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Finally, we would like to thank all those people from outside the project who were sufficiently interested to attend our project meetings in Cambodia and Laos, and whose observations and suggestions influenced our research.

List of acronyms and abbreviations

| Acronym | Explanation |
|---------------------|---|
| ACIAR | Australian Centre for International Agricultural Research |
| ADB | Asian Development Bank |
| ALIATS | Asian Livestock Identification and Traceability System |
| ARAHIS | ASEAN Regional Animal Health Information System |
| ASEAN | Association of Southeast Asian Nations |
| ASVI and YTSTAVD | Yunnan Animal Science and Veterinary Institute (China) Yunnan Tropical and Subtropical Animal Viral Disease Laboratory |
| CSF | Classical Swine Fever |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation (Australia) |
| DAFF | Department of Agriculture, Fisheries and Forestry (Australia) |
| DAH | Department of Animal Health (Vietnam) |
| DAHP | Department of Animal Health and Production (Cambodia) |
| DAFWA | Department of Agriculture and Food, Western Australia |
| DLF | Department of Livestock and Fisheries (Lao PDR) |
| DOAHP | District Office of Animal Health and Production (Cambodia) |
| FAO | Food and Agriculture Organisation (of the United Nations) |
| FMD | Foot and mouth disease |
| GIS | Geographic Information System |
| GMS | Greater Mekong Subregion |
| ISVEE | International Society for Veterinary Epidemiology and Economics |
| LMWG | Lower Mekong Working Group on FMD control |
| LMZ | Lower Mekong Zone |
| MAF | Ministry of Agriculture and Forestry (Lao PDR) |
| MAFF | Ministry of Agriculture, Forestry and Fisheries (Cambodia) |
| NaVRI | National Veterinary Research Institute (Cambodia) |
| NAHC | National Animal Health Centre (DLF, Vientiane) |

| | |
|----------------------|--|
| OIE | World Organisation for Animal Health (Office International des Epizooties) |
| POAHP | Provincial Office of Animal Health and Production (Cambodia) |
| RCU | Regional Coordination Unit (of the OIE Sub commission for South East Asia) |
| RUA | Royal University of Agriculture, Phnom Penh |
| SEAFMD SEACFMD | South East Asian Foot and Mouth Disease Campaign (until 2010) South East Asia and China Foot and Mouth Disease Campaign (from 2010) |
| TAD | Transboundary Animal Disease(s) |
| UMWG | Upper Mekong Working Group on FMD control |
| UMZ | Upper Mekong Zone |
| VAHW | Village Animal Health Worker |
| VVW | Village Veterinary Worker |
| YTSTAVDL and ASVI | Yunnan Tropical and Subtropical Animal Viral Disease Laboratory Animal Science and Veterinary Institute (China) |

2 Executive summary

The intent of this project was

- To obtain and analyse livestock movement information from Laos, Cambodia and neighbouring countries in the Greater Mekong Subregion (GMS);
- To determine the drivers of livestock movement;
- To determine the risk of disease spread associated with these movements, particularly for foot and mouth disease (FMD) and classical swine fever (CSF);
- To identify and trial non-regulatory methods for risk management.

Access to both retrospective and current official movement information was too limited to allow accurate reconstruction of historical or current movement patterns. The project subsequently engaged with livestock traders who were responsible for moving livestock within Cambodia and Laos and across their borders. A series of nationwide meetings and interviews was conducted with traders in each country which identified major movement pathways, trade volumes, trading practices which carry a high risk of disease spread, trader networks and influential participants in the livestock market chains. We noted:

- Cambodia and Laos are net exporters of cattle and buffalo, and also host transit pathways for consignments of large ruminants
- Although technically unofficial, international livestock trading is mainly a highly organised, officially sanctioned activity.
- Transit times for movements across countries are short. As little as 18 hours was required to move cattle from Thailand across Cambodia into Vietnam.
- Trade pathways are volatile – varying with prices, and affected by exchange rates. A single evaluation of a trade pathway is insufficient for disease control purposes. When a specific pathway winds down movements occur elsewhere, thereby shifting the risks.
- Trader attitude to FMD is related to the scale of their trading activity. About half the local-level traders profit from availability of cheap livestock during FMD outbreaks. Higher-level traders involved in interprovincial and international movements suffer considerable financial losses if FMD affects a consignment, making them particularly interested in education to avoid diseased livestock.
- While trader understanding of disease spread and biosecurity is limited, they are enthusiastic to receive training about safe trading and requested educational resources for this purpose. These were subsequently produced by the project.
- Traders operate on a tight financial margin. The time and cost associated with official movement protocols and long quarantine periods discourage compliance.

Assessment of transboundary disease risks associated with the livestock trade allowed the project to identify high risk trading practices and critical points for disease spread (and intervention). Non-regulatory interventions developed by the project included biosecurity educational material for traders and a functional livestock identification and tracing system. We also identified that village-level para-veterinary workers posed a risk of spreading livestock disease within their communities through poor biosecurity practices. The project consequently developed biosecurity education booklets specifically for Village Animal Health Workers (VAHW) in Cambodia.

A legacy of data, reports, presentations, publications and educational material will remain available for future projects and interested people to access at the project website for at least 5 years (<http://ulm.animalhealthresearch.asia/>)

3 Background

Livestock movements are responsible for a large proportion of new outbreaks of transboundary animal diseases according to data from the Southeast Asia and China Foot and Mouth Disease (SEACFMD) programme. Traditional approaches to controlling livestock movements through regulation have repeatedly failed in mainland Southeast Asia, due to long land borders and poor enforcement. In several cases, attempts at regulation have promoted the spread of disease by inadvertently increasing illegal and uncontrolled movements.

The general aim of this project was to assist with the control of transboundary animal diseases in mainland Southeast Asia. The project had a country focus of Cambodia and Lao PDR, a disease focus of Foot and Mouth Disease (FMD) and Classical Swine Fever (CSF), and a species focus of cattle, buffaloes and pigs. Both commercial and smallholder production systems were expected to benefit from the project's research.

Although the spread of transboundary animal diseases through livestock movement is a regional issue, the project was designed to specifically investigate the situation in Cambodia and Laos because:

- FMD and CSF are considered to be endemic in these countries.
- In addition to exporting homebred livestock into neighbouring countries, Cambodia and Laos were thought to host important transit pathways for livestock moving between other countries in the region.
- Disease control in these countries is consequently critical for the region, and both countries are entering into bilateral agreements with their neighbours in relation to transboundary animal movement and disease control.
- Cambodia and Laos are both active participants in regional animal disease control initiatives organised by the World Organisation for Animal Health (OIE), the Food and Agriculture Organisation of the United Nations (FAO) and the Asian Development bank (ADB). Transboundary disease control is an identified priority of each country.
- It was anticipated that the skills, data management systems and knowledge generated by the project's research would improve the disease control capacity of the veterinary services in both countries, which were included as project partners.

In order to seek new, more effective approaches to control the movement-related spread of livestock disease, the project considered it necessary to first understand livestock movement patterns, and what drives them.

In the past, patterns of movement have been assessed anecdotally and qualitatively on an irregular basis at regional workshops. Movement patterns are very responsive to a range of influences and therefore can alter radically in a short period of time.

The projects therefore aimed to:

- Identify and understand the social, cultural, seasonal, economic, biological and environmental drivers of livestock movement.
- Develop tools to provide accurate and up-to-date information on current movement patterns and the associated risk of spread of disease (to allow pre-emptive control measures to be implemented in high-risk areas)
- Identify and trial novel interventions to minimise the risk of disease spread through livestock movement – not to control or prohibit livestock movements, but to make movements safer.

The Australian National Livestock Identification System (NLIS) offered the project a unique opportunity to undertake parallel research in Australia. The NLIS is a permanent identification system for cattle designed to trace livestock movements, providing an immediate reliable source of current and past movement patterns. Livestock market price data is also readily available in Australia.

The project proposed to undertake research into livestock movements in Australia, using the data in the NLIS to rapidly and inexpensively develop systems and algorithms to understand and manage movement data.

The relationship between price data and movement patterns would be examined to forecast movement patterns from price data, and establish an analytical framework which could be applied to the more complex data sources that may be used in Cambodia and Lao PDR. It was hoped that Australia's Department of Agriculture, Fisheries and Forestry (DAFF) and Commonwealth Scientific and Industrial Research Organisation (CSIRO) might ultimately be able to use Lao and Cambodian data on the movement of transboundary diseases to help test their disease risk models in Australia. Such an output would have clear benefits for disease preparedness in Australia.

This project was closely aligned with ACIAR's priorities. The problems being addressed are explicitly discussed in ACIAR's Research and Development focus areas, Theme 1, (Meeting rising demand for animal protein), focus area 1.6, Better management of animal health by smallholders, including:

- the problem of smallholders selling diseased livestock, thereby spreading disease
- ACIAR's focus on the economic and biological aspects of disease
- the focus on transboundary diseases common to a number of countries
- diseases which are exotic to Australia and pose significant threats
- collaboration with other agencies in carrying out and extending the research
- links with the private sector.

The project was also designed to follow the *Future Directions for ACIAR's Animal Health Research* during 2006-2011. More specifically, the project was consistent with ACIAR's indicative research priorities for Cambodia, Subprogram 2 (income generation and better nutrition through agricultural diversification), point 4: *Improved health and production of poultry and ruminants*, and ACIAR's indicative research priorities for Laos, Subprogram 2 (Agricultural diversification to improve productivity of lowland farming systems), point 3: *Animal health and quarantine, especially related to the critical geographic location of Laos as a livestock transit point*.

Some previous efforts to understand livestock movement patterns were based on the accumulated knowledge of local stakeholders, usually government officers, while others attempted a sociological approach and focused on livestock traders. The sociological approach, while more complex and difficult to implement, was recognised by the project's designers and major stakeholders (including the OIE's Regional Coordination Unit [RCU]) as a preferred strategy. The project planned to combine information gathered from traders with other information on the drivers of movement and disease spread. This approach had not previously been undertaken in the region, and offered a solution to the problem of understanding rapidly changing movement patterns.

An important project aim was to develop close collaborative linkages with livestock traders and other market chain participants, and to investigate the feasibility of developing trader and producer (cattle/buffalo and pig) organisations as a means of obtaining and delivering information and providing industry with a representative voice for consideration by policy makers.

Because a major project output was expected to be a system to *sustainably* generate information on movement and disease risk in Cambodia, Laos and the GMS, there was consequently a significant capacity building aspect associated with the project's activities. Staff in Cambodia and Laos would need to be trained in managing the necessary data and know how to use the information generated to improve disease control. Regional technology transfer workshops planned for the end of the project were intended to extend the capacity building benefits to neighbouring countries as well.

The project's research was planned to support regional livestock disease control programmes. The OIE, FAO and the ADB were represented in project planning from the earliest stages in 2006. The project was particularly designed to maintain close ties with and contribute valuable research findings to the SEACFMD Campaign. The South East Asia Foot and Mouth Disease Campaign (SEAFMD) became the South East Asia and China Foot and Mouth Disease Campaign (SEACFMD) in 2010, reflecting increased engagement with China in regional disease control initiatives. *The project correspondingly expanded its research into China in 2010-2011 by supporting risk assessment work being attempted by a Chinese PhD student enrolled at Murdoch University.*

It was intended that ACIAR Project AH/2006/025 would pursue opportunities for collaboration with other ACIAR-funded research projects in the region, as well as with projects run by other organisations. *In fact, collaboration became the theme of the project's Annual Meeting in 2009, and collaborative data collection and sharing of results with numerous projects and organisations was a feature of the project's research.*

4 Objectives

Project Objectives

The overall aim of the project was to improve control of livestock diseases by

- providing information on the predicted spatial risk of disease spread (allowing pre-emptive preventative measures to be implemented in high risk populations), and
- investigating non-regulatory interventions to decrease the risk of disease spread associated with livestock movements.

Objective 1: *To understand livestock movement patterns to predict the risk of disease spread.*

Specific project activities designed to achieve this objective included:

Activity 1.1: To develop a quantitative description of actual livestock movement patterns (including both legal and illegal movements) in a number of defined study areas and time periods.

Activity 1.2: To identify the social, cultural, economic, biological and environmental drivers of livestock movement, and quantify the impact of a limited number of key indicators in order to predict movement patterns.

Activity 1.3: To combine predicted movement patterns with livestock disease surveillance information to predict the spatio-temporal risk of spread of livestock diseases through livestock movement.

Activity 1.4: To develop and institutionalise a sustainable information resource capable of providing movement and disease risk data to key stakeholders and decision makers.

Objective 2: *To investigate possible interventions to minimise disease spread through livestock movement.*

The primary project activity intended to achieve this objective was:

Activity 2.1: To identify and investigate novel, non regulatory interventions capable of minimising the disease risk associated with livestock movements

The *non-regulatory* nature of the desired interventions (outputs) recognised that:

- regulatory protocols had achieved very limited success in the GMS to date
- the necessary supporting legislation for such measures was not yet in existence in Cambodia and Laos
- increased or changed animal movement regulation would be unlikely to be enforced if it threatened the unofficial income derived by officials from the present unofficial (but sanctioned) system controlling animal movements in these countries
- our project staff would have a greater chance of obtaining the cooperation of livestock traders if they were confident that our intention was not to burden them with increased regulation.

In addition, there was a project management overlay to the research designed to:

- establish and maintain close linkages with related projects and activities (involving coordination meetings, and a communications strategy)
- ensure efficient project management and reporting, as well as monitoring and evaluation.

5 Methodology

Overview:

The project's research can be broken down into two phases:

- The **2008-2009** period was occupied with **data collection**, including:
 - movement records from 2005-2007, and those generated during 2008-2009
 - livestock prices during 2008-2009 from all provinces, every month
 - information from traders including sociological material, knowledge of livestock diseases and their transmission, trading practices, trading networks, and trade routes, volumes, seasons, and determinants
 - livestock population monitoring in selected villages in each country
 - an 'animal tracking' trial in Laos, requiring records of ear-tagged cattle and buffalo to be made at road checkpoints.
- During **2010-2011** data were used for the purposes of:
 - Summarising movement patterns and the factors that influence them
 - Describing trader attributes, trader networks, and trading practices (and associated disease risk)
 - Analysing the relationship between livestock movements and various indicator variables in an attempt to develop a computer model capable of predicting livestock movements and disease outbreaks
 - Performing risk assessments of various international trade routes running through these two countries
 - Identifying and developing strategies to reduce the disease risk associated with livestock movements.
 - Providing regular feedback to all stakeholders, particularly those who had provided us with information

The information from the data collection activities was combined to produce an understanding of how, why and when livestock movements occurred in Cambodia and Laos (Objective 1).

The final two years of the project were occupied by analysing this data and trialling disease risk reduction intervention candidates identified by this process (Objective 2).

Collaboration was pursued with other researchers, programs and organisations, and resulted in a number of rewarding research partnerships (described in this report).

Where was the work done?

Because the project planned to investigate livestock movement patterns in Cambodia and Laos on a national scale in order to understand their contribution to regional disease risk, the project collected data from all regions of both countries.

However, for certain more detailed studies, particularly research of local livestock movements and population dynamics, the project selected two study provinces in each country, which were chosen to:

- represent areas of high and low disease risk, associated with high and low levels of livestock movement, and
- foster involvement in other related projects to promote synergies.

The proposed study locations changed several times prior to project initiation, suggesting that departmental sources in each country may not have had an accurate idea of movement patterns at the time, or that movement patterns were undergoing change.

Takeo and Kampong Cham provinces were finally selected in Cambodia, both located in the south-east of the country, bordering Vietnam. Vientiane Capital province (bordering Thailand) and Xieng Khouang province (bordering Vietnam) were selected in Laos. All selected provinces turned out to have a high level of livestock movement and disease risk during the study period (2008-2011).

The project's research was intended to support the activities of SEACFMD, which is managed by the OIE's Regional Coordination Unit in Bangkok. The project's study province of Takeo in Cambodia lies within the SEACFMD's 'Lower Mekong Zone' (LMZ), and the Lao study provinces feature in the 'Buffer Zone' for the Upper Mekong Zone' (UMZ). Information about livestock movements gathered in these provinces was expected to assist the SEACFMD's *progressive zoning approach* for FMD control.

The nominated study provinces are indicated on Figure 5-1.



Figure 5-1: Map of Laos and Cambodia with project study provinces highlighted.

population changes) were subsequently recorded in two villages in each of three Lao provinces: Luang Prabang, Houaphan, and Xieng Khouang.

It was originally planned that project research would start in Cambodia in 2007, a year before the same activities began in Laos, with the intention that lessons learned in Cambodia would be applied in Laos. Initiation of project activities in Cambodia was delayed, however, by an unsigned Memorandum Of Understanding, problems establishing a project bank account in Cambodia, and failure to enlist project volunteers and staff. Research activities consequently began in both countries in mid-2008.

The nominated study provinces served as a starting point for our initial meetings with livestock traders in each country. As with our collection of official movement records and livestock prices, however, our research with livestock traders required us to develop a nationwide program of meetings and interviews.

The *Population Dynamics* study did take place in the nominated study province of Takeo in Cambodia, mainly to take advantage of a cooperative community of farmers for whom we had pre-existing background data collected by Dr Tum Sothyra, a Murdoch University PhD student associated with the project.

In Laos, the villages chosen for our 'Population Dynamics' study were those simultaneously being enrolled in ACIAR Project AH/2006/159: *Best practice health and husbandry of cattle and buffalo in Lao PDR*. This collaboration was designed to generate research efficiencies and

increased information from the study populations. Village livestock populations (and reasons for sales, purchases and other

Who was involved in the work? Staffing strategy

Project partners in Cambodia (DAHP) and Laos (DLF) were responsible for managing project activities in Cambodia and Laos respectively, with planning assistance and monitoring feedback from Australian project partners.

A full-time *Project Officer* position was funded in each country, to be managed by each country's part-time *Project Leader*. In Laos, the DLF decided to employ four very junior DLF staff rather than one more senior project officer, in order to provide employment and experience for as many DLF staff as possible. The project subsequently paid for English lessons for these staff and provided training in data entry and digital story making in order to maximise the capacity building benefits for the DLF.

Because personnel resources in Cambodia and Laos (in particular) were known to be limited, the project planned to avoid overstretching our departmental project partners in these countries by:

- enlisting Australian volunteers to help manage project activities in-country
- including the research of three PhD students (two Cambodian, one Australian) in the project's activities.

Two PhD projects went ahead (one Australian student, and one Chinese student), but we were unable to engage volunteers to work in either country. The routine, non-project workload of our project leaders and advisors in Cambodia's DAHP and the Lao DLF was too great to allow them to closely manage each of the project's six data collection activities. Consequently, the role envisaged for project volunteers was instead performed by consultants, who were engaged initially to manage the important activity of collecting information from livestock traders throughout both countries (Activity 1.2.1). Dr Axelle Scoizec in Laos, and Dr Socheat Sieng in Cambodia, both veterinary consultants with prior experience in their respective countries, were engaged to undertake this work. The Cambodian DAHP and Lao DLF concentrated on managing those data collection activities which required monthly submission of movement records and livestock prices from each of their provincial offices (Activities 1.1.1, 1.1.2, 1.1.3, 1.2.2 and 1.2.3 – described later in this section).

The consultants produced excellent results from their work with traders, and were subsequently re-engaged to conduct feedback meetings for the traders and departmental staff who had contributed to our research. Data collection by consultants was facilitated by our DAHP and DLF colleagues, as numerous meetings and interviews had to be arranged by each department's provincial offices throughout each country. In addition to arranging these provincial data collection trips, the DLF project leader in Laos (Dr Phouth Inthavong) also acted as translator for the project's consultants operating in that country.

As recommended by the Project Review in August 2010, consultants were again employed to assist project leaders in each country to manage the development of educational materials during 2010-2011 (Activity 2.1). Dr Kate Blaszak and Dr Malcolm Anderson, both Australian veterinarians, managed this activity in Laos, whilst Dr Socheat Sieng was once again nominated by the Cambodian DAHP to manage this activity on their behalf, as recorded in recommendation # 3 of the 2010 Project Review.

The project was granted an unfunded extension until the 30th June 2012 in order to further trial and refine the project's educational materials. These booklets, posters and digital stories were the primary non-regulatory 'intervention' developed by the project to reduce disease spread by improving the biosecurity standards applied by livestock traders. The project extension also allowed development of biosecurity educational materials specifically for Village Veterinary Workers (VVs) in Laos and Village Animal Health Workers (VAHWs) in Cambodia. Project research in 2010–11 had implicated VAHWs as

unintentional spreaders of livestock disease within their communities due to inadequate training in biosecurity. (Please refer to Appendix 13 – Kampong Cham case study). Dr Socheat Sieng managed Activity 2.1 in Cambodia during 2012, while Ms Nancy Bourgeois Luthi worked with Dr Phouth Inthavong during 2012 to finalise these materials in Laos.

It should also be noted that Ms Nancy Bourgeois Lüthi, a Laos-based livestock value chain expert with considerable experience in Laos and Vietnam, was employed by the project to undertake field research associated with various cross-border trade pathways as part of Activity 1.3.2 (Risk pathway analysis). Nancy was assisted in her research in Laos by Lao Project Leader Dr Phouth Inthavong, and her research for us in Vietnam was facilitated by Vietnam's Department of Animal Health (DAH). Dr Mai Van Hiep, Deputy Director of the DAH, was integral in arranging our project's collaborative research with the DAH in Vietnam. The results of Nancy's work, which was of a very high standard, are summarised in Section 7 of this document, and her full reports are attached as Appendices 6 and 7.

Ben Madin (AusVet Animal Health Services), a PhD student at Murdoch University, had responsibility for managing the analysis of all the data collected, requiring the design and implementation of online data entry systems for use in the Cambodian and Lao provincial offices where the data was collected. Ben's PhD research was fundamental in the project's attempt to '*develop and institutionalise a sustainable information resource capable of providing movement and disease risk data to key stakeholders and decision makers*'.

The Department of Agriculture and Food, Western Australia (DAFWA) had responsibility of leading and managing the project. Project Leader Dr Chris Hawkins also shared with Professor John Edwards (Murdoch University) responsibility for supervising the risk assessment of important regional trade routes identified by the project (Activity 1.3.2).

Details of project personnel engaged in the work are listed in Appendix 15

How was the work done? Methodology by Activity

The project's data collection fell into two categories, the first (**Activity 1.1**) aimed to *develop a quantitative description of actual livestock movement patterns (including both legal and illegal movements) in a number of defined study areas and time periods* and the second (**Activity 1.2**) intended to *identify the social, cultural, economic, biological and environmental drivers of livestock movement, and quantify the impact of a limited number of key indicators in order to predict movement patterns*.

To achieve these aims, six data collection activities took place simultaneously in each country (Cambodia and Laos) during the first two years of the project (2008 and 2009).

1. **1.1.1** : Retrospective movement study (using existing livestock movement records from the period 2003-2007)
2. **1.1.2**: Prospective movement study (using movement records collected by the project during 2008-2009)
3. **1.1.3**: Animal tracking study (following the movements of livestock wearing identifiers)
4. **1.2.1**: Sociological study of movement drivers: 'Working with traders' (gathering information from livestock traders)
5. **1.2.2**: Population dynamics study (recording livestock movements at a village level)
6. **1.2.3**: Market prices study (recording market prices throughout each country on a monthly basis).

It was intended that the data collected by these activities would be combined and analysed by computer in order to determine if any factors were predictive of livestock movements (*Activity 1.2.4: Predict movement patterns*, and *Activity 1.2.5: Evaluate predictions*).

For example, if the project could demonstrate that livestock were moved to take advantage of higher prices in particular locations, price data could be used as a predictor of livestock movements. Such a finding would have great value if the predictor variable (such as market price data) was more easily available than movement records, which are not readily available (or shared) throughout the GMS. Governments within the region would be able to predict livestock movements by monitoring livestock prices across the region.

If disease surveillance data could be added to the model, the risk of disease spread could be assessed for predicted livestock movements, allowing animal health authorities to take preventative steps to avoid disease outbreaks in susceptible areas.

Activity 1.1.1: Retrospective movement study

In order to gain an understanding of movement patterns in the 5-year period preceding project inception, this activity planned to analyse Cambodian and Lao livestock movement records from 2003-2007. The Cambodian DAHP and Lao DLF were asked to provide domestic movement records from that period, as well as import and export permits.

The Australian National Livestock Identification System (NLIS) offered the project a unique opportunity to undertake parallel research in Australia. The NLIS is a permanent identification system for cattle designed to trace livestock movements, providing an immediate reliable source of current and past movement patterns. NLIS movement records from Western Australia for the period July 2005 – June 2008 were analysed by Ben Madin to investigate statistical and network analysis techniques for later application with data from Cambodian and Laos.

Unfortunately, so few records were available in Cambodia and Laos for the 2003-2007 period that the project was forced to concentrate on *Activity 1.1.2: Prospective movement study* in those countries.

Activity 1.1.2: Prospective movement study

This activity was particularly important, as we needed movement data for the 2008-2009 period to compare with information about possible movement 'drivers' (prices, seasonal effects, festivals etc) collected over the same period. Data collection in Cambodia and Laos was managed by our partner organisation in each country, the DLF in Laos and the DAHP in Cambodia, and relied on submission of movement records (permits) and livestock prices on a monthly basis from each provincial office of the DAHP and DLF. To initiate this work in each country, provincial officers were provided with a training workshop where online data entry and mobile phone messaging systems were introduced.

Because these systems were unlikely to be taken up, or even feasible, in some provinces, an alternative paper-based reporting system was also established whereby movement permits could be submitted to our project officer(s) in each country, who would subsequently enter the data into the project's databases. The project officers received intensive training in data entry and management, as well as constant phone and email support and country visits by the project's computer expert, Ben Madin.

In the latter stages of data collection in Cambodia, the project also gained access to records from a large slaughterhouse in Phnom Penh, which represented a centralised source of livestock prices and Phnom Penh-directed livestock movements.

In Laos, road checkpoints were a feature of the livestock movement system during the project's data collection period (until their nationwide abolition in April 2011). The project paid to obtain movement records from a number of strategically located checkpoints for a 12-month period as a means of verifying the completeness of movement records supplied by the provincial DLF offices. These checkpoints were also enrolled to report the detection (and description) of any ear-tagged cattle or buffalo in passing consignments as the most practical means of capturing data for our 'Animal Tracking' activity (Activity 1.1.3).

Checkpoints on the main (all-weather) roads leading to Vientiane from the southeast, west, and north were used to record movements to and from the capital, which is the largest population (and demand) centre in Laos.

Because Xieng Khouang province in Laos was reported to be an important transit province for livestock moving unofficially into Vietnam (as well as being one of our two nominated study provinces, and the location of two study villages involved in *ACIAR Project AH/2006/159*), we specifically selected checkpoints on the roads entering and leaving this province as locations for data collection. The location of the project's data collection checkpoints in Laos is shown in Figure 5-2.

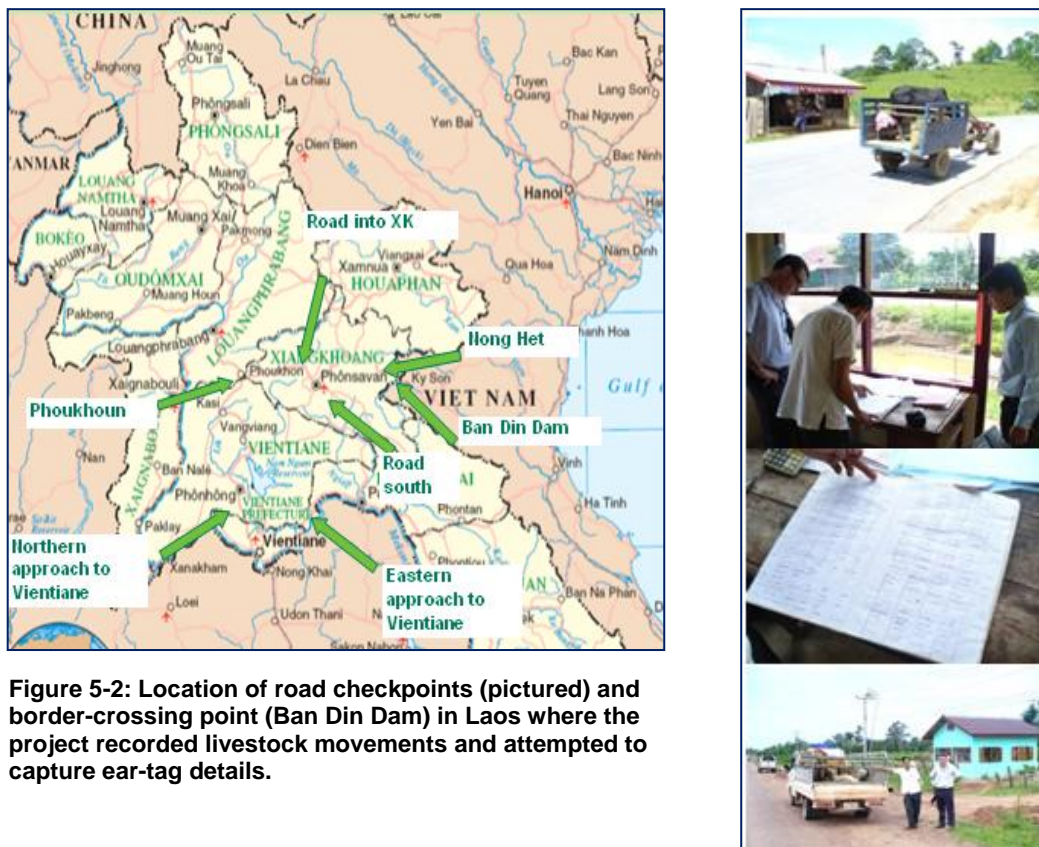


Figure 5-2: Location of road checkpoints (pictured) and border-crossing point (Ban Din Dam) in Laos where the project recorded livestock movements and attempted to capture ear-tag details.

In order to investigate anecdotal estimates of the unofficial livestock trade into Vietnam through Xieng Khouang province, we paid the villagers at the unofficial border crossing pathway at Ban Din Dam (see Figure 5.2) to record a full 12 month cycle of livestock movements across this pathway, as well as the presence (and details) of any ear-tagged animals (see Activity 1.1.3). In order to evaluate what proportion of the trade into Vietnam travelled over the pathway at Ban Din Dam and what proportion used other smaller pathways in the vicinity, we planned to compare the figures recorded at Ban Din Dam with those recorded further west (inside Laos) at the Nong Het checkpoint.

As described for Activity 1.1.1, the methodology for this Activity 1.1.2 required preliminary research into livestock movements in Australia, using the data in Australia's National

Livestock Identification System (NLIS) to rapidly and inexpensively develop systems and algorithms to understand and manage movement data.

The relationship between price data and movement patterns in Australia would be examined to estimate movement patterns from price data, and establish an analytical framework which could be applied to the more complex data sources that may be used in Cambodia and Lao PDR. The data collected in Cambodia and Laos would then be used to validate the predictive model.

Finally, in Activities 1.3.3 (Create risk maps) and 1.3.4 (Validate risk predictions), livestock disease data from Cambodia and Laos collected as part of Activities 1.3.1 (Disease reporting) and 1.3.2 (Risk pathways) would be added to the model in order to predict the risk of disease spread associated with the predicted livestock movements.



Figure 5-3: Cattle and buffalo moving unofficially from Laos into Vietnam across a mountain path at Ban Din Dam, Xieng Khouang province.

Activity 1.1.3: Animal tracking study

This activity planned to record details of unique animal identifiers applied to livestock in Cambodia and Laos so that information about livestock movement patterns could be obtained by capturing reports of these identifiers when they were observed in various new destinations. This activity was viewed as a pilot study to assess the prospects for larger scale animal identification and movement recording programs. It faced the following challenges:

- Animal identification is not practised in either country, and farmer attitudes towards visible identifiers such as ear-tags or brands were unknown.
- Our research ethics approval from Murdoch University included strict guidelines concerning protection of animal welfare and farmer income. Consequently, the project could not attempt to identify livestock in any manner that didn't satisfy Australian animal welfare standards or which might adversely affect the marketability of the animals.
- Facilities for livestock restraint are limited or unavailable in most Cambodian and Lao villages. Consequently, application of rumen boluses might not be possible, and application of ear-tags or brands (especially by inexperienced operators) might tear ears or unnecessarily damage hides, thereby breaching welfare requirements and possibly devaluing livestock.
- The scale of the activity, both in terms of participating livestock numbers and the duration of the study, was inadequate to expect many movements to occur involving the animals enrolled in the study.
- The possible destination markets for traded livestock were numerous, and included foreign destinations reached by illegal border crossings. Achieving sufficient official

and public awareness of the study across at least three countries in order to capture reports of movements featuring these animals was beyond the means of this project, and probably impossible. Moreover, it was difficult to nominate an incentive for traders or officials to report movements of these animals, particularly if they involved illegal border crossings.

The project opted to investigate two alternative animal tracking strategies:

- a. A prospective tracking study of ear-tagged cattle and buffaloes in northern Laos, undertaken in collaboration with another ACIAR project which planned to ear-tag these animals for other purposes
- b. An individual animal tracking study using a rumen bolus which contained a GSM transmitter, the movements of which could be recorded without human input (obviating the public awareness and compliance challenges otherwise required for data capture).

The methodology of the animal tracking study is described in more detail in Appendix 1, and the outcomes are described in Section 6.

Activity 1.2.1 (Working with traders): Methodology

Activity 1.2.1 was featured in the Project Document as a 'Sociological study of drivers of movements', and became known as 'Working with traders'. It was our most rewarding and successful activity.

The importance of working with livestock traders

For the project's retrospective and prospective movement studies (described above), government permits were compiled and analysed to describe livestock movement patterns in Cambodia and Laos. Whilst these official records were useful in identifying and helping to quantify seasonal and longer term changes in movement patterns, they failed to capture important information about movement drivers, trading practices that influence disease risk, and the significant unofficial livestock trade which accounts for the majority of cross-border livestock movements in the GMS (see Figures 5.3, 5.4 and 5.5).



Figure 5-4: Cattle moving across a river in Southern Laos towards the Vietnamese border.

Consequently, the project consulted extensively with livestock traders throughout Cambodia and Laos in our pursuit of the following information:

- Important trade routes for cattle, buffalo and pigs
- Quantitative movement data for those trade pathways
- Sociological background for livestock movements, including:
 - trading practices
 - trader networks
 - trader knowledge of disease and biosecurity
 - movement drivers and trade impediments (official and unofficial)

Our research was also intended to develop a relationship with traders throughout Cambodia and Laos for ongoing consultation, research and education.



Figure 5-5: Buffalo entering an unofficial mountain pathway from Laos into Vietnam, Xieng Khouang Province, Laos

It was originally intended that Activity 1.2.1 would be managed by Murdoch University's sociology department. In mid-2008, the project's first meetings with livestock traders and trial of our trader questionnaire took place in Vientiane (Laos), and in Phnom Penh, Kampong Cham and Takeo (Cambodia). Sociologists from the Faculty of Social Science and Humanities at Cambodia's Royal University of Phnom Penh participated in these initial Cambodian meetings and trader interviews.

Unfortunately, the Cambodian sociologists withdrew from the project in October 2008, citing an uncomfortable working relationship with the DAHP. Murdoch's nominated sociologist consequently also withdrew, disappointed by this development in Cambodia and unable to manage the very large project workload alone.

Project consultants were subsequently engaged to manage data collection from traders in each country, Dr Axelle Scoizec in Laos and Dr Socheat Sieng in Cambodia. The

Cambodian Department of Animal Health and Production (DAHP) and Lao Department of Livestock and Fisheries (DLF) continued to facilitate the process.

In Cambodia, a team of trained researchers used questionnaires to collect qualitative and quantitative data in one-on-one interviews with traders. The DAHP was excluded from these interviews to ensure confidentiality and encourage honest responses. The questionnaire is attached to this report as Appendix 2.

Data collection in Laos followed a less structured checklist approach, with DLF staff present as translators.

Our use of these different data collection techniques [i.e. with departmental representatives present (Laos) or absent (Cambodia); using a questionnaire in one-on-one interviews (Cambodia) versus a less structured approach relying mainly on focus group responses (Laos)] enabled us to make a number of observations about their comparative merit. These observations are featured in Section 7 of this report.

Traders were interviewed throughout each country, with an increased focus on those provinces that featured significantly in long distance and cross-border livestock trade. Data collection in important border provinces was undertaken in collaboration with the *'FAO ADB and OIE SEAFMD Study on Cross-Border movement and market chains of*

large ruminants and pigs in the Greater Mekong Sub-Region, the report of which can be found at our project website: <http://ulm.animalhealthresearch.asia/>.

'Snowball sampling' was attempted when following trader networks, whereby interviews with key traders (primary respondents) identified suppliers and buyers in their trading networks for follow-up interviews (secondary respondents). This technique presented time, cost and logistical challenges when investigating trading networks that operate on a national and international scale.

The results of our meetings and interviews with livestock traders are featured in Section 7 of this document.

Activity 1.2.2: Population dynamics study

This activity recorded village-level population changes and events during a 12 month period from late 2008 until December 2009. The aim was to understand livestock populations at a local level, including issues of supply and demand and the reasons (drivers) for sales, purchases and other livestock movements.

As described in the methodology for Activity 1.1.3 (Appendix 1), this activity was undertaken in Laos in collaboration with *ACIAR Project AH/2006/159: Best practice health and husbandry of cattle and buffalo in Lao PDR*, using livestock populations in six villages in northern Laos.

In Cambodia, population dynamics were recorded in two villages in the Tramkok district of Takeo province. The two villages that were chosen (Prey Kui and Taso) had previously been involved in a sero-surveillance study investigating FMD prevalence in cattle and buffaloes.

In both countries, the study began with a census of the cattle, buffalo and pig populations in each village. Thereafter, details of animals entering (birth, purchase, hire/loan) or leaving these livestock populations (death, sale, slaughter, hire/loan) were recorded over a 12 month period, hoping to observe any seasonal patterns that might exist. Information was also gathered about disease experienced by animals in the village, the reasons for any sales, slaughter or purchases, and the cause of any deaths.

Recording was the responsibility of each village's veterinary worker. The data was collected each month by our partner organisations in each country, the DLF in Laos and the DAHP in Cambodia, and entered into a database in each country's project office.

This data was subsequently analysed using standard univariate summaries as well as bivariate comparisons. Open answers were summarised.

Activity 1.2.3: Market prices

As described earlier in this section, market prices for livestock were considered to be a likely driver (and therefore predictor) of livestock movements. Collection of market prices throughout Cambodia and Laos was consequently a crucial activity in order to test their association with movements recorded over the same period (2008-2009).

Prices for livestock may be reported as a price per head, a price per kilogram bodyweight, or even as a price per kilogram of meat (for slaughter stock). Within each species (cattle,

buffalo, pig) prices also vary according to breed, age, sex and body condition. It was consequently necessary to define which of these parameters had to be submitted along with price to enable comparison of prices for different commodity classes. This was achieved by consulting animal health staff in Cambodia and Laos initially, and then canvassing the opinion of a larger group of experts working in the region.

Training courses were conducted in Cambodia and Laos in 2008 to teach staff from each provincial office about collecting market price data. Staff were brought to the national capital and provided with information about the reasons for the study, how to collect and describe the data, and how to enter it into pro-forma sheets or the online database interface (available to those with internet access). The use of a mobile phone short message service (SMS) system for submitting market prices was also demonstrated, and individual training on the SMS system was later delivered in three Cambodian provinces.

Provincial staff in Cambodia and Laos subsequently collected market price data for a 12 month period by visiting markets or talking to traders on a monthly basis. Data were recorded on a standardised reporting form and, where possible, entered directly into the online database created for this purpose. An example of the online web page for price entry is shown in Figure 5.6. More commonly, the completed paper reporting form was returned to the national office for entry into the project’s database by each country’s designated project officer.

Market Prices Report Entry Form

Species: Currency: Units: Use Quicktab: Update

Price Data Entry Form - Cattle

Country: Province: District: Location:

Reference: Report Date: Source of Data: Name:

| | Male | | | Female | | |
|----------|---|--|--|--|--|--|
| | Good | Medium | Poor | Good | Medium | Poor |
| Calf | <input type="text" value="\$ (USD) / H 1150.00"/> | <input type="text" value="\$ (USD) / H 100.00"/> | <input type="text" value="\$ (USD) / H 87.00"/> | <input type="text" value="\$ (USD) / H 105.00"/> | <input type="text" value="\$ (USD) / H 98.00"/> | <input type="text" value="\$ (USD) / H 90.00"/> |
| Weaner | <input type="text" value="\$ (USD) / H 147.00"/> | <input type="text" value="\$ (USD) / H 135.00"/> | <input type="text" value="\$ (USD) / H 95.00"/> | <input type="text" value="\$ (USD) / H 140.00"/> | <input type="text" value="\$ (USD) / H 110.00"/> | <input type="text" value="\$ (USD) / H 97.00"/> |
| Juvenile | <input type="text" value="\$ (USD) / H 163.00"/> | <input type="text" value="\$ (USD) / H 146.00"/> | <input type="text" value="\$ (USD) / H 135.00"/> | <input type="text" value="\$ (USD) / H 150.00"/> | <input type="text" value="\$ (USD) / H 140.00"/> | <input type="text" value="\$ (USD) / H 110.00"/> |
| Adult | <input type="text" value="\$ (USD) / H 230.00"/> | <input type="text" value="\$ (USD) / H 158.00"/> | <input type="text" value="\$ (USD) / H 145.00"/> | <input type="text" value="\$ (USD) / H 165.00"/> | <input type="text" value="\$ (USD) / H 153.00"/> | <input type="text" value="\$ (USD) / H 125.00"/> |
| Mature | <input type="text" value="\$ (USD) / H 265.00"/> | <input type="text" value="\$ (USD) / H 243.00"/> | <input type="text" value="\$ (USD) / H 235.00"/> | <input type="text" value="\$ (USD) / H 242.00"/> | <input type="text" value="\$ (USD) / H 217.00"/> | <input type="text" value="\$ (USD) / H 200.00"/> |

Figure 5.6: Example of market price data entry form. This example shows an outlier price which was adjusted during analysis (the male good condition calf price, arrow).

The data were then analysed to identify provinces with higher and lower animal value and quantify the differences between provinces. To account for the different categories on which the prices were based, the analysis used a multilevel linear model with province as a random effect. The use of a constant slope model with varying intercepts made it possible to determine a single value for a standardised livestock unit in each province in Cambodia and Laos. Intercept values estimate the price for animals that were in the reference categories for all of age, condition, sex, and month. For cattle, this was female calves in poor condition in January. For pigs, this was female crossbred piglets in poor condition in January.

To facilitate ongoing reporting and recording of price data, the use of a computer logged SMS system was set up. Field staff were able to enter limited price information that was transmitted directly to a central computer, removing the need for re-entry of data. This was of limited success (see Section 7).

Activity 1.3:

After information about movements and movement 'drivers' had been collected and analysed by Activities 1.1 and 1.2, Activity 1.3 would '*combine predicted movement patterns with livestock disease surveillance information to predict the temporo-spatial risk of spread of livestock diseases through livestock movement.*' In other words, if we knew where disease outbreaks were occurring from reliable, up-to-date surveillance data, then our ability to predict the destination of livestock moved out of diseased areas would allow animal health authorities to prepare for (or prevent) its arrival in new/unaffected areas.

After researching disease reporting (Activity 1.3.1) and disease spread (Activity 1.3.2) in both countries, we planned to 'create risk maps' (Activity 1.3.3) and 'validate risk predictions' (Activity 1.3.4).

Activity 1.3.1: Disease reporting

Because Activity 1.3 aimed to '*combine predicted movement patterns with livestock disease surveillance information*', our attempts to obtain surveillance data would afford us the opportunity to evaluate the existing disease reporting systems in Laos and Cambodia (Activity 1.3.1).

Our efforts to obtain surveillance data during 2008 had very limited success, and drew attention to weaknesses in the disease reporting and investigation systems in both countries. Because of the importance of disease surveillance data in developing the project's computer model for predicting the spread of disease, it was proposed at our Annual Project Meeting in July 2009 that the project should attempt to improve the current reporting system in each country, at least to the extent of creating a standardised format for the disease reports that were theoretically submitted by each province to the department on a monthly basis.

However, this proposition was not supported by all project partners, some of whom felt that the scope of this activity should be confined to evaluating the existing reporting systems, rather than trying to remedy them.

Our subsequent strategy for this activity, as decided at the 2009 Annual Project Meeting, was limited to assessing, as opposed to improving, the reporting system in each country by means of the following tasks:

Cambodia

- Rather than duplicating existing research being undertaken by the much larger EU-funded *Smallholder Livestock Production Programme* (SLPP), we would wait for the SLPP assessment of Cambodia's disease reporting system contained in Dr Han Hoogendijk's final project report. Access to this report had very kindly been offered by SLPP project leader Dr Dirk Van Aken, and was expected to be available in August 2009. Additionally, SLPP disease surveillance data would be available to our project by October 2009. (Dr Van Aken and Dr Hoogendijk both attended our 2009 Annual Project Meeting).

This plan was based on previous meetings and email discussions between Project Manager Jim Kerr (DAFWA) and Dr Hoogendijk about disease reporting in Cambodia, which had suggested similar findings from each project. Dr Hoogendijk was epidemiologist for the SLPP.

- Anecdotal disease reports gathered from traders would be compared with the monthly disease reports sent to the DAHP by the POAHP officers in the provinces to give some indication of the level of disease reporting by the provinces.
- Dr Tum Sothyra was nominated to assist the project in assessing disease reporting in Cambodia on behalf of the DAHP. His DAHP role as head of the Veterinary Public Health Office, combined with his very relevant PhD research, made him an appropriate choice for this task (particularly as our NaVRI project team already had their hands full in completing the 6 existing data collection activities).

Laos

- The Lao team would lead Activity 1.3.1 in Laos with initial tasks of:
 - assembling examples of provincial disease reports (monthly reports, outbreak reports)
 - forwarding by email examples of actual disease investigation / report forms (Specimen Submission forms)
 - conducting a literature review for any existing assessment reports that might be available at the NAHC and DLF offices in Vientiane.
- Contact with Dr Bounlom Douangngeun, Director of the National Animal Health Centre (NAHC), and Dr Joanna McKenzie (FAO consultant) was to be maintained in order to obtain FAO's assessment and recommendations regarding disease surveillance and reporting in Laos.
- Features of the reporting system that needed to be described included:
 - the reporting pathways from district to NAHC (DLF) and to the Ministry of Agriculture and Forestry (MAF) (existing vs. desired)
 - who receives the data, and what is done with it (DLF records, OIE reports etc)
 - what recording system (database) is used (TADinfo, ARAHIS etc)
 - combined use of movement records and disease surveillance data at NAHC.
- We would honour SEACFMD's request that we investigate the reasons for under-reporting in both Cambodia and Laos.
- A copy of Laos's Veterinary Law was to be provided when the English translation was available.

Activity 1.3.2: Risk pathways

Activity 1.3.2: 'Risk pathways' was intended to 'Analyse risk pathways for FMD and CSF', and be completed by late in 2009. However, project partners decided at the Annual Project Meeting in March 2010 that the results of this activity were sufficiently promising that it should be continued throughout the life of the project. This recommendation was subsequently supported by the Project Review in August 2010.

The 2010 Annual Project Meeting and Project Review in 2010 were also used to obtain outside opinion about which trade routes should be prioritised for risk assessment. Transboundary movement pathways were consequently selected due to their potential for spreading disease rapidly across the region.

The project used the spread characteristics of FMD within the risk models, and chose to focus on the movement pathways for cattle and buffaloes, rather than pigs, for the following reasons:

- Our time and resources were limited.
- Cambodia and Laos are exporters of cattle and buffalo (and the associated disease risk), possibly giving us the opportunity to trace some movements to their source and obtain important prevalence-at-origin data (a major determinant of disease risk).

- Cambodia and Laos are importers of pigs, mainly from Thailand and Vietnam, limiting our access to information about the origin of the pigs and associated disease prevalence.
- The commercial pig industry in Cambodia and Laos is the main recipient of non-slaughter pig imports, and they appear to be better educated about (and far more attentive to) biosecurity than their counterparts in the cattle and buffalo trade.
- The pathways chosen featured unofficial crossing of borders by walking or swimming animals across the 'green border', a practice not suited to pig movements.
- Assessment of FMD risk was of particular interest to the neighbouring countries which we were trying to engage in this research (especially China and Vietnam). The results would also be of particular value to the SEACFMD campaign.
- Recent FMD outbreaks in Cambodia and Laos appeared not to involve pigs to any significant extent.

An important feature of our methodology in attempting Activity 1.3.2 was to encourage interest and participation from neighbouring GMS countries by providing training in risk assessment. To that end, the project co-hosted a 'Risk Pathway Workshop' at the 2009 Meeting of the Lower Mekong Working Group for FMD (LMWG), held in Ho Chi Minh City on 25th November 2009.

This event gave project staff the opportunity to discuss our research findings with senior staff from Vietnam's Department of Animal Health (DAH), who were in the process of developing livestock importation protocols through bilateral talks with their colleagues in Cambodia. Interest sparked at this training workshop finally led to the project's collaborative research with the DAH in southern Vietnam in 2011. This research investigated the Vietnamese end of those transboundary market chains which deliver cattle and buffalo across Cambodia's border into Vietnam. The outcomes are described in Section 7 and in Appendix 6. Livestock value chain expert Ms Nancy Bourgeois Lüthi was engaged by the project to manage this research. Nancy had many years experience in Vietnam and Laos, and undertook risk pathway research for us in both countries.

Although the countries neighbouring Laos and Cambodia were not written into the project as partners, the 2010 Project Review encouraged our desire to expand our risk assessment activities into these countries, recommending that:

'An important direction for the project to evolve in is to develop a regional focus which engages the major trade players in south-east Asia including Vietnam, China and Thailand. Failure to involve these key countries removes the ability of researchers and policymakers to view the trader routes on the macro scale in which they occur.' (ACIAR, 2010)

Consistent with the Review's recommendation and regional attempts to increasingly engage China in regional disease control initiatives, the project provided funding and support for Chinese PhD student Ms Chang Cai and her risk assessment research in China. Part of this support was to fly her to Australia to receive additional training in risk analysis at a workshop run by the project at Murdoch University in January 2011. Her subsequent description and risk assessment of livestock pathways leading into China is summarised in Section 7 of this report, and included in more detail as Appendix 8.

Project efforts to elucidate trade routes and disease risk pathways into China have also involved training visits by project staff, described under Activity 1.4.1 (Technology transfer) in Section 6.

Details of the risk analysis components are provided in Appendix 3.

Activity 1.4: Technology transfer

The original aim of this activity was 'to develop and institutionalise a sustainable information resource capable of providing movement and disease risk data to key stakeholders and decision makers'. Because this objective turned out to be unrealistic, Activity 1.4 was revised to focus on:

1. training GMS countries in the project's online data management and reporting systems
2. training GMS countries in risk analysis
3. developing educational materials for livestock traders, depot operators, and VVWs/VAHWs in order to reduce disease risk by improving the standards of biosecurity practised.

The methodology for these tasks required development and delivery of customised training and training materials, as described in Sections 5, 6 and 7 of this report under each of these individual activities.

Activity 2.1: Non-regulatory interventions

Our research with livestock traders in Cambodia and Laos (Activity 1.2.1: 'Working with traders') specifically assessed trader recognition, understanding and attitude towards several important livestock diseases.

After analysing the information gathered from livestock traders, a nation-wide series of feedback meetings was conducted for traders and other stakeholders throughout each country early in 2010 to present our research findings *and to canvass trader opinion about possible measures to reduce the risk of disease spread associated with livestock trading*. The results of the feedback meetings in Laos are included as Appendix 11.

Activity 1.2.1 and the subsequent feedback meetings indicated that whilst many livestock traders had a poor understanding of disease prevention measures (biosecurity) and used trading practices that carried a high risk of spreading animal diseases, they were overwhelmingly enthusiastic to receive education and training about these issues.

Biosecurity education was consequently identified as the most promising non-regulatory intervention for the project to trial within Activity 2.1. Educational materials designed to teach traders how to prevent disease spread (biosecurity) were subsequently produced in Laos and trialled with trader focus groups in Xieng Khouang province during mid-2010. A variety of formats were developed for these materials, including colour booklets, posters, leaflets and digital stories. Digital stories deliver their message by spoken word superimposed over illustrative photographic images, making them a valuable extension tool for groups with limited literacy. Although their use requires a DVD player and TV (or at least a large screen computer), the increasing availability of such technology in Lao villages is making them a feasible extension option.

The Australian and Lao staff from ACIAR Project ASEM/2005/125: *Extension Approaches for scaling out livestock production in Northern Lao PDR (EASLP)* greatly assisted by training our own project staff in digital story making and guiding the production of the initial version

Feedback about the draft educational materials was also sought from project partners at a project meeting in Siem Reap in August 2010, and from DLF representatives of all Lao provinces at a workshop in September 2010.

Ongoing trial and feedback-driven refinement of these materials continued during 2011 and during the project extension in 2012. A description of the project's biosecurity materials and their content is featured in Section 7 of this report, with several products (English-language versions) featured in Appendix 14. All of our educational products are available at the project website: <http://ulm.animalhealthresearch.asia/>

6 Achievements against activities and outputs/milestones

| Activity | Outputs/Milestones | Assessment |
|---|--|--|
| Objective 1: To understand livestock movement patterns to predict the risk of disease spread. | | |
| Activity 1.1: To develop a quantitative description of actual livestock movement patterns (including both legal and illegal movements) in a number of defined study areas and time periods | Quantitative data sets, maps and report on livestock movements based on: <ul style="list-style-type: none"> Existing data in Laos and Cambodia (e.g. official movement permits) NLIS in Australia Trader interviews Animal tracking | Existing data sets (movement permits) in Cambodia and Laos were not suitable for retrospective analysis. While historical data were available, these were in paper format, and were not consistent with data needs. NLIS data have been analysed and impacts on disease spread and reporting published elsewhere. Trader interviews were successfully conducted in both countries. Separate reports are available. Animal tracking was not fruitful. Although villager cooperation was high, movement numbers were smaller than anticipated and tracking analyses not practical. |
| Activity 1.1.1 Retrospective movement study (using existing records) | <ul style="list-style-type: none"> Datasets obtained (Cambodia, Laos, Australia) Data summary produced | Limited success due to lack of suitable existing movement records prior to project initiation in 2007. |
| Activity 1.1.2 Prospective movement study | <ul style="list-style-type: none"> Gov. sources of data identified / developed Gov. reporting and data entry systems developed Quantitative movement data obtained from trader interviews Data sources analysed and compared Results delivered to stakeholders (various forums) | <ul style="list-style-type: none"> Data collection and submission arrangements were made with provincial offices of our partner departments in Cambodia and Laos by mid-2008. Training had also been provided for project staff and provincial departmental staff in both countries by mid-2008. Data collection from livestock traders was completed by late 2009. Results were delivered to stakeholders by: <ul style="list-style-type: none"> Presentations at meetings for traders and departmental staff throughout each country Presentations at regional meetings including LMWG, UMWG, and OIE Sub-commission for FMD Presentations to Bachelor and Master degree students at the Royal University of Agriculture, Phnom Penh Biannual project newsletters. <p>This activity basically achieved its goal of obtaining sufficient movement records on</p> |

| | | |
|--|--|--|
| | | <p>which to undertake an analysis, but:</p> <ul style="list-style-type: none"> • provision of data from some provinces was poor, despite payment, requiring ongoing efforts to collect missing data • data verification was still necessary to validate the data quality • official movement records (permits) are not a sustainable data source as the system presently operates in Cambodia and Laos. |
| <p>Activity 1.1.3 Animal tracking study</p> | <ul style="list-style-type: none"> • Paper identifying alternative strategies and selecting the most appropriate. • Equipment procured. • Data collected, analysed and reported. | <p>Alternative animal identification strategies were detailed in several discussion papers and teleconferences held April – September 2008.</p> <p>Attempts to develop a rumen tracking device containing a GSM transmitter did not proceed beyond the initial Australian design phase.</p> <p>The animal tracking activity was attempted in Laos in collaboration with ACIAR Project AH/2006/159: <i>Best practice health and husbandry of cattle and buffalo in Lao PDR</i>.</p> <p>Data capture (ear-tag recording) was attempted at strategic official road checkpoints, a border crossing point into Vietnam from Xieng Khouang province, slaughterhouses (bounty incentive scheme).</p> <p>This activity was NOT successful in Laos because:</p> <ul style="list-style-type: none"> • The rate of turn-over of cattle and buffalo by smallholders is very low, meaning that our: <ul style="list-style-type: none"> ○ sample size (1500 in 6 villages) was too small ○ study duration (12 months) was too short. • Livestock are often transported at night, making ear-tag detection at checkpoints difficult and unlikely. <p>This activity was NOT attempted in Cambodia because:</p> <ul style="list-style-type: none"> • The DAHP considered ear-tagging not to be acceptable to farmers and traders, and other forms of identification to be too impermanent • No opportunity was available for collaboration with ACIAR Project AH/2005/086: <i>Best Practice Health and Husbandry of cattle in Cambodia</i>. |
| <p>Activity 1.2: To identify the social, cultural, economic, biological and environmental drivers of livestock movement, and quantify the impact of a limited number of key</p> | <ul style="list-style-type: none"> • Quantitative (e.g. market price) and qualitative (e.g. social and cultural) datasets. • A report describing livestock trading and movements in Cambodia | |

| | | |
|---|---|---|
| indicators in order to predict movement patterns. | <p>and Laos, nominating factors that influence movements.</p> <ul style="list-style-type: none"> • Mathematical description of the relationship between indicators and movements. • Report quantitatively evaluating relationship | |
| <p>Activity 1.2.1 Working with traders</p> | <ul style="list-style-type: none"> • Field staff / consultants recruited and trained. • Questionnaires and other data collection methods developed and refined. • Databases developed to suit data collected • Trader data analysed and incorporated into Activities 1.1, 1.2, 1.3 and 2.1) • Reports on trader practices/networks progressively produced and disseminated to stakeholders (including SEACFMD) | <p>Consultants were employed to manage this activity in Cambodia and Laos.</p> <p>Non-DAHP researchers used questionnaires to gather data in confidence in Cambodia, whilst a less formal checklist approach was used in Laos (where the DLF was present as translator at all times).</p> <p>Cambodian data was compiled in SPSS format, and will be made freely available (ensuring anonymity of respondents) to all researchers on the project website during 2012.</p> <p>This activity achieved good results, which were valued by major stakeholders including SEACFMD and FAO. These results contributed to Activity 1.1 (Movement and prices study), Activity 1.3.2 (Risk pathways) and Activity 2.1 (Risk reduction interventions). Reasons for success included:</p> <ul style="list-style-type: none"> • Capable consultants engaged, who applied proper planning and activity management • Good cooperation / facilitation by DAHP (Cambodia) and DLF (Laos) • Collaboration with FAO/SEACFMD cross-border movement study |
| <p>Activity 1.2.2 Population dynamics study</p> | <ul style="list-style-type: none"> • Field staff recruited and trained. • Recording forms and databases established • Data collected and analysed (+/- postgraduate student involvement) • Village-level sociological data extracted and incorporated in Activity 1.2.1 report. • Population Dynamics study report generated for each country | <ul style="list-style-type: none"> • This activity was undertaken in six Lao villages in collaboration with ACIAR Project AH/2006/159: <i>Best practice health and husbandry of cattle and buffalo in Lao PDR (as with Activity 1.1.3)</i>. • In Cambodia, this activity used study villages in Takeo province that had previously cooperated with PhD research by Tum Sothyra. • Recording forms were created for recording monthly village data in both countries. The Lao data was recorded in an 'Access' database, whilst an Excel spreadsheet was used by the Cambodian DAHP. • This activity was successful in recording local population dynamics in both Cambodia and Laos, but the results confirmed (as with Activity 1.1.3) that turn-over and movement of livestock by smallholders is infrequent, meaning that a considerably larger sample size and longer study duration would be |

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| | | <p>required to generate useful movement data.</p> <ul style="list-style-type: none"> • The records may be useful in identifying findings for investigation by other projects, (such as the strikingly low reproductive rate in the Cambodian villages). • The Population Dynamics datasets may represent suitable material for analysis by students engaged in epidemiology-based post-graduate degrees. The project will consequently continue to make all project databases available to other researchers in accessible formats at the project website until at least 2017 in order to increase the value of the data collected. |
| <p>Activity 1.2.3 Market prices study</p> | <ul style="list-style-type: none"> • Sources of market prices identified. • Reporting system developed. • Data collected & analysed. | <ul style="list-style-type: none"> • This activity suffered from some of the same challenges that affected Activity 1.1.2, including: <ul style="list-style-type: none"> • inconsistent cooperation from the provinces • lack of a uniform format for reporting prices • failure to identify a sustainable source of market price data (such as routine newspaper or radio reports; routine data collection by Department of Commerce, Trade or similar). |
| <p>Activity 1.2.4: Predict movement patterns</p> | <ul style="list-style-type: none"> • Report of analysis | <p>Movement patterns were identified through trader discussions, including estimates of volume of trade. Attempts to identify high correlation predictors were unsuccessful (although price was a partial predictor). Movement pathways were highly volatile, with small changes in exchange rates causing rapid changes in movement patterns – although the direction of the change was not readily anticipated.</p> |
| <p>Activity 1.2.5: Evaluate predictions</p> | <ul style="list-style-type: none"> • Report of evaluation study. | <p>Not applicable (see above).</p> |
| <p>Activity 1.3: To combine predicted movement patterns with livestock disease surveillance information to predict the temporo-spatial risk of spread of livestock diseases through livestock movement.</p> | <ul style="list-style-type: none"> • Report evaluating available disease outbreak surveillance data • Report of disease risk pathways for the two target diseases. • Mathematical / GIS tool to predict temporo-spatial risk of disease outbreaks. • Evaluation of risk predictions | |
| <p>Activity 1.3.1: Disease reporting</p> | <ul style="list-style-type: none"> • Report evaluating existing reporting systems in Laos and | <p><i>'Existence of adequate basic disease surveillance capacity'</i> in Cambodia and Laos was listed as a <i>'Risk / Assumption'</i> for Activity</p> |

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| | <p>Cambodia.</p> | <p>1.3 in the Project Document, as access to reliable disease prevalence data was a prerequisite for development of the project's predictive computer model.</p> <p>Our evaluation of disease reporting (and investigation) in Cambodia and Laos indicated that it is presently so weak that it undermined the feasibility of our project's aim to develop and institutionalise an early warning system for TAD threats.</p> <p>The 2010 Project Review recommended that <i>'the project not pursue the evaluation of the disease reporting systems in Laos and Cambodia as these reports are not central to the delivery of current project objectives'</i>.</p> |
| <p>Activity 1.3.2 Study of risk pathways</p> | <ul style="list-style-type: none"> • Report of pathway analysis for FMD and CSF | <p>Project partners and the 2010 Project Review concluded that this activity had generated important findings and should be extended until the end of the project.</p> <p>Quantitative computer modelling using the scenario tree technique was applied to several international trade routes in order to assess the disease risk associated with these pathways. As expected, the major output was an indication that more data is required, especially regarding disease prevalence at each consignment's point of origin.</p> <p>Of more immediate use was the qualitative assessment of the disease risks associated with the practices of traders, VVWs / VAHWs and livestock depot operators, which have led to the development of biosecurity education materials for each of these groups in Activity 2.1.</p> <p>This activity also attracted the interest and involvement of animal health authorities in neighbouring countries, particularly Vietnam and China. Collaborative research with the Vietnamese DAH ensued, identifying critical points where the disease risk associated with imported livestock could be reduced.</p> <p>Collaborative risk assessment research with the Yunnan Animal Science and Veterinary Institute (ASVI) through a Chinese PhD student at Murdoch University was a notable project achievement. Subsequent Chinese interest in risk analysis has led to training visits by project staff, and represents one of our more successful efforts at 'Technology Transfer' (Activity 1.4.1) in response to 'User Needs' (Activity 1.4.2).</p> |
| <p>Activity 1.3.3: Create risk maps</p> | <ul style="list-style-type: none"> • Pilot spatial risk system developed. | <p>Data were unsuitable for specific risk mapping. However, from regional reporting data it was possible to construct spatial maps of disease reporting. On an assumption of FMD being endemic in the region, maps of inferred under-</p> |

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| | | reporting were produced. These maps have been presented to SEACFMD, form part of Dr Ben Madin's PhD thesis, and were published in 2011. |
| Activity 1.3.4: Validate risk predictions | <ul style="list-style-type: none"> • Report of validation. | As above. Validation requires time and resources beyond this project. However, acceptance of the outbreak reporting analyses mentioned above in a peer-reviewed journal (Preventive Veterinary Medicine) is indicative of validity. |
| Activity 1.4: To develop and institutionalise a sustainable information resource capable of providing movement and disease risk data to key stakeholders and decision makers | <ul style="list-style-type: none"> • Workshop report with an assessment of the feasibility of developing a regional information resource. | |
| Activity 1.4.1: Regional technology transfer | <ul style="list-style-type: none"> • Project presentations at LMWG/UMWG/Sub-comm. Meetings • Regional technology transfer workshop (or multiple country workshops) conducted – workshop report(s). • Country projects implemented and monitored; progress reports included in 'synthesis' workshop report. • Regional synthesis workshop conducted – workshop report. | <p>'Technology Transfer' was originally intended to involve training participants from GMS countries in the project's computer systems for data management and predictive modelling of livestock movements and animal disease.</p> <p>Because the sources of data required to support the model turned out not to be available, this activity was revised to focus on:</p> <ol style="list-style-type: none"> 4. training GMS countries in the project's online data management and reporting systems 5. training GMS countries in risk analysis 6. developing educational materials for livestock traders, depot operators, and VVWs/VAHWs in order to reduce disease risk by improving the standards of biosecurity practised. <p>Outputs:</p> <ol style="list-style-type: none"> 1. On the project's behalf, AusVet Animal Health Services continues to work with the FAO on developing a computer system for regional livestock identification and movement management (Asian Livestock Identification and Traceability System – ALIATS). 2. The project co-hosted a Risk Pathway Workshop at the 2009 Meeting of the LMWG in Ho Chi Minh City in November 2009, which led to collaborative risk pathway research with Vietnam's DAH during 2011. <p>The project ran a risk analysis training workshop for project staff and several Asian PhD researchers at Murdoch University in January 2011, including</p> |

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| | | <p>Chinese student Chang Cai. This training workshop generated a risk assessment of the livestock transit pathways running from Thailand to Vietnam through Cambodia. A paper describing this risk assessment was presented at the 2011 OIE Sub-commission Meeting, and is attached to this report in Appendix 9.</p> <p>The project pursued the opportunity to develop risk assessment skills in China by providing further risk analysis training for Chang Cai and staff at the Yunnan Animal Science and Veterinary Institute (ASVI) in June 2011. The results of Chang Cai's risk assessment of livestock trade pathways entering China are summarised in Appendix 8.</p> <p>3. The educational materials developed by the project to improve the biosecurity applied by livestock traders and VAHWs are described under Activity 2.1.</p> |
| Activity 1.4.2: User needs | <ul style="list-style-type: none"> • Survey results – paper on preferred system design | User seminars/workshops provided feedback on the system that has been developed (ALIATS), which covers all and more of the current user needs (i.e. the system caters for future developments). While a high level of enthusiasm was evident from the regional participants, implementation is questionable. |
| Activity 1.4.3: Prototype system | <ul style="list-style-type: none"> • Pilot system implemented. | As above: actual implementation is very slow. While end users would readily implement the system, bureaucratic machinery is not directed towards change of the magnitude required for implementation. |
| Objective 2: To investigate possible interventions to minimise disease spread through livestock movement | | |
| Activity 2.1: To investigate the feasibility of novel (non regulatory) interventions to minimise livestock movements which pose a risk of disease spread and to minimise the risk of disease spread through existing livestock movements. | <ul style="list-style-type: none"> • A shortlist of candidate interventions selected for feasibility assessment / pilot studies. • A report identifying research issues that must be resolved prior to trialling nominated interventions. | |
| Activity 2.1.1: Select interventions | <ul style="list-style-type: none"> • Short-list of non-regulatory interventions (supported by rationale and feasibility assessment) | Research with traders (Activity 1.2.1) and risk pathway analysis (Activity 1.3.2) identified a number of serious biosecurity weaknesses that could be addressed to reduce the disease risk associated with livestock movements within Cambodia Laos and across their borders. |
| Activity 2.1.2: | <ul style="list-style-type: none"> • Research priorities | The same research found that many of the |

| Identify key research issues | reported | |
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| <p>Activity 2.1.3: Report and support recommendations for trial interventions</p> | <ul style="list-style-type: none"> • Reports on recommended interventions delivered to stakeholders by mid-2010 • Support provided to stakeholders attempting to implement TAD control interventions during the life of project (until Oct 2011) • Plans/recommendations for ongoing intervention support (beyond Oct 2011) submitted to funding bodies planning future TAD control projects in the GMS. | <p>market chain stakeholders who influence disease risk (particularly traders, VVWs/VAHWs, depot operators, and trading companies) were very interested in receiving biosecurity education in order to reduce this risk.</p> <p>Consequently, biosecurity education was selected by the project as the primary non-regulatory risk reduction intervention to pursue, supported by the 2010 Project Review. The Cambodian DAHP and Lao DLF supported this initiative.</p> <p>Khmer and Lao language biosecurity training booklets and posters for traders and VAHWs were developed, trialled, refined and printed for distribution during 2010-12.</p> <p>Additionally, the project believed that official protocols for cross-border livestock movements could be improved if policy-makers were provided with:</p> <ul style="list-style-type: none"> • Research findings re risk assessment of current and alternative practices • Industry opinion about what aspects of the existing official protocols make them unjustifiably expensive and time-consuming. <p>The project consequently undertook risk pathway research during 2011 with Vietnam's DAH to investigate the market chain for cattle and buffalo imported from Cambodia, and initiated plans for a 'border meeting' of Vietnamese and Cambodian traders involved in the transboundary livestock trade between the two countries.</p> <p>A no-cost project extension was agreed by ACIAR and the project partners in order that these initiatives could continue to be developed until 30th June 2012, after which they will be adopted and further developed by ACIAR Project AH/2010/046: <i>Domestic and international market development for high-value cattle and beef in South East Cambodia.</i></p> |

7 Key results and discussion

Activity 1.1.1 & Activity 1.1.2: Quantitative movement studies

Few retrospective records of animal movement were available in Cambodia and Laos. The movement data collected during 2008-2009 was combined with the limited existing data that could be obtained, providing a final data set of 15 741 movements involving 381 000 animals between 2004 and 2010. The key findings were that the underlying current of regional cattle and buffalo trade had changed from movement to the south (Malaysia) and west (presumably Thailand initially, but anecdotally also Malaysia) to a clear pattern of movement to the east (Vietnam), and in some cases north (China).

