygiene	88.95	30.90	21.32	# 9
15	Records/log book	55.50	36.41	23.39	# 10
	Mean for all 34 criteria	(86.75)	(59.25)	(38.77)	

*#1 & #3 are not feasible for TIPs selection at this time

Table A3: Knowledge of Biosafety + Biosecurity Practices by Species in Dinh Quan District

Question No.	Biosafety Checklist Item	Knows the Requirements			
		Bamboo Rat	Civet	Porcupine	Other Species
1.1	Distance to industrial water treatment	95%	96%	89%	90%
1.2	Distance to schools/hospitals	95%	93%	100%	90%
2	Water source	95%	100%	100%	100%
3	Wastes	95%	100%	100%	90%
4	Walls	100%	96%	100%	90%
5	Isolation area	90%	93%	100%	100%
6	Barn cleaning	85%	100%	89%	100%
7	Food placement	100%	100%	100%	100%
8	Vermin risks	70%	59%	67%	80%
9	Vermin entry ban	100%	85%	89%	90%
10	Vermin protect net/cover	85%	63%	78%	90%
11	Breed certification	100%	100%	100%	100%
12	Isolation before combination	95%	89%	78%	100%
13	Food source identify	95%	93%	100%	100%

Question No.	Biosafety Checklist Item	Knows the Requirements			
		Bamboo Rat	Civet	Porcupine	Other Species
14	Water source	85%	96%	100%	100%
15	Records/log book	80%	26%	44%	60%
16	Farming techniques	70%	52%	44%	60%
17	Use PPE: boots, shoes	65%	93%	78%	90%
17.2	Gloves	75%	93%	89%	90%
17.3	Masks	95%	100%	89%	90%
17.4	PPE clothes	60%	81%	89%	80%
18	PPE changes and hand wash	60%	78%	67%	90%
19	Sterilization spray	75%	78%	56%	90%
20	Sterilization food/water trays	90%	100%	89%	100%
21	Diseases control prevention	70%	93%	67%	90%
22	Reproduction hygiene	90%	89%	67%	90%
23	Clean the farming devices	80%	100%	78%	90%
24	Separate room and device per ages	85%	96%	78%	90%
25	Solid waste treatment	80%	96%	78%	90%
26	Liquid waste transport	85%	85%	78%	90%
27	Liquid waste treatment	55%	85%	78%	90%
28	Vaccination	30%	56%	33%	70%
29	Animal health profile	40%	41%	11%	60%
30	Sick animal isolation	90%	100%	78%	100%
31	Animal health reporting	80%	93%	89%	90%
32	Zoning for diseases control	85%	100%	100%	100%
33	Training for farmers	65%	74%	67%	80%
34	Traceability profiles	90%	100%	100%	100%
	Average	81%	86%	80%	89%

Table A4: Attempted Compliance of Biosafety + Biosecurity Practices by Species in Dinh Quan District

Question No.	Biosafety Checklist Item	Attempted to Apply			
		Bamboo Rat	Civet	Porcupine	Other Species
1.1	Distance to industrial water treatment	95%	93%	89%	90%
1.2	Distance to schools/hospitals	95%	93%	100%	90%
2	Water source	95%	81%	100%	100%

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Question No.	Biosafety Checklist Item	Attempted to Apply			
		Bamboo Rat	Civet	Porcupine	Other Species
3	Wastes	65%	74%	89%	70%
4	Walls	60%	48%	56%	80%
5	Isolation area	50%	52%	33%	90%
6	Barn cleaning	55%	48%	22%	50%
7	Food placement	95%	74%	56%	90%
8	Vermin risks	40%	26%	11%	20%
9	Vermin entry ban	80%	48%	33%	90%
10	Vermin protect net/cover	65%	33%	33%	90%
11	Breed certification	100%	100%	100%	100%
12	Isolation before combination	50%	22%	11%	30%
13	Food source identify	65%	81%	67%	80%
14	Water source	60%	85%	67%	90%
15	Records/log book	50%	19%	22%	30%
16	Farming techniques	50%	15%	22%	60%
17	Use PPE: boots, shoes	40%	56%	22%	80%
17.2	Gloves	65%	78%	56%	80%
17.3	Masks	70%	89%	89%	90%
17.4	PPE clothes	30%	41%	33%	50%
18	PPE changes and hand wash	20%	33%	22%	30%
19	Sterilization spray	50%	37%	22%	60%
20	Sterilization food/water trays	85%	85%	67%	90%
21	Diseases control prevention	30%	22%	0%	30%
22	Reproduction hygiene	45%	30%	0%	10%
23	Clean the farming devices	45%	48%	44%	20%
24	Separate room and device per ages	70%	74%	56%	60%
25	Solid waste treatment	45%	70%	44%	60%
26	Liquid waste transport	55%	59%	22%	30%
27	Liquid waste treatment	10%	37%	11%	20%
28	Vaccination	5%	15%	0%	20%
29	Animal health profile	25%	15%	0%	20%
30	Sick animal isolation	85%	37%	44%	50%
31	Animal health reporting	20%	7%	0%	20%
32	Zoning for diseases control	40%	19%	33%	50%
33	Training for farmers	25%	22%	11%	10%

