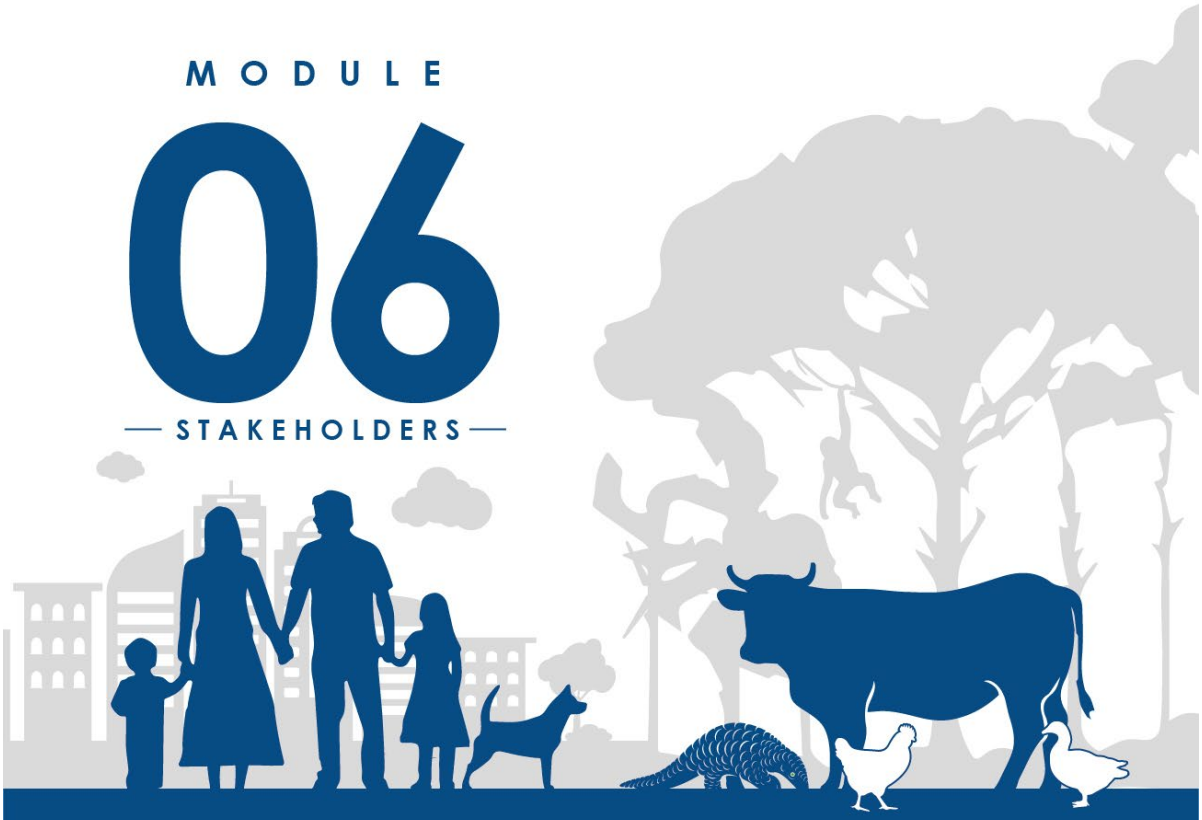
MODULE

06

— STAKEHOLDERS —



Strategies to Engage Diverse Stakeholders Across the Live Animal Value Chain to Address Risk

Co-Authors
Nur Firdaus Isa & Dirk Pfeiffer

STRATEGIES TO ENGAGE DIVERSE STAKEHOLDERS ACROSS THE LIVE ANIMAL VALUE CHAIN TO ADDRESS RISK

INTRODUCTION

Zoonotic disease transmission is a pressing global public health concern, with far-reaching implications for nations around the world. In low- and middle-income countries, the risk of zoonotic disease transmission is exacerbated by factors such as extensive farming activities, unregulated trading and slaughtering practices, and limited access to veterinary services, among others (Karesh et al., 2012). By incorporating a comprehensive array of perspectives, values, and interests, alongside evidence-based scientific insights, decision-makers can craft robust strategies for effectively addressing the emergence or resurgence of zoonotic diseases with pandemic potential, thereby reducing transmission from animals to humans. This module is dedicated to the elaborate process of identifying and engaging with all relevant stakeholders (Refer Module 1; Box 1-1 for a discussion on the term 'stakeholder'), from individuals and local communities to broader populations, who play pivotal roles in creating, assessing, and managing risks across value chains related to both domestic and wild animals. Humans come into contact with various animals through various avenues including live animal markets, domestic animals, and intensive wildlife farming or hunting. The central focus of this module lies at the juncture where humans and animals interact within shared environments, particularly highlighting critical points of contact facilitating transmission of zoonotic diseases. The module explores various stages of the animal and animal products value chain offering a set of culturally tailored, collaborative, and interdisciplinary efforts and recommendations to combat zoonotic disease spillover. The module broadly recommends collaboration with a more diverse set of stakeholders, some not traditionally engaged, to ensure greater transparency, coordination, and ultimate success in global public health efforts. The collaborative approach advocated within this module offers a holistic and inclusive perspective on zoonotic disease management, ultimately benefiting populations throughout Southeast Asia and beyond.

THE ANIMAL AND ANIMAL PRODUCTS VALUE CHAIN WITHIN SOUTHEAST ASIA: STRUCTURE AND COMPONENTS

In this section, we review the different steps in the value chain for food products derived from live domestic animals, with a particular focus on animal welfare standards and exposure of humans to zoonotic pathogens. Value chains related to animal-derived products exhibit a remarkable level of complexity and dynamism. They evolve in response to a myriad of factors, including seasonality, economic fluctuations, political shifts, and public health imperatives. Ultimately, these chains are shaped by consumer preferences and behaviours, which in turn dictate the spectrum of commodities available, production methodologies, processing techniques, and the overarching trends within the marketplace.

There are multiple opportunities for human-animal contact at each step along the value chain, such as, for example, in natural habitats, on farms, and during transport, marketing, and ultimately consumption. These chains of economic activities allow for intensive exposure and therefore increase the risk of potential pathogen spillover. By presenting region-specific or case-

specific value chain examples, this module aims to provide a practical understanding of the factors that may impact animal welfare and zoonotic disease risk within a particular local context.

Figure 6-1 showcases an example map of the value chain for a farm-based poultry food system, providing a comprehensive overview of the different stages, actors, and activities involved in the production of a commodity until it reaches the consumer. Along this value chain, the risk of zoonosis varies depending on the farm size and the time and space between steps. Figure 6-2 illustrates the diverse points of contact and modes of zoonotic disease transmission across different stages of the value chain. For example, at the slaughter stage, handlers may encounter direct contact with infected animals or animal products, as well as potential airborne and surface-contamination transmission of zoonotic diseases (Klous et al., 2016).

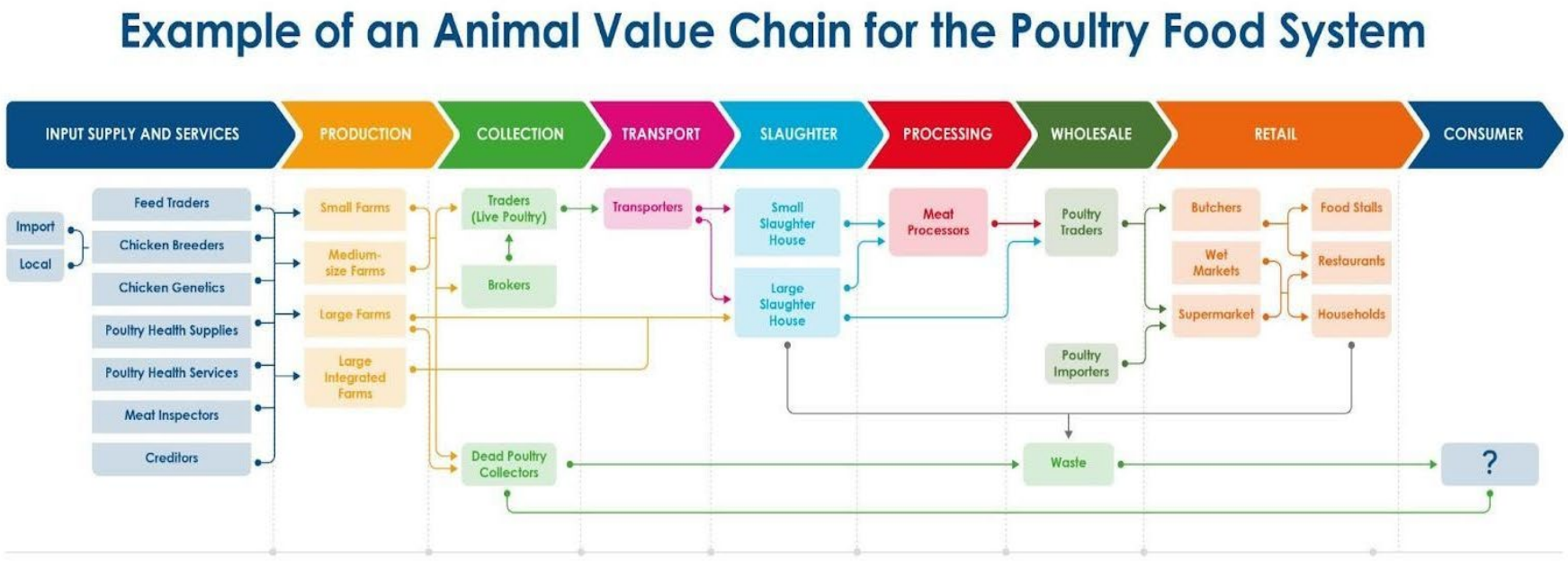


FIGURE 6-1 Example of value chain for a poultry food system.

