ADB Project Document

Livestock Movement and Disease Risk in the Greater Mekong Sub-region – Final Report

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ABBREVIATIONS[1]

ADB – Asian Development Bank
ASEAN – Association of Southeast Asian Nations
CASP – Core Agriculture Support Program
CBTA – Cross-Border Transport Agreement
CDM – Clean Development Mechanism
EWEC – East-West Economic Corridor
FAO – Food and Agriculture Organization
FMD - Foot and Mouth Disease
GHG – greenhouse gas
GMS – Greater Mekong Sub-region
GMS-AINS – Greater Mekong Sub-region - Agriculture Information Network Service
ICT – information and communication technology
LITS – Livestock Identification and Traceability System
MDGs – Millennium Development Goals
NSEC – North – South Economic Corridor
PRC – People's Republic of China
SEC – Southern Economic Corridor
SMEs – small and medium-sized enterprises
SPS – sanitary and phytosanitary
WGA – Working Group on Agriculture

[1] A glossary of technical terms is available in an appendix at the end of this document.

I. EXECUTIVE SUMMARY

1. Increased cross-border livestock trade in the Greater Mekong Sub-region (GMS) is changing disease risk landscapes, including higher incidence of tainted meat and meat fraud in regional markets. As part of ADB's GMS Core Agriculture Support Program, Phase II (CASP 2), a regional livestock identification and traceability system (LITS) was piloted in order to gain insights into how to more effectively manage and mitigate regional disease risk. Implementation of this pilot project demonstrated that a low cost technology based regional traceability system is possible to implement. However, experience with the pilot implementation also serves as a reminder that many challenges remain before widespread implementation of a regional traceability system is fully possible. Nonetheless, in this type of system has potential to not only improve animal and public health outcomes, but contribute to higher value agrifood trade and regional poverty reduction.

2. In addition to more detailed information on patterns of GMS animal movements and disease reporting, our general finding is that conditions are ripe for improved oversight and trade facilitation. At the transboundary level, informal animal flows predominate in many areas, leading to higher transactions cots and significant uncertainties regarding health status and other product quality characteristics. These market failures promote adverse selection, limited supply chain engagement, and underinvestment, undermining public trust and leaving this category of regional agrifood development far below its potential to contribute to regional livelihoods. More specifically, the experience of the three country LITS pilots support the following policy recommendations:

1. As regional integration progresses, GMS countries are facing dramatically changing agrifood market opportunities. To capture these effectively will require determined policy support for market access and supply chain modernization.
2. Agrifood market expansion can be a potent catalyst for poverty reduction if policies support adoption of appropriate technologies and institutions. In the GMS, these include e-Traceability, certification, contracting, and producer cooperatives.
3. Expanding agrifood markets present new opportunities and risks to the region, as increasingly diverse biological products and economic agency complicate the food safety landscape. Managing food safety, disease, and other risks will require technological modernization, including e-traceability to improve supply chain transparency and product quality accountability.
4. Partnership with private sector actors can accelerate and reduce the public costs of supply chain modernization. Technologies like e-Traceabilty enhance private value and adoption/diffusion of these innovations can be self-financing if governments take a leadership role in establishing and administering standards.
5. Regional government partnership for harmonized standards and adoption is essential to the credibility and effectiveness of supply chain technologies. Many of the potential benefits (e.g. product safety) of e-traceability cannot be sustained without transboundary coordination.
6. Global trade partners, especially in the larger and more advanced economies, have strong incentives to support GMS agrifood modernization, and the sub-regional governments and

their private sector agents should take full advantage of this to promote joint ventures, technology transfer, and export market access.

7. This project demonstrates that modest initial public investments can be leveraged by low-cost use technologies to significantly improve supply chain performance and participation. GMS governments and their development partners should follow this example of innovation leadership and continue making targeted investments to overcome information-base market access barriers.
8. The internet database platform developed for this project demonstrates its potential for universal information access. This presents opportunities for market transparency, but it also raises policy issues that should be addressed regarding privacy.
9. The successful implementation and positive reception of the LITS cattle pilots indicates that they should be expanded to national programs, not only in the three countries studied, but across the GMS.
10. Based on global experience with a wide array of other traceable agrifood products, the LITS results also indicate that e-traceability should be expanded to pilots for other animals including fish, fruits and vegetables, timber products, and many other live and processed agrifood products.

3. The project concluded with a workshop presenting our findings to delegates from each of the GMS countries. The proceedings of this meeting are documented separately, but after two days of review and dialog, the delegations unanimously endorsed the LITS project and its recommendations. The GMS sub-region is entering a period of rapid change, one that will present unprecedented opportunities and risks for the agrifood sector. Modernization of this sector to improve its information and incentive characteristics, as exemplified by e-Traceability, can play an essential role in realizing the region's enormous potential for sustained and inclusive economic growth.

II. Introduction

4. Increased demand for livestock and their products in the GMS presents a large transboundary disease risk due to the informal supply chains that cross borders. As part of ADB's GMS Core Agriculture Support Program, Phase II (CASP 2), this project addresses the challenges associated with expanding cross-border trade working towards the goal of helping the GMS become a leading producer of high-quality agriculture products. This goal can partially be achieved through a region-wide Livestock Information and Traceability System (LITS), which can identify and trace all animals as they move through supply chains. Traceability is a necessary component in the reactive control system of disease risk management as it can trace outbreaks to their source and remove any potentially contaminated animals from the supply chain, effectively containing the outbreak. The potential benefits however of a LITS go beyond disease risk identification and containment by improving animal quality and providing reliable information to end-users. Traceability allows producers to be recognized for higher quality products and encourages increased product quality and market access. Because market access is the primary gateway out of poverty for rural poor majorities in the GMS, traceability can be strongly pro-poor, supporting improved livelihoods for small farmers and enterprise intermediaries.

5. The piloted traceability system builds on the best practices from other developing countries and features low cost, efficient, and globally standardized technology with open source software support that can be easily adapted across the GMS. The piloted system relies on ear tags featuring QR codes *and* RFID chips. Using these technologies allows smart phones to act as scanners. For QR codes any smart phone with a camera and internet connection is able to scan tags. This allows great flexibility for producers as many already own smart phones and there is no need for separate technology to be purchased. In addition, we also deployed RFID scanners for certain users (such as checkpoint officials and other authorities). This system connects to a smart phone but allows quick scanning for large batches of cattle.

6. In the piloted LITS, scanning the tags occur (1) when the tag is initially registered to the cattle and (2) when an event occurs. During the pilot, scanned events included veterinary visits, sales, movement, and other activities deemed relevant by the executing agencies. Upon scanning, individual cattle information is automatically uploaded to web based database that was programed with open source software. The web interface can be viewed or edited at anytime with data available for download. Collectively, this system represents a flexible, low-cost, state-of-the-art traceability system was piloted under diverse conditions across three GMS countries as detailed in this report.

III. Contributions of the LITS Pilot to ADB's Core Agriculture Support Program in the Greater Mekong Sub-region

7. The theatre for LITS implementation was three countries in the Greater Mekong Sub-region (GMS), a group comprising five of the ten countries that make up the Association of Southeast Asian Nations (ASEAN). The GMS itself is made up of Cambodia, the People's Republic of China (PRC), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Viet Nam. The LITS pilot was deployed in Cambodia, Lao PDR, and Myanmar. This activity was part of a larger Asian Development Bank (ADB) project assisting all six countries that joined a sub-regional economic cooperation program (GMS Program) in 1992 to promote regional cooperation and economic growth. The GMS Program specifically focuses on improving connectivity, competitiveness and community, and has resulted in investments of over $15 billion in infrastructure and urban development.

8. The agricultural industries in the GMS are generally less developed compared to other industries, especially in remote upland and highland areas throughout member countries. This leaves significant opportunities for economic growth through product output, trade, employment, and income generation. Following the increasing regional and global demand for livestock products, GMS member countries have the opportunity to address supply gaps and achieve significant economic gains. There is an immediate need for agricultural production and trade that is resilient to climate change to fill these supply gaps, and one that operates through a modernized trade system in order to supply safe and high-value products.

9. The GMS has a comparative advantage in the food and agriculture sector as a result of the quality of natural resources, fertile agro-ecosystems, and rich biodiversity. Consequently, the GMS continues to gain shares of the global market for key food and agricultural products such as rice, prawns, processed fish, and poultry products. Main drivers behind the GMS agriculture sector include 1) accelerated globalization and trade liberalization, 2) climate change, 3) degradation of the agricultural resource base, and 3) investments in transport infrastructure. As the GMS experiences economic growth and expands its production capacity, it will become increasingly important for the member countries to seek economic development while preserving natural ecosystems.

10. One of the most important comparative advantages of the GMS and its economic development in the food and agriculture sector is the proximity of its member countries. Investments in transport infrastructure facilitate cross-border trade between GMS member countries and have consequently made intraregional agrifood trade one of the fastest growing sectors in the sub-region. Importantly, cross-border agrifood trade is underutilized and has the potential for large growth and spread both direct and indirect economic benefits throughout the region. Enhanced regional cooperation is a key factor in increasing the region's competitiveness in the agriculture sector and is considered a key priority sector in transitioning the region's transport corridors into economic corridors (Figure 1).

Figure 1: Transport Corridors in the GMS

Source: Progress Report on Transport and Trade Facilitation Initiatives in the Greater Mekong Sub-region. November 2013. ADB, Australian AID

A. The Core Agriculture Support Program (CASP)

11. Regional cooperation of GMS member countries in the agriculture sector has been promoted by the GMS Working Group on Agriculture (WGA) through the Core Agriculture Support Program (CASP). CASP Phase I (2006 – 2010) was supported by ADB and other development partners including the Food and Agriculture Organization (FAO) and the International Fund for Agricultural Development (IFAD). Several initiatives were implemented to promote regional cooperation and strengthen human and institutional capacity for trade, cross-border contract farming, and increased biosafety of agricultural products. Specifically, these initiatives included 1) public-private partnerships (PPPs) such as the GMS Agriculture Information Network Service (GMS-AINS) and the Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy, 2) regional emergency response mechanisms, 3) activities to prevent and control trans-boundary invasive species and animal diseases, and 4) customs and quarantine procedures at member country borders. As a result, intraregional trade increased from 5.7% of the total trade with the world in 1992 to 12.6% in 2002 (Table 1).

Table 1: Share of Intraregional Trade to Total Trade of the GMS (percentage of total trade with the world)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Cambodia	20.1	34.5	39.0	36.4	33.6	40.0	31.5	22.0	19.5	27.3	24.5
China**	1.2	1.2	1.3	1.9	1.7	1.8	1.7	1.7	2.1	2.1	1.9
Lao	63.3	48.9	55.8	57.3	61.1	66.8	65.7	70.6	65.5	68.6	67.8
Myanmar	23.4	23.6	22.8	24.1	18.1	17.5	18.5	27.6	28.9	34.0	35.6
Thailand	2.8	2.5	3.4	4.0	4.0	4.6	5.3	6.0	6.8	7.7	8.9
Vietnam	4.7	8.0	9.9	10.4	7.9	8.9	10.9	11.9	14.9	14.6	13.9
Average for GMS#	*5.7*	*6.2*	*7.2*	*7.6*	*6.7*	*7.4*	*8.3*	*9.5*	*10.7*	*12.0*	*12.6*

Notes: * Ratio of total trade with GMS countries to total trade with the world.

** Ratio of the total trade of entire China with GMS countries to total trade of entire China with the world. According to Chinese customs data, the total bilateral trade volume between China and the other five GMS countries in 2004 exceeded US$25bn, double that of 2002. Trade between the two participating Chinese provinces, Yunnan and the Guangxi Autonomous Region, and the five GMS countries of Southeast Asia was worth US$1.87bn in 2004, a 21.4 percent increase over 2003.[3]

Weighted average based on purchasing power parity-gross national income shares.

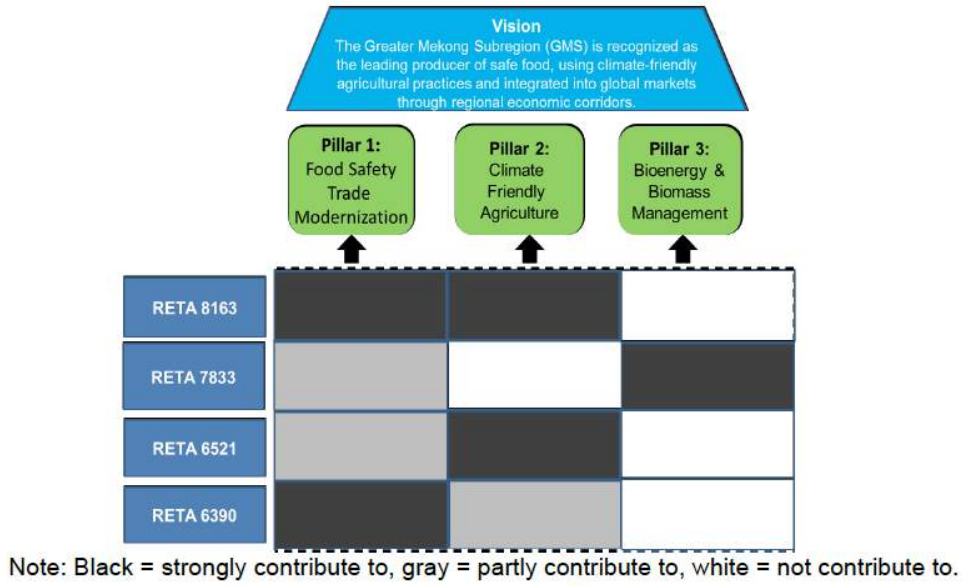
Source: ADB (2004), GMS Regional Economic Cooperation Strategy and Programme

12. Following on the success of CASP Phase I, CASP Phase II (2011 – 2015) was launched to focus on economic development while maintaining and preserving natural resources and ecosystems in the area. Phase II focuses on addressing challenges associated with expanding cross-border trade and climate change adaptation with the overarching goal of helping the GMS become a leading producer of safe food that is integrated into global markets through regional economic corridors. Many Phase II initiatives build upon Phase I investments to enhance cross-border trade and have helped smallholder farmers in GMS member countries produce agricultural

food products that comply with international food safety and quality standards, and improve access to markets both locally and globally.

13. There are three main pillars that lay the foundation for CASP Phase II and its efforts to promote safe food production using climate friendly agricultural practices. The three pillars are: 1) building global competitiveness by promoting food safety and modernizing agricultural trade, 2) promoting climate-friendly agriculture through market-based strategies to ensure food security and rewarding farmers for their ecosystem services, and 3) promoting agriculture as a leader in providing clean energy and eco-friendly cross-border supply chains. Based on these three pillars, Phase II maps new strategic directions to support expanded cross-border trade in food and agricultural products. Highest priority is placed on 1) accelerating the implementation of the Cross-Border Transport Agreement (CBTA) and other transport and trade facilitation initiatives, 2) transforming the GMS transport corridors into economic corridors, and 3) reducing environmental risks of the GMS development plans.

Figure 2: Four Regional Technical Assistance Projects and contributions to CASP



Source: Core Agriculture Support Program, Phase II; Annual Progress Report January – December 2014. ADB.

14. CASP Phase II is financed under four ADB regional technical assistance (RETA) projects, and each contributes to different goals of CASP (Figure 2). These RETA projects are: 1) RETA 8163: Implementing the GMS Core Agriculture Support Program, 2) RETA 7833: Capacity building for the efficient utilization of biomass for bioenergy and food security in the GMS, 3) RETA 6521: Accelerating the implementation of the core agriculture support program, and 4) RETA 6390: Trans-boundary animal disease control for poverty reduction in the GMS. Highlights of the CASP Phase II achievements can be found in Table 2, and more detailed progress on each of

the RETAs and countries can be found in the *Core Agriculture Support Program, Phase II Annual Progress Report – January – December 2014* published by ADB and the GMS CASP.

Table 2: Highlights of CASP Phase II Achievements in 2014

Highlights of CASP Phase II Achievements in 2014
• Inception workshops held in all six GMS countries • Successful establishment of six National Secretariat Support Units (NSSUs) to coordinate implementation of technical assistance (TA) activities • Enhanced regional integration and collaboration in GMS agriculture sector • Progress toward achieving "enhanced market access for environmentally friendly agricultural products produced by smallholders" • CASP Phase II emerged as a knowledge leader in climate-friendly agriculture • Enhanced government ownership and leadership tole through the Letter of Agreement (LOA) mechanism • Building private sector participation through the memorandum of understanding (MOU) instrument • Public private partnership (PPP) on CFA enhanced • Adoption of CASP Phase II activities in current and future investment projects • Collaboration with civil society organizations • Linkages to the Core Environment Program (CEP) and other regional programs • Advanced regional cooperation on knowledge exchange

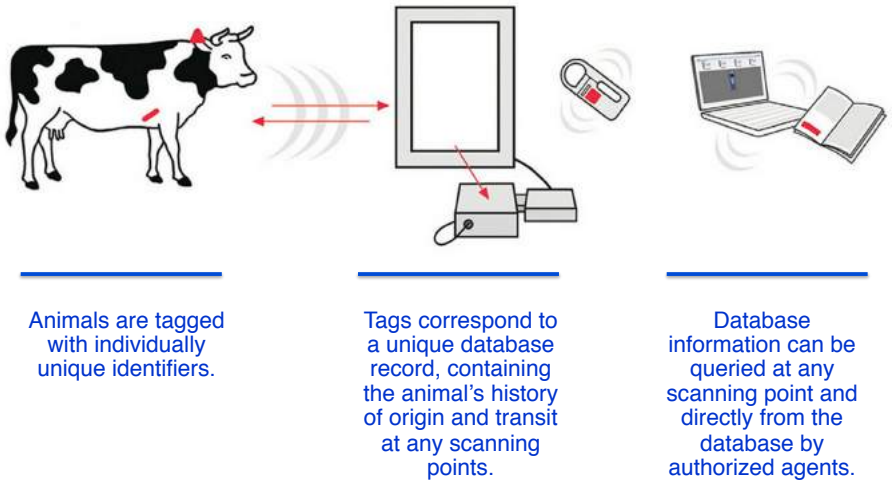
Source: Core Agriculture Support Program, Phase II; Annual Progress Report January – December 2014. ADB.

15. Despite significance advances in CASP Phase II, there is still a need to enhance the sub-region's regional cooperation and productivity. Better policies will be required to allow for effective cross-border trade, as well as innovative methods that improve efficiency of project implementation throughout the entire GMS.

B. What is the Livestock Information and Traceability System (LITS)?

16. The Livestock Information and Traceability System (LITS) is a cost effective method of tracing livestock movement in agrifood supply chains. It is a modern trading system that is able to link regional and global markets, which is critical in increasing agricultural competitiveness in the GMS economic corridors. LITS capitalizes on existing regional incentives and national agricultural development strategies and programs, and disseminates agricultural practices and safety standards that comply with international standards. Importantly, the traceability system plays a key role in developing regional certification and accreditation systems, enhancing community participation, and increasing public and private investment in science and technology for food safety and security.

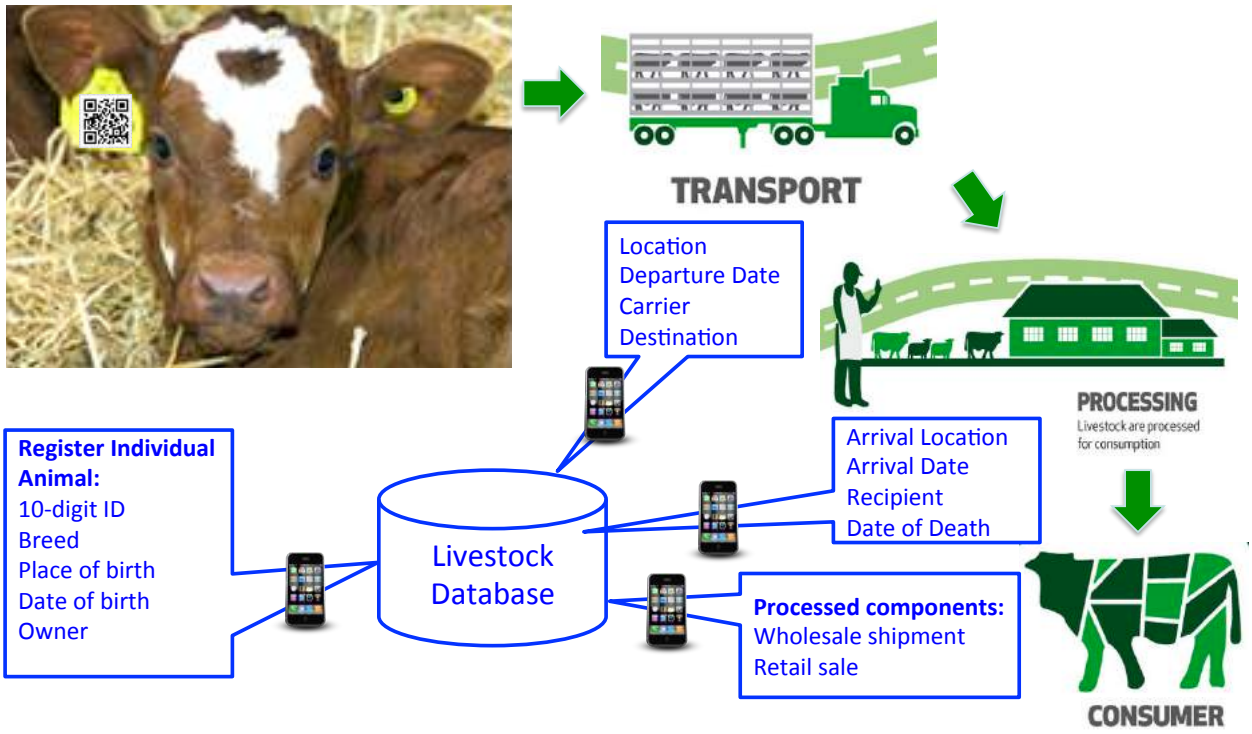
Figure 3: LITS Technology Pathway



Source: Introduction to the LITS Project; Introductory Meeting for Cambodian National Counterparts and the International Implementation Team (2015). Joachim Otte, Ph.D., Berkeley Economic Advising and Research.

17. LITS has the capacity to track and record a wide variety of information using digital scanning technology. Animals are given a unique digital tag that has two-dimensional bar codes that are compatible with scanning devices (including smart phones) (Figure 3). Metal ear tags, commonly used as an identification mechanism in many countries, are a cost effective, durable, and minimally invasive method for animal surveillance. As the registered animals move along the supply chain, information (e.g., livestock distribution, health status, movement across borders) is entered into an open source database (Figure 4) accessible to government ministries in real-time.

Figure 4: Tag and Scan Pathway



Source: Introduction to the LITS Project; Introductory Meeting for Cambodian National Counterparts and the International Implementation Team (2015). Joachim Otte, Ph.D., Berkeley Economic Advising and Research

18. Traceability systems such as LITS allow for effective means of recording and reviewing a large array of information. The piloted LITS incorporates prototypes from multilateral and bilateral development partners (i.e., UN FAO, OIE, EU, Australia, Japan, US) that form a system with international best practices that were then adapted to the institutional, geographical, and economic landscape of livestock flows across the GMS. For the purposes of the pilot a base set of information was collected. However, it is straightforward to include additional information information based on changing conditions or requirements of stakeholders. The type of information that can be collected through the piloted LITS in the GMS are listed in Table 3.

Table 3: Information collected open source database

1. Identification information collected for each animal and event	2. Location and Event Information
• Species and breed • Origin • Owner/custodian contact information • Physical location (global positioning system; GPS) • Date of birth • Production category • Sex • Breed • Number of animals of each species • Animal ID of parents • Health status for disease risk management	• Name of establishment • Establishment ID • Name and contact info for person legally responsible for animals • Physical address/GPS coordinates of establishment
3. Salient Events	**4. Movement within country**
• Birth of animal • Slaughter/death of animal • Ownership changes • Observations (e.g., testing, health inspection, health certification, etc.)	• Date of movement • Establishment of animal dispatch • Number of animals moved • Destination establishment • New location where animals are kept (GPS) • Any establishments used in transit • Description of means of transport (e.g., vehicle IDs where possible)
5. Animal export	**6. Animal import**
• Date of export • Number of animals moved • Establishment of animal dispatch • Border crossing • Destination establishment • Any establishments used in transit • Description of means of transport (e.g., vehicle IDs where possible) • Record of animal ID from exporting country to be provided to authority in importing country	• New animal ID assigned at time of import • Record of animal ID from exporting country; to be linked to new animal ID • Date of import • Number of animals moved • Establishment of animal dispatch • Border crossing • Animal identifier lost/replaced • Animal missing, lost, or stolen

Source: Livestock Information and Traceability System; Technical Approach and Methodology. David Roland-Holst, 2015

19. To complement the data that is collected using the LITS digital tagging system, there have been extensive efforts to train smallholder low-income farmers to create a sustainable LITS database. The LITS team developed a detailed training manual targeting smallholder low-income farmers, who are often unwilling to change their practices and use new services. Special efforts

were placed on creating a user-friendly training manual that enables low-income farmers to utilize the innovative telephonic trading system. In addition to education efforts, collaborations with partners to create a graphics-intensive local language guide have been critical in the successful adoption of this technology. Furthermore, experiences from developing a training manual for a mobile phone-based poultry trading system in Chiang Mai, Thailand was used to address potential challenges associated with introducing a new technology into a low-tech sector. All teaching materials were provided at no cost, along with meals and refreshments as a means to facilitate sustained participation.