Question No.	Biosafety Checklist Item	Attempted to Apply			
		Bamboo Rat	Civet	Porcupine	Other Species
34	Traceability profiles	85%	96%	100%	100%
	Average	56%	52%	42%	59%

Table A5: Successful Adoption of Biosafety + Biosecurity Practices by Species in Dinh Quan District

Question No.	Biosafety Checklist Item	Successfully Adopted			
		Bamboo Rat	Civet	Porcupine	Other Species
1.2	Distance to schools/hospitals	90%	85%	100%	90%
2	Water source	90%	81%	100%	100%
3	Wastes	60%	70%	89%	70%
4	Walls	50%	41%	33%	80%
5	Isolation area	40%	48%	22%	80%
6	Barn cleaning	45%	37%	22%	50%
7	Food placement	85%	70%	56%	80%
8	Vermin risks	35%	19%	11%	10%
9	Vermin entry ban	75%	33%	33%	70%
10	Vermin protect net/cover	35%	19%	11%	70%
11	Breed certification	95%	96%	100%	100%
12	Isolation before combination	35%	19%	11%	10%
13	Food source identify	55%	74%	67%	80%
14	Water source	50%	78%	67%	90%
15	Records/log book	40%	7%	22%	20%
16	Farming techniques	40%	7%	22%	50%
17	Use PPE: boots, shoes	25%	22%	11%	50%
17.2	Gloves	60%	59%	56%	80%
17.3	Masks	65%	78%	78%	60%
17.4	PPE clothes	10%	4%	0%	0%
18	PPE changes and hand wash	15%	7%	11%	10%
19	Sterilization spray	45%	19%	11%	40%
20	Sterilization food/water trays	80%	78%	67%	90%
21	Diseases control prevention	20%	11%	0%	10%
22	Reproduction hygiene	40%	22%	0%	0%

Question No.	Biosafety Checklist Item	Successfully Adopted			
		Bamboo Rat	Civet	Porcupine	Other Species
23	Clean the farming devices	40%	41%	44%	20%
24	Separate room and device per ages	65%	67%	56%	60%
25	Solid waste treatment	35%	56%	44%	50%
26	Liquid waste transport	45%	48%	22%	30%
27	Liquid waste treatment	10%	22%	11%	10%
28	Vaccination	0%	7%	0%	10%
29	Animal health profile	20%	11%	0%	10%
30	Sick animal isolation	85%	33%	44%	40%
31	Animal health reporting	20%	4%	0%	10%
32	Zoning for diseases control	35%	15%	33%	40%
33	Training for farmers	10%	7%	11%	0%
34	Traceability profiles	80%	93%	100%	100%
	Average	48%	41%	38%	49%

Appendix 3: Questionnaires for the Training Rapid Assessment for Management Officers

QUESTIONNAIRE

(For management agencies/training facilities)

For biosecurity training rapid assessment (TRA) related to wildlife in Dong Nai province

This Training Rapid Assessment (TRA) aims to:

1. Assess the current status of biosecurity training for wildlife farms in Dong Nai province;
2. Determine the current gaps by understanding via rapid assessment of the related management agencies and training units regarding their available knowledge, skills and practice related to (wildlife) biosecurity, the main barriers, and their needs in training and cooperation to improve the capacity to improve biosecurity measures at wildlife farming; and
3. Quantify the need for training, raising awareness and biosafety support and incentives on wildlife farms to reduce pathogen transmission from animals to humans.