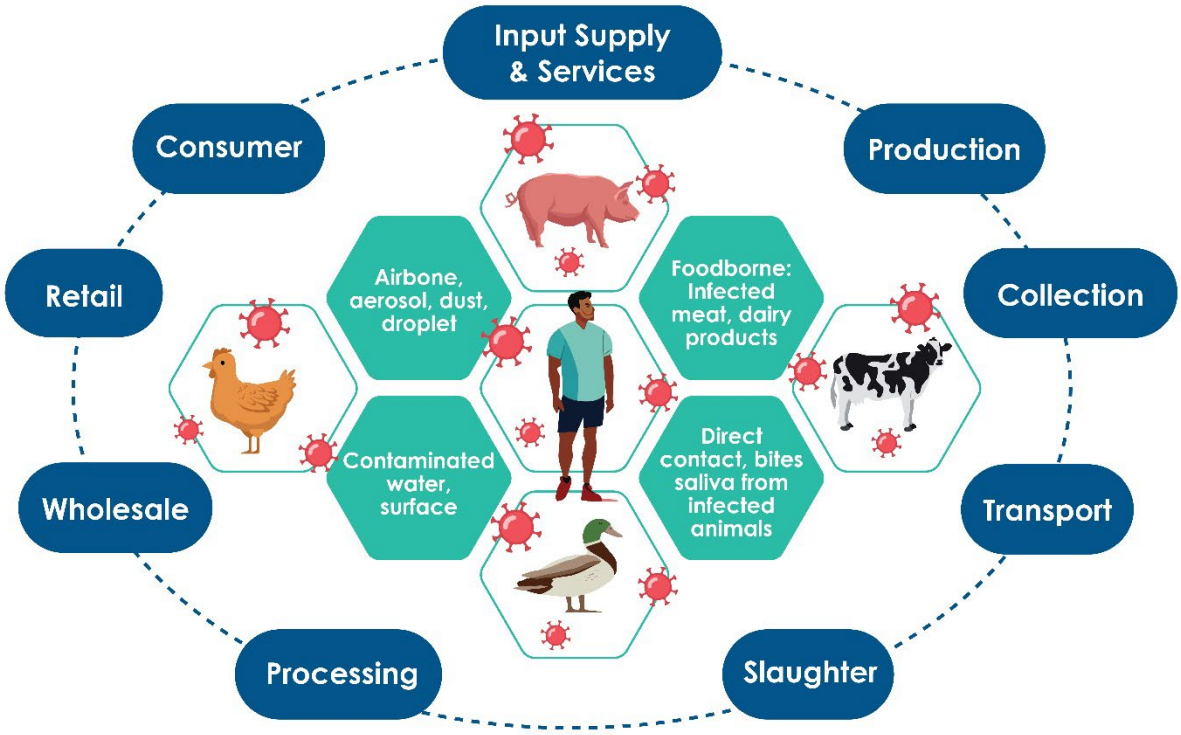


FIGURE 6-2 The animal value chain presents numerous critical points for zoonotic disease transmission pathways such as airborne, contamination, and foodborne transmission. From input to consumer, the sequence of processes along a value chain associated with livestock-derived commodities is typically structured into the groups of activities described below.

Input Supply and Services

This group of activities includes suppliers or service providers to provision essential resources such as animal feed, veterinary and health services, inspectors and creditors, extension services, and other goods or service inputs necessary to support the livestock production chain (Jaffee et al., 2010). These resources are crucial for ensuring the health, growth, and overall well-being of the animals. In many Southeast Asian countries, input suppliers and service providers may be private, state-provided, or industry-provided. Private suppliers are for-profit businesses selling these inputs, while state provision of inputs or services often involves a form of subsidies through national and local agricultural or veterinary offices. Industry-provided inputs are relevant where companies have contracted farmers to raise animals that are exclusively sold to them as contracting companies.

Production

Livestock production involves a range of actors depending on farm size and production outputs. They are typically grouped in at least three categories, i.e., smallholders, who are characterized as small-scale farmers managing areas varying from less than 1 to 10 hectares, and medium- and large-scale farmers (Dawe, 2015). Each country sets its own standards on the scale

classification of farmers, with various regulatory measures in place for each scale of production. Integrated farming (multi-dimensional farming that combines various sustainable agricultural practices to efficiently use resources while minimizes polluting inputs) also comes into play, incorporating multiple sustainable aspects of production, including breeding, raising, fattening, and potentially even processing of products derived from the animals, in a single business operation, utilizing modern technologies as well as traditional methods (Rose et al., 2019).

Collection

Once animals have reached slaughter age (in certain cases, the animals succumb to diseases), relevant actors, including traders, brokers, and dead-animal collectors, collect them for further processing. They gather animals from smallholders, medium- and large-scale farms, and integrated farms. This step in the value chain often involves negotiations and financial transactions associated with acquiring the animals, which will then be distributed to the next step in the value chain.

Transport

Transporters are responsible for moving the collected animals safely, while ensuring animal welfare, from their original locations to slaughterhouses or live animal markets, but other destinations may also be relevant, such as farms for fattening of the animals. The transporters may be the same individuals as the collectors. Depending on the specific context and geographical factors, modes of transportation to move animals or animal products vary. This may involve animal-drawn or motorized carts such as bikes, or even more well-built trucks.

Slaughter

Small and large slaughterhouses are facilities where animals are processed for meat extraction. The establishments should adhere to hygiene and food safety standards to ensure the quality and safety of the meat. In some countries, each town has designated slaughterhouses managed or regulated by local governments. In specific instances, slaughtering takes place in backyards or households, particularly during socio-cultural events. This riskier practice can impact both animal and human welfare, potentially elevating the risk of zoonotic diseases transmission.

Processing

Meat processors transform raw meat obtained from slaughterhouses into various processed products such as packaged cuts, sausages, and other value-added items. Processing enhances value of the meat and offers a wider range of items to consumers.

Wholesale

Processed meat products are distributed to various poultry traders and importers. They are involved in the distribution of meat to retailers, restaurants, and other consumers. Additionally, waste management entities handle byproducts and waste generated during processing and distribution stages.

Retail and Consumers

Finally, processed meat products ultimately reach retail outlets such as wet markets, supermarkets, food stalls, restaurants, and households for home consumption (Zhong et al., 2020).

As described above, the animal and animal products value chains involve sequential steps from source to consumer, with each actor typically benefitting financially. These steps involve a different and diverse set of actors and procedures. To illustrate this, Box 6-1 highlights a case example in Nueva Ecija, Philippines that exemplifies the timing, places, and actors involved in the initial steps of the value chain in a large-scale livestock facility. Animal production from small, medium, and larger farms along the value chain is well documented (OECD/FAO, 2017), and actors can be identified and effectively engaged given the right communication and collaborative tools (Module 8). The compilation and analysis of this information can lead to the successful implementation of regulatory or management tools to decrease the risks of zoonotic disease transmission. However, the complexity of the animal value chain varies, with input pathways, trading processes, selling practices, and actors involved depending on social, economic, religious, and seasonal drivers. The latter is particularly true for wild animal trade or smaller farms, which are sensitive to extreme climate events (Talukder et al., 2021) and global health crises, such as pandemics.

BOX 6-1
Contract Farmers and Growers Discussing Effective Integrated Livestock Systems in Nueva Ecija, Philippines

Southeast Asia is home to large-scale livestock production (Lee and Hansen, 2019). This particular case example in Central Luzon, Philippines, sheds light on a large-scale animal value chain and potential points for disease transmission. This case revolves around chicken contract farming of approximately 2.6-2.8 million heads per year. Private companies engage with poultry producers for exclusivity of their farming products (e.g., live chickens, eggs) during the production phase of the value chain. These companies hire experienced farm managers from selected farms who have received professional paid training. In these large-scale businesses, one to two farm managers oversee the buildings, with each building equipped with a leadman and a couple of handlers. Each person typically works in 8-hour rotating shifts for continuous monitoring.