20. LITS was piloted program in three high-activity cross-border areas in Cambodia, Lao PDR, and Myanmar. Smartphones were provided for veterinary and border officials to scan animals and record relevant events into the LITS database. One benefit of piloting new technologies is that potential challenges to widespread implementation are often revealed. In our efforts to work closely with local counterparts and government agencies, several challenges arose that must be addressed prior to widespread implementation: 1) a lack official policies that support a formal trans-boundary surveillance scheme, 2) the need to bring informal animal trade into compliance with LITS, and 3) the need for farmers to recognize the economic potential of LITS. Overall, there is still an urgent need to communicate the sustained social and economic benefits of LITS-type traceability systems to all users for widespread adoption.

C. LITS's contribution to CASP in the GMS

21. LITS contributes in many ways to CASP Phase II and ADB's overall efforts to improve the agriculture sector in the GMS corridors. The contributions are divided into three main criteria: 1) value creation by increasing product quality, 2) disease risk reduction, and 3) improved market access and poverty reduction.

Disease risk reduction

22. Consumers are demonstrating an increasing concern for food safety, which has resulted in an increased demand for agricultural food products grown using more environmentally friendly methods. This creates an incentive for producers to modify or adopt production methods and practices that can enhance product safety and quality. GMS member countries have increased risks related to mycotoxins and bacterial contamination due to the region's year-round high temperatures and humidity. The temperature increases resulting from global warming are expected to increase contamination risks. Thus, methods of limiting disease propagation and food contamination are critical as the GMS member countries expand their agricultural production and grade into the global market.

23. Informal cross-border trade of livestock remains prominent in the GMS, which results in significant challenges to national disease control policies under tropical conditions. Additionally, increased requirements for documentation and reporting to meet international trade standards

are challenging for smallholder farmers due to the high cost and complexity of reporting requirements. LITS offers a way through which smallholder farmers can reduce the cost of documentation while seamlessly meeting international trade reporting standards. Importantly, LITS combines certification, labeling, and traceability procedures that are required in international trade into a single step that complies with regional food safety and regulatory standards.

24. Most importantly, LITS offers an effective surveillance method for supply chains and is able to monitor disease propagation and food contamination. Traceability systems facilitate disease identification and containment in the even of outbreaks, creating an efficient method of monitoring and modifying supply chains as needed. Since end users can trace the animals transit route and original producers, LITS creates strong incentives for producers and middlemen to reduce disease transmission risk and improve the quality of the final product. Careful documentation of commercial animal movements through LITS, especially information regarding movements across national borders and health characteristics of animals, help create and maintain a safe supply chain throughout GMS member countries.

Value creation through increasing product quality

25. The information documented by traceability systems is essential in addressing issues in livestock trade that affect product quality and safety. In traditional smallholder livestock supply chains, animals pass through intermediary markets before reaching the final consumer. This leads to problems of moral hazard and adverse selection, where the inability of individual producers to be matched with animals of higher quality results in underinvestment and lower product value. LITS is able to increase the value of livestock production by linking animals to smallholder producers and overcoming these information asymmetries. With proper information exchange between producers and consumers, producers have higher incentives to invest in quality improvements and build a positive reputation.

26. A key component of LITS and its contribution to CASP Phase II initiatives is the ability of LITS to incorporate a certification system and visibly display quality control. In addition to the traceability system, LITS also includes a certification system in which registered animals carry a visible metal tag that is linked to their record within the database. This enables supply chain participants and end users to know the identity, transit history, and safety of animals, thereby confirming that the participating animals are safe and of high quality. Overall, the certification system allows for producers to be clearly recognized for higher quality products, making it more likely for them to invest in increasing product quality and also receive a price premium for higher quality products.

27. In addition to increasing the value of livestock products, LITS contributes to value creation by minimizing the costs associated with system participation. LITS is a cost-effective and simple method to share information and was designed to limit transaction costs. Proper certification not only adds a premium on animal products, but it also facilitates their passage through supply chains, ultimately lowering the cost of market access compared to informal transit methods.

Improved market access and poverty reduction

28. Market access is the primary gateway out of poverty for rural poor smallholder farmers in Asia. LITS creates incentives for smallholder farmers to make investments to increase the quality of their products and sell their products in cross-border trade at premium prices. LITS can increase market access and expand the agrifood sector for the rural poor, supporting ADB and CASP's efforts to improve livelihoods for small farmers and enterprise intermediaries. Additionally, since women allocate more labor to livestock keeping than men, LITS affords opportunities for women who may have been denied educational access. By increasing the production and trade of high quality livestock products and reducing poverty, LITS also helps implement national agricultural development strategies and meet national, social, and economic development targets of GMS member countries.

D. Summary

29. The agricultural industries in the GMS are underdeveloped and present significant opportunities for economic growth. GMS member countries have the comparative advantage of having high quality natural resources, fertile agro-ecosystems, and rich biodiversity, all of which contribute to their ability to meet the increasing demand for livestock products. ADB and other development partners have supported the growth of the GMS agriculture sector through CASP and its associated initiatives to help implement a modernized trade system in order to supply safe and high-value agrifood products.

30. LITS supports the agriculture support efforts in the GMS by ADB and CASP by providing a mechanism to improve livestock product quality, safety, and to improve market access for smallholder farmers. The system uses cost-effective and simple technology that can be adapted to the institutional, geographic, and economic landscape of specific livestock flows throughout the region. LITS and its database can provide proper incentives for farmers to make proper investments to improve product quality and value, limit disease propagation and food contamination, and adhere to international food safety standards for efficient and successful cross-border trade. Continued efforts are in place to train smallholder farmers on how to use LITS, but also to help them recognize the economic potential of the traceability system.

31. Despite the many accomplishments of CASP Phases I/II and LITS, there are several challenges that need to be addressed for the continued economic growth of the GMS agriculture sector. Regional cooperation between member countries tends to be ineffective outside of the projects initiated by multilateral and bilateral organizations. Consequently, public investments and technology transfer to support the modern market infrastructure are lacking in the GMS member countries. Improving the use of science and technology for agriculture remains a low priority for rural poor smallholder farmers, which slows down agricultural economic progress considerably.

32. In addition to the lack of public investments and interest, information and communication technology (ICT) among GMS member countries continue to be incompatible. While CASP offers support for strengthening regional cooperation, there is an urgent need for GMS governments to

improve delivery and hold country-led regional dialogues to effectively develop the regional economic corridors. With the right incentives, the combined efforts of GMS governments, multilateral and bilateral organizations, modern trading systems such as LITS, and smallholder farmers can help facilitate effective cross-border trade facilitation and improve product quality and overall agricultural productivity for successful economic development.

IV. LITS Opportunities and Challenges

33. As the demand for livestock and their products continues to increase in the developing world, livestock traceability is a crucial tool to limit the spread of disease, increase consumer confidence in animal products, and decrease threats to human health. This is especially true in the GMS, which has witnessed a dramatic growth in demand for meat and features a large, informal supply chain that is typically unregulated and frequently moves across borders. Furthermore, our previous research in the GMS has found that sales by smallholders are limited by a myriad of market access barriers, including transportation and search costs, information asymmetries, and limitations on bargaining power (Behnke et al. 2012; Heft-Neal et al. 2012). Smallholders traditionally overcome these access barriers by selling at the farmgate to intermediaries who buy animals and animal products from many farmers and "aggregate" them en route to downstream markets. By blending animals without adequate regard for safety, traders contribute to biocontainment problems and undermine value in three ways. First, is issue of disease risk spill over that occurs from the indiscriminate blending of animals. This blending promotes contagion within and between species and presents a huge risk as animals move further along the supply chain. Second, is the issue of adverse selection as masking producer sources reduces incentives to invest in quality, increasing risk and reducing producer incomes. Finally, the perception of these uncertainties undermines consumer willingness to pay given their perceived low safety standards of animals.

34. Traceability can achieve three key objectives: 1) managing risks related to animal health and disease issues, 2) guaranteeing animal quality/identity and providing reliable information to customers, 3) improve animal quality and processes. The first of these tools is the most important opportunity in the GMS to effectively manage disease risk given the frequent unregulated channels of animal movements. Both the official and unofficial movement of livestock and livestock products is a major risk factor in the spread of disease. The GMS features extensive borders and powerful market forces that move livestock across and within countries, and the potential for trans-boundary spread of disease is great. However, with limited enforcement of regulation and information on these cross-border movements of livestock and their products, several challenges to proper disease management arise. Even though the potential harm of disease spread is significant, there is little consistency in animal health regulations or in the governing of livestock movement within and between countries. In addition, conditions of disease risk vary significantly in a given region, especially with regards to habitat, production and trading practices. Because of this heterogeneity, disease transmission across a particular boundary often occurs in both directions. This persistent source of disease risk is especially true in the GMS, where health standards vary greatly, in addition to the variations in production and movement of livestock between countries. These conditions may be challenging for public health agencies, but they provide a great and mutually beneficial opportunity for multilateral cooperation. While national control measures may be ineffective due to the vast trading networks within the GMS, all member countries can gain from coordinated management of the livestock trade.

35. To address these public health concerns, governments usually devote their attention and resources to registering formal animal trade. While this may be easier to observe and monitor, it is still necessary to address the informal trade of animals. Regardless of the market size of informal trade, the contagious nature of many animal diseases proves its importance. Furthermore, attempting to formalize animal trade is often restrictive, resulting in behavior that only increases the spread of disease risk as movements are driven through unofficial channels and around legal checkpoints These unofficial movements of animals are not only common but are accepted as an integral part of the supply chain among farmers, traders, and vendors in the region. These unofficial movements will continue as long as price discrepancies exist across borders and actors in the supply chain can capture rents by moving animals. Rather than tightening restrictions and increasing enforcement along border areas which increases animal disease risk, these unofficial movements must be accepted as a legitimate.

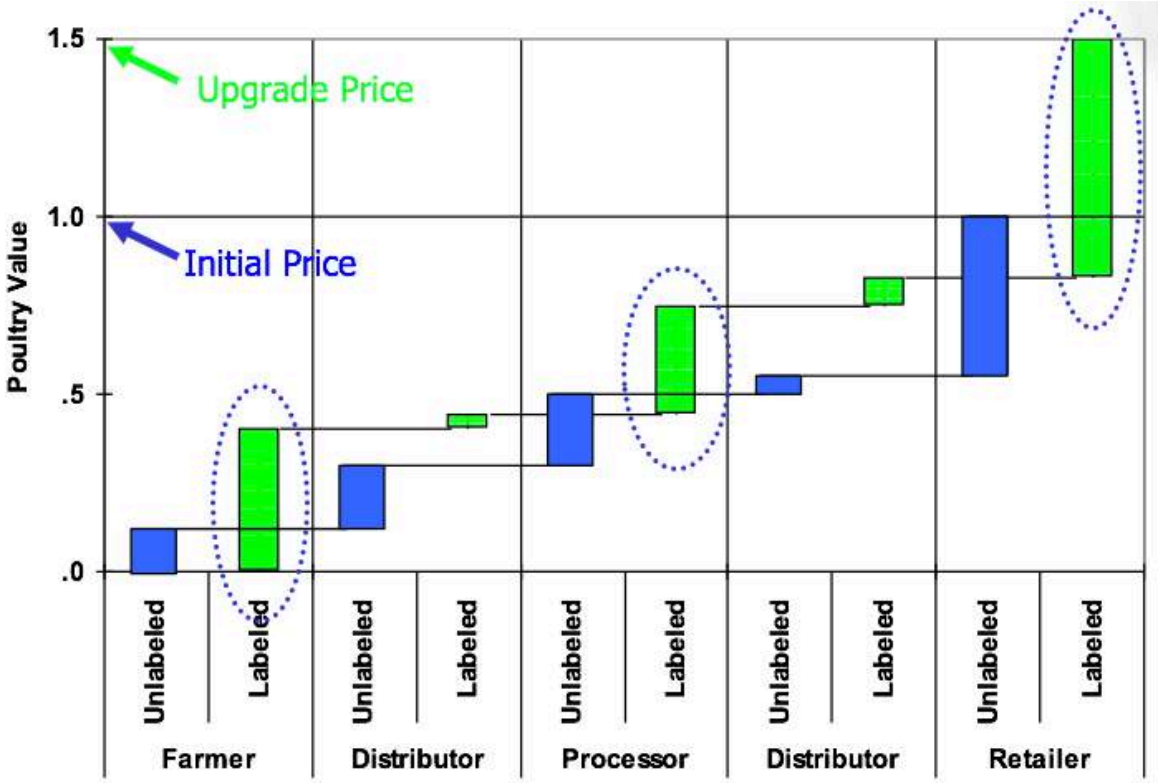
36. A region wide LITS that recognizes both the patterns of legal and illegal movements of animals is a necessary component in the reactive control system of disease risk management. The primary advantage is rapid identification allowing authorities to trace outbreaks to the source, eliminate any potential contaminated animals from the market and supply chain, and eventually contain the outbreak. This not only reduces the costs associated with control but it lowers the mutagenic risk limiting the scale of the outbreak. Traceability also creates incentives for producers to invest in animal health status if penalties are used for disease outbreaks. Furthermore, a LITS can be pro-poor in the sense there is a greatly reduced control cost through more effectively targeting culling. Livestock represents both an important income generating opportunity as well as a wealth of financial services for the poor, and widespread culling can be devastating for livelihoods.

37. The potential benefits however of a LITS go beyond disease risk identification and containment by reducing the problems associated with adverse selection and improving product quality. Existing supply chains in the GMS lack any salient mechanisms for individual producers to identify high quality, healthy animals. Without a way for individual producers to signal their animals are of high quality, this results in a race to the bottom, and the resulting minimal investments in production reduces the profitability of livestock and reinforces the transboundary disease risk. Therefore, a LITS not only has the direct benefit of limiting disease propagation and food contamination, but it also has far reaching indirect effects that promote beneficial agrifood sector expansion. When producers can be recognized for higher quality, they will make appropriate investments in both market participation and product quality. Because market access is the primary gateway out of poverty for rural poor majorities in the GMS, traceability can be strongly pro-poor, supporting improved livelihoods for small farmers and enterprise intermediaries. Within smallholder households, women allocate more labor to livestock keeping than males, and they in particular can benefit from appreciation of this asset class.

38. By far the biggest challenge of the LITS will be aligning incentives to ensure voluntary participation of producers to not only uptake the system, but also support its sustained use. Thus, any distortions to the existing producer supply channels must be limited to ensure that producers

will not avoid the system. If the system is disruptive from a production standpoint, producers will circumvent the system, further exacerbating the problems of disease risk and low product quality. Given the extremely limited margins in the livestock production system this means a LITS must actively incentive users to uptake the system. Three immediate incentive schemes can serve this purpose while simultaneously providing benefits to users, regulators, and consumers. The first is penalizing users responsible for disease outbreaks. This will naturally encourage farmers to invest in animal health, which subsequently will reduce the disease risk burden. Second, it encouraging producers to invest in higher quality to increase producer value. With a traceability system in place, producers are able to effectively signal their animals are of higher quality, which leads to value creation. As the livestock product is tracked along the supply chain it contributes value along the way (see Figure 5). Finally, a LITS allows producers to participate in larger, more advanced supply chains providing the benefit of increased market access and poverty reduction.

Figure 5: Value Added from Traceability



39. In the long run however, the strongest incentive will come from the possibility of a certification system, much like other premium goods use to designate their origin (such as the French AOC certification system given to specific wine, cheeses and other agriculture products). A certification system that carries an associated brand within a LITS allows end users to know the identity, origin, transit history, and health of animals within the system. Although not all consumers will care to

know these features, branding certainly allows a signaling process that animals are of high quality. Certification presents the opportunity to substantially add value, which will ensure sustained uptake and usage of a LITS.

V. Review of LITS Methods and Applications

40. Traceability can be defined as a class of strategies or mechanisms to trace of the movement of agriculture products through the food supply chain. The first step in any LITS is to identify and register the holdings from where animals originate. After this either individual animals or herds of animals can be registered. There is of course a tradeoff between individual animals or herds. Although individual identification is preferred, it can be cost prohibitive in developing countries. Still herd identification is better than none at all and there are tools to make it more effective. This includes dividing the herd into batches on the basis of uniform treatment, origin, or age groups. If disease is detected in an individual animal this allows traceability back to the batch to to which it belongs.

41. Individual traceability is preferred however and where we will focus our attention. This requires technology for basic identification and registration and are a variety of options used that offer different strengths and weaknesses. In general, the technology can be separated into two classes; Visual, non-electronic methods and electronic devices.

42. Visual, non-electronic methods are by far the most common in the developing world and include tools such as fire-branding, ear-incisioning, or simple plastic ear tags. Fire-brands can be effective and easy to read but are prone to concerns about registration and transmission of data as brands can be obscured and require manual recording of information which is prone to error. Plastic ear tags are also quite common, but when they are non-electronic they are prone to tag, loss, breakages or alterations and still have the problem of manual transcription errors and also data-recording.

43. The overarching goal of a LITS calls for clear, easily readable, durable means of identification. Animals should be quickly identifiable at any point of the supply chains with a low possibility of error. These requirements dictate that visual, non-electronic methods are not suitable for a LITS and instead electronic devices are required. There are several competing technologies that have been created to fill the need for reliable livestock traceability. These include: tags with chips and transponders, boluses, microchip implants, DNA fingerprinting and other identification tools (see Figure 6 for different technology examples).

44. Tags with chips and transponders consist of a tag with a unique identification number than can be read by a transponder. There are many variants of the specific technology, but in general, the transponder will read a code (either bar or QR) which compiles the identification code and

stores the data. This facilitates the reading, transmission, and registration of data and ensures fast, accurate and standardized recordings.

Figure 6: Different Identification and Traceability Technologies

- Tag with Bar Code B) Electronic Tags C) Bolus

- Bull with Ear Tag E) Transponder F) Reading the tag

45. Boluses are electronic, intra-ruminal devices that can also be read by transponders. These offer the advantage of hardly any field loses, tamper proof, easy to read, and recyclable. However, the implementation is not without health risks in the animal, especially young animals and is more invasive than tags. Furthermore, recovery of the bolus after slaughter can be time consuming and sometimes difficult.

46. Microchip implants are another related technology, but are more commonly seen in pets and horses. In animals intended for human consumption, implants can present a risk of migration, either creating a health risk or reducing the quality of meat. As with boluses, microchips can only be removed after slaughter.

47. DNA fingerprinting offers a precise, tamper-proof method of tracing animals but relies on high-tech equipment which carries a significant cost. However, with a system in place, live animals can

be easily identified with a sample. Other technologies include blood typing and iris/retina scanning, however these also rely on costly technology.

48. Given the added costs associated with traceability, it should come as no surprise that there is limited examples of LITS in developing country contexts. Although some developed countries, most notably in the EU, have developed mandatory traceability standards for livestock and their products, the standards for production vary significantly between developed and developing countries. Therefore, it is difficult to make comparisons between LITS in developed countries and our focus here will center on examples strictly from developing countries.

49. The six developing countries of Brazil, Argentina, Uruguay, Paraguay, Botswana, and Namibia have significant beef exporting industries and have began implementing varying degrees of LITS in their countries. The need for an LITS in these countries is immediately clear when considering that cattle exports to high value developed markets (such as the EU) are only eligible if they come from part of the country that is declared "FMD-free without vaccination." As only certain parts of Argentina, Columbia, and Namibia are recognized as FMD free without vaccination, traceability ensures access to high value urban markets for eligible producers. Not only does a lack of traceability standards contribute to the spread of FMD and other diseases, but it can possibly prevent healthy animals from reaching premium markets. In countries such as Namibia, where approximately 70% of the population's livelihoods depend on the export-oriented meat industry, the ability to effectively signal high quality animals can promote poverty alleviation.

50. Turning to specific country examples it is clear that developing countries have a long way to go achieve the necessary standards required to enjoy the benefits derived from a LITS. Of the cattle exporting countries previously discussed, only Uruguay has successfully implemented a nation-wide, fully digitalized LITS. In fact, Uruguay is now the leading country in the world for fully computerized cattle traceability system. Every single head of cattle in the country is tracked from across the entire supply chain from producer to final consumer. Traceability became mandatory by law in 2006 and the roll-out was completed in 2001. The entire system is financed by the state which consists of two ear tags – one visual and other containing a readable chip. When a farmer needs to add a new head of cattle, they request tags either by internet or phone and tags are delivered within 24 hours. When cattle reach meat processing facilities, they are labeled with bar codes that can be linked to the herd of origination Although the system has cost an estimated $3 million USD to implement, this pales in comparison to the anticipated loss in exports that could be expected from a FMD or other disease outbreak (http://www.bbc.com/news/world-latin-america-30210749).

51. Besides Uruguay, there are few examples to draw from in the developing world. Although the remainder of the cattle exporting countries have implemented traceability measures in recent years, their standards vary widely. For example, Argentina only traces cattle intended for export using plastic ear tags that require manual recording. Although this is an improvement over the previous system of fire branding, it falls below the standards required for a LITS. Paraguay has introduced a system referred to as SITRAP (*Sistema de trazeabilidad del Paraguay*) which uses

a system of ear tags bearing the country code PY, a four letter code for the holding, a four letter code for the owner, and an individual six-digit serial number. Some of the tags carry bar codes as well, but a fully digitalized, nationwide system is not currently operational.

52. Brazil's system is referred to as SISBOV and was created in 2001 as a farm-level identification system. Originally designed for mandatory participation to increase food safety and meet international market demands, SISBOV was not warmly received by producers. In September 2006, the system was updated to include the entire supply chain and not just producers. The system is based on ear tags and matches eartags with individual animal certificates, which are overseen by private companies. Participation is voluntary expect for export oriented producers, and as a result the overall usage of the system is limited (Bowling et al. 2008).

53. In regards to the African countries of Namibia and Botswana, both countries have implemented cattle animal traceability programs to access the EU, their primary export market. The Farm Assured Namibian Meat Scheme (FANMS) was introduced in Namibia in 1999, and contains detailed traceability information for cattle intended for export. The system relies on individual ear tags with registered bar codes and individual animal serial numbers. Animals are tracked using a transponder before they leave their origen, and an exit register must be created by the producer. Upon arrival at a new property, an arrival register must also be created and the individual serial number must match the exit register. Abattoirs participate in the system as well, completing arrival registers and serve as the final record (Bowling et al. 2008).

54. Botswana created their LITS in 2001 and relies on boluses with embedded RFID microchips. Each bolus is coded with the owner's name, a unique identification number, the visible fire-brand on the animal, the location of the brand, hide color, sex, the location of the animal, and date. Animals are along allowed to move after a digital movement permit is issued by the agriculture extension officer in the district where the cattle are located. As of 2005, an estimated 1.8 million of the 3 million cattle in Botswana could be individually identified (Bowling et al. 2008).

55. These examples demonstrate the difficulty of successfully implementing a fully digitalized, nationwide LITS. Although each of the six countries previously discussed has large, export-oriented cattle industries, there are many challenges to operating a LITS. It is clear however that ear tags with codes and transponders are the preferred system. We draw on the success of these systems and propose an innovate approach that uses the best practices seen here but relies on less expensive and open source technology ensuring the system is flexible and cost effective for targeted country use.

VI. Specification of LITS Technology

56. The Livestock Identification and Traceability System used livestock tags to identify individual cattle and track their information, event history, and movement. These livestock tags were scanned in order to view or (with password access) enter new information about a particular animal(s). The system used two types of mobile-based scanners and a web interface to provide straightforward access to the database from the field. The web interface was used to view data from a computer, as well as add or edit database information when access to the database from the field was limited or absent due to a weak network. All of the tracking data is downloadable from the online database as Excel files. Collectively, this system represents a flexible low-cost state-of-the-art traceability system that can operate under various circumstances across countries.