Conversely, analysis of cattle movement data collected in Australia for the period July 2005 to June 2008 was relatively straightforward. Just under four million records of individual animal movement were extracted from the WA database and analysed for trends and network characteristics. Significant variation occurred by season, and quite distinct locations were identified for high risk of disease spread and detection.

Data collection in Cambodia and Laos using office based Microsoft Access databases was unpopular due to the need to rely on USB flash drives to transfer data between offices. The role of USB flash drives as non-clinical carriers of highly virulent computer viruses is not unknown¹. It was similarly difficult to distribute updated versions of the database. The project's web based interface for recording animal movements was much safer and easier to maintain and provide consistency, but lack of internet availability in many parts of the project countries limited its utility. Attempts to collect data in Cambodia using SMS reports relayed to the project's computers were limited by unreliable power supplies at the new office of the Department of Animal Health. Although SMS reports could be received (due to latency in the SMS system) the lack of timely response and concerns over funding and distribution of phone credit were impediments to consistent uptake. Ultimately the most successful approach was to obtain (either by mail or facsimile) the original copies of the movement permits and pay a dedicated data entry person to enter this data. In some cases this also required a personal visit to the provincial office to obtain the copies of the permits. Although effective, this approach is not a solution to the project objective of creating a sustainable system.

More detail of the results from these activities is recorded in Appendix 4 of this report.

Activity 1.1.3: Animal tracking study

The outcomes of this activity are recorded in Section 6 and Appendix 1 of this report.

Results of Activity 1.2.1: 'Working with traders'

This was the project's most rewarding and productive research activity. Our use of different data collection techniques with traders generated the following observations about their comparative merits.

¹ http://www.paretologic.com/resources/newsletter/usb_drives_spreading_viruses.aspx (accessed 310812)

Presence versus absence of departmental staff:

In both Cambodia and Laos, arranging research events such as trader meetings will often require the approval and facilitation of relevant officials from central and provincial governments. However, using non-departmental researchers to conduct one-on-one interviews preceded by an assurance of confidentiality seemed to generate the most open (possibly self-incriminatory) responses from traders.

The possible inhibitory effect of departmental presence at such meetings was noted at one of our first trader meetings in Cambodia, in Kampong Cham province in July 2008. When responses were sought from the whole trader group prior to one-on-one interviews taking place, some of the traders specifically requested that departmental staff leave the room so that they could freely discuss their grievances about unjustified costs and delays associated with following official procedure for livestock movements.

In Cambodia, at least, the inhibitory influence within such meetings was not only due to the presence of government staff. At a trader meeting in Phnom Penh, also in July 2008, the responses from the trader group to questions about unreasonable costs and controls during the morning session were muted. During the afternoon session, the traders were far more forthcoming, owing to the departure at lunchtime of a representative of one of the three powerful, private trading companies which control all import and export movements in Cambodia.

We were fortunate to become aware of these considerations and influences early in our data collection program in Cambodia, and attribute much of our subsequent success with this activity to having engaged a knowledgeable, savvy Cambodian consultant to manage this activity. His research experience, understanding of Khmer culture and politics, and good relations with DAHP personnel due to his previous employment with that organisation placed him in an unusually good position to generate valuable research results for the project. In summary, ***engaging good project staff*** might be the most important 'methodology' of all.

Data collection by questionnaire versus group response:

In order to achieve responses that can be quantified and analysed, questionnaires (if well designed) have an advantage over group responses. The trader questionnaire used by the project in Cambodia is included as Appendix 2.

Overview of results:

The project consultants were successful in describing the major trade routes for cattle, buffalo and pigs in Cambodia and Laos, particularly those transnational pathways which represent the greatest risk of spreading transboundary diseases rapidly between countries (Figure 7.1). The researchers were also able to quantify the trade volumes across these major routes during the study period (2008-2009), as featured in Figure 7.2.

Some of the more significant livestock trading and movement patterns in Cambodia and Laos during the study period are described below. Although these patterns already appear to be changing, the research also generated less ephemeral information about trader networks, trading practices and the trading environment (including geographical, seasonal, political and regulatory influences). This information was used to identify interventions aimed at reducing the disease risk associated with livestock trading.

Livestock movements in Cambodia 2008-2010

Cambodia presently produces cattle and buffalo for consumption in Cambodia and for export to Vietnam. Generally speaking, Cambodian cattle and buffalo are directed to different slaughter markets according to body condition and quality. Vietnam appears to be the market for the best quality animals, followed by Phnom Penh, with provincial

slaughterhouses the destination for animals of a lower standard. The poorest quality animals, including the injured and diseased, are slaughtered locally.

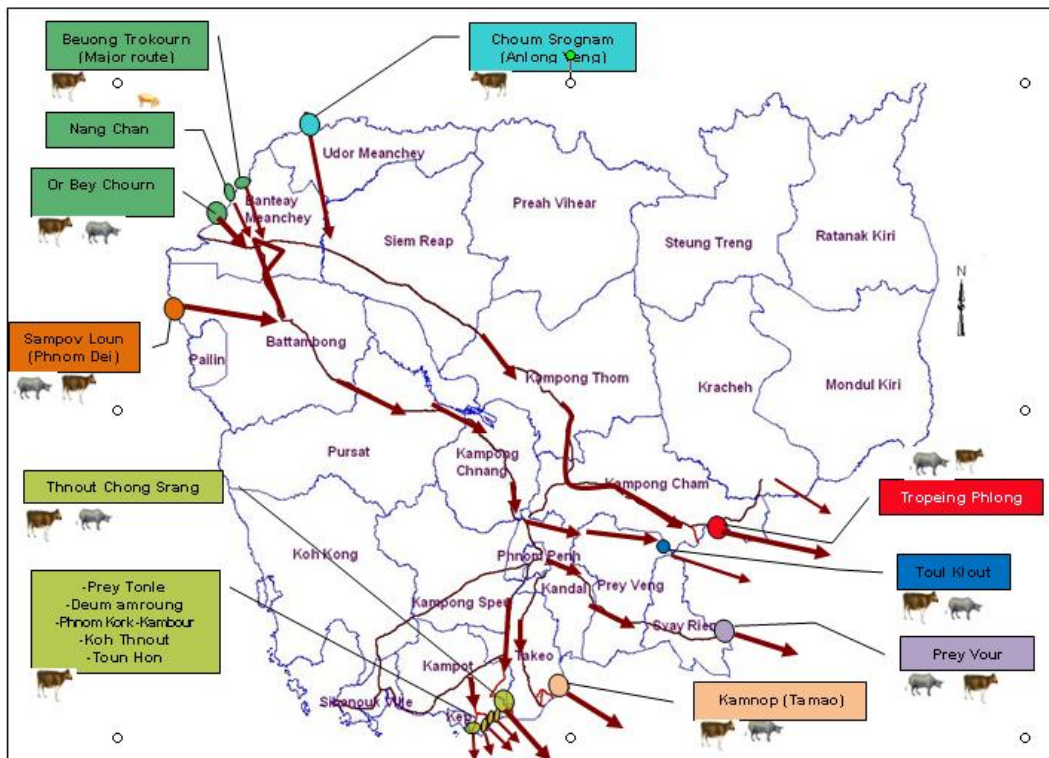


Figure 7.1: Transit routes for cattle and buffalo moving from Thailand through Cambodia into Vietnam

The movement of cattle and buffalo from Cambodia into Vietnam is an unofficial (but sanctioned) trade comprised mainly of organised trade via export depots, but also involving some village-level trade in the vicinity of the border.

Cambodia also acts as a conduit for cattle and buffalo moving from Thailand to Vietnam. During 2009, this transit trade involved the movement of 200-300 truckloads of cattle and buffalo per month, representing up to 150,000 head for the year. By mid 2010, this trade had declined to 100 truckloads per month, highlighting the variability of movement patterns. Project research in Cambodia and Vietnam during 2011 (refer to Activity 1.3.2 for a more complete description of results) suggested that a proportion of these ‘Thai’ transit cattle originated in Myanmar during the height of the transit trade, possibly influencing the risk pathways for transboundary livestock diseases across the region.

Transit movements through Cambodia are rapid, with most animals travelling in less than a day from the Thai border across Cambodia to export depots located close to the Vietnamese border in the south-eastern Cambodian provinces of Kampong Spea, Kampong Cham, Kampong Spea, Takeo, Svay Rieng and Kampong Cham (Figure 7.1). Once the transit livestock arrive in the Cambodian export depots, they may wait several hours to several days before being walked into Vietnam. Contact between various livestock consignments in these depots may be a significant feature of the disease risk pathways. Consequently, improved biosecurity practices or other interventions at these depots may represent an opportunity to significantly reduce (or at least assess) the disease risk associated with the livestock trade into Vietnam. (Please refer to Activity 1.3.2 for a more complete description of our findings).

Cambodia is an importer of pigs, with Vietnam and Thailand the main suppliers. In recent years, however, Cambodia has imposed importation bans on pigs from Vietnam due to

concerns about disease incursions. These import bans significantly altered movement patterns and pig population dynamics within Cambodia during 2008, with pig populations in some provinces greatly depleted in the attempt to meet market demand in Phnom Penh. Pigs are still imported from Thailand to meet the slaughter market demand in Phnom Penh and Siem Reap.

Livestock movements in Laos 2008-2010

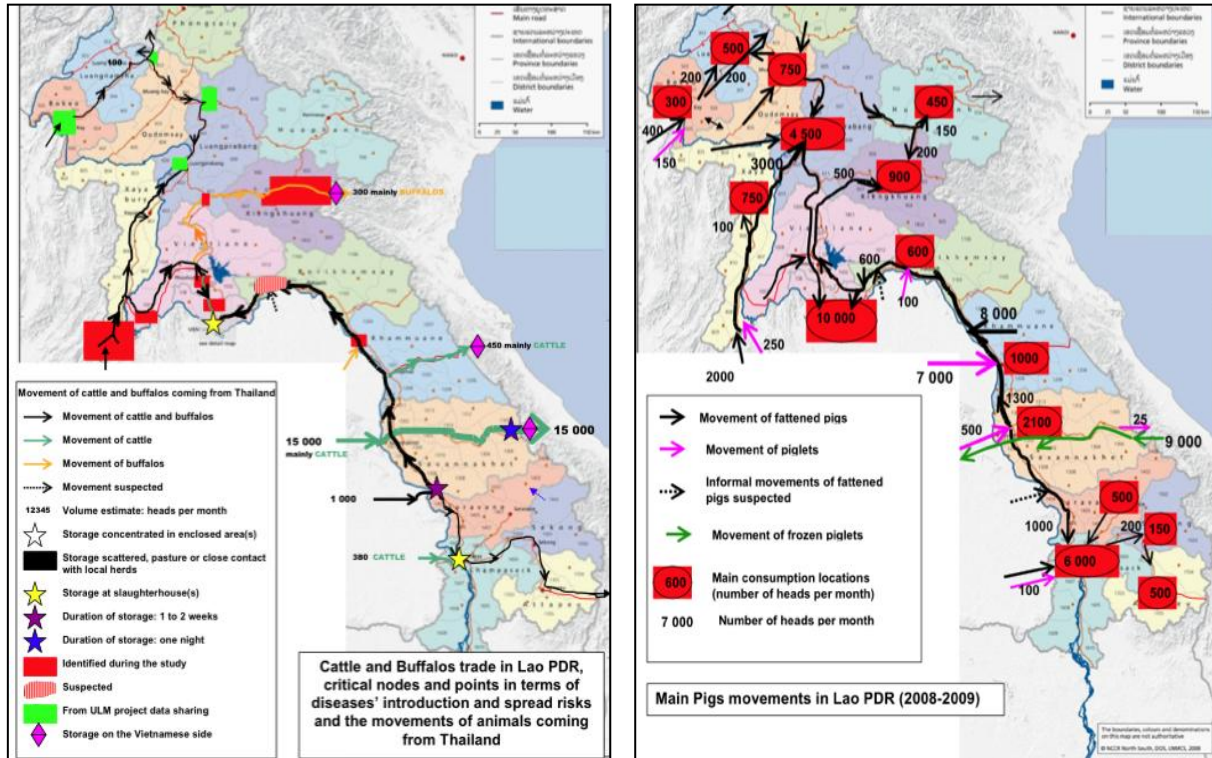


Figure 7.2: Trade routes and volumes in Laos for cattle and buffalo (left) and pigs (right)

Laos is both an importer and exporter of cattle and buffaloes, and a transit country for livestock destined for Vietnam and (more latterly) China. Quotas of Thai cattle are imported through various provinces to satisfy the slaughter demand in Vientiane capital, which is also serviced by home-grown livestock from northern Lao provinces including Sayabuli, Luang Prabang and Xieng Khouang.

The north-eastern province of Xieng Khouang is important as a production area for cattle and buffalo and also as an export pathway for Lao and imported livestock moving into Vietnam. Most of the cattle and buffalo (and horse and goat) trade into Vietnam through Xieng Khouang is unofficial. This trade pathway was estimated to represent 2500-3000 head of cattle (60%) and buffalo (40%) per month during 2008-2009, of which 10% were thought to have originated in Thailand. Some of the livestock movement pathways that exit Laos through Xieng Khouang stretch from the southern, western and northern provinces of Laos, and feature a number of transaction and storage locations along their length. As with the Cambodian export depots, these locations represent both high risk points for disease transmission and potential opportunities for application of risk reduction strategies.

Significant transit movements of cattle were reported through southern Laos from Thailand into Vietnam, particularly the movement of up to 15,000 head of cattle per month through Savannakhet province during 2008-2009 (see Figure 7.2). This particular movement reportedly had official approval from the Thai and Lao authorities, but required

unofficial entry into Vietnam, highlighting the difficulty of understanding regional livestock movements by examining official records.

Early in 2010, increased rapid movement of cattle from Thailand through north-western Laos into China was reported as an increasing trend. The project revisited Laos' north-western provinces in 2011 to investigate this so-called 'rapid transit pathway' in 2011 as part of our risk analysis of specific trade routes (Activity 1.3.2). The results are summarised under Activity 1.3.2, and provided in detail in Appendix 7.

As with the transit cattle trade through Cambodia into Vietnam, a varying proportion of the cattle and buffalo entering Laos from Thailand reportedly originate in Myanmar.

Like Cambodia, Laos is a net importer of pigs. A limited number of fattened pigs are imported from Thailand for slaughter, but imports from Thailand mainly take the form of piglets for fattening on Lao farms. The locations of highest demand for pig meat in Laos are the capital, Vientiane, Luang Prabang in the north, and Pakse in the south.

Other important results

Market chains and trader networks were described in both countries (Figures 7.3 and 7.4).

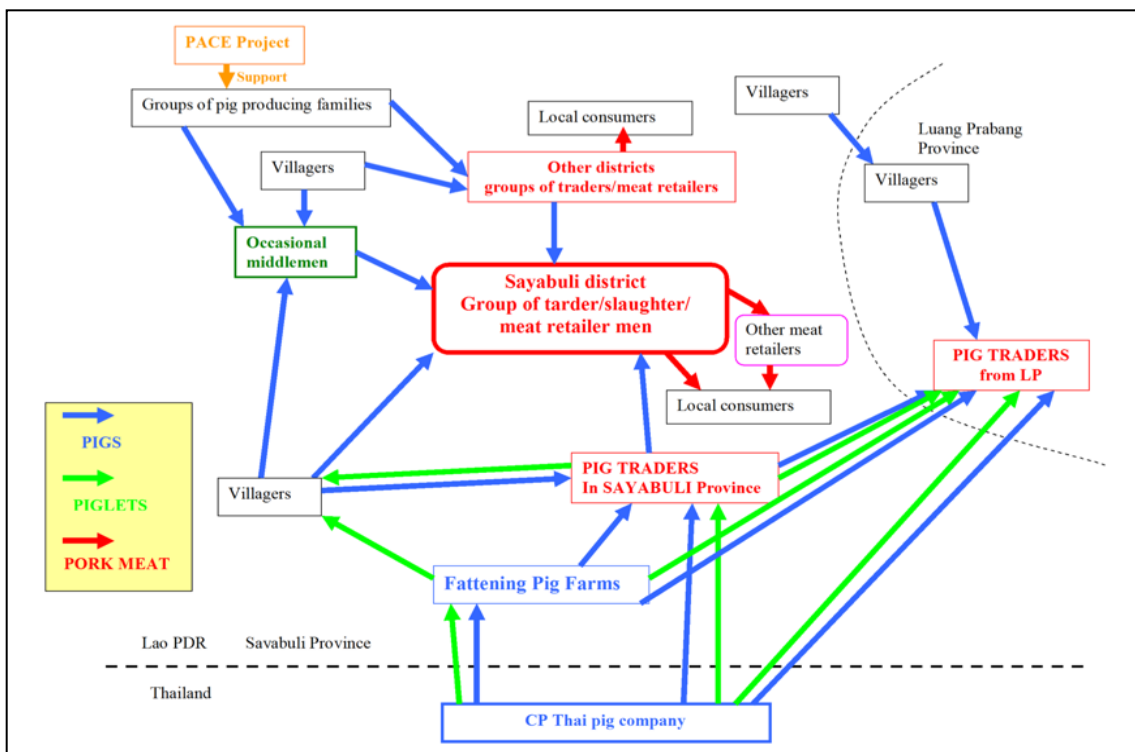


Figure 7.3: Market chain for pigs, Sayabuli Province, Laos

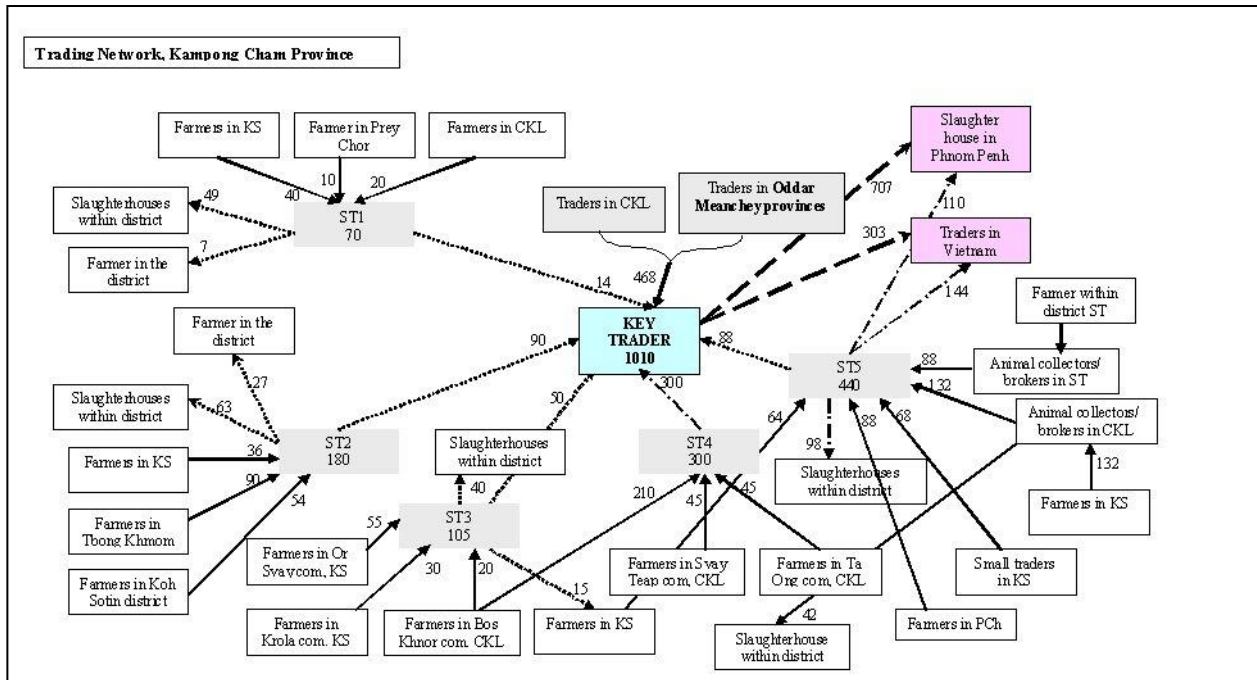


Figure 7.4: Trader network for cattle and buffalo in Kampong Cham province, Cambodia. ‘ST’ indicates a ‘secondary trader’, and numbers refer to the numbers of stock traded annually. Solid lines indicate the number of stock *bought* by secondary traders, and dashed lines and dotted lines indicate the number of stock *sold* by secondary traders (dotted lines represent sales up to 90 head, dashed and dotted lines indicate sales of 90-300 head). Bold dashed lines represent sales by key traders of more than 300 head.

One-on-one interviews with livestock traders identified trading practices that carry a high risk of spreading disease. 45% of Cambodian cattle and buffalo traders interviewed admitted to having traded in livestock affected with Foot-and-Mouth Disease (FMD), as the low prices accepted by farmers for sick animals can make them a profitable commodity for traders. Many of these sick animals are purchased for local slaughter, but some are kept for recovery and re-sale. In either case they represent an important feature of FMD spread within and between villages, given the common trader practice of housing them after purchase with other livestock in the trader’s village prior to re-sale or slaughter.

Fortunately, many livestock traders were keen to receive information about disease transmission and biosecurity, offering hope that trader education might modify high-risk practices engaged in through lack of awareness.

Discussion

Importantly, our research with traders identified a number of critical points along the trade pathways where interventions might be attempted to reduce the risk of disease spread. These critical points included:

- physical features of the trade pathways, such as the small number of livestock depots located in South-eastern Cambodia, through which all transit cattle from Thailand must pass before entering Vietnam (Figure 7)
- important stakeholders with the ability to influence the trade (risk) pathways, such as the small number of Cambodian trading companies that facilitate most livestock trade across Cambodia’s borders
- trading practices used by livestock traders which carry a high risk of spreading livestock diseases.



Figure 7.5: Livestock depots in South-eastern Cambodia for export of cattle and buffalo into Vietnam

Our research into unofficial movements, particularly the livestock trade moving across the borders of Laos and Cambodia into Vietnam, found that the busy unofficial pathways are often located in close proximity to the unused official border crossing points. Significantly, the unofficial payments made to border officials to permit illegal border movements are similar to the costs of following the official pathway. Our investigations into what drives trader preference for the unofficial route found that the *additional time associated with official border crossing protocols (which may include a mandatory 14 day quarantine period) makes them an uneconomic proposition*, as traders are often financed by short-term, high-interest loans. Additionally, there is often a lack of adequate affordable fodder for livestock detained in border quarantine stations. These animals are often in poor condition after long-distance movements, and suffer a considerable loss of weight and value during the prolonged quarantine period. These quarantine detention periods are particularly hard to justify for slaughter stock.

This information is contributing significantly to risk pathway analysis for Foot-and-Mouth Disease in the GMS, the outputs of which are intended to assist the development of animal movement policy in the region. The results of the project’s risk analysis of the transit trade routes for cattle through Cambodia are featured in Appendix 9, and risk analysis of several trade routes entering China are included in Appendix 8. Disease risks associated with the livestock market chains entering Vietnam from Cambodia and Laos are described in Appendices 6 and 7 respectively.

Opportunities have been identified for improved biosecurity practices and risk reduction interventions at various points along the risk pathways for these diseases. Ongoing work with livestock traders is fundamental to these proposed interventions.

The project developed and trialled educational materials in various formats to improve trader understanding of disease transmission and basic biosecurity. This work is described under Activity 2.1 and in Appendix 12, and examples of the educational materials are featured in Appendix 14.

Activity 1.2.2: Population dynamics study

The outcomes of this study are recorded in Section 6 of this report.

Activity 1.2.3: Market prices

During the period January 2008 to February 2010, 1 534 reports of provincial market prices were collected as shown in Table 7-1.

Table 7-1: Number of provincial market price reports by country and species

| | Buffalo | Cattle | Pig | Total |
|-----------------|---------|--------|-----|-------|
| Cambodia | 232 | 292 | 325 | 849 |
| Laos | 304 | 276 | 105 | 685 |
| Total | 536 | 568 | 430 | 1534 |

Data covered a period of 25 months in Cambodia, and just over 22 months in Laos. Each report could contain between 1 and 60 individual prices for various combinations of age, sex, condition and (for pigs) animal breed.

Data submission in Cambodia was affected by misunderstandings over the financial arrangements for the provision of these data.

The development of a data collection system using the Short Message Service (SMS) available on all modern mobile phones was trialled. This system allowed SMS reports to be relayed directly to the project’s computer database, offering an opportunity to capture data more rapidly, cheaply and without the need for data to be re-entered. However, the limited number of characters per message (160 ASCII characters) and high cost of sending messages to numbers outside the country also presented some challenges. Additionally, the large variety of livestock types meant that consistency was an issue.

We concluded that use of SMS to gain market price information is not immediately applicable, requiring tighter definition of livestock categories, or reporting on fewer categories to make SMS viable.

Initially, data were used to construct isoplethic maps (Figure 7.6) to evaluate the effect of price on movement of livestock. However, the complexity of data collection and evaluation made this task too cumbersome for practical application, and preliminary results did not indicate a close correlation between price differentials and livestock movements. Further research is warranted to clarify these relationships.

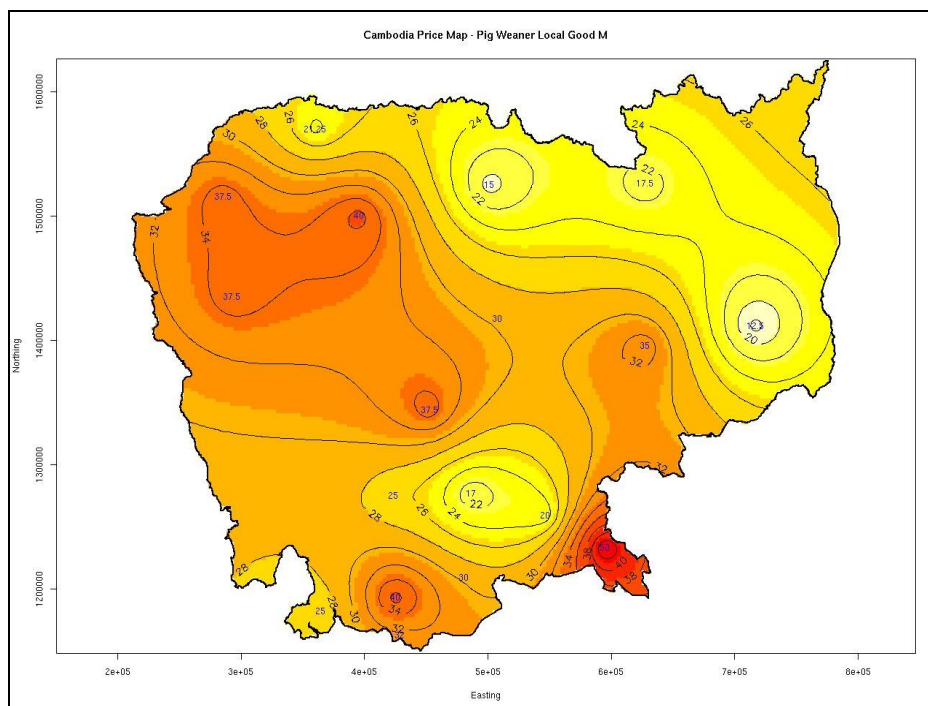


Figure 7.6. Price isopleths for weaner pigs in Cambodia (Jan 2008 – Feb 2010)

Activity 1.2.4: Predict movement patterns

The outcomes of this activity are recorded in Section 6 of this report.

Activity 1.2.4: Evaluate predictions

The outcomes of this activity are recorded in Section 6 of this report.

Activity 1.3.1: Disease reporting

Summary

The importance of disease reporting in achieving the project's objectives is demonstrated diagrammatically in Figure 7.7:

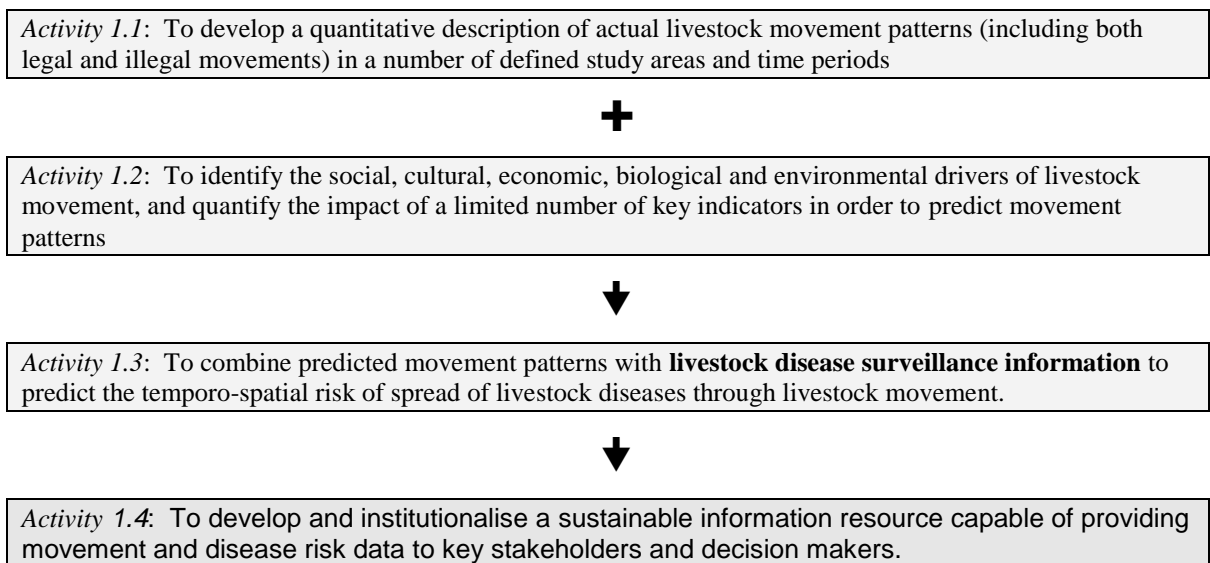


Figure 7.7: Steps in achieving Objective 1:

As described in Section 6 of this report, our evaluation of disease reporting and investigation in Cambodia and Laos indicated that it is presently too weak to support the project's aim of developing and institutionalising an early warning system for TAD threats.

The specific project findings that contributed to that assessment are described in Appendix 10, which also contains an assessment of disease reporting in Cambodia from the Final Report of the EU-funded **Smallholder Livestock Production Programme**.

Activity 1.3.2: Risk assessment of major trade routes

Project partners and other stakeholders assessed all project activities at the project's Annual Meeting in March 2010 (Vientiane, 12-13 March 2010) for the purpose of deciding which activities deserved to become the focus of our efforts during the final two years of the project life-cycle. An independent Project Review in August 2010, requested by project management to obtain an objective assessment of the most valuable direction for the project to follow, endorsed the conclusions of the 2010 Annual Meeting.

Consequently, three activities became the focus of project research in 2010-2011:

1. Risk assessment of several major transboundary trade routes running through Cambodia and Laos (Activity 1.3.2: Risk pathway analysis)
2. Development and trial of biosecurity education materials for livestock traders and other stakeholders (Activity 2.1: Non-regulatory interventions to reduce risk of disease spread)
3. Continued efforts to interest neighbouring countries in project-funded training in the project's computer systems for managing animal movement data (Activity 1.4.1: Regional technology transfer).

Risk assessment of trade routes

The information collected for Activity 1.2.1 ('Working with traders'), some of it collected in collaboration with the *FAO ADB and OIE SEAFMD Study on Cross-Border movement and market chains of large ruminants and pigs in the Greater Mekong Sub-Region (Cocks et al., 2009)*, identified important trade routes running through Cambodia and Laos and across their borders.

Some of these trade routes were largely transit pathways, whereby cattle and buffalo from Thailand and Myanmar were transported rapidly across Cambodia and Laos to destination markets in Vietnam and, more recently, China. Several of these transit pathways were ear-marked for further research due to their potential to rapidly move livestock (and consequently spread disease) across several countries in as little as 24 hours. Transit pathways nominated for further project research included:

1. the transit routes delivering Thai cattle and buffalo to southern Vietnam via Cambodia.
2. the route transporting cattle and buffalo from Thailand to central Vietnam via Savannakhet province in Laos
3. the so-called 'fast-track' route delivering cattle from Thailand (and reportedly Myanmar) to China through Laos' north-western provinces of Bokeo and Luang Namtha (reported for the first time early in 2010)

Features of these risk pathways that the project particularly aimed to investigate included whether these movement pathways also posed a risk of disease introduction to local livestock populations in Cambodia and Laos, and conversely whether local livestock populations in Cambodia and Laos had the opportunity to contribute a disease risk to the transiting livestock by inclusion in, or contact with, the transiting consignments.

The project also attempted to gather quantitative data about the important trade pathway for cattle and buffalo (and horses and goats) which enters northern Vietnam through the Lao province of Xieng Khouang. Whilst this trade route certainly includes cattle and buffalo originating in Thailand (and probably Myanmar), it also delivers a significant number of homebred livestock from various Lao provinces into Vietnam, so it cannot be considered merely a 'transit' pathway. Consequently, it is a complex pathway to analyse for disease risk. Our efforts to record trade volumes across this unofficial border pathway over a 12 month period (see Section 5, Figures 5.2, 5.3 and 5.5) were unrewarding, despite paying official road checkpoints and village 'smugglers' to do so. Consequently, we elected not to attempt a quantitative risk assessment of this transboundary trade route.

Most of the project's risk assessment work was attempted at a qualitative level, and was intended to identify opportunities to reduce the disease risk associated with these transboundary trade pathways (Activity 2.1.1).

The project recognised that these particular trade routes could not be considered a permanent feature of livestock movements in the region. The movement patterns which we reported in 2008/2009 were considerably different from those described a few years earlier, which featured, for example, movement of cattle and buffalo to the southern

provinces of Cambodia for export to Malaysia by ship. By 2010 the movement patterns which we had described in 2008/9 were already changing again, with a greatly reduced number of Thai cattle moving to Vietnam.

However, the project considered that certain aspects of the transboundary trade, particularly the identity of the major stakeholders and the practices of the traders, transporters, depot operators and other participants were likely to be less ephemeral, and therefore valuable to research for the purposes of identifying longer term risk reduction strategies.

For reasons described in section 5 of this report, the project chose to focus on the movement pathways for cattle and buffaloes, rather than pigs.

1. Trade route delivering cattle and buffalo into southern Vietnam from Cambodia

Our research of movement patterns suggested that Vietnam was the destination for most transboundary cattle and buffalo movements involving Cambodia and Laos. Vietnam was therefore also the recipient of the associated disease risk. We shared these findings with Vietnam's Department of Animal Health (DAH) at a Risk Pathway Workshop hosted by the project at the 2009 Meeting of the LMWG, held in Ho Chi Minh City on 25th November 2009.

The DAH was very interested in these findings, and enthusiastic to work with the project to better assess the risk pathways for transboundary livestock diseases that lead into Vietnam. Consequently, although Vietnam was not included as a project partner during the original design of this project, two research trips were undertaken by the project in collaboration with Vietnam's DAH in February and June 2011 in order to investigate the Vietnamese end of the livestock market chains (and associated risk pathways) that run through Cambodia into Vietnam.

This research was expected to complement similar research conducted for the *FAO ADB and OIE SEAFMD Study on Cross-Border movement and market chains of large ruminants and pigs in the Greater Mekong Sub-Region* (Cocks et al., 2009) in northern Vietnam in 2009, which described the Vietnamese end of the livestock market chains entering Vietnam through Laos. To maintain continuity of methodology and take advantage of existing research relationships, the project engaged the same consultant who had undertaken the market chain research for the FAO ADB OIE study, Ms. Nancy Bourgeois Luthi. Ms Bourgeois Luthi, who is based in Laos, was also contracted to undertake further research of the Savannakhet and Bokeo/Luang Namtha transit pathways for Activity 1.3.2 (Risk pathway analysis), in collaboration with our Lao project partners, the DLF.

Cambodian section of the transboundary risk pathway

The project's research to investigate risk pathways in Cambodia was managed by project consultant Socheat Sieng, facilitated by our DAHP partners and the Provincial and District Offices of Animal Health and Production (POAHP and DOAHP respectively). This arrangement was recommended by the 2010 Project Review, where our DAHP Project Leader and National Advisor agreed that their departmental workload left them with insufficient time to properly manage this activity themselves. Socheat, although an independent consultant with dual Australian and Cambodian nationality, had the distinct advantage of having previously been employed by the DAHP. Consequently, he had an excellent working relationship with our DAHP partners, an intrinsic understanding of how things operated in Cambodia, and a veterinary and epidemiological background which

was invaluable in investigating the disease risks associated with the livestock trade in Cambodia.

Socheat was also responsible for all information collected from livestock traders in Cambodia in Activity 1.2.1 ('Working with traders'), using a team of researchers to deliver a questionnaire in confidential one-on-one interviews (see Appendix 2). The results of this questionnaire also represented the initial stages in risk assessment of the livestock market chain in Cambodia, as the questions were designed to identify trading practices with an associated risk of spreading livestock diseases. Socheat was subsequently also enlisted by the *FAO ADB and OIE SEAFMD Study on Cross-Border movement and market chains of large ruminants and pigs in the Greater Mekong Sub-Region* (Cocks et al, 2009) as their Cambodian National Consultant, and his combined work for these two projects generated valuable descriptions of the major trade routes which operated in Cambodia during the study period.

Consequently, Socheat was ideally placed to undertake more detailed research of particular features of the disease risk pathways associated with Cambodia's major transboundary livestock trade routes (Activity 1.3.2), with the aim of identifying opportunities for risk reduction interventions (Activity 2.1).

Cambodian livestock depot operations

A significant research finding was the fact that each of the important trade routes which deliver cattle and buffalo from Cambodia into southern Vietnam features an 'export depot' in Cambodia close to the border with Vietnam.

Because animals from different consignments can have close contact in these depots, or share troughs and pens recently vacated by previous consignments, these depots represent a critical point for disease spread (and possibly control) in the transboundary risk pathways for various contagious diseases, including FMD.

The cattle and buffaloes which are delivered to these Cambodian depots originate in Thailand, Myanmar, and various parts of Cambodia. Those animals which enter Cambodia from Thailand are walked across the Thailand-Cambodia border after being selected for purchase by Cambodian and Vietnamese traders at Thai markets and farms located close to the border. The animals are then loaded onto trucks in the north-western Cambodian provinces of Banteay Meanchey, Battambang and Oddar Meanchey and transported across Cambodia in a single journey of less than 24 hours. There is usually a single stop at a midway point for the purpose of inspection by animal health authorities. This 'inspection' stop is for the purposes of checking paperwork rather than animal health, and the animals are not unloaded, so it appears to have little bearing on the disease risk posed by the consignment.

The transit trade routes run diagonally across Cambodia from the northwest to the southeast and terminate in export depots located in five Cambodian border provinces: Kampong Cham, Prey Veng, Svay Rieng, Takeo and Kampot. The depots are used as staging points for the final, unofficial movement of livestock across the border into Vietnam. The animals are generally delivered to the depots by truck, and are then walked and/or swum across the border into Vietnam, depending on the location of the depot and time of year.

The transit routes, including entry and exit points/provinces in Cambodia, are shown in Figure 7.8.

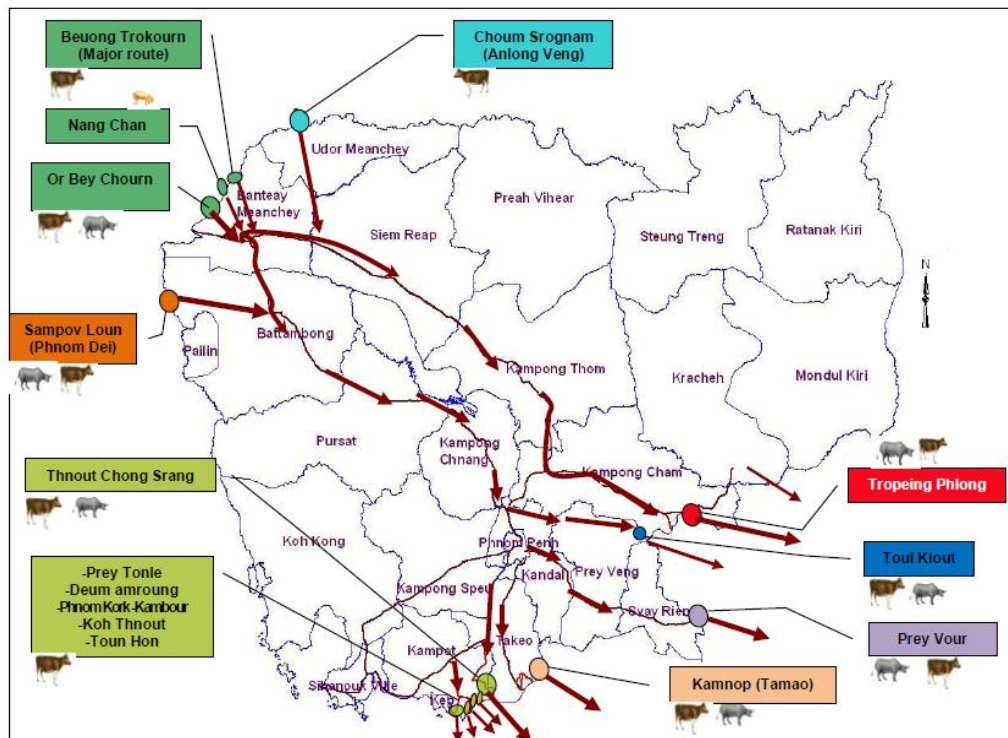


Figure 7.8: Transboundary trade routes passing through Cambodia (2007-2011)

The first of these export depots was established in 2006/7, and most have only been in existence since 2008. The majority of the livestock moving through them were originally Thai cattle permitted entry into Cambodia only for transit to Vietnam (i.e. it was not permitted that these animals be retained in Cambodia). This transit trade peaked in 2008, when as many as 45,000 head per month reportedly moved from Thailand into Cambodia via Or Bey Chourn in the Cambodian province of Banteay Meanchey province, destined for Vietnam (see Figure 7.8). Project research at the Vietnamese end of this market chain suggests that a proportion of these 'Thai' animals originated in Myanmar, but that the majority were genuinely of Thai origin.

The vast majority of livestock handled by some of the Cambodian export depots during the peak of the transit trade in 2007/2008 was made up of transit cattle/buffalo from Thailand. Other depots featured a regular throughput of Cambodian livestock, representing an additional risk factor for introduction of disease into the market chain. Since the volume of Thai cattle has declined, however, all of the depots for which we have obtained information now include Cambodian-bred cattle in their export operations. Given that FMD vaccination of livestock in Cambodia is practised far less commonly than in Thailand, the increasing volume of Cambodian livestock being imported into Vietnam presumably adds to the transboundary disease risk which Vietnam imports as a result of this trade.

Other risk factors which our research has identified in the operations of the Cambodian livestock depots include the following:

- The mechanisms of disease spread and the associated biosecurity measures for disease control are poorly understood by depot managers and staff.
- Animals from different consignments/owners are sometimes mixed in the same pen.
- Consignments entering the depots have the opportunity for nose-to-nose contact with other consignments in the depot, even if the consignments are theoretically kept separate.

- Whilst consignments of Thai transit cattle are generally kept separate from consignments of local Cambodian cattle, they are sometimes mixed if owned by the same trader.
- There is no effort made to clean water troughs, discard partially eaten feed, or clean or spell pens between consignments.
- Trucks delivering livestock to depots sometimes have to drive through livestock holding areas to reach the unloading ramp, offering an opportunity for contamination of trucks (or by trucks) in the process.
- Cleaning of trucks is dependent on how dirty they have become, and is never accompanied by disinfection.
- Although traders aim to reduce the time spent by livestock in depots to a minimum in order to limit costs, consignments sometimes spend more than 4 days in the depot.
- Many depot staff have their own livestock at home, but have no understanding of biosecurity. They seldom make any effort to clean themselves before returning home after working at the depot, creating an opportunity for transmission of disease from transit consignments to local livestock populations. The reverse risk also exists: depot workers who arrive at work after handling sick local livestock may introduce disease into transit consignments.
- Cambodian farmers sometimes use the export depots as a 'market' for purchase of replacement breeding and draught animals.
- FMD is reported to have occurred in some depots, and is well known/recognised by all depot staff interviewed.
- Sick livestock in the depots (including FMD-affected animals) are sold to local traders to partially recoup losses. Occasionally Vietnamese traders buy these animals cheaply for slaughter in Vietnam.
- Local livestock populations have the opportunity for contact with export consignments in some depots.
- Local livestock populations in the vicinity of some depots have the opportunity for contact with export consignments as they are moved across local grazing areas during their walk to the Vietnamese border.
- Vietnamese traders generally have no particular animal health requirements, such as a preference for vaccinated animals or vaccination certificates.

Given that our research has identified that these depots are critical points in the disease risk pathways associated with the regional livestock trade, and that there are a limited number of these depots in operation, it seems feasible that non-regulatory risk reduction interventions might be attempted with this small stakeholder group with reasonable prospects of success.

Although the feedback from depot managers generally suggested that they would willingly participate in non-regulatory biosecurity training initiatives, the hesitant response from a couple of depots made it clear that proceeding with such initiatives would depend on obtaining approval from the well connected owners of these depots and the three large trading companies that 'regulate' this export trade. ACIAR Project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia* plans to pursue this opportunity for introducing improved biosecurity into the market chain for cattle moving between Cambodia and Vietnam.

Due to less favourable exchange rates, increasing transport costs and increasing scarcity of Thai livestock, the transit trade from Thailand became less profitable for traders and declined substantially during 2010. By early 2011 the trade via Or Bey Chourn was estimated to represent only 650 animals per month. Ongoing Vietnamese demand for beef has subsequently been met (at least partly) by importing an increasing number of juvenile Cambodian cattle, which are subsequently fattened for up to 12 months on Vietnamese farms prior to slaughter (described below, and in Appendix 6).

Vietnamese section of the transboundary risk pathways

As described in Section 5, livestock value chain expert Ms Nancy Bourgeois Lüthi was engaged by the project to work with Vietnam's Department of Animal Health (DAH) to investigate the Vietnamese end of those transboundary market chains which deliver cattle and buffalo across Cambodia's border into Vietnam. Nancy undertook two research trips in Vietnam in the first half of 2011, a detailed report of which is included as Appendix 6.

Whilst it appears that all Vietnamese provinces bordering Cambodia are involved in the cross-border trade of cattle and buffaloes to some extent, four provinces are reported to channel the highest volumes: An Giang, Kien Giang, Tay Ninh and Long An. Not surprisingly, these four Vietnamese provinces lie across the border from the Cambodian depots located Takeo, Kampot, Kampong Cham/Prey Veng and Svey Rieng respectively.

The geographical relationship between the Cambodian and Vietnamese provinces on which feature in the cross-border livestock, and their proximity to the large beef market of Ho Chi Minh City, is shown in Figure 7.9.

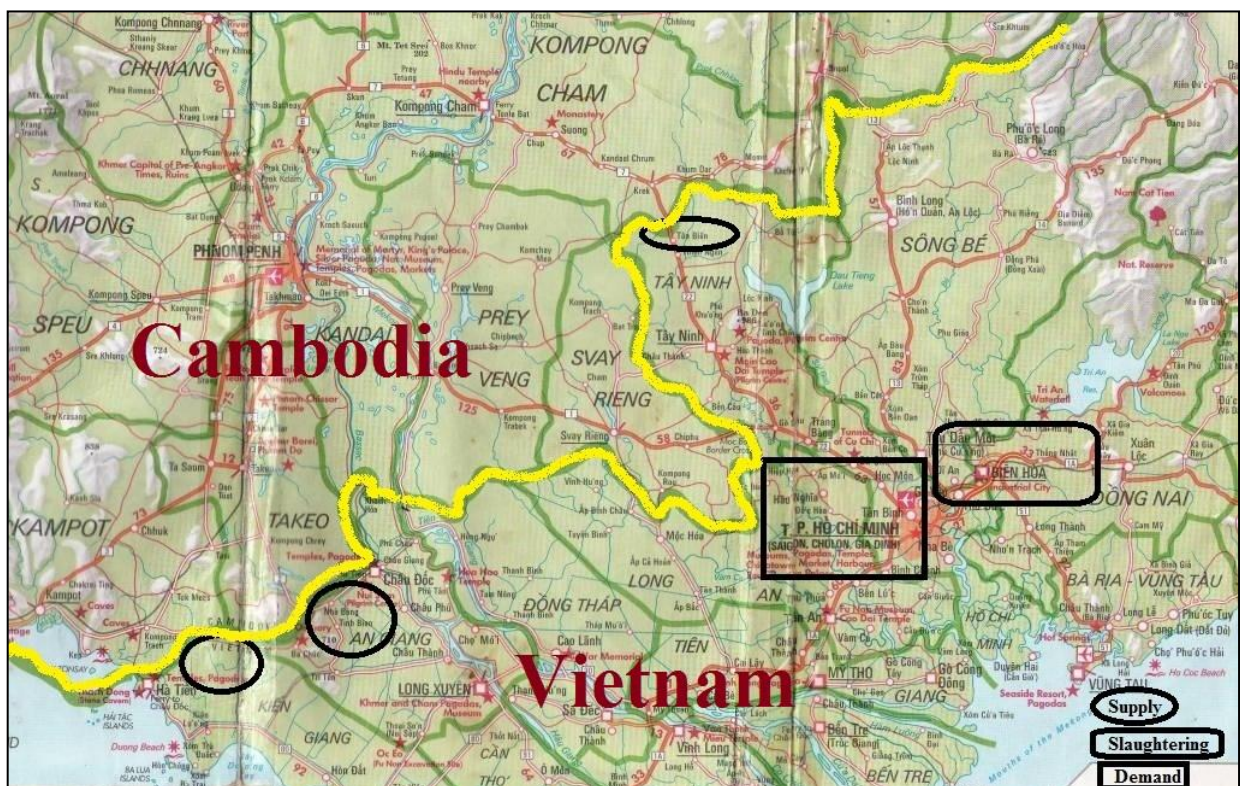


Figure 7.9: Location of Cambodian and Vietnamese border provinces featured in the cross-border movement of cattle and buffalo to service major markets for beef in southern Vietnam

Nancy's research confirmed that:

- the volume of Thai cattle and buffalo arriving in southern Vietnam via Cambodia peaked in 2008-9 and markedly declined in 2010-11
- an increasing trade has developed in juvenile Cambodian cattle for fattening in Vietnam.

Whilst this fattening scheme certainly involves Vietnamese border provinces, particularly An Giang province, many imported juvenile cattle are also distributed to other provinces in southern Vietnam for fattening. As none of the imported Cambodian cattle are likely to have vaccinated against FMD (unlike at least a proportion of cattle imported from Thailand), this growing trade represents a change in the disease risk to Vietnam associated with the cross-border trade.

Many of the cattle imports which enter Vietnam’s An Giang province from Takeo province in Cambodia are gathered at Ta Ngau Assembly Market prior to subsequent distribution to other locations. Vietnamese animal health authorities ensure FMD vaccination of livestock passing through this market, *but only for animals leaving the province*. Cattle retained for fattening within An Giang province wait for the free biannual FMD vaccination campaign in border provinces which occurs in April/May and September/October of each year. Our DAH research colleagues recognised this finding as a weakness in their disease control protocols and a valuable output of our collaborative risk pathway research.

The main reason offered by Vietnamese traders for the significant and rapid decline in the trade in Thai cattle and buffalo was unfavourable currency exchange rates, highlighting the narrow profit margins in this trade. Cambodian traders also blamed unfavourable exchange rates, in addition to increased transport costs.

It should be noted that DAH sources expected that our simultaneous risk pathway research in Laos would find that the decreased numbers of Thai cattle and buffalo imported via Cambodia would be balanced by a increased number entering Vietnam through southern Laos. This was not the case.

2. Trade route delivering cattle and buffalo from Thailand to central Vietnam via Savannakhet province in Laos

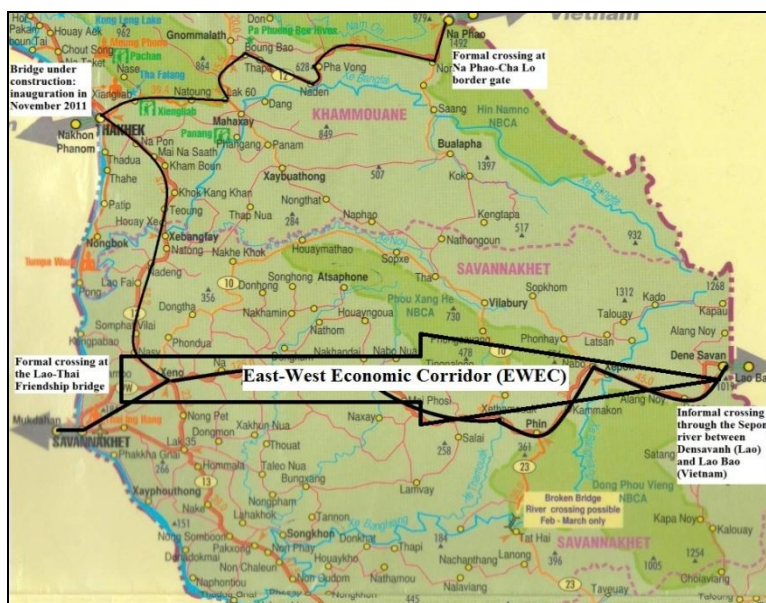


Figure 7.10: Transit pathway of cattle and buffaloes through Savannakhet and Khammouane provinces of Laos

Savannakhet province is situated in central Lao PDR along the East-West Economic Corridor (EWEC), a route extending over 1 300 km and linking the Indian Ocean to the South China Sea. Savannakhet has international borders with Thailand (Mukdahan province) along the Mekong River in the west and Vietnam (Quang Tri province) in the east (Densavanh / Lao Bao border gate) (Figure 7.10).

Project research in 2009 reported that cattle/buffalo movements through Savannakhet province from Thailand to Vietnam amounted to as many as 15,000 head per month. Project consultant Nancy Bougeois Luthi and Lao project Leader Phouth Inthavong revisited Savannakhet province in May 2011 in order to see if those trade volumes had been maintained (or increased, as expected by the Vietnamese DAH in Ho Chi Minh City), and to assess the border-crossing protocols applied at each of the two borders for risk of disease spread.

It was planned that our project partners in the Lao DLF would provide retrospective information about recent FMD outbreaks along this trade route in order that the disease risks associated with different border crossing protocols could be compared (unloading into export depots prior to border crossing versus direct transit across borders). Unfortunately, due to the more urgent, non-project workload required of our DLF project partners, the disease surveillance information was never provided, precluding our planned comparative risk assessment.

In summary, quarantine office records at the Thai-Laos Friendship Bridge border crossing indicated that the Savannaket transit trade in large ruminants had declined markedly from its peak in 2009 (up to 15,000 per month), and represented only 33,00 for all of 2010, and a mere 1,500 head for the first quarter of 2011.

The reasons offered by traders and officials for this decline were:

- Increased prices for Thai cattle due to shorter supply and unfavourable currency exchange rates
- floods in the Isaan region in eastern Thailand reducing availability of livestock.

A disease risk reported by this research was the fact that a proportion of the livestock granted importation permits by Lao authorities for the purpose of direct transit to Vietnam ‘disappear’ along the way, representing a possible threat of disease incursion. During the first few months of 2011, cattle and buffalo in all 15 districts of Savannakhet were affected by FMD outbreaks, but the Lao DLF did not provide us with their evaluation of the source of those outbreaks.

The complete report of this research is contained in Appendix 7.

3. So-called ‘fast-track’ route delivering cattle from Thailand (and reportedly Myanmar) to China through Laos’ north-western provinces of Bokeo and Luang Namtha

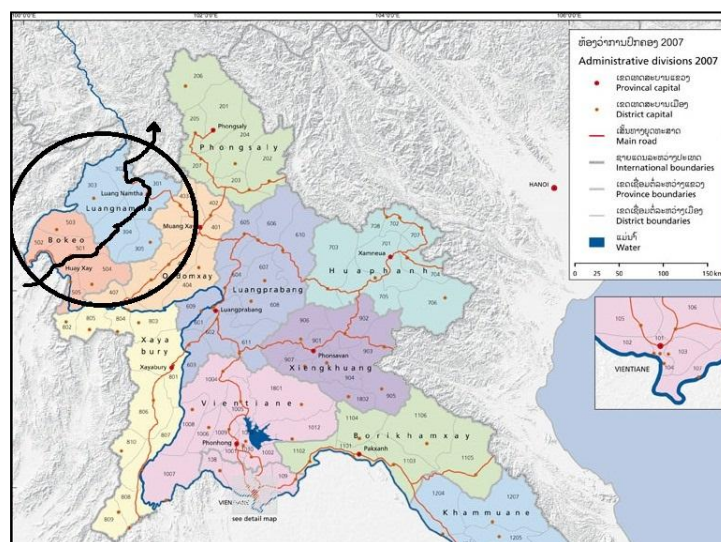


Figure 7.11: The main cross-border trade pathway for cattle and buffalo moving through north-west Laos from Thailand to China

Early in 2010 while conducting feedback meetings for traders in the north-west of Laos, project consultant Axelle Scoizec and Lao Project Leader Phouth Inthavong reported the following:

‘Chinese Large ruminants demand:

Chinese demand seems to have increased since last year. Now direct transit is officially done between Thailand and China through Bokeo and Luang Namtha

province. This movement is official in Thailand and Lao PDR but apparently the entry in China would be informal. The volume is about 300 to 400 heads per week.'

The project engaged Nancy Bourgeois Luthi to return to Bokeo and Luang Namtha provinces with Phouth Inthavong early in 2011 to investigate this cross-border trade, the 'fast-track' nature of which may have had implications for reducing the risk of disease spread associated with more protracted border crossing practices.

In summary, this research found that:

- The trade began in 2008, apparently to help satisfy demand created by the Beijing Olympics, and operated mainly between September 2009 and May 2010, and had ceased by late 2010.
- The trade volume was approximately 1600 head per month from October 2009 - September 2010, and was comprised mainly of Thai cattle, with some Lao cattle also sold into China.
- It was not a 'fast-track' movement, and the trade was not official.

The reasons for the cessation of this trade included:

- unfavourable exchange rates
- stricter bio-security measures taken by Chinese border officials
- scarcer supply of livestock in Thailand

In terms of disease risk associated with the trade pathways into China, transiting animals and/or itinerant traders were reported by one trader to be linked to FMD outbreaks in the north-western provinces and in Chinese depots, prompting stricter controls by Chinese authorities.

This research also suggested that this cross-border trade may well recommence when conditions become more favourable, highlighting the versatility of traders, who deal in commodities other than livestock when livestock are not profitable.

The complete report of this research is contained in Appendix 7.

Kampong Cham Case Study: Epidemiological features of an FMD outbreak

In August 2010, project managers were alerted to a spreading FMD outbreak in the Cambodian province of Kampong Cham. Project consultant Socheat Sieng was dispatched to Kampong Cham to record epidemiological features of this outbreak and the response of farmers and officials. This outbreak subsequently spread to most provinces in Cambodia by late 2010.

Our research found that disease spread within and between villages was aided by:

- Roadside tethering and communal grazing of livestock, practices which continued throughout the outbreak
- Movement, trade and slaughter of sick animals during the outbreak
- Inadequate understanding and application of biosecurity measures by Village Animal Health Workers (VAHWs).

This research confirmed that there is a pressing need for VAHWs to receive training in the biosecurity measures that should be applied in the course of their work. Unfortunately, the existing instruction booklet supplied to Cambodian VAHWs for investigation and treatment of FMD and Classical Swine Fever cases lacks adequate advice about personal biosecurity responsibilities.

The project consequently developed, trialled and printed a biosecurity training booklet for VAHWs, which will be promoted and distributed by the Cambodian DAHP and ACIAR Project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia*.

As a quantity of donated FMD vaccine was used in some Kampong Cham villages facing the onset of the outbreak, we also took the opportunity to undertake a crude assessment of vaccination effectiveness. Vaccination effectiveness was poor, drawing attention to weaknesses in the planning and management of the vaccination response, and highlighting again the parlous state of disease reporting and investigation in Cambodia.

The findings of this research are reproduced in full in Appendix 13, and we recommend them for consideration by the OIE in management of the proposed FMD vaccine bank in the GMS.

Activities 1.3.3 (Create risk maps) and 1.3.4 (Validate risk predictions)

The outcomes of these activities are recorded in Section 6 of this report.

Activity 1.4: Technology transfer

The outcomes of this activity are recorded in Section 6 of this report.

Activity 2.1 (Non-regulatory interventions)

Research findings

Project research during 2008 and 2009 identified a number of trading practices that carried a high risk of spreading animal disease, including the common and profitable practice of buying FMD-affected livestock at discounted prices during times of disease outbreak.

We found that trader attitude toward FMD is related to the scale of their trading activity. About half the local-level traders interviewed in Cambodia profit from availability of cheap livestock during FMD outbreaks. Higher-level traders involved in interprovincial and international movements, however, suffer considerable financial losses if FMD affects a consignment, as transactions may be cancelled sale prices discounted.

Fortunately, most traders were keen to receive education about disease epidemiology and biosecurity (i.e. how disease spreads, and how to prevent it spreading), as even the local traders who profit from disease outbreaks as a source of cheap cattle are keen to avoid infection of their own livestock, with which sick animals are often housed prior to slaughter or re-sale.