Veterinary services are offered at low cost or for free by the private company that engages the contract growers. Animal health screenings are performed on a weekly or biweekly basis and begin with wellness checks by the handlers. During this process, the handler wears disinfected slippers prior to entering the work building and wears disposable shoe covers indoors. Hand disinfectants (e.g., isopropyl alcohol) are also part of the routine hygiene requirements. While hygiene measures are generally well followed, strict compliance is not always guaranteed. In this case example, workers were sometimes seen without personal protective equipment (PPE) (as related by interviewee).

During screenings, the handlers look for physical symptoms such as “halak” (coughing), bulging eyes, and loose or wet faeces; review feed intake; and look for unusual mortality rates. When non-sick animal carcasses are discovered, the dead chickens are separated and placed in chest freezers and disposed of in mortality pits outside the farm. However, if an unusual symptom is observed, the handler must inform the leadman immediately, and the contracting private company calls a veterinarian. Because these events also represent occupational hazards, sick animals are either culled

or separated into an intensive care unit pen, and workers assigned in the infected buildings are isolated. In case of a disease outbreak, the grower first buries dead animals at the farm. Additionally, the grower power-sprays the delivery trucks prior to entering and leaving the farm, and directs the transporters, vets, and animal handlers to shower and change clothes. Fly control measures are also implemented such as cyromazine or green-labelled pesticides during the growth period, and non-green labelled pesticides during non-growth periods. Some farmers belong to federations or a group of contract growers with industry-standard practices. These groups sometimes notify farmers of an outbreak in the area or neighbouring provinces, alerting them to heighten their biosecurity measures. Social media groups or pages for chicken growers also exist and serve as extension service spaces, sharing information and posting for fly control techniques, hiring workers, and other product promotions.

Broilers grow in only one building, for a duration that usually lasts anywhere from 26 to 32 days; they then leave the building, going directly to slaughter or the market. The contracting company provides all poultry feed. Growers routinely check unfiltered water for pH levels. Poultry production usually generates two types of wastes: carcasses (that are disposed of in mortality pits) and animal manure (oftentimes a mix of chicken manure, carbonized rice husk (CRH) used as litter beds, and pesticides to prevent flies) that is used as fertilizer by neighbouring farms. Between batches of chicks, buildings are emptied for about 14-21 days. During this interval, the building's floors are layered with organic material such as manure and CRH as a litter bed and sit for roughly 4-5 days. For the next 7 days, the building is then cleaned, and the equipment is disinfected before the start of the next production cycle

Given pathways of disease transmission along the animal value chain, it also is important to consider where each step may have further inputs (opportunities for disease introduction) and outputs (further pathways for disease transmission) (Rushton, 2011). Inputs can include introduction of disease agents through feed sources, from higher-risk activities such as the use of live animals to feed other animals, to transmission of disease agents on animal byproducts or even plant-based feeds, e.g., African swine fever (ASF) and porcine epidemic diarrhea virus (PEDV) (Niederwerder, 2021). Outputs include animal wastes (litter, manure) and dead animals which may harbour live disease agents, sometimes for extended periods of time. Even effluent (wastewaters) from markets can be critical pathways for disease agents to be spread back into the environment onto land, including crop fields, and through surface runoff or direct discharge into surface waters (Davis et al., 2011). This can enhance indirect contact with wild animal populations that interface with contaminated land and water.

Importantly, from a risk assessment and management perspective, the behaviours of the actors along the value chain also influence the transmission risks of zoonotic infections associated with various commodities at any stage along the process (Win et al., 2023). This module highlights such examples in the sections below. For example, a small-scale poultry farmer raises chickens in a backyard business to sell to a trader or transporter, who then sells to a meat stall owner at a local wet market. Subsequently, the market worker slaughters the animals and sells the meat to consumers. For risk mitigation, risk assessments of current behaviours can provide valuable insights into the contributions of behaviours to the overall origin of risk factors. It is also crucial to emphasize the multifaceted and dynamic nature of the live animal trade, including legal and illegal wildlife trade and subsistence hunting, and the diverse places and settings involved, such as large-scale agricultural operations, backyard farmers, abattoirs, or wet markets (Challender et al.,

2015). Each of these places involves actors that bring distinct behaviours, which collectively shape the risk landscape.

GENERAL STAKEHOLDER MAPPING ACTIVITIES AND ENGAGEMENT IN BEST PRACTICES

In the preceding section, we provided a comprehensive overview of a regional animal value chain, shedding light on various stakeholders associated with it. In Module 8, we describe how to account for several layers of the social environment (e.g., public policies and regulations, community relationships, organizational culture, interpersonal exchange, and individual factors) to guarantee that actions and decisions are appropriately formulated (Module 8; Figure 8-1). This section emphasizes the significance of identifying influential actors within this chain who possess the capacity to impact the risks associated with commodities carrying zoonotic disease potential. This distinction sets the stage for more precise, targeted, and effective risk management strategies. Stakeholders can be categorized by their respective sectors, relationships, and levels of decision-making. Effective collaboration, open communication, and coordination among these stakeholders are instrumental in mitigating the consequences of an outbreak and preventing its spread. To illustrate, a detailed, but not exhaustive, list of relevant stakeholders involved at local, national, and international levels within Southeast Asian value chains can be found in Box 6-2. Box 6-3 offers an example of stakeholder collaboration from Cambodia, highlighting the critical role of engaging with diverse stakeholders to effectively respond to an avian influenza outbreak.

BOX 6-2

Examples of actors in the animal and animal product value chain by sectors and levels of decision

Local level:

- Hunters and butchers
- Landowners and farmers
- Medical and veterinary practitioners
- Law enforcement officers
- Border patrol agents
- Indigenous and local communities, including tribal and religious leaders and community representatives (e.g., monks, influencers, etc.).

Private and nonprofit non-governmental organizations (NGOs):

- Wildlife rescue organization
- Meat processing industry
- Food transportation and distribution
- Petting zoos and educational programs
- Animal interest groups, rescue centres, and biodiversity conservation organizations, including national chapters (Fauna and Flora International, World Wildlife Fund, Wildlife Conservation Society, National Academy of Sciences, CITES National Focal Point)
- Industry (e.g., logging, tourism, farming, and aquaculture)

State and federal level:

- Wildlife trade regulators
- State agencies (e.g., Department of Forestry)
- Government departments (e.g., Department of Health, Environment and Natural Resources, Agriculture)
- Accompanying organizations (e.g., Bureau of Animal Industry)
- Countries' leaders and prime ministers

Regional/international levels:

- International agencies (e.g., World Health Organization, the Food and Agriculture Organization, World Organisation for Animal Health)
- Regional consortia (e.g., Southeast Asia One Health University)

BOX 6-3
Responding to avian influenza outbreak, key stakeholders and strategies in Cambodia

A localized outbreak could have far-reaching consequences, potentially leading to a global pandemic, depending on the virulence and transmissibility of the disease. Cambodia's forests, wetlands, and other natural habitats are home to a wide variety of animal species, contributing to the country's reputation for rich biodiversity (USAID-Cambodia, 2011). Human activities, such as the unmonitored wildlife trade and the loss of ecosystems, have increased the stress on these species and contributed to the emergence of zoonotic disease (Esposito et al., 2023).

In 2023, two individuals in Cambodia were infected with avian influenza A (H5N1) virus. A joint animal-human health investigation is underway to identify the source and mode of transmission of the virus, with support from the in-country Centers for Disease Control (CCDC). Additionally, the investigation is led by the rapid response team, as well as the Cambodian Ministry of Health and other global public health professionals (CDC, 2023b).

However, in 2024, new H5N1 cases resulting in fatality were reported, revealing that the patient was exposed to sick or dead poultry before the onset of their illness (CDC, 2024). While efforts have been made to control the disease, continued vigilance and action are necessary to prevent future outbreaks and ensure food security. The key stakeholders to engage in response to an outbreak in Cambodia would include:

Government agencies: This includes the Ministry of Health, Ministry of Agriculture, Forestry and Fisheries, Ministry of Environment, and other relevant departments. They would coordinate the overall response and provide guidance and support to affected areas.

- Healthcare professionals: Examples are doctors, nurses, and other healthcare workers who would be responsible for treating patients and providing guidance to the public.
- Local communities: Examples are community leaders, religious figures, and other influential individuals who are crucial for effective communication and awareness-raising efforts within local communities.
- International organizations entities: The World Health Organization (WHO), the Food and Agriculture Organization (FAO), and other international organizations would provide technical assistance and support to the government of Cambodia.
- Donor agencies can provide financial and technical assistance to support the response efforts.
- The private sector can contribute by providing financial support, resources, and expertise to help address the outbreak.
- The media plays a critical role in communicating important information to the public and raising awareness about the outbreak.