57. Cattle were tagged with ear tags that included two types of scanning technologies integrated with an online database. Dual integration of these technologies allowed for both detailed data viewing and data entry as well as batch location traceability for large groups of animals. Scanning the tags occurred (1) when the tag was initially registered to the cattle and (2) when an event occurred. Events included Farm Departure, Market Arrival, Market Departure, Transit, Inspection, Abattoir Arrival, Slaughter/death of animal, and Border Crossing. While this was the preliminary list of events used for testing LITS technology in pilot implementation, additional events, such as veterinary visits or quarantine, could be included in National and/or Regional implementation. The flexible structure of LITS technology makes it easy to add (or eliminate) events as deemed relevant by executing agencies. All of the livestock information was contained in a central project database that was programmed with open-source software. Ultimately, the national databases would be controlled by each respective livestock office and linked to each other for cross viewing, however, for the purpose of the pilot BEAR managed the database. The tags, scanning technologies, central database, hardware, and other equipment associated with the piloted system are described in detail in this section.

58. Figure 7 illustrates the communication channels within the LITS. A web interface connected the underlying database with users through mobile phones and computers. Mobile phones could access and/or enter information about a particular animal by using either type of scanner. The scanners read the Animal Identification number (AID) from the livestock tags and the web interface queried the database for the history of the animal(s) with the entered AID. There were two levels of security in the system. The first level, with no security, allowed anybody to view the animal's history by scanning the QR code on the livestock tag. The second level of security, which required password access, allowed data entry into the system[2]. Within this structure, parties deemed trustworthy by the governments (customs officials, licensed veterinarians, etc) could be granted access to the data entry level of the system. Potential buyers, farmers, etc could view all of the animal's history without editing or adding information.

[2] Information on the time and location of scans is automatically sent to the database regardless of whether a password is entered or not.

59. Subsequent sections detail the specifications of the hardware and software used in pilot implementation, and the mechanisms for communication across technologies.

Figure 7: System Communication Channels

A. Tags

60. The scanning technology utilized was flexible enough to be implemented with any type of ear tag that has sufficient surface area to print a QR code. For widespread implementation, each country could choose the ear tag specification most suitable for local conditions (color, shape, material, etc). However, for the purpose of simplicity in implementing the research pilot across three countries, we used a standard tag for all project sites. Tags were yellow, measuring 80 mm x 70 mm, and equipped with a single passive H3 chip following the ultra high frequency RFID Class 1 Generation 2 (UHF Class 1 Gen 2) protocol operating in the 860 – 960 MHz frequency range. The UHF Class 1 Gen 2 protocol is considered the global standard for electronic product code identification across sectors. Tags were produced by Chengdu Mind Golden Card System Co., Ltd (MND®), a leading manufacturer specializing in RFID product design, research and production. Tags were custom printed with individually unique QR codes and AID numbers. Each QR code was matched to the respective tag's RFID ID number (16 digit TID code), enabling each tag to be linked to the database. QR codes measured approximately 5cm wide to enable up to a

½ meter reading distance, and QR generation utilized the Reed-Solomon Error Correction algorithm to withstand up to 25% damage before disrupting functionality. In practice reading distance varied depending on camera quality, scan angle, weather and light conditions, and animal movement. Smartphone camera quality varied significantly among models, enabling some scans to be taken at a further distance from others. In addition to camera quality, the angle at which a scan was taken, and how much the animal moved, impacted ability to scan. A scan that was conducted head on, on a still animal, was successful at up to a ½ meter distance, where as different angles and animal movement hindered scan access. For instance, cattle tied to a post or loaded in a truck were much easier to scan rather than one grazing in a field. Finally, lighting and weather conditions also influenced scan readability; with rain and darkness requiring a closer scan distance. Many QR scanning applications included a flashlight component, which greatly assisted with scanning in the dark.

Figure 8: Livestock Ear Tags with QR Codes and RFID Sensors

Notes: Livestock tags had the QR codes printed directly on them to ensure durability. RFID sensors were also embedded in the plastic tags.

61. QR Codes were generated using the service offered by qrstuff.com. The generation technology is standard and in future systems QR codes could be generated by any number of different sources. Each QR Code was defined by a unique 13-digit alphanumeric Animal Identification (AID) code, which was also printed on the tag. In the case that a scan was not accessible in present conditions, or if there was not network access, the AID could be recorded for manual data entry.

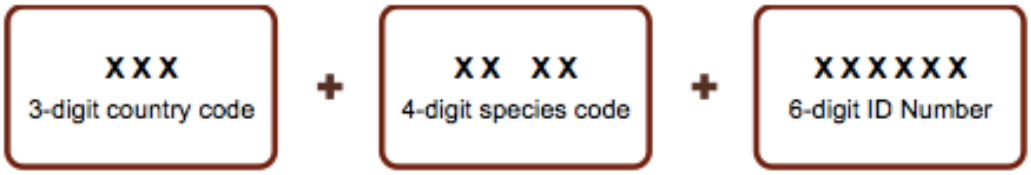
62. AID code structure included three components:

- A three character (ISO-3166-1-Alpha-3) country of origin code
- A four digit product code (species in the case of live animals)
- A six digit animal identification number

AID Examples:

KHM 0001 0000001 (Cambodia, Live Cattle, No. 000001)
LAO 0001 000012 (Lao PDR, Live Buffalo, No. 000012)
MMR 0001 000102 (Myanmar, Live Cattle, No. 000102)

Figure 9: Animal Identification (AID) Number Construction



3-Digit Country Code	
Code	*Country*
KHM	Cambodia
LAO	Lao PDR
MMR	Myanmar

4-Digit Species Code			
Code	*Live/Fresh*	*Animals*	
0001	00	01	Cattle
0002	00	02	Buffalo
0003	00	03	Pig
0004	00	04	Chicken

6-Digit ID Number
ID Number
000001
000002
.
999999

63. There were some concerns expressed by national counterparts and traders regarding farmers' resistance to tagging their cattle for fear of reducing its value. While this is certainly an issue that needs to be taken under consideration, ear tags are commonly used for livestock identification and traceability systems across the world. Likely, as tagging animals becomes more common, farmers will become accustomed to the practice. Moreover, there is some precedent for ear tag use in each project country. Ear tags have been used prior to pilot implementation in every project country, however, utilization was limited in many cases. Tags have generally been used to identify the owner of the livestock since groups of cattle from several owners often graze together. During pilot implementation the team observed paint being commonly used by traders to mark which cattle they owned, and to signal which location different animals were bound for. Field experience suggested that resistance to tagging was greater among small farmers than commercial farmers, who are more likely to have had experience with livestock tags. In a few cases traders did not allow livestock to be tagged and settled to instead carry the associated tags to the next location where the livestock would be scanned. Extensive training and education on the benefits of ear tags will be necessary in order to ensure farmer participation in a permanent system.

B. Scanning Technology on Tags

QR Codes

64. QR codes were printed on the ear tags.[3] The QR code is an established technology commonly used for a variety of applications around the world. This technology is a 3-dimensional version of the traditional barcode. In both the 2 and 3 dimensional versions, barcodes store information efficiently so that any compatible scanner can read and display the stored information. In recent years, it has become common to use QR codes to store URLs that link to websites. Any QR scanner can read the code and unpack the link. Due to the proliferation of mobile smart phones, and the numerous free QR code scanning apps available, QR codes are now commonly used for advertising purposes. By imbedding a QR code into an advertisement, companies provide convenient access to their websites for anyone that sees the ad and has a smart phone. In the context of a livestock traceability system, QR codes provide a way for people that come across tagged cattle to access the animal's information by scanning the code. In fact, one of the primary benefits of QR codes is that *anybody* that has a smart phone and the tag in front of them can view (but not edit) the cattle's information.

65. The primary drawback of QR code tags is that one needs to be directly in front of the tag to scan it and the tag for each animal needs to be scanned individually, which may be impractical for large groups of cattle. Recently this technology has been applied to different traceability applications, including tracking livestock in the United States and Europe.

Figure 10: Example QR Code

Notes: Example QR code. Any free smart phone app[4] can be used to read the QR code, which contains a URL. For the LITS the URL linked the tag to the animal database. In order to illustrate the technology here, the reader can use their smart phone to scan the above QR code.

Radio-frequency Identification (RFID)

66. In addition to QR codes, the livestock tags were also equipped with RFID chips. For large batches of cattle, or for situations where individual QR codes could not be conveniently scanned due to physical barriers or animal movement, RFID technology was used to record the location and time of an event. The RFID component in the tag emits a radio signal with associated data

[3] In the UK, some farmers have recently taken to imprinting QR code brands onto cattle with traditional branding methods.
[4] Examples of free smart phone barcode reading apps include *Bakodo*, *QR Reader, Quickscan, QRbot, etc,*. The system is not tied to a particular app so any scanning app will work.

that can be read by RFID scanners (including smart phones equipped with RFID reading technology).

Figure 11: Example Ear tag with printed QR code and embedded RFID chip

Notes: Example of RFID chip embedded in livestock tag. The chips were contained inside the plastic casing to maintain the tag's durability.

C. Scanners

67. Smart phones were used to scan both QR tags and RFID tags at registrations sites, checkpoints, and other monitoring locations.

QR Code Scanner

68. Any smart phone equipped with a camera and access to the internet could be used as a QR scanner. There are many free apps for enabling QR scanning. During the pilot the apps that were found most favorable in field conditions included *QR Droid Scanner* for androids and *Qrafter* and *QRweb* for IOS. These applications were identified for overall performance and convenient features including camera functionality within directed search engine, flashlight functionality, and a history of previously scanned QR codes. The apps read the QR code and allowed the user to follow the encoded URL to the LITS website interface. Upon accessing the website the user could: 1) register a new animal, 2) enter additional data about the scanned animal (with password access), 3) record an event, or 4) view the data associated with the scanned tag. The date and time of all scans of the tag were automatically recorded when registering an animal or entering new data.

RFID Scanner

69. Select pilot locations were equipped with smart phone enabled RFID scanners. At these locations relevant authorities (such as checkpoint officials and/or provincial officers) would record an event scan for multiple cattle at once. This was used at midway checkpoint, transit, and abattoir

locations, where a few to many cattle would need to be scanned at one time. The RFID scanner was an external device called *U Grok It*, which attached to the phone enabling equipped smart phones to read RFID signals. *U Grok It* turns a smartphone into a standard RFID scanner with the added benefit of an interactive screen connected to the internet. RFID scanning enabled officials to scan multiple animals at once, which saved time and is a necessary feature of any system striving for scalability.

U Grok It is compatible with a wide range of both Android and iOS mobile phones:

Apple iOS device compatibility

Supported Apple iOS devices have these specifications:

- iOS phones and tablets running 6.0 or higher
- iPhone 4 or higher, iPod Touch 4 or higher, iPad 2 or higher

Android device compatibility

Supported Android devices have these specifications:

- Android 3.0 (Honeycomb) or higher
- A standard 3.5 mm audio port that supports both speaker and mic
- Devices without audio enhancement technology such as modified audio sound or microphone modulation Samsung Galaxy Tab 4 - While the Galaxy Tab 4 is supported, you will need to update your Grokker to the latest firmware (v1.9.5 or later) in order to use the Galaxy Tab 4. You most do this with a non-Tab4 device (iOS or Android) and either the *Discover Grok* or *Send Grok* app.

70. In order to use the *U Grok It* device users downloaded the associated (free app): *Send Grok*. Configuring the *Send Grok* app was quick (less than five minutes) and required in order to send data to the database. Configuration included enabling the TID function, setting it to 16 bytes (this instructed the device to pick up the 16-digit TID code encrypted in the RFID chip which was used to match the tag to the respective AID), enabling location (this instructed the device to record GPS coordinates which were sent to the database), and entering the URL instructing the device where to send the data to. Figure 13 shows screenshots of configuration. Each smartphone needed to be configured only once, and then could be used with any *U Grok* It to receive and send data. To send data the official connected the *U Grok It* to the phone via the audio port, opened *Send Grok* and selected 'start' to begin scanning. During scanning the device recorded all TID codes in range, which were sent (along with time and location) to the database and added to each scanned animal's record by directing to the matched AID. The device's scan range was 1 to 3 meters depending on local conditions.

71. It is important to note that, while the pilot LITS used the *U Grok It devices*, any RFID scanner could serve the same function. The reason *U Grok It* was utilized in the pilot was its low cost and

smart phone compatability feature. However, any traditional RFID scanner could accomplish the same tasks. In other words, the pilot system is not reliant on technology from any one company.

Figure 12: Smart Phone

Notes: Any recent smart phone that has internet access would be compatible with the system.

Figure 13: RFID Scanner Attachment for Smart Phone

Notes: The U Grok It device connects to the smart phone via the audio port so it is not platform dependent. The device comes with an app (Send Grok) that facilitates communication with the database.

Figure 14: Send Grok Application Icon

D. Other Equipment

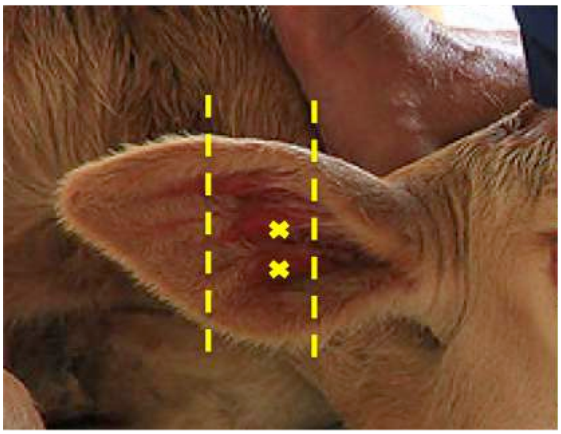
72. Tag applicators were used to apply ear tags to cattle. These were provided to all veterinary officers registering and tagging cattle. Livestock tags are a standard technology used around the world. However, experience with tagging livestock varied among participating officers. Some officers had extensive prior tagging experience, and felt confident tagging livestock, while other officers with limited tagging experience needed more training and practice before tagging in the field. All officers received tag training during the registration portion of LITS Training, and the officers with limited experience quickly grew confident tagging livestock as the pilot proceeded. Correct tag position is key for tag retention, and ensures the animal will experience the least level of discomfort. Tag Application included the following steps:

- Rubbing alcohol or other disinfectant was used to clean the jaw and pin portion of the applicator before and after use. Rubbing alcohol was also used to disinfect the tag.

- Animals were properly secured prior to tagging. It is important to secure the head, since movement could result in injury to either the person tagging or animal or both, and could also result in improper tagging of the animal.

- Prior to tag application the tagging site on the animal's ear was identified. Tags should be applied in the middle third of the ear between the upper and lower veins, as illustrated in Figure 15.

Figure 15: Image identifying correct placement for tag



- The tagging area of the animal's ear was cleaned prior to application with rubbing alcohol and cotton to prevent infection.

- After loading the tag into the tagging pliers it was protocol to check the alignment of the tagger. This was done by lightly closing the jaw of the applicator to the point where the two halves meet to ensure that the stud is in line with the hole of the tag.

- To apply the tag the officer quickly and firmly close and released the applicator over the identified tagging site on the animal's ear. A loud click confirmed the tag was securely fastened.

- Tag applicators were cleaned with alcohol or other disinfectant before use on a different animal to avoid the spread of germs.

73. Restraining equipment for holding cattle during the application of an ear tag included rope and wooden posts or nearby trees. Cattle were either secured to a post or tree, or were tagged while loaded on a truck, which also acted as a restraining mechanism to secured animal head movement during tag application. Ethyl Alcohol was applied to the ear of the animal-to-be-tagged as well as to the tag and tagging pliers to prevent infection and ensure sanitation. In some cases blood was drawn as a result of the animal flinching during tagging. In these cases an antiseptic such as Povidone-iodine solution was applied to the minor wounds to prevent infection.

Figure 16: Tag Applicator with correctly loaded tag

E. Initial Registration and Event Recording

74. Data entry into the database was triggered by the following three categories of event types:

(1) Initial registration (QR Code Scan): When a tag was assigned to an animal for the first time, the QR code on the tag was scanned and the relevant registration information was entered via the registration form viewed on the mobile phone. A screenshot of the mobile registration form is shown in Figure 15.

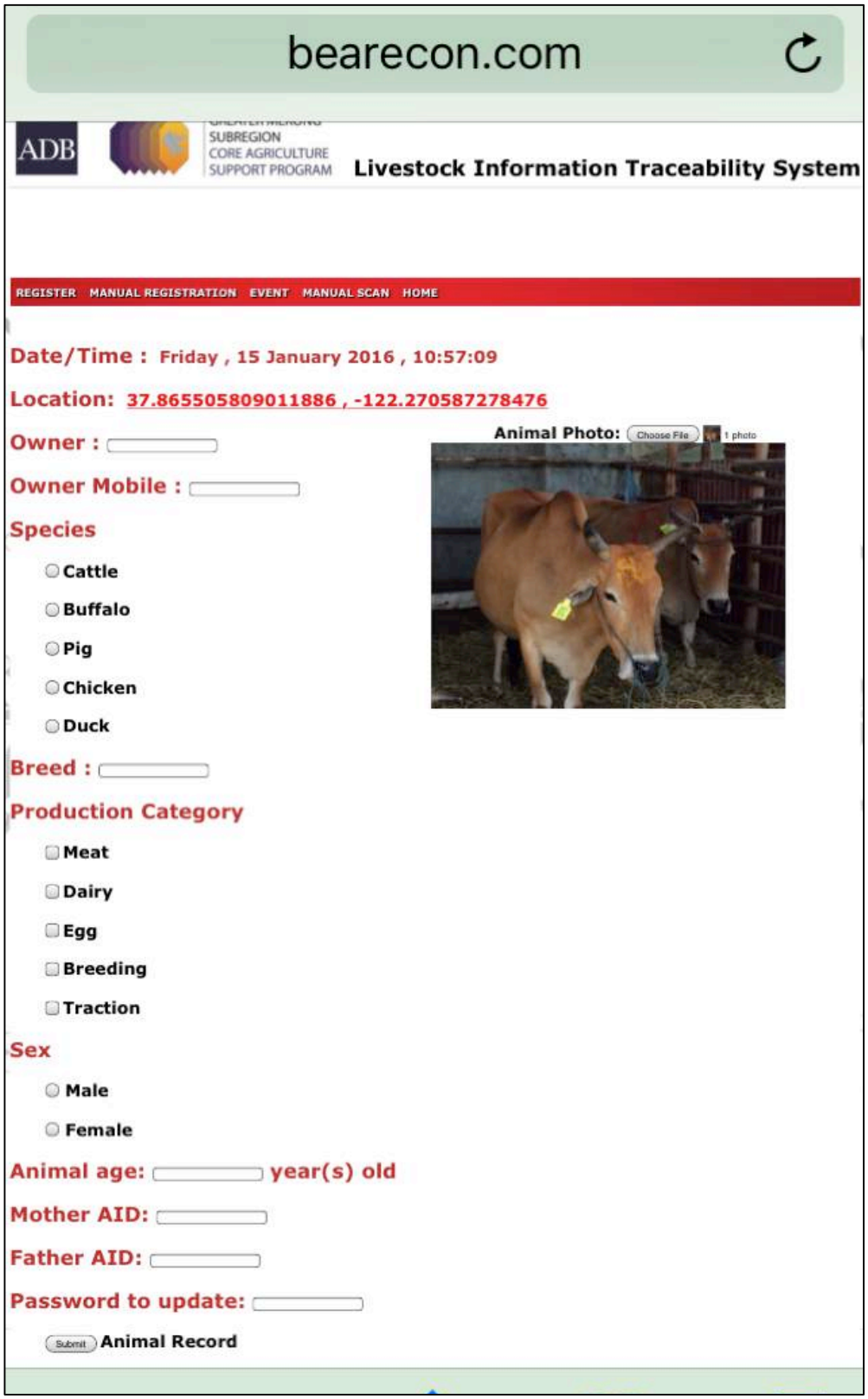
Whenever possible Initial Registration took place at the farm locations where livestock originated, however, given the pilot's time and resource constraints livestock were often registered at central holding locations such as cattle markets, feeding lot, or a trader's holding pen. During the registration process the following information was collected and entered using the online registration form:

Note: the three bold items (Animal ID, Current Location, and Current Date/Time) were automatically generated and entered based on the QR scan

- Animal ID (AID)
- Current Location (GPS Coordinates)
- Current Date/Time
- Owner Name
- Owner Mobile
- Species
- Breed
- Production Category (Meat, Dairy, Egg, Breeding, Traction)
- Sex
- Animal Age

In some locations network access was not available at the site of registration. In these cases registration information was recorded on provided Registration Data Sheets, and the information was entered into the database manually as soon as network access was available.

Figure 17: Screenshot LITS mobile registration form



(2) Scans taken during an Event (QR Code Scan or RFID Scan): Events constitute any actions (after Initial Registration) that trigger data entry into the database. For the context of LITS pilot Events included:

- Farm Departure
- Market Arrival
- Market Departure
- Transit
- Inspection
- Abattoir Arrival
- Slaughter/death of animal
- Border Crossing

Once registered, an animal's tag could be scanned during any of these events. QR code scans or RFID scans could be used to record the current location of the animal as well as additional information including:

- Current Manager
- Manager Mobile
- Means of Arrival (Walk, Truck, Car, Moto, Boat, Etc.)
- Means of Departure (Walk, Truck, Car, Moto, Boat, Etc.)

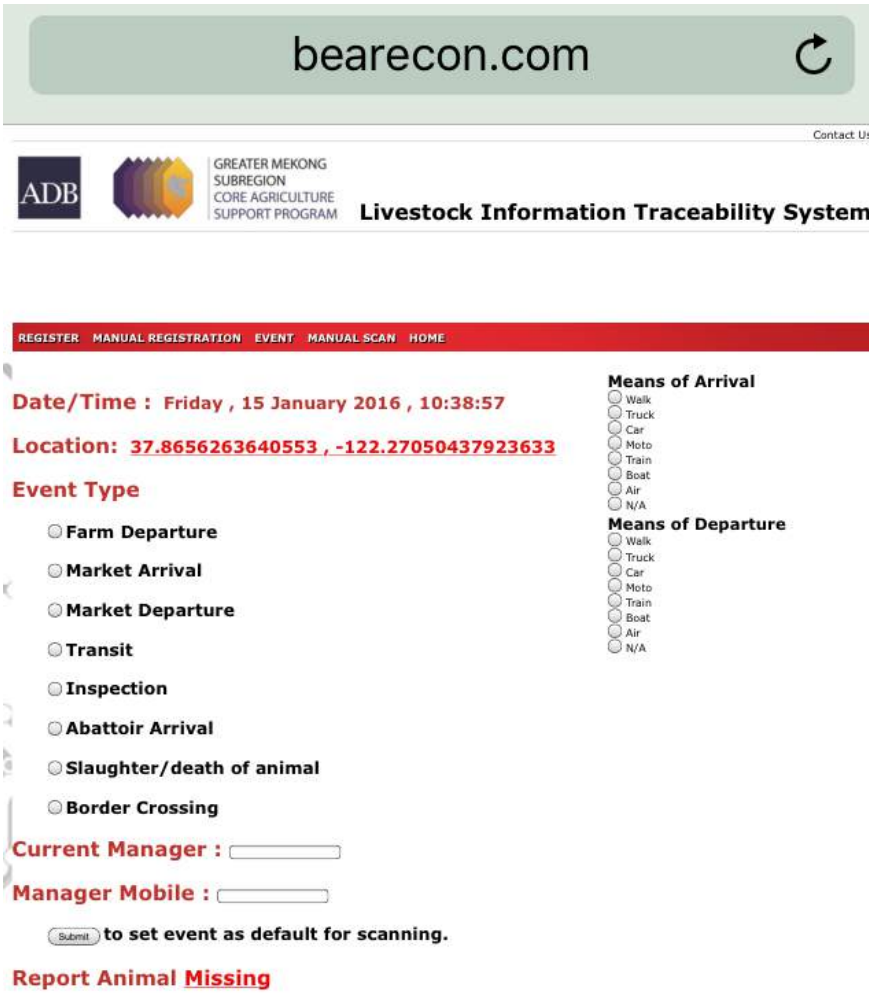
This data along with current date, time, and the animal's location would be sent to the database. A screenshot of the mobile Set Event form is shown in Figure X. There was no limit to the number of times an animal's tag could be scanned. To conduct a scan during an event the scanning agent followed two steps:

(I) The first step is to set the default event. This entailed entering the above event information (Current Manager, Manager Mobile, Means of Arrival, Means of Departure) on the database Event Page (easily accessible by mobile phone or any device with network connection).