Traders requested that information about prevention of animal diseases be presented in a colour booklet with plenty of pictures and a minimum of text. In order to expand the audience to include those with limited literacy, it was decided to produce a digital story in addition to the booklet, as digital stories deliver their message by spoken word commentary accompanying video or DVD images. This technology had been developed and trialled with Lao PDR villagers by ACIAR Project ASEM/2005/125: *Extension Approaches for scaling out livestock production in Northern Lao PDR (EASLP)*, and represented a cheap and accessible source of information that could be easily distributed throughout Lao PDR and Cambodia.

The disease prevention message was distilled into a '**5-step**' *approach to biosecurity for traders* to routinely apply on all buying trips.

- | | |
|---------------|--|
| Step 1 | Before you go |
| Step 2 | On arrival at the village/farm |
| Step 3 | Before buying animals (inspecting animals and questioning owners) |
| Step 4 | When moving between farms and villages |
| Step 5 | When you return home |

The 5-step protocol was advocated for use as a **standard** approach to biosecurity, rather than being targeted specifically for FMD prevention. Because most animals affected by FMD recover from the disease, many traders (as well as smallholders and animal health staff) view FMD as being less important than more fatal diseases. Consequently, the biosecurity message had to be publicised as being effective in reducing the spread of highly fatal diseases such as Haemorrhagic Septicaemia (HS), rather than just FMD, in order to gain the interest of most traders. We were also conscious that any suggested biosecurity measures had to be simple and no- or low-cost to encourage voluntary compliance.

From early 2010 until mid 2012, the project trialled and refined booklets and digital stories aimed at improving the biosecurity practised by livestock traders in Laos (initially) and Cambodia. The simple '5-step' biosecurity message also proved suitable to feature on posters, which have consequently been produced for distribution in both countries. (The Cambodian poster is featured in Appendix 14). A more complete description of the development of the trader biosecurity materials can be found in Appendix 12.

These activities were managed in Laos by consultants Kate Blaszak, Malcolm Anderson and Nancy Bourgeois, supported by our Project Leader in Laos, Dr Phouth Inthavong of the Lao PDR Department of Livestock and Fisheries (DLF). In Cambodia, consultant Soheat Sieng managed this activity, facilitated by the Cambodian Department of Animal Health and Production (DAHP). The final English (template), Lao and Khmer language versions of these booklets, posters and digital stories are available at the project website: <http://ulm.animalhealthresearch.asia/> Examples are also featured in Appendix 14.

As described in the results for Activity 1.3.2 (Risk pathways) and in Appendix 13, our research also identified a pressing need for VAHWs to receive training in the biosecurity measures that should be applied in the course of their work. The project consequently developed, trialled and printed a biosecurity training booklet for VAHWs as part of Activity 2.1, which will be promoted and distributed by the Cambodian DAHP and ACIAR Project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia*.

ACIAR Project AH/2006/025 has laid the groundwork for biosecurity education to be further developed as a risk-reduction intervention by ACIAR Project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia*. Field research was undertaken with depot operators in the second half of 2011 with that specific intention. The ongoing development, trial and printing of biosecurity educational materials and guidelines for livestock traders and VAHWs during the first half of 2012 in a no-cost project extension was intended to ensure that these initiatives do not falter before ACIAR Project AH/2010/046 begins. These biosecurity education initiatives will then be further developed and expanded for a broader audience, which will include Cambodian farmers.

8 Impacts

8.1 Scientific impacts – now and in 5 years

Improved understanding of regional livestock movements

The 17th Meeting of the OIE Sub-Commission for Foot and Mouth Disease (FMD) in South East Asia and China was held on 7-11 March 2011 in Bali, Indonesia. That meeting endorsed a *revised* SEACFMD 2020 Roadmap, which provides a strategic framework and direction to achieve FMD freedom in South East Asia and China by the year 2020. The revised roadmap reflects an improved understanding of regional livestock trading patterns and practices in the GMS, to which ACIAR Project AH/2006/025 contributed. The success of our research with livestock traders is expected to encourage increased consultation with industry in data collection and policy development in the region.

Opportunity to influence vaccination strategies

The project undertook an opportunistic case study of vaccination effectiveness in two Cambodian villages in which donated FMD vaccine was used as a protective measure in the face of an advancing FMD outbreak in August 2010. Our research suggested that vaccination will not be effective unless it is properly planned and managed. It is hoped that our findings (reproduced in full in Appendix 13) will influence vaccination strategy in the region, and we recommend them for consideration by the OIE in management of the proposed FMD vaccine bank in the Greater Mekong Sub-region.

Disease reporting

The project has helped to highlight the critically poor standard of disease reporting and investigation in Cambodia and Laos, which is presently inadequate to support:

- predictive computer models which rely on up-to-date surveillance data
- effective response to disease outbreaks, including the use of donated FMD vaccine.

Regional vaccination strategies feature plans to focus vaccination efforts on disease 'hotspots', where disease reports suggest an increased incidence of FMD. The project's research, however, which involved payment of Cambodian and Lao provincial authorities for regular disease reports, identified reporting 'coldspots' as well as 'hotspots', and highlighted the need (and present inability) to discern whether the amount of disease reported from different parts of these countries genuinely reflects disease incidence or merely staff ability or preparedness to submit reports. Section 7 and Appendix 10 contain more detail of our assessment of disease reporting in Cambodia and Laos.

If other projects and funding agencies are subsequently prompted to address this fundamental weakness in regional disease control capability, our findings will have generated an important scientific impact.

The positive response by other researchers to project findings presented at recent international meetings such as the FAO/OIE Global Conference on Foot and Mouth Disease Control (Bangkok, 27-29 June 2012) and International Society for Veterinary Epidemiology and Economics (ISVEE 13 - Maastricht, 20-24 August 2012) has been encouraging.

Contribution to ACIAR publications

The project has contributed to the collaborative production of a joint publication with two other ACIAR research projects operating concurrently in Cambodia:

- *AH 2003/008: Improved feeding Systems to more effective beef cattle production in Cambodia*
- *AH 2005/086: Best Practice Health and Husbandry of cattle in Cambodia.*

The three projects have combined their research findings about large ruminant production and trade in Cambodia in an English-language ACIAR monograph intended for the international research & development community. It is hoped that a second publication will be produced using the outputs of these three projects: a Khmer-language manual on large ruminant production and health intended for district and provincial extension staff in Cambodia.

The project also contributed several papers for *ACIAR Proceedings No. 137, Animal biosecurity in the Mekong: future directions for research and development* (Adams et al, 2012), which is intended to assist future research in this region.

Technology transfer

The project's original 'Technology Transfer' goals were reassessed at the 2010 Annual Project Meeting in March 2010, where it was concluded that computer models designed to predict livestock movements and the associated risk of spread of livestock disease will not be a realistic prospect in the GMS until movement records (or market price data as an indicator) and disease reports are available in a reliable, accessible and sustainable format in Cambodia, Laos and neighbouring countries. This is not presently the case.

Nevertheless, elements of the project's computer technology, such as online data entry and management systems for livestock movement records with the ability to produce reports and maps, are likely to be valuable to various Asian animal health services. During 2011, AusVet Animal Health Services began working with the FAO's regional representatives in Bangkok to develop a regional computer system for managing livestock identification and movement data. This collaboration is building on Ben Madin's work from ACIAR project AH/2006/025 in pursuit of the project's initial objective: development of an 'information resource capable of providing movement and disease risk data to key stakeholders and decision makers' throughout the GMS.

A prototype livestock identification and traceability system has been developed. The system is called ALIATS (Asian Livestock Identification and Traceability System). This system was developed to illustrate a number of key design features primarily for communication with stakeholders during the process of seeking agreement for the implementation of a regional system. However it was also designed to represent the core of a fully operational high-capacity system. It is hoped that the development effort invested during prototype design will result in dramatically faster and less expensive implementation of a live operational system for use by countries in the region, when agreement to adopt a regional system has been achieved.

Recently, the ASEAN Sectoral Working Group on Livestock has discussed the implementation of such a system and is looking forward to progressing it in the next 12 months.

We remain hopeful that the project's computer technology can generate important livestock biosecurity impacts throughout the region by being adopted in animal movement management systems.

Risk analysis

The project co-hosted a Risk Pathway Workshop at the 2009 Meeting of the LMWG in Ho Chi Minh City in November 2009, where we presented the results of our research about the international trade pathways delivering livestock to Vietnam. Vietnam's Department of Animal Health (DAH) subsequently collaborated with project research to better understand the disease risk associated with these market chains in 2011. The results of this research are featured in Appendix 6, and it is hoped that the risk assessment approach promoted

by the project will increasingly influence the development of cross-border movement protocols which are being negotiated in ongoing bilateral talks between Cambodia and Vietnam.

The project also attempted to promote more widespread adoption of risk assessment and animal movement management systems for use in China by:

- providing ongoing training and support for Murdoch University PhD student Chang Cai, who attempted to assess the disease risks associated with the informal livestock trade into China from Myanmar, Laos and Vietnam (Appendix 8)
- providing risk analysis training at the Yunnan Animal Science and Veterinary Institute (ASVI) in June 2011.

8.2 Capacity impacts – now and in 5 years

- Data entry skills have been enhanced for provincial DAHP (Cambodia) and DLF (Lao PDF) staff at computer training workshops (Phnom Penh, Jan 2008; Vientiane, June 2008). Project staff in each country subsequently received ongoing technical support and training for data entry and management skills throughout the life of the project.
- The 4 Lao project staff members received English language training throughout 2009 and the first half of 2010.
- The Lao staff were trained in the making of 'digitised stories' during June and July 2010. A second project consultant spent time with the Lao project team in January 2011 to reinforce these skills and further develop the draft digital stories that had been created for traders in 2010. The project investigated this extension technique for delivery of disease biosecurity education to Lao livestock traders, and it is expected that the Lao staff will continue to apply this extension skill throughout their careers with the DLF.
- Cambodian project consultant Socheat Sieng received training at Charles Sturt University in digital story making in July 2010, and subsequently trained our Cambodian project officer in this skill.
- The project offered customised training in our computer systems for animal movement management to South-East Asian countries throughout the life of the project, using project newsletters, direct contact with animal health authorities, and regional meetings of the LMWG, Upper Mekong Working Group (UMWG) and OIE Sub-commission Meetings from 2008-2012. Uptake has been limited, but work continues to promote the ALIATS system in the region.
- The project developed biosecurity educational materials for livestock traders and VAHWs, an activity supported by the 2010 Project Review as an important capacity-building exercise for the project to pursue. An improvement in the standard of biosecurity applied by livestock traders and VAHWs will have significant benefits for Cambodian and Lao farmers and the health of the livestock market chains in the region.

In response to the enthusiasm shown by the Cambodian government towards these materials, several thousand copies of each were printed for distribution to VAHWs and traders by the Cambodian DAHP and ACIAR Project AH/2010/046.

- The project attempted to increase regional skills in risk analysis by co-hosting a Risk Pathway Workshop with SEACFMD at the 2009 Meeting of the LMWG in Ho Chi Minh City on 25th November 2009.

- At a 3-day workshop In January 2011, more complex risk analysis training was provided for several project staff and Murdoch University PhD students currently researching animal movements and transboundary diseases in SE Asia. Participants included Cambodian consultant Soheat Sieng, Chinese PhD student Chang Cai, and Philippine PhD student Blesilda Verin. Risk analysis skills are expected to be a valuable asset to the animal health services in their respective countries. A summary of Chang Cai's risk analysis of livestock pathways entering China from Thailand, Myanmar and Vietnam is included as Appendix 8.

8.3 Community impacts – now and in 5 years

8.3.1 Economic impacts

It is anticipated that a better understanding of the economic imperatives that drive livestock traders to adopt high-risk trading behaviours and avoid official border-crossing pathways will assist policy-makers to develop movement protocols which are more effective in reducing disease spread, yet less costly and protracted for traders.

The project conducted research with the operators of the livestock export depots which act as the departure point for animals moving across Cambodia's border into Vietnam. These depots represent 'critical points' in the trade pathways that spread livestock diseases across the region. The project's efforts to address the biosecurity weaknesses identified in the depot operations will be continued by ACIAR Project AH/2010/046, and are expected to have economic impacts throughout the market chains in which they feature. Healthier, lower risk livestock is expected to become a more valuable commodity, particularly if animal health authorities can be sufficiently confident in livestock health status to reward suppliers with more streamlined, less expensive border-crossing protocols.

Collaborative risk assessment research was undertaken by the project during 2011 with Vietnam's Department of Animal Health (DAH) in order to better understand the disease risks associated with the transboundary livestock trade. Follow-on ACIAR project AH/2010/046 *Domestic and international market development for high-value cattle and beef in South East Cambodia* plans to continue this collaboration in order to decrease the disease risk and increase the value of Cambodian livestock destined for the beef markets of southern Vietnam.

On a more local scale, the project's research identified the unintentional role of livestock traders and VAHWs / VVWs in spreading disease within and between villages. Our subsequent efforts to develop educational materials to reduce this risk to animal health and smallholder income are expected to gradually generate economic benefits for smallholders and a safer, more valuable market chain for livestock.

In pursuit of these economic benefits for smallholders and other market chain stakeholders, follow-on ACIAR project AH/2010/046 *Domestic and international market development for high-value cattle and beef in South East Cambodia* will continue the biosecurity education activity initiated by ACIAR project AH/2006/025, expanding the range of educational materials and the target audience.

It is worth noting that the project recognised from the outset that biosecurity improvements would not be adopted unless they were accompanied by economic benefits for the stakeholders who were expected to implement them.

The project leaflet circulated in Cambodia in 2008 included the following page, emphasising the economic benefits of disease control:

Project benefits for farmers & livestock traders

1. The project aimed to reduce disease outbreaks caused by FMD and CSF. This will benefit farmers & traders by:
 - improving livestock health & value
 - increasing livestock prices
 - increasing trade opportunities

2. The project will give traders the opportunity to tell us:
 - what problems/barriers they face in trading livestock
 - what measures could be taken to help them trade.

We hope to reduce barriers to livestock trading in order to increase the wealth of the livestock sector.

The information provided by farmers and traders will be used to predict likely disease outbreaks, not to stop livestock movements.

3. Traders will be consulted about establishing trader associations, which could help traders by:
 - developing marketing networks
 - presenting trader concerns to government.

8.3.2 Social impacts

ACIAR project AH/2006/025 identified that the practices of livestock traders and VAHWs in Cambodia and VVWs in Laos appear to represent a clear risk of livestock disease introduction and spread within communities in Cambodia and Laos.

The project consequently attempted to reduce the impact of livestock diseases on villagers in Cambodia and Laos by improving the biosecurity practised by VAHWs/VVWs and livestock traders, as already described. It is expected that as villagers become better educated about the mechanisms of disease spread, they will become less accepting of high-risk livestock trading practices. This would represent a change to the present social order.

Project research during 2010/2011 suggests that this particular social change is already occurring, reflected in changing attitude toward (and reduced acceptance of) high-risk trading practices. Interviews with Cambodian smallholders after the widespread 2010 FMD outbreak confirmed that they are beginning to suspect that the activity of livestock traders is involved in introducing the disease into their communities.

Similarly, recent social research in Laos indicates that 'local people have become more aware of the risk of the traders' livestock animals spreading disease to their animals'. Consequently, '*the interaction between the community and these traders regarding livestock management is sometimes intense and leads to dissatisfaction*' (Aloun Phonvisay personal communication 2011).

Whilst there is an intention for follow-on ACIAR Project AH/2010/046 *Domestic and international market development for high-value cattle and beef in South East Cambodia* to protect the health of village livestock (and consequently smallholder income) by improving smallholder understanding of disease spread and biosecurity, there is a need to first educate the VAHWs and traders about desirable biosecurity practices so that they may change their work practices accordingly and be involved in spreading the biosecurity message to smallholders.

By adopting improved biosecurity practices, VAHWs and traders will represent community assets, rather than community liabilities, during disease outbreaks. VAHWs have a role to play in disease investigation and reporting, and subsequent treatment of animals and education of livestock owners. Traders provide livestock owners with a necessary salvage option for animals affected by disease. Both groups should consequently be offered the opportunity for education and behavioural change **before** villagers are armed with the knowledge to blame them for disease outbreaks and/or spread. It would not be a helpful social change to undermine community confidence in and respect for VAHWs/VVWs and traders.

However, the traders who profit from buying and selling diseased animals tend to be local-level operators, with most of the affected livestock destined for prompt local slaughter. This group of traders is important in the spread of FMD within and between villages. Because a change in their high-risk trading practices would represent greater benefits to their community than to themselves, it may require biosecurity education of other members of their communities to achieve that change by means of community pressure. Whilst such a community educational task would be a considerable undertaking if attempted even on a district scale, it may be feasible to educate influential community members such as village Chiefs and Headmen to drive such a change. It is planned that the educational work done by ACIAR Project AH/2006/025 will be expanded by ACIAR Project AH/2010/046 (and others), and that a change in social attitudes towards disease prevention will gain momentum.

8.3.3 Environmental impacts

The environmental impact of this study is not expected to be significant.

8.4 Communication and dissemination activities

8.4.1 Dissemination of project results (reporting and feedback)

- Annual Project Meetings were held alternately in Cambodia or Laos, where it was project policy to invite (and even fund) a broad range of participants to attend our Annual Project Meetings in order to:
 - publicise our work as widely as possible
 - benefit from wide ranging contribution to our discussions
 - increase opportunities for collaborative research with other projects and organisations.
- The project attached its annual 'National Development Coordination Meeting' for project staff to the annual meeting of the LMWG in November of 2008, 2009 and 2010. This strategy ensured at least biannual face-to-face discussion of project plans and issues by the project team from all three countries, and an opportunity to present project findings and plans to Member countries for feedback.

- From 2008-2012, project presentations were made to neighbouring country and regional representatives at every annual meeting of the LMWG, UMWG and the OIE Sub-commission for Southeast Asia. Alignment of project activities with national and regional animal movement and disease control strategies was thereby maintained. Opportunities for research collaboration with other projects and organisations were also pursued at these meetings.
- The project produced 5 newsletters at 6 monthly intervals, beginning in April 2009, with a wide international circulation list. These newsletters remain available at our project website: <http://ulm.animalhealthresearch.asia/>
- The project website also continues to be advertised as a repository of project reports, presentations, publications and educational materials, where past editions of the project newsletter and presentations from various meetings can be downloaded.
- The project partners agreed at the 2012 Annual Project Meeting that other researchers may be able to increase the value of the data collected by the project from 2008-2011 by extracting additional information which was not directly relevant to our objectives. For example, information about reproductive rates for cattle and buffalo in typical Cambodian and Lao villages can be derived from our 'Population Dynamics' data (Activity 1.2.2).

In order to ensure that the project's data remains readily available to other researchers in future years, a project extension was agreed whereby AusVet Animal Health Services will make the various datasets available at the project website in a number of download formats, and maintain the website until at least 2017.

- Nationwide feedback meetings were held throughout Cambodia and Laos during the first half of 2010. Livestock traders, slaughterhouse operators, district and provincial departmental staff, and influential Cambodian trading companies each received tailored presentations in meetings held throughout Cambodia and Laos. (A report of the outcomes of the trader feedback meetings in Laos is featured as Appendix 11).
- In April 2011, a Khmer-language report was produced and distributed to the district and provincial departmental staff who assisted in the project's opportunistic case study into the Aug-Oct 2010 FMD outbreak in Cambodia's Kampong Cham province.
- In May 2011, project consultant Soheat Sieng delivered a project presentation to the students of the Royal University of Agriculture (RUA) in Phnom Penh, describing project objectives, methodology and results.
- As described under *Scientific Impacts* (Section 8.1), the project has contributed to the collaborative production of a joint publication with two other ACIAR research projects operating concurrently in Cambodia:
 - *AH 2003/008: Improved feeding Systems to more effective beef cattle production in Cambodia*
 - *AH 2005/086: Best Practice Health and Husbandry of cattle in Cambodia.*

The three projects have combined their research findings about large ruminant production and trade in Cambodia in an English-language ACIAR monograph intended for the international research & development community. It is hoped that a second publication will be produced using the outputs of these three projects: a Khmer-language manual on large ruminant production and health intended for district and provincial extension staff in Cambodia.

- The project contributed several papers for ACIAR Proceedings No. 137, Animal biosecurity in the Mekong: future directions for research and development (Adams et al, 2012)

- The project has submitted several papers for the Open Session of EuFMD (European Commission for the Control of Foot and Mouth Disease), to be held in Jerez de la Frontera, Spain, 29-31 October 2012, with a theme of '*Application of science in the Progressive Control of FMD*'. We have also initiated discussion with the Australian Veterinary Association for presentations at the 2013 conference.

8.4.2 Dissemination of project extension materials

- During the data collection phase of the project, project information brochures were produced in Cambodia and Laos and disseminated to stakeholders including livestock traders, slaughterhouse operators and provincial / district DAHP/DLF staff.
- T-shirts and caps bearing project logos and a disease prevention slogan were also produced and distributed throughout both countries during the 2008-2010 period.
- Public meetings for traders, departmental staff and other stakeholders were held throughout both countries during 2008-2009 in order explain the project objectives, obtain trader opinions and grievances, and provide education about livestock disease prevention.
- Based on further nationwide feedback meetings for traders in Cambodia and Laos, the project developed, trialled and refined a colour information booklet, a digital story, and a poster aimed at educating livestock traders about biosecurity. Large quantities of these materials were printed during 2012 for distribution during ACIAR project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia*.

Our use of various extension methods was aimed at addressing a range of trader preferences and varying levels of literacy. Digital stories, for instance, overcome literacy problems by delivering their message by spoken word commentary accompanying a sequence of digital (DVD) images.

- The project supported (funded) trader education meetings (using our disease and biosecurity education materials) in southern Laos during February 2011 as part of the DLF response to widespread livestock disease outbreaks.
- The project developed, trialled and printed (5000 copies) a biosecurity training booklet for VAHWs as part of Activity 2.1, which will be promoted and distributed by the Cambodian DAHP and ACIAR Project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia*.
- It is planned that further development and dissemination of biosecurity educational materials for a wider range of stakeholders in the livestock market chain, including smallholders, VAHWs, traders, trading companies and depot operators, will continue during ACIAR project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia*.

9 Conclusions and recommendations

9.1 Conclusions

There is a matching numbered set of recommendations for the numbered list of conclusions featured below.

1. The project achieved its primary objective of significantly improving our understanding of livestock movement patterns in Cambodia and Laos and the disease risks associated with those movements. *Much of the most important information was derived from livestock traders, rather than official sources.* Traders subsequently became the primary target in our efforts to achieve our second project objective: investigation of non-regulatory interventions to reduce the risk of spreading disease when moving livestock.
2. Many of the participants in the livestock market chain who were interviewed by the project had an inadequate understanding of how livestock diseases are spread, but were uniformly enthusiastic to be educated about biosecurity. This finding motivated the project's education initiatives, which will hopefully be further developed by future ACIAR projects.

The creation and distribution of educational materials about livestock diseases and biosecurity is expected to help those individuals in the livestock market chains seeking to protect their animals and their incomes from the effect of livestock diseases. However, because regulation cannot realistically be expected to effectively support biosecurity initiatives by farmers and traders in the near future, biosecurity improvements in the regional livestock market chains are unlikely to be rewarded and gain momentum until there is a market demand for safer (lower-risk) livestock.

3. Disease reporting across the GMS is presently inadequate to support:
 - predictive computer models which rely on up-to-date disease prevalence data, diminishing the prospects for adoption of the project's technological outputs.
 - effective response to disease outbreaks, including the distribution and use of donated FMD vaccine.
4. Some project activities in Cambodia and Laos experienced delays and insufficient supervision due to lack of availability of our in-country project leaders. This situation was a predictable consequence of selecting senior staff from each country's veterinary services to be responsible for managing project activities, as they often had far more pressing and important duties to fulfil. Our solution was to engage in-country consultants to manage these activities and rely on our departmental colleagues in Cambodia and Laos to undertake the more suitable role of facilitating their work. This arrangement worked very well.
5. Continual reassessment of the project's progress and goals, which included regular invitation for comment from people outside the project, resulted in alternative staffing strategies being adopted and non-feasible activities being discontinued. ACIAR agreed to a number of project variations early in 2009, and also agreed to a Project Review in 2010, which helped to confirm which activities were most valuable to pursue during the final two years of the project. Our project's achievements are a reflection of our preparedness to reassess and change the focus of our research.
6. Other project conclusions also included the following:

- **Tracking livestock movements in time to act is almost impossible** - absence of a real-time recording and reporting system, and lack of animal identification preclude significant management options.
- **Government agencies have some control** over major movements – but do not use this control to best effect (inspect documents more than inspect animals).
- **Unofficial cross-border livestock movements** pose a significant risk of disease spread, but will be preferred to official border crossings by traders while they remain the cheaper *and faster* option.
- It is unclear if official border crossing protocols presently offer a disease control advantage, as the **risk of disease spread is increased by diverting slaughter consignments into quarantine facilities**, where the opportunity exists for close contact with non-slaughter livestock.

9.2 Recommendations

1. Because livestock traders have a better knowledge of how the livestock trade operates than official sources, future initiatives aiming to manage the disease risks associated with animal movements should continue to work with these important industry stakeholders. Policy makers in GMS countries should be strongly encouraged to actively seek industry input when developing animal movement and disease control policies.
2. ACIAR Project AH/2006/025 has laid the groundwork for biosecurity education to be developed as a non-regulatory risk-reduction intervention in the GMS. **ACIAR Project AH/2010/046: Domestic and international market development for high-value cattle and beef in South East Cambodia** should continue this work by:
 - a. Distributing and evaluating the effect of the educational materials created and printed by ACIAR AH/2006/025 for livestock traders and Village Animal Health Workers
 - b. Using the research undertaken by ACIAR AH/2006/025 with Cambodian export depot operators in the second half of 2011 to similarly develop biosecurity educational materials and protocols for the safer operation of these critical points on the transboundary disease pathways
 - c. Further expanding the audience for biosecurity education to include Cambodian farmers.
3. All research and development organisations aiming to assist with animal disease control in the GMS need to make improved disease reporting and investigation a research and development priority. This recommendation is particularly relevant for those planning to establish a bank of donated FMD vaccine for use as an outbreak control measure by the least developed nations in the GMS. Due to their lack of resources, those same nations are the least capable of effectively managing donations of vaccine. (Please refer to vaccination effectiveness findings in Appendix 13).
4. Animal health research projects in countries such as Cambodia and Laos should not allocate direct management responsibility for important project activities to senior departmental staff of the veterinary services, as the reactive nature of their departmental work will often make them unavailable to adhere to project timetables. Instead, it would be more effective to engage consultants to directly manage such activities, with departmental project leaders responsible for facilitating their work.
5. The precepts of project management should be a basic requirement of all ACIAR projects, including an adequate planning phase (including pragmatic assessment of

feasibility by researchers with experience in the host country), continual review (including input from outside the project team), and preparedness to make changes if required. Projects should not begin until decent staff has been recruited, with PhD students an excellent option for ensuring staffing continuity (as these individuals are committed to project achievement and are unlikely to be transferred or promoted away from their project role).

6. To address the issues listed under Conclusion # 6 (above), it was recognised that, in keeping with the observations of the OIE and FAO:
 - A regionally acceptable, **permanent animal identification system** is essential
 - A real-time **livestock movement** recording and reporting system is vital
 - A real-time **animal health** recording and reporting system is vital

Further,

- **Movement controls need to be effective, without unnecessarily restricting trade.** Stock destined for slaughter should not be detained and vaccinated in quarantine depots: their movement to slaughter should instead be expedited. Mid-journey movement stoppages for the purpose of inspection of documents (and collection of unofficial payments) are a trade impediment.
- **Vaccination strategies need to be “ready to go”** with sufficient of the right vaccine type, transported and delivered effectively within a few days of the occurrence of the disease. The success of OIE’s proposed FMD vaccine bank initiative will require considerable improvements in reporting and investigation (including sampling), where speedy notification is required.
- **All players in the cattle market chain should be educated to be aware** of their importance in the surveillance strategy for FMD and other diseases.
- **Educational and capacity building** for producers, traders, village animal health workers/veterinary officers and other market chain operatives is essential.

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Discussions regarding future presentations have commenced with the convenor of the 2013 Australian Veterinary Association Conference.

11 Appendices

Appendices are presented as a separate document.



Final report

project

Understanding livestock movement and the risk of spread of transboundary animal diseases:

APPENDICES

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Appendix 1. Alternative animal tracking strategies

Background:

This activity aimed to record (and, if necessary, apply) unique animal identifiers to livestock in Cambodia and Laos and gather information about livestock movement patterns by recording details of these identifiers when they were observed in various new destinations. This activity was viewed as a pilot study to assess the prospects for larger scale animal identification and movement recording programs. It faced the following challenges:

- Animal identification is not practised in either country, and farmer attitudes towards visible identifiers such as ear-tags or brands were unknown.
- Our research ethics approval from Murdoch University included strict guidelines concerning protection animal welfare and farmer income. Consequently, the project could not attempt to identify livestock in any manner that didn't satisfy Australian animal welfare standards or which might adversely affect the marketability of the animals.
- Facilities for livestock restraint are limited or unavailable in most Cambodian and Lao villages. Consequently, application of rumen boluses might not be possible, and application of ear-tags or brands (especially by inexperienced operators) might tear ears or unnecessarily damage hides, thereby breaching welfare requirements and possibly devaluing livestock.
- The scale of the activity, both in terms of participating livestock numbers and the duration of the study, was inadequate to expect many movements to occur involving the animals enrolled in the study.
- The possible destination markets for traded livestock were numerous, and included foreign destinations reached by illegal border crossings. Achieving sufficient official and public awareness of the study across at least three countries in order to capture reports of movements featuring these animals was beyond the means of this project, and probably impossible. Moreover, it was difficult to nominate an incentive for traders or officials to report movements of these animals, particularly if they involved illegal border crossings.

The project opted to investigate two alternative animal tracking strategies:

- a. A prospective tracking study of ear-tagged cattle and buffaloes in northern Laos, undertaken in collaboration with another ACIAR project which planned to ear-tag these animals for other purposes
- b. An individual animal tracking study using a rumen bolus which contained a GSM transmitter, the movements of which could be recorded without human input (obviating the public awareness and compliance challenges otherwise required for data capture).

a. Cohort ear tag study

Due to the difficulties described above, it was decided that the most practical and cost-effective way to attempt a tracking study of ear-tagged livestock was by taking advantage of another project's intention to ear-tag cattle and buffalo being enrolled in

a production and health trial in Laos. Because no similar opportunity for collaboration existed in Cambodia, it was decided not to proceed with this activity in that country. It was decided to limit the study to cattle and buffalo due to the greater difficulties of identifying and tracking pigs.

The 'Animal Tracking' activity was consequently undertaken in collaboration with *ACIAR Project AH/2006/159: Best practice health and husbandry of cattle and buffalo in Lao PDR*. We supplied the numbered **ULM** ('Understanding Livestock Movements') ear-tags for identification of the livestock study populations enrolled in *ACIAR Project AH/2006/159*, and attempted to collect information about their subsequent movements at strategic road checkpoints, border crossing points, and slaughterhouses.

Ear-tags were applied to a sample of approximately 250 head of cattle and buffalo in each of 6 villages in northern Laos, the details of which are summarised in Table A1.1.

| Province | District | Village | Ear-tag Colour | Number of animals tagged |
|-----------------|-----------------|----------------|-----------------------|---------------------------------|
| Luang Prabang | Pakao | Ban Hardpang | Blue | 258 |
| | | Ban Hueypen | Orange | 255 |
| Xiengkhouang | Pek | Ban Nadee | Pink | 250 |
| | | Ban Nong | Yellow | 250 |
| Houaphan | Viengthong | Ban Naviang | White | 249 |
| | | Ban Nakud | Green | 252 |

Table A1.1: Ear-tagging details for cattle and buffalo in six villages in Northern Laos

The colour of the ear-tag indicated the village-of-origin, and its number referred to the animal's original owner (see Figure A1.2). A bounty for reporting ear-tag details was publicised with slaughterhouse staff in Vientiane, Luang Prabang and Phonsavan (capital of Xieng Khouang province), and with road checkpoint staff along the main route running between Vientiane and the Vietnamese border in Xieng Khouang province via Phoukhoun (near Luang Prabang). The location of these checkpoints is featured in Figure 5.2 in Section 5 of the main report.

We also requested the assistance of neighbouring countries by publicising the ear-tags and our tracking activity at regional disease control meetings and in our widely-circulated biannual newsletters.



Figure A1.2: Ear-tag publicity in our project newsletter for our Animal Tracking activity

In order to obtain further research value from these livestock populations, we also made them the subject of our Population Dynamics Study (Activity 1.2.2) in Laos, and paid the Village Veterinary Worker (VW) in each village to record for 12 months the details of all livestock movements, *including the reason for any purchases, sales or other movements*. Details of births, deaths (and slaughter) and disease of livestock in the village were also recorded on project sheets designed for this purpose. These details were recorded for all cattle, buffalo and pigs in each village, not just those ear-tagged animals.

These records were collected by monthly visits to each village by the district DLF staff. It was anticipated that our continual recording of these populations would provide useful (and perhaps explanatory) information to augment that collected by the 3-monthly data collection visits by *ACIAR Project AH/2006/159*.

b. Rumen Bolus

In order to proceed with an animal tracking study following an animal carrying a rumen transmitter, the project would first need to develop such a device. AusVet Animal Health Services conceived the idea, and managed the subsequent investigation of its technical feasibility.

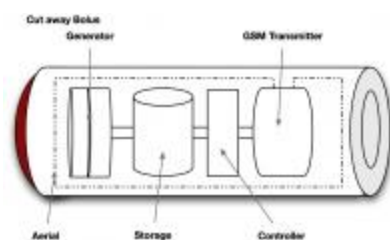


Figure A1.3: A GSM radio transmitter within a rumen bolus.

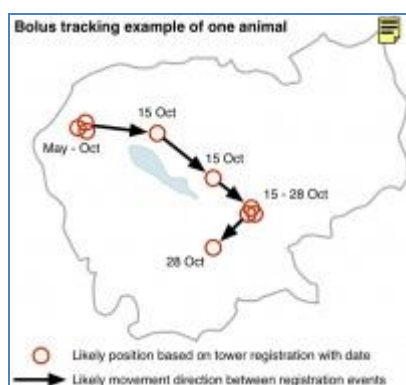


Figure A1.4: An example of how an animal's movements through Cambodia might appear if traced by proximity to GSM towers. In this example the final destination may well have been a slaughter house in Phnom Penh.

The concept of the rumen bolus involved a micro-generator (as found in a kinetic watch or torch) connected to a power storage device and a GSM transmitter (Figure A1.3). Normal ruminal activity moves the bolus and the micro-generator charges up the power storage. When the amount of power stored reaches a threshold value an electronic circuit is activated, turning on a GSM transmitter. The transmitter only needs to engage with the GSM network and register the device. The location can then be established by identifying which towers the device communicated with during the registration process. Information about the time, the location of the tower and the signal strength is then available through the network management system, and this information allows the animal to be approximately located within the working range of the tower—normally about 25km for GSM. Although this area ($\approx 2\,000\text{km}^2$) would not allow an individual animal to be 'found', it would provide sufficient resolution to allow useful information at a country scale to be recorded (for example, Figure A1.4). After slaughter signal transmission would cease due to the lack of ruminal activity.

Appendix 2. Trader questionnaire, Cambodia; Interview checklist, Laos

Trader questionnaire, Cambodia

ACIAR Project AH/2006/025

Understanding livestock movement and the risk of spread of transboundary animal diseases

Questionnaires for Livestock Traders

A- Intent and confidentiality statement:

This research project is undertaken to help us understand livestock trading within Cambodia and neighbouring countries. The project is not aimed at increasing trading regulations. We hope that it will assist livestock trading by improving the health of the animals traded and reducing the risk of disease outbreaks.

We are very grateful for your participation. We will make sure information you give us is anonymous. Your name will not be attached to this document. You are not obliged to participate, and may choose not to answer any of the questions that will be asked.

If you wish to contact us, you will find our addresses and phone numbers on the project leaflet.

B- General

- A. Province/Municipality :
- B. District:
- C. Date of interview: Date:Month.....2008
- D. Code number of interviewer:

I- Traders demographics

Trader code number:

1.1. Age: 1.2 Sex: M [] F []

1.3 Education background:

Grade 1-7 []

Grade 8-12 []

Uni/College []

No education []

- 1.4 Ethnicity:
- Khmer []
- Muslim []
- Others []

II- Respondent's background

- 2.1 Are you
- full-time []
- regular part-time []
- An occasional (opportunistic) []

- 2.1.a If you aren't a full-time trader, what else do you do?

- Farming []
- working for other []
- selling or buying goods []
- others []

- 2.2 Why are you a trader?

.....

.....

- 2.3 How long have you been involved in this business (how many years)?

- 1-3 years []
- 4-6 years []
- 7-10 years []
- more than 10 years []

- 2.4 Does anyone else in your family trade?

Yes [] No []

- 2.5 Do you think, members of your family want to become a trader in the future?
- Yes [] No []

III- Livestock trading practices

- 3.1 What livestock species do you trade in:

Cattle (only) []

- Buffalo (only) []
- Cattle/buffalo []
- Pig (only) []
- Cattle/buffalo and pig []

3.2 Do you raise animal at home?
 Yes [] No []

- 3.2.a If yes, what animals
- Cattle []
 - Buffalo []
 - Pig []

3.3 Do you raise animals because you are a trader?
 Yes [] No []

3.4 Based on your estimation, how many animals do you trade each year in average?

- Cattle heads
- Buffalo heads
- Pig heads

3.5 Please estimate the percentage of animal you have traded each year by quarter?

| Type of Ani. | Jan-Mar | Apr-Jun | Jul-Sep | Oct-Dec | Total Number |
|--------------|---------|---------|---------|---------|--------------|
| Cattle | | | | | |
| Buffalo | | | | | |
| Pig | | | | | |

3.6

- 3.6.a How do you find the animals that you buy? *(do not read the answers)*
- contact traders or buyers by yourself []
 - farmer come and ask to buy their animals []
 - contact with the animal collectors []
 - contact family's network to look for animals to buy []
 - communicate with traders by using mobile phone []
 - others []

- 3.6.b Where do you buy animal from?
- within your district []
 - other district []
 - other province []

3.7 3.7.a How do you find buyers for your animals? *(do not read the answers)*

- contact with other traders who want to buy animals
(including using mobile phone) []
- inform informal network in and outside the village []
- traders come to buy animals by themselves []

- go around to find buyers []

- others []

3.7.b Where do you buy animal from?

- within your district []
- other district []
- other province []

3.8 How do you transport animals after you have bought them?

- motorcycle []
- animal-drawn []
- trucks []
- hand-carried []
- tractors []
- bicycles []
- walk animal []
- others (Please specify):
.....

3.9 Do you transport animals to the buyer (farmer, abattoir, other trader etc) as soon as you have bought them? Yes and sometimes [] No []

If yes, Please explain

.....

If no, go to question 3.11

3.10 If you transport animals as soon as you have bought them, where you transport animals to?

(more than one answers)

- slaughterhouse []
 - within the district []
 - other district []
 - other province []
- places where keep more animals (enough for one truck) []
 - within the district []
 - other district []
- others:.....

3.11 Are animals for different buyers transported together (on the same vehicle/truck)?

Yes [] No [] Sometimes [] Please explain

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

3.12 Do you ever hold animals after buying them until you have filled an order or until you can find a buyer for them?

Yes and sometimes [] No [] If No, go to question 3.13

If Yes and sometimes, where do you hold the animals? (*more than one answers*)

under the house [] with your animals Yes [] No []
near the house [] with your animals Yes [] No []
neighbour house [] with their animals Yes [] No []
owner house []
other places:

3.13 If animals for separate orders, do you held those animals at the same place?

Yes [] No [] Sometimes []

3.14 When you transported your animals, do you ever ask to stop to get information about animal movement or not (by stopping your truck or ...)?

Yes [] No []

If Yes, who (*more than one answers*)

provincial or district vet []
vet from the DAHP []
police []
military police []
custom agent []
local authorities []
others:

3.15 Do you think, the purpose of stopping your truck is to check:

whether you have animal movement certificate or not []
whether sick animals in the truck or not []
if they saw sick animal, do they separate them []
just want to have money from you []
others:.....

3.16 If the payment was made, how much do you paid per check point?

.....Riel forcattle/buffalo

.....Riel forpigs

3.17 If the payment was made, how many check points do you have to pay from your place to the destination of the market?
 check point

3.17a If the payment was made, do you receive any receipt for that payment?
 Yes [] No []

3.18 When is the best, moderate and difficult time for you to trade animals?
 1- best time, 2- moderate time, and 3- difficult time

| Animal | Month | | | |
|---------|-----------|-----------|-----------|-----------|
| | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| Cattle | | | | |
| Buffalo | | | | |
| Pig | | | | |

3.18a Reasons for the best time:

.....

3.18b Reasons for the difficult time:

.....

3.19 What is the destination of the animals that you sell (to whom/where)?
 (Please estimate percentages based on the number of animals in question 3.5)

raiser/farmers%
 slaughterhouse%
 traders%
 other countries%

3.20 For instance, if 25% of the buffaloes that you buy are sold to farmers within the same district, you would write 25% in the box marked *. If 50% of the cattle that you buy are sold to slaughterhouse in other province, you would write 50% in the box marked * in the table.

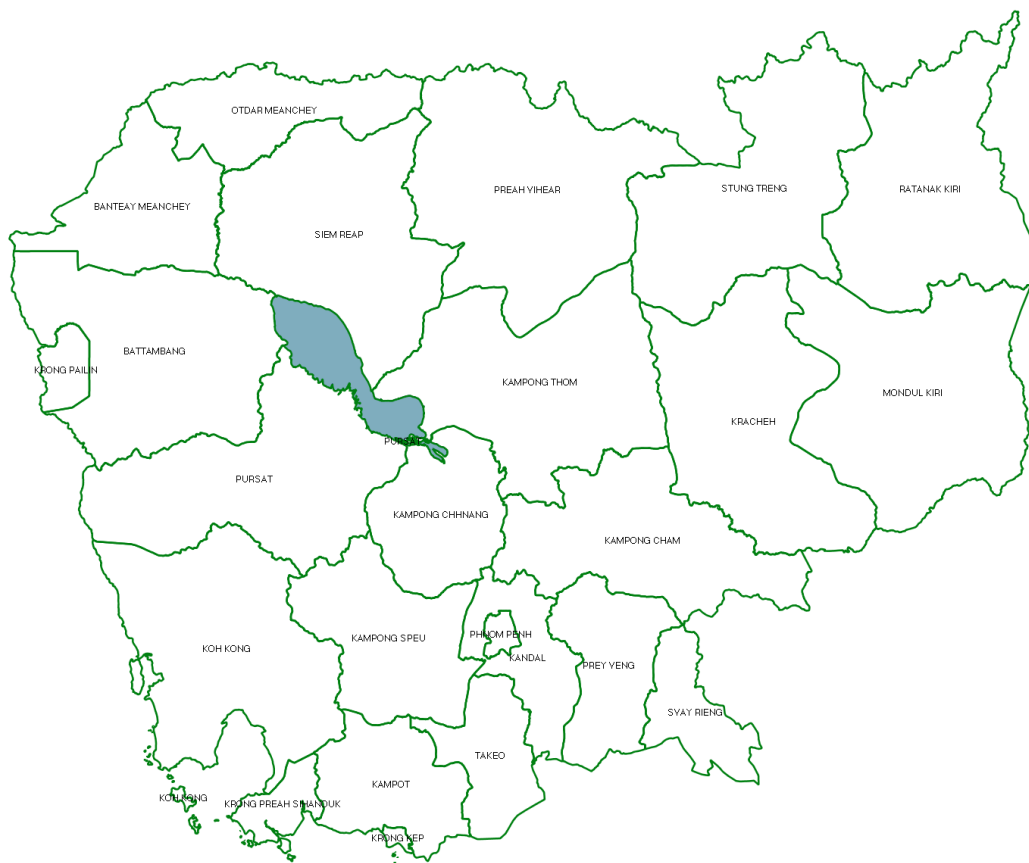
| Whom/Where | Animal | Within district (%) | Other district (%) | Other province (%) |
|---------------------|--------|---------------------|--------------------|--------------------|
| 3.20a | | | | |
| Farmer/anim. raiser | Cattle | | | |

| | | | | |
|---------------------|---------|---|--|---|
| Slaughterhouse | | | | * |
| Animal collector | | | | |
| 3.20b | | | | |
| Farmer/anim. raiser | Buffalo | * | | |
| Slaughterhouse | | | | |
| Animal collector | | | | |
| 3.20c | | | | |
| Farmer/anim. raiser | Pig | | | |
| Slaughterhouse | | | | |
| Animal collector | | | | |

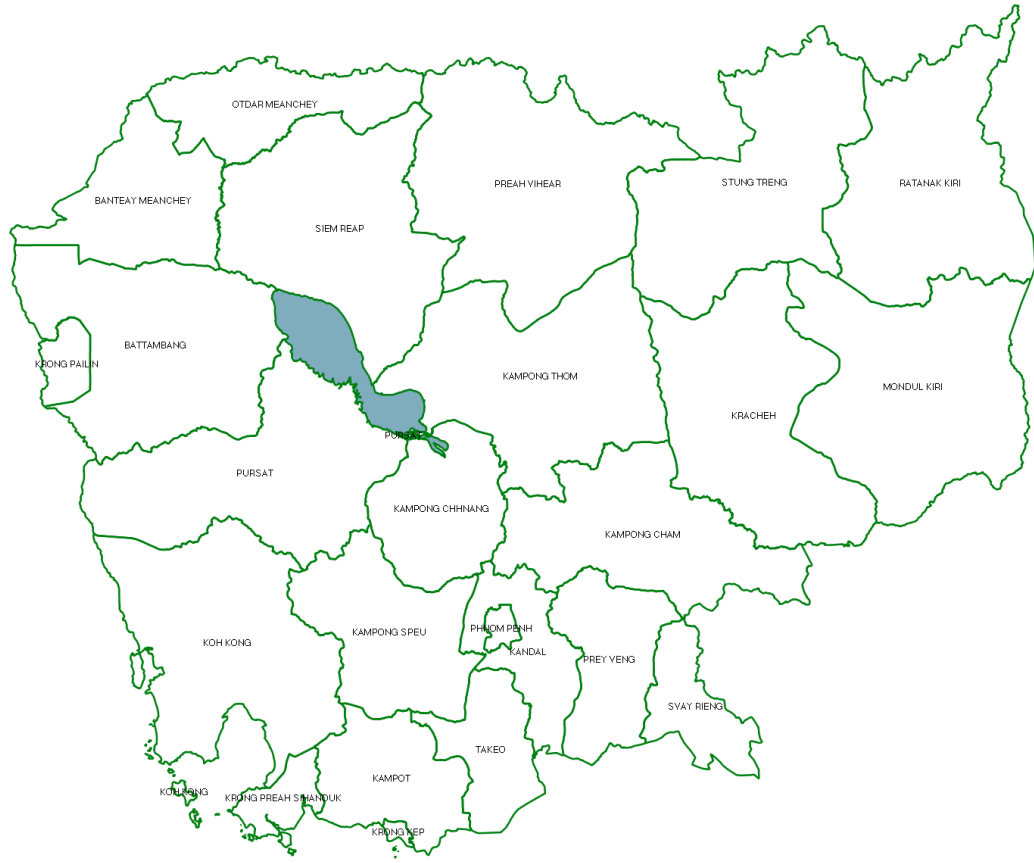
3.20d Other countries: Cattle.....%
Buffalo.....%
Pig.....%

3.21 Please use answers of question 3.20a, 3.20b, and 3.20c.

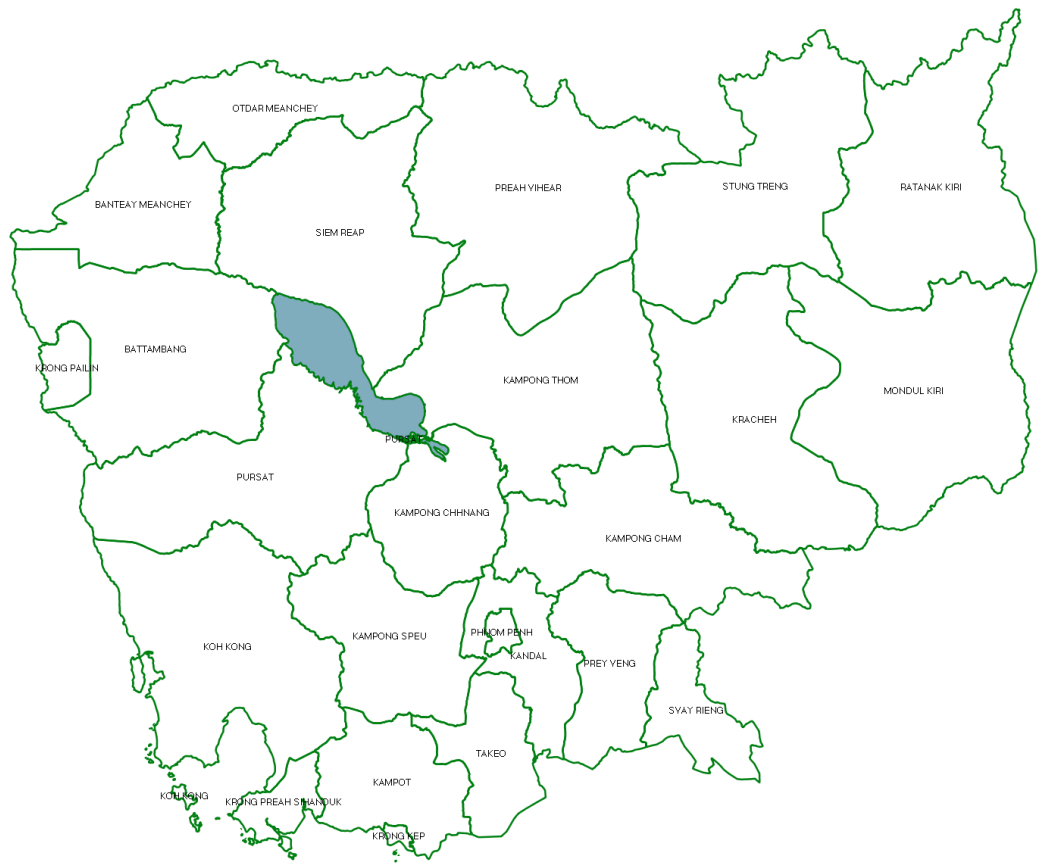
3.21a *If you trade (buy and sell) **cattle** between Cambodian provinces, please draw arrows on the map to show the direction of these cattle movements. Please write the number of cattle moved in that direction **each year** next to each arrow. (E.g. if you buy 100 cattle in Takeo each year for sale in Phnom Penh, you would draw an arrow from Takao to Phnom Penh with '100' written alongside it).*



3.21b If you trade **buffaloes** between Cambodian provinces, please draw arrows on the map to show the direction of these buffalo movements. Please write the number of buffaloes moved in that direction **each year** next to each arrow. (E.g. if you buy 100 buffaloes in Takeo each year for sale in Phnom Penh, you would draw an arrow from Takao to Phnom Penh with '100' written alongside it).



3.21c *If you trade (buy and sell) pigs between Cambodian provinces, please draw arrows on the map to show the direction of these pig movements. Please write the number of pigs moved in that direction **each year** next to each arrow. (E.g. if you buy 100 pigs in Takeo each year for sale in Phnom Penh, you would draw an arrow from Takao to Phnom Penh with '100' written alongside it).*



VI- Trading partners

4.1 Who do you usually trade with? *(more than one answers)*

raiser/farmers []
slaughterhouse owners []
traders []
others []

4.2 Who would or wouldn't you prefer or not prefer to trade with?
(more than one answers)

raiser/farmers [] prefer [] not prefer
slaughterhouse owners [] prefer [] not prefer
prefer
traders [] prefer [] not prefer
others [] prefer [] not prefer

4.3 Where wouldn't you trade? *(more than one answers)*

other countries []
far provinces []
not safety place []
others:.....
.....

4.4 Do any trader organizations / associations exist in Cambodia?

Yes [] No [] I don't know []

If yes, please name the association(s):

.....

If No or I don't know, go to question 4.7

4.5 Do you belong to any of these associations?

Yes [] No []

4.6 Do you think, traders will get benefits from the association?

Yes [] No []

Please describe if Yes or No.

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

4.7 Do you think, organisation or association should be formed?
Yes [] No need [] I don't know []

If No need or I don't know, go to question 4.9

4.7a If Yes, from your point of view, who is the appropriate person to start forming the organisation or association?

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

4.8 Please give your opinions, how to run the formed trader's association or organisations smoothly.

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

4.9 Do informal networks of traders operate in Cambodia?
Yes [] No []

If Yes, please explain:

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

4.10 How is the informal networks of traders?

- family's members/relatives []
- friends []
- other traders in and outside the province []
- the same nationality []
- the same religion [...]
- others.....
-

V- Livestock prices

5.1 Who / what determines the price of livestock in Cambodia? Please rate the following factors according to importance by placing a number (1-3) in each square of the table:

- 1=not an important in determining price
- 2=quite important factor in determining price
- 3=very important factor in determining price

| Factor | Cattle/ Buffalo | Pigs |
|--|--------------------|------|
| Demand within Cambodia | | |
| Prices in Vietnam | | |
| Prices in Thailand | | |
| Prices in Lao PDR | | |
| Prices in Myanmar | | |
| Prices in China | | |
| Time of year | | |
| Availability and cost of feed and water for livestock | | |
| Body condition of animals being sold | | |
| Animal Health: whether the animal is sick or healthy | | |
| Disease risk: whether a contagious disease is present in the village | | |
| Festive seasons | | |

5.2 What other factors determine market prices? (Please rate these factors from 1–3 as well)

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

5.3 How do you keep track of livestock prices in different parts of Cambodia, and in other countries?

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

VI- Reasons that farmers sell livestock

6.1 What factors cause Cambodian farmers to sell their livestock?
Please rate the following factors according to importance by placing a number (1-3) in each square of the table:

- 1=not an important factor
- 2=quite important factor
- 3=very important factor

| Factor | Cattle/ Buffalo | Pigs |
|--|--------------------|------|
| Good prices | | |
| Urgent need for money | | |
| Farmer has a surplus of animals | | |
| Replacement / exchange of draught and breeding animals | | |
| Availability and cost of feed and water for livestock (eg drought) | | |
| Body condition (i.e. animal is fat – ready to market) | | |
| Disease status of animal (i.e. poor health) | | |
| Disease status in district (i.e. fear of animals getting sick) | | |
| Sell before getting too old | | |

6.2 Other factors driving sale of livestock?
 Yes [] No [] If Yes, Please describe

.....

VII- Trade of sick animals

7.1 In general, do farmers ever sell livestock that are sick?

| | Cattle/buffalo | Pig |
|------------|----------------|-----|
| Yes | | |
| No | | |
| Don't know | | |

7.1a If "Yes", under what circumstances:

.....

7.2 If "No", under what circumstances:

.....

7.2 Do you know the disease called 'Foot and Mouth Disease' (FMD)?
 Yes [] No [] Not so sure []
 If No, go to question 7.11

7.3 Would you recognize FMD in an infected animal?
 Yes [] No []
 If 'Yes', how would you recognize it?

.....

7.4 Do you ever sell livestock that are sick with Foot and Mouth Disease?

| | Cattle/buffalo | Pig |
|-----|----------------|-----|
| Yes | | |
| No | | |

If No, go to question 7.8

7.4a If "Yes", under what circumstances:

.....

7.5 If you have sold animal sick with FMD, who you normally sell to?
 (Please estimate what percentage of sick animals are bought by each category of buyer. For instance, if 80% of sick cattle are bought by the slaughterhouse, you would write 80% in the box marked *).

| Stock for Sale | Buyer | | |
|----------------|--------|--------|----------------|
| | Farmer | Trader | Slaughterhouse |
| Cattle | | | * |
| Buffalo | | | |
| Pigs | | | |

7.6 Is the price much lower for an animal:

7.6a That is visibly infected with FMD? Yes [] No []

7.6b That has recovered from FMD? Yes [] No []

7.7 What would you do if an animal that you had bought was sick with FMD?

7.7a Re-sell immediately Yes [] No []

If Yes, re-sell immediately to whom? and within district or other district?
 within dis. [] other dis. [] other pro.
 within dis. [] other dis. [] other pro.

..... within dis. other dis. other pro.

7.7b Re-sell after waiting until it has recovered? Yes No

7.7c Sell immediately to slaughterhouse Yes No

If Yes, slaughterhouse
within district
other district
other province

7.7d Other (please specify)Yes No

7.8 If you answered 'Yes' to Q7.7b (above), where would you keep the animal until it had recovered from FMD?.....
.....
.....

7.9 Do you think, sick animal with FMD could spread the disease to other animal or not?

Yes No Don't know

If Yes, how the disease spread?

wind or air
physical contact with sick animal
infected equipments or materials
transportation (means)
others.....
.....

7.10 Based on your experiences, how long does it take for a sick animal to recover from FMD before it is re-sold?days

7.11 Do you know the disease called 'Classical Swine Fever' (CSF)?

Yes No Not so sure

If No, go to question 7.18

7.12 Would you recognize CSF in an infected pig?

Yes No

If 'Yes', how would you recognize it?

.....
.....

7.13 Do you ever sell pigs that are sick with Foot and Mouth Disease?

Yes No Sometimes

If No, go to question 7.18

7.14 Who buys pigs that are sick with CSF? (Please estimate what percentage of sick pigs are bought by each category of buyer. For instance, if 80% of sick pigs are bought by the slaughterhouse, you would write 80% in the box marked *).

| Stock for Sale | Buyer | | |
|----------------|--------|--------|----------------|
| | Farmer | Trader | Slaughterhouse |
| Pigs | | | * |

7.15 Is the price much lower for an animal:

7.15a That is visibly infected with CSF? Yes [] No []

7.15b That has recovered from CSF? Yes [] No []

7.16 What would you do if an animal that you had bought was sick with CSF?

7.16a Re-sell immediately Yes [] No []

If Yes, re-sell immediately to whom? and within district or other district?

..... within dis. [] other dis. [] other pro.

..... within dis. [] other dis. [] other pro.

..... within dis. [] other dis. [] other pro.

7.16b Re-sell after waiting until it has recovered? Yes [] No []

7.16c Sell immediately to slaughterhouse Yes [] No []

If Yes, slaughterhouse

within district []

other district []

other province []

7.17 Do you think, sick animal with CSF could spread the disease to other animal or not?

Yes [] No [] Don't know []

If Yes, how the disease spread?

wind or air []

physical contact with sick animal []

infected equipments or materials []

transportation (means) []

un cooked infected pork []

others.....

.....

7.18 Do you know transport sick animal could spread diseases from one to another places?

Yes [] No [] Don't know []

7.19 Would you ever report sickness in livestock?

Yes [] No [] If No, go to question 8.1

7.19a If "Yes", to whom would you report it? (*more than one answers*)

- village or commune chief []
- village animal health worker []
- provincial or district vet []
- staff of non-governmental organisation []
- others.....
-

VIII- Movement regulations and informal trade

8.1 Do you know, there are any regulations about moving animals?

Yes [] No [] If No, go to question 8.3

If Yes, please specify

- between villages [] []
- between communes [] []
- between districts [] []
- between provinces [] []
- into other countries:.....

8.2 Do you ever read the livestock movement regulation documents before?

Yes [] No []

If No, why?

- Do not have documents []
- Have document but not read []

8.3 If the DAHP have the livestock movement regulation documents, would you like to have copies of those documents to read?

Yes [] No [] Have it or not the same []

8.4 What percentage of livestock movements do you think complies with the regulations¹?

- between villages%
- between communes%
- between districts%
- between provinces%
- into other countries:%

8.5 Do you think, your livestock trading need to have trading permit]
 don't need to have trading permit]
 the same "have trading permit or not"] If the same, why?

.....

8.6 Whose approval do you need to trade animals?

.....

8.7 What costs are involved in complying with the movement regulations?

.....

8.8 What discourages traders from complying with the regulations for moving livestock?

8.8a Time delays:
 in obtaining permission/paperwork Yes] No] Sometime]
 due to quarantine of livestock Yes] No] Sometime]

8.8b Inconvenience / difficulty in obtaining permission / required paperwork
 Yes] No] Sometime]

8.8c Expense due to:
 legitimate official animal health certification Yes] No]
 Sometime]
 feed requirements during quarantine/transport delays Yes] No] Sometime]
 un official payments to government officials Yes] No]
 Sometime]
 possible loss of animals destroyed due to disease Yes] No] Sometime]

8.8d Other (please specify) ;.....

8.9 Is it possible to transport animals without the proper paperwork?
 Yes] No] Sometimes]

8.10 Is it likely that a person will be caught if they transport animals without proper paperwork?
 Yes] No]

8.11 If a person is caught transporting animals without proper paperwork, what is the likely penalty?

- nothing Yes [] No []
- a warning Yes [] No []
- a fine Yes [] No []
- imprisonment Yes [] No []
- other, please specify

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

8.12 If a fine is involved, how is the fine paid and to whom?

.....
.....

8.13 Is a trader likely to make more profit if he/she transports animals without proper paperwork?

- Yes [] No []

8.13a If Yes, why?

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

8.14 Do you ever attend meeting or workshop with the provincial or district vet about dissemination of new livestock movement regulation or not?

- Yes [] No []

IX- Barriers to livestock trade

9.1 What are the main problems you face as a trader?

.....
.....

9.2 What do you do to overcome/avoid these problems?

.....
.....

X- Trading patterns

10.1 Have trade patterns changed in the last:

- 1 year? Yes [] No [] Moderately []
- 5 years? Yes [] No [] Moderately []
- 10 years? Yes [] No [] Moderately []

10.2 How have trading patterns changed?

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

10.3 Why have trading patterns changed?

.....

10.4 Network map (please draw a network map of sources of animals, markets, and endpoints)



XI- Ongoing help for the project

11.1 It is important for the project to understand patterns of livestock trading over a longer period of time. Would you be prepared to provide information about livestock prices and trading on a regular basis, if you were contacted by someone working for this project?

Yes [] No []

11.2 If so, would you be prepared to give trading information to someone from the animal health authorities (e.g. your local district animal health worker), or would you prefer to be contacted by someone that doesn't work for the government?

staff from the DAHP []
project's staff []
staff from Non-government []
others.....

11.3 If you agree to provide price or trading information to someone, how you provide information that information?

message []
fax []
by phone []
other
means.....

Thank you very much for your time

Checklist as a guide for semi-structured interviews

1. Trader Profile

- a. Type of farm/trader: species, purpose, full-time or part-time operation
- b. Position of interviewee: trader/farmer/owner or farm manager
- c. Export and/or domestic trade of livestock
- d. Holding capacity or volume of livestock traded (either per week/per month/per year)
- e. How long has the business been established
- f. How the business has evolved over time

2. Procurement System

Establish a picture of the structure and the system by which livestock are procured:

- a. How and from where does the trader source animals
- b. Use of agents/middlemen/other traders/farmers (Names, contacts, location)
- c. Are these sources regular or do they change
- d. Estimate of number of animals from each source (use of flow diagram)
- e. Seasonal variation in number of animals traded/sources of animals/price – give reasons
- f. Market chain of livestock coming into this trader operation – probe back as far as possible to find original source of animals.
- g. What is the payment process between trader and suppliers
- h. Does the farm order certain numbers of animals from suppliers
- i. Do the suppliers have holdings or do they bring animals directly from where they purchase
- j. Does each supplier cover a specific area (province/district etc) or is there cross over between suppliers.
- k. Who buys animals from the village – what is the process of purchase from the village level farmer
- l. Confirm all routes coming in to the farm/trader
- m. Is there use of a livestock market or equivalent in procuring animals
- n. What is the process of bringing animals into the trader holding area/farm etc. (Probe regarding quarantine, treatments, examination to determine if any is done and whether sick animals are avoided or sought).

3. Distribution System

Establish a picture of the structure and the system by which cattle are sold.

- a. How and to where do they sell animals
- b. Who are their clients – type of client (other trader (same country or neighbouring country), slaughterhouse, farm, etc) (names, contacts, location)

- c. Do they use middlemen/agents etc to sell – how do they find their buyers?
- d. Are these clients regular or do they change?
- e. Estimate the number of livestock distributed to each client (use flow diagram)
- f. Seasonal variation in number of animals traded/clients/price – give reasons
- g. Market chain of livestock leaving this trader operation – probe forward as far as possible to find eventual destination of animals.
- h. Confirm all routes of distribution from the trader and stakeholders/locations involved.

4. Other Traders known to this trader but not connected directly

- a. Do they know who are their competitors/others doing similar work (names/locations)
- b. Do they know of other traders, even if doing different level of trading (names/locations)

5. Farm Operations

- a. Biosecurity measures used on the farm/trading area/vehicle
- b. Method of transportation: own vehicle/rented/shared and size of vehicle
- c. Vaccination: what, when, where
- d. Disinfection: what, when, where
- e. Collection and distribution of animals – by trader or collected/dropped off by buyer/seller.
- f. If they think animals are sick what do they do
- g. How do they detect fever
- h. Is it a continuous or an all-in-all-out system

6. Animal Health

- a. What are the main animal health issues they experience
- b. Have they experienced any outbreak of disease in their farm/business - describe
- c. What did they do
- d. How were they affected in terms of business: improve profits, increase losses, stop trading for a time? Other impacts?
- e. Information on suspected cause/source of outbreak

7. Pricing

- a. How do they monitor price of animals
- b. Who and what determines the price of animals

- c. How does price change according to area and what is the reason for the difference
- d. How does price change according to season and what is the reason for the difference
- f. How much they pay for livestock/for how much do they sell
- g. Try and get prices and financial arrangements at the different levels of suppliers/distributors (use of credit, paid employees, commissioned agents, traders, farmers, etc)
- h. Taxes and fees to enable them to trade
 - i. Official cost
 - ii. Unofficial cost

Appendix 3. Risk analysis components

The methodology for risk analysis increasingly features computer modelling and emphasis on quantitative methodology and outputs. Whilst our project did apply quantitative computer methodology, described below, to assess the disease risk associated with several major international livestock routes involving Cambodia and Laos, it should be acknowledged that rudimentary, qualitative assessment of disease risk is likely to remain the most appropriate methodology in these countries until more reliable data is available.