Stakeholders can also be identified through formal mapping activities, which is a visual process of identifying all the stakeholders of a product, project, or idea on a map (Bernstein et al., 2020). In this case, mapping is informed by data and input gathered through value chain analysis, as well as focus group discussions and other activities suitable for compiling a comprehensive list of all interested parties. The overall complexity of stakeholder environments suggests that formal stakeholder mapping is essential to the effort of spillover prevention and outbreak response.

An approach to mapping the roles of actors in zoonotic risk at a particular step of the value chain can be described by considering their influence and interest through an X-Y chart (Box 6-4). Stakeholder mapping helps illustrate the interrelationships between different stakeholders, aiding to inform decisions regarding their involvement in developing and implementing risk management strategies. Specifically, this X-Y chart enables mapping the power and interests of specific individuals or groups of individuals involved. This approach helps answer critical questions such as who should be prioritized for engagement (Module 8 for practical discussions on actor engagement). It is highly likely that for each future scenario that leads to the increased risks of spillover, every country will have a different composition of stakeholders and different networks of influence created between these stakeholders. These dynamics may also vary between regions, even within countries, and evolve over time. Therefore, conducting stakeholder mapping is a critical prerequisite in the development of effective risk management strategies.

Establishing Trusted Networks in a Fragmented System

The risk of zoonotic disease emergence is influenced by activities and processes shaped by actors from the human, animal, and environmental health sectors (Gilbert et al., 2014). Once interested and influential actors and leaders have been identified using the stakeholder mapping activity highlighted above, establishing trusted partnerships and consistent and efficient communication channels becomes critical. These partnerships should be forged between key actors and decision-makers across sectors and disciplines, involving different governmental and research levels, medical professionals, private organizations, commercial entities, farming communities, and the public. Increasing cross-sectoral collaborations to improve national and local zoonotic disease management in Southeast Asia could benefit all countries at all levels in the region (Binot et al., 2015).

BOX 6-4

Stakeholder mapping at the retail step of the value chain using power-interest grids (X-Y chart)

Conventional retailers, such as traditional merchants in markets in Indonesia, play a significant role in shaping the cultural and economic landscape of Southeast Asia (Aliyah et al., 2016). However, they often grapple with issues such as substandard sanitation, poor infrastructure, and labour inequity. The intricate web of relationships among various stakeholders or stakeholder categories adds complexity to the situation, as each party brings its own unique challenges, making it difficult to establish effective coordination among them. To nurture a secure and thriving environment for traditional traders in Indonesia, a thorough stakeholder analysis of the traditional markets business ecosystem in Indonesia has been conducted (Prabowo et al., 2017). The X-Y chart (Figure 6-3; top) categorizes various stakeholders based on their influence and interest in the traditional market (Figure 6-3; bottom). This categorization informs our understanding of each stakeholder's needed level of participation in the future development of a resilient traditional market business.

FIGURE 6-3 Power-interest grid for stakeholders of traditional markets in Indonesia. Image adapted and enhanced for resolution from Prabowo et al., (2017) (top). Image of a retailer in a traditional market in Indonesia. Photo credit: Rafal Cichawa (bottom).

The challenge in creating trusted networks of different actors along the value chain lies in identifying effective mechanisms for bringing together relevant individuals or groups who need to be involved in emerging zoonoses management dialogues (Binot et al., 2015). In many countries around the world, different sectors are not accustomed to working together. Most countries in Southeast Asia are currently promoting the integrated One Health approach for the governance of pandemic risk within social-ecological systems (WHO, 2023d). However, government bodies remain fragmented in terms of their roles and responsibilities. For example, one department focuses on human health, another on production or companion animal health, and a separate one on forestry health, which includes wild animal health as well. Additionally, environmental health may fall under the jurisdiction of yet another government department. Given the interconnectedness of factors driving pandemic risk within this complex system, close coordination among these bodies is essential to achieve effective risk mitigation.

The impact of inaccurate information via social media should not be underestimated, particularly in terms of how interventions can influence public perception (Angawi and Albugmi, 2022; Liu, 2022; Zhou et al., 2023). Furthermore, the prevailing lack of trust and established relationships between farmers and government authorities often leads farmers to perceive disease control and prevention measures as threats to their livelihoods (Pao et al., 2022). Establishing trust with stakeholders in the value chain becomes imperative, as this trust can significantly enhance the effectiveness of outreach initiatives aimed at bridging knowledge gaps.

Different models have been implemented to foster such cooperation and develop truly integrated risk mitigation strategies using the One Health approach. For example, Bangladesh has established the One Health Secretariat, which acts as a coordinating body for managing risk governance for zoonotic infectious disease risks (CDC, USAID and FAO., 2017). The implementation of the One Health approach alongside operational tools enables the active participation of various stakeholders, integrating information and expertise from diverse perspectives to collaboratively evaluate and mitigate risks and threats posed by zoonotic diseases at the human–animal–environment interface (Binot et al., 2015). Three operational tools outlined in the Tripartite Zoonoses Guide (TZG) that promote cross-sector coordination are:

1. Joint Risk Assessment Operational Tool (JRA OT) provides countries with a qualitative methodology for assessing the risks associated with selected prior diseases. The guide identifies relevant risk factors that can form the foundation for risk-based surveillance and highlights opportunities for cross-sector collaboration to mitigate disease risk, including management, operational, and technical guidance that can be easily tailored to within-country situations.
2. Multisectoral Coordination Mechanism Operational Tool (MCM OT) provides countries with a stepwise approach to establishing or strengthening their multisectoral One Health coordination mechanism. This tool is adaptable for use in countries that currently lack any such mechanism or in those countries with an existing One Health task force. The tool directs the user in a very practical way through the process of bringing stakeholders together in a workshop and developing a One Health action plan, including its subsequent impact evaluation. The tool provides an Excel spreadsheet that can be used to assist in the process.
3. Surveillance and Information Sharing Operational Tool (SIS OT) provides countries with a tailored list of resources that can be implemented to improve intersectoral surveillance and information sharing. These tools contribute to building the country's capacity and strengthening the national system, ultimately resulting in the development of an action plan aligned with existing resources.

The diversity of socio-ecological systems in Southeast Asia countries poses a challenge to effective utilization of stakeholder mapping and operational tools (Ginige et al., 2018). Therefore, regional-level efforts must be initiated to address the challenge of implementing and sustaining collaborative efforts between member states, especially those sharing borders and engaging in trade. Box 6-5 describes several local, national, and regional initiatives and partnerships to enhance resilience against zoonotic diseases in Southeast Asia.

BOX 6-5
Overview of ASEAN and other multisectoral partnerships

The ASEAN Leaders's Declaration on One Health Initiative, made during the 42nd ASEAN Summit in May 2023 in Labuan Bajo, Indonesia, emphasizes the significance of collaborative efforts across sectors in adopting a One Health approach. The declaration underscores the importance of engaging stakeholders and raising community awareness to enhance prevention, preparedness, and response (PPR) activities while building national and regional capacities to address future threats and sustainably maintain the human-animal-environment.

Local ongoing initiatives such as Akademi Sains Malaysia (ASM) Special Interest Group (SIG) on Zoonosis, international organizations (Nature for Health, PREZODE, USAID EPT Projects such as RESPOND), and representatives from other various sectors, including the commercial and economic sectors such as the food industry, are collectively valuable in assessing policies, challenges, and strategies to enhance resilience against zoonotic diseases in ASEAN.

World Zoonoses Day, celebrated on July 6, serves as a platform for bringing together leaders and the public to enhance awareness about zoonotic diseases (WHO, 2021). Leaders of ASEAN Member States have embraced it by incorporating it into local languages, such as 'Hari Zoonosis Sedunia' in Malaysia and Indonesia.

The interconnectedness between organizations such as FAORAP, TRAFFIC etc., with local and regional authorities, helps engage with local communities to raise awareness of zoonotic diseases and encourage the reporting of unusual animal or human health events. For example, to address African swine fever (ASF) outbreaks, FAORAP initiative on educational videos (e.g., Be a Champion Farmer, Just Like Farmer Su) plays a critical role in inspiring smallholders to adopt better biosecurity measures, ultimately safeguarding the economies of small-scale farms by preventing massive pig losses.