(II) The second step was to scan the animal's tag (either by QR code or RFID scan), and the Default Event information entered in step one would apply to any animal scanned in the next hour. For instance an event could be set as Abattoir Arrival, and all animals

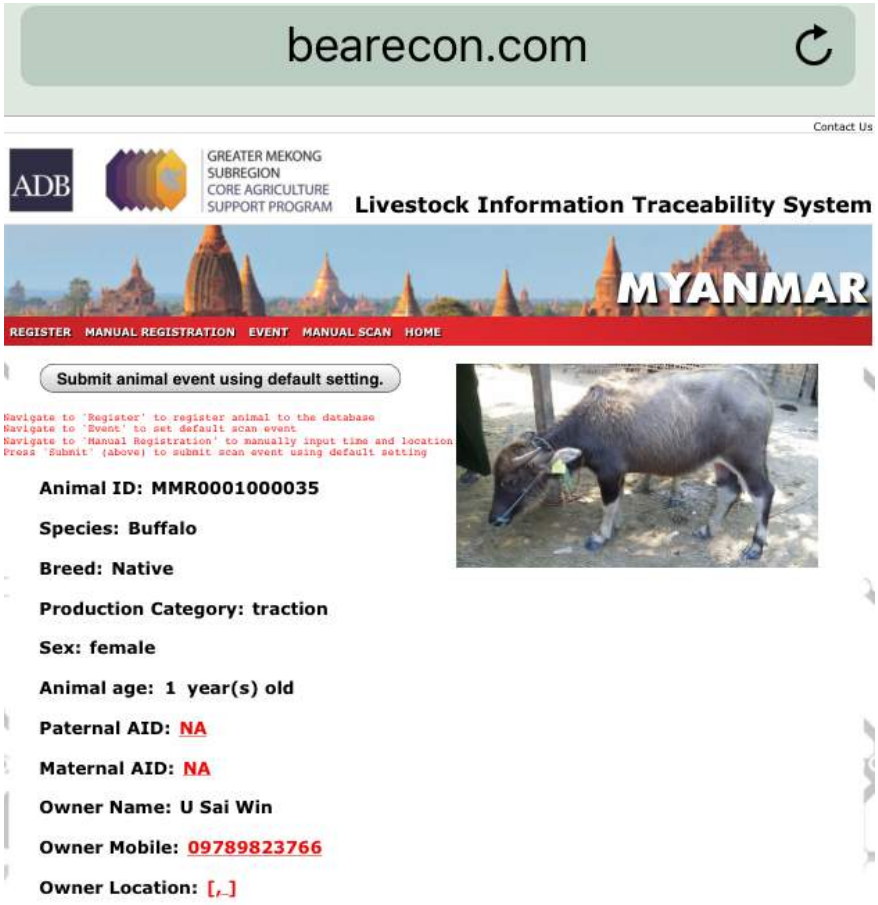
scanned upon entering the Abattoir would be recorded in the database according to the set Abattoir Arrival Event.

Figure 18: Screen Shot LITS Mobile Set Event Page



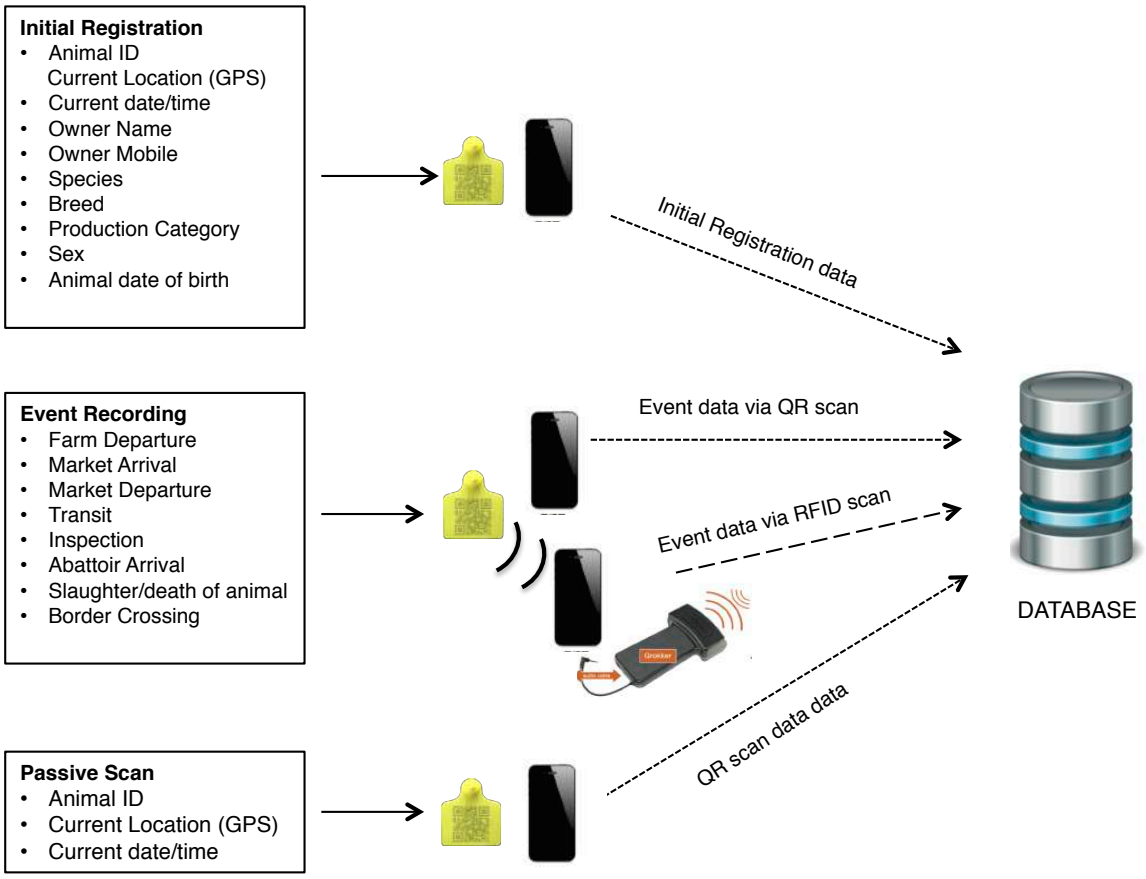
(3) Passive scans viewing animal information (QR Code Scan): Any individual could scan the livestock tag to view the animal's information. Examples of these types of passive scans include a farmer scanning his own cattle to show his friends, potential buyers scanning the tag to see the animal's history, etc. These scans could only be done using the QR codes since passive users did not have access to an RFID scanner. An example of the information viewed during a passive scan is shown in Figure 17.

Figure 19: Screenshot Example Passive Scan



75. An overview of the type of information that was recorded in the database for each type of event is displayed below in Figure 18. A detailed description of OIE guidelines for animal tracking information is detailed in Annex I.

Figure 20: Schematic of Database Record for Individual Animals



F. Central Database

76. The central database hosted the records of livestock in the system. For the pilot, BEAR managed the database for each country. For a permanent system, each country would have control of its own database with a shared component so that the information revealed from scanning an animal with foreign origins is possible. For the pilot, the database was in English, but in a permanent system information would be multi-lingual.

77. Each registered animal had its own record, indexed by AID. The information associated with each animal in the database included registration data as well as subsequent event data. Every scan of the animal's tag constituted an event, which added information to the database. Together this showed an animal's trajectory over the period of the pilot. Although there was no limit to the amount of new event data that could be entered, once registration data was entered, this primary data could not be amended without password authorization.

78. In addition to being accessed by scanning livestock in the field, the database was also accessible from a computer. Conducting a search using an animal's AID could retrieve all information associated with a single animal. Records could be downloaded into an Excel spreadsheet for analysis. During the pilot BEAR regularly downloaded and shared data in Excel format with participating officials. In a permanent system officials in each country would have training in how to access and manage the database so that they could view tagged cattle information, monitor cattle movement, and edit information for individual entries as required.

VII. Pilot Implementation in Cambodia

A. Pilot Locations

79. Site visits and pilot implementation confirmed that both transit and domestic cattle supply chains are prevalent in Cambodia. Transit cattle refer to animals entering Cambodia from Thailand and traveling across the country for sale and slaughter in Vietnam markets. Primary provinces of cattle entrance identified by Department of Animal Health and Production (DAHP) include Bantey Meanchey and Oddar Meanchy, and primary provinces of cattle exit are Takeo, Tbaung Khmum, Prey Veng and Kampot. High demand for beef products in Vietnam, and in particular Ho Chi Minh City, drives this market. In addition to cattle, it was noted that there are a large number of pigs moving across the Cambodia-Vietnam border as well. Whereas cattle move strictly from Cambodia to Vietnam, it is common for pigs to move in both directions depending on life stage and intended market. Due to limited time and resources LITS primarily targeted cattle and buffalo in pilot implementation, however, a permanent system would include pigs and all livestock species.

Figure 21: Cross-Border Cattle Movement in Cambodia

Notes: Entry and exit points for cross-border cattle trade. (Source: FAO-ADB-OAE 2009)

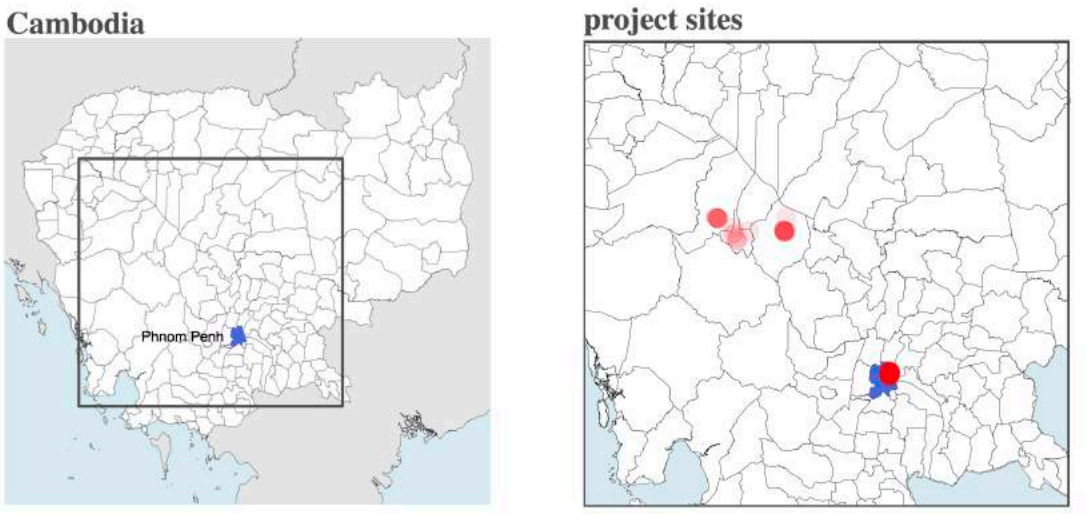
80. Domestically, cattle raised in Cambodia may be consumed locally, sold for consumption in Phnom Penh, or exported through similar networks to Vietnam. At some points along the market chain, both Cambodian and foreign cattle may be held and moved together. DAHP Officers, regional traders and local farmers all confirmed that cattle originating in Cambodia are exported to Vietnam. Many traders expressed that Cambodia cattle had a higher value in Vietnam than cattle originating from Thailand. Anecdotal evidence suggested this was due to the natural processes by which Cambodia livestock are raised, which leads to better tasting meat, and the cheaper price they could be purchased for.

81. LITS pilot planned to target both the transit and domestic cattle markets. In order to achieve this BEAR, in consultation with DAHP, organized two field teams. One team was positioned to register, tag, and track transit cattle moving from Thailand through Cambodia for sale in Vietnam, and the other team would register and track domestic cattle bound for processing in Phnom Penh abattoirs.

82. Prior to pilot implementation, site visits to border crossing checkpoints conducted by a joint BEAR and DAHP mission team confirmed daily movement of trucks bound for Vietnam markets. During the week of pilot implementation, however, fluctuations in market dynamics reduced the number of trucks moving cattle at that time so that no trucks were schedule to enter in Bantey Meanchey province where tagging and registration was planned to take place. In response to the market shift the transit pilot team instead tagged and registered cattle originating in Pursat Province. This province was selected for its dependable cattle flows (cattle moved daily from Pursat to Phnom Penh markets) and due to it's location, which ensured cattle bound for Phnom Penh would stop at Kampong Chnnang's official midway checkpoint, allowing for midpoint scan data to be collected.

83. Once the cattle arrived in Phnom Penh a second team conducted the endpoint scan. The endpoint scan was taken either at the Phnom Penh abattoir, or a nearby holding facility, depending on where the tagged cattle ended up. In addition to conducting this endpoint scan the Phnom Penh team also tagged and registered local cattle intended for domestic processing.

Figure 22: Pilot Locations in Cambodia



84. In order to capture cattle movement throughout the supply chain, scanning sites were designed to include:

- Animal registration location (ideally farm of origin)

- Midpoint/Checkpoint Scan (Kampong Chnnang official checkpoint, Samaki Meanchey district)
- Endpoint Scan (Abattoir or other endpoint)

85. The purpose for registering cattle at farm locations was important for demonstrating a credible traceability system, which follows an animal from origin to endpoint, and for achieving the smallholder benefits of LITS by enabling farmer branding and increased farmer market access. This concept was emphasized throughout pilot planning and consultations, as well as in LITS training. The pilot implementation team made all effort to reach as many farmers as possible in the time allotted, however, in order to accommodate the strict time constraints, cattle were also registered at central locations in coordination with district officers and district traders. In Pursat Province central registration locations included a number of truck loading sites, and in Phnom Penh the central registration location included holding and fattening facilities where farmers and traders housed cattle prior to selling.

86. Pursat Network Pilot

87. 1. Animal Registration

88. Traders moved cattle from Pursat Province to Phnom Penh markets daily. LITS Pilot took advantage of this dependable regular movement to test and demonstrate LITS technology in a robust market chain. LITS team worked closely with Pursat's Chief of Animal Health and Production to identify farmers and traders moving cattle. Trucks were typically loaded with livestock in the afternoon (12:00 – 15:00). Loading locations ranged from the house of a farmer or trader, to communal grazing land. The number of animals loaded at a time ranged from 14 to 60 individuals and depended on the number of trucks and traders working. Animals were typically tagged once loaded on the truck, since loading positions naturally restrained animal movement allowing for swift and easy tag application. All tags were registered using smartphones and QR scanning applications. Network access varied across the province, and in locations where network was weak pocket wifi devices were used to send data to the database. In some instances network was too weak to successfully send data, and so registration information was recorded by hand on LITS datasheets and uploaded as soon as network access was available.

89. In addition to working with traders moving livestock bound for Phnom Penh abattoirs, LITS team also worked with local farmers to register individual livestock. In these instances Provincial Officers coupled cattle registration with the administration of parasite medication. In both instances LITS team began with a single farmer and cow, though ended up tagging neighboring farmer's cows as well. In one occurrence, what was planned to be a registration including three cows ended up including over twenty individual cows as curious neighbors gathered to first observe and then join. On this evening registration lasted well after sunset as more and more neighbors opted to have their cows tagged and registered as well.

90. Each local cow registered received a parasite injection, and each cow owner learned about the benefits and mechanics of a LITS system. While many of these individuals were smallholder farmers not intending to sell or move their cattle in the pilot timeframe, the tagging and registration process acted as an informal regional training and education session, which enabled local officers to practice and share with their resident farmers the tagging and registration process. In most Cambodian Provinces livestock tags are not commonly used, so providing experience for officers and farmers alike to gain familiarity with them was highly valuable.

91. 2. Midpoint Scan

92. After trucks loaded with cattle bound for Phnom Penh departed from Pursat, officers stationed at the official checkpoint in Kampong Chnnang province awaited truck arrival to conduct the midpoint scan. Trucks typically arrived at the midway checkpoint between 19:00 to 22:00 depending on the time they departed from Pursat. At the checkpoint RFID scans were conducted using smartphones and a connected *U Grok It*. Network access was very weak at the checkpoint location, and so pocket wifi devices were used to ensure collected data was sent to the database.

93. All trucks moving livestock across Cambodia are required to stop at the Kampong Chnnang checkpoint. In practice, however, this is not always followed. Discussion with DAHP implementing officers explained that small trucks can take alternate routes to dodge the checkpoint, and these "back" routes do not have midway checkpoints.

94. 3. Endpoint Scan

95. The final endpoint scan was conducted at the Phnom Penh abattoir. Trucks typically arrived at the slaughterhouse around midnight, and animals were slaughtered before first light. Arrangements were made with abattoir officials to save ear tags so the scan could be conducted in the morning. This saved officers from having to stand guard all night at the abattoir awaiting truck arrival. Scans were conducting first thing in the morning by the Phnom Penh team.

96. The implementation team conveyed that all animals tagged in Pursat and loaded onto trucks were bound for Phnom Penh market. A few trucks, however, disappeared during the pilot, and were not retrieved by the Phnom Penh team, and so no endpoint scan was conducted. Although we cannot confirm for certain where these animals ended up, there were a few possible outcomes that could explain the disappearance. Most likely there was miscommunication between trader and officer on truck destination, and these trucks went to an alternate Phnom Penh collection center where animals were held only 3 to 5 hours before slaughter. The other possibility is that some of these animals went to Vietnam via one of the many border exit points.

97. Phnom Penh Network Pilot

98. 1. Animal Registration

99. The Phnom Penh pilot targeted local cattle bound for slaughter and processing in Phnom Penh. Most cattle were held on grazing land, or at a holding facility, prior to sale or slaughter. Traders commonly kept cattle at nearby facilities to allow them to gain body mass, and therefore go up in value, before selling. The grazing land and holding facility were located in close proximity to the Abattoir. The length of time an Individual animal spent in a grazing or holding location varied.

100. The LITS team worked closely with local traders to identify animals ready for movement to the Abattoir that we could register and tag. The ear tag technology and traceability concept was unfamiliar to local farmers and traders, and at first traders were skeptical about participating in LITS pilot. Early discussions between DAHP implementing officers and traders identified only a handful of animals ready to move, and little information was offered up on the intended movement of the other cattle staged at the holding location. After a handful of animals had been registered and tagged, however, additional traders gathered to learn about LITS, and readily decided to participate as well. As the pilot proceeded throughout the week, the LITS team continued to arrive at the grazing and holding locations to register new cattle. Each day, the number of traders who participated grew as people observed, and became more familiar with, LITS registration process. Since the grazing and holding facility was located close to the Phnom Penh Abattoir, no midpoint scan was taken.

101. Phnom Penh traders expressed to DAHP officers that they were pleased to have a method to label their cattle with. An individual trader from Kampong Chnnang shared that it was easier to identify all his cattle with ear tags, and understood how the ear tag could be useful for explaining the history of an animal. By the end of the pilot, information regarding LITS and ear tag technology spread to a neighboring province, Kampon Thom, prompting farmers and traders to ask whether they would have an opportunity to participate as well. Phnom Penh traders inquired further as to when national implementation would take place.

102. 2. Endpoint Scan

103. Endpoint scans were conducted for all registered Phnom Penh cattle, which ended up moving to the Abattoir. Since movement and slaughter happened in the middle of the night, the method used for the Pursat cattle was also implemented, in which the Abattoir held onto the ear tags for slaughtered cattle, and the end point scan was conducted in the morning.

104. During pilot implementation the entire pilot team began in Pursat for the first day of registration. Following registration the Kampong Chnnang and Phnom Penh teams followed the first truckload to the Kampong Chnnang checkpoint to conduct the midpoint scan, and the Phnom Penh team continued to follow the truckload to the Abattoir. For the remainder of the pilot the Pursat team remained in Pursat to continue registering cattle, while the other teams remained in their respective locations to conduct midpoint and endpoint scans. On the final day of the Pilot the entire team reconvened in Phnom Penh and viewed and discussed the collected data. During this session questions about truck movement, and trader/farmer responses were discussed.

B. Pilot Staffing and Training

105. LITS Training for Cambodia ran from 9 December to 10 December 2015. Training was held in Kampong Cham Province at Phnom Pros Hotel and included field instruction, which took place at a nearby abattoir. The objective of the training was to provide instruction and practice in LITS technology and implementation, and to enhance knowledge in livestock traceability as a tool for managing transboundary animal disease (TAD), improving food safety, and enhancing opportunities for smallholder farmers to access higher value markets.

106. A total of 33 officers and technical staff participated in LITS training. Participants included 13 DAHP Officials from Phnom Penh as well as Provincial Officers from ten additional provinces including Tbon Khmum, Battambang, Bantheay Mean Chey, Takeo, Kampong Cham, Kampot, Svay Rieng, Prey Veng, Preah Seihanuk, and Kampong Chnang. The first day (9 Dec 2015) included morning and afternoon sessions designed to equip participants with a firm grasp on LITS technology and its application in Cambodia. The second day (10 Dec 2015) was devoted to continued practice in LITS technology and working with participants to discuss current livestock movement conditions in order to plan logistics and prepare for upcoming pilot implementation.

107. The opening session included Dr. Suon Sothoeun, Deputy Director of Department of Animal Health and Dr. Prum Somany, Deputy Director of Department of International Cooperation, MAFF. Welcome Remarks were delivered by Dr. Suon Sothoeun. Dr. Sothoeun emphasized his sincere support for the timeliness of this workshop given the progression of the draft Animal Health and Production law, which had recently received council approval and had been submitted for parliamentary approval. The law would require Cambodia to enact a livestock identification and traceability system, which adds significant relevance to the LITS pilot. Dr. Sotheoun encouraged all participants to learn from the training and respond with their feedback on proposing this technology as a National system. Dr. Sotheoun also remarked on the importance of the social and environmental components of the CASP2 initiative of which LITS falls under. Welcome Remarks were followed by a group photo, leading into LITS instruction sessions. All sessions were translated by a DAHP appointed translator with extensive experience in regional livestock research, which added great value to the clarity with which information and instruction was translated to participants. The morning and afternoon sessions included the following components:

Morning Session

- Introduction to the LITS Project: explanation of project origin, objectives, expected output, and the social and economic benefits and incentives associated with traceability.
- Introduction to LITS Technology: instruction on LITS technology and implementation including QR code scans, RFID scans, database functionality, and registration and event scanning protocol.

- LITS Training Facilities and Implementation: detailed instruction on the procedures for using and implementing LITS technology including tag registration demonstration, webpage interface, event scanning, and RFID scans. This session included instruction on how to download relevant free applications in order to execute LITS.

Afternoon Session

- For the afternoon session participants relocated to a nearby abattoir to practice tag application, registration, and event scans. During this session officers practiced tagging on cattle soon to be slaughtered, and entered sample registration data to practice smartphone data entry. Many officers had limited experience in tagging livestock, and required many demonstrations in tagging technique and methods. A holding facility was constructed prior to the training to assist in restraining animals during tag application. Alcohol and antiseptic solution were used to demonstrate proper hygiene practices to use during tagging to prevent infection and the spread of germs. In addition to practicing field methods, instruction on application download and use was emphasize throughout the training.

108. During pilot consultations Dr. Sothoeun and his team noted that limited technological capacity among potential project participants could be a possible barrier to successful implementation. In response, training materials were carefully designed in close consultation with DAHP to maximize the chance of capacity uptake. Time was spent with each implementing officer during Training and Pilot implementation to ensure everyone understood how to use LITS technology. While BEAR provided support early on in pilot implementation, by mid-pilot project participants were working independently to tag, register, and record all data.

109. BEAR managed pilot implementation in close collaboration with Technical Focal Point, Dr. Sothoeun, and Vice Chief of Animal Production, Dr. Mam Somony. Pilot implementation staff included veterinary officers from multiple provinces, and a research assistant from the Royal University of Phnom Penh. The staff was divided into three teams. The first team was stationed in Pursat and registered new cattle, the second team was stationed at Kampong Chnnang checkpoint and conducted the midway scan, and the third team was stationed in Phnom Penh and conducted the endpoint scan (for Pursat cattle moving to Phnom Penh) as well as registered and traced local cattle movement. A list of officers who participated in pilot implementation is listed in Table 4.