Scenario tree methodology was found by the project to be a particularly useful technique for describing disease risk along a movement pathway, regardless of whether the risk assessment remained at a qualitative level or proceeded to a quantitative evaluation.

Scenario tree methodology

Data from trader surveys and discussions with trading organisations were used to construct scenario trees of the livestock movement processes, and assign estimates of risk of carrying/spreading foot and mouth disease to each branch of the tree. The scenario tree is therefore a model of each identified important step in the livestock movement activity, with branches occurring at points where changes occur that may influence the prevalence of disease in a group (shipment or consignment) of livestock. The prevalence at each point or node along the tree is described by a probability distribution. Some branches of the scenario tree may be "dead ends" and not contribute to the final "risk" of disease at the destination. In general, the approach taken by Martin et al (2007)¹ has been used. Apart from identifying the steps in the livestock movement process, the key driver of risk is prevalence of disease. The important features of the scenario tree include:

- Prevalence at the source of livestock
- Numbers of animals in each shipment/consignment
- Number of consignments per unit of time (usually a year in this case)
- Factors - or activities (such as vaccination) occurring along the way that increase or decrease the prevalence in the consignment
- Other events that influence the prevalence (such as a period of quarantine that may result in identification and removal of a consignment, or deaths in transit)
- Other human interventions - such as the impounding by government authorities of livestock that are moved informally (i.e. without appropriate approvals, health checks, and documentation)

Many of these features are not known quantitatively, meaning that trader estimates, expert opinion, and historical data that may be several years old may be the only available data for

¹ Martin PAJ, Cameron AR, and Greiner M (2007) *Demonstrating freedom from disease using multiple complex data sources. 1: A new methodology based on scenario trees.* *Preventive Veterinary Medicine* **79**, 71-97

use in the model. Attempts are made to strengthen the modelling process through the use of sensitivity analysis, which indicates the impact that changes in a given variable (i.e. an influencing factor) have on the final risk. Where small changes in a variable are seen to have large impacts on the final prevalence or risk, caution is exercised with interpretation, and a recommendation made to quantify the variable more precisely (i.e. through further research)

Each scenario tree was constructed using Microsoft Excel®, and a risk or probability assigned to each branch of the tree. Each probability was entered as a range of possibilities, assigned empirically from best guess information, using @Risk (©Palisade Corporation, New York). This software enables an evaluation of the importance of each component of the scenario tree, and in this case, indicates where the “weak links” are, and where more information is needed. In some cases, the same data in the scenario tree were used to construct a discrete quantitative model to predict the number of infected shipments likely to enter (e.g.) Vietnam, as a cross-check to assist in the verification of model outcomes. The scenario tree is included in Appendix 9.

Appendix 4. Results of livestock movement and price mapping

Overview of Livestock Movements in Southeast Asia and China

(Provided by Project Scientist Emeritus Professor Dr John Edwards, who was the Regional Coordinator of the OIE SEAFMD programme 2001-2004)

Movements of livestock in Southeast Asia and China have varied in direction and numbers have fluctuated over time. This has been reflected in the spread of new strains of Foot and Mouth Disease. The main drivers appear to be demand for particular livestock products and particularly in larger centres.

The current project has been conducted in the Mekong Basin countries of Cambodia and Lao PDR, which are in the middle of major movements of livestock across the whole of mainland Southeast Asia and China. Several of the major pathways pass through these countries.

For pigs, the movements are generally on a smaller scale to satisfy local demand or are movements direct to slaughter in neighbouring countries. The risk of transmission of FMD is generally lower. Movement over larger distances is generally as meat and a significant risk is the movement of frozen or chilled suckling pigs at times of religious festivals.

Below is a brief synopsis of the changing patterns of the livestock movements and examples of related spread of new or emerging FMD strains.

1990s and early 2000s

In the 1990s, the major pathways for movements of cattle and buffalo were to Malaysia and Thailand where the demand and prices were highest. The main sources were Myanmar and Vietnam (through Cambodia and Lao PDR). There were also movements from China to Vietnam and also down the Mekong through Myanmar and Lao PDR by land and boat (Ted Chapman). Some of these animals had originated from Myanmar. Cattle were sourced from the south eastern provinces of Cambodia to satisfy the demand in HCMC. Cattle from the western parts of Cambodia moved to Thailand.

During this time new FMD strains followed these pathways and these included the introduction of the Pan Asia toptotype, the first Southeast Asian reports of the Cathay strain in Vietnam and new strains of Type A in Thailand, Lao PDR and Malaysia.

Mid 2000s

During the 2000s, as livestock prices in China began to increase, the flow of animals from China along the Mekong stopped. Movements to China then began to increase, particularly through Myanmar.

In the mid 2000s (about 2005), there were significant increases in prices for livestock in Vietnam. This led to a reversal of trade direction, with cattle and buffaloes being moved through Cambodia and Lao PDR to Vietnam. This coincided with the

detection of the first outbreaks of FMD in cattle in Vietnam due to type A strains similar to those found in Thailand.

Late 2000s

Strong growth in China and higher prices of livestock products increased the numbers of livestock to China through Myanmar, Lao PDR and Vietnam. Many of these animals originated from Myanmar and Thailand. These changes have seen the Myanmar 98 strain of Type O become the dominant FMD strain throughout Southeast Asia. This strain then spread to the north through China, Mongolia, Russia, South Korea and Japan in 2009-10. The spread of a type A strain of Thai origin to China and other places also occurred during this time. Movements of meat and people may have contributed to some of this disease spread.

Further expansion of the pig adapted strain of Type O FMD to Thailand and Malaysia occurred during this time.

In 2011 the major cross regional movements appear to be changing again.

For these reasons, many of the price changes and livestock movements in Cambodia and Lao PDR are part of a larger regional pattern and the movements and the spread of new strains of FMD reflects this.

Activity 1.1.1 & Activity 1.1.2: Movement studies based on existing recording systems

Greater Mekong Sub-region

Data collection started in January 2008 in Cambodia and July 2008 in Laos. Retrospective records were included in Cambodia, going back as far as 2004. Where it was possible to identify the original source of the data, 3 028 records were derived from sanitary certificates, 2 885 from movement permits and 1 098 from purchasing permits.

The details of a total of 15 743 official movement permits were collected during the research. Of these, 3 060 were collected in Cambodia using the Access database system by provincial office staff. The remaining 11 643 records were entered into the database using the web interface by three national level staff each from Cambodia (5 915 records) and Lao PDR (5 728 records).

A number of provinces submitted very few (if any) movement records. Seven provinces in Cambodia and 4 in Laos submitted less than 100 records. In Cambodia these provinces were visited and if further records were available they were collected and entered into the system. In a number of these provinces this was a valid representation of the real situation and that few movement permits are issued as the province is a net importer of livestock.

Seventy of 211 provinces in South East Asia (and 5 of 34 in China) were involved in the overall set of data collected between January 2004 and December 2010, including all provinces in Cambodia (24) and Laos (17), and a number in Thailand (12), Vietnam (7), China (5), Myanmar (4) and Malaysia (1). The geographic range of movements identified during this study extended from Chin State in Myanmar and

Kelantan in Malaysia through to Liaoning in China. This research was primarily conducted in Cambodia and Laos, so it is ironic that at no time during this period were there any records of cattle movements directly between Cambodia and Laos in either direction, and only very few of pigs moving from western Cambodia to southern Laos.

A number of records (< 1%) had errors in the movement dates, due to the lack of internal validity checking in the Access database. While some could be corrected using other information available, in some cases where the date could not be validated, the data had to be discarded (2 records).

A summary of the data collected (number of movements and number of animals moved) is shown in Table A4.1.

Table A4.1: Number of movement consignments and total number of animals in those consignments recorded during the project.

| Species | Movements | Number of animals | Average size |
|--------------|---------------|-------------------|--------------|
| Buffalo | 3 273 | 32 685 | 10 |
| Cattle | 6 147 | 141 676 | 23 |
| Pigs | 6 321 | 206 519 | 33 |
| Total | 15 741 | 380 880 | |

The numbers of animals (For example, < 40 000 per year in Cambodia and \approx 6 500 per year in Laos) covered by permits is likely to be an underrepresentation of the total number of movements. To illustrate this, during the course of this research some summary data from road checkpoints in Laos during 2009 were assessed. Although there appear to be some errors in the data the number of animals passing through the checkpoints is shown Table .

Table A4.2: Number of animals recorded travelling through checkpoints in Laos

| Checkpoint | Buffalo | Cattle | Goat | Pig | Total |
|---------------|--------------|--------------|------------|--------------|--------------|
| Ban Din Dam | 349 | 391 | 20 | 539 | 1299 |
| Ban Nong Het | 585 | 507 | 90 | 10 | 1192 |
| Khoun | 779 | 343 | 0 | 77 | 1199 |
| Nan Ngen | 239 | 263 | 0 | 24 | 526 |
| Nasaythong | 5143 | 5698 | 131 | 14616 | 25588 |
| Naxai Neua | 39 | 55 | 0 | 290 | 384 |
| Nong Buathong | 9692 | 7832 | 23 | 31746 | 49293 |
| Phoukoun | 930 | 417 | 590 | 241 | 2178 |
| Phoukout | 1658 | 1172 | 42 | 378 | 3250 |
| Total | 19414 | 16678 | 896 | 47921 | 84909 |

Perhaps the most important finding is the almost complete change in direction of movement of cattle since 2004, although Phnom Penh remains a major destination for cattle. The early records included movements of cattle to Malaysia by sea, and to Thailand. The more recent records had no movements to Malaysia or Thailand, but cattle moving to Vietnam.

When the movement records from Laos are also included, it combines to create a compelling picture for the importance of China as a source of livestock demand. This is illustrated in Figure A4.1, which demonstrates movement into Yunnan province and beyond from a plethora of sources including Chin State in Myanmar, North and North Eastern Thailand and Laos. Additionally, as well as cattle moving from Cambodia into the southern provinces of Vietnam, there are now records of animals moving into northern Vietnam.

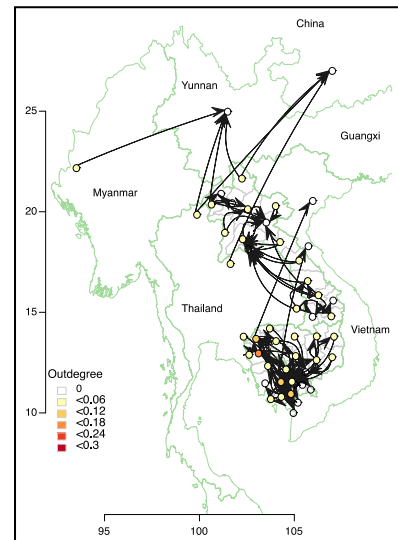


Figure A4.1: Movement of Cattle and Buffalo through Cambodia and Laos from 2008 to 2010

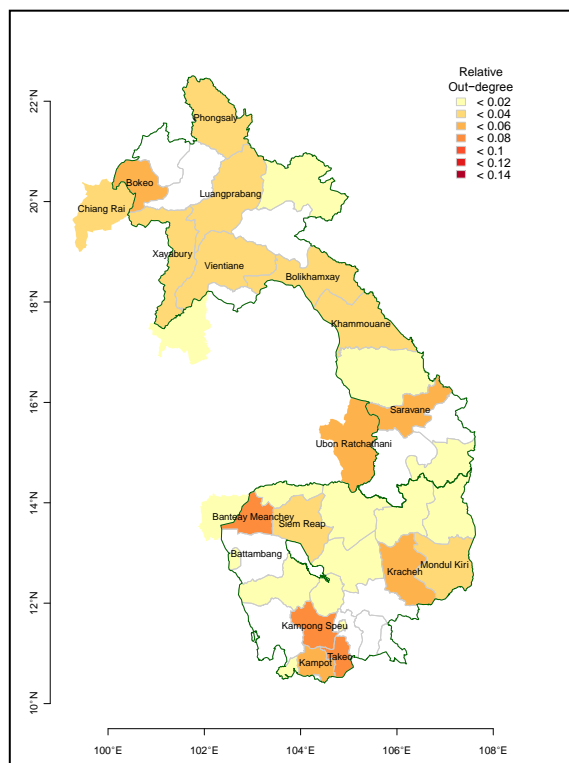


Figure A4.2: Choropleth map showing province out-degree in Cambodia and Laos

Network Analysis of movements by province concurred with the basic animal movement data for 2009 showing provinces with higher out degree to the west of Cambodia and Laos (Figure A4.2), and higher in degree to the east and north (Figure A4.3). It also identified that movements from provinces such as Banteay Meanchey dispersed to a wide range of other provinces, and that Phnom Penh, Vientiane and Xiengkhouang were receiving cattle from a larger number of other provinces than most other provinces.

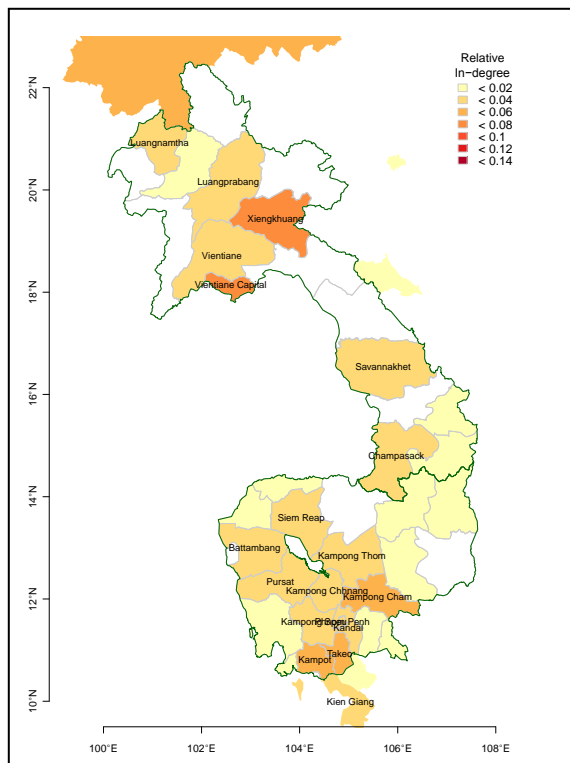


Figure A4.3: Choropleth map showing province in-degree in Cambodia and Laos

Western Australia

The data for the period July 2005 to June 2008 included 1 737 920 animals completing 3 962 188 movements. This included twelve movements of a total of 107 cattle from eight property source codes and 19 movements of 482 cattle to ten property destination codes which could not be identified due to anomalies in the data. Six of these movements involved the same property. These records were excluded from further analysis as no further information was available to identify to which shire they related. A further two movements to a destination type of 'exported' were adjusted to a destination type of 'port'—in the case where the origin was a Queensland saleyard they were assigned to export through the closest WA port to Queensland—Wyndham. Where the origin was the Swan Valley (the shire where the Midland Saleyards are located) they were assigned to the Fremantle Port—again the nearest live export port. This resulted in a final data set of 3 961 600 movements undertaken by 1 737 833 animals.

Although the NLIS theoretically captures all cattle movements, for historical/political reasons some classes of cattle movements (typically direct to slaughter or live export from the property of origin) are not required to be reported to the NLIS in WA. Regardless, an increasing trend of animals arriving at abattoirs with RFID tags suggests that producers are tending to tag more animals.

Over the period the number of movements recorded on the database have increased. The numbers going to saleyards have not changed substantially during this period, while numbers going to abattoirs and live export have increased.

The number of discrete movements undertaken by WA cattle ranged from one to 19 during the three year period. 589 animals (0.03%) moved ten or more times. The three animals that moved 19 times travelled together and covered approximately 7 500 km each between January 2007 and May 2008.

Unlike in the GMS, there was a significant ($p < 0.05$) seasonal variability to the movements in WA. This is shown in Figure A4.4.

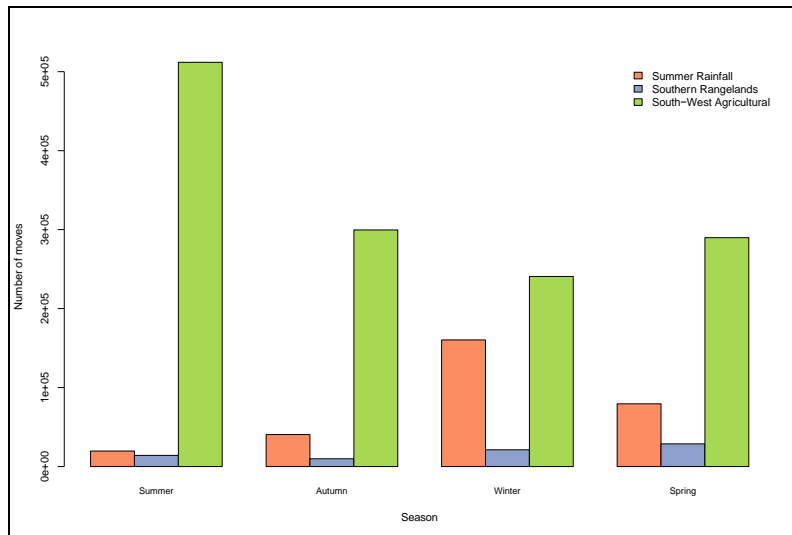


Figure A4.4: Plot of movements by season and region in Western Australia.

Network analysis by type of property identified 11 types of node in a directed network (Figure A4.5). The largest number of movements was from producer to saleyard, producer to producer and saleyard to producer. There were also large numbers of animals moving directly from producer to abattoir and export depots.

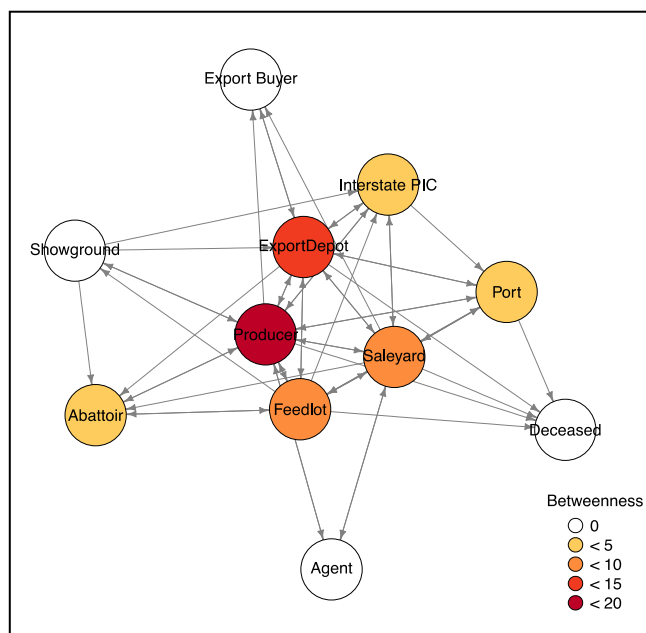


Figure A4.5: Plot illustrating betweenness in a network of livestock ownership type.

When analysed by location, there were 126 nodes (120 shires and 6 other states or territories). Over the three year period, only two shires (Sandstone and Mount Magnet) and one state (Tasmania) received no cattle. The Shire of Swan had the highest centrality with a betweenness of 2 561 and in-degree of 116. These measures of the network will vary when the temporal period is adjusted, as some nodes will no longer be linked by movement. On a weekly basis the network diameter ranged from 5 to 11, with a median 6.

To aid identification of high risk areas for disease spread (high in-degree) and source (high out-degree) as well as locations where prevention activities should be focussed the centrality parameters were displayed on maps, an example of which is in Figure A4.6.

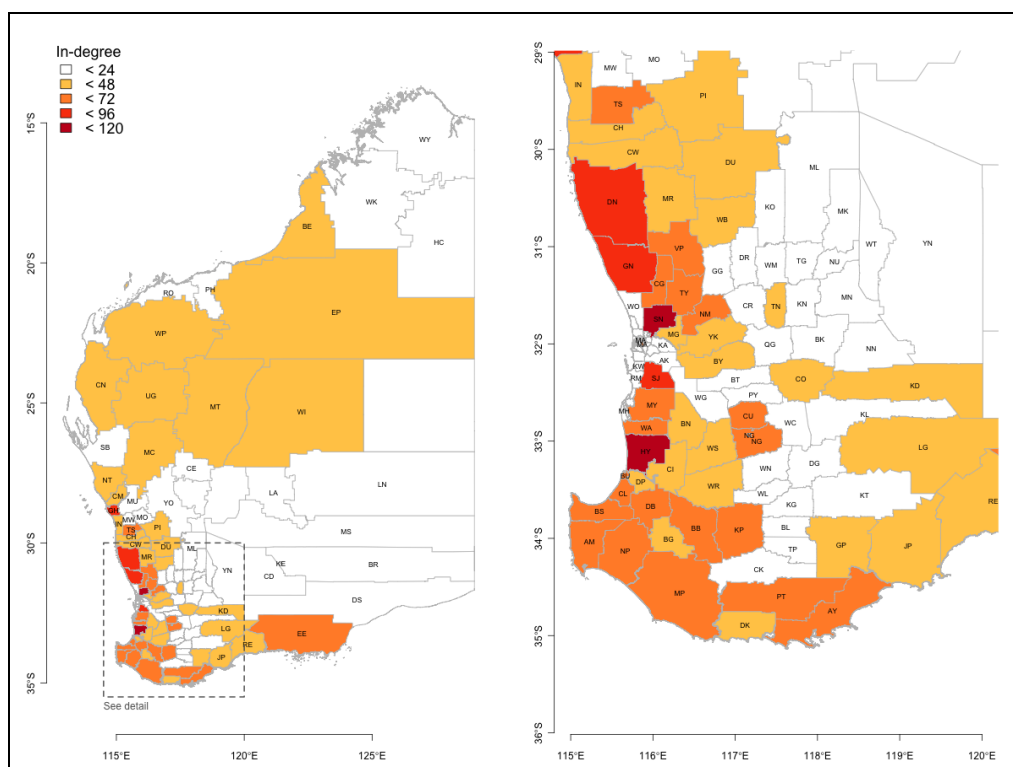


Figure A4.6: Choropleth map showing in-degree of a cattle movement network by shire in Western Australia

Appendix 5. Characteristics of livestock traders in Cambodia

Characteristics of Livestock Traders and Trading in Cambodia

Socheat Sieng, Hawkins CD, Madin, B, Kerr J

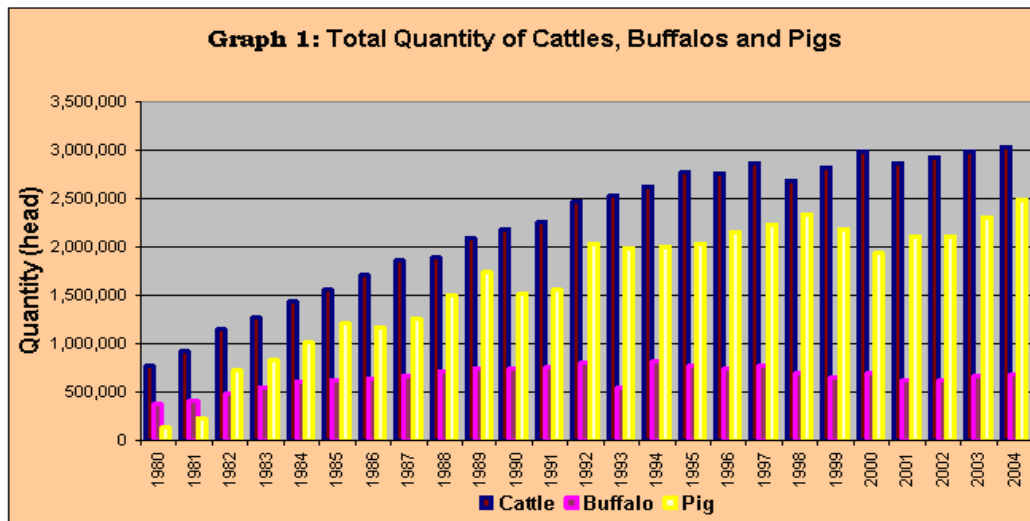
Introduction

Transboundary animal diseases, particularly foot and mouth disease and swine fever (hog cholera) limit production and invoke resistance by trading partners to international movement of livestock and livestock products. Management of these diseases by traditional methods of checkpoints, movement permits, and fines for unregulated movement of livestock tend to be counterproductive, resulting in further unregulated movements to avoid regulatory processes. In the absence of a national livestock identification system, tracking animals and their products is difficult, and determining livestock movements within countries and between neighbouring countries is problematic. As part of ACIAR project AH/2006/025, discussion with livestock traders was initiated, with the view to determining the characteristics of trade and traders within Cambodia, and the nature of the interface between domestic and cross-border trade.

Current knowledge

Livestock numbers in Cambodia appear to be increasing, with the exception of buffalo, where numbers are relatively static (Figure 1), and livestock production (excluding poultry) comprised about 11% of agricultural GDP in 2005, equivalent to about \$US158 million Cambodia's trade is primarily with China, Thailand and Vietnam. Although there is trade with Lao PDR and Myanmar, available data suggests this is limited. The comparative advantage of live animal exports to China particularly, is increasing (Hing et al 2007).

Figure 1. Livestock numbers in Cambodia – Cattle, Buffalo and Pigs (Source: MAFF Cambodia)

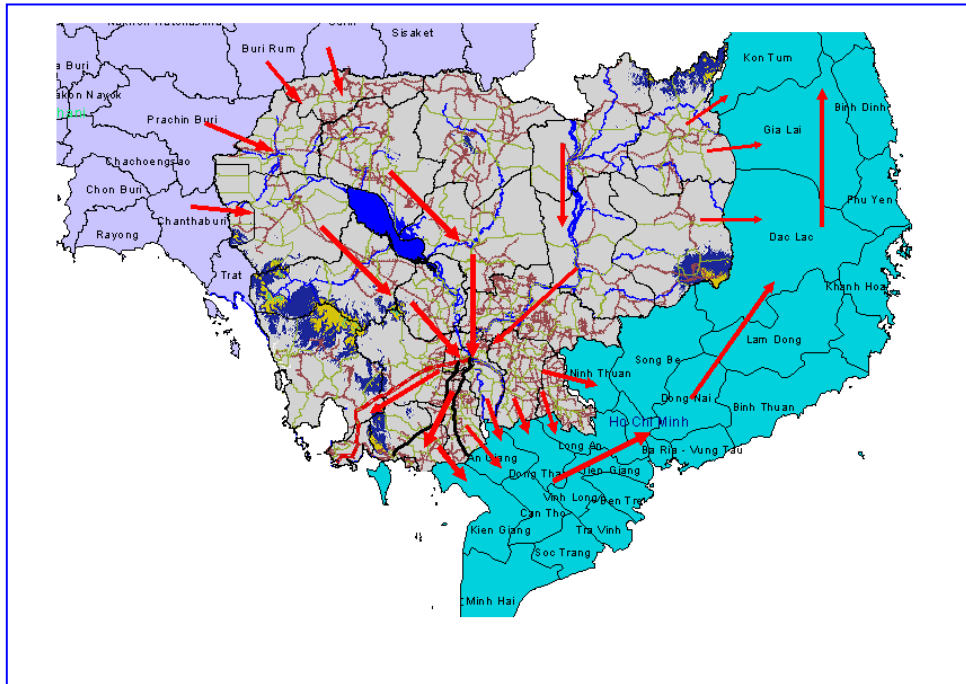


However, statistics do not reveal the full extent of livestock (and other agricultural products) moving into and out of Cambodia, because much trade is unrecorded (Hing *et al* 2007). With support from international organisations, collection, compilation and reporting of agricultural and other statistics have been enhanced in recent years (Hor 2008)

Work undertaken by the OIE² has identified general movement directions of livestock into and out of Cambodia (Figures 2 and 3, Abila and Linchongsubongkock 2004). While this is valuable in providing an overview of general trends in movements, it is not quantitative, does not indicate major movements, and it is also a static picture of movements at one point in time, whereas drivers of movement, and therefore movements themselves, change with season, feed availability and consumer demand for livestock.

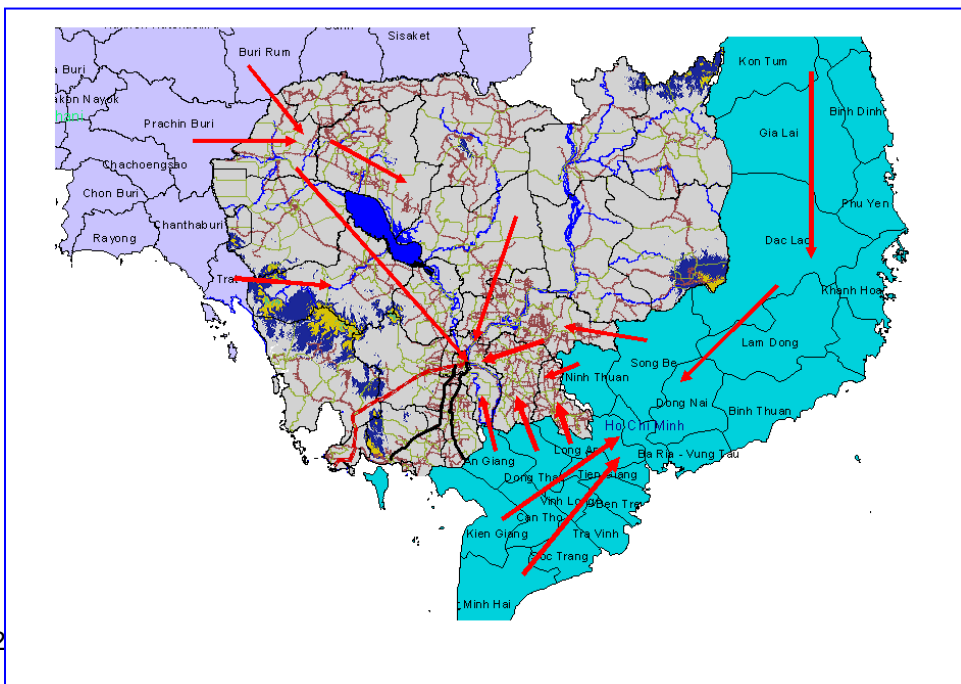
² Office Internationale des Epizooties: World Organization for Animal Health, South East Asian Foot and Mouth Disease Campaign, Regional Coordination Unit, 69/1 Phaya Thai Road, Rajathevee 10400 Bangkok, Thailand

Figure 2. Direction of movements of cattle in Cambodia and neighbouring Thailand and Vietnam



In a world that is increasingly concerned with the spread of transboundary diseases, it is essential understanding livestock movements and the risks these pose to trade because of disease spread. Therefore, to support Cambodia's growing livestock export trade with Thailand, Lao PDR, Vietnam and China, and in particular to protect Cambodia's markets, it is important to gain a foundational understanding of the people who facilitate the trade in livestock – that is, the traders, and the nature of that trade.

Figure 3. Movement of pigs in Cambodia and neighbouring Thailand and Vietnam



Livestock trade requires the movement of live animals and animal products, and it has long been recognized that such movements are prime means for spreading disease – with rinderpest probably being the classic example (Scott 2000; Pastoret *et al* 2006, Murcia *et al* 2009). The ongoing challenges of controlling foot and mouth disease and classical swine fever (which are primarily spread by contact directly and indirectly between livestock) require an understanding of livestock movements and how these can be influenced to reduce the risks of disease spread.

In Cambodia, susceptible livestock (cattle, pigs, buffalo) are widespread in villages across the country and used for transport, draught, and food. Movements within the country occur on foot and by vehicle, with additional movements of cattle and pigs across national boundaries. Outbreaks of FMD are common (Gleeson 2002), and Cambodia is participating in the regional control of FMD through the OIE Regional Coordination Unit. The present study seeks to provide qualitative and quantitative data on livestock traders and their activities, with the view to developing non-legislative strategies to enhance the safety of livestock movements within Cambodia, and across national boundaries.

Methods

Traders are required to apply to the Department of Animal Health and Production for permits to move livestock. From departmental records, regular traders operating in the Phnom Penh district, Takeo and Kampong Cham provinces were identified, and asked to participate in a survey by interview. Traders were selected on the basis of availability and willingness to participate. They were invited to a convenient location, and provided with refreshments before interviews. A small incentive payment (\$US5) was provided to traders on completion of the interview.

Preliminary discussions were held with two groups of traders, to build rapport between them and project staff, to gain an understanding of their willingness to share information, and pilot the questionnaire.

The survey questionnaire was developed by project personnel, with input from sociologists at the Royal University of Cambodia. The interview questionnaire sought information about personal characteristics such as age, gender, and education, but primarily sought details of trading, biosecurity practices, impact of regulations, and of factors that traders considered influenced their activities.

Interviews were conducted in Khmer by a bilingual veterinarian, who also translated findings into English, and entered these into a computerised database for later analysis. Strict confidentiality was maintained for all interviews.

A total of 60 traders were interviewed in the period September to December 2008, with 20 from each of the three districts.

Analysis was basic, using frequency distributions, and where comparisons were required, using cross tabulation or analysis of variance. Results are presented as overall outcomes, unless a specific group or province varied significantly.

Characteristics of traders

All but one trader were males. The only female trader was from Kampong Cham, she traded in cattle, and was aged between 31-40 years.

Age of traders is given in Table 1. This distribution was consistent across provinces.

Table 1. Age of Traders

| Age Range | Number (Percentage) |
|-------------|---------------------|
| 20-30 | 8 (13) |
| 31-40 | 23 (39) |
| 41-50 | 17 (28) |
| 51 and over | 12 (20) |

Educational level was evenly distributed between completion of grades 1-7, and grades 8-12. One trader advised that he had a college or university education.

Just over half (57%) were part time traders who pursued other work for themselves (e.g. rice cultivation), or were involved in a small business or worked for another person. About a third (32%) indicated that they were full-time traders, and 8% stated that they sometimes pursued other activities. Two respondents indicated that they were full time rice farmers, who occasionally traded livestock. A large majority (77%) stated that they raised animals at home for consumption, or to supplement family income. A decision to raise livestock was made independently of their trading business by 71% of respondents, whereas the other 29% said that raising stock was because of their trading business.

Most had been trading for several years, with 12 (20%) indicating that they had been trading for 3 or fewer years. Reasons given for being a trader were: family tradition (62%), a good source of income (48%), or encouraged to do so by others (17%). Of note was the sense by some (30%) that they had no other option. A clear majority (82%) indicated that they ran their business alone, without assistance from family members. Traders were evenly divided on whether they knew that a family member (e.g. a son) wanted to become a livestock trader.

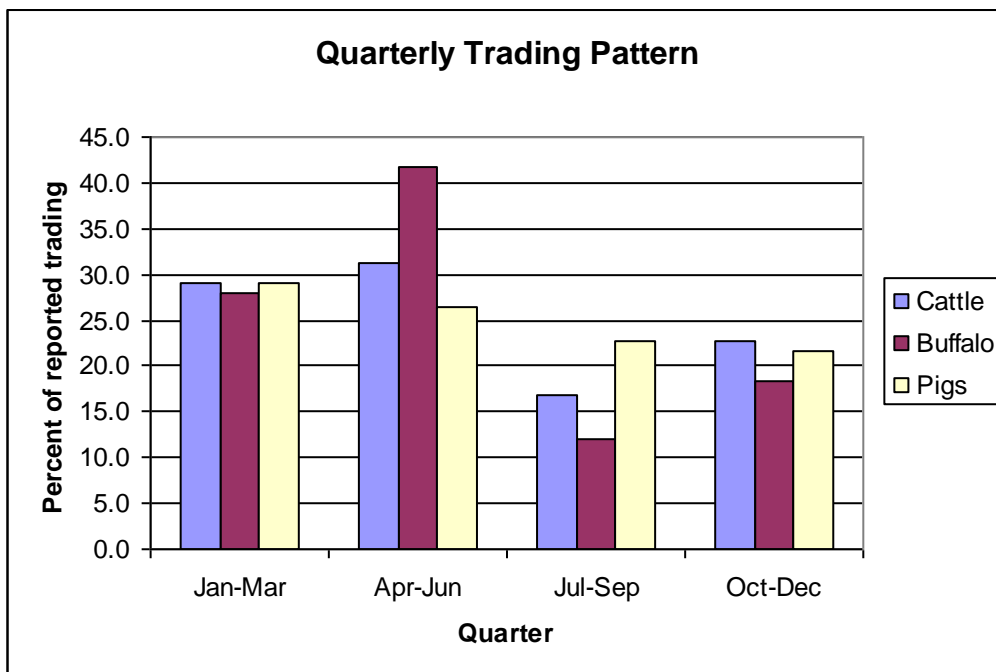
Trading practices

Cattle and buffalo were the main animals traded (59%), with the remainder trading pigs. Of those trading cattle and buffalo, 13 (22%) traded in cattle exclusively.

Annual estimates

Each year, an average of 519 (47 – 3650) cattle, 88 (10 – 384) buffalo, and 1840 (48 – 18250) pigs were sold by traders. Volumes traded were heavily skewed towards the lower end of the range, with a small number of traders dealing in the larger numbers reported.

Figure 4: Trading by quarter



Trading was generally greater in the first half of the year ($p < 0.05$, Tukey's HSD) for all species, although not as marked for pigs. Festivals in the early part of the year (e.g. Chinese and Cambodian New Year celebrations) may account for this. The percentage of buffalo traded was markedly higher in the April-June quarter, but traders did not comment on the reasons for this. Drivers of this pattern need further elaboration, and the effect of feed availability and season may have an influence.

Traders recognized that the first half of the year was generally better for trading for all species, and offered their own reasons for this (Tables 2 and 3).

Table 2: Major reasons given by traders for greater cattle/buffalo trading in the first half of the year

| Reason | Percentage of Traders indicating |
|-------------------------------|----------------------------------|
| High demand of meat markets | 41 |
| Farmer preferred selling time | 35 |
| Higher sale price | 32 |
| Festive seasons | 29 |
| High demand from Vietnam | 21 |
| Low season for fish | 18 |

Table 3: Major reasons given by traders for greater pig trading in the first half of the year

| Reason | Percentage of traders indicating |
|-----------------------------|----------------------------------|
| Festive season | 62 |
| Low fish season | 54 |
| High demand of meat markets | 31 |
| High sale price | 19 |

The predominant reasons given for the second half of the year being a more difficult time for livestock trade were generally the opposites of the above. However, traders did indicate that the rainy season had some effect, and the involvement of both people and livestock in rice cultivation temporarily removed some suppliers and livestock from the market. A large number of pig traders (77%) identified the high fish season adversely affected their trade. This indicates that consumers are substituting fish and pork at different times of the year. The reasons for this may be price related, but further investigations are needed to determine whether there are specific social drivers of this, or whether it is simply a supply and demand issue.

Method of sourcing animals

Traders use a variety of means to obtain livestock for sale. Most commonly, stock is sourced directly from producers, either directly by travelling round to known sources, or indirectly through phone contact, or family networks. An important way of finding

stock for purchasing is contact made by producers wanting to sell. This suggests a local supply network that traders develop as part of their operational strategy.

For the most part, traders obtain stock locally (within their home district, or within their province), although all traders indicated that they will move beyond their provincial boundaries to obtain stock.

Finding buyers

Again, trader networks are the primary ways of locating buyers. These networks extend to other traders within Cambodia, and across the border into Vietnam (6 traders). Information about local demand is circulated through local village networks. A small number (8) reported linkages with slaughterhouses, and sold stock directly to these. Two (2) traders mentioned a specific company that they deal with (Yuveak Peanik Company). Further discussion is warranted to determine the role played by bigger companies in the national/international movement of livestock.

Transport methods

Trucking was the main method of transport, with 77% of cattle traders and 69% of pig traders indicating transport by truck. A further 23% of cattle traders walked their stock to markets. Interestingly, about 58% of pig traders indicated that they also walk their pigs to markets, with 73% of pig traders also using motor cycles as transport.

Figure 5 Transport to and from a pig market using motorbikes



On occasions, where roads were poor or non-existent, traders had used boats to take cattle (4 traders) and pigs (1 trader) to Vietnam.

Time before sale and holding practices

About two-thirds (39) of traders sold their stock within a short time of purchase (several hours to a few days). This included virtually all the pig traders, who tended to trade locally. Transportation of pigs was considered relatively inexpensive compared with cattle, but the cost of transport was not volunteered. Reasons given for this rapid on-selling were to take advantage of good prices, and the concern that livestock could lose weight while waiting to go to markets.

Because of the higher costs involved in cattle transport, about a third of traders hold their animals pending transport and sale. Holding areas included their own land, leaving stock with the original seller until transport was arranged, or using a third party holding area where animals could be kept until a full load was available. Traders sometimes share transport (i.e. to make up a load), but only if this was mutually beneficial (such as going in the same direction, or to the same market).

Destinations of livestock

Only two-thirds of traders responded to this question. Most of those who responded (25) delivered stock to slaughterhouses within their province and district, or to a slaughterhouse in another district but within their province. Other destinations included other farms in the district, locations in Phnom Penh, slaughterhouses in other provinces, or delivery to a collection point within the district. Two traders indicated that they delivered to a holding point on the border of Vietnam.

Trading partners and trading alliances

Clear trading preferences were expressed by the majority of traders. Almost all (58) would prefer to purchase directly from livestock producers, and a large proportion (45) would prefer to supply directly to slaughterhouses, rather than deal with markets or other intermediaries. There was also a high acceptance of trade between traders (40). However, only 11, or 18% expressed a desire to be involved in the international trade. Reasons given for this low rate were inexperience with international trade, and lack of a suitable international trading network through which to operate.

About half of the traders indicated that they had little or no awareness of trader associations in Cambodia³.

If an association of traders were to be formed, the majority of those who had an opinion (19) felt that traders themselves should form this. Other organisations mentioned that could assist in the formation of a trader association included the Department of Animal Health and Production (14), or other government agency (7). Formation of an association by a private company, a local authority, or a non-government organization (NGO) were mentioned, but did not have strong support. Traders felt that an association had to be inclusive, allowing all members to be involved in decision making, that procedures should be fair and transparent, and be able to enlist support from the national government as well as NGO's.

³ Discussion with the Cambodian Development Resource Institute (CDRI) indicate that there are no trader organisations.

Trader networks

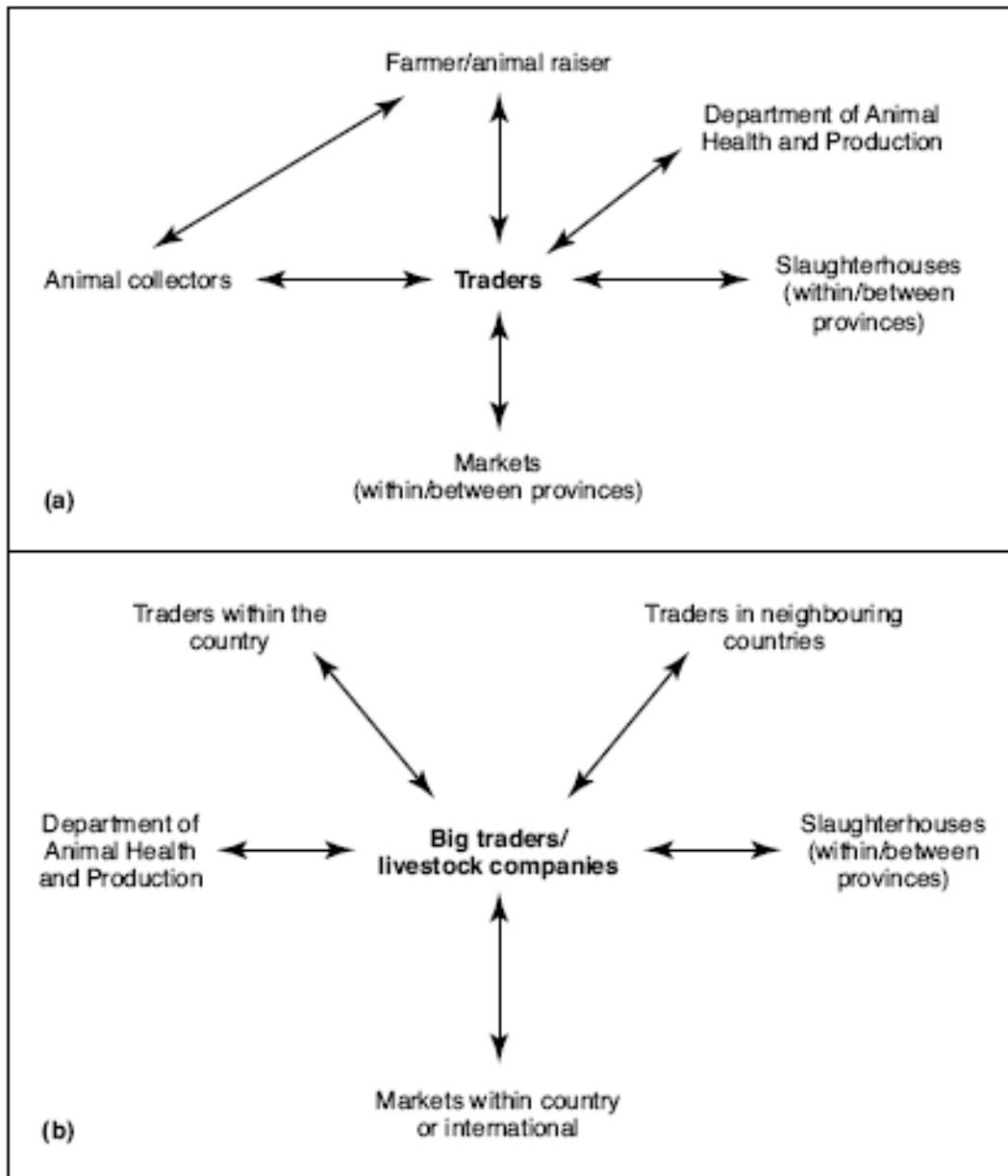
Preliminary discussion with traders had previously indicated that there were informal networks of traders operating in Cambodia. All the traders indicated that this was the case, and that the effectiveness of the networks was based on positive relationships between players. However, the networks were considered to be fairly fluid, depending on the nature of each trader's operations. For example, part time or short term traders had more limited networks, whereas some of the bigger traders had stable networks involving several provinces, slaughterhouses, and international connections. Network maps were constructed from information provided by traders (Figures 6a and 6b)

Networks were maintained by a mixture of social and financial linkages. Informal communication was the main driver (78%), with more formal methods (telephone, in person information transfer) playing a lesser role. Financial drivers included payment (commission or retainer) to collectors who obtain livestock for traders, small traders who sell to the larger traders, and buyers from Vietnam sourcing stock in Cambodia. Specific linkages were developed with friends (83%), other traders (75%) family or relatives (45%), people within the same religious group (20%), and villagers (10%).

Price awareness

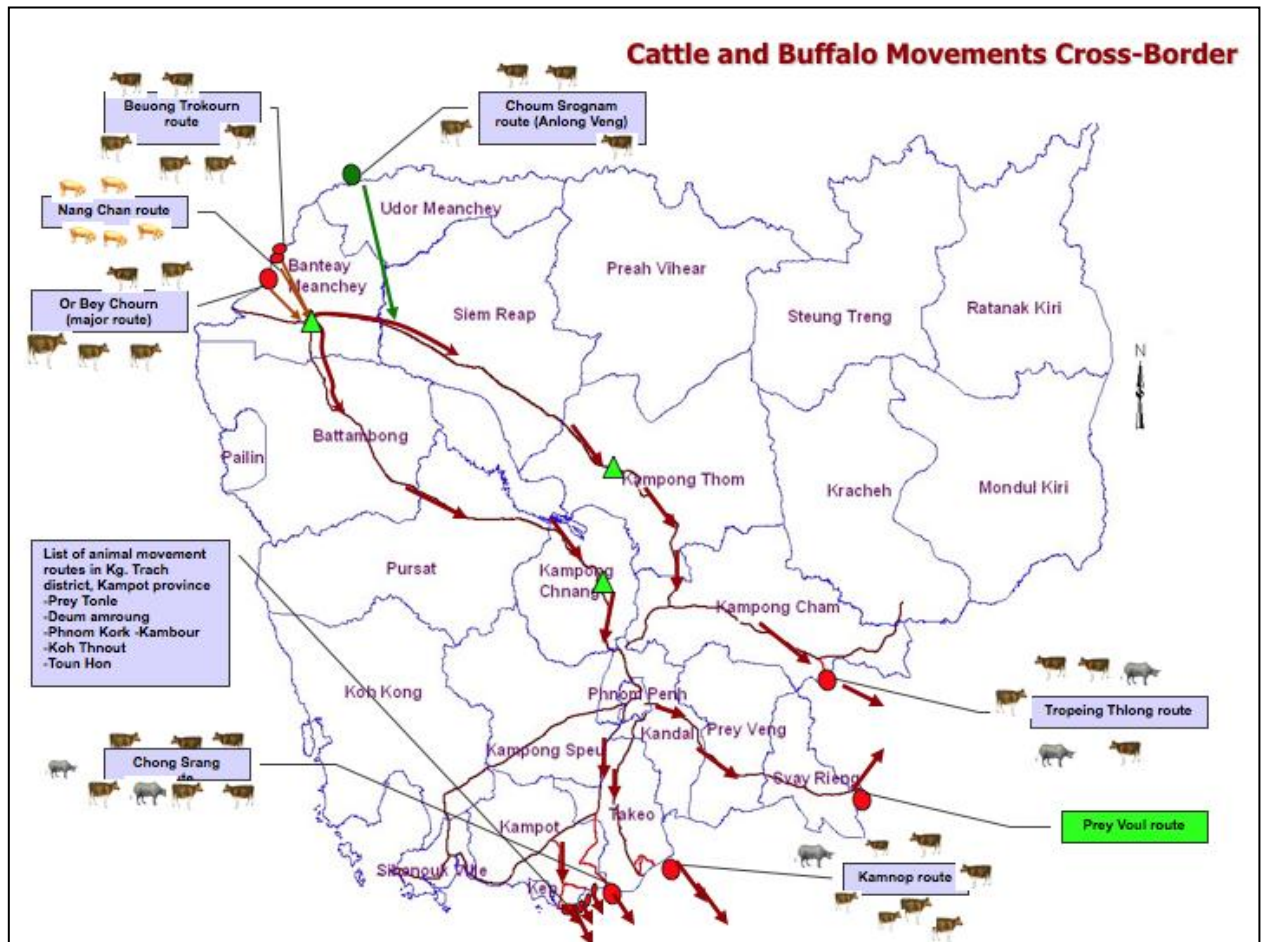
Traders perceived that price of livestock was a multi-factorial issue, and identified some factors that influenced price. For cattle and buffalo, price was strongly determined by the health and body condition of the animal itself. Demand within Cambodia was important, but internationally only the price in Vietnam was seen as important. Time of year was mentioned as being important, and this may be influenced by seasonal supply, or festivals as discussed previously. Of note was that the cost and availability of feed for holding cattle/buffalo was not seen as an important issue, and this was possibly related to the fact that most cattle and buffalo are on-sold quickly after purchase.

Figures 6a and 6b: Network linkages traders recognize for domestic trading (a) and international trading (b). Arrows indicate flow of information.



For pigs, the same issues of health, body condition and demand within the country were seen as important. Internationally, the demand from Vietnam and Thailand were identified as relevant. Festive seasons were also identified as important drivers of price, but unlike cattle and buffalo, the availability and cost of feed and water was seen as important.

Figure 7: Movement of cattle and buffalo from Thailand across Cambodia to Vietnam



Why farmers sell stock

In an ideal system, sale of stock would result from planned production which enables traders to optimise their activities on the basis of a regular production cycle. However, traders perceived that production is not necessarily predictable, and producers sell for a range of reasons other than planned production. Reasons given by traders for sale of stock are provided for cattle/buffalo and sheep in Tables.....

Table 5. Reasons given by traders for why producers sell cattle or buffalo (listed in order of major reason)

| Reason given | Major reason | Minor reason | No effect |
|------------------------------|--------------|--------------|-----------|
| Urgent need for money | 33 | 1 | 0 |
| Good prices | 25 | 9 | 0 |
| Replacement/exchange stock | 19 | 11 | 4 |
| Disease status of animal | 18 | 15 | 1 |
| Age of animal | 15 | 18 | 2 |
| Surplus stock | 12 | 22 | 0 |
| Disease status in district | 10 | 23 | 1 |
| Body condition | 8 | 21 | 5 |
| Cost or availability of feed | 5 | 19 | 10 |

Table 6. Reasons given by traders for why producers sell pigs (listed in order of major reason)

| Reason given | Major reason | Minor reason | No effect |
|------------------------------|--------------|--------------|-----------|
| Urgent need for money | 26 | 1 | 0 |
| Good prices | 18 | 9 | 0 |
| Cost or availability of feed | 18 | 7 | 2 |
| Body condition | 15 | 11 | 1 |
| Disease status of animal | 15 | 10 | 2 |
| Age of animal | 13 | 14 | 0 |
| Disease status in district | 12 | 13 | 2 |
| Replacement/exchange stock | 11 | 14 | 2 |
| Surplus stock | 6 | 21 | 0 |

The perception of traders was that the need for funds was the main driver behind the sale of both cattle/buffalo and pigs by producers. Good prices were identified as important to producers, but that this took a secondary place to other pressing demands. The need for replacement or exchange stock was strongly identified as a

major reason for selling cattle/buffalo, but not as strongly for pigs. This may reflect an ongoing need for draught animals, a reason which would not apply to pigs. However, some replacement of boars and sows would be warranted, and this is reflected in trader responses.

Cost or availability of feed was rated highly by traders as a major reason for selling pigs, but was not for cattle/buffalo, although it may be an important secondary reason for their sale.

Disease status was identified as a major reason for the sale of all stock by producers, although the number of traders indicating this was less than a third. Although not specifically indicated in the questionnaire, producers possibly sell stock they identify as diseased in order to minimise financial loss (i.e. sell for slaughter before the animal dies⁴).

Impact of sick animals

Anecdotal evidence suggests that traders actively seek out animals that are sick, particularly with foot and mouth disease, and purchase them at greatly reduced prices. These stock are then either sold to slaughterhouses at close to full price, or kept in a holding yard for several days until symptoms of FMD have resolved. Traders were therefore asked about trading in sick animals, and to provide information about their knowledge of stock infected with either foot and mouth disease or classical swine fever.

About 83% of traders advised that farmers do sell sick livestock. The reasons they gave for farmers doing this included: fear of the animal dying (67%); salvage some of the animal's value before death (48%); concern that the animal may not fully recover (23%); concern about the spread of disease (23%); high cost of treatment (2%); chronic weight loss (2%). Of those who commented that farmers did not sell sick animals, reasons given were that no-one will buy them, and that sick stock cannot be transported over long distances (3 traders).

A large majority (92%) stated that they were aware of and could recognize foot and mouth disease because of common clinical signs. About half (53%) acknowledged that they sold stock with FMD. Reasons given were: concern that the animals might not recover fully (22%); to make more profit (13%); concern that the animal might die (32%); concern about losing money (23%). A variety of other reasons were given, including: diseased cattle/buffalo cannot be used for rice cultivation; concern about the spread of virus to other animals; salvage some value to put towards replacement stock; disease is not contagious to people; and sell stock for meat processing (dried meat). Some of these latter reasons for selling stock relate to animals that the trader may personally own or use in ancillary activities, and may be less related to trading *per se*.

⁴ Subsequent discussion with village producers in Kampong Cham confirms this practice, which applies to foot and mouth disease. Even though FMD is rarely fatal in adult cattle, villagers will often accept a low price when offered by a trader.

While the majority of traders indicated that they would sell diseased stock to a slaughter house, some (7%) stated that they would on-sell to other traders, and one trader mentioned selling diseased stock to other producers. Twenty-five percent (25%) of traders resold diseased stock immediately, and 12% waited for stock to recover before sale. Sale of diseased stock was primarily to slaughterhouses (33%), which were in the same district from which the stock were purchased (28%), in an adjacent district (3%), or another province (3%).

Where stock were retained until clinical signs resolved, these were kept at the traders premises (house) and may have been treated (5%), or in an isolation facility (8%). A small majority (58%) were aware that FMD was contagious. Understanding of the method of spread varied, with the following methods reported by traders: wind (17%); physical contact with sick animals (58%); on infected equipment or materials (13%); by transportation (15%); and contacting the virus in the field (25%).

About half the traders (48%) indicated that the price of FMD affected stock was lower than for healthy stock, but did not indicate the size of this difference. The majority (52%) indicated that once stock had recovered from FMD, prices returned to that of healthy stock.

Of particular note is that there appears to be ongoing trade in livestock infected with FMD, which could be expected to contribute to the persistence of the disease in an area, and/or the spread between districts or provinces.

A similar approach was taken in regard to trader understanding of classical swine fever. However, only 8 traders (13%) knew of this disease and felt they could recognize it. The remainder of the traders were not aware of this disease. A reason for this may be that CSF is fairly acute, and pigs become very debilitated, often dying.

Although five (5) stated that they traded pigs with CSF, it would be unlikely that affected pigs were being traded in large numbers. However, this cannot be ruled out without further investigation; movement of pre-clinical infections and convalescent carriers are also possibilities. This requires further follow-up

The majority of traders (67%) realized that spread of livestock diseases could result from transporting sick stock.

Disease reporting

Traders generally (35, 58%) recognized a need to report disease in livestock. Of those responding, the majority (24, 69%) would report to the village animal health worker. Others would notify the village or commune chief (10, 29%), a neighbour (10, 29%), a district or provincial veterinary officer (6, 17%), or report back to the original traders (4, 11%).

Regulations affecting trade

Although a large proportion of traders interviewed (78%) recognized that trade was regulated, those who did not (22%) comprised a substantial group.

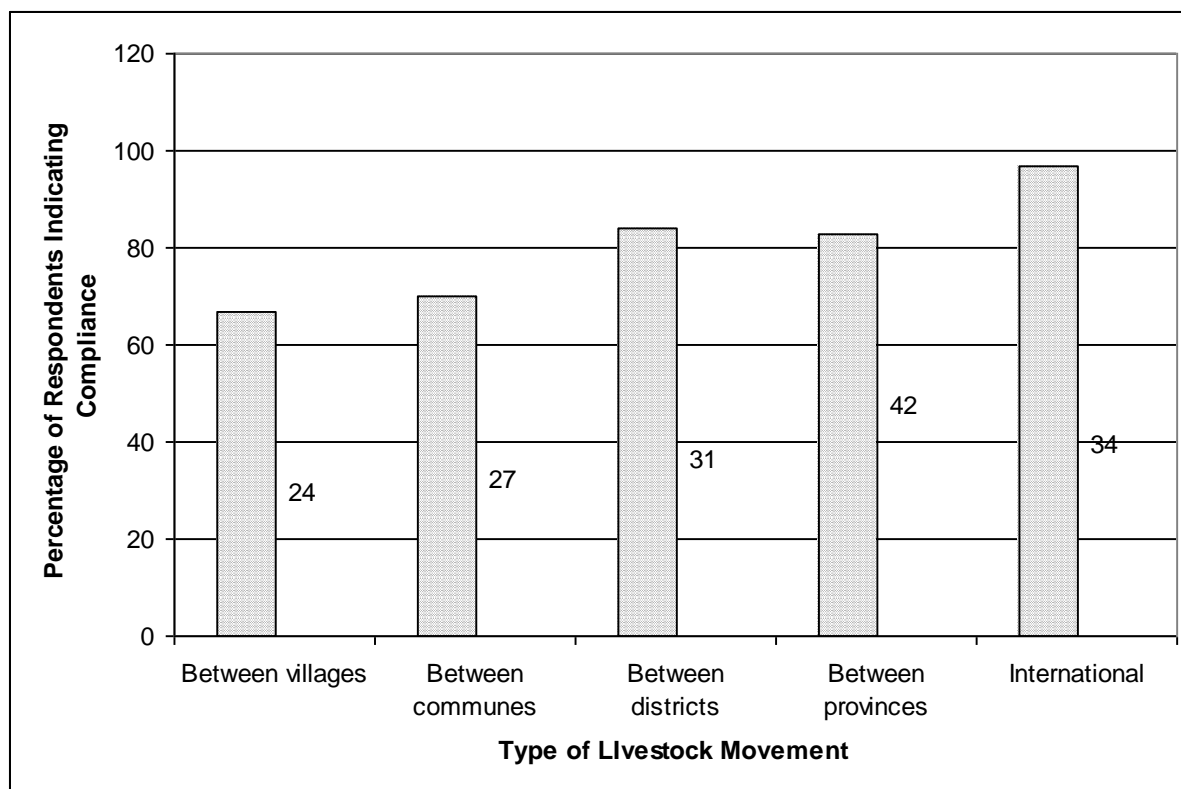
Trade regulations apply to all trading activities. Traders were aware that trade regulations applied to trade between: villages (47%); communes (37%); provinces (71%); and internationally (57%).

Traders were asked if they had read the livestock movement regulations documents. Most did not have a copy (81%), and the remainder who did had not read the documentation. As a separate question, traders were asked whether they would like a copy of the regulations if available. A large majority (92%) indicated that they would. This latter response (i.e. 92% wanting a copy compared with 19% saying that they had a copy) suggests that any documentation previously accessed may have been only available to read in a district office, rather than to take away for future referral.

Compliance with regulations

Traders were asked to indicate whether livestock movement types were compliant with regulations. A varying number responded to each section of the question, but rarely more than about half of the survey group. Responses were asked for in increments of 10% (i.e. ten options for each movement type). Responses tended to be spread across the range, and for simplicity are reported as the percentage of respondents indicating that more than 50% of movements in each category were compliant with regulations (Table X).

Figure 8. Percentage of respondents indicating that compliance with trading regulations was over 50% for different types of livestock movement. Number to the right of each column is the number of respondents answering for each movement type.



It should be noted that this is what the traders themselves perceive as the situation. No attempt has been made to verify the accuracy of this.

There was some ambivalence towards the need for movement permits. Twenty seven (27) traders indicated one was needed, 7 were opposed to permits, 5 were neither opposed nor in favour. Twenty one did not respond to the question.

Approval to trade

Traders recognized the need to gain approval for trading activities. However, recognition of the source of that approval varied (Table ..)

Table 7. Trader recognition of agencies granting trading approval.

| Agency Granting Trading Approval | Number (%) of Traders |
|--|------------------------------|
| Provincial Department of Agriculture | 14 (23) |
| Provincial Veterinary Officer | 15 (25) |
| Department of Animal Health and Production | 4 (7) |
| Commune Authority | 10 (17) |
| Major Trading Company | 12 (20) |

This variety of approval sources may reflect the type of trading undertaken by traders – for example, those trading primarily between villages may seek commune authority to do so, rather than seeking authorisation from a higher tier of administration.

A small majority of traders (34) indicated that it was not possible to transport stock without proper paperwork, the remainder indicating that it was possible, or sometimes possible. Most traders (75%) indicated that there was a likelihood of being caught if they did not have proper paperwork. If traders were stopped without proper paperwork, they expected that there could be a warning (38%), a fine (75%), or nothing would occur (77%). Traders indicated that imprisonment was not going to occur (100%).

When a fine was paid, it was simply given to the person or group that stopped the truck – police or military police, or the officer manning an inspection checkpoint. The truck owner was considered responsible for paying the fines.

Costs of compliance

Producers indicated that the costs of compliance were varied. Table .. lists the type of compliance cost, and the number of traders who listed it.

Table 8. Costs associated with compliance with trading regulations.

| Payments associated with: | Number (%) of Traders |
|--|------------------------------|
| Stamp duty | 5 (8) |
| Customs Officers | 2 (3) |
| Head tax | 5 (8) |
| Trade certification | 23 (38) |
| Police/Military Police <i>en route</i> | 23 (38) |
| Company fees and charges | 6 (10) |

There was some reluctance to respond to this question, with ten (10) traders not willing to comment.

Traders commented that they expected to be stopped (by civil or military authorities) while transporting stock, and required to pay an unscheduled fee. This was

considered a form of insurance against being subject to theft during transit, because the authorities patrolled the highways and kept them safe for transporters.

Profitability of a shipment or consignment was considered to be the same or greater if transport occurred without proper paperwork. In other words, it was cheaper to risk paying fees or fines along the way than to obtain official paperwork. This may be because the fees or fines totalled less than the cost of obtaining official transportation documents (48% of respondents), or because of the time consumed gaining official permission (28% of respondents).

When new regulatory information is made available by provincial or district veterinary staff, 27% of traders indicated that they sometimes attended updates.

Barriers to livestock trade

Traders were asked what the main issues were that faced them as traders. Their responses are provided in Table X..

Table 9. Main problems experienced as traders

| Trader concern | Number |
|---|---------------|
| Low interest by farmers in cattle raising | 18 |
| Market price fluctuation (price falls after purchase) | 16 |
| Difficulty in caring for stock during transport | 15 |
| Limited trading budget | 14 |
| Time consuming to negotiate prices | 13 |
| Price pressure from large companies | 13 |
| Difficulty in finding new buyers | 6 |
| Difficulty with paperwork | 5 |
| Weight loss in transit/sickness | 4 |
| Competition from imported cattle | 2 |

Trader suggestions for overcoming or avoiding these issues were as follows (Table 10)

Table 10. Trader suggestions to address the issues listed in Table 9..

| Trader suggestions | Number |
|--|---------------|
| Transport stock through larger companies | 12 |
| Check stock more regularly in transit | 11 |
| Stop trading (temporarily) when prices are low | 11 |
| Can't avoid selling when prices low | 5 |
| Reduce the tax on animals transported | 3 |
| Bigger trading budget | 3 |
| Careful price-watch | 2 |
| Arrange suitable funding ahead of time | 2 |
| Use stored feed during transport | 2 |
| Better government control on imported stock | 1 |

Ongoing help – perceptions.