Additionally, one way to develop risk communication strategies is to identify partners with the expertise, interest, and capacity to work collaboratively and determine the most effective ways to engage them (WHO, 2017a). Communication and engagement strategies should also take into consideration stakeholders in geographically challenging areas that are difficult to reach. Module 8 of this guidebook provides examples of how partners around a common set of issues can take part in participatory activities to collaboratively address them. Biosafety practices in Southeast Asia differ from country to country, influenced by variations in resources, infrastructure, and regulatory frameworks. Each nation customizes its biosafety protocols to meet its unique requirements while also adhering to international standards and best practices set by organizations like the World Health Organization (WHO) and the World Organisation for Animal Health (WOAH). Effective engagement with groups or individuals who may not be aware of biosafety issues at each step of the animal value chain but are influenced by top-down approaches for animal farming, handling, and consumption requires the use of targeted approaches or assistance aimed at facilitating their participation in the decision-making process. These voices are essential for co-producing solutions and successful implementation on the ground.

Tailoring social and behavioural change interventions to various stakeholders

The utilization of targeted participatory methods to enhance the knowledge, attitudes, and practices of stakeholders focuses on addressing the unique needs of each group. Participatory approaches actively engage stakeholders using tools such as straightforward diagrams pertinent to value chains and risk pathways to track the spread of infectious pathogens (Module 8). This effort ensures a comprehensive understanding of the dynamics involved in disease transmission and containment across the value chain. Other ways for social and behavioural change include prioritizing human development in remote areas, particularly among smallholders, cultural or tribal leaders, and the stateless community at bordering countries. An essential prerequisite for such stakeholder engagement is that it must be based on mutual trust (Harrison et al., 2019). It will take time to develop the required trust relationship, and once it has been lost, it takes time to re-establish. It is very rarely possible to develop a new trust relationship during an outbreak (Gambetta and Morisi, 2022).

Engagement initiatives should be designed to empower a diverse range of stakeholders, regardless of their power or interest in the issue. Often, meaningfully engaging various actors participating in value chains relevant to the emergence of pandemic risks falls short of conveying the impact of their actions and the significance of specific interventions. This deficiency frequently arises from the presentation of knowledge to stakeholders, often lost in complex technical jargon, without due consideration for adapting the information to the local context. Younger generations, such as schoolchildren and individuals lacking formal education, cannot fully comprehend the intricacies of zoonotic diseases, threats, and risks due to the highly technical nature of the available materials. It is, therefore, essential to integrate the concept of One Health into school-level education (Haxton et al., 2015), covering vital aspects such as the food system, food security, health and diseases, environment health, as well as biodiversity and ecosystem (Angelos et al., 2017). This initiative seeks to instil awareness in the younger generation of standard food safety and hygiene practices (One Health Commission, 2018).

Effective communication entails explaining the potential risks faced by individuals involved in farming and/or consuming animals that may be infected with zoonotic diseases and engaging them in plain and straightforward language. Such examples were featured in a recent report on wildlife animal trade and consumption (Box 6-6; Campbell et al., 2021). This approach not only has the power to mitigate the risks associated with disease exposure but also to create awareness among entire communities of food providers, especially those residing in remote areas with limited access to vital information about the transmission of zoonotic diseases in the agricultural sector. Box 6-7 lists a series of suggested questions to facilitate a dialogue regarding risk awareness. These questions are designed to be informal, allowing for a nuanced understanding of risk perception among smallholders from various backgrounds and responsibilities.

BOX 6-6
Practical strategies for effective communication in the context of zoonotic disease prevention

A comprehensive Situation Analysis report using Social and Behavioural Change (SBC) messaging identified strategic communications and stakeholder engagement success factors in relation to wildlife disease risks (Campbell et al., 2021):

- Messaging and communications should be directed to the most appropriate target audiences.

- Base messaging on pre-existing values.
- Use positive social messages, not just negative environmental (or health) messages.
- Ensure messengers are relevant and can speak credibly and with authority on the issue.
- Focus on what is relevant to and resonates with locally specific audiences.

Clarify and simplify guidance on change, and enabling, rather than instructing.

BOX 6-7
Communicating Risks: Risk awareness and perception towards spillover events

As individuals, our interactions with animals are shaped by our lifestyle choices or may also be influenced by our occupations. Recognizing the points of contact with animals, where and when they occur, can help mitigate the risks of zoonotic disease transmission. By posing these questions to oneself, a person can become aware of the risks they may incur:

- What significance do animals have to you?
- What types of animals are in close proximity to you?
- In what kind of environment do you and the animal coexist?
- Are you aware of what disease animals can carry?
- Do you feel like you have the capacity to assess animal health or recognize the signs and symptoms of a sick animal?
- Are you aware of the risk of exposure to zoonotic diseases when in contact with animal body fluids, blood, carcasses, faeces, and whether the animal is healthy or sick?
- Are you aware of any biosecurity guidelines and animal welfare standards currently in place, in relation to the animal?

CRITICAL POINTS OF CONTACT BETWEEN HUMANS AND ANIMALS IN THE VALUE CHAIN IN SOUTHEAST ASIA AND ASSOCIATED COMPLEX RISK FACTORS

Zoonotic disease hazards are interlinked and multifaceted, arising from a complex interplay of numerous factors. To comprehensively understand and address these risks, a One Health approach rooted in genuine interdisciplinary research has been proposed throughout this guidebook and in other avenues. Developing effective and sustainable interventions within such complex systems necessitates an in-depth understanding of the various risk factors (variables that are associated with an increase of zoonotic disease transmission) and actors involved. It is crucial to recognize that risk emergence within these systems typically results from elaborate interactions among multiple components, often entangled in complex feedback loops that are exceptionally challenging to identify (Ghai et al., 2022).

This complex web of both direct and indirect causal relationships complicates the prediction of intervention impacts across ecological, economic, social, and cultural dimensions whether at local, regional, or global scales. Focusing solely on isolated risk factors identified through research on specific subsections of the system, such as epidemiological studies on cross-species transmission risks between wildlife and domestic animals, is likely to fall short of achieving the real-world impact required. Such an approach often neglects the broader direct and indirect effects, as well as feedback loops within the entire ecological and social system.

The challenge lies in bridging diverse knowledge domains and cultures, encompassing individual, local, specialized, strategic, and holistic knowledge (Parkes et al., 2005). It is overly simplistic to compartmentalize wildlife, domestic animals, and humans as distinct entities isolated within the vast ecological and social system of our planet. Instead, the critical factors leading to the emergence of climate change and pandemic risks are the shifts in dynamics within this complicated system. This includes alterations in the frequency of interactions, consequently affecting the flow of pathogens among wild animals, domestic animals, and humans (Lefrançois et al., 2023). These shifts elevate the potential for cross-species transmission and genetic alterations that can enhance transmissibility. The mechanisms underpinning increased contact between various susceptible hosts, be they wild or domestic animals, or humans, are linked to phenomena such as rising deforestation or heightened demand for wildlife as pets or for consumption and other purposes (Box 6-8).

BOX 6-8
Navigating trade-offs between prioritizing food security and wildlife conservation: Malaysia example

Food security awareness varies from country to country and community to community (Gallegos et al., 2023; Breene, 2016). In rural communities characterized by predominantly lowland paddy fields, upland crop cultivation, or coastal-aquaculture reliance, the countryside farmers and their cooperatives sustain their livelihoods while experiencing periodic short-term fluctuations in demand. With readily accessible crops and backyard microfarms, the approach to food security is rather straightforward—to cultivate a modest amount of produce primarily for household consumption or local markets.

Despite land ownership for crops, fish farming and animal farms, Malaysia imports around 30% of its rice along with a substantial amount of other farm produce and animal feed from other countries (ITA, 2024). A recent investment in modern technologies to increase planting and production by the Malaysian government emphasizes the importance of this group of stakeholders for a sustainable food industry (Zalani, 2023). Food security and the role of smallholders in this country (and other Southeast Asian countries) are vulnerable to numerous factors, some of which are beyond stakeholders' control. These factors include political dynamics, ecosystem variations, such as unpredictable wet-dry seasonal changes, migration patterns, and land holdings or farm locations in rural areas. While government financial subsidies aim to enhance agrarian agriculture, several other factors pose a potential threat to the success of the National Food Security Policy Action Plan (Ministry of Agriculture and Food Security Malaysia, 2024) and all other initiatives if not closely monitored. One critical aspect is the zoonoses and risks of zoonotic diseases.