Target groups in this TRA include:

- Provincial, district, and commune government agencies:
 - Department of Agriculture and Rural Development (DARD)
 - Dong Nai Sub-Divisions of Livestock and Animal Health
 - Sub-Division of Forest Protection
 - Agricultural Service Center
 - Quality Control Centers
- International organizations: FAO, WCS, WWF, Traffic

ADMINISTRATION

Name of Interviewer:		
Time: hour date/...../2022	
Commune:	District:	Dong Nai province

		ID (for entry data only)
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SECTION I: GENERAL INFORMATION

#	Question	Response
1.	What gender do you identify with?	1. Male 2. Female 3. Other
2.	What is your organization?
3.	What is your current position?	Leader Manager Officer Staff Other
4.	How long have you been in your current position?year

SECTION II: PROFESSIONAL QUALIFICATIONS OF MANAGERS AND TRAINING STAFF RELATED TO BIOSECURITY/WILDLIFE IN DONG NAI PROVINCE

#	Question	Response
5.	What is the highest level of your education?	1. Post-graduate 2. Graduate 3. Other
6.	In which faculty have you been trained? (You can choose more than one option)	1. Agriculture 2. Livestock 3. Animal Health 4. Forestry 5. Quality Control 6. Other

7.	Which training institute have you been trained by?	1. Training agencies under the Ministry of Education? 2. Training agencies under Ministry of Agriculture MARD/DARD 3. Training agencies under other programs 4. Other
8.	How long have you been in your current position?year

SECTION III: CURRENT STATUS OF TRAINING ON KNOWLEDGE AND SKILLS RELATED TO BIOSECURITY / WILDLIFE IN DONG NAI PROVINCE

#	Have you ever been trained on?	Yes/ No	What type of training? (1. Short-term; 2. Long-term)	Which training institute?	How many times have you been trained?
9.	General biological threats and benefits of biosafety and biosecurity?				
10.	Biological threats posed by wildlife and the benefits of implementing appropriate wildlife related biosafety and biosecurity measures?				
11.	Common biosafety and biosecurity issues in animal husbandry?				
12.	Common biosafety and biosecurity issues related to wildlife?				
13.	Biosafety and biosecurity measures in livestock farming?				
14.	Biosafety and biosecurity measures in wildlife farming?				
15.	Biosafety and biosecurity in zoonosis prevention related to animal husbandry?				
16.	Biosafety and biosecurity in zoonosis prevention related to wildlife?				
17.	Bio-risks classification and response?				

SECTION IV: KNOWLEDGE AND PRACTICE OF BIOSAFETY AND BIOSECURITY BY WILDLIFE-RELATED OFFICIALS/GROUPS IN DONG NAI PROVINCE

#	Question	Response 1. Yes; 2. No; 3. Don't know
18.	“Biosecurity” refers to actions that reduce the risk of disease spread onto a farm	
19.	Regular vaccination can prevent animals getting infectious diseases	
20.	It is important to separate sick animals from healthy animals to prevent disease spread	
21.	Good management of animal waste can prevent disease spread	
22.	If sick and healthy livestock drink from the same water source there is a risk of disease spread	
23.	Selling sick animals will not spread infectious disease to areas outside of the source farm	
24.	From your point of view, are there many domestic and wild animal diseases that pose an infection risk to humans?	
25.	From your point of view, should zoonotic spillover be considered as a threat to national/local security?	
26.	Does your work involve direct contact with wildlife?	
	Do you use protective equipment during your contact with wildlife? (If so, please specify what type(s))	

	According to you, what bio-risks do managers/people face during their work? (Multiple choice questions)	Risk of zoonotic diseases Risk of vector-borne disease Risk of foodborne illness Other (Please specify)
	From your point of view, how serious is the issue of zoonosis spread and amplification currently in Vietnam?	Not serious Somewhat serious Serious Very serious Extremely serious

SECTION V: THE NEED FOR BIOSECURITY TRAINING FOR MANAGERS AND COMMUNITIES RELATED TO WILDLIFE IN DONG NAI PROVINCE

#	Question	Response
27.	According to you, is it necessary to strengthen training and knowledge about biological risks for managers/people?	Unnecessary Somewhat necessary Necessary Very necessary Extremely necessary
28.	What training contents would you select if offered free bio-risks training programs? (Multiple choice question)	Basic biosecurity practice Some technical solutions on breeds, barns Biosecurity practice for rangers Bio-risks reduction measures Others.....
29.	What training type would you select if offered free bio-risks training programs? (Multiple choice question)	Formal Training Short Training Course Self-Study Other