Table 4: Cambodia Pilot Staff

Name	Position	Pilot Location
Dr. Suon Sothoeun	Deputy Director, DAHP	Phnom Penh
Mr. Mam Somny	Vice Chief Of Animal Production	Pursat
Mr. Hun Sarath	Officer Of Animal Office	Phnom Penh
Mr. Meng Sothea	Officer Of Animal Office	Phnom Penh
Mr. Cheth Phala	Acting Chief Of AHP	Phnom Penh
Mr. Roth Rithy	Officer	Phnom Penh
Mr. Khim Sam Oeun	Officer	Phnom Penh
Mr.Hun Ly	Vice Chief Of AHP	Kampong Chnnang
Mr. Nut Phurin	Officer	Kampong Chnnang
Mr. Iv Vanna	Vice Chief Of AHP	Pursat
Nhek Vibol	Officer	Pursat
Mr. Chhm Nem	Vice Chief Of AHP	Pursat
Mr. Chhuon Bunthoeun	Officer	Pursat
Mr. Khoun Chamroeun	Vice Chief Of AHP	Pursat
Mr. Kang Chharat	Offical	Pursat
Ms. Rineth Sen	Graduate Research Assistant	Phnom Penh

C. Challenges and Lessons Learned

Challenges

110. The dynamic nature of the transboundary market, as well as time limitations, made it a challenge to capture transit cattle movement during the pilot timeframe. Despite information collected during pre-pilot site visits regarding daily truck activity, by the time of pilot implementation no trucks were entering the Thai border site designated for cattle registration, Bantey Meanchey. A combination of market factors in Thailand and Vietnam, as well as weather and seasonal impacts on livestock trade all contributed to variable transit livestock patterns. While LITS pilot was still able to capture cross-country movement by targeting an alternate market chain, additional time would be needed to track transit livestock movement.

111. Another challenge in targeting a cross-border market chain is facilitating transboundary cooperation and communication. Provincial officers expressed frustration in efforts to cooperate with other National officials regarding the illicit movement of livestock across country borders. Until bilateral agreements are made, efforts to manage and regulate unofficial trade continue to be compromised by rent seeking behavior. During the project inception meeting Dr. Sothoen emphasized that Cambodia's role as a transporter country complicates implementation of a LITS because even tagging every animal born in Cambodia would be insufficient for monitoring much of the cross-country cattle movement associated with increased risk of FMD and other livestock diseases.

112. The pilot's time frame posed a challenge for capturing movement of smallholder livestock. Often smallholder farmers raise only a few animals to supplement household income. As opposed to a trader who moves animals weekly or even daily, it is less certain for a smallholder farmer when he/she will move or sell their livestock. The wait could be many months, or years. LITS pilot

was able to connect with, and register, cattle of smallholder farmers, however, tracing cattle movement was a challenge in the timeframe allotted. In a permanent system it could take months or years for an animal on a small farm that has been registered to move.

113. Another challenge with accessing smallholder farmers is the difficulty associated with locating individual households. While traders tend to be better connected with district and provincial officers, smallholder farmers and households are more likely to be in isolated locations, and detached from the informal trade network. Greater time would be needed to develop a strategy to access, and travel to, a larger number of smallholder farmer locations. Facilitating information and training sessions in remote areas would be an important component in gaining the trust and interest of local farmers.

114. A final challenge experience in LITS implementation in Cambodia had to do with the pockets of stigma associated with livestock tags. Resistance from traders to tag cattle appeared to be due to a few factors. Several Pursat traders expressed fear that tagged cattle might be mistaken for Thai cattle, which were claimed to be of less value than Cambodian cattle. A few Pursat traders also voiced uncertainty about tagging cattle that they would sell to other traders, since other traders may or may not be okay with the tags.

115. Inconsistencies in trader feelings towards LITS suggested that conflicting information was being spread: some traders heard tags increased cattle value, while other traders heard the opposite. In addition to its negative association with Thai cattle, concern about making holes in the ears of animals, and thus reducing its value, was also expressed. In some cases, gaining familiarity with tagging technology and learning more about LITS objectives from DAHP officers helped alleviate uncertainty. The response varied, however, and after gaining more information from DAHP officers some traders agreed to tag all cattle, while other traders agreed to tag only a select sample, or none. The few traders who refused to have their cattle tagged still agreed to register their cattle and carried the associated tags to subsequent destinations.

Lessons Learned

116. While there was a greater sense of initial uncertainty among Pursat traders regarding livestock tags, Phnom Penh traders more quickly accepted the new technology. Interest even spread to neighboring provinces. One explanation for these distinct responses could be due to the close proximity of Phnom Penh traders to the Phnom Penh market. Whereas Pursat traders were often selling livestock to another trader, Phnom Penh traders were more likely to be connected to end point sales, such as a Phnom Penh abattoir and local markets. Discussion with DAHP officers suggested Phnom Penh traders had more familiarity with high quality markets, which may contribute to why Phnom Penh traders more naturally made the connection between traceability and product value. Many upscale restaurants and hotels in Phnom Penh import beef as opposed to using local products. Phnom Penh officers and traders expressed interest in establishing a defined traceability system as a tool for signaling product quality in order to access these high-end markets, as well as a tool for exporting legally. The familiarity with Phnom Penh's upscale meat consumption was a helpful foundation for explaining the value of a traceability

system, and for engaging interest and participation, as many Phnom Penh officers and traders felt that high quality meat products could be domestic products as well as imported products.

117. The opportunity to link the registration and tagging of local Pursat cattle with the administration of parasite medication was a valuable platform for engaging local farmers, as well as connecting provincial and district officers with resident farmers. Veterinary Officers expressed a strong desire to assist their farmers with animal production, health, and marketing, and saw LITS as a useful tool for connecting with farmers on these topics. Many smallholder farmers have transitioned from crop to livestock production, and lack technical knowledge. If National law mandated the identification and registration of livestock, then Animal Health and Production (AHP) Officers would gain credibility in their respective jurisdictions, and have greater opportunities to provide technical assistance for livestock owners. In a permanent system, coupling livestock registration with animal health programs, such as the distribution of parasite medication or vaccination administration, would provide a useful method for encouraging local farmer participation, as well as connecting AHP officers with local farmers, and providing public exposure to the health benefits of a LITS system.

118. In addition to coupling LITS livestock registration with animal health initiatives, Pursat project sites also exhibited sustainable agriculture projects, which related to CAPS2's long-term development objectives of enhancing opportunities for smallholder farmers and promoting climate friendly agriculture. Some of the smallholder farmers identified in Pursat who participated in the pilot were already engaged in a project promoting the growth of forest species to supplement cattle feed. AHP provided the seed for forest grass species, which could be grown sustainably and provide valuable nutrient supplements to existing livestock feed. A similar project, managed by Dr. Sothoeun, was observed during the pre-pilot site visit in Ampil Chrum Village, Tonle Bet Commune, Tbaung Khmum District, Tbaung Khmum Province. This village was growing forest grasses to supplement cattle feed with the objective of improving animal reproductive and overall health. In both locations farmers expressed support for the forest grass project, and were therefore more willing to participate in LITS. This suggests a useful strategy for engaging farmer participation, as well as linking LITS to the wider CASP2 agricultural objectives.

Table 5: Implementation Schedule for Cambodia

Pilot Activities	Description	Dates
Inception Meeting Department of Animal Health and Production, Phnom Penh	Introductory meeting between BEAR, DAHP, and ADB. Meeting objectives: introduce LITS, discuss preliminary pilot details, and identify TFP	10 August 2015
Consultative Meeting with National Counterparts	Work with DAHP to finalize pilot plan including site location, implementation staff, and selection of traders and farmers for pilot participation.	27 October 2015
Site Visits	Site visits conducted by BEAR and DAHP officers to border checkpoints and other potential pilot locations to observe market conditions and finalize pilot logistics.	27 – 31 October 2015
LITS Training, Kampong Cham Province	Training on LITS conducted in Kampong Cham Province	09 – 10 December 2015
LITS Pilot Implementation, Pursat, Kampong Chnnang, and Phnom Penh	Pilot Implementation in Pursat and Phnom Penh locations	11 – 19 December 2015

VIII. Pilot Implementation in Lao PDR

A. Pilot Locations

119. Cross-border cattle trade in Lao PDR is driven by high demand for beef products in Vietnam and China markets, and domestic cattle trade is driven by Vientiane Capital's steady demand for fresh meat. In order to capture movement in both supply chains we implemented a pilot LITS in two locations:

- **Xieng Khouang Pilot** – cross-border market chain along route from Lao PDR to Vietnam

  Scanning sites will include farm, subsequent Pak and Nonghad district traders, and the final DOLF checkpoint prior to border crossing.

- **Vientiane Pilot –** domestic market chain

  Scanning sites will include farm locations in Savannahket Province, and Dondu slaughterhouse arrival in Vientiane.

Figure 23: Pilot Locations in Lao PDR

120. Targeting cattle movement in Vientiane Capital and Xieng Khouang locations was valuable for piloting LITS technology on both Vientiane's growing domestic cattle market and also a primary objective of the ADB's regional initiative - transboundary movement of cattle. Tracking the movement of cattle in both domestic and regional supply chains contributes to the project's overall priority of improving capacity to protect food safety, enhancing higher value market access for smallholder farmers, and limiting regional propagation of animal disease risk.

121. Due to the limited time available for the pilot implementation, we were restricted in the number of cattle and buffalo we were able to register. In total 135 animals were registered in both pilots. The Lao pilots were designed so that registered cattle and buffalo were scanned at least

twice including a scan at registration location and an endpoint scan at destination point. In the Vientiane Pilot cattle were registered in Savannakhet Province, and the final scan was taking at Dondu slaughterhouse. In the Xieng Khouang pilot cattle were registered in Pak district and the final scan was taken at the DOLF checkpoint at the Xieng Khouang/Vietnam border. The scanning locations and activities respective to each pilot site are described below.

122. 1. Xieng Khouang Pilot

123. A large number of domestic cattle are regularly exported from Lao to Vietnam. In order to develop a LITS system that effectively tracks GMS regional livestock movement across borders, it was necessary to include this supply chain in the pilot. In coordination with Xieng Khouang Province's Department of Livestock and Fisheries, LITS pilot worked with district veterinarian officers and the Xieng Khouang's Trader Association to implement pilot activities in Xieng Khouang Province.

124. Pilot activities took place in Pak and Nonghad districts. Cattle and buffalo bound for Vietnam were tagged and registered in Pak district at respective trader and farmer locations. There are a large number of traders and farmers of varying sizes operating in Xieng Khouang Province. Xieng Khouang's Trader Association is an extensive and high-functioning network of farmers and traders sourcing domestically bred cattle for export. The majority of livestock are exported to Vietnam (estimated 70%), and the remaining are sold to Vientiane Province (estimated 30%). The Trader Association already works closely with Xieng Khouang's Department of Livestock and Fisheries, and was readily willing to participate in pilot implementation.

125. Trader Association Members include: (i) farmers who typically hold cattle purchased from a number of smallholders throughout the province for 3-6 months before trade, and (ii) traders who purchase livestock from smallholder farmers in their respective locations for a quick turn around (1-7 days). The Association pools cattle from members to fill up truckloads for export. Each truckload holds 16-18 animals. Similar to Vientiane, cattle movement in Xieng Khouang is lower during rainy season months, when the roads for accessing farmers are difficult to travel on. In October and November the Association moves on average one truck a week, though this number picks up in January when trucks move daily. During pilot implementation there were several trucks moving a week.

126. The final checkpoint before crossing the border is located in Nonghad District in Ban Din Dam Village. Paperwork is issued for all livestock crossing the border at this checkpoint, and this is where the final scan occurred. After this point, livestock were walked across the border utilizing unofficial routes and entry points. Vietnamese traders purchase livestock at these subsequent locations.

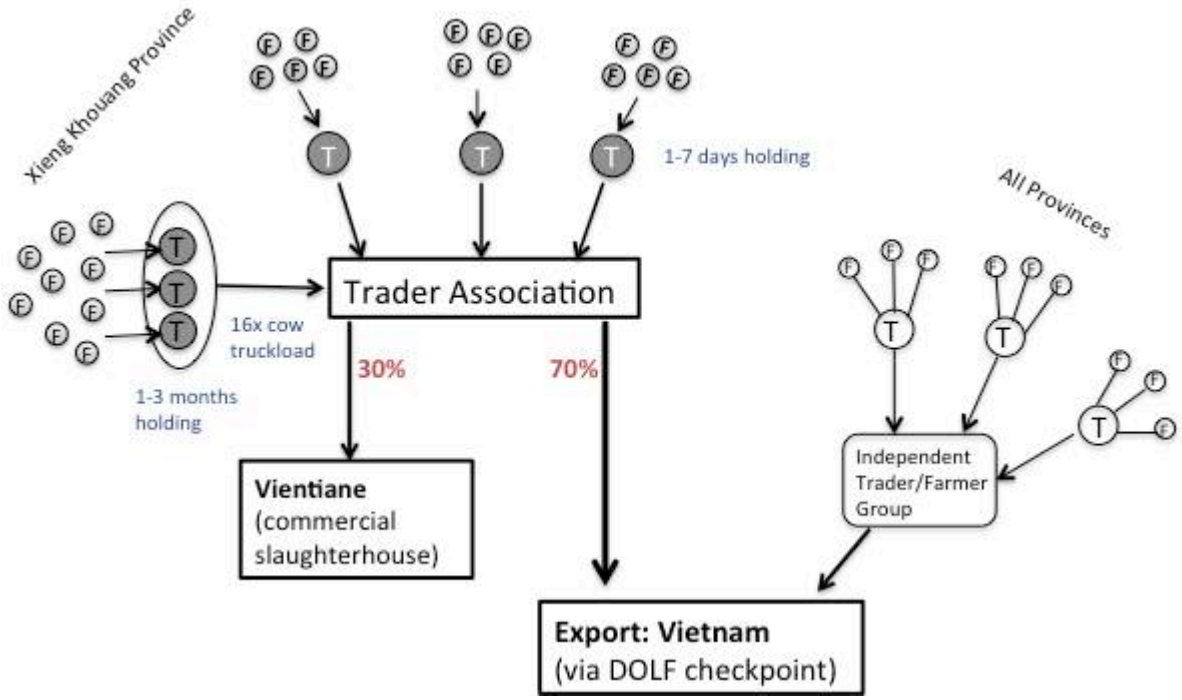
127. A total of 69 animals were registered including 47 buffalo and 22 cattle. Of the 69 registered livestock, 56 individuals (81%) were found again and successfully re-scanned during an event. Events included farm departure and border crossing.

128. Provincial and District veterinary staff worked with Pak District traders to identify farmer locations for registering and tagging cattle. Registration took place at both farmer and trader locations, depending on which animals were identified to be likely moving within the pilot timeframe. QR code scans were used to register cattle at farmer/trader locations. Network access varied across the district; however, in most cases registration data could be uploaded directly from the field.

129. Information regarding cattle movement changed daily depending on perceived market prices, and so some of the registered cattle identified for export remained in Pak District and did not move within the pilot's timeframe. Farm Departure Event scans were taken when the LITS team was on site during the time of cattle movement. Pak officers notified the border officers when registered cattle were in route for the border. A team of officers and a BEAR supervisor were stationed at the border to conduct the final scan. Network access was unavailable at the checkpoint location, hindering the team's ability to send data from the field. In this case the team recorded data by hand using LITS datasheets, and entered data directly into the database when network access was available.

130. The network between Xieng Khouang Officers and district traders was strong in Pak district, which assisted in quickly identifying animals ready to move. This network was weaker in Nonghad district, which made it difficult to identify additional animals closer to the border to register.

Figure 24: Xieng Khouang Cattle Movement



Key

T Association Member (trader): each trader collects cattle from smallholder farmers in respective region, and holds animals up to a week until they have a full load to sell to the Association (7-8 cows at a time).

T Association Member (trader/farmer): each individual trader/farmer purchases a small number of cattle from various smallholder farmers located throughout the outskirts and isolated regions of Pak District. These traders hold cattle for up to several months, until the Association comes to collect cattle from the entire group in order to fill up a truck (~16 cows).

T Independent traders/farmers raising and purchasing cattle to export to Vietnam.

F Smallholder farmer sells cows to trader/middlemen

131. 2. Vientiane Pilot

132. LITS implementation in Vientiane Capital tagged 66 locally bred buffalo originating from Savannakhet Province bound for Dondu slaughter House, located in Vientiane Capital. The team worked closely with Dondu officials as well as Savannkhet's Provincial and District Livestock Officers to identify traders and anticipate buffalo movement. Of the 66 buffalo registered, 64 buffalo were re-scanned in subsequent events including Farm Departure and Abattoir Arrival.

133. The pre-pilot Dondu slaughterhouse Site visit conducted with DOLF in mid-September verified that while there is a limited number of cattle processed a Dondu (a few per month), there is a steady number of buffalo processed daily (average of 23 per day). Therefore, LITS targeted buffalo, another FMD susceptible species, in the Vientiane pilot. Buffalo processed at Dondu slaughterhouse generally originate from Lao's southern region including Savannakhet, Khammuane, and Bolikhmxai provinces, where there are a large number of smallholder farmers. Vientiane Province traders and vendors affiliated with Dondue slaughterhouse purchase buffalo from smallholder farmers to move to Dondu for processing. Transactions occur directly between the trader and farmer. Transit permits issued by the Ministry of Commerce are required for all livestock movement. Traders typically hold buffalo up to a week before transit in order to fill a truck, which carries 7-12 buffalo at a time.

134. LITS team targeted Savannakhet Province due to the high number of buffalo that regularly move from Savannakhet to Dondu. Although the team had extensive meetings with provincial officers, and regional traders and farmers, the tax for moving animals between provinces (issued by the Ministry of Commerce) was unexpectedly raised during pilot implementation, resulting in traders needing to pay up to two or three times more then the previous rate to move animals to Dondu Slaughterhouse. The increased tax took provincial officers and traders by surprise, and resulted in many traders who had planned to move buffalo within the timeframe of the pilot to wait, or to change their mind about participating. The latter outcome was likely due to traders deciding to take an unregulated route to avoid the high fee, in which case they would want to avoid tracking their product. In response to the tax increase Savannakhet officers and traders arranged a joint

meeting to try to resolve the resulting challenges. Despite the tax a few traders moved their animals anyway, since each day of holding and feeding costed them money, and they could not wait any longer. These were the animals registered and scanned in the pilot.

135. Buffalo tagging and registration took place at farm locations. QR scans were used to register buffalo, however, network access was weak in Savannakhet's farm locations and so manual data entry was often necessary. The final scan taken at Dondu Slaughterhouse was conducted using RFID codes and a handheld *U Grok IT.* Network access was strong in Vientiane, and data was successfully submitted from the Abattoir location.

136. Previously there had been a mid-way checkpoint in Pakgnam District where a veterinarian officer inspected permits and livestock. This checkpoint, however, was disabled three years ago. In a complete system the reinstitution of an official midway checkpoint prior to entry into Vientiane would be valuable for recording movement, as well as updating animal health information.

B. Pilot Staffing and Training

137. LITS Training for Lao PDR took place on 12 November 2015 and was held in Vientiane at the Vasana Hotel. The training provided LITS instruction, demonstrations, and opened up space for valuable discussion and feedback from Lao National counterparts and executing agents. In addition to both Technical Focal Points, there were 23 Lao participants with representation from Xieng Khouang Province, Vientiane Province, and Vientiane Capital. The event began with introductions by both Technical Focal Points: Mr. Anousone Fongmany and Mr. Phetmakhoneyxay, and by all Lao participants who introduced their name, title, and department. Following introductions, Dr. David Roland-Holst, Berkeley Economic Advising and Research Lead Researcher, and Dr. Somphanh Chanphengxay, Deputy General of Ministry of Agriculture and Forestry (MAF) delivered welcome remarks introducing the LITS project and outlining the bigger development objectives.

138. LITS presentations and instruction followed welcome remarks. All presentations were translated by a DOLF appointed interpreter, who had extensive technical experience in livestock and traceability, which contributed to successful communication and quality translation.

139. The training included three sessions:

- Introduction to the LITS Project: explanation of project origin, objectives, and the benefits and incentives associated with traceability. This presentation was followed by some questions regarding concerns about local resistance to ear tags, and the pro-poor components of LITS.

- Introduction to LITS Technology: instruction on LITS technology and implementation including QR code scans, RFID scans, database functionality, and registration and event scanning protocol. Questions regarding tag-loss or damage were raised.

- LITS Demonstration: detailed instruction on and demonstration of LITS technology including sample tagging, registration, and event scanning procedures. Participants were encouraged to download a free QR scan application, and practiced registering sample ear tags.

140. DOLF officers who had participated in the Xieng Khouang pilot assisted in LITS technology demonstrations, and contributed to discussion with lessons learned from the preliminary pilot. These included challenges associated with the remote location of farmers and the far distances between them, making it difficult to access smallholder farmers in the short period of time available. Remarks also included challenges associated with limited network access. Overall there was a high level of discussion and engagement during the training, with questions and comments raised on both the technical and livelihood impacts of LITS.

141. BEAR managed pilot implementation in close collaboration with Technical Focal Point, Mr. Anousone, and technical staff, Mr. Phetmakhoneyxay. Pilot implementation staff included provincial and district officers from Xieng Khouang, Savannakhet, and Vientiane provinces. A list of officers who participated in pilot implementation is listed in Table X.

Table 6: Lao PDR Pilot Staff

Name	Position	Pilot Location
Mr. Anousone Fongmany	DAHP Officer, TFP	Xieng Khouang Province and Vientiane
Mr. Phetmakhoneyxay	DOLF Technical Staff	Xieng Khouang and Savannakhet Provinces
Mr. Bounmy Nuntha	Deputy of XKH Province	Xieng Khouang Province
Mr. Kham Khong	Deputy of Pak District	Xieng Khouang Province
Mr. Oubon Vilayvong	Border Officer	Xieng Khouang Province
Mr. Sythavone Vannasin	Border Officer	Xieng Khouang Province
Mr. Daosuk Thaoyongvang	Provincial General Deputy	Xieng Khouang Province
Mr. Vandee Saisomphun	DOLF Driver	Xieng Khouang Province
Mr. Phetsamone Vorasane	Technical Staff, SVK	Savannakhet Province
Mr. Somphan Sitilad	District Supervisor of Livestock Division, SVK	Savannakhet Province
Mr. Seng Sivisack	Director of Livestock, SVK	Savannakhet Province

C. Challenges and Lessons Learned

142. During the Vientiane Pilot, challenges arose associated with the volatility in market regulation and the prevalence of middleman dominance. The unexpected tax increase exemplified how quickly information changes, which directly impacts market behavior and activity. Furthermore, the increased fees incentivized traders to take unregulated routes, which made it more difficult to engage trader participation. Naturally, traders were primarily concerned with doing business, which made nailing down logistics, such as arranging a time to meet, difficult.

143. The remote locations of smallholder farmers in Xieng Khouang and Vientiane provinces were a challenge for engaging smallholders in pilot participation and cattle registration. Apart from the distance, time and resources required for accessing their geographic locations, the isolation also required tapping into additional trader networks. While there was a strong existing social network between livestock officers and traders in Pak District, which greatly contributed to identifying pilot participants, more time would be required to develop similar networks in Nonghad and other districts.

144. In addition to geographic isolation, the timescale for cattle trade among smallholder farmers also posed a challenge for capturing cattle movement within the pilot timeframe. Not surprisingly, many farmers and traders could not say for certain when they would sell their animals, especially smallholder farmers who had only a few animals, and sold one or two cows only if they needed cash. Months if not years would be needed to capture significant cattle movement among these populations.

145. Hosting district trainings targeting local farmers and traders could assist in engaging participation among this population. In addition to providing instruction on how to participate in LITS, local trainings would also be important for explaining the values associated with traceability. Developing localized trainings that emphasize the opportunities for improved market access and benefits from signaling product value could provide a platform for provincial and district officers to connect with their resident farmers and highlight the market opportunity for farmers and traders alike.