Examples of risk factors include (but are not limited to):

- Housing nested within these farms/estates allows animals to access cooking and sleeping areas
- Household practices and perception of standard hygiene and food safety
- Limited access to veterinary services and other healthcare facilities
- Limited awareness of zoonotic disease prevention and control practices such as vaccination, surveillance, quarantine, monitoring and evaluation
- A lack of incentives to improve biosecurity in animal farming
- Absence of transparency and enforcement in wildlife habitat protection

Sabah and Sarawak are geographically blessed with abundant marine resources, mangrove forests, mountain rainforests of rich biodiversity, and various mammals and bird species (Figure 6-4) that have the potential to act as reservoirs or intermediate hosts for the emergence of new infectious diseases in humans (Sabah State Government et al., 2020). Lands in this region are slated for transformation into modern agriculture hubs (Khazanah Research Institute, 2022) and are projected to become one of Malaysia's major rice production centres in the next decade. Land development and repurposing exert stress and pressure on the local environment and biodiversity leading to the loss of wildlife habitats and the expansion of contact zones between human and animal reservoirs of disease-causing pathogens (Plowright et al., 2021). Modern agrotechnology with improved biosecurity measures (Youssef et al., 2021) and active engagement from various stakeholders could mitigate the risks associated with zoonotic disease transmission while simultaneously ensuring food security.

FIGURE 6-4 Local flora and fauna. Images depicting the Bornean horseshoe bat, Irrawaddy dolphins, and small-toothed palm civets found in Sabah and Sarawak. The breathtaking Gunung Mulu in Sarawak, along with other mountains, serves as a magnet for ecotourism enthusiasts. Photo source: Mammals of Borneo.

Small-scale agrarian socio-economy and zoonotic disease risks in Southeast Asia

In Southeast Asia, small-scale landowners, predominantly individuals and families (Figure 6-5), play a crucial role in the local animal value chain (Mason-D'Croz et al., 2022). Together with the diversity of crops and food produced, and the different types of agricultural infrastructure employed, these factors place the local agrarian socio-economy as a proven practice to achieve national and global food security, poverty reduction, and sustaining rural livelihood. Such agrarian economies often involve the use of domesticated animals for a variety of activities and benefits (Turcotte et al., 2017).

FIGURE 6-5 Smallholder farmers in Myanmar (Burma). Photo credit: Pexels.

Farmers rely on farm animals for their labour in cultivation and use manure for fertilizer, amongst other animal-dependent agrarian activities, including livestock rearing, fishing, and aquaculture. The Southeast Asia region hosts a multitude of smallholder farms or backyard producers with daily direct and indirect contact with animals (Mason-D'Croz et al., 2022). While variation exists from one country to another, these smallholder farms typically involve family-operated farms (Thapa and Gaiha, 2014) that raise a limited number of heads that are fed with a combination of commercial and naturally available feeding sources.

Smallholder farming is highly dependent on its natural surroundings for ecosystem resources and services essential to the functioning of their livelihoods (Fan and Rue, 2020). An example case is the traditional smallholder cattle raisers in Southern Luzon, Philippines, as documented by Galang and Calub (2020a). Historically recognized for their cattle raising, these communities now face challenges posed by unprecedented climate change and increased risk of disease exposures (Box 6-9).

BOX 6-9
Smallholder cattle raisers in Southern Luzon, Philippines

In Southern Luzon, Philippines, the cattle raising system is traditionally a mixed cut-and-carry grazing model, highly dependent on several natural ecosystems around their landscape. During the rainy season, cattle raisers utilize grasslands teeming with healthy grasses and shrubs. However, when these grasslands dry during the summer, cattle are moved to natural forests in upland areas and riparian forests along riverbanks, where they can graze over perennial shrubs present in these ecosystems. Furthermore, cattle raisers gather additional feed from forest trees as supplementary biomass for their cattle. In recent years, dependency on natural and riparian forests has intensified due to a shortening of the rainy season. Compounded by other drivers such as overexploitation and privatization of grasslands, cattle raisers are increasingly compelled to source food from forests, increasing the risks of human-wildlife encounters that have the potential to spark zoonotic disease transmission (Galang and Calub, 2020a).

In general, the growing rate and intensity of zoonotic disease transmission have been shown to be driven in a large proportion by the intensification of animal agriculture and other

human-induced, or anthropogenic environmental drivers (Rohr et al., 2019). Examples of critical anthropologic socio-ecological drivers of risks are:

1. **Human encroachment,** exemplified by urbanization and agricultural expansion into natural ecosystems leads to extensive land-use changes (Lawler et al., 2021; Simkin et al., 2022). These developments not only threaten biodiversity but also expose humans to animals by creating novel assemblages of all the species existing in a particular habitat, thereby providing pathogens with new opportunities to seek out and exploit alternative host species (Daszak et al., 2000).
2. **Intensification of animal production** results in larger and denser animal populations within confined facilities, which encourages disease spread among animals and between animals and workers, and often leads to waste and wastewater discharges that can harbour pathogens (Bernstein and Dutkiewicz, 2021). Large-scale animal production can generate discharges well in excess of the local ecological carrying capacity for nutrients in the land, which may drive use of manure lagoons or litter piles to capture the excess wastes (Davis et al., 2011). The pathways by which pathogens can move around and off production facilities can relate to their facilities and processes for biosecurity (prevention of disease introduction) and biocontainment (prevention of disease release) (Davis et al., 2011). For example, capture (e.g., in a lagoon) and then spread of manure or litter onto crop fields locally or at a distance can allow for runoff of pathogens into surface waters, direct exposure of wildlife on the fields, and contamination of crop products, which may be consumed by either people or livestock populations. If pathogens can survive desiccation (drying), they also may be present in the soil and in airborne dusts, exposing workers and community members (Davis et al., 2011). At the same time, these environmental media (wastes, wastewater, surface water, soil, or air) can be leveraged for disease surveillance activities using environmental sampling methods, e.g., eDNA (Module 5).
3. **Expansion of the types of animal husbandry** gives rise to new forms of subsistence-based animal consumption. For instance, in China, the expansion of wildlife farming in the 1990s prompted many smallholder farmers to turn to wildlife trade (legal or illegal) as a means of income generation, and this trend persists to date (Wang et al., 2019).

Several reports also indicate that agricultural workers and people living in rural areas adjacent to these agricultural lowlands and uplands, as well as those in semi-urban areas, are at higher risk of exposure to zoonotic diseases from both domestic and wild animals, and this heightened risk is attributed to inadequate biosecurity measures and vaccination protocols (Jori et al., 2021; Magouras et al., 2020). For instance, backyard and small-scale farmers often rear free-ranging poultry and livestock in close proximity to households. This intermixing allows wildlife and farmed animals to access humans' sleeping, eating, and cooking areas, creating a situation where human–animal interactions are frequent. Additionally, cohabitation of multiple other species (chickens, ducks, pigs) within the same environment leads to an elevated risk of cross-species transmission.

In the region, the limited adoption and enforcement of biosecurity measures in backyard farms remain challenges, primarily due to the high cost of such measures or affording more space for different types of animals. There is also a severe lack of awareness of these biosafety and biosecurity guidelines, extending not only to the farmers themselves but also to local governing bodies who have jurisdiction over these backyard farms. Furthermore, healthcare services should

be meeting and engaging with farmers and other community members *in situ*—where they work—to reinforce the need for cross-governmental collaborations with health departments etc., thus ensuring that backyard farmers stay updated with immunizations and maintain good health. In Malaysia, permits for urban farming in residential areas typically fall under the jurisdiction of the local municipality (Murdad et al., 2022), but the temporary presence of farm animals such as cows and goats in residential compounds for Muslim celebrations is permitted with approval from the Department of Veterinary Services (DVS). Box 6-10 illustrates an example of biosafety and biosecurity concerns in small-scale backyard poultry farms in Indonesia.

Hygiene practices in these communities tend to be minimal and occasionally insufficient, with some relying on unsafe water sources and lacking access to improved sanitation. These small farming households often face challenges in accessing both human and animal veterinary health services, in addition to a wide range of household practices are linked to a heightened risk of exposure to zoonotic pathogens. For examples, the following household practices could contribute to increased likelihood of exposure: inadequate handwashing and hygiene practices, improper handling of poultry upon slaughtering (Vong et al., 2009), consuming of undercooked meat (Petersen et al., 2010), feeding animals raw meat (Stull et al., 2013) and culling sick animals for consumption and eating animals found dead (Osbjer et al., 2015).

BOX 6-10
Challenges and opportunities in West Java's poultry industry: A biosecurity perspective

West Java, Indonesia, is a region renowned for its fertile agricultural landscape and agrarian-centred economy. Here, animal farms, domestic poultry, and a variety of avian species constitute commonplace commodities. The province has been particularly hard-hit by HPAI H5N1 outbreaks, largely due to its extensive poultry trade, diverse poultry industries, and substantial poultry population (Karo-karo et al., 2019). The struggle to contain the spread of this disease stems from various factors, including an ineffective vaccination strategy, underreporting of cases out of fear of inadequate compensation for culling, and unsuccessful implementation of biosecurity measures (Indrawan et al., 2018).