SECTION VI: COORDINATION IN WILDLIFE RELATED BIOSECURITY

#	Have you ever participated in	Yes/No	Time	Host institute	Name of training course/document/program
30.	Organizing or coordinating training courses on biosecurity				
31.	Monitoring and evaluation of biosecurity				
32.	Implementing activities on biosecurity communication and education				
33.	Developing manual/guideline related to biosecurity				

#	Question	Response
34.	How do you rate the collaboration between your agency and other agencies in biosecurity?	1. Never 2. Rarely 3. Sometimes 4. Often 5. Always

35.	How do you rate the effectiveness of collaboration between your agency and other agencies in biosecurity	<ol style="list-style-type: none"> 1. Extremely ineffective 2. Somewhat ineffective 3. Effective 4. Very effective 5. Extremely effective
-----	----------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

SECTION VII: BARRIERS TO BIOSAFETY AND BIOSECURITY TRAINING

	Barrier to biosafety and biosecurity training	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
36.	Governance					
	No policy guidelines					
	Poorly formulated guidelines					
	Poor guideline dissemination					
	Not adhering to laws					
37.	Financial barriers					
	Biosafety/biosecurity program poorly financed					
	No finances for training					
38.	Human resources					
	No trained personnel					
	Inadequate numbers trained					
	Heavy workload					
	Lack of TOT teams					
39.	Information and instructional materials					
	Limited database					
	No biosafety and biosecurity literature					
	Lack of information on suspected pathogens					
	No curriculum on biosafety and biosecurity					
	No instructional materials					
40.	Infrastructure and supplies					
	Inadequate infrastructure					
	Lack of equipped laboratories					
	Lack of provision of PPE					

Appendix 4: Questionnaire for KAP Rapid Assessment on Biosecurity in Wildlife Farming for Small-Scale Farms and Open Barns

Research information

This study aims to understand the current biosecurity-related knowledge, attitudes, and practices of farmers in Dong Nai province. The qualitative and quantitative data collected in this questionnaire will be used to identify spillover risks and develop measures to reduce zoonotic disease spillover in wildlife farms throughout the Dong Nai province.

ADMINISTRATION

Name of Interviewer:		
Time: hour date/...../2022	
Commune:Village:.....	District:	Dong Nai province
		ID (for entry data only)

SECTION I: GENERAL INFORMATION

1. Gender: 1. Male 2. Female 3. Other
2. Highest level of education:
 - a. No education
 - b. Primary school (grade 1-5)
 - c. Secondary school (grade 6-9)
 - d. High school (grade 10-12)
 - e. Intermediate school
 - f. College/university/professional and above
 - g. Don't know
3. Total years' experience with wildlife farming:
4. How many people are working on the farm?
5. Type of farm: 1. Wildlife only 2. Wildlife with Poultry 3. Wildlife with other animals (specify)
.....
6. Type and number of animals present in your farm
7. How old (in years) is the oldest building in which wildlife are being kept? years

SECTION II: Checklist for Knowledge and Practice Assessment

	Biosecurity Criteria	Do you know requirement?		Have you tried/applied? (If No => Skip. If Yes => Ask further)		
		Yes	No	Yes	Successful	Not Successful
I	Location					
1.	Is the location of the farm in compliance with the local land use planning, or is it allowed by the competent state management agencies?					
2.	Is the minimum distance from the wildlife farm to:					
	a. the concentrated waste treatment area for domestic, industrial, and residential areas 100 meters?					
	b. schools, hospitals, and markets 150 meters?					
	Does the farm have clean and sufficient water reserves for wildlife?					
3.	Does the farm have a separate place for liquid wastes?					
II	Requirements for the animal enclosures					
4.	Does the farm have walls or fences around it to control the entry and departure of people and animals?					
5.	Does the farm have a separate isolation area for sick wildlife or newly imported wildlife?					
6.	Is the barn cleaned regularly? (How many times per week?)					
7.	Is the place for food ventilated, dry and easy to clean and disinfect?					
III	Vermin and bird control					
8.	Are vermin (i.e. rats, mice, etc.) considered to be a problem at the farm?					
9.	Do pets have access to the stables (including storage areas for feed and bedding material)?					
10.	Is the net covered in the cage to prevent cockroaches, mice and insects?					
IV	Requirements of breeds					
11.	Do the wildlife breeds bought and raised have a known origin/have full quarantine certificates?					
12.	Before entering the herd, are wildlife kept in isolation according to regulations?					