Table 7: Implementation Activities for Lao PDR

Pilot Activities	Description	Dates
Inception Meeting	Introductory meeting between BEAR, DOLF, and ADB. Meeting conducted to introduce LITS, identify TFP, and discuss preliminary pilot details	23 July 2015
Consultative Meeting with National Counterparts	Work with DOLF to finalize pilot plan including site location, implementation staff, and selection of traders and farmers for pilot participation	10 Septebmer 2015
Site Visits	Site Visits conducted by BEAR and TFP to potential Vientiane and Xieng Khouang pilot locations to observe market conditions and finalize pilot locations	11-16 September 2015
Xieng Khouang Pilot	Pilot implementation in Xieng Khouang Pilot (Pak and Nonhad Districts)	2 - 8 November 2015
LITS Training, Vientiane	LITS Training conducted in Vientiane Capital	12 November 2015
Vientiane Pilot	Pilot implementation in Vientiane and Savannakhet Province	13 - 19 November 2015

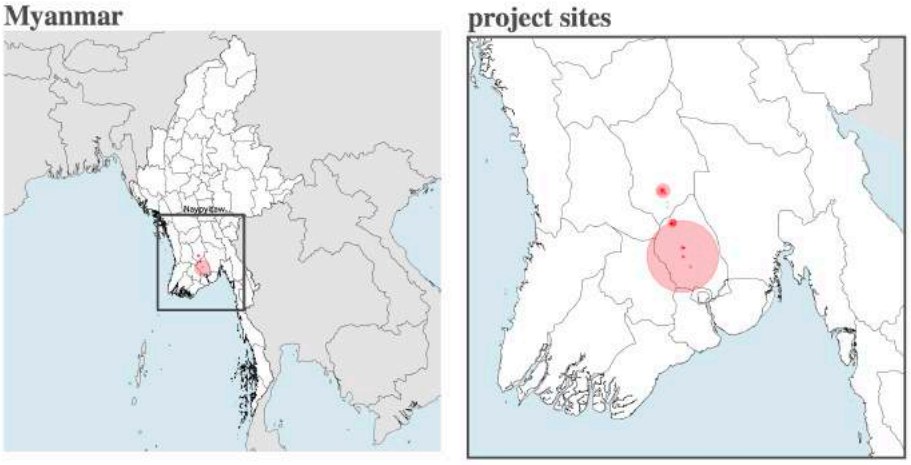
IX. Pilot Implementation in Myanmar

A. Pilot Locations

146. The Myanmar pilot targeted domestic cattle and buffalo market chains in the Yangon Region. Four Yangon Townships: Taikkyi, Okkan, Letpadan, and Mhawbi, were selected as pilot locations due to high levels of cattle movement and frequent cattle markets. Prior to pilot implementation, meetings with Deputy Township Officers and Licensed Traders conducted by BEAR and LITS TFP, Dr. Khin, confirmed local cooperation in the selected townships to assist in LITS pilot implementation.

147. A combination of a lack of official cattle movement found in Mandalay region during the pre-pilot site visits, as well as the promising cooperation of Yangon Township Deputy Officers and licensed traders informed the decision to conduct LITS (as well as LITS Training) in Yangon region only.

Figure 25: Pilot Locations in Myanmar



148. There are three primary types of cattle in Myanmar: dairy, draught, and beef. Movement of dairy cattle is limited while draught and beef cattle move frequently, and thus were better suited for the pilot timeframe and objectives. In addition to labor, draught cattle is also used for beef production when animals are considered too old to work.

149. During the pilot locally bred cattle and buffalo in the Yangon region were tagged and registered by township veterinary officers at respective township cattle markets. In order to capture cattle movement throughout the market chain, scanning sites were designed to include:

150. Animal registration location

151. Transit Scan

152. Endpoint Scan

153. As in Cambodia and Lao PDR pilots, efforts were made to register cattle at farm of origin locations. However, Myanmar traders strongly resisted sharing information about where their cattle came from, and expressed concern about pilot activities interfering with their business. In order to preserve the cooperation of traders, central registration locations were identified, which typically included morning cattle markets where a large number of traders and farmers sold and traded livestock.

154. 1. Animal Registration

155. LITS implementation team worked closely with Taikkyi, Okkan, Letpadan, and Mhawbi Township officers to identify traders in respective townships to register livestock. The majority of tagging and registration took place at cattle markets, which rotated daily between townships throughout the week. The market schedule included: Letpadan Cattle Market (Thursday), Okkan Cattle Market (Saturday), and Mhawbi Cattle Market (Monday). In addition to cattle markets, cattle were also registered at a Taikkyi farm location.

156. During cattle registration field assistants helped restrain cattle while veterinary officers tagged individual animals. Experience in tagging varied among officers, however most officers had some prior experience, and a few had extensive prior experience. BEAR assisted officers in scanning QR codes and entering registration data. Network was strong in most locations, enabling data to be successfully submitted from the field.

157. Cattle markets provided a convenient central location for tagging and registering cattle, as well as a platform for demonstrating LITS technology to resident farmers, and traders. During registration it was common for a crowd of curious community members to gather and observe tagging. Many observers helped in restraining cattle, and additional traders would volunteer to participate in the pilot after watching another trader's cows get tagged. At Okkan market traders continued to volunteer to participate as the morning went on, enabling the number of registered cattle to grow. As the LITS team registered livestock traders simultaneously sprayed symbols on the heads of their cattle to mark ownership as well as destination.

158. While most traders willingly volunteered to participate in LITS, a few individuals expressed hesitation in giving personal information such as mobile number during registration.

159. 2. Transit Scan

160. After registration the LITS team set up temporary "checkpoint" locations to re-scan registered livestock while in transit. Transit locations were selected based on the typical routes traders took. Transit transportation included walking and trucks, depending on the trader and the intended destination. Cattle moving to another township were typically transported on foot, whereas cattle moving to Yangon for slaughter were typically transported by truck.

161. When livestock were transported on foot it was easy to see the tags as they approached, and the LITS team simply scanned the cattle as they passed. Veterinary officers conducted this

scan using the handheld RFID scanner (U Grok It). When livestock were transported by truck, LITS team members peered into the truck bed to verify whether cattle were tagged or not. If there were tagged cattle in the truck, then the implementing officer used the RFID scanner to scan the tags. To do this the officer waved the scanner over the heads of the tagged cattle.

162. In addition to transit scans some of the registered cattle were seen again at subsequent cattle markets. In these cases animals were scanned using either the QR code or U Grok It, and the event was recorded as market arrival or departure.

163. 3. Endpoint Scan

164. The majority of registered animals ended up at the Yangon Abattoir. In order to conduct the endpoint scan, the LITS team traveled to the Abattoir to scan cattle after they arrived. Although a different government division managed the Yangon Abattoir, the managing officer was still willing to cooperate with LITS and permitted the team to scan all tagged cattle that arrived for the endpoint scan. In addition to the large Yangon Abattoir there were smaller township abattoir facilities. However, township abattoirs processed only one to three animals a day.

165. The endpoint scan was taking using the U Grok It. Implementing officers walked along the troughs in between the rows of cattle held at the slaughterhouse to conduct the RFID scan. Network access was fairly strong enabling data to successfully send from the Abattoir location.

B. Pilot Staffing and Training

166. LITS training for Myanmar took place on 23 November 2015, and was held in Yangon at the Livestock Breeding and Veterinary Department (LBVD) training facility. The objective of the training was to provide instruction and practice for participants in LITS technology and implementation, and to enhance knowledge in livestock traceability as a tool for managing transboundary animal disease (TAD), improving food safety, and enhancing opportunities for smallholder farmers to access higher value markets. The project covered the travel costs for up to 20 staff to travel and stay in Yangon for LITS training.

167. LITS training opening session included welcome remarks by Deputy Director General of the Ministry of Livestock, Fisheries, and Rural Development. DDG outlined LITS broader development objectives, and focused on its relevance for Myanmar in contributing to food safety, smallholder livelihood, and export opportunity. In addition to export potential, DDG also emphasized the importance of regulating and expanding the local livestock market to ensure fair prices and healthy food for the people of Myanmar.

168. Participants included LBVD officers and epidemiologists, from both Yangon and Mandalay regions, as well as traders and farmers. The diversity in participant makeup added value to the training, and provided a range of outlets for information to be shared. Overall there was a high level of interest and engagement from participants, who expressed support for implementing a national system to monitor, and regulate, livestock trade. Participants were motivated to take the

training back with them to share with their respective regions. The Myanmar training included three sessions:

- **Introduction to the LITS Project**: explanation of project origin, objectives, and the benefits and incentives associated with traceability. This presentation was followed by some questions regarding why Myanmar, Lao PDR, and Cambodia were chosen as pilot countries, and how the pilot sites within each country were selected.

- **Introduction to LITS Technology**: instruction on LITS technology and implementation including QR code scans, RFID scans, database functionality, and registration and event scanning protocol.

- **LITS Demonstration**: Application of LITS technology demonstrated by sample tagging, registration, and event scanning procedures. Facilitators worked with participants to download a QR scan application during this session to practice scanning sample tags and entering sample data into the LITS database.

169. BEAR managed pilot implementation in close collaboration with Technical Focal Point, Dr. Khin, and LBVD Officer, Dr. Thi Ha Lwin. Dr. Khin and Dr. Lwin worked closely with township officers throughout pilot implementation to conduct pilot activities. A list of officers who participated in pilot implementation is listed in Table 8.

Table 8: Myanmar Pilot Staff

Name	Position	Pilot Location
Dr. Khin Myat New	Deputy Director, LBVD, Nay Pyi Taw	Yangon
Dr. Thi Ha Lwin	Staff Officer, LBVD, Nay Pyi Taw	Yangon
Dr. Zaw Min Oo	District Veterinary Officer	Yangon
Ye Naung Win	District Veterinary Officer	Yangon
U Hlaing Win Soe	District Veterinary Officer	Yangon
Zaw Zaw Pun	District Veterinary Officer	Yangon
Archan Mya Kyaw	District Veterinary Officer	Yangon

C. Challenges and Lessons Learned

Challenges

170. The prevalence of unregulated cattle trade and movment in Myanmar livestock markets presented a persistent challenge for engaging trader participation, and tracking animals. Although Mandalay LBVD Officers acknowledged high levels of livestock movement in the Mandalay region, securing trader participation was prohibitively difficult. Site visit observations suggested

that traders participating in unofficial livestock trade did not want to participate in LITS pilot, and so refrained from providing information on cattle movement.

171. Although the LITS team was able to successfully track the majority of tagged cattle, there were some animals that disappeared during the pilot timeframe. While the location of these individual animals cannot be confirmed, anecdotal evidence suggested that the larger bulls were likely to be illicitly exported to China, while the remaining (smaller) animals would continue for processing at domestic abattoirs.

172. In addition to uncertainty regarding animal movement, the lack of existing regulation also meant there were no established midway checkpoints. Officers explained that it was not uncommon for traders to take back routes (as opposed to transporting cattle on the main roadways) in order to avoid bribes from police officers. While conducting transit scans the LITS team observed a police officer dressed in civilian clothing demanding bribes from passing traders. In a permanent system, checkpoints and associated fees would need to be established, and regulated, Nationally.

173. Gaining direct contact with smallholder farmers was a major challenge during pilot implementation, as well as during site visits. LBVD and Township officers worked directly with local traders, however, traders refused to identify farmer cattle sources. The explanation appeared to be a combination of inconvenience (many farmers lived far from central township locations), and fear that pilot implementation would interfere with business. The relationship between local traders and Township Officers varied by township, which also influenced the number of cattle we were able to access during pilot implementation. In future systems, a longer time period would be required build up a local network in order to access smallholder farmers.

Lessons Learned

174. The greatest lesson learned during pilot implementation in Myanmar was the value for tagging and registering cattle at public locations, such as cattle markets. Cattle markets were instrumental in building awareness among the local population, and generating increased participation. Despite initial skepticism, traders frequently decided to participate in LITS after seeing other traders participate, and after growing more familiar with the tagging procedure. The frequency and regularity of cattle markets ensured consistent flows of cattle. In addition to improving public awareness, the relationship between township officers and local traders was also an important factor in engaging pilot participation.

Table 9: Implementation Schedule for Myanmar Pilot

Pilot Activities	Description	Dates
Inception Meeting	Introductory meeting between BEAR, LBVD, and ADB. Meeting objectives: introduce LITS,	13 August 2015

Ministry of Livestock, Fisheries and Rural Development, Nay Pyi Taw	and discuss preliminary pilot details, and identify TFP	
Consultative Meeting with National Counterparts	Work with LBVD to finalize pilot plan including site location, implementation staff, and selection of traders and farmers for pilot participation.	20 October 2015
Site Visits	Site Visits conducted by BEAR and TFP to potential Mandalay and Yangon pilot locations to observe market conditions and finalize pilot locations.	20 – 22 October 2015
LITS Training, Yangon	Training conducted in Yangon Region at the Livestock Breeding and Veterinary Department (LBVD) training facility	23 November 2015
LITS Pilot Implementation, Yangon Region	Pilot Implementation in Yangon Region (Taikkyi, Okkan, Letpadan, and Mhawbi Townships)	24 November – 2 December 2015

Table 10: International Issues in Animal Health Risk Management

- Animal populations species distribution herd management
- Farming and industry structures, production systems, and location
- Animal health status, capacity for testing and record keeping
- Public health status, services, and infrastructure
- Trade issues - practices, policies, and infrastructure
- Aspects of animal husbandry
- Zoning and schematics for compartmentalization
- Animal movement patterns (including transhumance)
- Information management and communication, infrastructure and practices
- Availability of resources (human and financial)
- Social and cultural aspects
- Stakeholder knowledge of the issues and expectations
- Gaps between current enabling legislation and what is needed long term
- International experience
- National experience
- Existing and available technology options
- Existing identification, testing, and registration system(s)
- Expected benefits and costs from the *animal identification systems* and *animal traceability* and to whom they accrue
- Issues pertaining to data management, ownership, and access rights
- Reporting requirements.

Source: http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_ident_design.htm

175. The LITS system we propose represents a synthesis of international best practices in agrifood supply chain traceability, adapted to the institutional, geographic, and economic realities of livestock flows across the GMS. In particular, we draw upon prototypes for LITS from a variety of multilateral and bilateral development partners, including UN FAO, OIE, the European Union, Australia, Japan, and the United States (references and source material available upon request).

D. Design and Development of a Livestock Identification and Traceability System (LITS)

176. The database supporting LITS should comprise any and all information relevant to commercial animal movements in the sub-region. While it may not be feasible to detail every animal's movements during their lifecycle, particular attention should be focused on movements across national borders and information bearing on market and health characteristics of animals being moved in response to commercial incentives. In this section we summarize this information as it would be incorporated into an online database, updated by scanning technologies applied to animals at their points of origin, transit, and processing.

177. Procedures need to be incorporated into the design of the program in order to ensure that relevant information and events are registered in a timely and accurate manner. Depending on the scope, performance criteria and desired outcomes, database records should specify, *at a minimum*, the species, unique animal or group identifiers, the date/time of the event, an identifier of the establishment where the event took place, and a standardized code for the event itself. Ideally, the information recorded would include the following:

Table 11: Identification Information Collected For Each Animal And Event

- Species and breed
- Origin
- Owner/custodian contact information
- Physical location where animals are kept (GPS)
- Date of Birth
- Production category
- Sex
- Breed
- Number of animals of each species
- Animal id of parents
- Health status - although the TOR does not call for (e.g. FMD) health testing in the pilot, we plan to design a system that can accommodate this because disease risk management is a primary goal for traceability in livestock trade

Location and Event Information

Standards for location and event information are straightforward.
Location information should include:

- Name of establishment
- Establishment ID
- Name and contact info for person legally responsible for animals
- Physical address or GPS coordinates of the establishment

Salient events that occur should be recorded in the LITS, including:

- Birth of animal
- Slaughter/death of animal
- Ownership changes

- Attachment of unique identifier to animal
- Observation of an animal (testing, health inspection, health certification, etc)
- Movement within country
  - Date of movement
  - Establishment which animal group was dispatched from
  - Number of animals moved
  - Destination establishment
  - New location where animals are kept (lat-lon)
  - Any establishments used in transit
  - Description of means of transport (including vehicle ID where possible)
- Animal export:
  - Date of export
  - Number of animals moved
  - Establishment which animal group was dispatched from
  - Border crossing
  - Destination establishment
  - Any establishments used in transit
  - Description of means of transport (including vehicle ID where possible)
  - Record of animal id from exporting country should be provided to authority in importing country
- Animal import:
  - Animal id should be assigned to imported animal
  - Record of animal id from exporting country should be recorded and linked with the animal id provided by exporting country
  - Date of import
  - Number of animals moved
  - Establishment which animal group was dispatched from
  - Border crossing
- Animal identifier lost or replaced
- Animal missing (lost/stolen)

X. Preliminary Pilot Results

178. The pilot LITS was implemented in four sites across three countries between October and December 2015. At each site, animals were registered into a central database with information about their species, location, owner's information, etc. This section presents a preliminary overview of the data from the central database, which includes both identification information from registration and tracking data from system scans.

179. In each location, the same LITS technology was deployed. However, differences in local sector characteristics necessitated differences in implementation, which are detailed in the previous section. The types of animals, locations equipped with scanners, sample size, and duration of tracking all varied by site. The following section presents an overview of results for all countries. Subsequent sections detail the results for each country individually.

A. Overview

180. In total, approximately 600 animals were registered across the pilot sites. Registered animals were tagged then tracked by scanners across different components of the supply network. In total, tagged animals were scanned nearly 700 times (Figure 24 – right panel). All registered animals were scanned at the time of system registration and 70% of the registered animals were subsequently scanned further down the supply chain. The remaining 30% were never scanned after registration. The rate of successful tracking varied by country. Possible reasons that registered animals were never scanned again include:

- The animal was transported through a supply network outside of the LITS
- The animal was transported through the LITS network after the piloting period
- The animal did not move
- The animals were transported through the LITS network during pilot but technological failures or human error prevented the scans from being entered into the database

181. Given the limited scope of this pilot, we did not expect to be able to track every registered animal. All of these reasons are highly feasible explanations why some registered animals were not tracked. Due to the short timeframe for pilot implementation, efforts were made to only register animals that were going to be transported within a short timeframe and to known areas. However, there were no guarantees that registered animals were going to be moved through the monitored networks or during the pilot implementation period. Explanations for why an animal was transported through a network outside of the LITS could include miscommunication between traders and executing officers on intended route, and changes in trader movement in response to dynamic market conditions. In addition, there were reports of both human error and technological failure preventing scans from occurring.

182. For the 70% of registered animals that were successfully tracked, the number of times an individual animal was scanned (Figure 25) depended on several factors including the frequency of trading activity at the time of the pilot and the types of sites that were equipped with scanners. Animals were scanned at as many as 5 different locations along the supply networks.

Figure 26: Pilot Sites and LITS Participation by Country

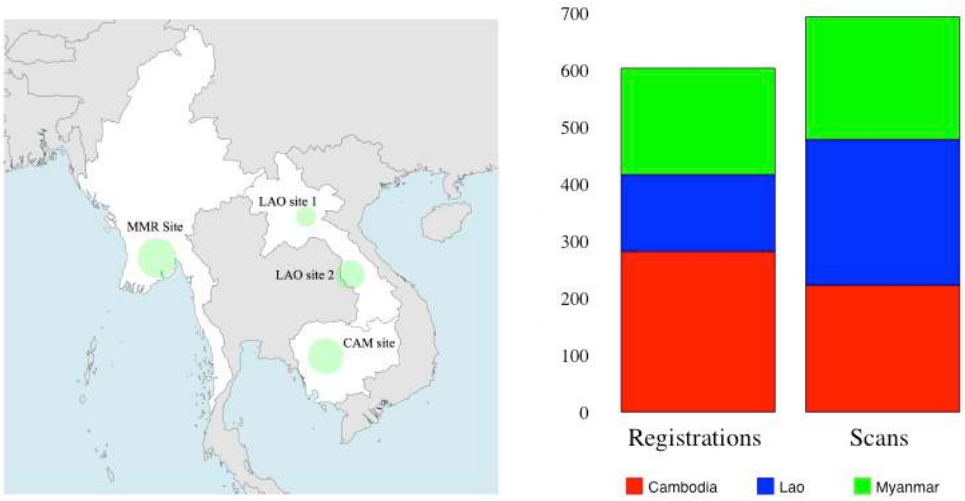
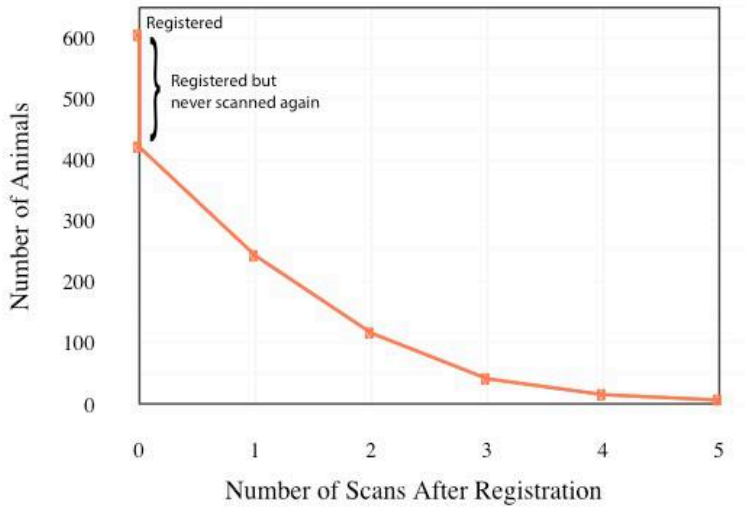


Figure 27: Number of Times Registered Animals Were Scanned After Registration



183. The types of sites where animals were scanned also varied by location depending on local supply networks. Sites equipped with scanners included slaughterhouses, official checkpoints, collection centers, farms, border checkpoints, markets, and transit points. The map below shows the location and number of scans that were recorded during each pilot by site type.

184. The center of the circle indicates the location of the scan and the size of the circle is proportional to the number of scans at that location. The total number of scans by event type and by country is also shown in Figure 27. Inspection and transit points were the most common scanning sites followed by abattoirs. In Lao some animals were scanned at farms, abattoirs and border checkpoints while in Cambodia some scans occurred at abattoirs and in Myanmar at markets.

185. Both buffalo and cattle were tagged and tracked by our pilot LITS with the relative number of each varying by country (Figure 27). While many of the features of the LITS pilots were similar across countries, differences were also prevalent in the piloting experiences. The next sections discuss preliminary results at the country level.

Figure 28: Location and Number of Scans by Site Type

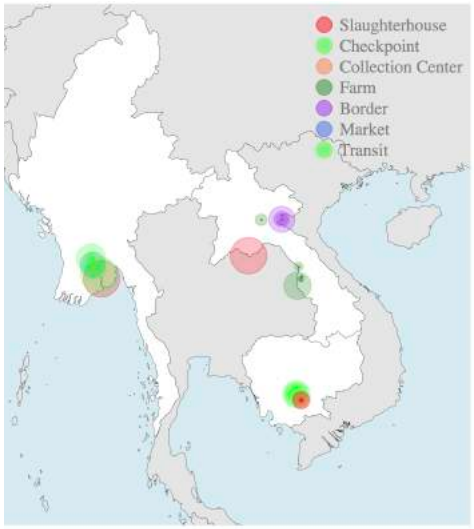
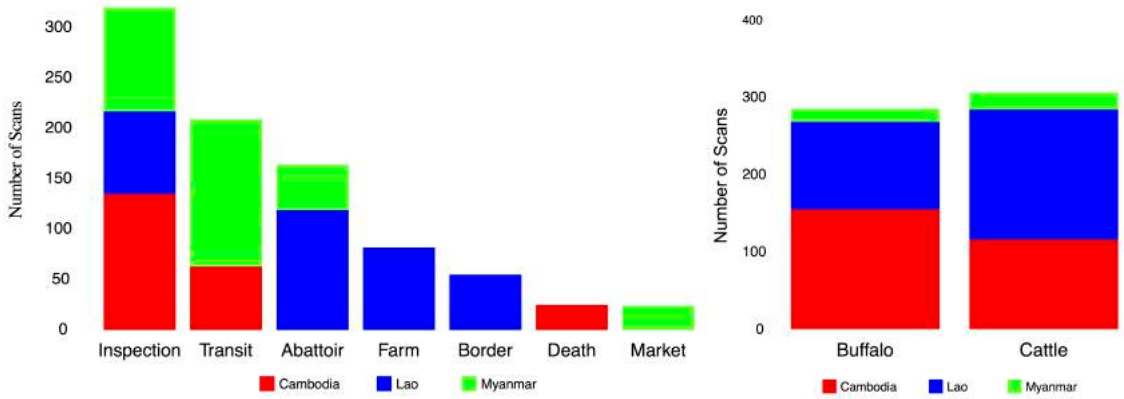


Figure 29: Type of Event Sites and Animals

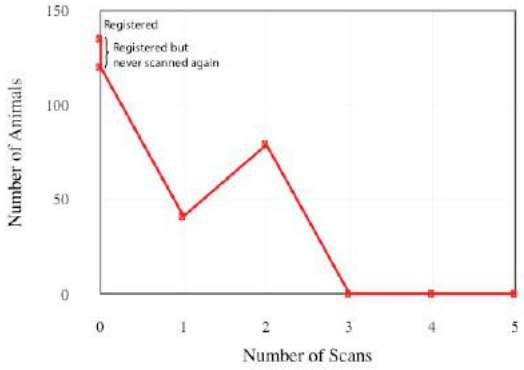


B. Lao PDR

Participation

186. A total of 135 animals were registered in the Lao pilots across two regions. While the scope of the pilot limited the feasible sample size, rates of tracking registered animals were very high in Lao PDR. Of the 135 animals registered, 120 (89%) were scanned later in the supply chain. Moreover, 79 of the registered animals (63%) were scanned more than once by the LITS (Figure 28).