Traders were asked if they would be prepared to continue assisting the project in the future. All of them indicated that they would be willing to provide information on livestock trading and prices on a regular basis. This was conditional on contact being maintained by project personnel (i.e. traders were comfortable talking with project staff).

However, only half were prepared to share such information with a government agency and only a third were prepared to share with a non-government organisation. Some traders indicated a willingness to share with other people, including district office staff or a district veterinary officer (6), a provincial veterinary officer (1), or a village chief (2).

The preferred method of contact was by phone (92%), but personal contact would be accepted by the majority (80%).

Discussion

The survey confirmed that there are two major groups of livestock traders – those whose activity is primarily within Cambodia – domestic traders who move stock from village to village, between districts, or between provinces, and those who move cattle across national borders. The social characteristics of traders is similar between the provinces surveyed, and would appear typical of Cambodia's livestock traders.

International movements appear to be highly organised, with a limited number of large companies overseeing the trade. Contract work moving livestock for these larger traders is common. Much of the cattle trade originates in Thailand, and terminates adjacent to the Vietnamese border, with a short transit time (15-24 hours, mostly at night) between loading and delivery.

There is some fluidity in trading activities of domestic traders. Many have their own properties and/or businesses, to which trading on occasions forms an additional income stream. Lower trading activity in the second half of the year for reasons outlined earlier makes this option attractive, and in the case of small traders, an alternative enterprise is essential to maintain income.

There are different implications for disease spread resulting from each trader grouping. Some domestic Cambodian traders have acknowledged purchasing diseased livestock at reduced prices, before on selling them. This practice could reasonably be expected to result in spread of disease between villages, districts and provinces.

Rapid transit of stock for international destinations can contribute to the spread of disease between countries, rather than within Cambodia, although spread to local cattle in Cambodia may result from mixing with local cattle prior to final delivery. Risks associated with rapid transit movements have been evaluated and reported elsewhere (Hawkins *et al* 2011).

Networks of traders were identified, but these were loose, informal, and maintained by face to face encounters, and phone conversations. No formal networks or trader associations were present.

Drivers of trade from the traders' perspective were market price – in that sales to traders by producers increased as prices rose; festivals within Cambodia created an increased demand for cattle particularly. An interesting product substitution was noted between pigs and fish in Cambodia, resulting in lower pig trading when fish were plentiful. Traders also commented that sale of stock for the domestic trade was also influenced by the supplier's need for funds (e.g. for ceremonial purposes such as weddings, or debt repayment). Opportunistic sale of cattle when prices were high was reported.

Notably, price was not based on age, weight or body condition for cattle, but these characteristics were important in setting the price for pigs. Similarly, rises in the cost of feed for pigs would result in more pigs being available for sale.

Traders reported that livestock owners were more likely to sell stock that were sick, and more stock were available when diseases were prevalent in an area. Producers sold sick stock in order to get some return, in case the animals died. This also applied to foot and mouth disease (which although not usually fatal, created a fear of fatality in producer minds, leading to sale at discounted rates). Again, the implications of this practice for the spread of disease are apparent. Importantly, recent information (Charleston *et al* 2011) reinforces the importance of early detection and management of foot and mouth disease.

Cost of disease

The cost of disease is recognised by traders in relation to the cost of trading. Sick stock result in delays in delivery, and sometimes rejected shipments. Delays were costly because of the need to feed stock while being held pending later sale. However, some traders recognised an opportunistic benefit from some diseases. Foot and mouth disease is rarely fatal, and affected animals can be purchased at a discounted price. A small investment in feed and time results in the trader having a full-priced animal for on-sale within 7-10 days. There is little recognition of the impact that transboundary diseases in general either impact international trade, or have the potential to do so.

Although not specifically disease, traders reported that they would value information on caring for stock during transport. Facilities are often very basic, and injuries during loading, transport and unloading are expected.

Biosecurity practices and knowledge

Traders indicated that they generally had little knowledge or understanding of biosecurity practices relevant to trading. Mixing of stock in consignments, agisting stock in transit with their own animals, putting known sick animals with healthy ones, driving onto and off farms without truck washing, and carrying multiple consignments without truck wash-down were all standard practices.

Traders indicated that they would like more information on appropriate biosecurity practices for safe trading, without the message being complicated with biosecurity for other activities.

Biosecurity activities and infrastructure, such as disease notification to relevant authorities, quarantine facilities, health certification, inspection services, livestock market management, and truck wash-down facilities were recognised by traders, but were not routine practice. Notification options were confusing, certification related only to the nature of the consignment, and inspection services related to shipment integrity and payment of appropriate fees and charges. Because of the confusion and cost of regulatory processes, compliance was considered by traders to be low for domestic trade, but somewhat better for international trade. This latter was attributed to the fact that large companies managed the international trade, and ensured that all documentation was in place.

Other issues affecting traders

Traders perceived that producers had a low interest in cattle raising as an enterprise, and used cattle primarily as a financial reserve to be realised when required. Consequences of this for domestic traders were that quality of stock, and continuity of supply were substantial issues. Traders reported that they had to travel widely to make up a consignment. This in turn created an unacceptable level of price instability, making it harder to finance a shipment or trading venture. This was further compounded by personal financial constraints, and the general difficulty in obtaining venture capital at reasonable interest rates.

Recommendations

Traders have been a very congenial group to work with, willing to share their experiences and concerns with the investigators. They expressed a desire for ongoing collaboration, and requested input in the areas of disease recognition, safe trading (biosecurity), and transport management of stock. Consequently recommendations for traders directly include:

- Development of culturally appropriate biosecurity messages;
- Regular disease updates, and information on disease management and disease prevention;
- Strategies for care of stock during transport;
- Ongoing liaison with traders for current awareness updates;
- Facilitation of an industry run and operated livestock trader association to support and negotiate on behalf of traders

In a wider context, recommendations from this survey include:

- Effective implementation of regional and national strategies for disease prevention;
- Fostering livestock production systems, for continuity of supply of quality stock;
- Revision and consistent application of movement permit systems;
- Introduction of biosecurity practices in livestock markets;
- Biosecurity facilities development, such as truck wash-down, at strategic locations;
- Implementation of effective quarantine and inspection services, offered at low cost to traders;
- Development of a clear disease reporting mechanism, with a field service able to implement effective disease controls;

It is seen as appropriate to continue liaison with traders as they request, to review and assess changes or progress in management of trade and its implications for transboundary animal diseases.

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Appendix 6. Investigation of large ruminant market chains entering Vietnam from Cambodia

A. Exploratory survey on the market for beef in Ho Chi Minh City and the market chain for live cattle/buffalo in the Mekong delta

Draft report prepared for
The Australian Centre for International Agriculture Research (ACIAR)
Project AH/2006/025 Understanding Livestock Movement and the risk of
spread of transboundary animal diseases
(ULM) Project



Vientiane, June 2011

Nancy Bourgeois Lüthi
Consultant, livestock value chain expert

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Abbreviations & Acronyms

| | |
|------------------|--|
| ACIAR | Australian Centre for International Agriculture Research |
| BSE | Bovine Spongiform Encephalopathy |
| BTA | Bilateral Trade Agreement |
| CIAT | Centre for International Tropical Agricultural Research |
| CIDA | Canadian International Development Agency |
| CoD | Cash on delivery |
| DAH | Department of Animal Health (central level, Vietnam) |
| DARD Vietnam) | Department of Agriculture and Rural Development (provincial level, Vietnam) |
| DVS | District Veterinary Station |
| e.g. | exempli gratia, for instance |
| FMD | Foot and Mouth Disease |
| FoB | Free on Board |
| GMS | Greater Mekong Sub-region |
| GOV | Government of the Socialist Republic of Vietnam |
| HCMC | Ho Chi Minh City (former Saigon) |
| HPAI | Highly Pathogenic Avian Influenza |
| KHR 4,095 | Khmer Riel, Cambodia's currency: 1 USD=4,035 KHR on 15.02.11 and 4,095 KHR on 01.06.11 |
| <i>Laisind</i> | Cross-bred cattle between Red Sindhi and Vietnamese Yellow cattle |
| LW | Live Weight |
| MARD | Ministry of Agriculture and Rural Development |
| Mt. | Metric ton (1,000 kg) |
| OIE | Office International des Epizooties |
| <i>Pho</i> | Noodle soup |
| PRRS | Porcine Respiratory and Reproductive Syndrome, a.k.a. "blue ear disease" |
| RAHO- | Regional Animal Health Office (No.1 to 6) |
| SDAH | Sub-department of Animal Health (provincial level Vietnam) |
| SEACFMD | South East Asia and China Foot and Mouth Disease Control Project |
| TAD | Trans-boundary Animal Disease |
| <i>Tet</i> | Vietnamese New Year, following the lunar calendar, usually falling between January 15 th and February 15 th |
| ULM | Understanding Livestock Movements |
| US(A) | United States (of America) |
| USDA | United States Department of Agriculture |
| VND 20,300 | Vietnam Dong, Vietnam's currency. 1USD=20,895 VND on 28/02/2011, 20,300 on 06.06.11 |
| WTO | World Trade Organisation |

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- Dr. Mai Van Hiep, Deputy Director of the DAH standing office in HCMC for the overarching organization of the research
- Dr. Le Hong Phong, Deputy Head of the DAH standing office in HCMC for ensuring a smooth schedule of activities
- Dr. Nguyen Truc Ha, Chief of Epidemiology Division, Regional Animal Health Office (RAHO) No.6, for translating and giving technical guidance throughout the field work

The consultant would like to address her warmest thanks to the people interviewed throughout the surveys: farmers, traders, slaughterers, wholesalers, retailers and government officers.

Background to the survey

ACIAR has implemented the “Understanding Livestock Movements and the Risk of Spread of Trans-boundary Diseases” (ULM) Project (ACIAR Project AH/2006/025)⁵ in the Lao PDR and Cambodia since 2008. Two experts appointed by ACIAR, Dr. Socheat Sieng and Dr. Axelle Scoizec carried out research on commercial livestock movements in Cambodia and Lao PDR respectively during the last three years. Their research showed, among other things, that Vietnam is the main destination market for cattle and buffaloes traded in the greater Mekong sub-region (GMS).

While livestock cross-border movements through central and northern Vietnam were already surveyed and documented by other institutions, among others the World Animal Health Organization (OIE) and the International Centre for Tropical Agriculture (CIAT), the situation in the Mekong delta has not been thoroughly documented so far.

During the South-East Asia and China Foot and Mouth Disease Campaign (SEACFMD) workshop held in Thailand in November 2010, Dr. Jim Kerr⁶ discussed with Dr. Mai Van Hiep⁷ the opportunity to conduct a research on movements of livestock from Cambodia into the Mekong Delta, in order to better understand trade mechanisms in southern Vietnam. ACIAR proposed Ms. Nancy Bourgeois Luthi, a livestock value chain expert, to conduct the research. The proposal was approved by the Director General of the DAH in December 2010. Arrangements were made by Dr. Hiep and Dr. Kerr in January 2011, so

⁵ <http://aciarc.gov.au/project/AH/2006/025>

⁶ ACIAR

⁷ DAH standing office in Ho Chi Minh City (HCMC)

that the research could be undertaken in February 2011, after *Tet*, the Vietnamese New Year.

Objectives of the research

The research aims at:

- gaining a broad understanding of the marketing environment for local and imported live cattle/buffalo in HCMC and surrounding provinces
- identifying the main stakeholders of live cattle/buffalo and beef market chain in HCMC and surrounding provinces
- assessing major entry points of locally produced (Central and/or northern Vietnam) and imported (from neighboring countries) live cattle/buffalo into the Mekong Delta
- assessing major risks of disease spread associated with movement pathways and trade practices
- identifying potential risk mitigation practices

Methodology

The research was conducted within the snowball sampling methodological approach, whereby “entry points” are selected based on their perceived relevance to the study. Stakeholders of such “entry points” are interviewed with a generic list of questions used during similar surveys conducted in the Lao PDR and Cambodia, shown in annex 1. Based on the information provided by entry-point stakeholders, further relevant actors of the market chain are identified and selected for interviews. The consultant pre-selected three main entry points: (1) Pham Van Hai meat wholesale market⁸ (2) VISSAN meat processing company⁹ and (3) Big-C supermarket. The DAH included additional entry points: (4) Hoc Mon pork wholesale market, (5) two slaughterhouses, one in Binh Duong province and one in Dong Nai province, (6) two wet markets in HCMC. In addition, a trader specializing in cross-border cattle/buffalo trade was selected by the DAH upon the consultant’s request.

Except for one stakeholder (Big Chi meat wholesale & retail shop identified through interviews at Big C), downstream stakeholders¹⁰ could not be interviewed during the present mission. This situation derives from the fact that mid-term pre-arrangements are usually required to conduct interviews, a specificity of the Vietnamese institutional context.

Similarly, due to timing and organizational constraints, two provinces (An Giang and Kien Giang) identified through the snowball sampling method as crucial cattle/buffalo suppliers to HCMC’s end market could not be included in the first survey. It was therefore proposed to carry out a second survey specifically targeting these two provinces. The local District

⁸ *Already investigated in 2006 by the consultant*

⁹ *known to be a major stakeholder of the cattle/buffalo and pig value chains in southern Vietnam*

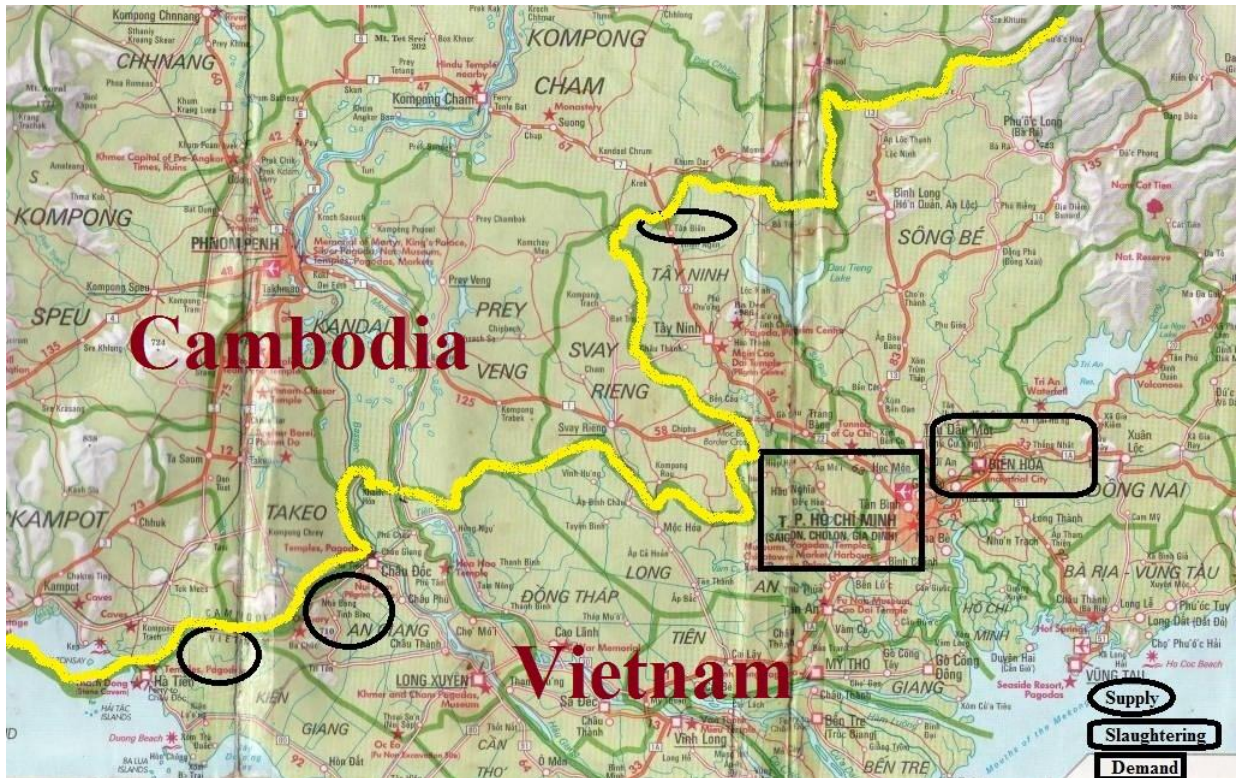
¹⁰ *identified through interviews of “entry points” stakeholders*

Veterinary Station (DVS) selected a few traders as entry points and additional stakeholders (traders, farmers) were interviewed, as far as the schedule would allow.

Stakeholders, schedule and location of the research

The research was conducted from 14 to 19 February 2011 and 5 to 10 June 2011 (annex 2). The following picture shows the location of the research in HCMC and five southern provinces.

Figure 7 Location of the research in HCMC & southern provinces

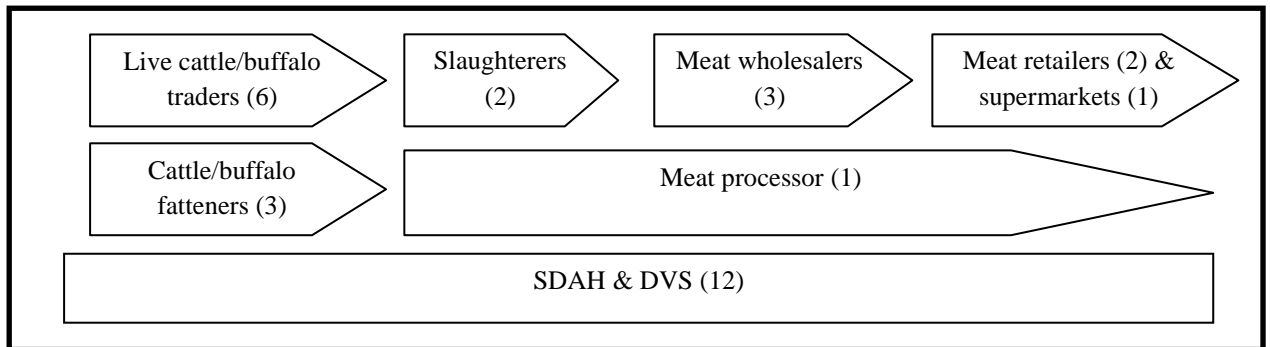


The research was conducted by the following team members, under the guidance of Dr. Mai Van Hiep, Head of the standing DAH office in HCMC:

- Dr. Nguyen Truc Ha, Chief of Epidemiology Division, RAHO-6
- Dr. Le Hong Phong Deputy Head, DAH standing office HCMC
- Ms. Nancy Bourgeois Luthi Consultant, livestock value chain expert

Eighteen core market stakeholders were interviewed in HCMC and five southern provinces. In addition, meetings were conducted with DVS and Sub-Department of Animal Health (SDAH) officers in HCMC and targeted province, as highlighted by the following figure.

Figure 8 Wider marketing environment and core market stakeholders of the live cattle/buffalo market chain into HCMC & southern provinces



1 Results

The wider marketing environment: Vietnam

According to a survey carried out by Nguyen Le et al. (2009) the average meat consumption in Vietnam amounted 80.3 kg per capita in 2006¹¹. The survey highlighted large differences in consumption between meat types and across income groups as shown by the following table.

Table 1 Per capita average annual meat consumption in Vietnam in 2006

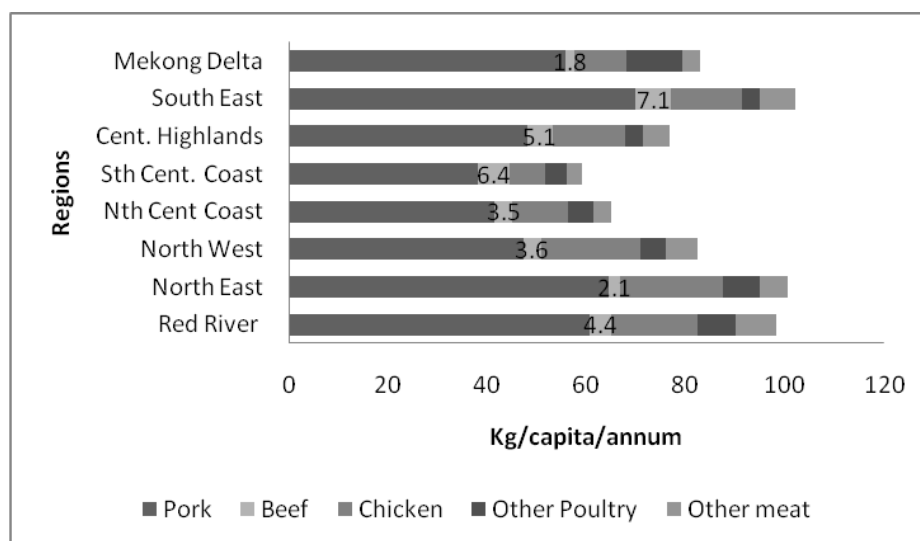
| | Lowest income quintile | Highest income quintile | Average |
|---------------------------------------|-------------------------------|--------------------------------|----------------|
| Chicken | 9.5 | 18.9 | 14.1 |
| Duck and other poultry species | n.a. | 4.4 | 4.1 |
| Pork | 30.8 | 69.6 | 56.0 |
| Beef | 0.9 | 11.3 | 6.1 |
| Seafood | n.a. | n.a. | n.a. |

Nguyen Le et al. (2009)

In Vietnam, meat consumption is dominated by pork, followed by poultry products and beef. The latter makes out roughly eight percent of the total meat consumption. The survey conducted by Nguyen Le et al. (2009) further showed regional consumption differences as illustrated by the following figure:

¹¹ *Excluding seafood and fish*

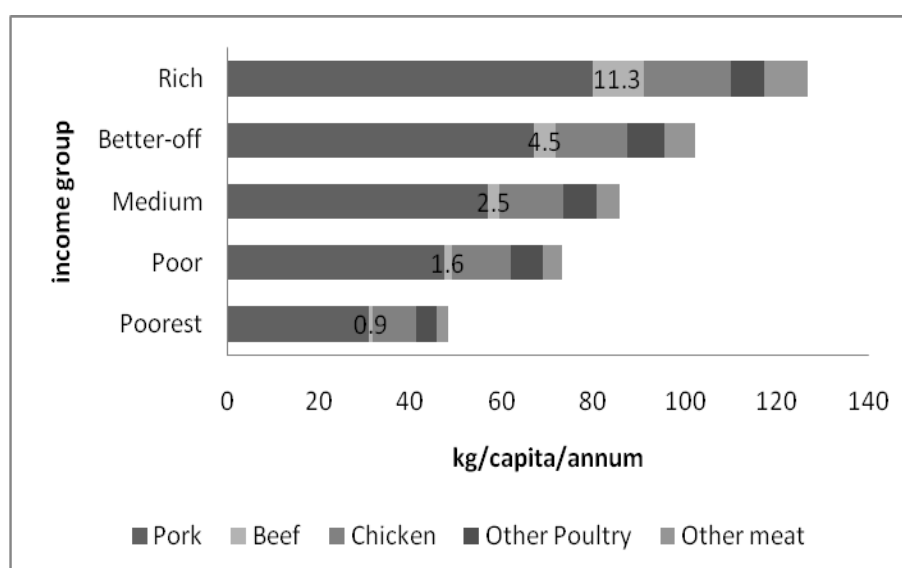
Figure 9 Regional per capita average annual meat consumption (in kg) in Vietnam in 2006



Source: Nguyen Le et al. (2009)

South-eastern, south-central as well as central provinces show the highest per capita annual beef consumption, while Mekong Delta provinces exhibit the lowest average beef consumption with 1.8 kg per capita per annum. The study further showed large discrepancies between income groups, with low income group consuming only eight percent of the beef consumption of the best-off consumers, as illustrated by the following figure.

Figure 10 Average annual meat consumption (in kg) per capita and per income group in Vietnam in 2006



Source: Nguyen Le et al. (2009)

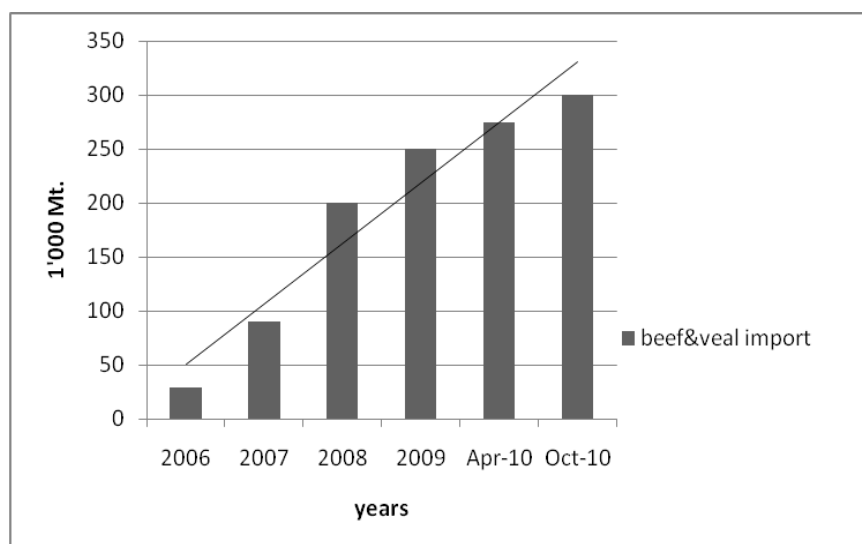
According to Nguyen Le et al. (2009), the average annual per capita beef consumption is expected to double by 2020. All regions are expected to undergo such a change in the beef

consumption pattern, the highest increase is however expected to occur in the Red River Delta.

Previous surveys (Bourgeois Lüthi, 2007; Bourgeois Lüthi et al., 2009, Bourgeois Lüthi, 2010) showed that Vietnam has been a net importer of live cattle/buffalo for slaughter for decades. A recent survey conducted in the Lao PDR and northern Vietnam showed that the regional value chain for live cattle/buffalo is affected by short-term shocks, such as climatic events, disease outbreaks and exchange rates fluctuations, within a long-term trend of increasing regional demand for animal products (Bourgeois Luthi, 2010).

In addition to importing live cattle/buffalo for slaughter, Vietnam imports beef cuts and offal from overseas, as shown by the following figure.

Figure 11 Total beef and veal imports to Vietnam (1 000 Mt. carcass weight equivalent)



Source: USDA, 2010

While joining the World Trade Organisation (WTO) in January 2007, Vietnam committed to reduce trade barriers (Balmer, 2009). Import tariffs on boneless beef were reduced from 22 percent to 12 percent in 2008, ahead of the WTO requirement of 14 percent by 2012 (Fiorucci et al., 2008)¹². In 2009, Vietnam lifted the import ban on United States (US) boneless, bone-in and offal beef that it had imposed following Bovine Spongiform Encephalopathy (BSE) cases in the USA (USDA, 2009). Beef imports consequently trebled between 2007 and 2008, which pushed some producers out of the sector (Fiorucci et al., 2008).

In 2010, Vietnam was rated as one of the five largest importers of US beef together with Mexico, Canada, Japan and South Korea¹³. Despite rapidly rising imports from abroad,

¹² The tariff was raised again in 2009 (USDA, 2010)

¹³ <http://www.cattlenetwork.com/cattle-news/latest/cattle-outlook-world-beef-production-expected-to-decline-in-2010-114332384.html>

Vietnam's beef market remains dependant on neighboring countries for imports of live cattle/buffalo destined to slaughter (Bourgeois Lüthi et al., 2009). In February 2011, HCMC's SDAH confirmed that most live cattle/buffalo destined to HCMC's beef market originated from Cambodia.

The demand side: HCMC¹⁴ and surrounding provinces

HCMC beef market demand and supply

As an urban pole, HCMC exhibits a low level of livestock production coupled to a high consumption rate of livestock products. In 2010, HCMC (7.15 millions inhabitants in 2010) counted approximately 110 000 heads of cattle and buffaloes raised by 16 168 households. Seventy-one percent were dairy cattle, 24 percent Laisind and local cattle and five percent buffaloes. HCMC's SDAH estimates the City's overall meat consumption requirements at 1 000 to 1 200 tons per day. Meat consumption is dominated by pork (69 percent), followed by poultry (17 percent) and beef (14 percent). According to the previous estimated figures, HCMC's requirements for beef are estimated at 140 to 168 tons per day.

HCMC's SDAH estimates the number of heads slaughtered daily as follows:

Table 2 Estimated volume of cattle/buffalo slaughtered daily to cover HCMC's requirement for beef (heads/day)

| | Locally produced (heads/day) | Imported from other provinces (heads/day) | Total (heads/day) | "imported" from other provinces |
|--------------------|------------------------------|---|-------------------|---------------------------------|
| Pigs | 7 500-8 000 | 1 500-2 000 | 9 000-10 000 | 16%-20% |
| Cattle & buffaloes | 35-50 | 700-750 | 750-900 | 93%-95% |
| Poultry | 45 000-48 000 | 50 000-55 000 | 90 000-100 000 | 61% |

Fresh beef consumed in HCMC originates from two main channels:

1. Slaughterhouses in neighboring provinces
2. Slaughterhouses in HCMC

Data collated by HCMC's SDAH and disaggregated according to the origin of the meat are detailed in the following table.

Table 3 Estimated volume of cattle/buffalo (heads/year) procured and slaughtered for HCMC's beef market

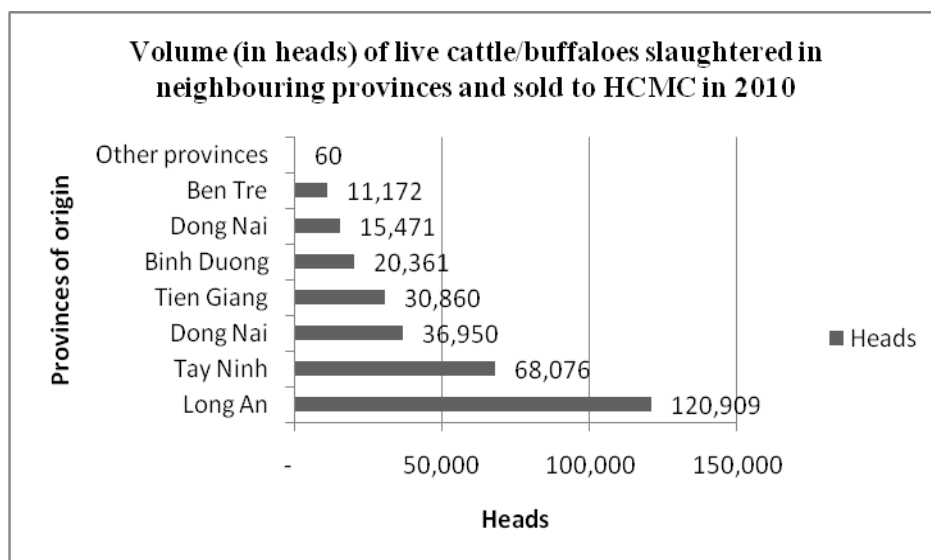
| | |
|--|---|
| | Equivalent in heads¹⁵ |
|--|---|

¹⁴ If not otherwise stated all information has been provided by HCMC's SDAH

| | | |
|---|---|----------------|
| 1. Beef “imported” from slaughterhouses located in neighboring provinces | Total | 303 858 |
| 1) From live animals imported from Cambodia | No distinction made | |
| 2) From native animals “imported” from other provinces | | |
| 3) From locally raised animals | | |
| 2. Beef procured from slaughterhouses within HCMC | Total | 14 608 |
| 1) From live animals imported from Cambodia | Comprised in the figure immediately below | |
| 2) From native animals “imported” from other provinces | | 11 979 |
| 3) From locally raised animals | | 2 629 |
| Total estimated number of cattle and buffaloes | | 333 074 |

The table above shows that 303 858 live cattle and buffaloes destined to HCMC beef market were slaughtered in **neighboring provinces** in 2010 and 14 608 head were slaughtered in HCMC. The figures are extrapolated from meat volumes registered by DVS at the respective slaughterhouses and collated by HCMC SDAH. The provenance of **meat** (=the place of slaughter) traded to HCMC is detailed in the following figure. The figure shows live animal volumes extrapolated from meat volumes.

Figure 12 Volume (in heads) of live cattle/buffalo slaughtered in neighboring provinces and destined to HCMC’s beef market in 2010



The figure above shows that Long An, Tay Ninh and Dong Nai provinces slaughter 74 percent of all cattle & buffaloes destined to HCMC market¹⁶.

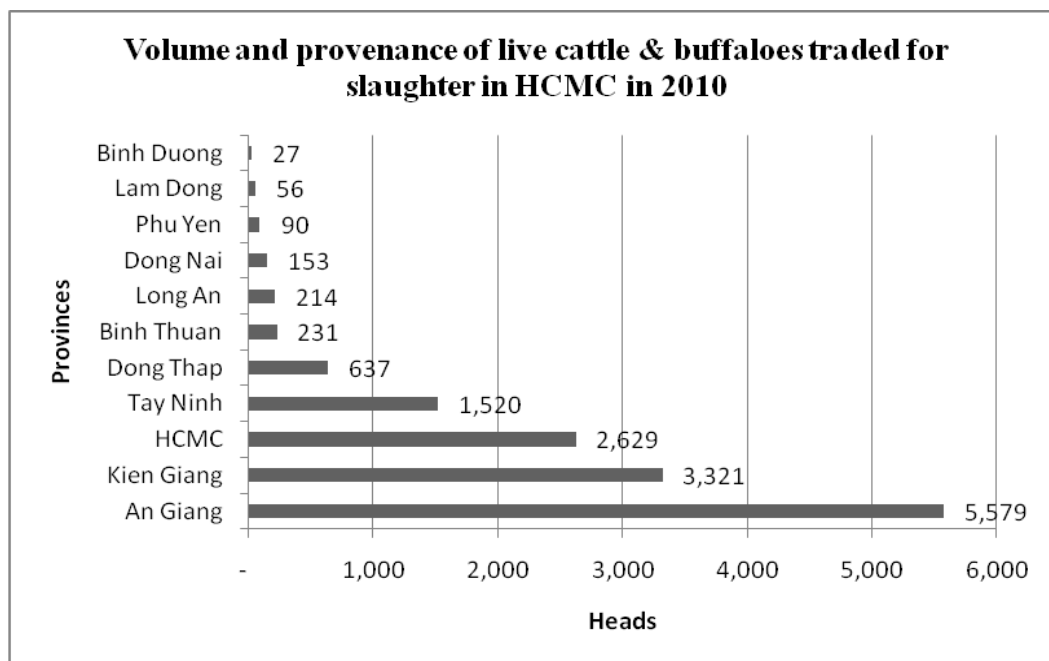
As mentioned previously, beef consumed in HCMC is also procured from local slaughterhouses. As such the meat originates to some extent from local animals (kept in

¹⁵ Figures extrapolated by HCMC’s SDAH from estimated meat output registered from slaughterhouses

¹⁶ Dong Nai appears twice in figures given by HCMC’s SDAH. Need to be checked during the next survey

HCMC) but to a greater extent from animals “imported” live from neighboring provinces. The following figure shows the provenance of live cattle/buffalo traded live into HCMC and slaughtered at **slaughterhouses within the city** in 2010.

Figure 13 Volume and origin of live cattle/buffalo slaughtered in HCMC in 2010



The figure above shows that 14 457 heads were slaughtered in HCMC in 2010. A minority (18 percent) originate from HCMC, while the bulk (62 percent) are traded from An Giang and Kien Giang provinces. The remaining 20 percent are procured from other southern provinces. HCMC’s SDAH confirmed that An Giang and Kien Giang provinces are important supply sources of live cattle/buffalo in southern Vietnam.

Slaughterhouses

Two private slaughterhouses, one in Binh Duong and one in Dong Nai provinces, and VISSAN abattoirs were visited.

Binh Duong province

M. Pham Van Hao is the owner of Ut Thao slaughterhouse, the largest of the two private slaughterhouses found in Binh Duong province¹⁷.

Beside the slaughterhouses, the province counts ten small slaughter-points. Ut Thao has been operating for over 20 years and was upgraded from a slaughter-point to a slaughterhouse in 2003. Ut Thao slaughters both pigs and cattle, but no buffaloes.

The slaughter volume amounts 60 heads of cattle and 200 heads of pigs¹⁸ per day. Cattle are procured from the Central Highlands (Kon Tum, Gia Lai provinces) and south-central

¹⁷ The second one is located in An Dien, in Ben Cach district

¹⁸ Pigs are slaughtered in 2 shifts, one early morning and one at noon

provinces (Phu Yen, Binh Thuan, Ninh Thuan...), as well as from southern provinces (Tay Ninh, An Giang, Kien Giang...). Supply from central provinces reduced approximately one year ago due to increased demand for beef emanating from cities in these provinces, among others Danang. Import of Chinese cattle stopped three to four years ago. Due to scarce local supply, all southern provinces and HCMC are supplied by imports from Cambodia. Ut Thao owner estimates HCMC's¹⁹ demand for beef at 2 000 heads per day. This figure is more than twice higher than HCMC SDAH's estimates.

Dong Nai province

Dong Nai province counts 26 registered private slaughter-houses slaughtering cattle & buffaloes. Slaughter-houses are concentrated in Trang Bom district and Bien Hoa city²⁰. According to the SDAH, 72 000 heads of cattle/buffalo were slaughtered in Dong Nai province in 2010, which is equivalent to 6 000 heads per month on an average. In January 2011, the volume slaughtered was lower, with 5 500 heads. Cattle/buffalo registered at slaughter in Dong Nai province originate from other provinces. Local cattle/buffalo²¹ are not registered at slaughter, as they are butchered at local slaughter-points. According to one DVS staff from Trang Bom district, An Giang province has been the main supplier of cattle/buffalo since 2009, followed by Kien Giang province. Central provinces (central Highlands, south-central provinces) supply cattle/buffalo mainly between February and April. Supply of cattle/buffalo from central provinces depends on price levels prevailing in northern provinces, in China and in HCMC. Central provinces can supply both northern and southern markets, as distances are almost equivalent. Previously, northern provinces (Cao Bang, Quang Ninh...) used to be major suppliers of cattle/buffalo imported from China.

Observations made by the SDAH are corroborated by Ms. Hue, the owner of a private slaughterhouse in Trang Bom district. Ms Hue has run her business for over 20 years. She used to slaughter cattle/buffalo traded from south-central provinces (Binh Thuan, Ninh Thuan), until she faced a shortage of supply. She started slaughtering livestock from Kien Giang province by mid of the year 2010.

She slaughters cattle/buffalo on behalf of two to three traders, but does not know their names²². She does not trade animals herself but slaughters only, for a fee of 50 000 VND/head (30 000 to cover water/electricity costs, 20 000 for profit). Meat, offal and by-products belong to traders and are sold within Dong Nai. She slaughters one to three heads per day on an average, up to five heads during peak times. Her slaughterhouse shows a stocking capacity of 25 heads. Feed and labour costs amount 10 000 VND per head per day.

Meat processor

¹⁹ 10 million inhabitants

²⁰ Dong Nai's provincial city

²¹ The province's cattle/buffalo population amounts 80,000 heads

²² Or she does not want to disclose their names. Certificates bear the names of truck drivers

Vietnam's largest meat processor is the VISSAN Limited company, a former State company. Its main factory is situated in Binh Thanh district in the outskirts of HCMC. The company also operates a smaller processing unit in the North, in Bac Ninh province, in the vicinity of Hanoi. VISSAN is a major stakeholder in cattle/buffalo slaughtering, beef processing and retailing in southern Vietnam. The company operates in a vertically integrated manner, except for procurement, which is diversified. The company currently sources approximately 95 percent of its raw material (live cattle/buffalo) from traders operating across the Cambodian border in An Giang, Kien Giang, Dong Thap and Tay Ninh provinces. The company does not have any fixed procurement network, but reports trading with five to six large traders only. It occasionally sources animals from central and northern Vietnam. The company requires animals with a minimum live body weight of 350 kg. It procures mainly cattle, buffaloes make out ten percent of the company beef volume. Animals and meat are checked by HCMC's SDAH. The latter also takes samples to test for residues (eg growth promoters) and germs.

The company currently slaughters 40 heads of cattle/buffalo per day, this volume comes up 80 heads during the peak season, shortly before *Tet*.

Fifty percent of beef slaughtered at the company's slaughter facilities is destined to wet markets, 30 percent to restaurants and supermarkets, while the remaining 20 percent supply VISSAN processing facilities, which transform beef into sausages, dry beef and tinned meat. VISSAN meat products are not destined to export markets, but are consumed locally. According to VISSAN's vice-director, beef consumption in HCMC is rather stable and not easily affected by disease outbreaks in other species, eg Highly Pathogenic Avian Influenza (HPAI) and Porcine Reproductive and Respiratory Syndrome (PRRS). VISSAN customers' base is not affected by imports from overseas, as the latter are mainly targeted towards higher end consumers' markets (hotel restaurants).

Meat wholesalers

Three locations specialized in meat wholesale, two in beef and one in pork, were visited in the course of the research.

Hoc Mon pork wholesale market

Hoc Mon meat wholesale market was established in Xuan Thoi Son commune in Hoc Mon district, in HCMC suburbs in 2008. The market place was developed in the frame of project implemented by HCMC's Department of Agriculture and Rural Development (DARD) under funding from the Canadian International Development Agency (CIDA) (Project FAPQDCP) and was moved from its previous location in Pham Van Hai street in district 16. Hoc Mon market is the largest pork wholesale market in southern Vietnam, followed by Binh Dien market in Binh Chien district (HCMC).

Hoc Mon currently channels 252 tons of pork meat (appr. 3 600 heads) per day. The season peaks a few days before *Tet* (mid to end of January) and slows down the first few days of the new year, when shops and restaurants are closed. Hoc Mon market channels carcasses

of pigs raised on farms in provinces around HCMC and slaughtered at the following main slaughter points within and around HCMC:

- Nam Phong, Binh Thanh district
- District 12
- Hoc Mon district
- An Ha, Cu Chi District

Pork carcasses are inspected and stamped by the DVS at slaughter-points, before being loaded into vans (refrigerated or not), which are then sealed by the DVS. According to Hoc Mon wholesale market manager, vehicles are disinfected before entering slaughterhouse premises, but not between slaughterhouses and the wholesale market. Once vans reach Hoc Mon market premises, papers are inspected, the seal is severed and carcasses are unloaded by market employees. Carcasses are inspected again at the market premises. Suspicious carcasses can be isolated in a separate room and destroyed in other premises, but no cases were encountered since the opening of the market three years ago.

Pork is now wholesaled and retailed under stricter hygienic and sanitary conditions than at its earlier location²³. Hoc Mon wholesale market premises are cooled down²⁴, although not down to refrigerator temperatures, are cleaned and disinfected under the supervision of HCMC environmental services.

Pork is wholesaled, either as whole carcasses which leave the premises by vans to be cut and retailed at further markets or as cuts prepared at one of the numerous booths found on the market. Offal are mostly wholesaled directly from slaughterhouses.

Offal reaching Hoc Mon market are retailed directly from the retail booths and do not enter the carcass premises. The market counts 23 carcass booths and 58 retail booths and hosts 420 workers. Retail booths found on the market are rented by retailers who employ their own workers to debone carcasses.

Clients, mostly retailers or restaurant owners, buy deboned carcasses or meat cuts and pay a market fee of 3 000 VND per load. Hoc Mon market delivers 3 000 delivery vouchers/market fee receipts per day on an average. Wholesaled cuts are transported in metal boxes on motorbikes.

In February, wholesale prices for carcasses ranged between 48 000 and 54 000 VND/kg, while retail prices for deboned meat ranged at 16° from 38 000 to 68 000 VND/kg, depending on cuts. Prices peak early morning. The market operates from 12 p.m. to 6 a.m. at the carcass section, up to 8 a.m. in retail booths.

²³ Visited by the consultant in November 2006

²⁴ At 16° C

Pham Van Hai beef wholesale market, Tan Binh District, HCMC

HCMC' main beef wholesale market is located in Pham Van Hai street in Tan Binh district. It is planned to move the market to Hoc Mon district within the next two to three years. The market hosts seven beef wholesale outlets, as well as pork retail booths (not visited). Hygienic and sanitary conditions have not changed since November 2006, when the consultant last visited the area, except for vans bringing carcasses and meat, which are now systematically sealed by the DVS at the slaughterhouses. The market is supervised by three DVS staff.

The seven wholesalers procure either deboned meat or whole carcasses from 15 to 20 traders and slaughterhouse owners. The market's largest supplier is reported to be Ms. Anh Thi Thu Ba from Long An province. Cattle are supplied by traders mainly from Long An, Dong Nai and Tay Ninh provinces. A large proportion is known to be imported from Cambodia. Approximately 18 tons of beef transit daily through the market. The largest market wholesaler handles six tons of beef per day, the second largest (interviewed) handles two tons per day. According to the latter, the volume of beef wholesaled at the market has not increased much since 2006. This observation is corroborated by a survey conducted in 2006, which estimated the daily volume at 200 heads (500 heads during peak times, before *Tet*).

Volumes are reported to be constant except for religious days (twice a month, on the fifteenth and first day of the lunar calendar), when other species than beef are consumed and before *Tet*.

Wholesalers process deboned carcasses to cuts and supply approximately 950 clients, mostly wet markets retailers and local restaurants (number of market fee tickets issued daily). According to the wholesaler interviewed, Pham Van Hai market hardly supplies supermarkets, which source meat mainly from VISSAN and wholesalers operating in other locations.

Restaurants from up-market hotels use premium beef cuts imported from overseas. Bones and offal are usually sold at slaughterhouses, but can be found at the wholesale market as well.

On February 15, wholesale beef prices came up 95 000 VND/kg on an average, 150 000 VND/kg for category 1 meat (fillet).

Bich Chi beef wholesale & retail shop, Bien Hoa City, Dong Nai province

Bich Chi beef wholesale & retail shop is owned by Ms. Bui Thi Chi, who has traded beef for 30 years, first as a retailer, now both as a wholesaler and a retailer. She procures carcasses from slaughterhouses in Dong Nai province.

She trades mainly beef, occasionally buffalo meat, upon order. She knows that cattle/buffalo slaughtered in Dong Nai are traded from An Giang, Kien Giang as well as other southern provinces and is aware that most animals originate from Cambodia. She is able to distinguish local from Cambodian cattle, the latter is said to exhibit darker meat.

She however says that her customers are not able to see any difference. Carcasses are transported by her own refrigerated van.

She trades approximately 15 carcasses per day, upon order from her suppliers. If demand increases, she adjusts volumes by ordering from slaughterhouse in advance. She has a freezing store at her shop, containing mainly bones.

As a wholesaler, she supplies supermarkets (Big C²⁵ and Lotte Mart²⁶ in HCMC), as well as private wet market retailers in Bien Hoa City. She has been Big C's main supplier since 1998, when the French-based supermarket was established in southern Vietnam. She supplies all Big C outlets in HCMC (five in total) with approximately 700 kg per day and Lotte Mart supermarkets with 500 kg per day.

As a retailer, she supplies *pho* shops and end customers through her shop and a retail outlet at one of in Bien Hoa city's wet markets. She faces competition from three to four similar wholesalers in Bien Hoa City. In February, wholesale carcass prices amounted 110 000 VND/kg, excluding bones.

Meat destined to Big C is transported by a different vehicle than the one bringing carcasses from slaughterhouses. Carcasses are inspected by DVS at the slaughterhouses and meat is inspected once again by other DVS at her shop. In both cases vans are sealed for transport. Her shop is cleaned and disinfected daily before being inspected by the DVS.

Meat retailers

Three beef retailers were interviewed, two at Ben Thanh wet market (district 1) and one at An Dong wet market (district 5).

Ben Thanh is one of the largest wet markets in HCMC²⁷. Ten meat retailers sell beef, the daily volume is estimated at 800 to 1 000 kg (against 3 000 kg for pork). Beef is procured from Pham Van Hai and Ton That Dam²⁸ wholesale markets, as well as from VISSAN. The latter owns retail booths at the market and rents them out to meat retailers. One of both retailers interviewed was aware that beef she retails originates from cattle traded from Cambodia through An Giang province. The other retailer was not aware of the origin of beef.

According to one meat retailer, since mid of the year 2010 HCMC's local government has been supporting consumers by subsidizing retailers in order to curb inflation.²⁹ To date, subsidies were still given on pork.

Beef retail prices registered at Ben Thanh market are given in the following table.

²⁵ *Belonging to French based Casino group*

²⁶ *Belonging to a Korean chain*

²⁷ *Beside Ba Trieu, Cho Lon and An Dong wet markets*

²⁸ *That Ton Dam wholesale market is slightly smaller with 5 to 6 wholesalers*

²⁹ <http://news.vneconomy.vn/20110111035043984P0C2/a-rock-and-a-hard-place.htm>

Table 4 Beef retail prices registered at Ben Thanh wet market on 15.02.2011 at 6 a.m.

| English terms | Vietnamese terms | Price (VND/kg) |
|---------------------------|-------------------|----------------|
| Loin | <i>Phi lê</i> | 159 000 |
| Rib | <i>Cót (suon)</i> | 150 000 |
| Hip | <i>Đùi</i> | 130 000 |
| Chuck | <i>Vai</i> | 100 000 |
| Shank | <i>Bắp</i> | 100 000 |
| Minced meat (third class) | <i>Vụn</i> | 50 000 |
| Liver | <i>Gan</i> | 70 000 |

An Dong market retails less beef than Ben Thanh, with approximately 450 kg per day. According to the retailer interviewed at An Dong market, customers' criteria for beef are freshness, color (pale red) and texture (tender). According to her, customers cannot distinguish between locally produced and regionally produced (imported cattle from Cambodia or Thailand) beef.

Supermarkets

Big C supermarket, which belongs to the French Casino group, currently runs five outlets in HCMC. Beef completes the meat assortment, but is outweighed by poultry and pork products. Big C retails approximately 100 to 120 kg fresh local beef per day at each outlet.

All outlets have been supplied by Bich Chi wholesaler from Dong Nai province since the opening of the first store, back in 1998. All outlets are responsible for their own supply. Local beef is occasionally sourced from Pham Van Hai market as well. During peak times, alternative sources may also be searched for. Big C has no traceability on the meat origin beyond its first tier suppliers. The company has signed a procurement contract with Bich Chi, which complies with order specifications.

Big C places weekly and monthly orders from Bich Chi, but has flexibility to adjust daily volumes. Meat is delivered daily at 5 a.m. and is inspected upon arrival at the supermarket by the local DVS.

Premium beef is imported from Australia through Hao company and retailed in small volumes (five to ten kg per day). The purchase department does not disclose purchase prices, only retail ones.

The range of retail prices is the following:

Table 5 Beef retail prices registered at Big C supermarket on 15.02.2011

| | Vietnamese denomination | Price (VND/kg) |
|-------------|-------------------------|----------------|
| Rumen | <i>Bao Tu Bo</i> | 69 900 |
| Heart | <i>Tim bo</i> | 77 900 |
| Shank | <i>Bắp</i> | 134 900 |
| Ground beef | <i>Thit bo xay</i> | 144 900 |
| Beefsteak | <i>Bo bit Tet</i> | 157 900 |
| Fillet | <i>Phi lê</i> | 179 000 |

| | | |
|--------------------|------|---------|
| Australian rib-eye | n.a. | 556 000 |
|--------------------|------|---------|

The sanitary context

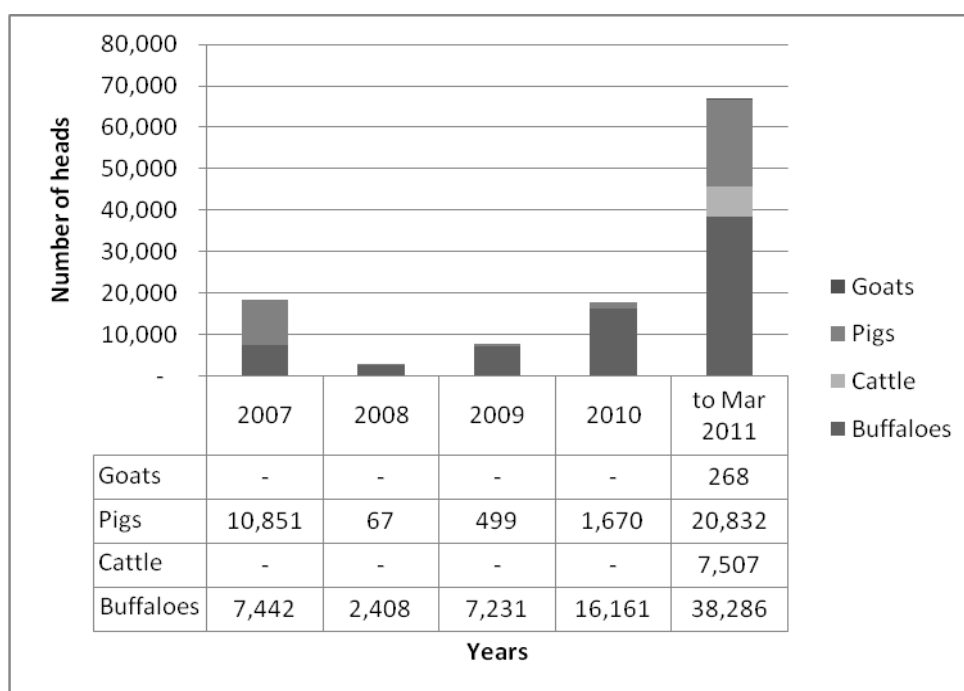
Institutional structure of veterinary services

The management of animal health issues falls under provincial authorities, under the aegis of the Department of Animal Health (DAH), one of the departments of the Ministry of Agriculture and Rural Development (MARD). Its organizational structure follows at provincial level with the Sub-Department of Animal Health (SDAH), at district level with District Veterinary Stations (DVS). Animal health workers, also called paravets conduct preventive and curative interventions at commune and village level.

FMD outbreaks

FMD is endemic in Vietnam (OIE, 2007). The location and number of outbreaks considerably varies between the years. The following figure shows the number of animals affected by FMD, declared and recorded since 2007.

Figure 14 Number of animals (in heads) affected by FMD, declared and recorded in Vietnam since 2007



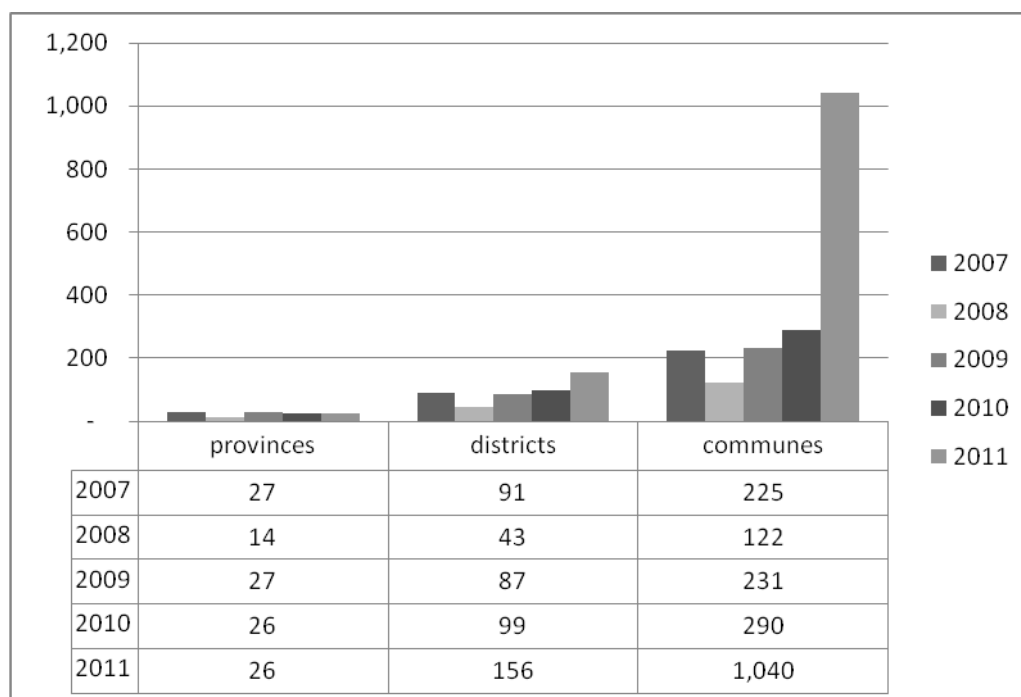
Source: DAH standing office, HCMC

The figure above shows that Vietnam has been hit by a severe FMD outbreak during the first quarter of the present year, with over 66 000 heads affected³⁰.

³⁰ Until 2011, figures were disaggregated into two categories: ruminants and pigs only

The following figure shows the geographical scope of the most recent outbreak, with 1 040 communes affected (156 districts in 26 provinces).

Figure 15 Number of communes, districts and provinces affected by FMD outbreaks since 2007



Source: DAH standing office, HCMC

The geographical scope of FMD outbreaks is found in annex 2.

Animal movement and FMD control

International and domestic livestock movements have been regulated since decisions No.70/2006/QD-BNN and No.49/2006/QD-BNN, dated 13 June 2006 have been issued by the MARD.

- **Domestic trade**

Since 2006, ear-tagging of cattle/buffaloes has become compulsory for inter-provincial trade. In parallel, the Ministry decreed compulsory vaccination against Foot and Mouth Disease (FMD) and quarantine prior to transport, as accompanying measures to control FMD. Such measures, as well as animal movement monitoring are implemented by DVSS in their respective districts under the supervision of the provincial SDAH.

In addition, in all districts sharing a border with Cambodia, DVSS carry out bi-annual vaccination campaigns against FMD in all cattle/buffaloes, as foreseen by the national FMD control programme. **Formal cross-border trade**

Monitoring of **formal** cross-border livestock movements through border gates falls under the responsibility of Regional Animal Health Offices (RAHO). However, most provinces with an international border do not exhibit any official movement of livestock so far.

Bourgeois Lüthi et al. (2009) reported occasional official movements of cattle/buffaloes through Cha Lo (Quang Binh province) and Lao Bao (Quang Tri province) border gates, commissioned by large private companies and supervised by the RAHO-3 (Nghe An) and provincial SDAHs.

- **Informal cross-border trade**

In some provinces, monitoring of **informal** cross-border livestock movement through the “green border” falls under the Regional Animal Health Office in charge, while in others respective DVSS and SDAHs are in charge. In some provinces, the RAHOs are directly involved when private or government official depots have been set up by the government to channel the flow of imported cattle/buffaloes.

The supply side: cross-border trade of live cattle/buffaloes

Tay Ninh province

Cross-border trade practices

Cross-border cattle/buffalo trade practices in Tay Ninh province were investigated in Tan Lap commune, Tan Bien district on 17 February 2011. Although Tay Ninh exhibits five border gates, four domestic and one international one (Moc Bai), import of live cattle and buffaloes occurs through the “green” border, across fields. Once in Vietnam, cattle/buffaloes are then traded along two distinct pathways:

Informal pathway: Vietnamese villagers are paid 15 000 to 20 000 VND per head to walk cattle across the border (five to ten heads per batch). Traders transport animals to their private grounds within Tan Bien district or to other districts of the province. This pathway concerns 30 percent³¹ to 50 percent³² of imported animals.

³¹ According to the trader interviewed

³² According to SDAH officer

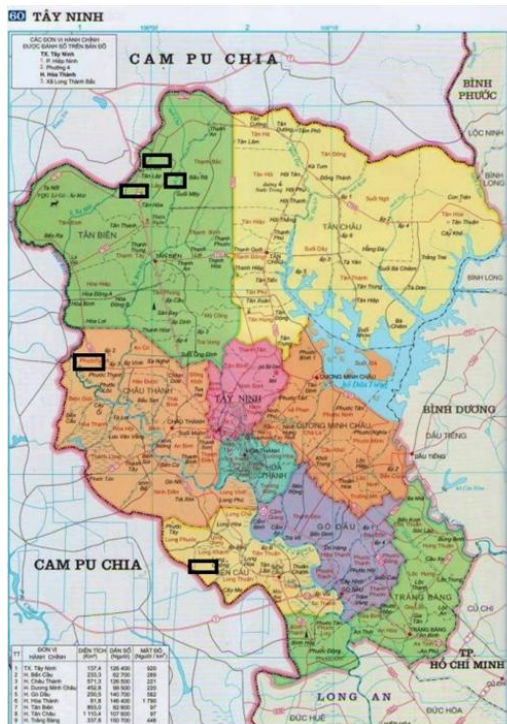
Figure 16 Informal private cattle/buffalo border “depots” in Tay Ninh province

Buffaloes informally imported from Cambodia and stocked at a trader’s private ground near the border (unofficial “depot”)



Official pathway: animals are stocked at one of the five official large private depots that Tay Ninh counts: three in Tan Bien district³³, one in Chau Thanh district³⁴ and one in Ben Cau district³⁵ as shown by the following figure.

Figure 17 Official private cattle/buffalo border depots in Tay Ninh province



Advertising board of a depot:

Purchase & Sales,

Disease inspection point, confined assembly point of imported cattle & buffalo

Such depots, called “quarantine areas” (*khu cach ly*), were set-up in 2010 under the technical guidance of Tay Ninh’s SDAH and the DAH standing office in HCMC. In Tan

³³ My Thi Bich and Dam Quang Tham

³⁴ Luc Chay

³⁵ My Van Tung

Bien district, this pathway encompasses 50 percent to 70 percent of all cattle/buffalo traded from Cambodia. Prior to the inception of depots, all animals were traded informally.

Animals reaching “quarantine” depots are vaccinated against FMD, ear-tagged and are due to be kept for 15 days before being traded further. Cattle are inspected by staff from the provincial SDAH who permanently stay at the depots (and not DVS staff, which is usually the case). Each official depot in Tay Ninh is staffed with an officer from the SDAH. The owner of the largest depot was interviewed and his trade practices are described below.

Official cattle/buffalo depot

Than Tien village, Tan Lap commune, Tan Bien district, Tay Ninh province



M. Le Thanh Long is a cattle/buffalo trader operating at the border with Cambodia. M. Long has been informally trading livestock across the border for over ten years. Early 2010, he was granted a government license to officially stock live cattle/buffaloes traded across the border. He set up a depot in the vicinity of the border (one km) with a maximum stocking capacity of 300 heads. He trades mostly cattle, to a lesser extent buffaloes.

He works with five to six Cambodian collectors from Kampong Cham province who operate across the border¹. He selects cattle at the Cambodian depot found in Kampong Cham province (across Xa Mat commune, Tan Bien district). Animals selected at the Cambodian depot are marked and walked across the border.

Until 2009, cattle originated from Myanmar, Thailand and Cambodia. Usually, the origin of livestock can be identified by the animals' aspect and their specific breed traits (e.g. ear length). Thai cattle are the only ones bearing (yellow) ear-tags, which are kept by Cambodian traders and removed only once they reach Vietnam. Cattle trade from Myanmar decreased over the last two years, due to stricter control by Thai authorities. M. Long fears that recurrent political and military clashes between Cambodia and Thailand may hamper livestock trade and raise prices in future.

The main trade season extends from November and peaks before *Tet*. He buys 20 to 30 heads per day on an average. However the volume of cattle/buffalo traded from Cambodia has recently decreased, due to unfavorable exchange rates between the KHR and the VND, thus increasing prices paid in Cambodia. On 17 February, 1 000 KHR were exchanged for 5 000 VND (=25 cents USD). Cambodian traders do not accept USD or VND, only KHR and are paid cash on delivery (CoD). Exchange rates are said to fluctuate daily. Rates are obtained from the Bank. The current purchase average price is 110 000 VND/kg estimated meat output. According to him, an official export tax of 100 000 KHR per head (=25 USD per head) is levied in Cambodia, but no import tax in Vietnam. Feeding costs for animals kept at his depot come up 10 000 VND per head per day for feeding and supervision (5 000 for straw and 5 000 for labour). Vaccination costs amount 20 000 VND per dose and ear-tagging costs 9 000 VND per head.

M. Long owns a slaughter-point in Trang Bang district, bordering HCMC. He slaughters ten heads per day and supplies Pham Van Hai beef wholesale market in HCMC. Meat is inspected at the slaughterhouse and transported by hired van, sealed by the DVS, to Pham Van Hai market. Meat of Cambodian cattle is reported to be tastier than meat of Thai cattle, as the latter is said to be fed in an industrial way. Cattle weigh 280 kg on an average (LW), with an expected meat output of 48 percent.

M. Long also supplies VISSAN abattoirs with 20 heads every two or three days. Cattle destined to VISSAN are transported by the company's own transport means (20-heads truck). VISSAN purchases cattle/buffalo at a price of 42 000 VND per kg LW. VISSAN requires larger sized cattle/buffalo with a minimum live weight of 350 kg. A premium of 500 VND per kg LW is paid for large-sized ones.

In order to cover other costs and obtain a margin, the purchase price for a 350 LW animal should not exceed 2 800 000 KHR or 14 000 000 VND (=40 000 VND per kg LW or 8 000 KHR per kg LW). M. Long's farm and other farms in the commune were affected by FMD in 2006. In 2010, Cambodian depots were affected by FMD outbreaks and were closed. He is able to recognize FMD clinical signs and does not purchase suspicious animals. Thai cattle are usually vaccinated and thus less at risks than Cambodian cattle.