	Biosecurity Criteria	Do you know requirement?		Have you tried/applied? (If No => Skip. If Yes => Ask further)		
		Yes	No	Yes	Successful	Not Successful
V	Feed and drink					
13.	Does the feed have a known origin?					
14.	Does drinking water for wildlife meet the prescribed quality standards?					
15.	Is there adequate recording and storage of information on import, export and use of feed, information when using antibiotics mixed in feed?					
VI	Care and nurture					
16.	Is there a different breeding process which is suitable for different types of wildlife according to each growth and development stages?					
VII	Veterinary hygiene					
17.	The farm needs to use the following types of protection:					
	• boots					
	• gloves					
	• masks					
	• protective clothing, aprons					
18.	Before and after entering and leaving the wildlife farm, do you change your boots and disinfect your hands?					
19.	Do you periodically spray disinfectant in the barn? If so, how often?					
20.	Are feeders and water sources cleaned and disinfected regularly?					
21.	In the event of an epidemic outbreak, are the current regulations on anti-epidemic fully implemented? Can you describe the epidemic response at the farm?					
22.	After each breeding (mating and delivery), do you clean and disinfect the cages and wildlife equipment?					
23.	Is the barn empty after each breeding period?					
24.	Are equipment, tools and facilities used in wildlife production regularly disinfected?					

	Biosafety Criteria	Do you know requirement?		Have you tried/applied? (If No => Skip. If Yes => Ask further)		
		Yes	No	Yes	Successful	Not Successful
VIII	Control of means of transport, equipment, and wildlife tools					
25.	Is there a separate arrangement of wildlife equipment and tools between the rows of cages?					
IX	Waste treatment and environmental protection					
26.	Is solid waste of organic origin (e.g. ???) collected on a daily basis and treated with appropriate heat, chemicals, or biological products? If not, what is done with this solid waste?					
27.	Are liquid wastes routed directly from the barns to the treatment area by a separate drain?					
X	Disease management					
28.	Wildlife must be vaccinated according to regulations. Have they had any vaccines?					
29.	Are there records of the diseases seen in wildlife, their causes, preventative measures taken and treatment approaches followed - including drugs administered?					
30.	When there are sick wildlife, are they kept in isolated areas or cages?					
31.	When an epidemic is detected, do you notify the veterinary staff to take measures to handle it?					
32.	When an epidemic occurs in the barn or the whole barn, is it disinfected immediately?					
XI	Personnel and farm management					
33.	Are employees trained and guided on animal husbandry, veterinary procedures and environmental protection?					
34.	Are there records to enable traceability and product recalls?					

SECTION III: CONCLUSION OF THE ASSESSMENT TEAM

.....
.....
.....
.....
.....
.....

SECTION IV: LEVEL OF BIOSECURITY ACHIEVED BY WILDLIFE FACILITIES:

- Level:
- Reason:
.....
.....

(Note: Level A - Establishments achieve at least 80% (56/70) of the required indicators; Level B - Establishments achieve from 60% to less than 80% (42-56/70) of the indicators. Satisfactory criteria; Level C - Facility achieves less than 60% (42/70) of satisfactory criteria)

SECTION V: COMMENTS AND RECOMMENDATIONS OF THE ASSESSMENT TEAM

.....
.....
.....
.....
.....

SECTION VI: OPINION OF FACILITY REPRESENTATIVE

.....- The Best:.....
.....
.....- The Worst:.....
.....
.....- Preferred 3 practices for improvement trial:.....
.....

C. BARRIER TO BIOSAFETY PRACTICE IN THE FARM

Below is the list of identified barriers that have prevented people from implementing biosafety practice in the farm	Please rank these according to how relevant they are to you and your farm	Do you think this barrier could be addressed/changed? (Yes/No)	
Cost to make changes			
Attitude toward biosafety			
Legislative uncertainty			
Comfort of PPE			
Changes restrict innovation			
Lack of access to information about safety			
Administrative burden			
Hassle of making changes			
Turnover of staff			
Training cost			
Time to make changes			
Other			

CI.1. Have we missed any barrier? Please explain.