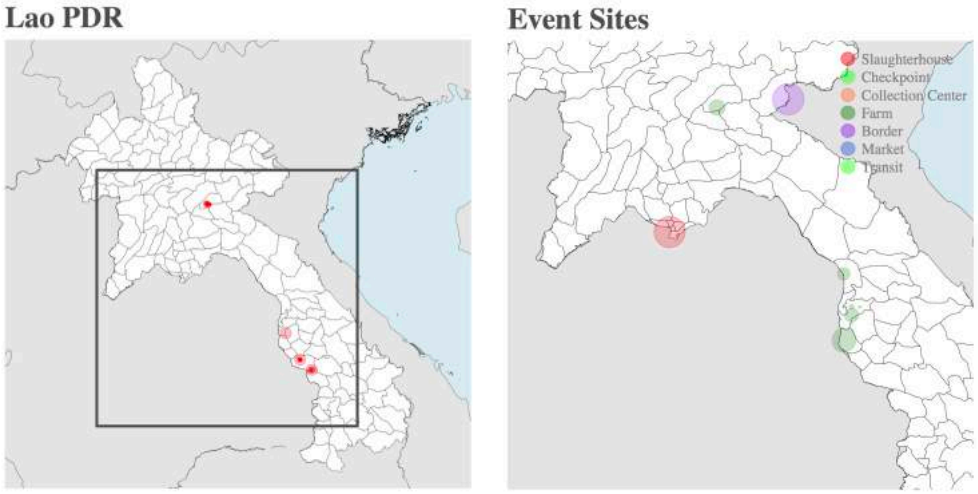
Figure 30: Number of LITS Registrations and Scans in Lao PDR



Network Elements

187. In each country, the elements of the trading network equipped with scanners varied depending on local context. In Lao PDR, animals were scanned during registration and departure on farms (Figure 27 – left panel) and then again at slaughterhouses (domestic supply chain) or border checkpoints (cross-border supply chain).

Figure 31: Event Sites in Lao PDR

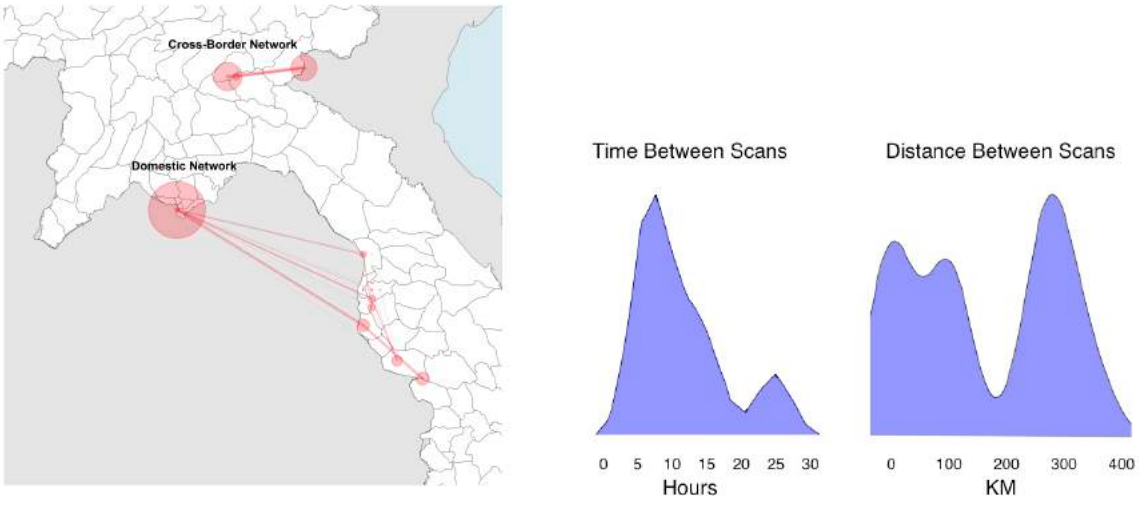


Movement

188. Figure 30 shows the travel paths of the tracked animals. The circles represent scan points with radii proportional to the number of animals scanned at that location. Lines represent movement between scanning points where the thickness of the line is proportional the amount of movement recorded. Separate pilots were implemented for a cross-border network and a domestic network, detailed above in the implementation section. The domestic network fed into urban markets in Vientiane while animals traded in the cross-border network were bound for Viet Nam.

189. Since the time and date are automatically recorded by the system, the system allows us to track the distance and speed of movement by examining the elapsed time and distance between scans.[5] In most cases, the average time and distance between scans[6] was 5-10 hours. The distance between scanning points was, on average, about 100km. However, in this case these estimates likely underestimate the total distance traveled because they assume the animals were transported in a straight line. Subsequent analyses taking into account likely transport routes will provide better estimates of the distance traveled.

Figure 32: Animal Movement in Lao PDR



Note: While the lines connecting origin and destination (on the map) for the domestic network cross into Thailand, in reality, the animals traveled entirely through Lao PDR.

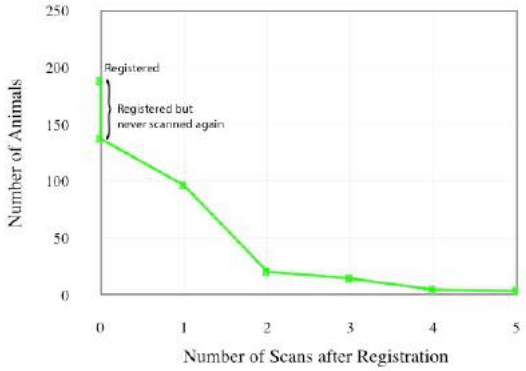
[5] The data for both pilot sites are grouped together here, however, they will be disaggregated and analyzed separately in the future.
[6] These times represent average time between scans. This includes time between registration and first scan, time between first and second scans, etc.

C. Myanmar

Participation

190. A total of 188 animals were registered in the Myanmar pilot. While the scope of the pilot limited the feasible sample size, rates of tracking registered animals were fairly high in Myanmar. Of the 188 animals registered, 161 (73%) were scanned later in the supply chain. 41 of the registered animals (21%) were scanned more than once by the LITS and some animals were scanned as many as 5 times (Figure 31).

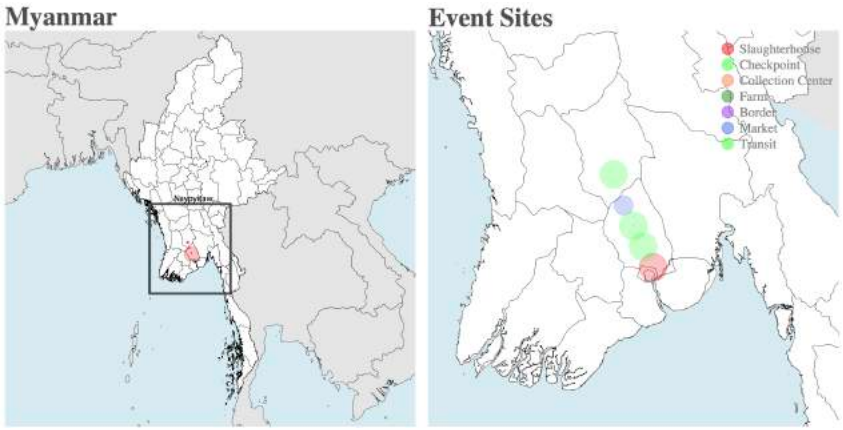
Figure 33: Number of LITS Registrations and Scans in Myanmar



Network Elements

191. In each country, the elements of the trading network equipped with scanners varied depending on local context. In Myanmar, animals were scanned during registration and then again at slaughterhouses, markets, checkpoints, and transit points (Figure 32 – right panel). Since Yangon cattle markets rotate throughout the week from one Township to the next, registered cattle sometimes showed up at multiple cattle markets, allowing for additional event scans.

Figure 34: Event Sites in Myanmar

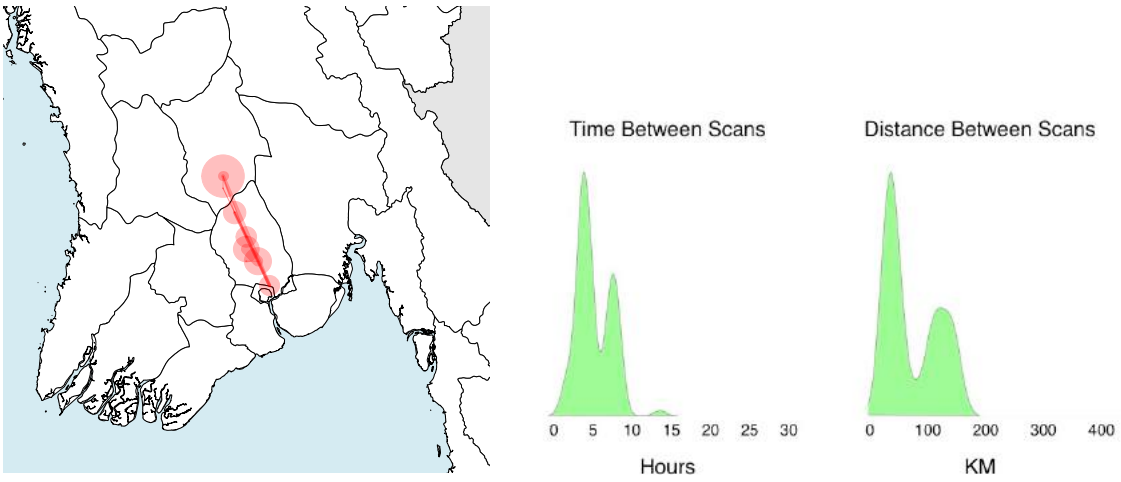


Movement

192. Figure 33 shows the travel paths of the tracked animals in Myanmar. The circles represent scan points (both registration and event scans) with radii proportional to the number of animals scanned at that location. Lines represent movement between scanning points where the thickness of the line is proportional the amount of movement recorded.

Since the time and date are automatically recorded by the system, the system allows us to track the distance and speed of movement by examining the elapsed time and distance between scans. In most cases, the average time and distance between scans was 5 hours. The distance between scanning points was, on average, about 50km.

Figure 35: Animal Movement in Myanmar

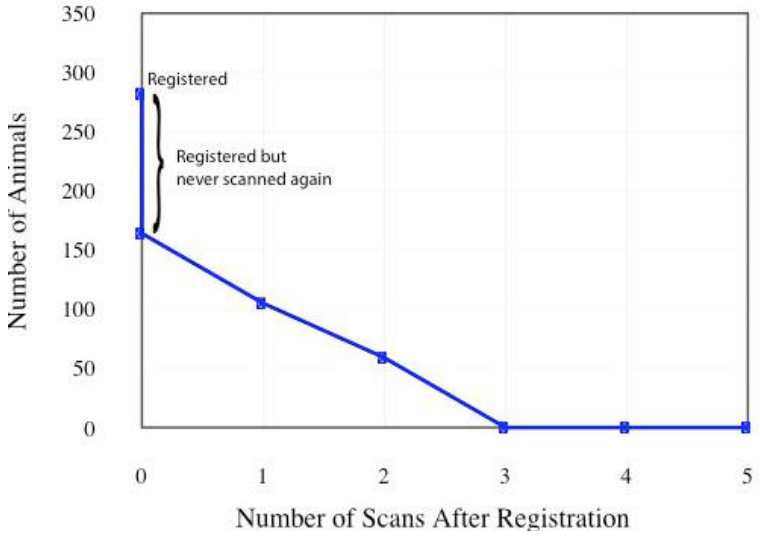


D. Cambodia

Participation

193. A total of 282 animals were registered in the Cambodia pilot. This was our largest sample size of any GMS pilot. Of the 282 animals registered, 164 (58%) were scanned later in the supply chain. 59 of the registered animals (20%) were scanned more than once by the LITS and some animals were scanned as many as 2 times (Figure 32). As expected, since we had the largest sample size for our pilot, we also had the largest number of animals registered but never scanned. The Cambodia pilot also incorporated a more extensive educational component where provincial officers worked with smallholder farmers to register individual animals. In these cases animal movement was not always guaranteed, but LITS registration provided an opportunity to spread awareness on the benefits of traceability for farmers. Other likely reasons for this occurrence were discussed above in Section A.

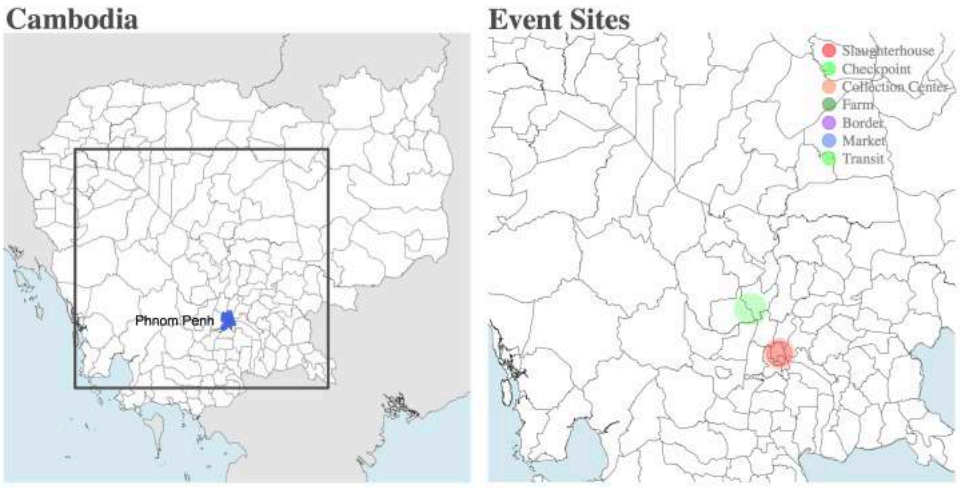
Figure 36: Number of LITS Registrations and Scans in Cambodia



Network Elements

194. In each country, the elements of the trading network equipped with scanners varied depending on local context. In Cambodia, animals were scanned during registration and then again at slaughterhouses and collection centers (Figure 35 – right panel).

Figure 37: Event Sites in Cambodia

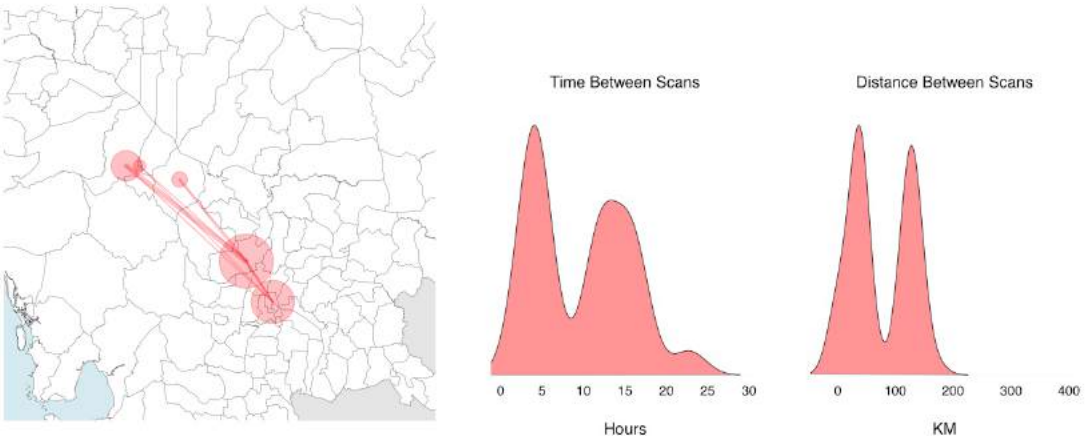


Movement

195. Figure 36 shows the travel paths of the tracked animals. The circles represent scan points (both registration and event scans) with radii proportional to the number of animals scanned at that location. Lines represent movement between scanning points where the thickness of the line is proportional the amount of movement recorded.

Since the time and date are automatically recorded by the system, the system allows us to track the distance and speed of movement by examining the elapsed time and distance between scans. In most cases, the average time and distance between scans was 10-20 hours. The distance between scanning points was, on average, either 50 or 150 km.

Figure 38: Animal Movement in Cambodia



E. Preliminary Results Summary

196. The results from preliminary data analysis of the pilot LITS database have been discussed in this section. While the results presented here have been limited, this exercise hints at some of the types of applications that might be possible if widespread adoption of a similar LITS were feasible. Data collected included information on farmers, animals, trading networks, and the timing and location of animal movements. This information, particularly related to movement, has potential to be highly useful to government agencies. There are many potential applications for improving both public health and stakeholder livelihoods that could be considered. For example, if this type of system was implemented over a longer period then all of the movement figures could be compared to historical patterns. Similarly, timing and scale of movement could be presented in forms (e.g, animated over time) to allow monitoring agencies to easily search for useful patterns.

197. By monitoring virtually real-time animal movements, government researchers could potentially identify unexpected changes in trading patterns that might be triggered by yet undetected disease outbreaks or other events that may warrant government intervention. While drawing conclusions on limited data may not be possible, this information could help target further investigation into potential issues. For now, data from the pilot database illustrate that, albeit on a limited scope, it is possible to identify and trace cattle in the GMS livestock sector.

XI. Policy Recommendations

198. Experience with the three LITS pilots supports the following policy recommendations:

11. As regional integration progresses, GMS countries are facing dramatically changing agrifood market opportunities. To capture these effectively will require determined policy support for market access and supply chain modernization.
12. Agrifood market expansion can be a potent catalyst for poverty reduction if policies support adoption of appropriate technologies and institutions. In the GMS, these include e-Traceability, certification, contracting, and producer cooperatives.
13. Expanding agrifood markets present new opportunities and risks to the region, as increasingly diverse biological products and economic agency complicate the food safety landscape. Managing food safety, disease, and other risks will require technological modernization, including e-traceability to improve supply chain transparency and product quality accountability.
14. Partnership with private sector actors can accelerate and reduce the public costs of supply chain modernization. Technologies like e-Traceabilty enhance private value and adoption/diffusion of these innovations can be self-financing if governments take a leadership role in establishing and administering standards.
15. Regional government partnership for harmonized standards and adoption is essential to the credibility and effectiveness of supply chain technologies. Many of the potential benefits (e.g. product safety) of e-traceability cannot be sustained without transboundary coordination.
16. Global trade partners, especially in the larger and more advanced economies, have strong incentives to support GMS agrifood modernization, and the sub-regional governments and their private sector agents should take full advantage of this to promote joint ventures, technology transfer, and export market access.
17. This project demonstrates that modest initial public investments can be leveraged by low-cost use technologies to significantly improve supply chain performance and participation. GMS governments and their development partners should follow this example of innovation leadership and continue making targeted investments to overcome information-base market access barriers.
18. The internet database platform developed for this project demonstrates its potential for universal information access. This presents opportunities for market transparency, but it also raises policy issues that should be addressed regarding privacy.
19. The successful implementation and positive reception of the LITS cattle pilots indicates that they should be expanded to national programs, not only in the three countries studied, but across the GMS.
20. Based on global experience with a wide array of other traceable agrifood products, the LITS results also indicate that e-traceability should be expanded to pilots for other animals including fish, fruits and vegetables, timber products, and many other live and processed agrifood products.

XII. Conclusions

199. Determined GMS dialog, supported by a decade of large-scale infrastructure commitments, has laid the groundwork for rapid and irreversible economic integration across the subregion. To realize the enormous potential of this for inclusive economic growth, every leading economic sector needs a new generation of complementary policies that facilitate market access and information flows. One of the most important economic activities in this regard is agrifood production, processing, and distribution, extending from the gate of every farm in the GMS to the tables of consumers in local, national, and global markets. Until recently, the phenomenon of globalization has largely bypassed low income rural majorities in the GMS, but modern supply chain technologies hold the potential to give them market access, a potent catalyst for self-directed poverty reduction.

200. At the same time, increased cross-border livestock trade in the Greater Mekong Subregion (GMS), the changing disease landscapes, and increased incidence to tainted meat and meat fraud in the market—a regional livestock identification and traceability system (LITS) is essential for transboundary disease control and food safety in the GMS. The LITS is an important initiative under the GMS Core Agriculture Support Program, Phase II (CASP 2) since it will expand market access for smallholder farmers and provide an effective mechanism for transboundary disease control in the GMS.

201. This project has evaluated a leading technology for improving supply chain information and facilitating access, e-traceability. Our pilot studies in three GMS countries, e-tagging cattle, registered and followed their commercial movements on the internet. This technology experiment shows that individual animals on remote smallholder farms can be identified, their movements and owners/intermediaries traced in a low cost, universally accessible online database. This technology intervention holds the potential to transform many dimensions of the GMS agrifood economy, including:

- Market access for producers and intermediaries of all sizes
- Investment incentives for improving product quality, safety and value
- Supply chain efficiency
- Compliance with downstream market access standards all way to the largest export markets

202. The project concluded with a workshop presenting our findings to delegates from each of the GMS countries. The proceedings of this meeting are documented separately, but it should be noted that, after two days of reviewing the LITS project, the delegations unanimously endorsed this project and its recommendations. The GMS sub-region is entering a period of rapid change, one that will present unprecedented opportunities and risks for the agrifood sector. Modernization of this sector to improve its information and incentive characteristics, as exemplified by e-

Traceability, can play an essential role in realizing the region's enormous potential for sustained and inclusive economic growth.

XIII. Annex 1: OIE Recommendations for LITS

204. Procedures need to be incorporated into the design of the program in order to ensure that relevant events and information are registered in a timely and accurate manner. Depending on the scope, performance criteria and desired outcomes, records as described below should specify, *at a minimum*, **the species, the unique animal or group identifier, the date of the event, the identifier of the establishment where the event took place, and the code for the event itself**. Ideally, the information recorded will include the following:

- **Livestock Identification System:**
  Identification information collected for animals should include:
  - Species
  - Owner contact info
  - Physical location where animals are kept (lat-lon)
  - DOB
  - Production category
  - Sex
  - Breed
  - Number of animals of each species
  - Animal id of the parents
- **Livestock traceability system:**
  Information should be collected on establishments involved in the supply chain and on relevant events that occur throughout the animals lives.
  Establishment information to be recorded-
  Information on establishments where animals are kept in the system should be recorded. Examples of relevant establishments are slaughterhouses, farms, assembly centers, markets, dead stock collection points, border posts, quarantine stations.
  Information should include:
  - Name of establishment
  - Establishment ID
  - Name and contact info for person *legally* responsible for animals
  - Physical address or lat-lon of establishment

  Events to be recorded:
  Events that occur should be recorded in the LITS, including:
  - Birth of animal
  - Slaughter/death of animal
  - Ownership changes
  - Attachment of unique identifier to animal
  - Observation of an animal (testing, health inspection, health certification, etc)
  - Movement within country
    - Date of movement
    - Establishment which animal group was dispatched from

- Number of animals moved
- Destination establishment
- New location where animals are kept (lat-lon)
- Any establishments used in transit
- Description of means of transport (including vehicle ID where possible)

- Animal export:
  - Date of export
  - Number of animals moved
  - Establishment which animal group was dispatched from
  - Border crossing
  - Destination establishment
  - Any establishments used in transit
  - Description of means of transport (including vehicle ID where possible)
  - Record of animal id from exporting country should be provided to authority in importing country
- Animal import:
  - Animal id should be assigned to imported animal
  - Record of animal id from exporting country should be recorded and linked with the animal id provided by exporting country
  - Date of import
  - Number of animals moved
  - Establishment which animal group was dispatched from
  - Border crossing
- Animal identifier lost or replaced
- Animal missing (lost/stolen)

Model veterinary certificate for international trade in live animals and hatching eggs

http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_certif_live_animals.htm

Part I: Details of dispatched consignment	I.1. Consignor: Name: Address:	I.2. Certificate reference number: I.3. Veterinary Authority:
	I.4. Consignee: Name: Address:	
	I.5. Country of origin: ISO Code*:	I.6. Zone or compartment of origin**:
	I.7. Country of destination: ISO Code*:	I.8. Zone or compartment of destination**:
	I.9. Place of origin: Name: Address:	
	I.10. Place of shipment:	I.11. Date of departure:
	I.12. Means of transport: Aeroplane □ Ship □ Railway wagon □ Road vehicle □ Other □ Identification:	I.13. Expected border post: I.14. CITES permit No(s)**:
	I.15. Description of commodity:	I.16. Commodity code (HS code): I.17. Total quantity:
	I.18.	I.19. Total number of packages:
	I.20. Identification of container/seal number:	I.21.
	I.22. Commodities intended for use as: Breeding/rearing □ Competition □ Slaughter □ Wildlife management □ Pets □ Exhibition/education □ Other □	
	I.23. For import or admission: Definitive import □ Re-entry □ Temporary admission □	
	I.24. Identification of commodities: Species (Scientific name): Breed*/Category*: Identification system: Identification number/details: Age*: Sex*: Quantity:	

Part II: Zoosanitary information		II.a. Certificate reference number:
	The undersigned Official Veterinarian certifies that the animal(s)/hatching egg(s) described above satisfy(ies) the following requirements: Official Veterinarian: Name and address (in capital letters): Official position: Date: Signature: Stamp:	

Guidelines and considerations for designing an LITS:

http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_ident_design.htm

System should include procedures for:
i) the *establishment* of birth, and time period within which an *animal* is born;
ii) actions to be taken when *animals* are introduced into an *establishment*;
iii) actions to be taken when an *animal* loses its identification or the identifier becomes unusable;
iv) arrangements and rules for the destruction and/or reuse of identifiers;
v) penalties for the tampering and/or removal of official animal identification devices.
Where group identification without a physical identifier is adequate, documentation should be created specifying at least the number of *animals* in the group, the species, the date of identification, the person legally responsible for the *animals* and/or *establishment*. This documentation constitutes a unique group identifier and it should be updated to be traceable if there are any changes.
Where all *animals* in the group are physically identified with a group identifier, documentation should also specify the unique group identifier.