An Giang province

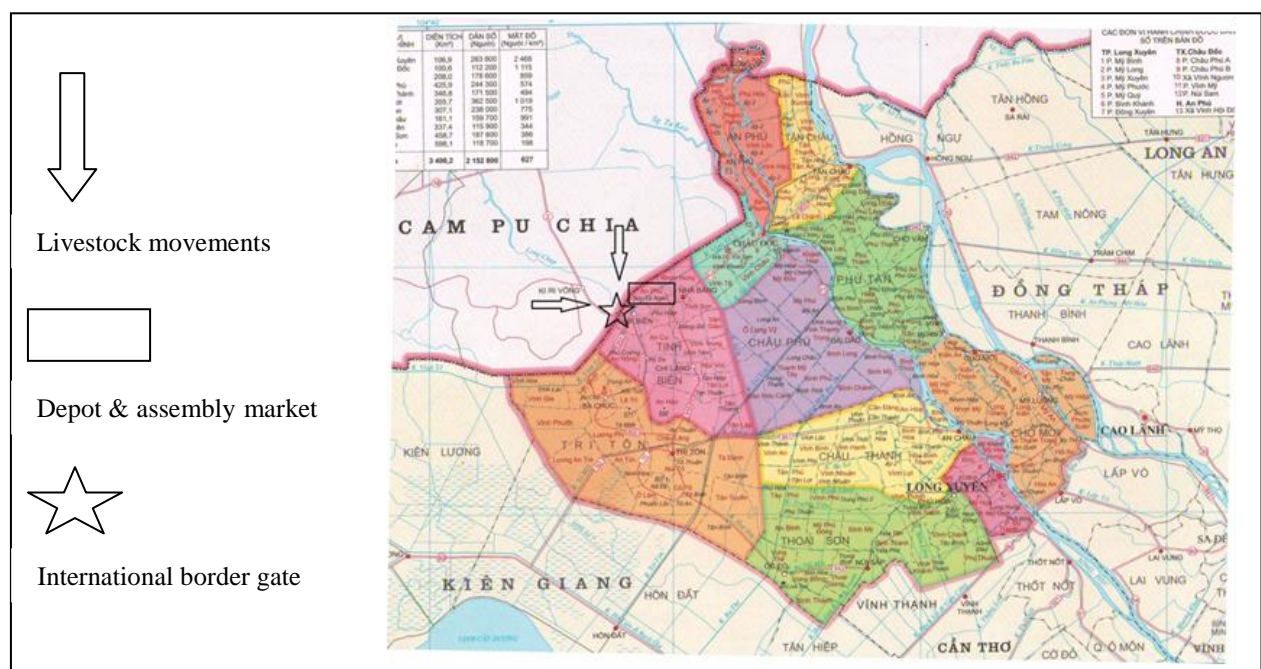
Cross-border trade in An Giang province was investigated in An Phu commune, Tinh Bien district between 6 and 9 June 2011. Interviews were carried out with Tinh Bien DVS staff,

SDAH staff at the international border gate quarantine checkpoint, as well as three traders and two farmers practicing cattle fattening.

Cross-border trade practices

The bulk of cattle/buffalo cross-border trade between Takeo province (Cambodia) and An Giang province (Vietnam) occurs between Kirivong (Cambodia) and Tinh Bien (Vietnam) districts, as shown by the following picture.

Figure 18 Main livestock movement from Takeo province (Cambodia) to An Giang province (Vietnam)



An Giang has two official border gates, one international (Tinh Bien border gate) with a main road access and one domestic gate with no proper road access. Although since 2008, cattle/buffalo import from Cambodia has been acknowledged and tolerated by Vietnamese sanitary authorities, it has remained illicit so far. As such, official border gates do not exhibit any movement of live animals and cross-border trade occurs though the “green border”. Cattle/buffalo trade from Cambodia has been going on for decades and is facilitated by the extensive “green border” and the lack of natural obstacles, with exception of the *Vinh Te* canal, which runs between the border and the main road on Vietnam side. Animals are walked by Cambodian traders though paddy fields across the border.

Once they reach the Vietnamese side, animals are selected and taken over by Vietnamese traders who “swim” them across the canal and stock them along the road.

From this point animals follow three distinct pathways:

1. They are **gathered at the assembly market in Ta Ngao village in An Phu commune**
 - for further trade to slaughterhouses within the province

- for further trade to slaughterhouses outside the province
 - for further trade to private farms (fattening or breeding) within the province
 - for further trade to private farms (fattening or breeding) outside the province
2. They are brought directly to private farms within the province for fattening
 3. They are sold directly to slaughterhouses within the province

Cross-border trade in An Giang is characterized by the existence of:

- cattle/buffalo assembly markets
- an official depot
- a high proportion of farmers practicing fattening-finishing

Ta Ngao official cattle assembly market

Ta Ngao assembly market³⁶ has existed since 2005 as an informal collection point for traders. In 2008, MARD released an official letter recognizing the market as an official collection point. Since then, Ta Ngao market has been supervised by Tinh Bien district veterinary station (DVS). Animals are gathered at the market before being distributed to their temporary destination (fattening/breeding farms) or end destination (slaughterhouse). Animals are aggregated independently of their end destination and no segregation is made between slaughter and breeding/fattening animals.

The market is held daily and usually counts 30 to 50 heads, 100 heads at peak times. A few Cambodian traders come to the market to directly sell exported animals to Vietnamese traders and/or farmers. An Phu commune counts approximately 12 large traders, each trading approx. 300 heads/month.

The official depot

In theory, all animals imported from Cambodia through An Phu commune and destined to be **exported outside** An Giang province for slaughtering, breeding or fattening shall be kept in the quarantine depot set-up by the Company No.622 (belonging to the army).

The official depot is found within the same compound as Ta Ngao assembly market and is placed under the supervision of the Regional Animal Health Office No 7. The official depot is surrounded by a few private depots supervised by Tinh Bien DVS. Stocking at depots, be it the official one or private ones, is continuous (no “all in-all out” system).

Fattening-finishing schemes

Fattening of juvenile cattle is widely practiced in An Giang provinces. The trend in juvenile cattle export from Takeo province was highlighted by Sieng (2009) in 2009 already. The

³⁶ Ta Ngao village in An Phu commune, Tinh Bien district

following case study shows how fattening with juvenile cattle is practiced in An Giang province.

**M. Pham Van Vu, farmer specialized in cattle fattening,
Phung Tam village, An Phu Commune, Tinh Bien district, An Giang province**

M. Vu has specialised in cattle fattening cattle since 2007. He fattens 100 heads per year on an average and currently keeps 60 male cattle aged eight to 12 months. With another farmer, he is the largest cattle holder specialized in fattening in the commune. Most farming households fatten cattle on a smaller scale (one to three heads). He sources cattle mostly from local traders within the commune, rarely from Ta Ngao assembly market. He usually buys small-sized and thin animals, of lower value. He does not know anyone buying cattle from Cambodia. His procurement system is continuous; he buys batches of three to five heads to replace fattened animals sold for slaughter. Fattened animals are sold to local traders for slaughter within the province or in other southern provinces.

The fattening period extends over six to 12 months. Cattle are fattened in an extensive way by grazing on natural grass around his rice fields and along the canal. (Untreated) rice straw and rice husk complete the ration. His herd usually does not graze along other herds and is kept enclosed at night. Manure is kept for his orchard.

Ten animals of his herd were affected by FMD in August 2010. He does not know where the disease spread from, as affected animals had been at his farm for a long period already. He called the DVS, the whole herd (incl. sick animals) was vaccinated, sick animals were separated from healthy animals and the shed disinfected with Benkocid. Affected animals recovered after one week. He stopped procuring animals during the outbreak.

His herd is vaccinated against FMD during the bi-annual vaccination campaign in April/May and September/October, when vaccine is free of cost. The cost of vaccination otherwise comes up 21 000 VND/head, depending on the number of animals to be vaccinated³⁷.

It is estimated that app. 90 percent of farming households in An Phu commune fatten cattle on a small scale (less than ten heads at a time) and only two farmers fatten imported cattle on a larger scale, with 30 to 50 heads per batch.

Cattle, mostly young males, are either bought from Cambodian or Vietnamese traders directly at the border, or at Ta Ngao market, or from Vietnamese traders in the commune (who usually source from Cambodia). Such cattle are not vaccinated before entering the farm premises. Fattening is practiced in a continuous system. When a few cattle are ready for slaughter they are sold and replaced by a new batch to complete the existing stock. The fattening period extends over six to 12 months depending on the initial condition of animals,

³⁷ Farmers need to pay for the whole vaccine vial, 25 doses in total. If their herd is smaller than 25 heads, the average vaccination cost per head increases

available resources and market demand conditions. Cattle are grazed in paddy fields and may occasionally be in contact with other grazing herds (fattening or breeding cattle).

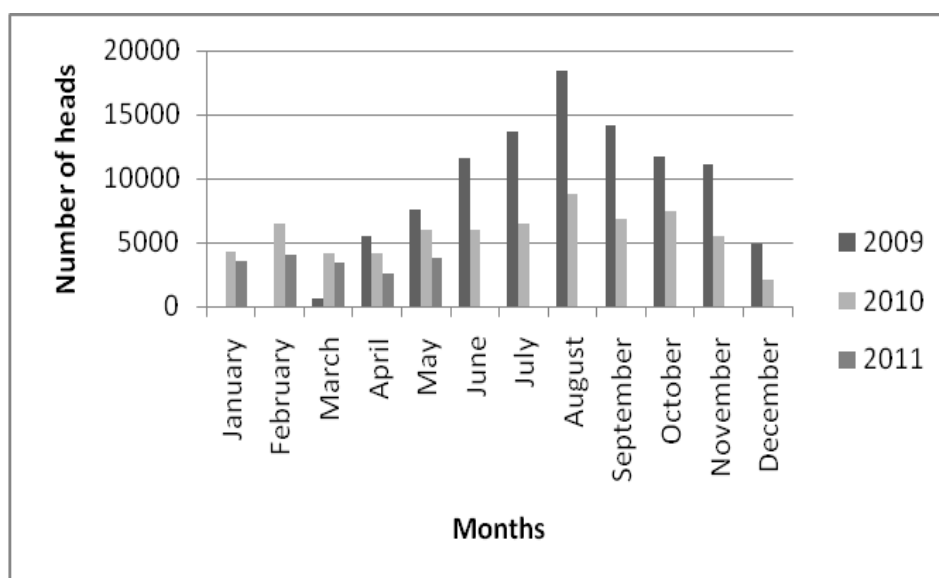
Types and volumes of livestock traded

In Tinh Bien district, cross-border trade of large ruminant concerns both mature animals destined to slaughterhouses and juvenile cattle destined to fattening-finishing. Currently, only Cambodian cattle are imported, since transit of cattle from Thailand has stopped in 2010. Buffaloes account for a lower proportion of imported livestock and pigs are not traded across the border. According to the DVS, Tinh Bien district channels the bulk of cattle/buffaloes cross-border trade, with up to 3 000 heads per month at peak times. Registers however show high export volumes (up to 18 000 heads per month), which cannot reasonably comprise a high proportion of domestic animals, owing to the low cattle/buffalo population found in the district.

Trade seasonality

According to traders interviewed in An Phu commune, cattle/buffalo supply from Cambodia peaks during the rainy season in August-September, when animals are not needed for the rice cultivation and prices are thus cheaper at this time of the year. On the other hand, the demand peak in Vietnam is reached in January-February, before *Tet*. The following figure shows volumes exported from Tinh Bien district to other provinces since 2009³⁸.

Figure 19 Number of cattle/buffaloes exported from Tinh Bien district to other provinces



³⁸ According to the DVS, export figures are almost equivalent to import (non registered) figures

“Export” destination for slaughtering cattle

Cattle destined to slaughter are “exported” to most provinces in the Mekong delta and provinces surrounding HCMC. Besides, VISSAN company buys one truck (25 heads) per day on an average from Tinh Bien district.

Registration, vaccination & ear-tagging

Animals stocked at the official depot and destined for **“export” out of the province** are vaccinated against FMD and ear-tagged and shall, in theory, be kept for 15 days at the depot. Animals kept at private collection points and destined to export follow the same procedure. SDAH (provincial level) staff are responsible for vaccination at depots, while DVS (district level) staff are responsible for bi-annual vaccination campaigns.

Animals destined for fattening or breeding **within the province** are usually directly transferred to private farms without vaccination, veterinary inspection and registration. Such animals will be vaccinated during the bi-annual national FMD vaccination campaign if they are still kept at the farm premises. This campaign has been implemented throughout Vietnam since 2005 in all districts bordering Cambodia, the Lao PDR or China. Vaccines are free of cost. Until 2005 and the inception of the national FMD control programme, border districts in An Giang province were already covered by a provincial FMD vaccination programme.

Between the two campaigns, farmers can choose to have their animals vaccinated at any time of the year, but at their own costs (appr. 23 000 VND/head).

Vaccination outside bi-annual vaccination campaigns is not compulsory and as such most farmers do not take the initiative to have their animals vaccinated.

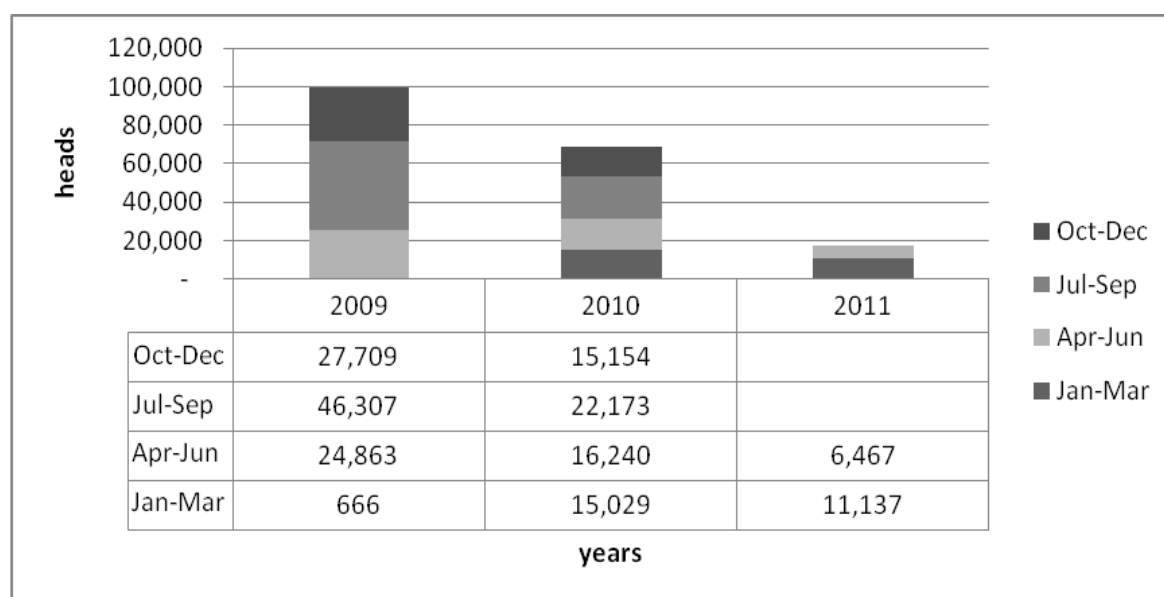
FMD outbreaks

According to Tinh Bien DVS, the district has not encountered FMD outbreaks since 1995. This assertion is in contradiction with information given by the farmer interviewed in An Phu commune, whose herd was affected by FMD in 2010 and who reported the case to the DVS. Neither the three traders interviewed in An Phu commune, nor the other farmer interviewed have seen their own businesses directly affected by FMD outbreaks.

Latest trends in cross-border trade

Traders indicated that cattle/buffalo imports from Cambodia peaked in July-August 2009 and have decreased since then. Thai cattle are rarely seen anymore and the overall volume of Cambodian cattle decreased as well. These observations are supported by data registered by Tinh Bien DVS and compiled in the figure below.

Figure 20 Quarterly volumes of animals traded from Tinh Bien district (An Giang province) to southern provinces



Export volumes from Tinh Bien district to southern provinces decreased by 31 percent between 2009 and 2010. According to traders, the decrease cannot be imputed to changes in market demand or supply. They report a stable market demand in throughout the year, with a slight peak before *Tet* and over the last years. The overall supply from Cambodia has remained stable as well. According to them, the main driver behind the decreasing volumes is less favorable exchange rates between the KHR and the VND. The local exchange rate is currently at one KHR to 5.2 VND, whereas one KHR amounted to 4.5 VND a few months ago.

Kien Giang province

Cross-border trade in Kien Giang province was investigated in Vinh Dieu commune, Giang Thanh district on 8 June 2011. Interviews were carried out with Giang Thanh DVS staff, SDAH staff at the quarantine checkpoint in Cong Ca village, two traders and one farmer practicing cattle fattening.

Cross-border trade practices

The bulk of cattle/buffalo cross-border trade between Kampot province (Cambodia) and Kien Giang province (Vietnam) occurs between Tuk Meas district (Cambodia) and Giang Thanh district³⁹ (Vietnam), as shown by the following picture.

³⁹ newly established which separated from Kien Luong district

Figure 21 Main livestock movement from Kampot province (Cambodia) to Kien Giang province (Vietnam)



Cross-border trade practices found in Kien Giang province are similar to the ones encountered in An Giang province. Cambodian traders walk cattle over the “green border” (rice fields) to be selected by Vietnamese traders. Vietnamese traders communicate in Khmer, although none of the traders found in Vinh Dieu commune are of Khmer descent⁴⁰, all of them being Kinh. Vietnamese traders “swim” cattle across the *Vinh Te* canal and stock them at their collection points (=small private depots) along the road. The highest density of collection points, at least ten, is found in Cong Ca village, Vinh Dieu commune, Giang Thanh district.

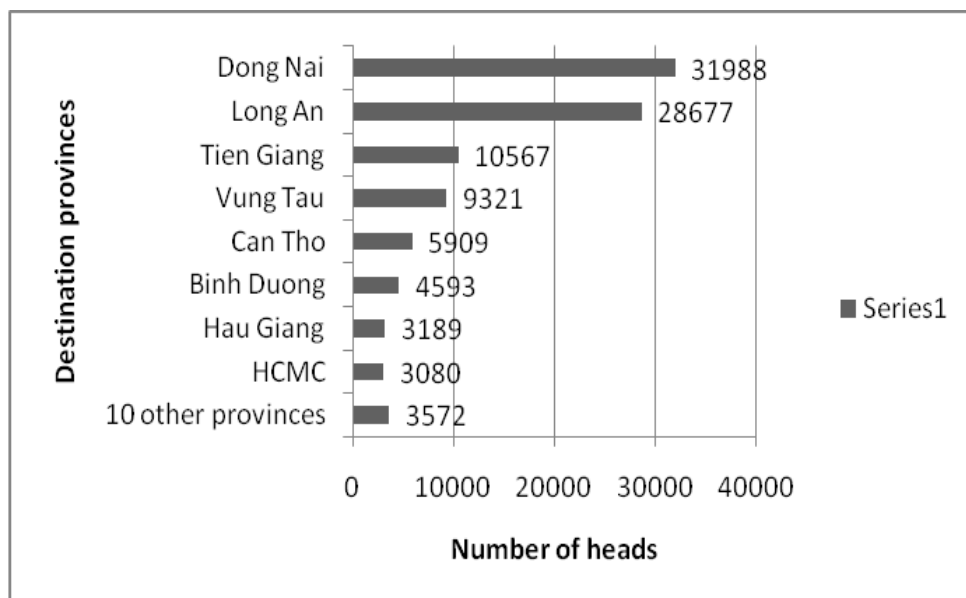
⁴⁰ According to *Giang Thanh DVS*, 30 percent of people in the district are of Khmer descent, but they all live other communes

Types and volumes of livestock traded

Juvenile cattle are imported in large volumes, as in An Giang. The trend in juvenile cattle export from Kampot province was highlighted by Sieng (2009) in 2009 already. However fattening-finishing is less practiced in Kien Giang than in An Giang. According to the DVS, most cattle/buffaloes imported are sooner or later ‘exported’ to other provinces and export figures can be considered almost as net import figures, given that the district’s own “domestic” population only amounts to 3 692 heads of cattle and 2 175 heads of buffaloes.

Volumes of cattle exported from the district are shown in the following figure.

Figure 22 Export destinations of cattle and buffaloes exported from Giang Thanh district, Kien Giang Province between January 2010 and June

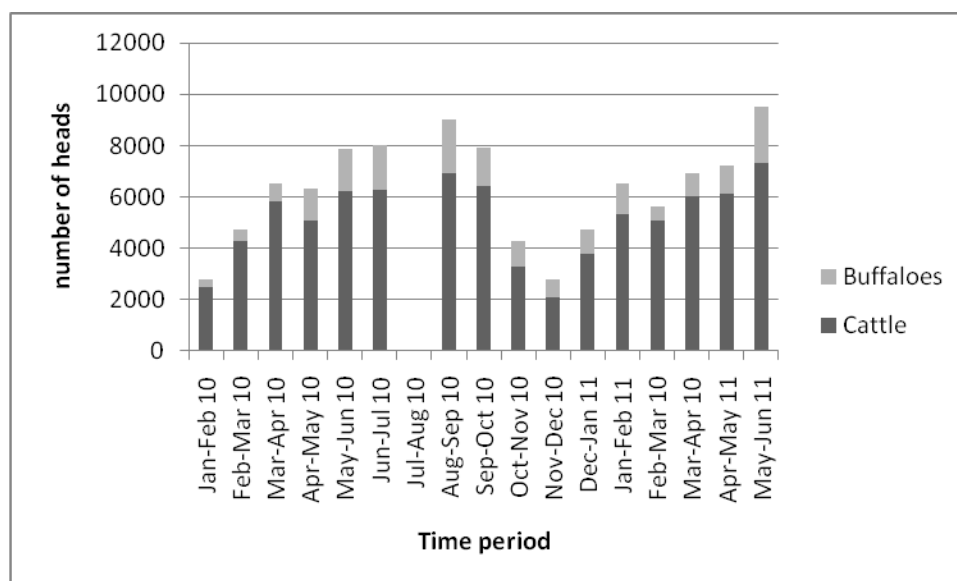


The figure above shows that over the last 18 months, Giang Thanh district has exported cattle and buffaloes to HCMC and 17 southern provinces, Dong Nai being the main destination with almost 32 000 heads. VISSAN is a regular customer with 25 heads (one truck) per day.

Trade seasonality

Between January 2010 and June 2011, slightly over 100 000 heads were officially exported from Giang Thanh district to other provinces. The following figure shows monthly export of cattle and buffaloes from Giang Thanh district to southern provinces.

Figure 23 Number of cattle and buffaloes exported from Giang Thanh district, Kien Giang Province to other provinces between January 2010 and June 2011



Source: monthly reports from SDAH quarantine checkpoint at Cong Ca village, Vinh Dieu commune, Giang Thanh district

The figure above confirms stakeholders' information about seasonality of cattle/buffalo trade. Trade volumes usually peak during the rainy season in July and August, when Cambodian farmers sell animals after rice cultivation. A second peak, lower than the summer peak usually occurs before the New Year in January-February.

Registration, vaccination & ear-tagging

In contrast to An Giang, Kien Giang does not exhibit any assembly market or official depot. Sale of animals to other traders, slaughterhouses or farmers occurs at traders' collection points. A quarantine checkpoint placed under SDAH (provincial) supervision has been set up in Cong Ca village. Its staff check animals destined to be exported to other provinces and issue movement certificates 15 days after animals have been vaccinated and ear-tagged by the DVS.

FMD outbreaks

Officially the district has not been affected by FMD since 1995, however the two traders interviewed encountered FMD outbreaks in their herd in the last five to six years. One saw his herd affected in 2010 and the other one in 2005 and 2006. Outbreaks were declared to the DVS.

Latest trends in cross-border trade

According to DVS and SDAH staff interviewed, three out of the nine large traders operating in Vinh Dieu commune in Giang Thanh district stopped trade in 2011, due to losses incurred by unfavorable KHR to VND exchange rates.

Discussion

Cross-border entry points

Slaughterers interviewed in February sourced their supply from traders operating in various southern provinces. The latter traded mainly cattle imported from Cambodia. According to slaughterers and HCMC's SDAH, the following provinces are major entry points for live cattle/buffalo traded from Cambodia into southern Vietnam:

1. An Giang
2. Kien Giang
3. Tay Ninh
4. Long An

Interviews subsequently carried out in the first three provinces showed that the Long An indeed channel large volumes of live cattle/buffaloes destined to HCMC and southern provinces. Interviews and field visits showed that each province exhibits specific trade patterns.

Tay Ninh province shows a high level of institutional interventions to channel post-border trade through official depots. The type of cattle traded in Tay Ninh is rather mature animals destined to slaughter.

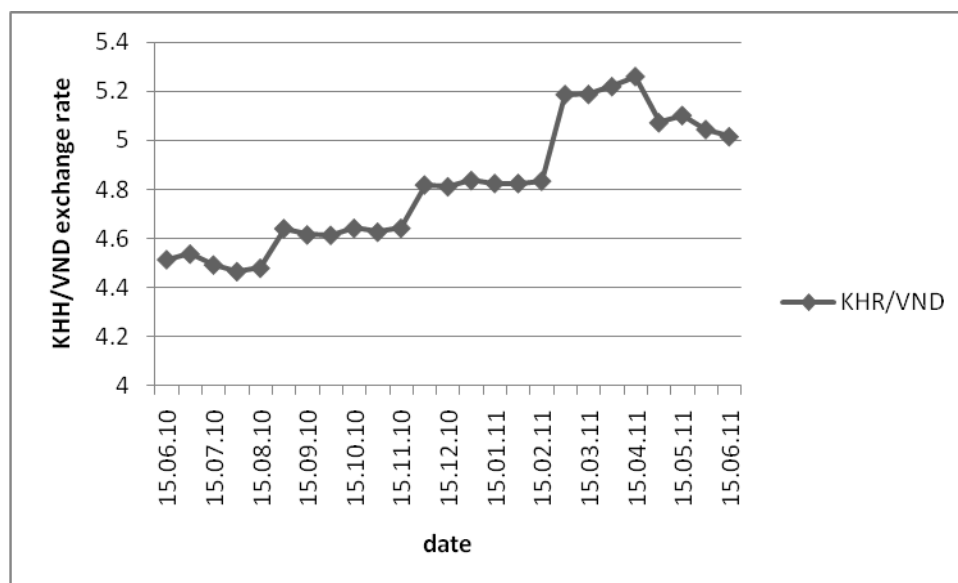
An Giang province shows a high level of institutional interventions to channel post-border trade as well, through one official depot and one assembly market. However, these official points coexist with numerous collection points. Cross-border trade patterns found in An Giang's are more complex than in Tay Ninh owing to the large volumes of juvenile cattle destined for fattening.

Kien Giang shows a lower level of institutional interventions to monitor post-border trade, with only one quarantine checkpoint in Cong Ca village. Juvenile cattle destined to fattening are imported as well, but to a lower extent than in An Giang.

Drivers of trade patterns

The research highlighted the fact that while the cattle supply from Myanmar and Thailand stopped, the supply of Cambodian animals is reported to be large enough to match the steady demand emanating from southern Vietnam. Nevertheless the cross-border flow has slowed down. This situation has been imputed to the impact of exchange rates between Cambodian and Vietnamese currencies on cross-border trade. The following figures shows how the KHR to VND exchange rates evolved over the last 12 months.

Figure 24 Bi-monthly KHR to VND exchange rates from 15 June 2010 to 15 June 2011



Source: <http://khr.exchangerates24.com/vnd/trend/?q=365> [accessed June 19th, 2011]

The figure depicted above shows significant changes in exchange rates starting from September 2010. At constant KHR prices for cattle in Cambodia, prices converted in VND increased for Vietnamese traders who pay their suppliers in KHR and sell to their customers in VND. This matter of fact can be illustrated by the following simple calculation with a fixed delivery price of 2 000 000 KHR for a young cattle. At an exchange rate of one KHR to 4.5 VND, the animal costs 9 000 000 VND to a Vietnamese trader, while the same animal costs him 10 400 000 VND at an exchange rate of one KHR to 5.2 VND.

Stocking of animals

Interviews showed that imported cattle can be stocked in different ways and at different locations before being traded further:

1. at border (confined) depots
2. at collection points (confined or not)
3. at slaughterhouses (confined or not)
4. at farms

Border official depots

The inception of depots was supported by the DAH, their status is therefore official and their operations on the Vietnam side of the border are recognized. However, for want of an official bilateral trade agreement (BTA) between Cambodia and Vietnam, cross-border movement is still informal. As such, depots operate in a “grey zone” and do not necessarily apply stringent control measures.

A previous study conducted for the OIE (Bourgeois Luthi et al., 2009) has shown that for economic reasons, depot owners are not able to cope with the 15 days quarantine regulation and further trade live animals within a few hours or days after import.

If quarantine measures are not respected, large-sized depots may even pose a greater risk of disease spread than small collection points through their larger dissemination potential, especially if they do not operate in an “all in-all out”, but in a continuous basis. Larger volumes of animals are consequently mixed before being traded further, and a larger number of traders source their animals from large depots.

Border informal collection points

In theory, private collection points are less stringently supervised than official depots. In reality, private collection points face similar “quarantine measures” as official depots if they want to export livestock to other provinces and they are confronted to the same difficulties to implement them.

Temporary stocking at slaughterhouses

Cattle can be kept for a few days in these locations and act as a buffer stock to match demand with supply. Cattle can be confined, but also often graze on industrial land plots or even on communal grazing land.

Traceability

Traceability of both live animals and meat is an issue which needs to be raised knowing that the geographic provenance of live animals differs from their location at slaughter.

The distinction between the “place of origin” of live cattle & buffaloes, actually where live animals were first loaded and the place of origin of meat (=where live animals were slaughtered) is crucial for traceability and risk assessment. For instance, the meat of an animal originating from Cambodia, loaded in An Giang province, slaughtered in Dong Nai province and sold in HCMC will be declared as originating from Dong Nai province.

The discrepancy between the place of origin of live animals and the provenance of meat is illustrated by the following figure: An Giang, Kien Giang and Tay Ninh provinces provide most live cattle & buffaloes for slaughter in HCMC, while Long An, Tay Ninh and Dong Nai provinces provide most beef imported into HCMC as illustrated by the following figures.

Figure 25 Schematised value chain of live cattle/buffalo slaughtered in HCMC and destined to HCMC’s beef market

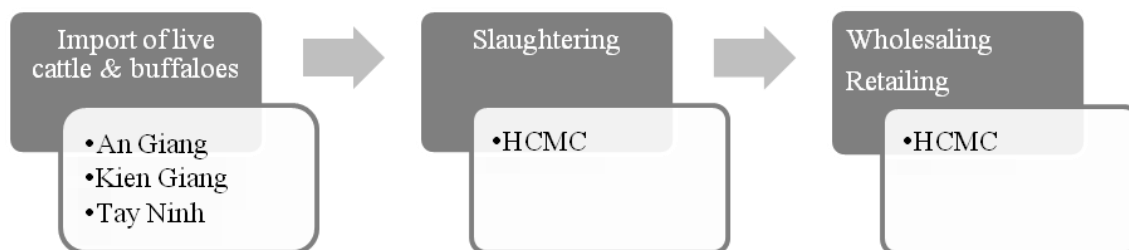
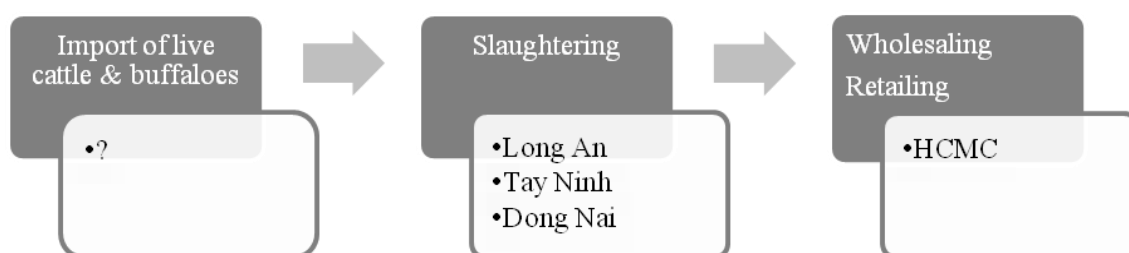


Figure 26 Schematised value chain of live cattle/buffalo slaughtered in neighbouring provinces and destined to HCMC’s beef market



HCMC’s SDAH collates data on the **provenance of meat** and the origin of **live animals** separately.

While traceability of live cattle & buffaloes slaughtered within HCMC may be relatively easy to follow thanks to certificates, the **origin of live cattle & buffaloes** whose **meat** is imported into HCMC is more difficult (although not impossible) to trace back. Provincial SDAHs are responsible for collating data on the origin of live cattle/buffalo slaughtered within their respective provinces.

Sanitary status of imported animals

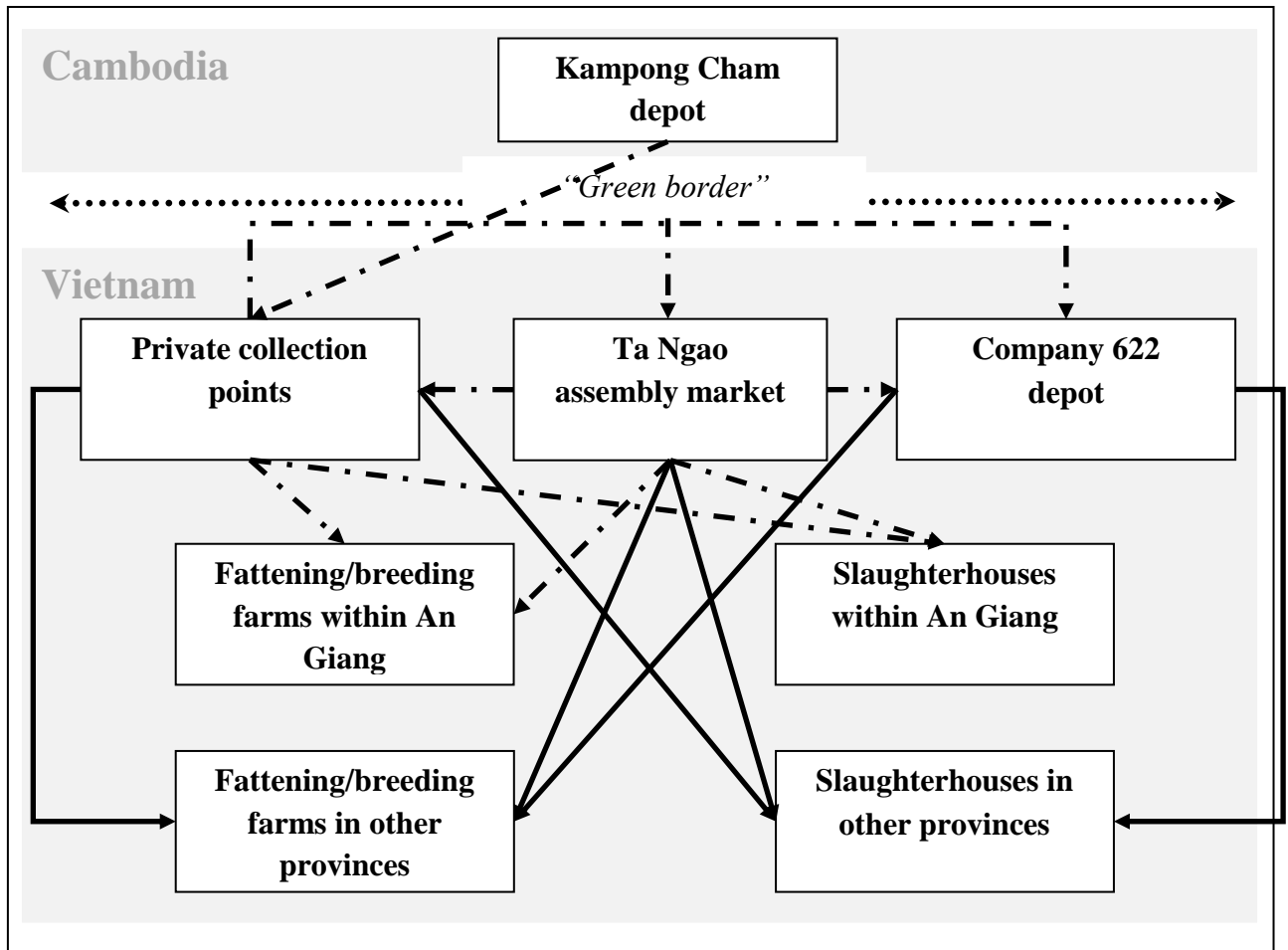
Interviews could not shed a clear light on the vaccination status of imported animals. Traders generally assert that cattle from Myanmar are not vaccinated, while Thai cattle are, as the latter bear yellow ear-tags. According to some traders, Cambodian animals are vaccinated, while according to others they are not. Traders however agree on the fact that they do not specifically target vaccinated animals for import.

Risk pathways

Each trade route and practice encountered through this research potentially bears risks of FMD transmission. However, some pathways and some practices bear higher risk than others.

The following figure shows all pathways found in Tinh Bien district, An Giang province. Dashed arrows show the trade pattern where animals are **not vaccinated** against FMD immediately upon arrival in Vietnam. Plain arrows show pathways where animals are **in theory vaccinated** against FMD, before leaving An Giang province.

Figure 27 Pathways for cattle/buffaloes imported from Cambodia in An Giang province



It appears that import provinces show the highest exposure to FMD transmission but also contamination, as imported animals are not vaccinated against FMD unless and until they leave the province or until the next bi-annual blanket vaccination is carried out. The vulnerability of border districts has been recognized by central authorities. As a result, these districts have been specifically targeted for bi-annual blanket vaccination in the national FMD control programme.

Although movement control measures have been implemented over the last five to six years, certain gaps still remain.

The following figure highlights four basic categories of animals which are at higher or lower risks of FMD contamination and transmission, depending on whether animals are vaccinated or not and whether they will be slaughtered or not.

Figure 28 Pathways for cattle/buffaloes imported from Cambodia in An Giang province

| | No slaughter | Slaughter |
|-----------------------|--|--|
| No vaccination | <p>Animals remaining within An Giang province for fattening or breeding bear most risks to contaminate other animals if they are FMD carriers.</p> <p>If they are healthy, they ultimately become most at risk of being contaminated by newcomers</p> | <p>Animals destined to be slaughtered within the province bear a risk, which will depend on the time gap between arrival and slaughter and the occurrence of contact with healthy animals.</p> <p>If animals can be channeled through a fast track procedure, they bear low risks</p> |
| Vaccination | <p>Animals traded outside An Giang province for fattening or breeding bear low risks to contaminate other animals provided they are vaccinated and “quarantined” before further transport.</p> <p>If they are not vaccinated, they bear high risks</p> | <p>Animals traded outside An Giang province for slaughtering bear low risks to contaminate other animals provided they are “quarantined” before further transport <u>or</u> they are channeled to slaughterhouses through a fast-track procedure</p> |

The figure above shows that livestock kept for fattening or breeding bear the highest risk, while animals destined to slaughter bear lower risks, provided they are not kept roaming with other animals until slaughter.

Beside live animal movements, the role of additional movements in the spread of the virus need to be considered as well. Such movements encompass the trade of meat and offal from infected animals, improperly disinfected trucks, humans in frequent contact with potentially infected animals (e.g. traders, animal health workers, DVS or SDAH officers...).

The present research has shown that beef is predominantly consumed in large urban poles, e.g. HCMC, while it is increasingly sourced from external⁴¹ slaughterhouses. The rapid expansion of urban centres in the Mekong delta tends to push slaughtering and activities revolving around meat further to the outskirts of urban centres.

This trend is illustrated by the newly established wholesale market Hoc Mon district. This trend is likely to continue and accelerate and ultimately most slaughtering activities will take

⁴¹ *In surrounding provinces*

place in rural areas close to the Cambodian border. Concentrating slaughtering activities closer to the border would mean less transport of live animals and hence less risks, provided slaughtering, meat processing and transport occurs under strict sanitary measures. Moreover, disinfection measures may be easier to implement with trucks transporting meat than with trucks transporting live animals, owing to food safety issues.

Preliminary conclusion and way forward

The survey enabled us to sketch out a broad picture of the main destination market in southern Vietnam, by identifying its major stakeholders and major trade routes.

HCMC is the main destination market for meat of cattle and buffaloes slaughtered at its slaughterhouses or at slaughterhouses operating in surrounding provinces. A large proportion of cattle and buffaloes slaughtered to supply HCMC's market demand are live animals imported from Cambodia.

Import of live cattle and buffaloes originating from Myanmar and Thailand and transiting through Cambodia is reported to have stopped in 2010. Import of live cattle and buffaloes originating from Cambodia has persisted so far, although it has slowed down over the last months due to unfavorable exchange rates between the KHR and the VND.

It appears that all provinces bordering Cambodia are involved in cross-border trade of cattle and buffaloes. However, four provinces, viz. An Giang, Kien Giang, Tay Ninh and Long An are reported to channel the highest volumes.

Although concerned central, provincial and district authorities have made attempts to formalize and regulate post-border trade, cross-border trade itself remains illicit and informal. As such, an adequate surveillance of trade practices and pathways is difficult to achieve.

The research highlighted the following practices as potential vectors of FMD transmission risks:

- No control and sanitary measures specifically targeting cattle destined to fattening or breeding within import provinces
- Lack of evidence of thorough and systematic implementation of regulation pertaining to vaccination and quarantine of animals destined to be traded out of the province, either for slaughter, breeding or fattening
- Absence of segregation between animals destined to fattening/breeding and animals destined to slaughtering at Ta Ngao assembly market in Tinh Bien district (An Giang province)
- Proximity of cattle assembly market, official quarantine depot and private collection points in Ta Ngao village
- Temporary stocking of animals destined for slaughter outside slaughterhouse premises (e.g. on communal or industrial land) or at traders' premises

In order to narrow down transmission risks, it is proposed to discuss the following measures aiming at adapting the existing policy:

- FMD vaccination and marking (ear-tagging or branding) **specifically targeted at animals destined to fattening or breeding**, rather than at animals destined to be slaughtered

- Implementation of a fast-track procedure for animals destined to be slaughtered
 - Inspection
 - Segregating from breeding/fattening animals
 - Marking and registering
 - No quarantine and no vaccination
 - Fast movement and stocking at slaughterhouse premises in a confined environment (shed or pasture)

Facilitate slaughtering

If an adaptation of the existing policy is deemed necessary, proposed measures could be undertaken on a trial basis in Tinh Bien district in An Giang province, since it concentrates several of the issues discussed in the report.

While the research did not come across any evidence of cross-border trade of pigs, it is advised to consider the role played by pig trade in FMD spread in southern provinces in further research.

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Checklist as a guide for semi-structured interview

8. Trader Profile

- g. Type of farm/trader: species, purpose, full-time or part-time operation
- h. Position of interviewee: trader/farmer/owner or farm manager
- i. Export and/or domestic trade of livestock
- j. Holding capacity or volume of livestock traded (either per week/per month/per year)
- k. How long has the business been established
- l. How the business has evolved over time

9. Procurement System

Establish a picture of the structure and the system by which livestock are procured:

- o. How and from where does the trader source animals
- p. Use of agents/middlemen/other traders/farmers (Names, contacts, location)
- q. Are these sources regular or do they change
- r. Estimate of number of animals from each source (use of flow diagram)
- s. Seasonal variation in number of animals traded/sources of animals/price – give reasons
- t. Market chain of livestock coming into this trader operation – probe back as far as possible to find original source of animals.
- u. What is the payment process between trader and suppliers
- v. Does the farm order certain numbers of animals from suppliers
- w. Do the suppliers have holdings or do they bring animals directly from where they purchase
- x. Does each supplier cover a specific area (province/district etc) or is there cross over between suppliers.
- y. Who buys animals from the village – what is the process of purchase from the village level farmer
- z. Confirm all routes coming in to the farm/trader
- aa. Is there use of a livestock market or equivalent in procuring animals
- bb. What is the process of bringing animals into the trader holding area/farm etc. (Probe regarding quarantine, treatments, examination to determine if any is done and whether sick animals are avoided or sought).

10. Distribution System

Establish a picture of the structure and the system by which cattle are sold.

- a. How and to where do they sell animals

- b. Who are their clients – type of client (other trader (same country or neighbouring country), slaughterhouse, farm, etc) (names, contacts, location)
- c. Do they use middlemen/agents etc to sell – how do they find their buyers?
- d. Are these clients regular or do they change?
- e. Estimate the number of livestock distributed to each client (use flow diagram)
- f. Seasonal variation in number of animals traded/clients/price – give reasons
- g. Market chain of livestock leaving this trader operation – probe forward as far as possible to find eventual destination of animals.
- h. Confirm all routes of distribution from the trader and stakeholders/locations involved.

11. Other Traders known to this trader but not connected directly

- c. Do they know who are their competitors/others doing similar work (names/locations)
- d. Do they know of other traders, even if doing different level of trading (names/locations)

12. Farm Operations

- i. Biosecurity measures used on the farm/trading area/vehicle
- j. Method of transportation: own vehicle/rented/shared and size of vehicle
- k. Vaccination: what, when, where
- l. Disinfection: what, when, where
- m. Collection and distribution of animals – by trader or collected/dropped off by buyer/seller.
- n. If they think animals are sick what do they do
- o. How do they detect fever
- p. Is it a continuous or an all-in-all-out system

13. Animal Health

- i. What are the main animal health issues they experience
- j. Have they experienced any outbreak of disease in their farm/business - describe
- k. What did they do
- l. How were they affected in terms of business: improve profits, increase losses, stop trading for a time? Other impacts?
- m. Information on suspected cause/source of outbreak

14. Pricing

- a. How do they monitor price of animals
- b. Who and what determines the price of animals
- c. How does price change according to area and what is the reason for the difference
- d. How does price change according to season and what is the reason for the difference
- n. How much they pay for livestock/for how much do they sell

- o. Try and get prices and financial arrangements at the different levels of suppliers/distributors (use of credit, paid employees, commissioned agents, traders, farmers, etc)
- p. Taxes and fees to enable them to trade
 - i. Official cost
 - ii. Unofficial cost

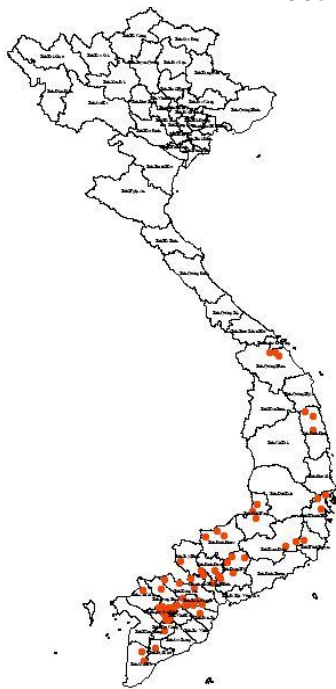
Annex 2 Survey schedule

| | | | |
|-------|-----------|----------|--|
| Day 1 | Monday | 14.02.11 | Arrival of the consultant from the Lao PDR |
| Day 2 | Tuesday | 15.02.11 | HCMC <ul style="list-style-type: none"> • visit of Hoc Mon pork wholesale market, interview with market supervisor & SDAH staff in charge • visit of Pham Van Hai beef wholesale market, interview with beef wholesaler & DVS staff in charge • visit of Ben Thanh retail market, interview with 2 meat retailers & DVS staff in charge • visit of An Dong retail market, interview with 1 meat retailers & DVS staff in charge • meeting with HCMC-SDAH officers • visit of Big C supermarket & interview with meat procurement staff • visit of VISSAN abattoir & discussion with VISSAN deputy director & staff |
| Day 3 | Wednesday | 16.02.11 | Binh Duong province <ul style="list-style-type: none"> • discussion with SDAH & DVS officers • interview of Ut Thao slaughterhouse owner |
| Day 4 | Thursday | 17.02.11 | Tay Ninh province <ul style="list-style-type: none"> • discussion with SDAH & DVS officers • interview of cattle depot owner (trader & slaughterer) |
| Day 5 | Friday | 18.02.11 | Dong Nai province <ul style="list-style-type: none"> • discussion with SDAH officer & DVS staff • interview of slaughter-point owner (Ms Hue) in Trang Bom district • interview of Bich Chi meat wholesale company owner |
| Day 6 | Saturday | 19.02.11 | HCMC <ul style="list-style-type: none"> • Debriefing session with DAH and SDAH officers • Departure of the consultant to the Lao PDR |
| Day 7 | Sunday | 5.06.11 | Arrival of the consultant from the Lao PDR |
| Day 8 | Monday | 6.06.11 | An Giang province <ul style="list-style-type: none"> • departure for Tinh Bien district, An Giang |

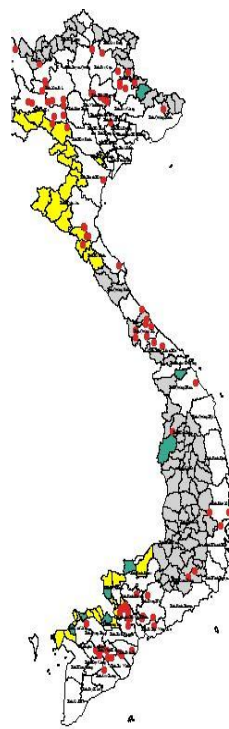
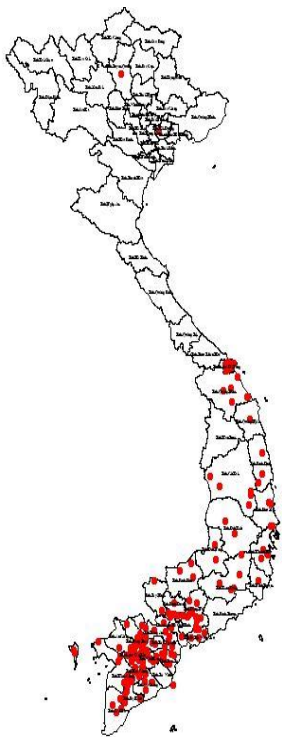
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|--------|-----------|----------|--|
| | | | province (5 hours) <ul style="list-style-type: none"> • meeting with Tinh Bien DVS staff • meeting with border gate quarantine checkpoint staff |
| Day 9 | Tuesday | 7.06.11 | An Giang province <ul style="list-style-type: none"> • interview of 1 cattle trader in Phu Hoa village, An Phu commune • interview of 2 cattle traders in Phu Tam village, An Phu commune • Visit of cattle market, official & private depots area • Interview of 1 cattle trader & fattener |
| Day 10 | Wednesday | 8.06.11 | Kien Giang province <ul style="list-style-type: none"> • Departure for Giang Thanh district, Kien Giang province (1 hour) • discussion with Giang Thanh district DVS staff • meeting with quarantine checkpoint SDAH staff • interview of 2 cattle traders in Cong Ca village • interview of 1 cattle fattener in Cong Ca village • Back to An Giang province |
| Day 11 | Thursday | 9.06.11 | An Giang province <ul style="list-style-type: none"> • Interview of 1 cattle fattener at DVS • Departure to HCMC (6 hours) |
| Day 12 | Friday | 10.06.11 | HCMC <ul style="list-style-type: none"> • Debriefing session with DAH and SDAH officers • Departure of the consultant to the Lao PDR |

Annex 3 Geographical scope of FMD outbreaks in Vietnam

2005



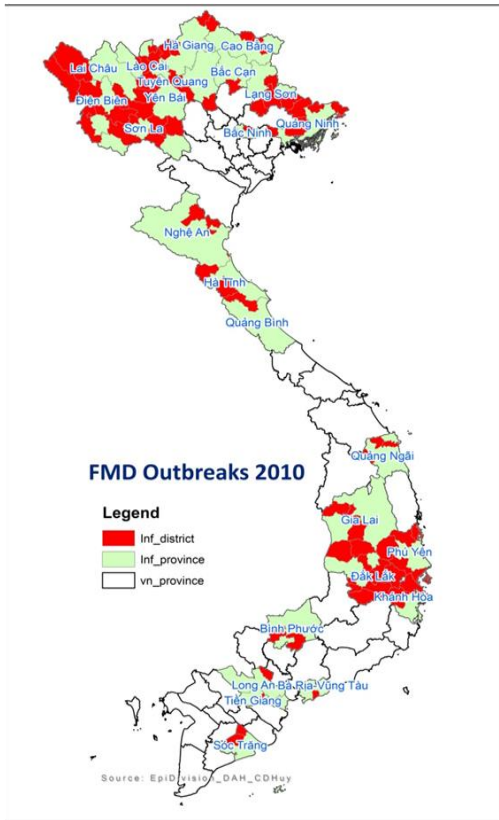
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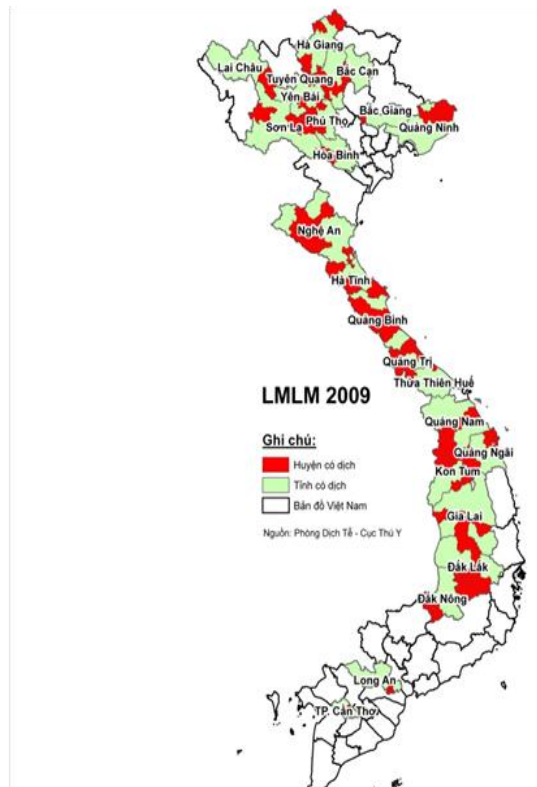
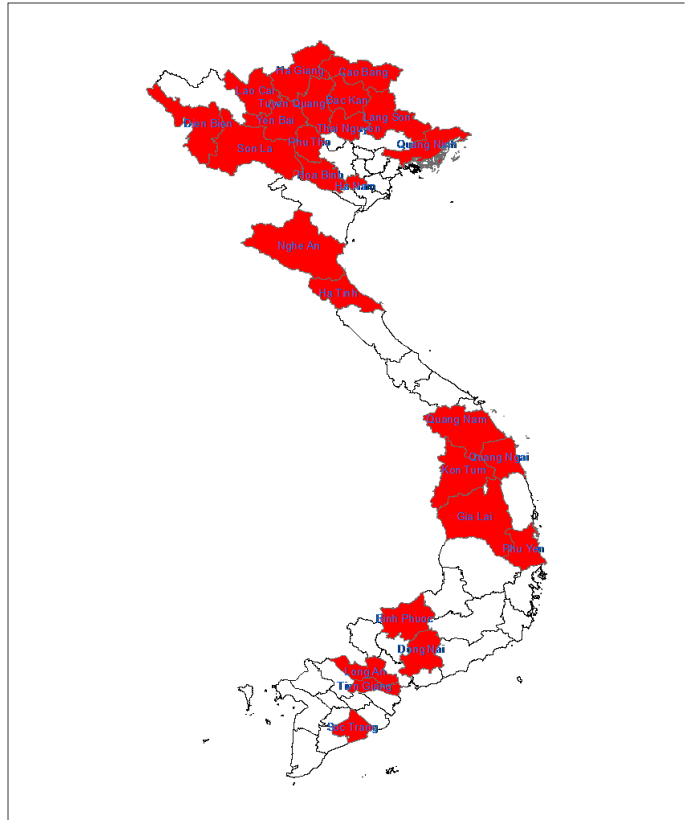
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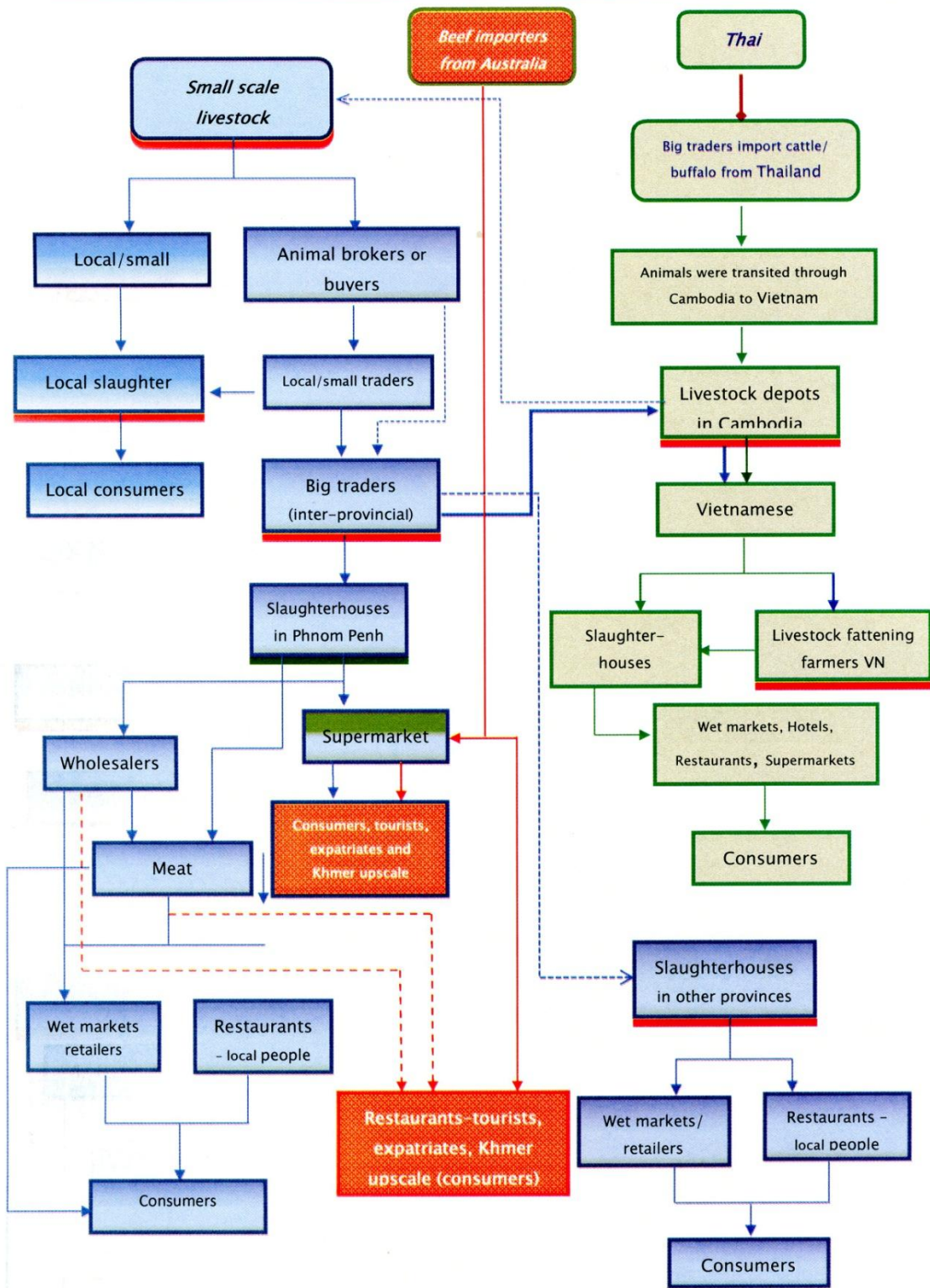
2010



2011



THE DOMESTIC AND INTERNATIONAL CATTLE (BEEF) MARKET CHAIN IN CAMBODIA & VIETNAM



Socheat Sieng, 2012

*A MARKET CHAIN DIAGRAM IS PREPARED FOR THE COORDINATION MARKET CHAIN ANALYSIS RESEARCH AND INTERVENTIONS MEETING

Appendix 7. Investigation of large ruminant market chains entering China and Vietnam from Laos

**Survey on the “fast track” livestock movement pathways
for large ruminants & pigs
in Bokeo, Luang Namtha and Savannakhet provinces
in the Lao PDR**

16-20 and 25-27 May, 2011

Draft Survey Report prepared for

ACIAR Project AH/2006/025

**Understanding Livestock Movement and the risk of spread of
transboundary animal diseases**

(ULM) Project



Vientiane, June 2011

Nancy Bourgeois Lüthi

Consultant, livestock value chains expert

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Abbreviations

| | |
|-----------------|--|
| ACIAR | Australian Centre for International Agriculture Research |
| BTA | Bilateral Trade Agreement |
| CP conglomerate | Charoen Pokphand Group, Thailand's largest business conglomerate |
| CYN | Chinese Yuan Renminbi, China's official currency |
| DAFO | District Agriculture and Forestry Office |
| e.g. | exempli gratia, for instance |
| EWEC | East West Economic Corridor |
| FMD | Foot and Mouth Disease |
| GMS | Greater Mekong Sub-region |
| HPAI | Highly Pathogenic Avian Influenza |
| LAK | Lao Kip, the Lao PDR's currency |
| OIE | Office International des Epizooties |
| PAFO | Provincial Agriculture and Forestry Office |
| PDR | Peoples' Democratic Republic |
| SEACFMD Project | South East Asia and China Foot and Mouth Disease Control Project |
| TAD | Trans-boundary Animal Disease |
| THB | Thai Baht, Thailand's currency |
| ULM | Understanding Livestock Movements |

Acknowledgements

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The consultant would like to extend her warm thanks to the people interviewed throughout the surveys: government officers, traders, owners and staff of the transit companies.

Background to the survey

ACIAR has implemented the “Understanding Livestock Movements and the Risk of Spread of Trans-boundary Diseases” (ULM) Project (ACIAR Project AH/2006/025)⁴² in the Lao PDR and Cambodia since 2008. In the Lao PDR, the project team⁴³ carried out a nation-wide research on commercial livestock movements between 2008 and 2010.

In March 2010, the project team conducted several feedback meetings for livestock traders involved in the research. During one of these meetings, a “fast-track” pathway of cattle and buffaloes trade from Thailand to China through Luang Namtha and Bokeo provinces, in the north west of the Lao PDR, was identified. The recently established movement was described as being “*official in Thailand and the Lao PDR, but informal in China*” (Scoizec, 2010). In February 2011, Dr. Jim Kerr proposed to make a follow-up on this “fast-track movement”, in order to assess its characteristics and potential role in spread of trans-boundary animal diseases (TAD). For timing reasons and availability of the national project coordinator and the consultant, the survey could be carried out only in May 2011.

After the survey was conducted in north-western provinces in May 2011, the team felt necessary to verify if trends in cross-border trade observed in the north also applied to Savannakhet province, the main transit pathway identified and researched so far. A second survey was therefore planned on short notice and carried out a few days later in Savannakhet province.

⁴² <http://aciarc.gov.au/project/AH/2006/025>

⁴³ Dr. Phouth Inthavong, national project coordinator and Dr. Axelle Scoizec, international project adviser

Main objectives of the surveys

The main objectives of the present research are to assess:

- whether fast-track movements described in 2010 by Scoizec (2010) in Bokeo, Luang Namtha and Savannakhet still prevail

and if so

- the disease risk associated with this trans-boundary trade

Schedule and location of the research

The research was conducted in two surveys between 16 and 20 May in Luang Namtha and Bokeo provinces and between 25 and 27 May in Savannakhet province, respectively in the north-west and the centre of the Lao PDR.

Luang Namtha province shares domestic borders with Oudomxay province in the east and Bokeo province in the west and an international border with China (Yunnan province) in the north. It comprises 5 districts: Namtha, Sing, Long, Vieng Poukha and Nalae.

Bokeo province shares domestic borders with [Luang Namtha province](#) in the northeast, [Oudomxay province](#) in the southeast and Sayaburi province in the south and international borders with Myanmar (Shan State) in the north and Thailand (Chiang Rai province) in the west, along the [Mekong river](#). It comprises 5 districts: Houay Xay, Ton Pheung, Meung, Pha Oudom and Pakha.

Savannakhet province is situated in central Lao PDR along the East-West Economic Corridor (EWEC), a route extending over 1 300 km and linking the Indian Ocean to the South China Sea. The province shares domestic borders with Khammouanne province in the north and Saravan province in the south and international borders with Thailand (Mukdahan province) along the Mekong in the west and Vietnam (Quang Tri province) in the east. It comprises 15 districts.

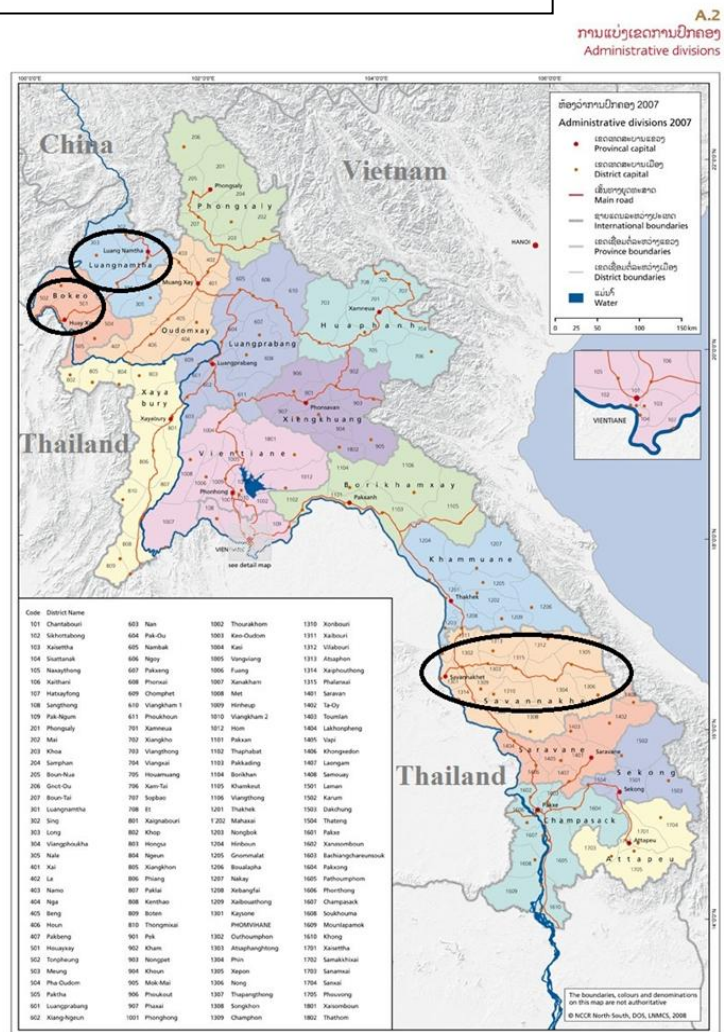


Figure 1 Location of the research in north-western and central provinces of the Lao PDR

Bokeo and Luang Namtha provinces belong to the Golden Triangle Special Economic zone, as shown by the following picture.