To exacerbate the situation, unwell poultry have been making their way into the market through traditional distribution channels. For example, agricultural products from rural or small-scale backyard poultry farms are frequently marketed as fresh poultry meat without proper refrigeration or freezing (Indrawan et al., 2021). Local customers tend to favour freshly culled poultry meat, which they perceive as being the freshest due to its warm, freshly-cut nature, over chilled or frozen poultry meat (Indrawan et al., 2021). Given the severity of the situation, government intervention is of greatest importance. It is imperative to halt the sale of diseased sick poultry through these channels and educate the community about food safety, all while enhancing the implementation of biosecurity measures.

Innovative strategies such as circular economy practices, have the potential to mitigate the risk of zoonotic disease transmission (Rejeb et al., 2023). Circular economy initiatives promote efficient resource use and reuse, adoption of sustainable technology innovations, and responsible behaviours, for example, using crop residues and agro-industrial byproducts for animal feed or implementing precision livestock farming to minimize waste (Yang et al., 2023). These approaches not only help reduce the need for additional resource extraction links to deforestation or mining, but also safeguard biodiversity and ecosystems, while curbing encroachment activities in areas

where potential zoonotic diseases may emerge. Circular economy measures such as sustainable farming practices, diversified crop systems, and improved animal welfare, can effectively lower the risk of zoonotic diseases emerging within farm environments (Possas et al., 2021; Rejeb et al., 2023). A strong enforcement and implementation of circular economy initiatives at the local level, such as those illustrated in Figure 6-6, can minimize disease transmission associated with long-distance transportation as well as limit the spread of disease through extensive or global animal supply chains.

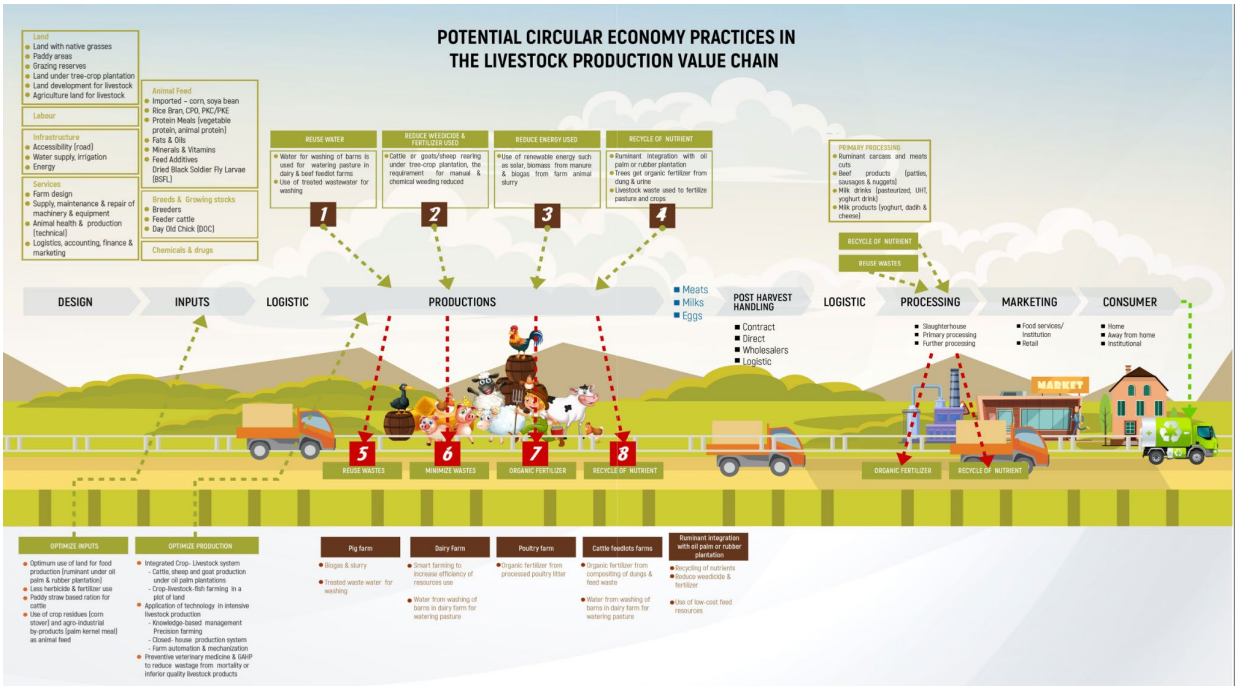


FIGURE 6-6 Potential circular economy practices in the livestock production value chain. Source: MPC, 2020.

Uncovering potential cultural and behavioural risk factors in Southeast Asia

Southeast Asia is home to a mixture of ethnicities and religions each with its own unique practices and beliefs. Within this context, the utilization of animal meat extends beyond mere subsistence and income, extending to ritual slaughter, religious sacrifice, offerings, and celebratory events. Some examples include the use of domesticated animals for Muslim animal sacrifice (al-Qayrawani, 2019), birds and pigs for Balinese Hindu ritual (Bali Spirit, 2024) and the practice of animal sacrifice in Lao Buddhism (Sprenger, 2005). While practices and beliefs hold significant importance across various countries in Southeast Asia, legal inconsistencies across the region may also lead to welfare concerns and unethical practices (Boxes 6-11 and 6-12).

BOX 6-11
Legal inconsistencies across region

FIGURE 6-7 Dog and cat meat trade in Southeast Asia. Dogs in cages near a dog meat restaurant in Vietnam. Photo credit: FOUR PAWS and Animal Reader.

While dogs and cats are cherished as the most commonly kept companion animals in many parts of the world, in certain regions of Southeast Asia, they are often viewed as a source of food and are featured in celebratory meals (FOUR PAWS, 2020). In these areas, regulations and oversight concerning the capture, transportation, and slaughter of these animals are not sufficiently stringent (Figure 6-7). This lack of oversight raises significant concerns related to animal cruelty, the theft of pets, and the potential for zoonotic diseases such as rabies to emerge and reemerge (FOUR PAWS, 2020; ICCWC et al., 2022). To counter this issue, dedicated advocacy groups such as the Dog Meat-Free Indonesia Coalition (DMFI), Soi Dog, FOUR PAWS, and others, are actively working to advocate for government intervention. Their aim is to enforce stricter penalties for those engaged in this trade, ultimately fostering a more humane and responsible treatment of dogs and cats in these regions.

BOX 6-12
Wildlife conservation and challenges: Religious establishments, animal welfare, and collaborative efforts in Southeast Asia

FIGURE 6-8 Macaques symbolize both revered spiritual connections and the challenges of animal welfare in Southeast Asia. Photo credit: K. Yoganand.

Many religious establishments in Southeast Asia are closely associated with symbolic animals, such as macaques (Figure 6-8) or felines, adding to their allure as local attractions (Wessing, 2006). In rural parts of these countries where animal welfare organizations are scarce, these establishments also serve as crucial rescue centres for abandoned animals. However, the well-being of these animals is often compromised by the lack of veterinary resources, proper care, and education (FOUR PAWS, 2021; Nizamuddin and Rahman, 2019). Consequently, they frequently suffer from malnutrition and zoonoses, posing a potential risk of disease transmission to humans (FOUR PAWS, 2022; Nizamuddin and Rahman, 2019). Furthermore, in rural areas, there exist cultural leaders, tribal communities, and animal specialists who often collaborate with various stakeholders to address similar challenges. These stakeholders may include government or non-governmental agencies engaged in jungle expeditions, search-and-rescue operations, ecotourism and biodiversity initiatives, research endeavours, or efforts to combat illegal hunting. However, these groups often encounter barriers and gaps, such as lack of adequate information, necessary empowerment, and support when it comes to animal welfare issues. These collaborative efforts are also critical to mitigate unsustainable practices such as wildlife capture and trade harvesting.

The dependence on resources, which are at times limited, often conflicts with deeply ingrained cultural practices that promote livestock farming. Farmers are often forced to seek means of enhancing production, occasionally resorting to unlawful methods, all in pursuit of economic advancement (Marks et al., 2015). Growing diversity in agribusinesses in Southeast Asia tends to drive land-use changes to meet booming trade demands, oftentimes at the expense of natural forests, biodiversity, and wildlife habitats (Liu et al., 2020). Some examples include:

- High-grades durian farming, palm oil and rubber plantations, and cattle farming have led to deforestation
- Aquaculture often leads to the destruction of mangroves and coastal habitats
- Increasing ownership of exotic pets and demand for commercially extinct species, especially in urban communities where well-off households can afford to keep exotic

pets. Social media platforms and online dark marketplaces have further fuelled this trend, encouraging petting of exotic animals as part of the new lifestyle

FIGURE 6-9 Rats, frogs, squirrels, and monitor lizards are often sold in local fresh markets in Lao PDR. Photo credit: K. Yoganand.