OIE guidelines for conducting preliminary studies before implementing an LITS:

http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_ident_design.htm

In designing *animal identification systems* it is useful to conduct preliminary studies, which should take into account:

- animal populations, species, distribution, *herd* management,
- farming and industry structures, production and location,
- animal health,
- public health,
- trade issues,
- aspects of animal husbandry,
- zoning and compartmentalisation,
- animal movement patterns (including transhumance),
- information management and communication,
- availability of resources (human and financial),
- social and cultural aspects,
- stakeholder knowledge of the issues and expectations,
- gaps between current enabling legislation and what is needed long term,
- international experience,
- national experience,
- available technology options,
- existing *identification system(s)*,
- expected benefits from the *animal identification systems* and *animal traceability* and to whom they accrue,
- issues pertaining to data ownership and access rights,
- reporting requirements.

Pilot projects may form part of the preliminary study to test the *animal identification system* and *animal traceability* and to gather information for the design and the implementation of the programme.

Economic analysis may consider costs, benefits, funding mechanisms and sustainability.

Other potentially useful info:
Table of Contents for all guidelines:
http://www.oie.int/en/international-standard-setting/terrestrial-code/access-online/

Process for certifying veterinarians
http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_certification_procedures.htm
Animal health steps to take prior to export
http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_aahm_before_and_at_departure.htm
Animal health steps to take prior to import
http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_aahm_arrival.htm
Approaches to disease surveillance
http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_surveillance_general.htm

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XV. Glossary of Terms

ACCEPTABLE RISK - a risk level judged by each Member Country to be compatible with the protection of animal and public health within its territory.

ANIMAL - a mammal, bird or bee.

ANIMAL FOR BREEDING OR REARING - a domesticated or confined animal which is not intended for slaughter within a short time.

ANIMAL FOR SLAUGHTER - an animal intended for slaughter within a short time, under the control of the relevant Veterinary Authority.

ANIMAL HANDLER - a person with a knowledge of the behaviour and needs of animals who, with appropriate experience and a professional and positive response to an animal's needs, can achieve effective management and good welfare. Competence should be gained through formal training and/or practical experience.

ANIMAL HEALTH MANAGEMENT - a system designed to optimise the physical and behavioural health and welfare of animals. It includes the prevention, treatment and control of diseases and conditions affecting the individual animal and herd, including the recording of illness, injuries, mortalities and medical treatments where appropriate.

ANIMAL HEALTH STATUS - the status of a country or a zone with respect to an animaldisease in accordance with the criteria listed in the relevant chapter of the Terrestrial Code dealing with the disease.

ANIMAL IDENTIFICATION - the combination of the identification and registration of an animal individually, with a unique identifier, or collectively by its epidemiological unit or group, with a unique group identifier.

ANIMAL IDENTIFICATION SYSTEM - the inclusion and linking of components such as identification of establishments/owners, the person(s) responsible for the animal(s), movements and other records with animal identification.

ANIMAL TRACEABILITY - the ability to follow an animal or group of animals during all stages of its life.

ANIMAL WELFARE - how an animal is coping with the conditions in which it lives. An animal is in a good state of welfare if (as indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behaviour, and if it is not suffering from unpleasant states such as pain, fear and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and human slaughter/killing. Animal welfare refers to the state of the animal; the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, and humane treatment.

ANTIMICROBIAL AGENT - a naturally occurring, semi-synthetic or synthetic substance that exhibits antimicrobial activity (kill or inhibit the growth of micro-organisms) at concentrations

attainable in vivo. Anthelmintics and substances classed as disinfectants or antiseptics are excluded from this definition.

APIARY - a beehive or group of beehives whose management allows them to be considered as a single epidemiological unit.

APPROPRIATE LEVEL OF PROTECTION - the level of protection deemed appropriate by the country establishing a sanitary measure to protect human or animal life or health within its territory.

APPROVED - officially approved, accredited or registered by the Veterinary Authority.

ARTIFICIAL INSEMINATION CENTRE - a facility approved by the Veterinary Authority and which meets the conditions set out in the Terrestrial Code for the collection, processing and/or storage of semen.

BEEHIVE - a structure for the keeping of honey bee colonies that is being used for that purpose, including frameless hives, fixed frame hives and all designs of moveable frame hives (including nucleus hives), but not including packages or cages used to confine bees for the purpose of transport or isolation.

BIOSECURITY - a set of management and physical measures designed to reduce the risk of introduction, establishment and spread of animal diseases, infections or infestations to, from and within an animal population.

BIOSECURITY PLAN - a plan that identifies potential pathways for the introduction and spread of disease in a zone or compartment, and describes the measures which are being or will be applied to mitigate the diseaserisks, if applicable, in accordance with the recommendations in the Terrestrial Code.

BORDER POST - any airport, or any port, railway station or road check-point open to international trade of commodities, where import veterinary inspections can be performed.

CAPTIVE WILD ANIMAL - an animal that has a phenotype not significantly affected by human selection but that is captive or otherwise lives under direct human supervision or control, including zoo animals and pets.

CASE - an individual animal infected by a pathogenic agent, with or without clinical signs.

COLLECTION CENTRE - a facility approved by the Veterinary Authority for the collection of embryos/ova and used exclusively for donor animals which meet the conditions of the Terrestrial Code.

COMMODITY - live animals, products of animal origin, animal genetic material, biological products and pathological material.

COMPARTMENT - an animal subpopulation contained in one or more establishments under a common biosecurity management system with a distinct health status with respect to a specific disease or specific diseases for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.

COMPETENT AUTHORITY - the Veterinary Authority or other Governmental Authority of a Member Country having the responsibility and competence for ensuring or supervising the implementation of animal health and welfare measures, international veterinary certification and other standards and recommendations in the Terrestrial Code and in the OIE Aquatic Animal Health Code in the whole territory.

CONTAINER - a non-self-propelled receptacle or other rigid structure for holding animals during a journey by one or several means of transport.

CONTAINMENT ZONE - a defined zone around and including suspected or infected establishments, taking into account the epidemiological factors and results of investigations, where control measures to prevent the spread of the infection are applied.

DAY-OLD BIRDS - birds aged not more than 72 hours after hatching.

DEATH - the irreversible loss of brain activity demonstrable by the loss of brain stem reflexes.

DISEASE - the clinical or pathological manifestation of infection or infestation.

DISINFECTION - the application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; this applies to premises, vehicles and different objects which may have been directly or indirectly contaminated.

DISINFESTATION - the application of procedures intended to eliminate infestation.

EARLY DETECTION SYSTEM - a system for the timely detection and identification of an incursion or emergence of diseases/infections in a country, zone or compartment. An early detection system should be under the control of the Veterinary Services and should include the following characteristics:representative coverage of target animal populations by field services;ability to undertake effective disease investigation and reporting; access to laboratories capable of diagnosing and differentiating relevant diseases; a training programme for veterinarians, veterinary para-professionals, livestock owners/keepers and others involved in handling animals for detecting and reporting unusual animal health incidents; the legal obligation of private veterinarians to report to the Veterinary Authority; a national chain command.

EMERGING DISEASE - a new occurrence in an animal of a disease, infection or infestation, causing a significant impact on animal or public health resulting from: a change of a known pathogenic agent or its spread to a new geographic area or species; or a previously unrecognised pathogenic agent or disease diagnosed for the first time.

EPIDEMIOLOGICAL UNIT - a group of animals with a defined epidemiological relationship that share approximately the same likelihood of exposure to a pathogen. This may be because they share a common environment (e.g. animals in a pen), or because of common management practices. Usually, this is a herd or a flock. However, an epidemiological unit may also refer to groups such as animals belonging to residents of a village, or animals sharing a communal animal handling facility. The epidemiological relationship may differ from disease to disease, or even strain to strain of the pathogen.

EQUIVALENCE OF SANITARY MEASURES - the state wherein the sanitary measure(s) proposed by the exporting country as an alternative to those of the importing country, achieve(s) the same level of protection.

ERADICATION - the elimination of a pathogenic agent from a country or zone.

ESTABLISHMENT - the premises in which animals are kept.

EUTHANASIA - the act of inducing death using a method that causes a rapid and irreversible loss of consciousness with minimum pain and distress to animal.

EXPORTING COUNTRY - a country from which commodities are sent to another country.

FERAL ANIMAL - an animal of a domesticated species that now lives without direct human supervision or control.

FLOCK - a number of animals of one kind kept together under human control or a congregation of gregarious wild animals. For the purposes of the Terrestrial Code, a flock is usually regarded as an epidemiological unit.

FREE COMPARTMENT - a compartment in which the absence of the animal pathogen causing the disease under consideration has been demonstrated by all requirements specified in the Terrestrial Code for free status being met.

FREE ZONE - a zone in which the absence of the disease under consideration has been demonstrated by the requirements specified in the Terrestrial Code for free status being met. Within the zone and at its borders, appropriate official veterinary control is effectively applied for animals and animal products, and their transportation.

FRESH MEAT - meat that has not been subjected to any treatment irreversibly modifying its organoleptic and physicochemical characteristics. This includes frozen meat, chilled meat, minced meat and mechanically recovered meat.

GOOD MANUFACTURING PRACTICE - a production and testing practice recognised by the Competent Authority to ensure the quality of a product.

GREAVES - the protein-containing residue obtained after the partial separation of fat and water during the process of rendering.

HATCHING EGGS - fertilised bird eggs, suitable for incubation and hatching.

HAZARD - a biological, chemical or physical agent in, or a condition of, an animal or animal product with the potential to cause an adverse health effect.

HERD - a number of animals of one kind kept together under human control or a congregation of gregarious wild animals. For the purposes of the Terrestrial Code, a herd is usually regarded as an epidemiological unit.

IMPORTING COUNTRY - a country that is the final destination to which commodities are sent.

INCIDENCE - the number of new cases or outbreaks of a disease that occur in a population at risk in a particular geographical area within a defined time interval.

INCUBATION PERIOD - the longest period which elapses between the introduction of the pathogen into the animal and the occurrence of the first clinical signs of the disease.

INFECTED ZONE - a zone in which a disease has been diagnosed.

INFECTION - the entry and development or multiplication of an infectious agent in the body of humans or animals.

INFECTIVE PERIOD - the longest period during which an affected animal can be a source of infection.

INFESTATION - the external invasion or colonisation of animals or their immediate surroundings by arthropods, which may cause disease or are potential vectors of infectious agents.

INTERNATIONAL TRADE - importation, exportation and transit of commodities.

INTERNATIONAL VETERINARY CERTIFICATE - a certificate, issued in accordance with Chapter 5.2., describing the animal health and/or public health requirements which are fulfilled by the exported commodities.

JOURNEY

An animal transport journey commences when the first animal is loaded onto a vehicle/vessel or into a container and ends when the last animal is unloaded, and includes any stationary resting/holding periods. The same animals do not commence a new journey until after a suitable period for rest and recuperation, with adequate feed and water.

KILLING - any procedure which causes the death of an animal.

LABORATORY - a properly equipped institution staffed by technically competent personnel under the control of a specialist in veterinary diagnostic methods, who is responsible for the validity of the results. The Veterinary Authority approves and monitors such laboratories with regard to the diagnostic tests required for international trade.

LAIRAGE - pens, yards and other holding areas used for accommodating animals in order to give them necessary attention (such as water, feed, rest) before they are moved on or used for specific purposes including slaughter.

LISTED DISEASE - a disease, infection or infestation listed in Article 1.2.3. after adoption by the World Assembly of OIE Delegates.

LOADING/UNLOADING - Loading means the procedure of moving animals onto a vehicle/vessel or into a container for transport purposes, while unloading means the procedure of moving animals off a vehicle/vessel or out of a container.

MARKET - a place where animals are assembled for the purpose of trade or sale.

MEAT - all edible parts of an animal.

MEAT-AND-BONE MEAL - the solid protein products obtained when animal tissues are rendered, and includes any intermediate protein product other than peptides of a molecular weight less than 10,000 daltons and amino-acids.

MEAT PRODUCTS - meat that has been subjected to a treatment irreversibly modifying its organoleptic and physicochemical characteristics.

MILK - the normal mammary secretion of milking animals obtained from one or more milkings without either addition to it or extraction from it.

MILK PRODUCT - the product obtained by any processing of milk.

MONITORING - the intermittent performance and analysis of routine measurements and observations, aimed at detecting changes in the environment or health status of a population.

NOTIFIABLE DISEASE - a disease listed by the Veterinary Authority, and that, as soon as detected or suspected, should be brought to the attention of this Authority, in accordance with national regulations.

NOTIFICATION - the procedure by which: the Veterinary Authority informs the Headquarters, the Headquarters inform the Veterinary Authority, of the occurrence of an outbreak of disease or infection

OFFICIAL CONTROL PROGRAMME - a programme which is approved, and managed or supervised by the Veterinary Authority of a Member Country for the purpose of controlling a vector, pathogen or disease by specific measures applied throughout that Member Country, or within a zone or compartment of that Member Country.

OFFICIAL VETERINARIAN - a veterinarian authorised by the Veterinary Authority of the country to perform certain designated official tasks associated with animal health and/or public health and inspections of commodities and, when appropriate, to certify in accordance with Chapters 5.1. and 5.2.

OFFICIAL VETERINARY CONTROL - the operations whereby the Veterinary Services, knowing the location of the animals and after taking appropriate actions to identify their owner or responsible keeper, are able to apply appropriate animal health measures, as required. This does not exclude other responsibilities of the Veterinary Services e.g. food safety.

OUTBREAK - the occurrence of one or more cases in an epidemiological unit.

OWNED DOG - a dog for which a person claims responsibility.

PATHOLOGICAL MATERIAL - samples obtained from live or dead animals, containing or suspected of containing infectious or parasitic agents, to be sent to a laboratory.

PLACE OF SHIPMENT - the place where the commodities are loaded into the vehicle or handed to the agency that will transport them to another country.

POPULATION - a group of units sharing a common defined characteristic.

POST-JOURNEY PERIOD - the period between unloading and either recovery from the effects of the journey or slaughter (if this occurs before recovery).

POULTRY - all domesticated birds, including backyard poultry, used for the production of meat or eggs for consumption, for the production of other commercial products, for restocking supplies of game, or for breeding these categories of birds, as well as fighting cocks used for any purpose.

Birds that are kept in captivity for any reason other than those reasons referred to in the preceding paragraph, including those that are kept for shows, races, exhibitions, competitions or for breeding or selling these categories of birds as well as pet birds, are not considered to be poultry.

PRE-JOURNEY PERIOD - the period during which animals are identified, and often assembled for the purpose of loading them.

PREVALENCE - the total number of cases or outbreaks of a disease that are present in a population at risk, in a particular geographical area, at one specified time or during a given period.

PROTECTION ZONE - a zone established to protect the health status of animals in a free country or free zone, from those in a country or zone of a different animal health status, using measures based on the epidemiology of the disease under consideration to prevent spread of the causative pathogenic agent into a free country or free zone. These measures may include, but are not limited to, vaccination, movement control and an intensified degree of surveillance.

QUALITATIVE RISK ASSESSMENT - an assessment where the outputs on the likelihood of the outcome or the magnitude of the consequences are expressed in qualitative terms such as ‘high’, ‘medium’, ‘low’ or ‘negligible’.

QUALITY - defined by International Standard ISO 8402 as ‘the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs’.

QUANTITATIVE RISK ASSESSMENT - an assessment where the outputs of the risk assessment are expressed numerically.

QUARANTINE STATION - an establishment under the control of the Veterinary Authority where animals are maintained in isolation with no direct or indirect contact with other animals, to ensure that there is no transmission of specified pathogen(s) outside the establishment while the animals are undergoing observation for a specified length of time and, if appropriate, testing and treatment.

REGISTRATION - the action by which information on animals (such as identification, animal health, movement, certification, epidemiology, establishments) is collected, recorded, securely stored and made appropriately accessible and able to be utilised by the Competent Authority.

RESPONSIBLE DOG OWNERSHIP - the situation whereby a person (as defined above) accepts and commits to perform various duties in accordance with the legislation in place and focused on the satisfaction of the behavioural, environmental and physical needs of a dog and to the prevention of risks (aggression, disease transmission or injuries) that the dog may pose to the community, other animals or the environment.

RESTING POINT - a place where the journey is interrupted to rest, feed or water the animals; the animals may remain in the vehicle/vessel or container, or be unloaded for these purposes.

RESTRAINT - the application to an animal of any procedure designed to restrict its movements.

RISK - the likelihood of the occurrence and the likely magnitude of the biological and economic consequences of an adverse event or effect to animal or human health.

RISK ANALYSIS - the process composed of hazard identification, risk assessment, risk management and risk communication.

RISK ASSESSMENT - the evaluation of the likelihood and the biological and economic consequences of entry, establishment and spread of a hazard.

RISK COMMUNICATION - the interactive transmission and exchange of information and opinions throughout the risk analysis process concerning risk, risk-related factors and risk perceptions among risk assessors, risk managers, risk communicators, the general public and other interested parties.

RISK MANAGEMENT - the process of identifying, selecting and implementing measures that can be applied to reduce the level of risk.

SAFE COMMODITY - a commodity which can be traded without the need for risk mitigation measures specifically directed against a particular listed disease, infection or infestation and regardless of the status of the country or zone of origin for that disease, infection or infestation.

SANITARY MEASURE - a measure, such as those described in various chapters of the Terrestrial Code, destined to protect animal or human health or life within the territory of the Member Country from risks arising from the entry, establishment and/or spread of a hazard.

SLAUGHTER - any procedure which causes the death of an animal by bleeding.

SLAUGHTERHOUSE/ABATTOIR - premises, including facilities for moving or lairaging animals, used for the slaughter of animals to produce animal products and approved by the Veterinary Services or other Competent Authority.

SPACE ALLOWANCE - the measure of the floor area and height allocated per individual or body weight of animals.

SPECIFIC SURVEILLANCE - the surveillance targeted to a specific disease or infection.

STAMPING-OUT POLICY - a policy designed to eliminate an outbreak by carrying out under the authority of the Veterinary Authority the following:

the killing of the animals which are affected and those suspected of being affected in the herd and, where appropriate, those in other herds which have been exposed to infection by direct animal to animal contact, or by indirect contact with the causal pathogen; this includes all susceptible animals, vaccinated or unvaccinated, on infected establishments; animals should be killed in accordance with Chapter 7.6.;

the destruction of their carcasses by rendering, burning or burial, or by any other method described in Chapter 4.12.;

the cleansing and disinfection of establishments through procedures defined in Chapter 4.13.

STOCKING DENSITY - the number or body weight of animals per unit area on a vehicle/vessel or container.

STRAY DOG - any dog not under direct control by a person or not prevented from roaming. Types of stray dog:

free-roaming owned dog not under direct control or restriction at a particular time,

free-roaming dog with no owner,

feral dog: domestic dog that has reverted to the wild state and is no longer directly dependent upon humans.

STUNNING - any mechanical, electrical, chemical or other procedure which causes immediate loss of consciousness; when used before slaughter, the loss of consciousness lasts until death from the slaughter process; in the absence of slaughter, the procedure would allow the animal to recover consciousness.

SUBPOPULATION - a distinct part of a population identifiable in accordance with specific common animal health characteristics.

SURVEILLANCE - the systematic ongoing collection, collation, and analysis of information related to animal health and the timely dissemination of information so that action can be taken.

TERRESTRIAL CODE - the OIE Terrestrial Animal Health Code.

TERRESTRIAL MANUAL - the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.

TRANSIT COUNTRY - a country through which commodities destined for an importing country are transported or in which a stopover is made at a border post.

TRANSPARENCY - the comprehensive documentation of all data, information, assumptions, methods, results, discussion and conclusions used in the risk analysis. Conclusions should be supported by an objective and logical discussion and the document should be fully referenced.

TRANSPORT - the procedures associated with the carrying of animals for commercial purposes from one location to another by any means.

TRANSPORTER - the person licensed by the Competent Authority to transport animals.

TRAVEL - the movement of a vehicle/vessel or container carrying animals from one location to another.

UNIT - an individually identifiable element used to describe, for example, the members of a population or the elements selected when sampling; examples of units include individual animals, herds, flocks and apiaries.

VACCINATION - the successful immunisation of susceptible animals through the administration in accordance with the manufacturer's instructions and the Terrestrial Manual, where relevant, of a vaccine comprising antigens appropriate to the disease to be controlled.

VECTOR - an insect or any living carrier that transports an infectious agent from an infected individual to a susceptible individual or its food or immediate surroundings. The organism may or may not pass through a development cycle within the vector.

VEHICLE/VESSEL - any means of conveyance including train, truck, aircraft or ship that is used for carrying animal(s).

VETERINARIAN - a person with appropriate education, registered or licensed by the relevant veterinary statutory body of a country to practice veterinary medicine/science in that country.

VETERINARY AUTHORITY - the Governmental Authority of a Member Country, comprising veterinarians, other professionals and para-professionals, having the responsibility and competence for ensuring or supervising the implementation of animal health and welfare measures, international veterinary certification and other standards and recommendations in the Terrestrial Code in the whole territory.

VETERINARY LEGISLATION - laws, regulations and all associated legal instruments that pertain to the veterinary domain.

VETERINARY MEDICINAL PRODUCT - any product with approved claim(s) to having a prophylactic, therapeutic or diagnostic effect or to alter physiological functions when administered or applied to an animal.

VETERINARY PARA-PROFESSIONAL - a person who, for the purposes of the Terrestrial Code, is authorised by the veterinary statutory body to carry out certain designated tasks (dependent upon the category of veterinary para-professional) in a territory, and delegated to them under the responsibility and direction of a veterinarian. The tasks for each category of veterinary para-professional should be defined by the veterinary statutory body depending on qualifications and training, and in accordance with need.

VETERINARY SERVICES - the governmental and non-governmental organisations that implement animal health and welfare measures and other standards and recommendations in the Terrestrial Code and the OIE Aquatic Animal Health Code in the territory. The Veterinary Services are under the overall control and direction of the Veterinary Authority. Private sector organisations, veterinarians, veterinary paraprofessionals or aquatic animal health professionals are normally accredited or approved by the Veterinary Authority to deliver the delegated functions.

VETERINARY STATUTORY BODY - an autonomous regulatory body for veterinarians and veterinary para-professionals.

WILD ANIMAL - an animal that has a phenotype unaffected by human selection and lives independent of direct human supervision or control.

WILDLIFE - feral animals, captive wild animals and wild animals.

ZONE/REGION - a clearly defined part of a territory containing an animal subpopulation with a distinct health status with respect to a specific disease for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.

ZOONOSIS - any disease or infection which is naturally transmissible from animals to humans.