C.1: Perceived susceptibility

Which zoonotic disease (ZD) do you think could cause risks to your farms?

Do you think the current farming practices of your family may lead to transmission of ZD to your family members and/or workers?

1. Yes
2. Maybe/Possible
3. No
4. Don't know

Have there been any cases of ZD in wildlife animals or people as a result of improper biosecurity practices on your farms so far?

1. Yes
2. No
3. Not sure

If yes, please describe in detail of the disease types and symptoms here:

.....

.....

.....

C.2: Perceived severity

How serious are the zoonotic diseases caused by improper farming practices?

1. Very serious
2. More or less serious
3. A little serious
4. Not at all serious
5. Don't know

Can infected people die from the zoonotic diseases caused by improper farming practices?

1. Yes
2. No
3. Don't know

C.3 Action efficacy (Does the preventive action work?)

Do you believe that applying all the biosafety and biosecurity practices help avoid/prevent zoonotic disease transmission among wildlife and to humans?

1. Yes
2. Maybe/Possible
3. No
4. Don't know

Do you think that if the farm workers do not follow the biosafety and biosecurity practices, they will be at risk of infection with zoonotic diseases?

1. Yes
2. Maybe/Possible
3. No
4. Don't know

C.4. Perceived social acceptability

Do you think that all your friends, family members and community members support your adoption of biosafety and biosecurity practices in wildlife farming?

1. Yes
2. Maybe/Possible
3. No
4. Don't know

C.5. Perceived self-efficacy (Is it easy to do?)

Do you believe that you can adopt all of the necessary biosafety and biosecurity practices in wildlife farming **with your current knowledge and skills?**

1. Yes
2. Maybe / possible
3. No
4. Don't know

Reasons for your answers:

.....

.....

Do you need any training on biosafety and biosecurity practices?

1. Yes
2. No
3. Not sure/Don't know

Do you believe that you can adopt all of the biosafety and biosecurity practices in wildlife farming with the time, money and other resources currently available to you?

1. Yes
2. Maybe / possible
3. No
4. Don't know

Reasons for your answers:

.....

.....

C.6. Cues for action (Can I remember to do it?)

How easy is it to remember to follow all the standards of biosecurity practices in wildlife farming?

1. Very difficult
2. More or less difficult
3. A little difficult
4. Not difficult at all

C8. Possibility of change

Based on the list of barriers, the following are the main priorities identified:

What is the likelihood that removal of this barrier could make a difference to biosafety practice?

How long would it take to see the difference once the barrier is removed?

Who should be responsible for ensuring that the barrier is removed/providing the tools to remove the barrier?

	Likelihood of making difference			Time frame for seeing difference					Responsibility for providing the tools to remove the barrier		
	<i>Highly Likely</i>	<i>Likely</i>	<i>Not / Likely</i>	<i>Long-term</i>	<i>Medium-term</i>	<i>Short-term</i>	<i>Never</i>	<i>Not Applicable</i>	<i>Individual Farm</i>	<i>Government</i>	<i>All Levels</i>
Cost to make changes											
Attitude toward biosafety											
Legislative uncertainty											

	Likelihood of making difference			Time frame for seeing difference					Responsibility for providing the tools to remove the barrier		
	Highly Likely	Likely	Not / Likely	Long-term	Medium-term	Short-term	Never	Not Applicable	Individual Farm	Government	All Levels
Comfort of PPE											
Changes restrict innovation											
Lack of access to information about safety											
Administrative burden											
Hassle of making changes											
Turnover of staff											
Training cost											
Other											
Time to make changes											

C.9. Have we missed any barrier? Please explain.

C10. What is your estimated income per year from captive wildlife?

..... thousand VND

C11. What is your estimated family income per year from captive wildlife?

.....

C12. How would you rate the importance of biosafety practices on your farm?