Human behaviour and unregulated or illegal animal sourcing activities play a critical role in shaping the structure of live animal value chains and significantly influence the risks associated with pathogens spread through or amplification within these value chains (Module 3). For instance, in large cities in Vietnam, the consumption of wild animal meat has evolved from previously only being accessible to the high-income strata of the population, to becoming a much more widespread cultural practice (Shairp et al., 2016). This has led to increased wildlife hunting activities (Anh et al., 2021) to meet the demand of consumers.

In addition to behavioural factors, weak regulatory frameworks and mechanisms are closely associated with illicit trade activities (UNODC, 2023), which create conditions and opportunities favourable for the emergence and spread of zoonotic diseases. This issue has been consistently observed throughout the region, highlighting the need to address inadequate action and enforcement practices, involving multiple sectors and stakeholders, to mitigate the increased risk of zoonotic disease outbreaks.

In some parts of Southeast Asia, the wet market scene typically features an array of hunted species made available for human consumption, further exacerbating the risks for zoonotic transmission (Naguib et al., 2021) and providing another way for zoonotic infectious diseases to come into close proximity with humans. In these places, species not subject to wildlife trade restrictions are openly traded (Figures 6-9 and 6-10). Specifically, one of the long-standing issues in the region is wildlife trafficking (Module 3), particularly the illegal trade in endangered species and their products. Legal inconsistencies and loopholes in action and policy measures (license revocation etc.) pertaining to wildlife vary across regions (Jiao et al., 2021). Variations in penalties for wildlife crimes prevent the development of a unified strategy between and within countries in the region for addressing wildlife crime, contribute to difficulties in effective wildlife protection, and create disparities in the conservation efforts for different wildlife species (ACET, 2019).

FIGURE 6-10 A variety of animals serve as meat sources in the region. Grilled rats are commonly sold in streets of Cambodia (top left); monitor lizards and rodents are sold in an Indonesian market (top right); and several amphibian, reptile, bird, and mammal species are sold in local fresh markets along with fishes across the Southeast Asia region (bottom four photos). Photo credit: K. Yoganand.

Examples of culturally driven practices that may introduce zoonotic risks include the substantial market demand for premium high-end products and other regional delicacies such herbal chicken, bird nests, rats, fried tarantula, bats, amphibian dishes, Kopi Luwak coffee, and snake wines believed to have preventive and wellness benefits. Similarly, in the Philippines, *balut* eggs are a common street food. *Balut* is a delicacy that consists of a duck embryo boiled and eaten within its shell. Some believe that it contains aphrodisiac attributes (Alejandria et al., 2019). Similar dishes with different preparations can also be found throughout other Southeast Asian countries, such as Vietnam and Lao PDR (Hochberg and Bhadelia, 2016). Notably, Kopi Luwak coffee consists of partially digested coffee cherries, which have been consumed and defecated by

Asian palm civets (Gaiser, 2024) (Figure 6-11). Consequently, civets have been increasingly captured in the wild, raised, and traded for this purpose (Shepherd, 2012), creating a direct connection from wild animal products to consumers. In this case, ineffective welfare monitoring and law enforcement often result in animals held in captivity enduring substandard living conditions, lacking access to necessary veterinary care, and frequently exposed to stressful environments during recreational events featuring loud music, overcrowding, and an influx of visitors (Coleman, 2021).

FIGURE 6-11 The common palm civet (*Paradoxurus hermaphroditus*), native to South and Southeast Asia, in its cage on a wildlife farm in Vietnam in 2017. Photo credit: Wildlife Conservation Society, Vietnam.

In addition to live wet markets in the open, illegal virtual marketplaces, some operating through social media platforms or black-market websites, have proliferated in Southeast Asia. These platforms cater to diverse customers, offering a variety of animal and animal products that can be discreetly purchased and shipped. This creates opportunities for animal-based illegal trade and enables criminal networks to operate and thrive (Fallin, 2021; ASEANPLUS, 2023).

Animals are also used in recreational, sports and games, and local ecotourism activities (Zamri and Md-Zain, 2022) (Figure 6-12). Some examples include:

- Animal commodification for entertainment and tourism, such as elephant riding, tiger petting, local animal contests, and cockfighting, which are considered to have a potential role in the spread of avian influenza viruses. Some countries promote these activities, including gambling, as tools to boost tourism. In the Philippines, recent cases have involved virtual versions of cockfighting, usually live streamed through websites or social media platforms (Murphy, 2023). In contrast, other countries' governments have made all forms of gambling involving animal fighting illegal and prohibited animal fighting and baiting altogether (AWI, 2024; Mota-Rojas et al., 2022).
- Sought-after attractions, such as street and alleyway traditional wet market venues which are popular among tourists (Seneviratne, 2020). Some wet markets are poorly structured, without doors or gates, and are susceptible to intrusions by stray animals in search of refuge at night.
- Hobby farms, small-scale animal-based businesses, and individual pet owners. In these cases, the confinement and captivity of animals in inadequate living conditions can lead

to significant physical and physiological stress (Fischer and Romero, 2019; World Animal Protection, n.d.), exacerbating the risk of zoonotic disease transmission.

Southeast Asian countries exhibit varying operating guidelines, policies, and practices concerning animal welfare, rights, and ethics, particularly regarding the use of animals for human interests such as animal tourism, sports, and local competitions (Nizamuddin and Rahman, 2019; Rivera et al., 2021). The Southeast Asian Zoos and Aquariums Association (SEAZA) was established in response to the growing need for standards and guidelines for zoos and conservatories in Southeast Asia, but more support is needed to keep up with animal welfare standards. In addition, the lack of access to veterinary care, poor hygiene practices, and overall absence of regulatory measures further exacerbate the potential for zoonotic diseases to emerge, thereby posing a significant threat to both animal and human health (UNEP and ILRI, 2020).

FIGURE 6-12 Ecotourism images of long-tailed macaque monkeys interacting with human tourists at the Batu Caves in Selangor, Malaysia. Photo credit: Meghan Davis.

Human behaviour is shaped by personal knowledge, beliefs, experiences, and values, among other factors. External factors, such as the socio-cultural and economic-political systems by which actors live, are critical in shaping these behaviours (Burke et al., 2009). Module 8 further includes practical suggestions on how to engage all parties involved in the animal value chain to help manage zoonotic risks. To effectively address these risks, an essential step is identifying and understanding the human behaviours contributing to them. This calls for a participatory approach that integrates diverse knowledge systems, especially local knowledge, to enable a more comprehensive understanding of key actors and their potential contributions to creating these risks. Participatory methods and community engagement go a long way to ensuring critical stakeholder inclusion and successful implementation of public health response writ large. Module 8 (How to use this guidance: applying participatory methodologies to countering spillover) outlines some of the key components of the implementation process, including the cultural, social, economic, and political contexts. By meticulously mapping out animal value chains and the associated risk pathways, specific stages where risk originates, and actors need to be involved in the conversation could be effectively identified. Indeed, Module 8 emphasizes that this guidebook is useful only if the approaches described in it are implemented by the intended actors.

CONCLUSION

Efficiently preventing and controlling the emergence and transmission of infectious pathogens with pandemic potential require the active involvement of diverse stakeholders interconnected within the socio-ecological system. These stakeholders occupy varying roles, all of which either influence the risks at play or are directly affected by the resultant hazards and mitigation measures. Recognizing and comprehensively understanding the multifaceted local contexts and their impact on pandemic risks is the foundational step towards crafting effective risk mitigation strategies.

Central to this process is the imperative engagement of stakeholders, fostering a co-production of knowledge that empowers them to take ownership of the interventions under development, thereby maximizing the likelihood of their effectiveness and long-term sustainability. Furthermore, it is crucial to acknowledge the dynamic nature of socio-ecological systems. Any intervention can trigger direct and indirect consequences, reverberating through intricate feedback loops that are challenging to predict, potentially altering the socio-ecological system in unforeseen and undesirable ways. This dynamism isn't confined solely to human behaviour but extends to the natural and ecological systems, owing to their inherent complexity. Effective stakeholder engagement is pivotal for capturing the intricacies of the social dimension within the underlying socio-ecological system.

In the pursuit of harmonious coexistence between humans and animals, identifying tailored solutions to mitigate the risk of zoonotic transmission between humans, livestock, and wildlife remains critical. It is essential to acknowledge that intervention plans and biosecurity measures cannot adhere to a 'one-size-fits-all' paradigm, given the unique circumstances of each operation. Stakeholders must join forces, collaboratively striving to prevent zoonotic transmission by employing the most effective strategies aligned with their specific communities, culture, or regions. Simultaneously, relevant authorities must multiply their efforts to raise awareness among local communities involved in the animal and animal products value chain regarding the significance of zoonotic diseases and the critical importance of preventive control measures.