Figure 2 Signboard of the northern special economic zone



As mentioned already, Savannakhet province extends along the East West Economic Corridor and is traversed daily by container trucks, as shown by the following picture.

Figure 3 Truck transiting through the East West Economic Corridor in Savannakhet province



Table 6 Schedule of survey No.1 in Luang Namtha and Bokeo provinces

| | | |
|-------|--------------------|---|
| Day 1 | Monday 16.05.11 | <ul style="list-style-type: none"> • Flight from Vientiane to Luang Namtha • Meeting at PAFO Luang Namtha |
| Day 2 | Tuesday 17.05.11 | Luang Namtha province <ul style="list-style-type: none"> • Interview of three traders in Dok Khoun village, Namtha district • Interview of one trader in Na Teuy village, Namtha district • Stop-over at Na Teuy road checkpoint • Interview of one trader at New Boten village • Interview of staff at Boten border gate quarantine office |
| Day 3 | Wednesday 18.05.11 | Luang Namtha and Bokeo province <ul style="list-style-type: none"> • Interview of Trader 6 owner • Travel to Bokeo (3 hours) • Meeting at PAFO Bokeo • Visit of boat-landing and cattle loading area in Ban Dan |
| Day 4 | Thursday 19.05.11 | Bokeo province <ul style="list-style-type: none"> • Interview of one trader • Interview of Trader 8 trade company owner • Meeting at Bokeo Mekong port quarantine office • Travel to Thailand and back to Vientiane by bus (14 hours) |
| Day 5 | Friday 20.05.11 | Arrival in Vientiane |

Table 7 Schedule of survey No.2 in Savannakhet province

| | | |
|-------|--------------------|--|
| Day 1 | Wednesday 25.05.11 | <ul style="list-style-type: none"> • Travel from Vientiane to Savannakhet by car (7 hours) |
| Day 2 | Thursday 26.05.11 | Savannakhet province <ul style="list-style-type: none"> • Meeting at PAFO in Savannakhet town • Interview of Trader 13 staff • Meeting at Lao-Thai Friendship bridge quarantine office • Departure for Densavanh border gate (4 hours) • Interview of staff at Densavanh border gate quarantine office • Visit of Densavanh depot • Departure for Savannakhet (4 hours) |
| Day 3 | Friday 27.05.11 | <ul style="list-style-type: none"> • Travel back from Savannakhet to Vientiane (7 hours) |

Methodology

The survey was conducted by interviewing targeted stakeholders of the cattle and buffalo market chain. Meetings were requested by the national project coordinator and arranged by the concerned Provincial Agriculture and Forestry Offices (PAFO) prior to interviews. A list of specific questions was designed by the international project supervisor to meet the objectives of the survey.

Table 8 List of specific questions asked from stakeholders

- Does the trade as described by Scoizec (2010) still exist, or was it a temporary phenomenon?
- Where are the trade routes/roads/entry points?
- If it exists, what are the volumes (by species) that move through Laos into China, respectively Vietnam via this pathway?
- Is there a seasonal pattern to this trade, or seasonal changes to the routes (according to road conditions etc)?
- What is the origin of the livestock moving along this pathway? (Where in Thailand do they originate? Do any originate in Myanmar?)
- Is anything known about the destination of the livestock? (slaughter close to border vs. slaughtered elsewhere vs. feedlot vs. breeding/draught stock?)
- Which countries officially sanction this cross-border route? (Thailand vs. Laos vs. Vietnam), and which countries view it as unofficial?
- How do the livestock cross the Thailand-Laos border and Laos-China, resp. Laos-Vietnam border? Does it involve livestock moving across country borders without
 - i. changing vehicles
 - ii. walking/swimming around official border crossing points
 - iii. being accumulated (even temporarily) in depots/quarantine stations?
- Key traders/stakeholders in each country (confidential info), and other significant features of the market chain?
- Critical points in the pathway where disease spread is likely to occur (or where disease control interventions might most effectively be applied)?
- Official/unofficial paperwork and payment systems/details? (Possibly sensitive info)
- Disease outbreak reports associated with the trade (in Laos, Vietnam)?
- Forecast for the trade?

1 Results

Luang Namtha province

The survey was conducted in Luang Namtha between May 16 and 17. Five traders and one company owner were interviewed as shown by the following table.

Table 9 Stakeholders interviewed in Luang Namtha province

| | Species traded | Location | Volume per month | Source |
|----------|--|-------------------|-------------------------------|-----------------------------------|
| Trader 1 | Cattle/buffalo Pigs | Namtha district | 1 truck (ten-12 heads) | Bokeo province Namtha district |
| Trader 2 | Cattle/buffaloes | Namtha district | 20 heads | Bokeo province |
| Trader 3 | Pigs | Namtha district | n.a. | Vieng Poukha district |
| Trader 4 | Cattle/buffalo (now second hand clothing) | Na Theuy village | Before: 20-40 Now: stopped | Bokeo province |
| Trader 5 | Cattle/buffalo Pigs | New Boten village | n.a. stopped | Bokeo province |
| Trader 6 | Cattle/buffalo | Namtha town | 150 heads Now: stopped | Bokeo province |

In addition, meetings with government officers were conducted at:

- PAFO Luang Namtha
- Wildlife and forestry road checkpoint
- Quarantine checkpoints at Lao-China border gate (Boten)

Domestic trade

According to the PAFO, the “**domestic export**”⁴⁴ **ban** on cattle and buffaloes reported by Scoizec in 2009 (Scoizec, 2009) still prevails in Luang Namtha. Besides, the province does not exhibit any **transit** of domestic livestock to other provinces, except for horses, which are traded from Sing district to Xieng Khouang province. Until four to five years ago, traders from Xieng Khouang used to source cattle and

⁴⁴ To other provinces, not to neighbouring countries

buffaloes from Luang Namtha, but they have stopped since then. Compulsory export quotas to Vientiane were abandoned four to five years ago as well.

On the other hand, the province **imports domestic** cattle and buffaloes from Bokeo province. This fact was confirmed by two cattle/buffalo traders interviewed in Namtha district, who trade cattle and buffaloes from Bokeo province for slaughter.

In Namtha district, slaughterers-retailers are organized in seven groups and each group orders one truck of cattle and buffaloes (app. ten to 12 heads) per month. They slaughter at the slaughterhouse⁴⁵ and retail meat at one of the three wet markets which sell beef. The market demand in Namtha town is estimated to come up four to seven heads of cattle/buffaloes and ten to 12 heads of pigs per day.

According to the PAFO, pigs are sourced locally and from Bokeo province. The local meat consumption increases with improved living standards, higher number of tourists and immigrants from China⁴⁶. The official price of retail beef amounts 30 000 LAK/kg (36 000 LAK/kg for the unofficial price). The price of pork comes up to 26 000 LAK/kg.

Cross-border trade

The following picture shows the cross-border trade pathway in the two north-western provinces.

⁴⁵ *Until its establishment there were three private slaughter points, each supplying one retail market*

⁴⁶ *The province's human population increased from 145 000 heads in 2005 to 159 000 in 2011*

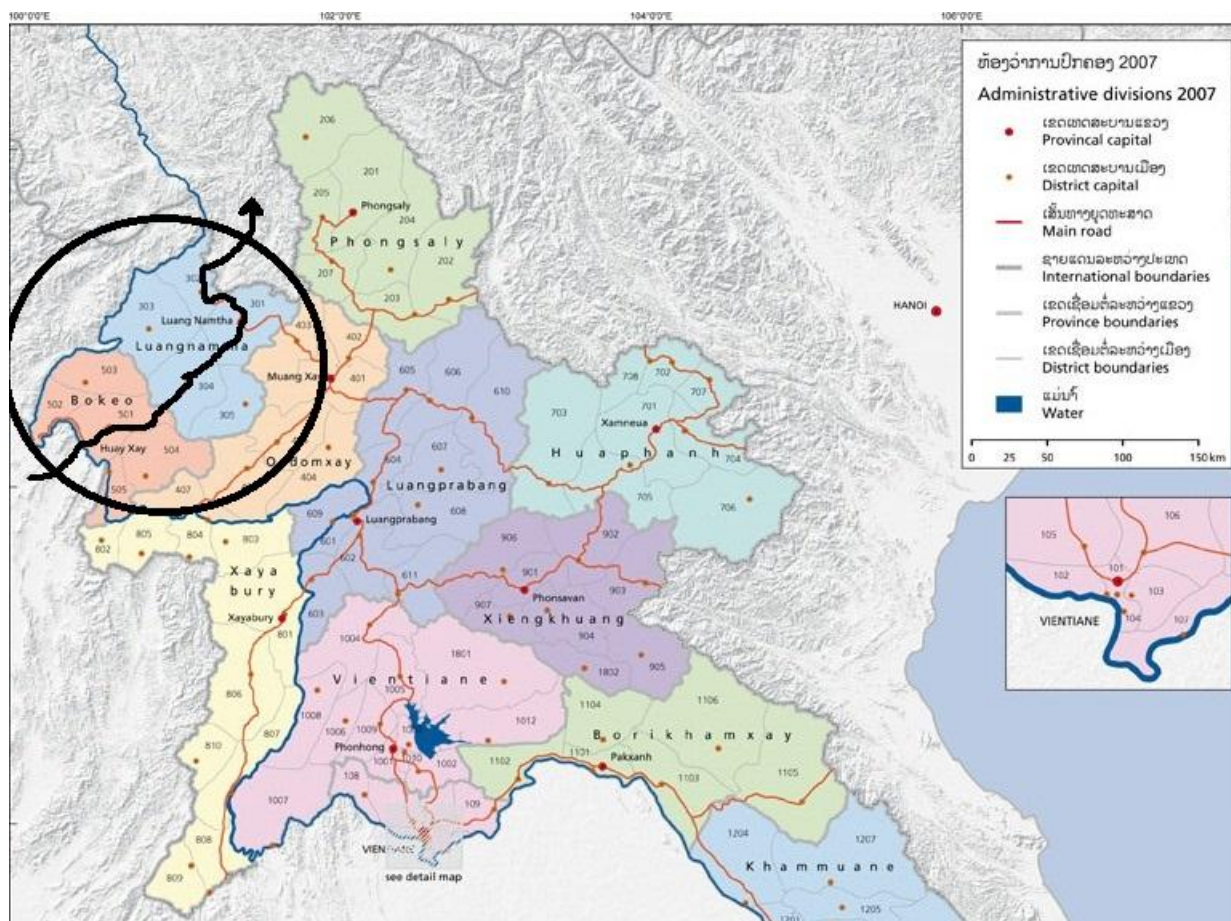


Figure 4 The two main cattle and buffalo cross-border trade pathways between Thailand and China in the north-west of the Lao PDR

Cross-border movements of livestock between Myanmar, Thailand and China and transiting through Bokeo and Luang Namtha province was estimated at 300 to 400 heads per week in February 2010 (Scoizec, 2010). **Trader 6** alone facilitated **transit of over 1'500 heads between October 2009 and September 2010**. However, according to Luang Namtha's PAFO the transit volume amounted 845 heads of cattle and 1 300 heads of buffaloes between October 2009 and May 2010.

Transit of cattle and buffaloes in the north-western provinces stopped in 2010 and has not resumed so far. This matter of fact was confirmed by all stakeholders interviewed:

- **Trader 4**, a trader interviewed in Na Theuy village close to Boten border gate, used to be one of the largest traders involved in trade of imported cattle from Houay Xay district (Bokeo) to China. Cattle were imported from Thailand, but she could not assert if they originated from Thailand or Myanmar. She used to buy cattle (20 to 40 heads per month) from a trader⁴⁷ in Bokeo province and sold them in Boten for export to China. She also sold a few heads to the local slaughterhouse in Ban Na Theuy. She

⁴⁷ **Trader 9**

stopped this trade in August 2010 due to unfavourable THB-LAK exchange rates⁴⁸ and lower supply in Thailand. She switched her activities to second hand clothing and material from the Casino. She does not know if there are movements between Luang Namtha and north-eastern provinces (Phongsaly, Udomxay, Luang Prabang).

- **Trader 6** used to import cattle from Thailand for direct export to China, but it stopped importing in 2010 due to scarcer supply in Thailand.
- **Trader 5**, another large trader also stopped exporting ruminants to China in 2010. According to him, Chinese authorities became stricter after FMD cases occurred at depots on the Chinese side of the border. Outbreaks occurred after Chinese traders started going themselves to Thailand to select animals.

The officer met at the wildlife and forestry products checkpoint in Ban Na Theyu confirmed that transit of cattle and buffaloes stopped in 2010. Reasons behind the stop of trade could not be ascertained but were related to disease outbreaks in China.

According to **Trader 5**, there were two main ways to transit animals:

- Lao traders procured animals from Thai traders in Sing⁴⁹ or in Houay Xay districts⁵⁰. Animals transited to Boten, where they were unloaded on the Lao side of the border and checked by Chinese traders
- Chinese traders with established contacts in Thailand, directly ordered from their Thai suppliers. Lao traders (e.g **Trader 5**) or Lao companies facilitated the transit, mainly by supervising transport and paperwork

In both cases, traders or companies applied for import & movement permits with the PAFO in Bokeo and transit permits with the PAFO in Luang Namtha. Transit papers were checked at Nateuy checkpoint.

The PAFO informed officers from the border quarantine checkpoint in Boten to check animals at the unloading place. From there, animals were walked across the “green border”. Transaction used to be made in THB in Houay Xay and in CYN in Boten. THB are usually changed directly in CYN if changed at unofficial rates, in LAK and then in CYN if changed at the bank.

The following box illustrates cross-border trade practices and pathways.

⁴⁸ THB/LAK=270 now THB/LAK=250

⁴⁹ Luang Namtha

⁵⁰ Bokeo

Trader 6

Trader 6 is of H'mong ethnic descent from Xieng Khouang province. He owns a company specializing in import and export of products, international transport services and agriculture production, among others rubber trees.

He started cattle and buffaloes cross-border trade in 1999, by importing animals from China through Boten for export to Thailand through Sing district. At that time, the road through Sing district was better than the main Luang Namtha-Bokeo road, which was upgraded only in 2006. Animals were loaded on boats in Xieng Kok in Sing district and were shipped down the Mekong to Chiang Saen (Thailand) in the Golden Triangle. He also traded animals, mostly buffaloes, exported from Son La and Dien Bien Phu provinces in Vietnam to Mai district in Phongsaly province. The flow of trade from Vietnam to Thailand reversed in 2005-2006 and he started exporting to China in 2008 during the preparation of the Olympic Games. During Highly Pathogenic Avian Influenza (HPAI) outbreaks in Thailand and in the Lao PDR in 2008, trade of any livestock was prohibited. Export of cattle and buffaloes from Thailand to China peaked in 2009 and stopped in early 2011 for want of demand in China. He suspected that cattle originated from Myanmar, although they had Thai certificates.

His company provided logistics support only, but did not provide its own vehicles. There were two pathways to trade livestock from Thailand:

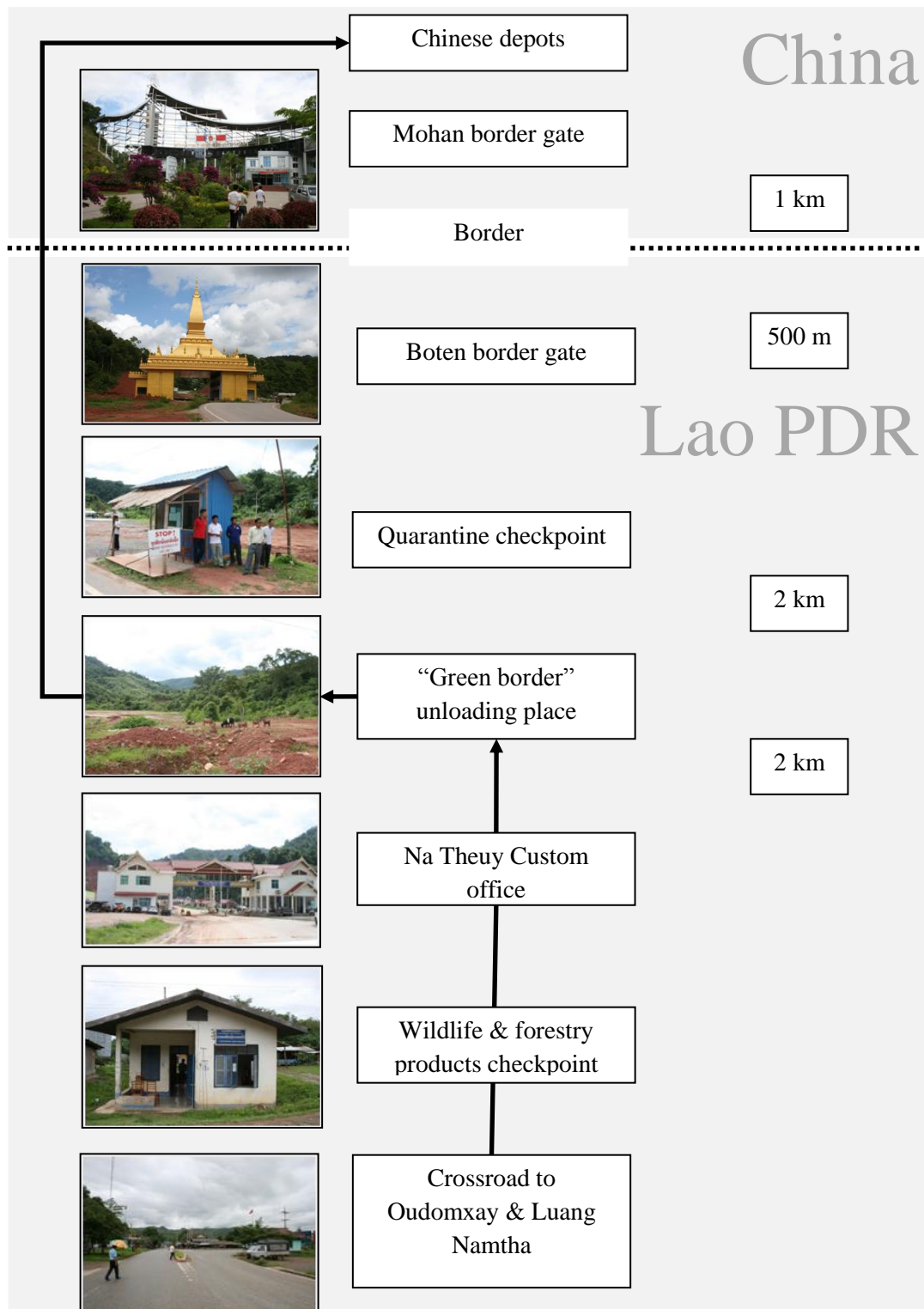
1. Through Bokeo and Luang Namtha province by truck
2. By boat through Chiang Saen on the Thai side of the Golden triangle to Xieng Kok in Sing district and then by truck to Boten in Luang Namtha

In the first case, the company had to apply for movement permits at the PAFO, custom office and trade office in Bokeo and for transit permits at PAFO and custom office in Luang Namtha.

He estimates the total trade from Thailand to China at 300 heads per month, 150 heads by his company and 150 heads by other stakeholders. Transport costs for a 30 heads-truck from Houay Xay to Boten came up three to four millions LAK (200 km, 4 hours drive), excluding paperwork. The latter was billed 1 000 THB per paper set (one set per truck). He currently trades agricultural and horticultural products, as well as electric appliances.

According to **Trader 5**, most animals destined to export to China were unloaded near Ban Boten and walked across the “green border” after being selected by Chinese traders. The export cross-border pathway is illustrated in the following figure.

Figure 5 Export pathway from Luang Namtha province to China through Boten



Pigs

According to the PAFO, until 2010 pigs from the CP company used to be traded from Thailand to supply the Casino in Boten. At that time, the number of Casino workers and guests came up to 7 000 people and the daily demand for meat amounted ten heads per day. The number of people at the Casino went down to 2 000 in 2011 and the demand for pigs dropped to two to three heads per day.

Trader 5 also traded pigs from Thailand to China beside cattle and buffaloes. He stopped cross-border trade as well, as prices in Thailand increased and the demand from China subsequently decreased. He used to supply pigs to the Casino until the latter's demand dropped. According to other traders, breeding pigs, as well as fattened pigs are now imported from China, the latter being destined to the Casino.

Besides, a large private farm with 300 sows was set up three years ago by a Chinese company in Luang Namtha. It supplies the local market, as well as the Casino.

Other species

Transit of imported agricultural products across Luang Namtha provinces currently concerns mainly fruit and vegetables: temperate varieties from China to Thailand and tropical varieties from Thailand to China. Vegetable and poultry are imported from Myanmar and exported to China through Sing district.

FMD outbreaks

According to the PAFO, the last FMD outbreak in the province occurred in October 2010 in Boten, near the cattle and buffalo unloading place. Animals imported from Thailand were suspected to be FMD carriers.

Since 12 May 2011 and at the time of the survey, a vaccination campaign⁵¹ supported by the ADB/FAO project⁵² was being carried out in three districts along the main road: Vieng Phoukha, Namtha and Sing.

Future trends

According to the PAFO, future trends in cross-border trade are difficult to predict as they depend on the supply in Thailand, demand in China and currency exchange rates. Cross-border trade may resume in future. This view is shared by **Trader 4**, who currently trades second hand material from the casino. If cattle and buffalo trade becomes profitable again, she may switch back to this activity.

⁵¹ 10 000 doses of pentavalent inactivated vaccine: O1 Manisa, O3039, A May 97, A22, Asia 1 Shamir

⁵² Awaiting details from Dr Phouth Inthavong, Lao PDR Department of Livestock and Fisheries, Vientiane

Bokeo province

The survey was conducted in Bokeo province between May 17 and 18. One trader and one company owner were interviewed, as shown by the following table.

Table 10 Stakeholders interviewed in Bokeo province

| | Species traded | Location | Volume per month (heads) | Source |
|----------|------------------------|------------------------|--------------------------|-------------------------------|
| Trader 7 | Cattle/buffalo Pigs | Huay Xay | n.a. | Thailand Bokeo province |
| Trader 8 | Cattle/buffalo Pigs | Ban Pa Oy, Huay Xay | >1 000 | Thailand |

In addition, meetings with government officers were conducted at:

- PAFO Bokeo
- DAFO Houay Xay at Ban Dan boat-landing point
- Lao-Thai border ferry port quarantine checkpoint in Houay Xay

Domestic trade

Houay Xay counts 55 meat retailers who are organized in several groups and have set up a slaughter-point. Approximately four heads of cattle/buffaloes and ten heads of hybrid pigs (or 25 local pigs) are slaughtered per day on an average.

Official cross-border trade

Formal cross-border trade occurs at the ferry port in Houay Xay town and concerns various types of non agricultural, agricultural and animal products (e.g. frozen meat). Imports of frozen piglets from Thailand for export to China occurred before the Chinese New Year in 2011.

Live animals are so far excluded from official trans-boundary trade, except for fish fingerlings and piglets imported from Thailand. According to the PAFO officer met at the port quarantine office, batches of live piglets are officially imported from Thailand every two to three months. The procedure to officially import live animals is the following:

1. Importer must declare future import to the quarantine office as well as to the custom office
2. The consignment and documents are inspected by the ferry port quarantine unit

According to the PAFO officer met in Bokeo, for want of a bilateral agreement (BTA) between Thailand and Laos cattle, buffaloes and fattened pigs are excluded from this procedure and are still traded informally.

Informal cross-border trade

According to the PAFO officer, informal cross-border trade of cattle and buffaloes between Thailand and China stopped in October/November 2010 and since then no cattle and buffaloes have been imported from Thailand. According to him, Chinese authorities increased bio-security measures in order to discourage illegal trade.

In Bokeo, two companies were specializing in fast-track trade of cattle and buffaloes:

1. **Trader 8**
2. **Trader 9**

and four main traders were specializing in cross-border trade: **Trader 10**, **Trader 11**, **Trader 12** and **Trader 7**. All traders stopped cross-border trade by end of the year 2010.

The following box describes informal trade practices of **Trader 8**, one of the two main import-export companies based in Bokeo province.

Trader 8: import-export company

Between October 2009 and September 2010, **Trader 8** organized the transit of 15 000 heads of Thai cattle and 5 000 and 6 000 heads of local cattle/buffaloes to China through Pang Hai (Pang Khong) or through Boten. Cross-border location between the Lao PDR and China depends on the local demand on the Chinese side. Boten was the main destination.

There was no specific season of trade. Chinese traders used to select animals in Thailand. The company organised transit logistics, paperwork and transport. Animals were loaded in Ban Dan or further upstream in Ton Pheung in the Golden Triangle.

Imports of live animals from Thailand stopped due to higher prices in Thailand and stricter bio-security measures taken in China. The company currently organizes the transport of frozen pork and frozen chicken from Thailand to China and vegetables, flowers and electric appliances from China to Thailand.

The following box describes informal trade practices of **Trader 7**, a private trader.

Trader 7: cattle, buffaloes and pig trader

Trader 7 started with domestic trade of pigs, which he used to sell to Luang Namtha. He now has a license to import and export livestock. He started trading cattle and buffaloes from Thailand to China in 2009 and stopped in 2011, mainly due to fluctuations in currency exchanges between the THB and LAK and LAK and CYU. He now exports rice from the Lao PDR to Thailand.

He used to import piglets destined to Bokeo, Oudomxay and Phongsaly provinces and fattened pigs for further trade to Bokeo, Luang Namtha or export to China through Sing district.

He used to trade one truck (15 heads) per week on an average, mainly cattle. He used to place order from his suppliers in Thailand. He used to drive with his own truck to deliver animals in Boten. Villagers belonging to the *Lu* ethnic population and found on both sides of the border walk animals across the “green border”. He sometimes used to deliver animals to Sing district.

Transport costs from Houay Xay to Boten come up 400 000 LAK per head or 1 000 THB per head for transport and paperwork. The price for beef currently amounts 30 000 LAK in Bokeo and 120 THB in Thailand.

Although cattle and buffaloes were imported informally, a specific trade procedure was put in place. The trader or the company organizing transit contacted the PAFO and the DAFO where animals were loaded. Animals were then inspected by DAFO officers before being traded further.

The informal trade of fattened pigs imported from Thailand for local supply and further trade to Luang Namtha is still going on but on a lower scale than before. This market chain is organized by slaughterers.

Informal cross-border trade pathways for cattle and buffaloes

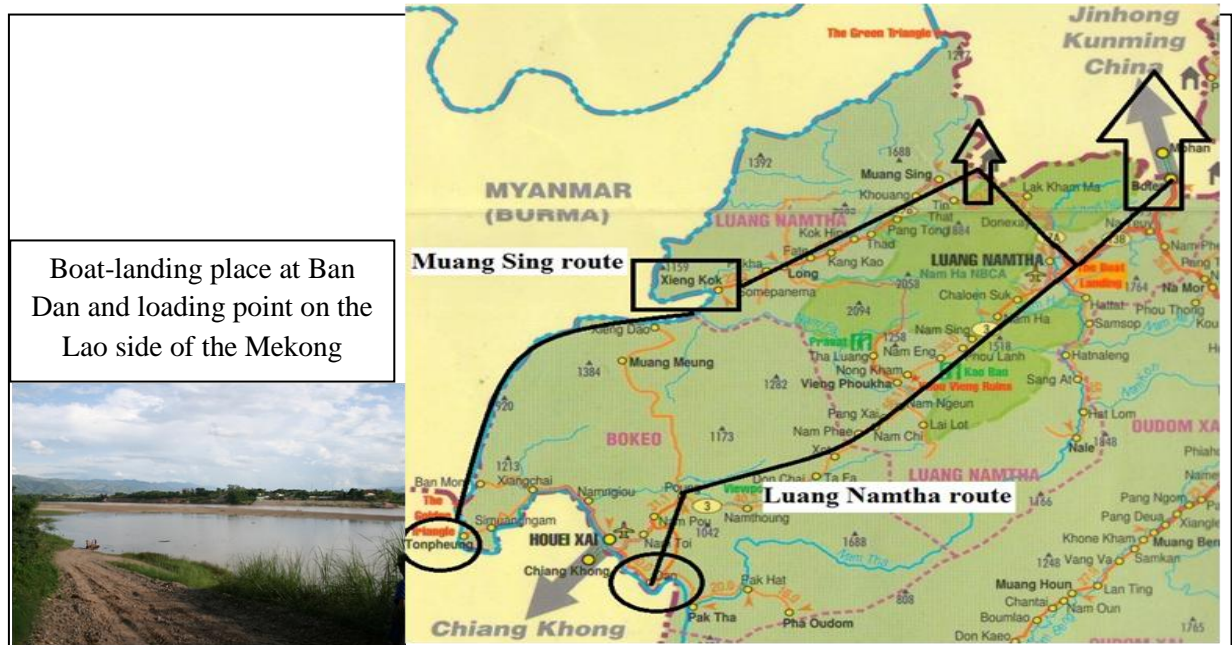
Cattle and buffaloes used to be traded mostly from Nan and Phrae provinces, in north-eastern Thailand, which reportedly exhibit cattle assembly markets. Cattle and buffaloes are unloaded below Chiang Khong on the Thai side of the Mekong and are trailed across the river by boats. Once on Lao side, they reach Ban Dan village, 14 km downstream Houay Xay port.

The PAFO officer mentioned a secondary movement pathway through Sing district in the northern part of Luang Namtha province in the Golden Triangle.

This was confirmed by the officer met at the quarantine checkpoint at Boten border gate, who was previously posted in Sing district. According to him, cattle (local and

Brahman), but mostly buffaloes originating from Thailand and Myanmar transited through Sing district for export to China, through Boten or through Pang Hai border gates. Both pathways are depicted in the following map.

Figure 6 The two main cross-border pathways in north-western Lao provinces



Animals are checked by DAFO staff at the checkpoint in Ban Dan village when animals are loaded on trucks.

The secondary pathway is found 50 km upstream, at Thon Pheung, opposite Chiang Saen in the Golden Triangle. Animals transit by boat to Xieng Kok in Sing district in Luang Namtha province and then by trucks through Muang Sing town. Animals following this pathway are exported either at Pang Hai (Pang Khong) border gate in Sing district or in Boten.

Fattened pigs are transported by small boat across the Mekong a few hundred meters downstream Houay Xay port. According to the PAFO officer, piglets are also informally imported from Thailand through this pathway for further trade to Luang Namtha. The road checkpoint located app. 26 km from Houay Xay on the main road to Luang Namtha was closed down in April 2011, when road checkpoints were removed nationwide.

FMD outbreaks

According to the PAFO officer, the last FMD outbreak in Bokeo province occurred in March and April 2010 in Houay Xay. Animals imported from Thailand were suspected to be carriers.

Savannakhet province

The survey was conducted in Savannakhet province between May 26 and 28, 2011. Interviews were carried out with the two main operators of cross-border cattle and buffaloes transit.

Table 11 Stakeholders interviewed in Savannakhet province

| | Location | Species traded | Volume | Source |
|-----------|------------------|------------------|--------|------------------------------|
| Trader 13 | Savannakhet town | Cattle/buffaloes | | Mukdahan province (Thailand) |
| Trader 14 | Savannakhet town | Cattle/buffaloes | | Mukdahan province (Thailand) |

In addition, meetings were organized at:

- PAFO Savannakhet
- Lao-Thai Friendship bridge quarantine office
- Lao-Vietnam border gate (Densavanh) quarantine office

Cross-border trade

Cross-border trade and transit through Savannakhet was extensively described by Scoizec (2009) and post-transit trade practices in Vietnam were investigated by Bourgeois Luthi et al. (2009). In contrary to Bokeo and Luang Namtha, the transit was organized solely by large Lao companies and not by individual traders. Moreover, the movement from Thailand to the Lao PDR is done officially by Thai trucks crossing the Mekong through the Lao-Thai Friendship bridge.

Figure 7 Friendship bridge in Savannakhet province



In 2009, four large companies were involved in transit of cattle between the Lao-Thai Friendship bridge and the Lao-Vietnam border. In 2011, two main companies (Trader 13 and Trader 14⁵³) were still operating, while others operate occasionally. By 2011, Trader 13 seems to have increased its share in cattle and buffalo transit from 40% to 60% to the detriment of Trader 14.

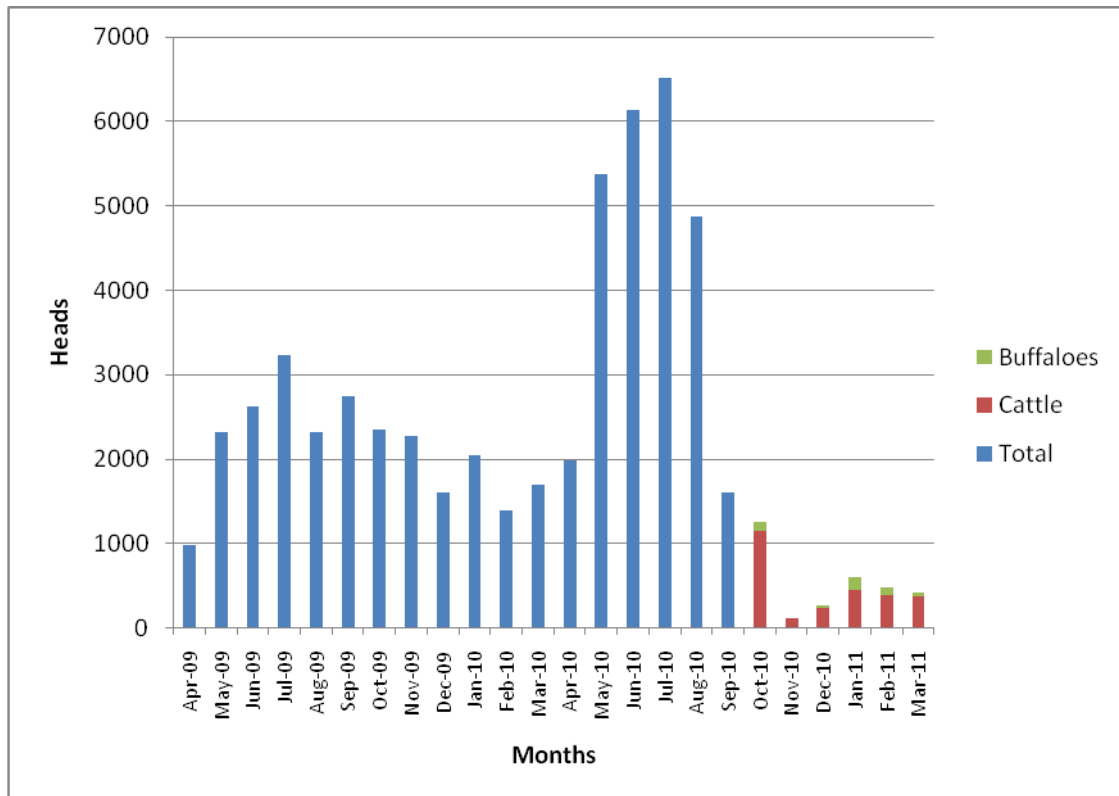
Historically, livestock were transiting from Vietnam to Thailand. The flow reversed in 2006/2007. Scoizec (2009) estimated that 15 000 heads were imported from Thailand in 2009, according to the PAFO officer met during the present survey the volume was lower with 11 000 heads. However, figures collated in registers by quarantine officers at the Friendship bridge showed that over 20 000 heads were imported from Thailand between April and December 2009, over 33 000 in 2010 and approximately 1 500 heads for the first quarter of 2011.

According to the PAFO officer met, the volume significantly dropped in Summer 2010 after floods affected the Isaan region in eastern Thailand.

The sudden reduction in transit volumes was confirmed by the deputy head of the quarantine office met at Densavanh border gate and is corroborated by data obtained from registers kept at the Friendship bridge quarantine office and presented in the figure below.

⁵³ Previously called Trader 15

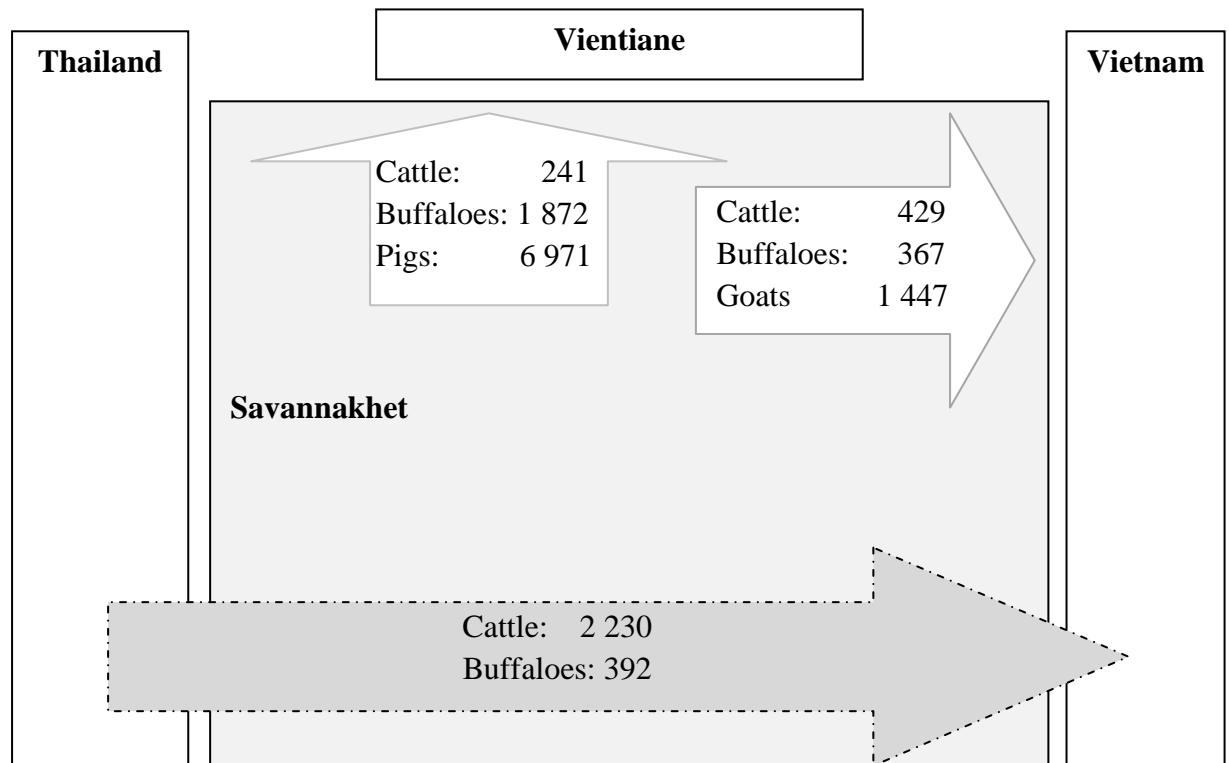
Figure 8 Number of cattle and buffaloes imported at the Friendship bridge in Savannakhet



According to the PAFO officer, prices for Thai cattle increased both due to shorter supply in Thailand and unfavourable currency exchange rates.

The latest detailed figures obtained showed that between January and May 2011, the number of animals imported from Thailand and exported to Vietnam, as well as the number of domestic animals traded to Vientiane or exported to Vietnam is the following:

Figure 9 Import, export and domestic trade of cattle and buffaloes (in heads) in Savannakhet province



Cross-border trade pathways

The PAFO describes two ways to import animals:

- Animals are transported by **Thai trucks** and unloaded near the Friendship bridge to be transported by Lao trucks further to Densavanh border gate
- Animals are **loaded on trucks in Thailand** and transported directly to Densavanh. The latter option is rarely encountered, concerns specific types of animals (e.g. breeding stock) and specialised companies.

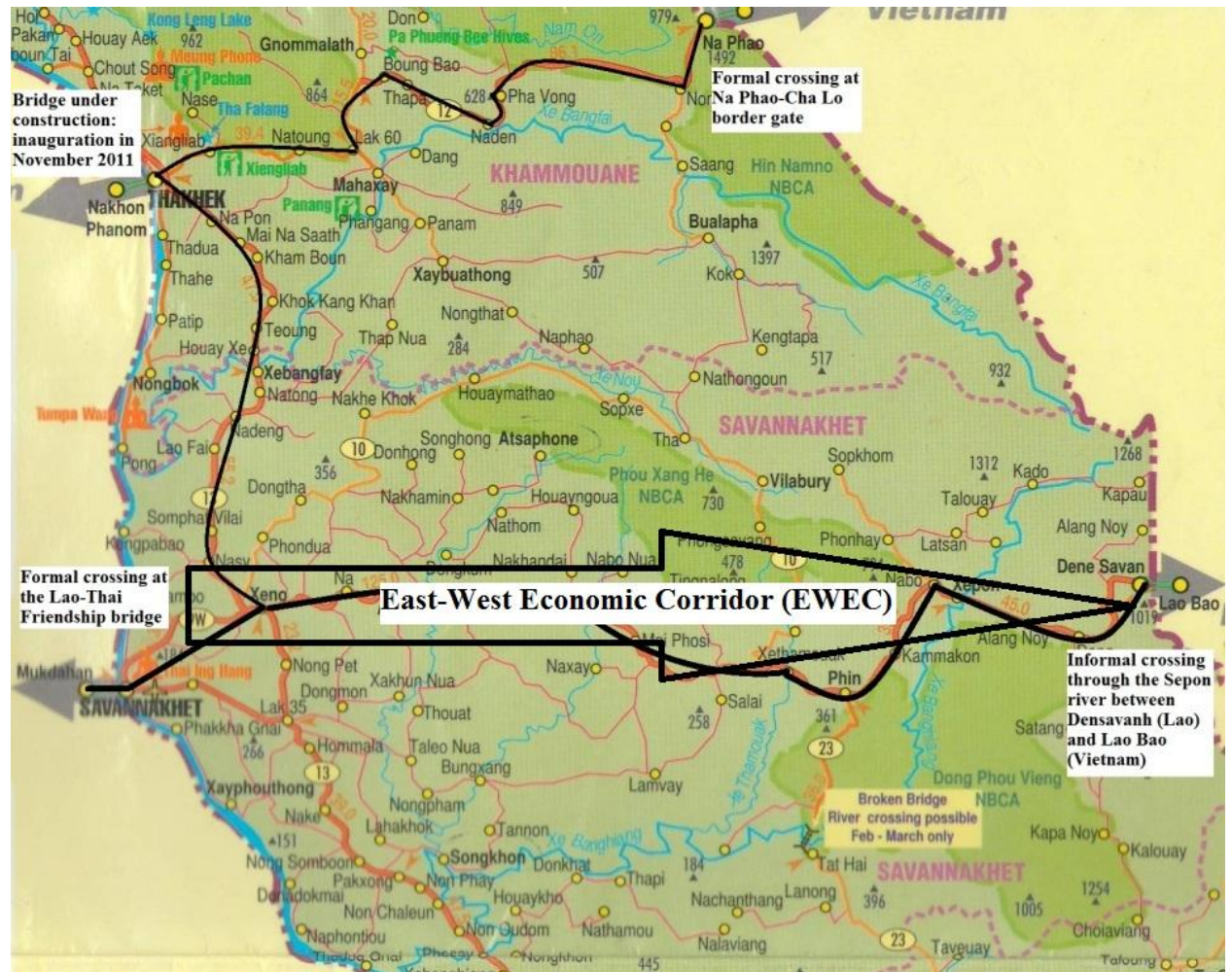
According to the head of the quarantine office met at the Friendship bridge, **Trader 16** is the only company allowed to use Thai trucks for delivery of live animals across the Lao-Vietnam border at Lao Bao border gate. Other companies have another status (import-export companies) and thus have to use Lao trucks for delivery.

The main pathway between Mukdahan province in Thailand and Vietnam occurs along the EWEC through Savannakhet province. The transit takes between 4 and 5 hours between Savannakhet town and Densavanh border gate.

A second, less direct, transit route between Mukdahan province and Vietnam was mentioned by the PAFO. This pathway was already recorded by Scoizec (2009) and Bourgeois Luthi et al. (2009). This transit pathway occurs through Khammouane province.

Both pathways are highlighted on the following map.

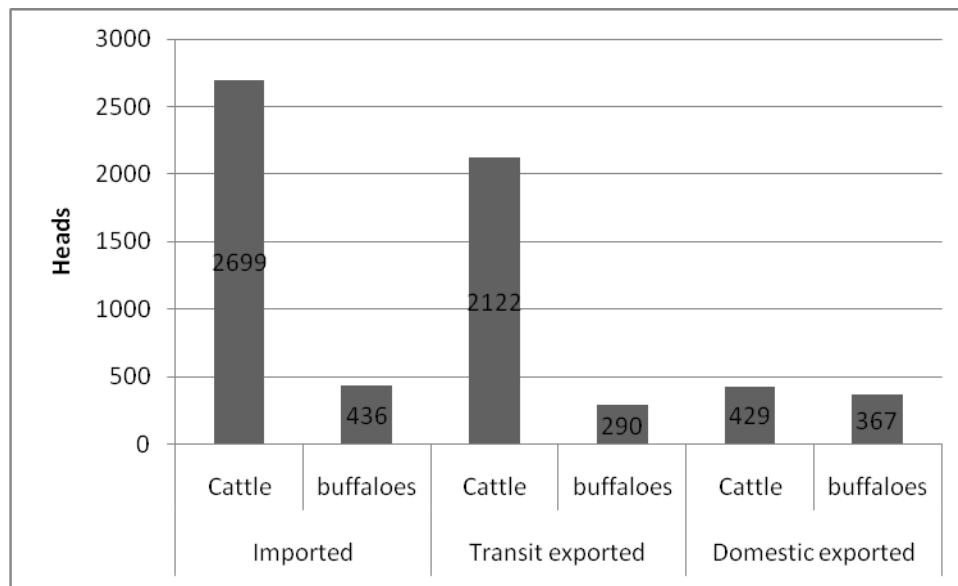
Figure 10 Transit pathway of cattle and buffaloes through Savannakhet and Khammouane provinces



In 2009, Bourgeois Luthi et al. (2009) highlighted the fact that cross-border trade was **formal** at Na Phao-Cha Lo border gates (Khammouane to Quang Binh provinces), while it was **informal** between (Densavanh and Lao Bao border gates (Savannakhet-Quang Tri provinces). This situation has prevailed until 2011.

The following figure shows the number of cattle and buffaloes imported to and exported from Savannakhet province.

Figure 11 Transit pathway of cattle and buffaloes through Savannakhet and Khammouane provinces



The figure above shows that a certain amount of animals on transit are not re-exported. This matter of fact poses a risk of disease spread in the Lao PDR, if animals are FMD carriers.

FMD

By May 2011, all 15 districts of Savannakhet were affected by FMD outbreaks in cattle and buffaloes. Pigs were not affected so far. According to the PAFO, containing the spread was rendered difficult by the large number of free-ranging cattle and buffaloes in the province.

2 Discussion

Latest trends in cross-border trade

The “fast-track transit” in the north-western provinces, described by Scoizec (2010), stopped a few weeks after the last investigation carried out by the project team in March 2010. It appears that the “north-western fast-track” was actually rather a “standard transit” of livestock informally imported and exported, similar to the one encountered in other provinces (e.g. Sayaburi, Xieng Khouang), rather than an established fast-track procedures as found at the Friendship bridge in Savannakhet.

No official cross-border procedures were established, neither on the import side in Bokeo, nor on the export side in Luang Namtha. Hence, the cross-border trade pattern found in Bokeo and Luang Namtha shall rather be referred to as ‘north-western informal transit pathway’ than “fast-track trade”.

The present survey highlighted the presence of local companies in Bokeo and Luang Namtha, who facilitated the transit of livestock, as well as large traders who either facilitate trade or play an active role in trade. Although these companies and traders have momentarily stopped operations involving cattle and buffaloes, they may resume this specific trade, as soon as market conditions have improved.

The change in the north-western transit pathway motivated the research team to investigate the current pathway in Savannakhet. The short survey subsequently carried out with targeted stakeholders in this province showed that the fast-track transit has prevailed until now, however with considerably lower volumes than in 2009 and 2010.

Drivers of change

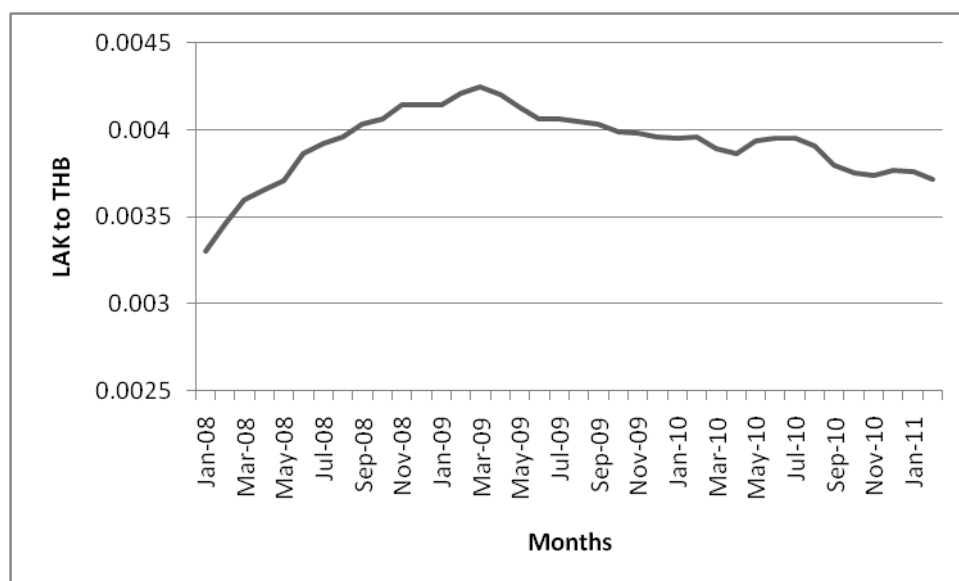
The research sketched out the main drivers behind the stop in transit in the north and the lower volumes in Savannakhet as being the following:

- Environmental factors (floods in the Isaan region in Thailand)
- Political factors: stricter control by Chinese authorities consecutive to FMD outbreaks
- Macro-economic factors: fluctuating exchange rates between THB, LAK and CYN currencies

Currency exchange rates seem to be the strongest driver of change. These findings are in line with findings from similar researches carried out in the GMS region in 2010 and 2011 (Bourgeois Luthi, 2010 and 2011).

The following figure shows the LAK exchange rates against the THB between January 2008 and January 2011.

Figure 12 Average monthly LAK to THB currency exchange rates from 2008 to 2011

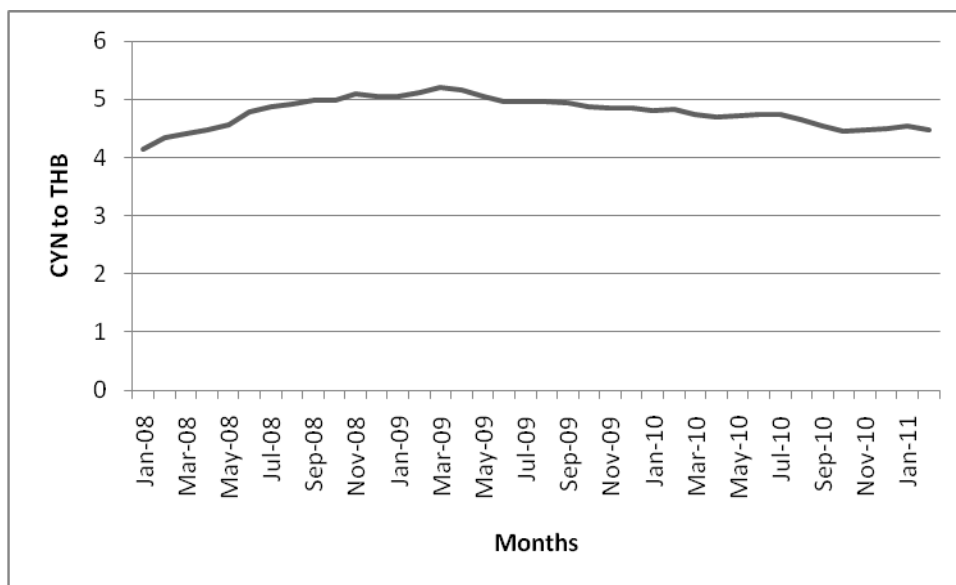


Source: <http://www.gocurrency.com/v2/historic-exchange-rates.php?ccode2=THB&ccode=LAK&frMonth=11&frDay=31&frYear=2008>
[accessed 26 June 2011]

The figure shows that the appreciation of the LAK to the THB (or depreciation of the THB against the LAK) peaked during the first quarter of 2009. Lao traders who base their procurement on THB had a more favourable exchange rate to buy animals in Thailand. The highest exchange rate between LAK and THB coincides with the peak in trade in March 2009. Since then, the THB has appreciated against the LAK and imports have become more expensive for Lao trader.

For Chinese traders who pay their suppliers directly in THB, as well as for Lao traders who sell in CYN and pay in THB, the appreciation of the THB against the CYN (or depreciation of the CYN against the THB) which has occurred since March 2009 implies a worsening of the terms of trade. Imports from Thailand become dearer for Chinese traders *ceteris paribus*. The following figure shows the CYN to THB average monthly exchange rates since January 2008.

Figure 13 Average monthly CYU to THB currency exchange rates from 2008 to 2011



<http://www.gocurrency.com/v2/historic-exchange-rates.php?ccode2=CNV&ccode=THB&frMonth=11&frDay=31&frYear=2010>

The present survey highlighted the versatility of companies and traders in trade. Thanks to their large trade portfolio, they are able to respond to market signals rather quickly and to change the nature of their trade. This ability means that cattle and buffalo transit can resume at any time, when the market situation allows it.

The BTA issue

The research highlights the regional differences pertaining to bilateral trade agreements (BTA) between Lao and Thai provinces. Cross-border trade of live cattle and buffaloes is official in Savannakhet province, while it is not the case in Bokeo province.

The survey in Bokeo showed that, within the same province, cross-border trade regulations (or their absence) vary according to species and purposes. Cross-border trade of live fattened pigs is not official, while cross-border trade of live piglets is official, at least for some consignments. Such discrepancies render trans-boundary trade activities more opaque and hence their monitoring difficult.

Latest trends in domestic trade

In April 2011, road checkpoints and road toll booths were removed nationwide, as per a national decision. The road checkpoint between Bokeo and Luang Namtha was hence closed down. Road checkpoints were regularly incriminated for hampering domestic trade of cattle and buffaloes. The removal of such checkpoints is expected to potentially modify the geography of domestic, as well as cross-border cattle and buffalo trade in future.

It is however still too early to measure the impact of such measures.

Main risk pathways of FMD spread

According to one trader interviewed in Luang Namtha province, FMD outbreaks occurred in Chinese depots after Chinese went to Thailand themselves to select animals for export. According to him and other stakeholders, this event triggered stricter control measures on Chinese side, which subsequently halted export of cattle and buffaloes. No evidence supports this assertion and the last FMD outbreak which affected ruminants in Luang Namtha occurred in October 2010, two or three months after imports of cattle and buffaloes from Thailand stopped. Nevertheless an increased geographical scope of trade and increased movements of animals, vehicles and humans will undoubtedly increase the risk of disease spread.

An accurate traceability of animal movements can theoretically be achieved through fast-track procedures. However, such procedures will not guaranty safer pathways, if they are not properly implemented. This is illustrated by “the missing animals” figures obtained by comparing “transit import” figures⁵⁴ and “transit export” figures⁵⁵. It appears that a number of animals on transit “disappear” between both checkpoints. This means that these animals:

⁵⁴ obtained from the quarantine checkpoint at the Friendship bridge

⁵⁵ obtained from the quarantine checkpoint at Densavanh border gate

- either continue on a fast-track transit to other provinces (e.g. Khammouanne province for export to Vietnam through Cha Lo border gate
- or are sold with the Lao PDR, most likely for slaughter

It could not be ascertained if “missing” animals continue their transit on another fast-track pathway to Vietnam, e.g. to Khammouane province or are stored somewhere. These animals bear risks of disease transmission in case they were carriers.

Although goats were never explicitly mentioned during the research, figures obtained from Savannakhet province show that large numbers of these animals are exported to Vietnam. Goats are known to be potential silent carriers of FMD.

3 Conclusions and way forward

The investigation of so called fast-track movement pathways for cattle and buffaloes in two north-western provinces of the Lao PDR revealed that:

- import procedures between Thailand and the Lao PDR, as well as export procedures between the Lao PDR and China are not official. Hence the transit of cattle and buffaloes through the Golden Triangle economic zone cannot be compared to the “fast-track transit” found along the EWEC in Savannakhet province
- transiting animals and/or itinerant traders are reported to be linked to FMD outbreaks in the north-western provinces
- the north-western transit stopped in 2010, reportedly owing to unfavourable exchange rates and stricter bio-security measures taken in China
- the fast-track transit between Savannakhet and Vietnam has persisted throughout the years, however with considerably lower volumes in 2010 and 2011 than in 2009
- lower volumes observed in the EWEC were linked to unfavourable exchange rates, decreasing supply and hence increasing prices of cattle and buffaloes in Thailand
- the fast-track transit procedure in Savannakhet does not prevent the province of being highly exposed to FMD outbreaks, as it is currently the case

Recommendations made by Scoizec in 2009 still apply to date:

- the harmonization of BTAs shall be addressed at national level
- the fast-track procedures shall be strengthened wherever possible
- reinforcement of surveillance and reporting systems shall be further strengthened

It is further recommended that:

- intra-provincial procedures shall be harmonised between species (cattle/buffaloes and pigs)
 - the role of goats as silent carriers shall be investigated, as considerable numbers of these animals are traded throughout the country. It is advised to more specifically include this species in any future research pertaining to livestock movements and risks of FMD spread
-

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Appendix 8. Risk assessment of livestock pathways into China

Risk Analysis of Cattle Movements in China from Neighbouring South-eastern Countries⁵⁶

Chang CAI PhD Candidate, Murdoch University

ACIAR Project AH/2006/025

Understanding Livestock Movement and the Risk of Spread of Trans-boundary Animal Diseases

1. Aim

The project aims to provide an epidemiological basis for progressing zoning for Foot and Mouth Disease (FMD) in the Upper Mekong Sub-region with particular emphasis on Yunnan Province and Guangxi Province of P. R China.

To develop strategies for zoning, the control of outbreak and the spread of the FMD, this project was organized to support the upper Mekong zoning proposal by conducting the epidemiological study required to understand the epidemiology patterns of spread of FMD in China. In this project, GIS, risk assessment and epidemiological modelling were used to understand the patterns of spread and the risk of transmission of FMD between Yunnan Province and Guangxi Province, China and its neighbouring countries.

This project is a part of ACIAR Project AH/2006/025, and closely associated with regional initiatives for the control of trans-boundary disease in Southern Asia and particularly the Southeast Asia and China Foot and Mouth Disease Campaign (SEACFMD) and the FAO/OIE Global Framework on Trans-boundary Animal Diseases. With the assistance of the SEAFMD Campaign, and Australian Centre for International Agricultural Research (ACIAR) research project AH/2006/025 (Understanding livestock movement and the risk of spread of trans-boundary animal diseases); this project is proceeding according to the plan.

2. Materials and Methods

Information and data related to this research were collected from China, including published Chinese papers, Chinese government documents and informal talk with Chinese traders. About ten people (including local vets, animal traders and farm holders) were invited to a dinner or lunch to provide their knowledge on informal animal movements. These informal talks were conducted by the Yunnan Tropical and Subtropical Animal Viral Disease Laboratory

⁵⁶ This appendix is a summary of research carried out by Ms Chang Cai, a Chinese PhD candidate at Murdoch University. The project supported Ms Cai's training and field research in risk analysis of livestock movements. Her work was also supported by the Government of the People's Republic of China and the South East Asia and China Foot and Mouth Disease Campaign (SEACFMD). This research represents an initial attempt to assess the disease risk associated with the unofficial livestock trade into China. This is the first official Chinese-sanctioned report into informal movements of cattle into China from neighbouring countries. The report has not been edited.

(YTSTAVD). As a part of this research's supervision, YTSTAVD provided the details and confirmation of materials.

To analyse the risk of the animal movement, three stochastic models were built to epitomized the informal animal movement Route A, B and C. In order to develop the quantitative analysis of these three models, data, collected from field trips, informal dinner, government documents, and public published articles and meeting records, was organized to quantitate the parameters of three models. All parameters were estimated by various probability distributions which included Pert distribution, Binomial distribution, Beta distribution etc. Distributions results were simulated by Monte Carlo analysis for the reason of structuring corresponding distribution curves.

3. Results

Three cattle movement routes are found in this research. These three routes happen between Myanmar, Thailand, Laos, Vietnam and China. Since Thailand and Laos share the Upper Mekong River as their cattle transportation watercourse, cattle from these countries are considered from the same route.

- Route A. Cattle in Sagaing province, Myanmar walk through the mountains to Western Yunnan Province, China.
- Route B. Cattle in Thailand and Lao PDR are shipped to Southern Yunnan, China, along the Mekong River.
- Route C. Cattle in Northern Vietnam are driven to South-western Guangxi Province, China.

The results of this study indicates that the risk of spreading FMD from Upper Mekong Region countries to China does exist, even though a few years ago the risk was pointed out to a opposite direction (Nam 2005). Cattle business as one of the biggest live animal informal business in Upper Mekong Region brought big profit to exporting countries, but brought risk of spreading FMDV to importing countries.

The first route is from Myanmar to China, along landway across the boundary of these two countries. Every year, there are about 1064 (95% CI: 616 – 1529) cattle are traded successfully to China. About 24 (95% CI: 7 – 116) of them is estimated to be FMD positive. The possibility of a cow from Myanmar to China and finally staying in China is 2.21% (95% CI: 1.05% – 11.82%).

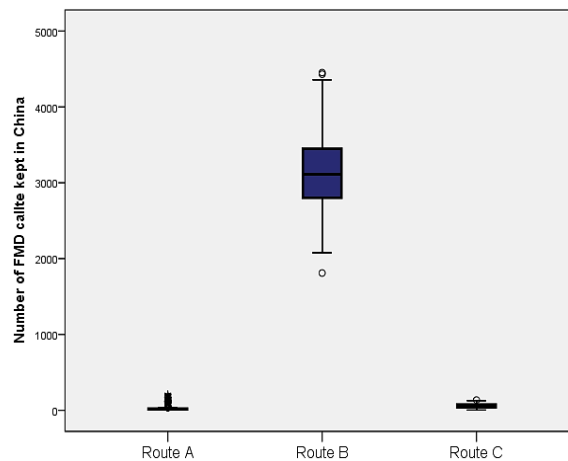
Route B is the river course from Thailand and Laos to China, Yunnan Province in particular. The number of cattle traded on Mekong River changes along with the water yield of the Mekong River. In dry season, there is no animal business on Mekong River. In peak season, from October to January, about 1511 (95% CI: 1083 – 1973) cattle per month are travelling to China, and kept in China. In hypo-peak season, 374 (95% CI: 260 – 512) FMD cattle per month are estimated. The FMD cattle coming (69%) from Thailand has a higher chance than cattle coming from Laos.

Cattle traded from Vietnam to China only need one or half a day go across country boarder. The loss possibility on the way is very low, which is only 1%. However, they can be detected

by Chinese Customs, as high as 23%. Every year, from 16 to 104 FMD positive cattle can be found in China, which are from Vietnam. The most likely number of this is 59. What's more, the possibility of a FMD cow in Vietnam is traded and kept in China is 3.48% (95% CI: 0.83% – 4.79%).

Horizontal comparison among three routes was constructed to compare the quantitative risks of them (Figure. A). The biggest number of FMD cattle being traded to China located in Route B. The FMD cattle came from Route A and Route C were about the same, and both of them located on a very low level. The number of FMD cattle from Route B is over 50 times as high as from Route A and Route C. The conclusion shows that in Upper Mekong Region, even though China is facing the FMD risks from Myanmar, Thailand, Laos and Vietnam, the highest risk is from Thailand. There are different trading ways between countries; the highest risk locates on Upper Mekong River.

Fig. A. Boxplot of the number of FMD cattle from three routes finally kept in China



Appendix 9. Risk assessment presented to OIE Sub Commission Meeting 2011

- **Livestock Trading and FMD Risk**

Hawkins CD, Socheat Sieng, and Kerr JW

ACIAR PROJECT AH/2006/025 Understanding livestock movement and the risk of spread of transboundary animal diseases.

Introduction

While the movement of people, equipment, and animal products such as meat and milk pose a real risk of transferring foot and mouth disease (FMD), movement of live animals poses probably the greatest risk. In the greater Mekong area, cattle move over large distances in short times, with few stops or health checks between departure and destination. Further, looking to see if an animal has FMD will only detect those with active or recent infection. It will not detect those incubating the disease, nor will it detect those carrying the virus post infection. As part of the ACIAR Project AH/2006/025, *Understanding livestock movement and the risk of spread of transboundary animal diseases*, we have interviewed traders, and observed their activities in the commercial movement of livestock internationally overland. Information collected in this study has been integrated and used to examine the impacts of prevalence, inspection effectiveness, and potential for infection in transit, on moving FMD across international borders.

Trading pattern

Cambodian traders intent on selling into the Vietnamese market will often source stock from Thailand markets near the Cambodian border. These stock are inspected, and if considered satisfactory by the trader, incorporated into a shipment or consignment of about 50 animals. Transport is by truck, and vehicles travel more-or-less diagonally across Cambodia, terminating near the Vietnamese border. Two main routes may be taken (Map 1). The journey usually takes under 24 hours, and any inspections along the way are for shipment integrity purposes – that is, to ensure that the number and type of stock on the truck corresponds to that listed on the transport permit. On arrival near the Vietnamese border, stock are unloaded, and placed in a holding facility. Holding facilities may allow contact between different shipments. At this point, Vietnamese buyers may inspect the consignment and could reject any showing signs of diseases. Stock are then walked across the Cambodian/Vietnamese border, before completing their onward journey by truck to an abattoir, or occasionally a feedlot. About 700 such journeys occur each year. During the walk across the border, cattle may come in contact with domestic cattle tethered nearby.