C13. How biosafe would you rate your farm on the scale of 0 to 10 (with 0 being not biosafe at all and 10 being totally biosafe)

Appendix 5: Guiding Questions for Focus Group Discussion

Interviewers collect the answers for the following questions after talking with whole group

1. Age:..... Average (Oldest Youngest.....)
2. Total people by Gender: Male Female Other
3. Total people by service?
 - a. Wildlife farmers
 - b. Wildlife workers
 - c. Wildlife traders
 - d. Transporters

- e. Slaughters/Butchers
 - f. Wildlife retailers
 - g. Restaurant owners
 - h. Wildlife consumers
 - i. Other: (please describe) _____
4. How many species have you cared for in the last month (approximately)? _____
5. How many years of experience have you had in this current job?
- <1 Year
 - 1-2 Years
 - 2-5 Years
 - 5-10 Years
 - >10 Years

Facilitator's welcome, introduction, and instructions to participants

Welcome and thank you for volunteering to take part in this focus group. You have been asked to participate as your point of view is important. I realize you are busy and I appreciate your time.

Introduction: This focus group discussion is designed to assess your current thoughts and feelings about the quality improvement program which involves the introduction of the Biosecurity Checklist in your wildlife farms. The focus group discussion will take no more than two hours.

Anonymity: I would like to assure you that the discussion will be anonymous. The transcribed notes of the focus group will contain no information that would allow individual subjects to be linked to specific statements. Please try to answer and comment as accurately and truthfully as possible. I and the other focus group participants would appreciate it if you would refrain from discussing the comments of other group members outside the focus group. If there are any questions or discussions that you do not wish to answer or participate in, you do not have to do so; however please try to answer and be as involved as possible.

Ground rules

- The most important rule is that only one person speaks at a time. There may be a temptation to jump in when someone is talking but please wait until they have finished.
- There are no right or wrong answers - all views and opinions are important.
- You do not have to speak in any particular order.
- When you do have something to say, please do so. There are many of you in the group and it is important that I obtain the views of each of you.
- You do not have to agree with the views of other people in the group, but please be constructive if you disagree.
- Does anyone have any questions? (answers).
- OK, let's begin.

Warm up

- First, I'd like everyone to introduce themselves. Can you tell us your name and main task related to wildlife?

Introductory question

I am just going to give you a couple of minutes to think about your experience of your work related to wildlife value chains. Is anyone happy to share his or her experience?

Guiding questions

1. What is the current situation of the value chains of the selected wildlife species? (Interviewers need to name the wildlife species related to coronavirus transmission)? (i.e., breeding and raising situations, forms of product sold out, market outlets.)
2. Have you ever heard about Zoonoses? (If no, ask them about Rabies, H5N1, SARS, Covid 19, etc.) Please describe types of zoonotic diseases or the most popular diseases that have occurred in wildlife and human populations so far, their frequency, and magnitude of infection.
3. What are the key benefits of biosafety adoption in wildlife farming?
4. What are the key barriers to adopting biosafety practices along the wildlife value chains? And what are your suggested solutions to promote adoption of biosafety practices?

	Key barriers to adoption of biosafety practices (both subjective and objective reasons).	Suggested solutions to promote adoption of biosafety practices.
Input supplies	•	•
Production	•	•
Transport	•	•
Consumption	•	•
Recycling	•	•
Others...	•	•

5. Can you please provide us details of typical actors (names, addresses, types of improved practices) that have been adopting biosafety practices?
6. Which biosafety practices along the wildlife value chains should be established to serve as showcases for community members and wildlife value chain actors to learn from?

#	Name of potential improved biosafety practices	Reasons for your suggestions	Suggested locations
1			
2			
3			
4			
5			

(Notes: inputs for selecting the most three potential biosafety practices along the wildlife value chains for demonstration).

7. To make the biosafety application more useful and relevant, what are your suggestions for improvement? (Which people expect/like the most?)
 - a. Guiding contents
 - b. Guiding methods/channels
 - c. Time, duration, seasons
 - d. Location of training/guiding
 - e. Guiding persons/lecturers, coach, facilitators
 - f. Guiding source/training facilities

- g. Related regulations/mandate, monitoring and evaluation
- h. Other support

Concluding question

- Of all the things we've discussed today, what would you say are the most important issues you would like to express about this checklist?

Conclusion

- Thank you for your participation. This has been a very successful discussion.
- Your opinions will be a valuable asset to the study.
- We hope you have found the discussion interesting.
- If there is anything you are unhappy with or wish to complain about, please contact the local PI or speak to me later.
- I would like to remind you that any comments featuring in this report will be anonymous.
- Before you leave, please hand in your completed personal details questionnaire.
- Please write your report based on the results of the focus group. Please remember to maintain confidentiality of the participating individuals by not disclosing their names.