Assessing the risk

A scenario tree was constructed using Microsoft Excel®, and a risk or probability assigned to each branch of the tree. Each probability was entered as a range of possibilities, assigned empirically from best guess information, using @Risk ©Palisade Corporation, New York. This software enables an evaluation of the importance of each component of the scenario tree, and in this case, indicates where the “weak links” are, and where more information is needed. The same data in the scenario

tree were used to construct a discrete quantitative model to predict the number of infected shipments likely to enter Vietnam, as a cross-check to assist in the validation of model outcomes.

Results

The scenario tree itemises the conceptual events in the transport of stock from Thailand to Vietnam in a stepwise manner. This is outlined in Figures 1a and 1b. Each step is assigned a likelihood value, obtained primarily from discussion with traders, with inputs from provincial and district offices, and Department of Animal Health and Production staff. These likelihood values are expert opinion and best guesses. They are not researched or confirmed by reference to collated data. Such data, though highly desirable, is not available. The scenario tree takes into account the possible prevalence at the market in Thailand; the ability of traders to remove animals that may be affected with FMD, and the chances of reinfection during stopovers or when walking across the border into Vietnam,

Simulation using the model

Calculation of the likelihood of an infected shipment entering Vietnam was undertaken using @Risk as described above. The model was recalculated 1000 times, and yielded the following data (Table 1)

Table 1. Likelihood of an infected shipment arriving in Vietnam

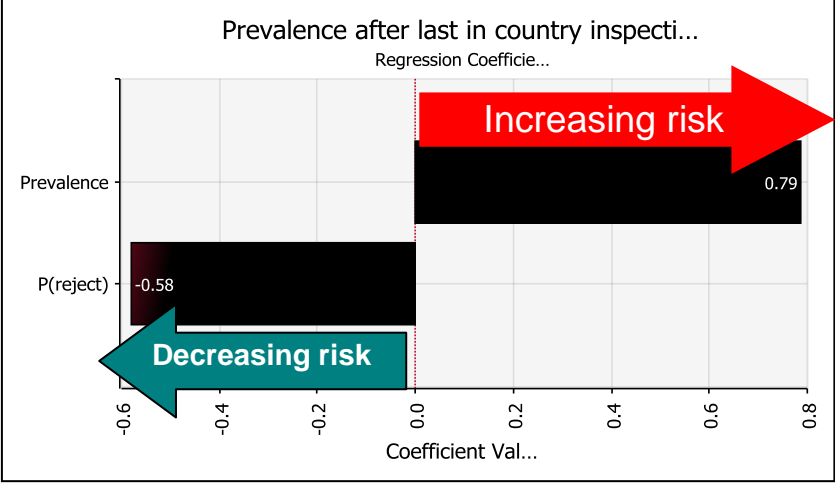
| SIMULATION OUTPUT - Likelihood of an infected shipment arriving in Vietnam | | | | | | |
|---|-----------------|----------|----------|----------|------------|----------|
| Min | Mean | Max | 5% | 95% | Iterations | Variance |
| 5.68E-04 | 5.65E-03 | 1.78E-02 | 1.55E-03 | 1.17E-02 | 1000 | 9.87E-06 |

The model indicates that with the given estimates, the chance of a shipment arriving in Vietnam with infected cattle is about 6 in 1000 by this trade route. Since there are about 60 shipments a month, or about 700 a year, then maybe four (4) would be infected. This value is an average, that lies somewhere between about 3 in 2,000, and 2 in 100. At this stage, we do not know whether this figure is realistic or not, and the very wide spread around the average indicates that there is a need to further research this data. Information is being sought on FMD in Vietnam associated with this trade route.

One of the very valuable outcomes of this approach to risk is that we can gain an indication of the important components of each of the output calculations along the way, sometimes referred to as sensitivity analysis.

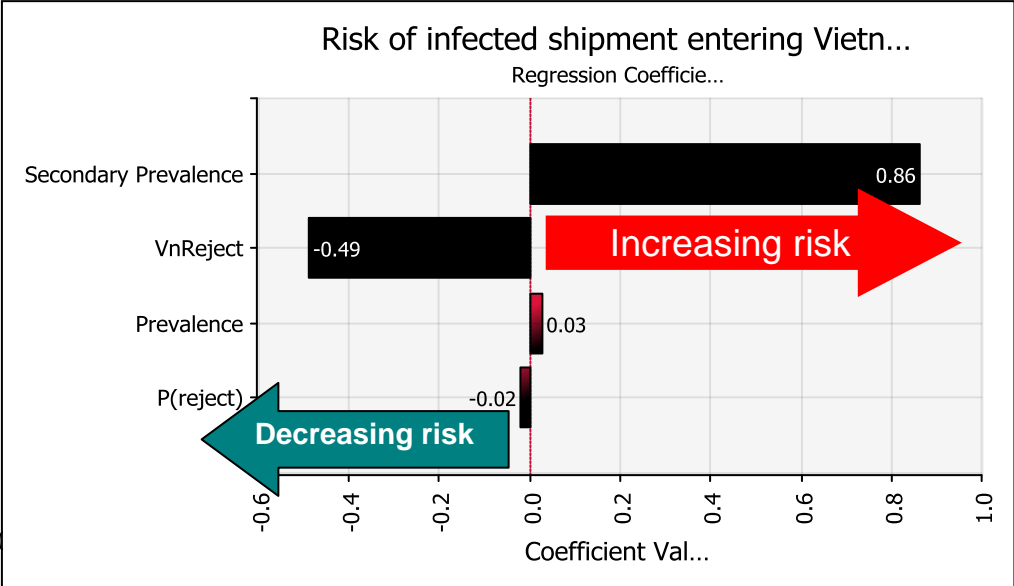
The first output of interest is the likelihood that infected cattle will make their way to the final destination in Cambodia, a holding facility just before the border with Vietnam. The tornado chart below (Chart 1) indicates that the biggest contributors to this are the prevalence in the cattle when purchased initially, and the ability of traders to exclude animals affected with FMD.

Chart 1. Tornado diagram indicating main contributors to prevalence after the last in-country inspection, and the shipment enters the holding facility near the Vietnamese border. “Prevalence” is the disease frequency at the point of purchase; P(reject) is the likelihood that infected cattle will be rejected.



Secondly, it is helpful to know the key determinants for an infected shipment entering Vietnam. This is given in Chart 2, and the analysis shows that the two key factors are the likelihood of a shipment becoming infected in the holding facility (secondary prevalence), and the ability to exclude infected stock at this stage. Cattle could become infected in a number of ways during their time in the holding facility: by using an area recently vacated by an infected consignment; by mixing an uninfected consignment with an infected one; or by contact between pens at feed or water points. Each of these possibilities is included in the model. Earlier factors, the original prevalence and capacity to remove infected animals prior to the holding facility, although still present, play an insignificant role at this stage of the transport chain.

Chart 2. Tornado diagram of key factors determining whether an infected shipment enters Vietnam. Secondary Prevalence is the likelihood of infection during a stopover in a holding facility, and VnReject is the likelihood of being rejected by Vietnamese traders.



Discrete quantitative modelling approach

A discrete quantitative shipment model was constructed using information from traders, who indicated that there were about 50 animals in a shipment, with about 50 - 60 shipments each month, contributing to about 36000 cattle moving into Vietnam annually by this trade route. While there is some seasonality to livestock movements, this was not modelled due to lack of detailed information. Such variations may influence the timing of infected cattle moving, but in a model of this nature would not affect the final numbers in the outcomes. Onto this movement information, the probabilities used in the scenario tree were applied to determine the number of infected animals entering Vietnam. Being a discrete model, only whole shipments, and whole numbers of animals were “allowed” to move. This influences the output, and adds a level of realism that the scenario tree approach lacks.

The model was run for 1000 iterations, each iteration representing a month of trading. Outcomes were much as expected: there were 46 to 59 shipments per month, resulting in 2303 to 3461 cattle shipped monthly, and the number of infected animals was 0 to 4 per month, with an average of less than 1 per month, and averaging about 8 per year. This is a little higher than the scenario tree approach, and reflects the nature of the model, which only deals with whole animals, rather than probabilities, as described earlier.

What doesn't seem to make a big difference to the risk outcomes are: inspections in transit, and the possibility of becoming infected by contacting local cattle while walking across the border from Cambodia into Vietnam. These are probably because transit inspections are intended to count the animals to ensure that the number on the truck corresponds to that on the trade movement permit (i.e. no biosecurity activities are undertaken) and that shipments tend to travel at night when visual appraisal of the stock is difficult. Walking stock across the border allows for very minimal contact with stock that may be tethered on the roadside, and any sick stock are more likely to be retained in the village for extra care rather than be walked to the roadside for feeding.

Understanding and interpreting the models

It is always wise to remember that a model is only a *representation* of the world, not the real world. However, such models do give a level of clarity that may not otherwise be apparent, and may identify areas where information is lacking.

Overall, the models indicate a number of areas where further investigation is needed. These are:

- Prevalence at the source of cattle – it is important to know whether cattle are infected in the markets where they are purchased by the traders.
- Ability of traders to exclude infected animals – how effectively can buyers identify and remove animals carrying FMD?
- Potential for new infections before reaching the destination – how likely is it that cattle will become infected in holding facilities near the border of Vietnam?
- Ability of the trader from Vietnam to exclude infected animals – how well can a trader from Vietnam recognize and remove infected stock from a shipment?

Addressing these issues first and foremost requires a genuine commitment to surveillance for FMD, and an effective strategy to keep infected animals out of markets. This is probably the biggest challenge facing an export livestock industry seeking to minimise the threat of FMD.

Secondly, the ability to identify and remove animals infected (or carrying) FMD is problematic. Stock showing signs of active disease would be relatively easy to exclude, as would those with suggestive lesions, or lesions that are healing after active infection. Visual appraisal is unlikely to detect convalescent carriers, or cattle incubating FMD. The transit time for livestock from Thailand to Vietnam is in the order of 24 hours, which is sufficient for the virus to spread, but may not always be sufficient for clinical disease to become apparent. A rapid test to determine whether stock are infected (a cow-side test) is needed to ensure that all stock are free from FMD virus.

Thirdly, the potential to spread between consignments in holding facilities requires very high level biosecurity practices – the ability to keep shipments strictly separate, so that there is no physical contact, movement of aerosols, or other body products between shipments. Staff engaged to feed, water and tend to stock in holding facilities would need to maintain strict biosecurity standards.

Clearly, some of these strategies are not practical at present, and some alternative methods would need to be considered. In the short term, the following could be worthwhile:

- Ensure every animal coming into the market has been effectively vaccinated with the most commonly occurring strains of FMD – at a time prior to market that enables protective antibodies to develop. This would markedly reduce the effective prevalence of infection in trading cattle at markets. However, it would still be wise for traders to inspect stock carefully, and exclude any that show active or recent signs of infection with FMD.
- Make better use of the official checkpoints along the journey – increase the benefits of stopping to examine livestock on trucks: any signs of FMD in the stock warrant biosecurity action. Confirming or excluding FMD in the shipment will have long-term benefits to transporters and buyers.
- Minimise time in holding facilities, and implement a management system for these facilities that includes: thorough cleaning of holding areas between shipments; construction of an isolation area for suspect consignments, away from the main holding area; development of a rapid communications process that alerts traders to the presence of FMD when or if it occurs; application of total quarantine of a holding facility if FMD is detected.
- For traders in Vietnam buying stock, ensure a minimum time from purchase to slaughter. In other words, as soon as purchased, consign to the abattoir. If stock are to be kept for any length of time (e.g. in a feed lot), arrange these as a special consignment, ensure they were vaccinated ahead of time, and keep them isolated from other stock from the time of vaccination.
- Trucks carrying livestock should be routinely cleaned after every shipment. There is no way round this – trucks become contaminated, and can be very efficient spreaders of FMD.
- Promote the importance of these strategies through effective media and educational campaigns.

Again, these suggestions may sound impractical. However, we are dealing with a highly infectious disease that nobody anywhere in the world wants. Only with long-term commitment from all stakeholders (traders, buyers, cattle growers, governments, NGO's and private companies) can advances in FMD control be achieved.

Figure 1a. Scenario tree for the transport of stock from Thailand to Vietnam (Thailand to final transit inspection)

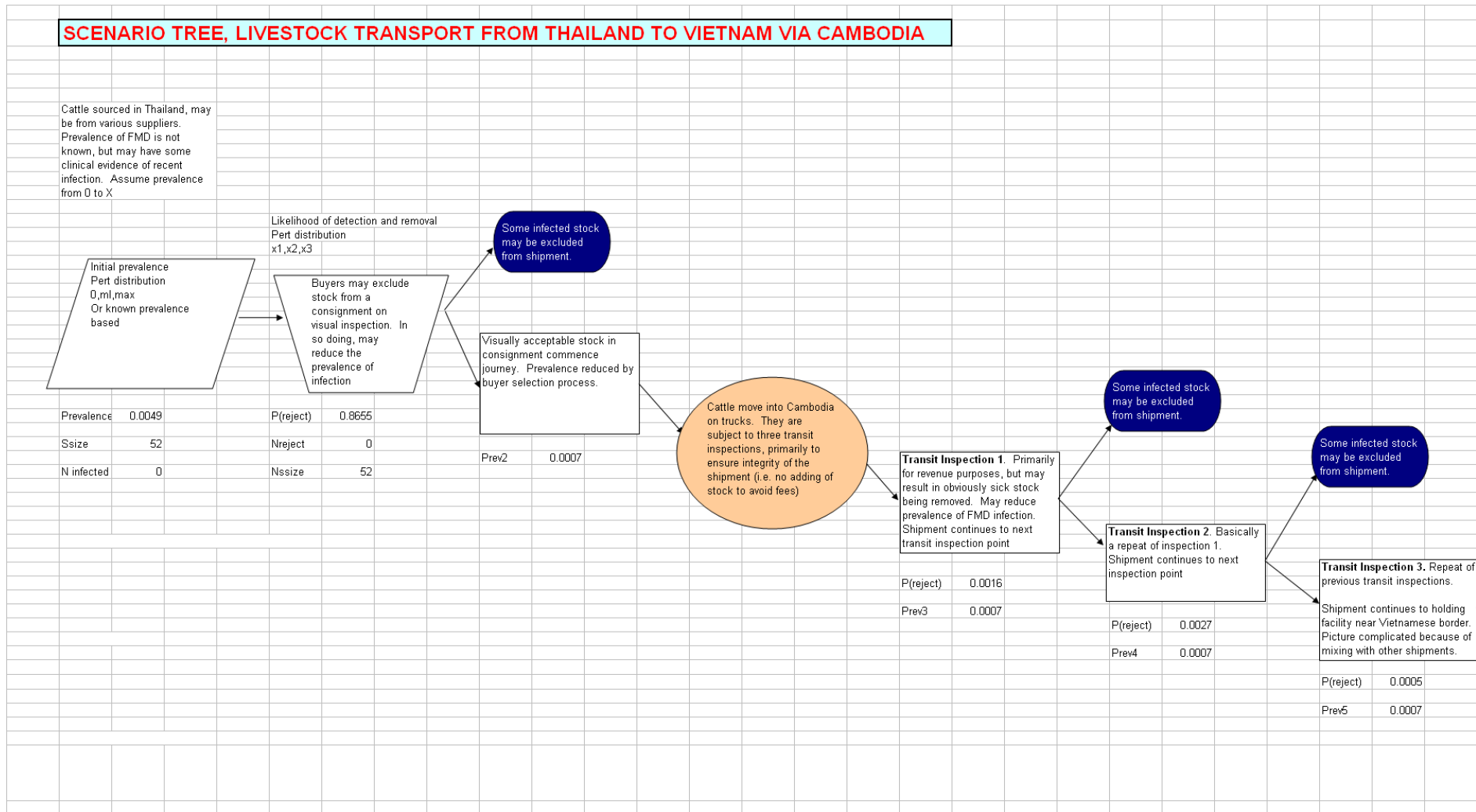
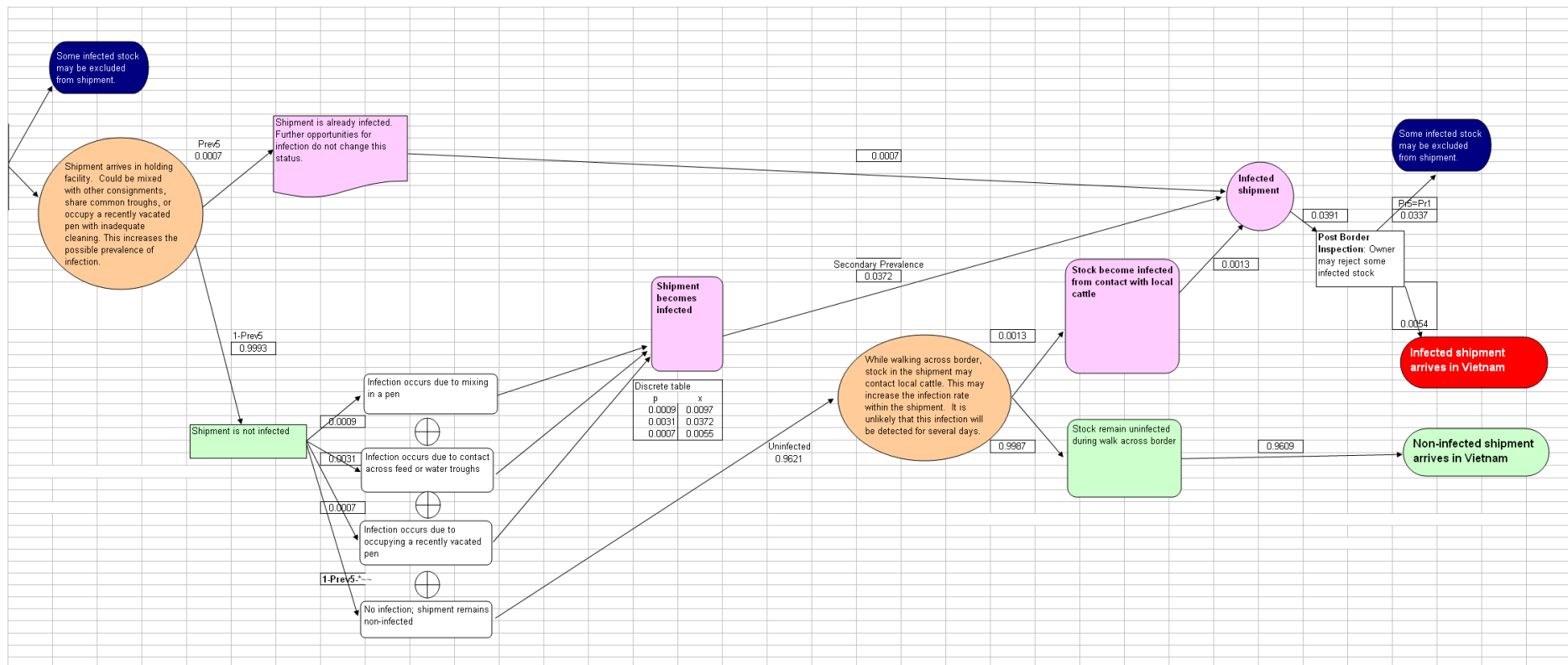
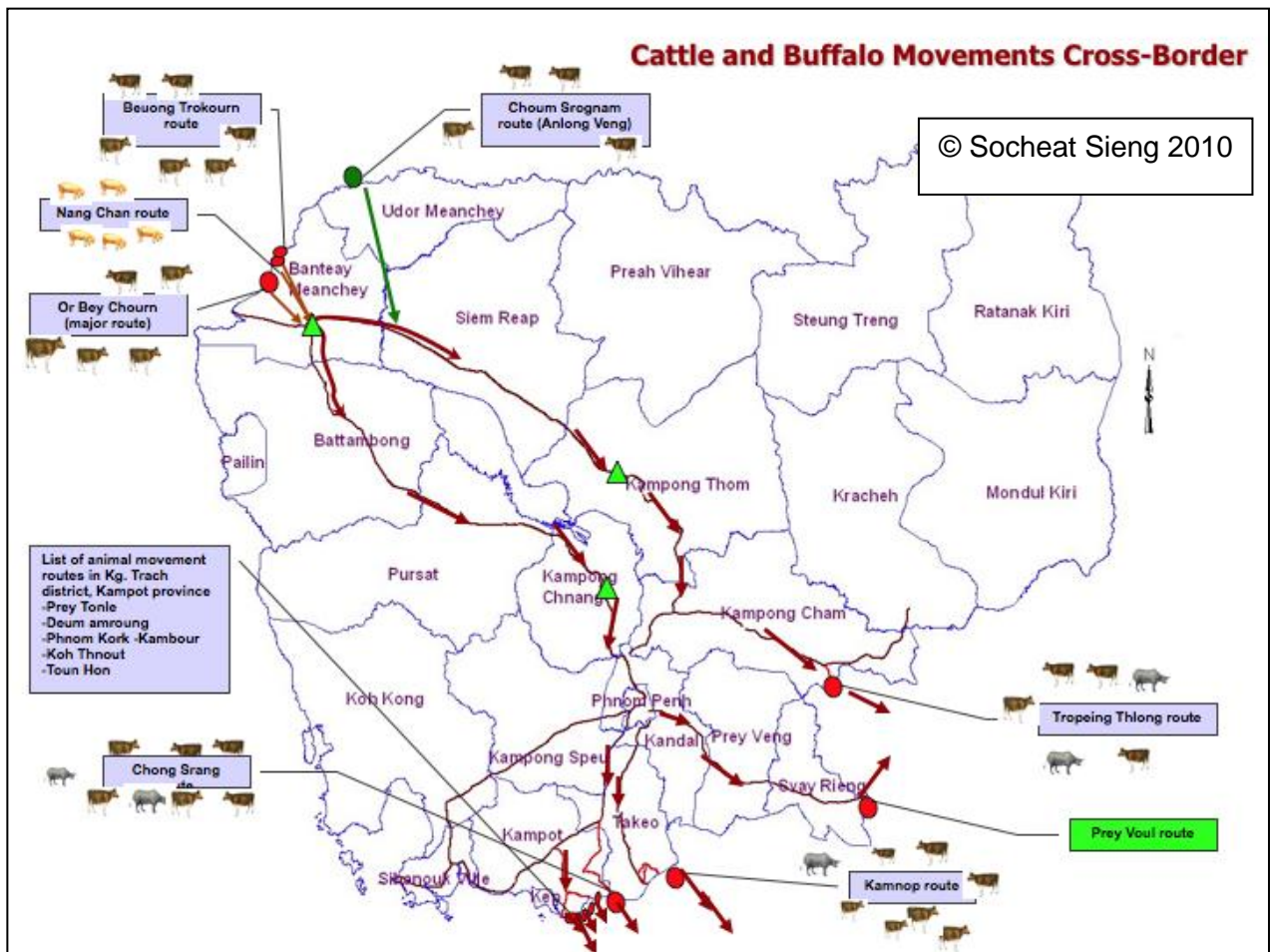


Figure 1b. Scenario tree for the transport of stock from Thailand to Vietnam (Final transit inspection to arrival in Vietnam)



Map 1. Recognized trade routes across Cambodia from Thailand to Vietnam.



Map Copyright: Socheat Sieng

This information has been expanded and reproduced in ACIAR Proceedings 137. Animal biosecurity in the Mekong: future directions for research and development.

Appendix 10. Disease reporting in Cambodia and Laos

The Project Review of August 2010, specifically recommended that ‘the project not pursue the evaluation of the disease reporting systems in Laos and Cambodia as these reports are not central to the delivery of current project objectives’ (ACIAR, 2010).

Nevertheless, it is the firm conviction of project staff that improvements to disease investigation and reporting in Cambodia, Laos and neighbouring countries should be a primary focus of research and development in the GMS, without which many disease control initiatives (such as timely vaccination programs) will have little if any success. Although our own project’s evaluation of disease reporting was finally curtailed as a result of the Project Review in August 2010, we were conscious that such an evaluation should include an investigation of **why** disease reporting is so poor, and we strongly recommend to ACIAR and other research bodies the importance of completing that research.

Although the FAO continues to make efforts to entrench *TADinfo* as the answer to disease reporting problems in these countries, the FAO (like our own project) continues to ignore the impracticalities of esoteric, computer-based reporting systems in many Cambodian and Laos provinces, where basic paper-based reports from district and province level continue to underpin the surveillance system. As expressed by the DAHP’s Dr Sorn San (Director of Cambodia’s National Veterinary Research Institute) in his presentation to the 2011 meeting of the OIE Sub-commission for FMD:

“FMD reporting system: TAD-Info has been introduced but it does not work so that the paper-based report system (paper report is still important)” (Sorn San, 2011).

Although our own project’s plans to standardise the format of these base-level paper reports in both countries were blocked, we recommend this course of action as a starting point for improvement of disease reporting at national and regional level.

Disease reporting in Cambodia

In Cambodia during 2008-2010, the project attempted to compile the monthly disease reports which are theoretically submitted to Cambodia’s National Veterinary Research Institute (NaVRI) on a regular basis from each Provincial Office of Animal Health and Production (POAHP). In addition to extracting disease surveillance data from these reports, we also hoped to use them as a source of market price data for livestock (and/or meat) in each province, as price reporting is a feature of these reports. Unfortunately, our findings can be summarised as follows:

- The reports are not reliably submitted from every province, and certainly not on a regular basis (despite assurance of payment by the project for so doing).
- The format and content of the reports vary considerably between provinces.

- The usefulness of the content for the purposes of disease surveillance is limited, because:
 - there is a loss of data in the reporting process (i.e. loss of district data and specific disease incidence when producing a summarised province report, as described in the SLPP report excerpt reproduced below).
 - it seems likely that foreign interest in (and funding for) Avian Influenza (AI) and Foot-and-Mouth Disease (FMD) biases disease reporting towards those diseases. FMD reports from Cambodia and Laos featuring unusually high mortalities could probably be more accurately attributed to a mixture of common, genuinely fatal diseases such as Haemorrhagic Septicaemia (HS) and clostridial infections.
- Disease (specifically outbreak) reporting by district and provincial staff of the veterinary services lacks the urgency that would be required to attempt meaningful control measures.
- Pathways for disease reporting do not necessarily flow through departmental channels from district to province to head office, and thence to Ministry. Instead, the department's head office may be alerted to disease outbreaks by the Ministry, the reports having been forwarded by provincial politicians or other well-connected individuals. In whatever way the report reaches departmental officers responsible for disease response activities, the reporting process is often too slow to prevent further spread of disease, as described below.

Case study findings on FMD outbreak reporting

The project undertook an opportunistic case study in Kampong Cham province during the widespread Cambodian FMD outbreak of 2010. The aim of the case study was primarily to record epidemiological features of the spread of the disease, including the attitudes and practices of villagers, traders, and local animal health authorities. This case study also generated a crude assessment of FMD vaccine effectiveness in the study villages, and a description of disease reporting at district and provincial level. An excerpt describing disease reporting during the outbreak (taken from the case study reproduced in Appendix 13) is included immediately below (in italics).

'The 2010 FMD outbreak in Cambodia emphasised that disease reporting and investigation in Cambodia remains a critical weakness in any disease control efforts. Our research in Prey Chhlor district discovered that although the district animal health authorities had collected and collated outbreak data into a report dated 3rd August 2010, the report had still not been forwarded to the Provincial Office of Animal Health and Production (POAHP) by 31st August. This lack of urgency in FMD reporting suggests that either FMD is not viewed as a serious disease by many stakeholders, including animal health staff, or that reporting of disease is considered

unlikely to achieve a useful response from the authorities further along the reporting pathway.'

Moreover, 'outbreak samples were not received by the Regional Reference Laboratory for FMD in Bangkok until 24th September 2010, and it was a further 18 days (12th October 2010) before the results of that serotyping (Serotype O) were available. Given that Vietnamese-donated FMD vaccine was used in the two study villages on 2nd and 3rd August, it is concerning that a delay of greater than 2 months occurred before laboratory confirmation of serotype was obtained. Consequently, it seems reasonable to suggest that a proportion of the funds donated for FMD control in the GMS should be directed toward understanding and addressing fundamental flaws in disease reporting and investigation before allocating them to ad hoc vaccination response efforts that may be doomed by serious weaknesses in the attitude and capability of those charged with managing the use of donated vaccine.'

SLPP assessment of disease reporting in Cambodia

As described in Section 5 of this report, it was determined at our 2009 Annual Project Meeting that our evaluation of disease reporting in Cambodia would include the relevant findings of the EU-funded Smallholder Livestock Production Programme (SLPP).

The following excerpt from that project's TECHNICAL ASSISTANCE REPORT; Epidemiologist / Veterinary Investigation Adviser: Final Report (Hoogendijk, 2009) mirrors our project's findings.

'District veterinarians work in close contact with VAHWs. VAHWs report animal disease information to district veterinarians at least on monthly basis, sometimes more frequently. The district veterinarians include this information as well as their own observations (which may include slaughterhouse observations) in monthly disease occurrence reports. However, the reporting formats and content vary between provinces. This makes it difficult to compare the data reported from different provinces. Subsequently these district reports submitted to provincial animal health and production offices are combined into provincial reports. In this process useful district-based data are lost as disease occurrence is often reported for a group of diseases. For example a report might indicate 120 cases of foot and mouth disease, haemorrhagic septicaemia and blackleg without specification per disease.'

Reports from the provincial animal health and production offices are submitted to the Administration Department, DAHP headquarters. Then the reports are sent to the NaVRI Epidemiology Unit, which leads to delays.'

Reasons for poor disease reporting in Cambodia

Attempts to identify reasons for weak disease investigation and reporting in the provinces generated the following:

- Central authorities receiving the reports will fail to respond in a meaningful way.
- Funds/resources are inadequate to investigate disease reports.
- Staff are inadequately trained to investigate diseases and / or write useful reports.
- There may be a failure of the reporting system *within* the province (i.e. reports not passed on from district level).
- Central authorities of the DAHP (specifically NaVRI) have not developed a standardised format for the provincial and/or district level reports.
- Central authorities of the DAHP (specifically NaVRI) do not drive / follow-up provinces which fail to submit reports on time.
- There is a government culture of not being prepared to provide reports without payment.
- Staff quality and POAHP leadership vary between provinces.
- The lack of urgency shown by district and provincial staff in reporting FMD outbreaks may reflect an underlying attitude that non-fatal diseases like FMD are not as important as fatal diseases like haemorrhagic septicaemia (HS). It should be noted that the Cambodian government subsidises the price of HS vaccine but not FMD vaccine.
- High rates of disease reported from a province may make the provincial staff look bad (i.e. suggest that they are not doing their job in controlling disease).

Disease reporting in Laos

- Axelle Scoizec (Project consultant in Laos) reported that knowledge of disease prevalence and outbreaks appeared to be good at a district and provincial level, but that subsequent reporting from the provinces to head office of the Lao Department of Livestock and Fisheries (DLF) in Vientiane often didn't occur because assistance was seldom provided from the central authorities in response to disease reports.

- Lack of funding for district and provincial authorities to investigate animal disease events was also raised as an impediment to disease surveillance and reporting in Laos.
- In a meeting in Vientiane on 20th July 2009, Dr Bounlom Douangngeun (Director, National Animal Health Centre [NAHC]) noted that the disease reporting pathway from the provinces sometimes led directly to the Ministry of Agriculture and Forestry, rather than via the Department of Livestock and Fisheries, as intended.
- Dr Bounlom Douangngeun hosted an FAO project being conducted by Dr Joanna McKenzie to improve the capability of the epidemiology section of the NAHC, part of which will involve an assessment of the DLF's present disease surveillance and reporting system.
- Disease reporting in Laos may be hampered by the fact that the DLF disease reporting form available to provincial and district staff is the Laboratory Specimen Submission Form. As in other countries (including Australia), this means that disease reports/investigations are often not completed and despatched unless there are specimens submitted as part of the investigation.

Appendix 11. Trader feedback in Laos: Disease reduction measures



**A. Lao-Australian Project
Understanding Livestock Movement Project
ACIAR Project AH/2006/025**

Investigation on
the Pig/Cattle/Buffalo trade network and the trade
patterns
in Lao PDR

**FEED BACK MEETINGS FOR TRADERS
REPORT
March 2010**

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1 Meetings' purpose and content

1.1 Meetings' purpose

In order to pay back the big ruminants and pigs' chains' stakeholders who participated to the survey conducted in 2009, the project will organize meetings in the provinces surveyed to present the results of the survey that interest the stakeholders of each province. The meetings will be also an opportunity to pay them back for the information they shared with the project by providing them a short training about main animal diseases that affect the animal trade and production in Lao PDR and about the ways to reduce the risk of disease spread and/or introduction.

In order to prepare the next steps of the project, a consultation of the stakeholders about potential measures to be implemented for reducing diseases risk will be also undertaken. The understanding of the final purpose of the potential measures by the stakeholders will be evaluated. The possibility (is the measure realistic and can be implemented in the real conditions of the field?) and the way to implement these measures will be discussed with the stakeholders. The measures potential impacts on the trade will be evaluated by the traders and stakeholders.

In order to promote the project and its goals and to maintain a contact with the animal trade chains' stakeholders, polo shirts with project's logo, contact and slogan will be distributed.

1.2 Meetings' content

Part 1: Presentation of the results of the survey (for both pigs and big ruminants chains, diseases concerned are HS, CSF and FMD)-1 hour

Power point presentation in Lao language on screen plus distribution of the presentation on paper to the attendants (Cf. annexe 1).

1.1 animal production in the province (strong and weak points)

1.2 description of the animal trade chains within and in/out the province (exporting province, importing province, transit province)

1.3 diseases' situations and risks in the province (endemic, non endemic, risks linked to the trade movement, etc)

1.4 problems or limitations for the animal trade (listed by the stakeholders during the survey)

1.5 Consultation of the meeting attendants about these results

**Part 2: Short Training on animal diseases and ways of diseases' introduction and spread-
40 min**

Power point presentation in Lao language on screen plus distribution of documents to the attendants (cf. annexe 2)

3.1 CSF

- causal agent of the disease
- contaminants and contamination ways, duration of the potential infectivity of an animal according to its symptoms (how long before and after the symptoms it remains infective)
- symptoms and description of an outbreak's evolution in a village
- list of the possibilities of introduction of the disease into a village with the participants

3.2 FMD

- Collection of the knowledge of the attendants about the disease
- causal agent of the disease
- contaminants and contamination ways, duration of the potential infectivity of an animal according to its symptoms (how long before and after the symptoms it remains infective)
- symptoms and description of an outbreak's evolution in a village
- list of the possibilities of introduction of the disease into a village with the participants

Part 3: Presentation of the possible measures to be implemented at a provincial level to reduce the risk of diseases introduction and spread 1 hour

Power point presentation in Lao language on screen

The list of the measures to be discussed with the stakeholders is presented in the annexe 3.

For each measure, the realism and the impact is discussed with the stakeholders.

2 Meetings' schedule

2.1 First trip: Northern provinces

| Date | Location | Activities |
|----------|---------------------------|--|
| 15/02/10 | VTE-Luang Prabang | Travel to LP |
| 16/02/10 | Luang Prabang Sayabuli | Morning: Feed Back Meeting (FBM) Afternoon: travel to Sayabuli province |
| 17/02/10 | Sayabuli Luang Prabang | Morning: FBM Afternoon: travel to LP |
| 18/02/10 | LP-Xieng Khouang | Travel to Xieng Khouang |
| 19/02/10 | Xieng Khouang | Morning: FBM Afternoon: visit to Nong village |
| 20/02/10 | XK-Huaphan | Travel to Huaphan |
| 21/02/10 | Huaphan | Day off |
| 22/02/10 | Huaphan Viengthong | Morning: FBM Afternoon: travel to Viengthong |
| 23/02/10 | Viengthong-Oudomxay | Travel to Oudomxay |
| 24/02/10 | Oudomxay Luang Namtha | Morning: FBM Afternoon: travel to LNT |
| 25/02/10 | Luang Namtha Bokeo | Morning: FBM Afternoon: travel to Bokeo |
| 26/02/10 | Bokeo Oudomxay | Morning: FBM Afternoon: travel to Oudomxay |
| 27/02/10 | Oudomxay-VTE | Travel by plane to VTE of Phouth and Axelle |

| | | |
|----------|---------------|---|
| | Oudomxay-Kasi | Travel by car to kasi of Anouson and the driver |
| 28/02/10 | Kasi-VTE | Travel by car to VTE of Anouson and the driver |

2.2 Second trip: Southern provinces

| Date | Location | Activities |
|----------|----------------------------------|--|
| 02/03/10 | Bolikhambay Khammuane | Morning: Travel from VTE to BLK Afternoon: FBM travel to Khammuane province |
| 03/03/10 | Khammuane Savannakhet | Morning: FBM Afternoon: travel to SVN |
| 04/03/10 | Savannakhet Kongxedon dist | Morning: FBM Afternoon: travel to Kongxedon (Saravane prov) |
| 05/03/10 | Kongxedon Laokhongpeng VTE | Morning: travel to Laokhongpeng Morning: FGM Afternoon: travel back to VTE (arrival at midnight) |

3 Results of the feed back meetings conducted

The detailed results of the meetings conducted in each province are presented in the annexe 4.

3.1 Main changes in the trade patterns since last year

3.1.1 Cattle and Buffalos trade:

Chinese Large ruminants' demand:

Chinese demand seems to have increased since last year. Now direct transit is officially done between Thailand and China through Bokeo and Luang Namtha province. This movement is

official in Thailand and Lao PDR but apparently the entry in China would be informal. The volume is about 300 to 400 heads per week.

Luang Prabang traders were used to buy animals from Phongsali province but the supply stopped. The animals would be bought by Chinese traders. Luang Prabang traders said that the Phongsali traders are going to buy animals from them to supply this demand.

Importation of Thai cattle and buffalos in Sayabuli province:

The importation is now allowed officially through quotas. It started for supporting the supply demand expected during the SEAgames and still goes on. The quotas are attributed to a big trader located in Phonhong (Vientiane capital) and to some traders in Sayabuli province. The animals are mainly destined to Vientiane slaughterhouse. This supply source of Thai large ruminants supplanted the one from Saravane province in Vientiane slaughterhouse. The animals imported in Sayabuli province are also sent to Vietnam through the Xieng Khouang traders. A new destination for these animals would maybe emerge soon. The trader from Phonhong wants to supply the Luang Prabang traders and started negotiating with them already. The animals if they are supplied to Luang Prabang are likely to be slaughtered there but also to be maybe sent to Phongsaly for supplying the increasing Chinese demand. This potential new movement is risky in terms of FMD introduction risk in Luang Prabang and Phongsali province which haven't been affected by FMD for a long time (or by very few cases at the border with other provinces).

Importation of Thai cattle and Buffalos in Saravane province:

The importation that was stopped some months last year, has started again. But the traders stopped by themselves this movement one month ago because the animal prices in Thailand increased and the ones in Vientiane remain the same. They said that there is too much competition for buying animals in the alive animals market in Thailand now, especially with Vietnamese traders. In Savannakhet the transit movement from Thailand to Vietnam is said to have decreased. Maybe the supply is less important in the alive markets of Thailand.

Exportation of Cattle and Buffalos to Vietnam in Xieng Khouang province

Official taxes and fees are now collected at the checkpoints in Xieng Khouang province. They are paid only once whatever is the movement destination (another district or Vietnam). The Vietnamese demand is said to have remained the same.

3.1.2 Pigs trade

Pigs Production:

The prices of pigs dropped nearly to the production costs in the provinces where pigs are produced in Pig farms and where the prices are linked to the Thailand market (Vientiane, southern provinces etc.). The prices dropped to 55Bath/alive kg in Khammuane province which is the production costs. A small augmentation of the prices started already.

Importation of fattened pigs from Thailand in Sayabuli province for Luang Prabang demand

These official importations decreased since last year. The demand in Luang Prabang is now more supplied by the pig production in Sayabuli province. Importation of piglets from Thailand to be fattened in Sayabuli occurs. Possible informal or formal importation of fattened pigs to the local pig farms is suspected. The pig farmers/traders in sayabuli go to buy pigs from cheaper Thai producers. Before they bought animals from CP company but now they buy them from cheaper producers.

Quota of pigs importation from Khammuane province in Vientiane capital

Pig farmers and pigs producers in Vientiane capital pushed for reducing the supply of the Vientiane slaughterhouse from Khammuane production. Vientiane capital decided that a quota of only 6000 fattened pigs per month, can be supplied from Khammuane province. Last year, we estimated that around 8000 heads per month were supplied from KMN to Vientiane. The KMN pig traders complain about the reduction of the market opportunities for them. They cannot sell at the right time all the pigs produced in the province. The pig farmers complain also. They have to keep pigs ready to be sold because there is less market opportunities to sell them which is particularly costly for them because the prices of animals are already so low that they nearly don't make any profit at the moment and can even loss money by producing pigs.

The supply sources for Vientiane capital demand are still first Khammuane and secondly Vientiane capital but the part from VTE capital increased.

3.2 Diseases situation

At the period of the feed back meetings, the FMD outbreaks occurring in the provinces visited were:

- outbreaks in XK province since at least December 2009, affects at least 3 districts. (serotype O)
- outbreak in Oudomxay in July August 2009 (stopped now) in 4 villages after importation of large ruminants from Bokeo (serotype O)
- outbreak in Bolikhamxay province: late February 2010 4-5 villages in Paksan district
- outbreaks in Savannakhet province: sporadic cases all around the province

The annexe 4 presents the detailed information per province.

3.3 Results of the consultation on the possible measures for reducing diseases risks due to animal trade

3.3.1. Measure 1

| |
|--|
| Harmonization of official taxes and fees within provinces and between provinces |
|--|

Purpose of the measure:

- Facilitation of the trade
- Reduction of informal movements due to change of citizenship for reducing the amount of fees

Discussions results

| Province | Realism | Impact | Comments |
|---------------|---------|---|---|
| Luang Prabang | - | Would be very good if can be done | <p>Would like no quotas anymore: now they need quota from origin and from destination to move animals!</p> <p>Free movements</p> <p>Movement regulations must be the same every where</p> <p>Idea: a central phone call center to be consulted when officers at checkpoint want to collect unofficial fees from them: help for negotiation or for solving the problem</p> |
| Sayabuli | | <p>Would like.</p> <p>At present time, a lot of animals are moved</p> | <p>If taxes and fees already paid in Boten, they would like to move animals by applying animal</p> |

| | | | |
|---------------|---|---|--|
| | | between districts without papers (because taxes and fees are too much expensive) | movement permit in Sayabuli without paying them again and just paying for administrative service (papers delivery) |
| Xieng Khouang | Difficult because all offices concerned in all provinces must cooperate to implement this measure, | Very good if possible | |
| Huaphan | Difficult to achieve | Could be good for the trade | |
| Oudomxay | Very difficult to achieve. All the provinces and districts (expensive or cheap ones) would maybe used this opportunity to increase all fees and taxes | Would be good for trade Would like at least harmonization of taxes and fees between the districts of the province | Here the fees and taxes paid at slaughterhouses are quite high (could explain the development of illegal slaughtering for supplying market with meat) |
| Luang Namtha | Could be possible between PAFOs but maybe difficult with other offices concerned\ PAFO officer said that they already submit proposition to DLF for harmonising the taxes and fees | Very good idea because of duplicate taxes/fees they have to pay presently: per year for license, plus importation fees when imports animals from Bokeo (already taxes paid at origin) | The profit is highly reduced by taxes and fees: the difference of prices between Bokeo and LNT is around at least 300 000 LAK/head of CB but after taxes and fees, the final profit is around 50 000 LAK |
| Bokeo | Already there is a decree of finance ministry fixing the nature and the amount of taxes but for the moment each province readapt to its own situation, needs. Would be difficult to achieve: idea already exists at central level but couldn't be implemented in the field | Good idea if can be implemented | From axelle: this would touch to the autonomy of decision of the provinces and districts: could be quite sensitive and difficult to achieve. |
| Bolikhamxay | The possibility of implementation is small The possibility to regulate the taxes and fees charged at the | Idea is good | One trader said that in VTE capital the traders pay only at the Agriculture office and not a Finance and commerce |

| | | | |
|-------------|--|---|---|
| | village is nearly impossible but this cost varies a lot: between 5000 LAK up to 200 Bath per head of CB within the province. | | offices: cheaper and simpler than in BLK province |
| Khammuane | Difficult to achieve: there is already a regulation from finance ministry fixing the taxes amount but it is not followed at provincial and districts level. | Good idea if the harmonization is made at small amount and not at highest amount occurring now. | |
| Savannakhet | Difficult to implement It is already planned to implement such thing in SVN province: the district administration office would deliver the total documentation and collect all taxes and fees at once. This is made to copy what is done for transit trade of any products. | Good idea | |
| Saravane | If possible, it would be good if the agriculture and commerce ministries decree on taxes-fees and their amount as done by finance ministry. | Good idea (officer) Could be good (traders) | |

CONCLUSION for the measure 1:

The measure is considered as good or very good by the traders, but the harmonization of the taxes and fees mustn't be done at the most expensive amount occurring in the country. The implementation of the measure is considered as difficult or very difficult because it would require the collaboration of all offices of Agriculture, Commerce and Finance of all districts and provinces. There is already a central will for harmonising the taxes all around the country: the Ministry of finance made a decree describing the taxes and their amount for every kind of products etc. But the provinces and districts still implement according to their own ways. They generally use the same kind of taxes but modify the amounts. They can also create other kind of taxes. The measure implementation will be difficult because it is in

conflict with the decision autonomy of the districts and provinces which would want to keep that autonomy.

The implementation approaches evocated were the decree from central level fixing taxes and fees from Ministries of Agriculture and Commerce as from the Ministry of Finance or to start by collaboration between PAFOs. The other approach done in Savannakhet province is the harmonization within the province first.

The fees charged at the village level are considered to be impossible to be harmonized at all.

3.3.2. Measure 2

No trade of sick animals (all disease but especially for HS because high risks for consumers):

Purpose of the measure:

- Reduces diseases' spread

Discussions results

| Province | Realism | Impact | Comments |
|---------------|--|---|---|
| Luang Prabang | Can be implemented only if sick animals can be detected at checkpoints by officers | If sick animals can be detected, they won't trade, so no impacts for them (traders of slaughterhouse) | |
| Sayabuli | Generally, traders trading long distance already avoid buying sick or suspected animals. But traders for slaughtering purpose buy them. Possible to stop only through officers intervention | Impact won't b so important. A trader buying for slaughter purpose, buy maybe 2 or 3 times per years animals from affected village. Around 10 to 20% of the animals slaughtered in Sayabuli are from disease affected village/area. | |
| Xieng Khouang | Could be done if officers able to detect sick animals (because the traders cannot detect by themselves): need of strong control | They make a lot of profit when trading sick animals, so they cannot stop by themselves, they have to be forced to (traders) Average profit for trading-slaughtering animals: 100 000LAK/head of CB and 50 | Finally, the traders said that they never trade sick animals... It is very difficult to make people (traders, and even officers) recognize |

| | | | |
|--------------|---|---|--|
| | | 000 LAK per head of pig. For sick CB the profit can be 500 000LAK or more per head. Generally they don't trade a lot of sick pigs, so they don't know the profit. | that some sick or suspected animals are still trade and slaughtered. |
| Huaphan | Possible, already achieved in Huaphan province: prohibition of movements in case of outbreaks and restriction at the slaughterhouse | | |
| Oudomxay | possible if traders able to recognize sick animals they already try to avoid buying sick animals because of the risk of carcass destruction | Would be good if this decrease the risk of destruction of carcass at slaughterhouse | (from axelle opinion: could be difficult to achieve if the illegal slaughtering goes on) |
| Luang Namtha | Possible, already some achievement in LNT For getting the mvt permit, the animals are checked by officer at DAFO and received a spray mark. Sick animals are not allowed to be slaughtered by inspector officers at SH. | Officer estimated that maybe 10% of animals slaughtered are risky ones : this can happen when the morning slaughtered amount of animals is not sufficient for the daily demand and some animals are slaughtered during afternoon (no inspection during afternoon slaughtering). | |
| Bokeo | Could be possible if strong control implemented The implementation of a proper slaughterhouse already decreased the risk of sick animals slaughtering for consumption (but must still occurs sometimes) | Would be good if achievable according to officers If a trader buy a sick animals, the price of the animals could be only 50% of the normal price (if not sick). So the profit can be 50% of the animal value! Generally the average profit per head is 500 Bath for a head of B which value is 10 000 Bath: so the profit is only 0.5% of the value, for pigs the average profit is around only 100 000 LAK for 5 heads (around 1,5% of the value) | Before when there were no SH: maybe sick animals could be slaughtered |

| | | | |
|-------------|---|--|--|
| Bolikhamxay | | <p>Presently, there is just a small amount of sick animals trade</p> <p>Traders declared that they try to avoid to buy sick ones and just want healthy ones. But some traders from VTE capital come to buy suspected cheap animals within the province.</p> <p>Average profit by trading an animal : 100 to 150 000 LAK/head of CB and around 30 000LAK/head of pig</p> <p>If the animal sick: Trader can buy at 50% of its normal value: so the profit can reach 500 000LAK for one pig and more than 1 millions of LAK for a CB.</p> | |
| Khammuane | <p>At the local SH, anta mortem check is already implemented according to the officers</p> <p>In case of outbreaks, if there is high mortality they really go on the field to prohibit the movements, in case of no big mortality (as for FMD), they don't go on the field.</p> | <p>Traders said they never trade sick animals</p> <p>But when they trade to VTE slaughterhouses, they say the trader there never refused to buy animals from them even if one is weak because he cannot refuse one animal within a batch, their trustful business relationship would be compromised.</p> | |
| Savannakhet | <p>Very difficult to implement because needs strong controls</p> | <p>There is still trade of sick animals for slaughtering (when there are outbreaks). If a trader buys a sick animals he goes directly to the nearest location for slaughtering it (reduces the risk of mortality before slaughtering and reduces the risk of being caught by controls)</p> <p>Average profit for trading an animal:</p> <p>150 to 300 000 LAK per head</p> | |

| | | | |
|----------|--|---|--|
| | | of CB If sick animal, can buy it at 500 000LAK whereas its normal value is 3.5 millions of LAK. | |
| Saravane | <p>Possible: no trade of sick animals within the district at present time:</p> <p>The meat demand is quite low within the district and consumers are already very sensitive to the food safety.</p> <p>There is meat inspection at the slaughterhouse. But no destruction of carcasses occurred in the past.</p> <p>There is promulgation of prohibition of movements in case of outbreaks: letters sent but no implementation of road controls. The traders are informed of the prohibition by heads of village and VVWs.</p> | <p>Apparently it is already achieved in the district.</p> <p>Traders declare not trading sick animals because there is risk that the animal die before slaughtering at transportation, they cannot slaughter it at the SH because there is inspection or the meat would be destroyed.</p> | |

CONCLUSION for the measure 2

The trade of sick animals generally doesn't concern the traders who trade on long distance. It is done by traders supplying local meat demand. The animals after purchase are slaughtered as quickly as possible in the nearest place available generally. This can be done at slaughterhouses or at home etc. The profit per head is generally quite small for the traders supplying the meat demand: 100 to 300 000 LAK per head of cattle or Buffalo and 20 to 50 000 LAK per head of pigs. But the profit when trading a sick animals can be huge in comparison. They can buy a sick animal at 50% of its normal value (or even less) and sell the meat as the same price than usual. So the profit can be more than 10 times the usual profit or even much more than that.

The measure could be really implemented on the field if the risks of trading such animal are more important that the potential high profit traders can make by trading sick animals. In some provinces, the traders declared that they already try to avoid to buy such animals because it is too risky in terms of detection at the slaughterhouse by the officers followed by the destruction of the carcass. In the provinces where there is high public sensitivity about

food safety with consumers really reluctant to buy meat presenting a suspected aspect, the traders seem to be more careful when they buy animals.

In every province, the possibility to achieve this measure is said to be linked to the capacity of detection of that trade by the officers (detection of the sick animals' trade at the checkpoints, at the slaughterhouse, by meat inspection) and the actual destruction of carcasses suspected and removal of the sick animals from the slaughtering process.

3.3.3. Measure 3

Special procedure for slaughtering sick animals (FMD, CSF): bringing animals to slaughterhouse and slaughtering after the end of the slaughtering of the healthy animals

Purpose of the measure:

- Reduces possible contact with other traders and trucks
- Reduces risk of fomites' contamination
- Reduces risk of diseases' spread from slaughterhouse

Discussions results

| Province | Realism | Impact | Comments |
|---------------|--|---|----------|
| Luang Prabang | <p>Could maybe be implemented because the costs to implement is very low</p> <p>Not possible to sell meat labelled as risky one</p> | Too much losses at the sell of risky meat | |
| Sayabuli | <p>Could be possible</p> <p>But this is in contradiction with the good practice regulations (veterinary law) so it would be difficult to implement that through official way.</p> <p>Agriculture office won't agree to allow officially the trade and slaughter of unhealthy animals</p> | No important impact for traders | |

| | | | |
|---------------|--|-----------------------|---|
| Xieng Khouang | Could be possible | No impact for traders | |
| Huaphan | | | Not relevant in Huaphan province: animal suspected are not slaughtered. |
| Oudomxay | No idea: they never let sick animals that could be diagnosed to be slaughtered | Already done | |
| Luang Namtha | Not possible because not in accordance with regulation, not good idea, must be prohibited | | Not relevant in that province because they don't allow the slaughtering already. |
| Bokeo | They don't slaughter sick animals here. | | Cannot create discussion on that: they didn't admit that some sick animals or suspected ones (from affected villages) can be slaughtered here. |
| Bolikhamxay | Not a good idea It is in contradiction with the regulation prohibiting the trade of sick animals | | Not a good idea |
| Khammuane | Not in accordance with regulations (according to officers) | | If an animal is suspected, it is not allowed to slaughter it, it is kept by the trader for some days to monitor the evolution and then slaughtered if recovery. |
| Savannakhet | Not relevant: Generally the sick animals are not slaughtered at the slaughterhouse but at home, in forest and then the meat is transported to the market. | | |

| | | | |
|----------|--|--|--|
| Saravane | <p>Not possible. The sick animals cannot be slaughtered at the SH and this is already implemented.</p> <p>Some can slaughter the animal in village or at home but only to supply the village(s) because the meat market is quite small (demand small) and it is already totally supplied by the animals slaughtered at the SH (only 2 CB slaughtered per day).</p> | | |
|----------|--|--|--|

CONCLUSION for the measure 3

The measure is not in accordance with the regulations. The officers were very reluctant to consider it as possible. In the province where the enforcement of the control as meat inspection and ante mortem inspection are stronger, the traders found the idea not good. The measure is irrelevant in many cases because the sick animals are in some provinces not slaughtered at the slaughterhouse to avoid the risks of control but at home or elsewhere. In some provinces where the sensitivity of the consumers about food safety is high, the traders said that such measure if known by consumers will discredit the quality-safety of all the meat at the market and this will reduce the sell of meat at the market.

3.3.4. Measure 4

Special procedure for marketing meat from sick or suspected animals: meat labelled as risky meat that must be boiled and not given to pigs

Purpose of the measure:

- Reduces diseases' spread through infective meat consumption

Discussions results

| Province | Realism | Impact | Comments |
|----------|---------|--------|----------|
|----------|---------|--------|----------|

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|---------------|--|--|---|
| Luang Prabang | <p>Could maybe be implemented because the costs to implement is very low</p> <p>Not possible to sell meat labelled as risky one</p> | Too much losses at the sell of risky meat | |
| Sayabuli | Not possible, traders would never agree, nobody would like to buy the meat labelled as risky | Big negative impact: not possible to sell the meat or meat so cheap that no profit or losses for traders | |
| Xieng Khouang | Not possible | Nobody would sell such labelled meat or buy it. | |
| Huaphan | <p>Not possible</p> <p>It works for cysticercosis because they cannot diagnose the affection ante mortem, for the disease that can be diagnosed ante mortem they don't slaughter for consumption</p> | Nobody would accept to buy the meat | If animal brought for slaughtering is disease suspected they delay the slaughtering up to 2 weeks, animal is raised (mixed with local herds) to see if symptoms come out or recovery: purpose is food safety but not animal disease control |
| Oudomxay | They do already for cysticercosis (low contaminated carcasses, after removal of cysts) but the meat is sold without label (sold as any meat) | Not possible to sell the meat if labeled | |
| Luang Namtha | Not possible, economically no sense | Could not sell the meat labelled as risky ones | in the province, the consumers are sensitive to food safety. If they hear about outbreaks occurring with livestock the meat selling at market decreases. |
| Bokeo | Not possible | Nobody would buy the | |

| | | risky meat | |
|-------------|---------------|---|--|
| Bolikhamxay | Not possible | Not possible to sell the meat | Already now, when the meat is not of good aspect, it is not possible to sell it. The consumers are already sensitive to meat aspect and smell. |
| Khammuane | Not possible | Nobody would agree to buy the meat | |
| Savannakhet | Not possible | Cannot sell the labelled meat | |
| Saravane | Not good idea | Consumers won't buy the meat labelled and maybe not buy any meat if they think that the meat is not safety enough at the market. The consumers are very sensitive to the meat quality, they don't buy meat not fresh enough. | |

CONCLUSION for measure 4

The implementation of such measure is totally impossible because nobody would agree to buy a meat labelled as risky one.

3.3.5. Measure 5

Systematic cleaning and disinfection of trucks and traders shoes after animal delivery (at the exit of slaughterhouse, at the exit of farms, at transaction point: e.g. at Phonehong traders' houses)

Purpose of the measure:

- Reduces diseases' spread through fomites

Discussions results

| Province | Realism | Impact | Comments |
|---------------|---|---|---|
| Luang Prabang | <p>They already clean with detergent the trucks at Nongduang SH. Now no cleaning of trucks that deliver animals to them.</p> <p>If service provided and checkpoints on road control the cleanliness of the trucks, could be implemented</p> | <p>Now, they pay 30 to 50 000 LAK per truck (small or big) at Nong Duang SH.</p> <p>Would agree to pay 5000 more for disinfectant.</p> | |
| Sayabuli | <p>Possible if service provided at delivery point</p> <p>Now they already clean by themselves at Sayabuli SH after delivery the trucks inside slaughterhouse compound (clean for free)</p> | <p>They would agree to pay 5 to 10 000LAK more to get disinfection</p> <p>In VTE they already pay 60 000LAK per truck for cleaning, they agree to pay 10 000LAK more for disinfection</p> | |
| Xieng Khouang | <p>Possible if the service is provided at the slaughterhouse and checkpoints.</p> | <p>They would agree to pay 50 000 to 70 000 LAK per truck for cleaning-disinfection service.</p> | <p>Presently not enough water supply capacities at the SH for cleaning.</p> |
| Huaphan | <p>Can be organised if they receive subsidies for investment in the water supply (weak at dried season)</p> | <p>The traders don't want to pay any additional fee for using cleaning, disinfection service because their profit is already very low.</p> | <p>Present time: no cleaning of trucks at slaughterhouse</p> |
| Oudomxay | <p>Could be done if not too much expensive</p> | <p>Presently, they clean for free their trucks at the slaughterhouse. They agree to pay an extra fee of 15000LAK per truck</p> | |

| | | for disinfection | |
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| Luang Namtha | <p>Yes it is possible to implement at the slaughterhouse</p> <p>If there is facilities in the SH, and they are forced to use it, they will do it</p> | <p>At the present time, if they use cleaning facilities for their trucks, they pay : 20 to 30 000 LAK/small truck or pick up to 50 to 100 000 LAK for big long truck</p> <p>But generally they clean for free in the river</p> <p>They would agree to pay 10 000 LAK extra fee for disinfection</p> | <p>For the moment, no cleaning facilities at the SH</p> <p>They clean the trucks in the river !!!</p> |
| Bokeo | <p>Could be done</p> <p>Not so difficult to implement</p> | | <p>No cleaning facilities at the slaughterhouse at the present time</p> <p>Trucks are cleaned at home</p> |
| Bolikhamxay | <p>Cleaning is possible: they already use the water supply at the Paksan slaughterhouse for cleaning their trucks by themselves after delivery.</p> <p>In VTE slaughterhouse, they generally use the cleaning facilities (cleaning service or water supply) but not always: sometimes if they deliver at night they go back home without cleaning first and then they clean at home.</p> <p>Disinfection could be possible if the service is provided at the slaughterhouse and if they are obliged to do it.</p> | <p>They would agree to pay 10 000 extra LAK for disinfection</p> | <p>One trader explained that he cleans his truck everyday between the moment he delivers animals at the SH and the moment he gets the meat back and then transport it to the market for selling.</p> <p>Normally the pig farms don't allow you to enter with a dirty truck but when it is for collecting pigs you can enter anyway even if you charged some pigs from an other farm just before.</p> |
| Khammuane | <p>Could be done: they already clean their truck in VTE slaughterhouse after delivery: in Nongduang they pay 50 000</p> | <p>They would agree to pay 10 000 extra LAK for disinfection of the truck.</p> | |

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| | <p>LAK per trucks for the cleaning service, in Dondu there is no cleaning service so they clean for free by themselves with the water supplied there or go to Nongduang for cleaning.</p> <p>In Takhec slaughterhouse, some clean their trucks for free with the water supplied there but if the truck is not too much dirty some go back home for cleaning.</p> <p>At pig farms: the truck for collecting can enter even if there is already pigs from other locations inside. The thai trucks delivering piglets or food don't clean before going back to Thailand.</p> | | |
| Savannakhet | <p>Difficult: in the local slaughterhouse there is not enough water even for cleaning the slaughterhouse.</p> | <p>They would agree to pay an extra fee of 10 to 15 000 LAK per truck for disinfection.</p> | <p>Traders proposed that trucks will be sprayed with disinfectant between districts also.</p> |
| Saravane | <p>Would be possible</p> <p>At Dondu they already clean their truck by themselves after delivery with the water supplied in the SH.</p> <p>At Densavan, when they deliver animals for Vietnamese traders, they don't clean their trucks (no facilities) and come back home before cleaning.</p> <p>At the local SH: no facilities for cleaning. It is just a slaughterpoint.</p> | <p>If they are not forced to clean and disinfect their truck, they won't pay for it.</p> <p>If they are forced, they will do it.</p> <p>They are happy if they can clean for free by themselves at any delivery point.</p> <p>And if they are forced, they will agree to pay 10 000 LAK per truck for disinfection.</p> | |

CONCLUSION for the measure 5

In most of the cases, the traders would agree to clean and disinfect their truck after delivery if the service (water supply available and disinfectant) is available at that point. The traders trading longer distance (to Vientiane for example) generally agree to pay for cleaning service already and declare to agree to pay extra fee for disinfectant around 10 000 LAK per truck. The traders supplying the local slaughterhouses, are more reluctant to pay extra fees for cleaning and disinfecting because they make less profit from their trading activity. They generally clean for free their truck when water supply sufficient at the slaughterhouse. They would agree to pay some extra fee for disinfectant only if they are forced to.

3.3.6. Measure 6

No mixing of trade animals with local herds before their final destination (no mixing, no contact with local herds in the trader village)

Purpose of the measure:

- Reduces diseases' spread in the area around traders' locations

Discussions results

| Province | Realism | Impact | Comments |
|---------------|--|---|----------|
| Luang Prabang | Could be for pigs because they are already in separated pen because they cannot be mixed with local ones (fighting) For CB it could be done, but it is not really happening at the present moment | They cannot afford to fence areas for storage. They could only tight the animals to prevent contact with local herds (but sharing pasture field is already too much contact) | |
| Sayabuli | Need special area provided to implement that | At present time, they store the CB for at least 1 week. They have to put them on pasture field with local herds. Difficult to do another way. They have no idea about the price for storing | |

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| | | animals in fenced area with feed brought to animals. | |
| Xieng Khouang | <p>CB: difficult to implement because no place available for isolated storage. Generally they store the animals at home up to 2 weeks of duration.</p> <p>Pigs: already implemented: the pigs collected are delivered directly at the slaughterhouse and stored there before slaughtering</p> | | |
| Huaphan | <p>Could be done for pigs</p> <p>For CB, the authorities must provide a pasture land nearby the slaughterhouse to do so</p> | | <p>Present time: duration of storage is 1 week in average with possibility of CB contacts with local herds but there are very few animals raised around the city so these contacts are very limited (prohibition of raising because of traffic accident) No storage at the slaughterhouse (only 1 day before slaughtering)</p> |
| Oudomxay | <p>For CB: it is already done: CB are stored for 2 or 3 days in slaughterhouse area with no contact with local herds</p> <p>For pigs: they are directly brought to SH after purchase and stored before slaughtering (up to 6 days)</p> | No impact: already done | |
| Luang Namtha | <p>Difficult to have for a trader a special isolated area for storage for CB, but the contact with local herds is already very reduced.</p> <p>Could be possible if a fenced</p> | <p>Costs too expensive if they have to fence the CB and feed them</p> <p>If a fenced pasture area is provided, they would agree to pay</p> | <p>Generally for CB, they agree with farmers on transaction before and come to collect all the animals to fulfil the truck the same day. They store the animals</p> |

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| | <p>piece of pasture land is provided by government nearby the SH (if not fenced, they would have to tigh the animals to prevent animals going to crop land and to feed them: too costly)</p> <p>Possible for pigs: they already store the pigs they buy at the slaughterhouse for 1 or 2 days.</p> | <p>5000 LAK/head/day during storage period</p> <p>This is possible only if the land is provided by government (local authorities). Private will never agree because the renting fees for land will give much more money than this activity.</p> | <p>up to 3 days at home. The local herds in town area are really small amount of heads now: so very few possibility of contact</p> |
| Bokeo | | <p>CB storage: presently, less than 7 days of storage after purchase, stored at SH area or around their home in the town area (very few animals are raised in the town area)</p> <p>Pigs: they plan to buy just before the moment they need them: very short storage duration (avoiding food costs): storage at the slaughterhouse (9 pens available)</p> <p>Trade to chine: no storage: animals moved straight away from Thai border to Chinese border (direct transit)</p> | |
| Bolikhamxay | <p>Difficult to not mix the animals (CB) with the local herds because they don't have fenced land for storing the animals and it is difficult to isolate them from the local ones.</p> | | <p>They generally stored CB for 3 days before selling them to VTE. Sometimes the animals can be mixed with local herds. The time factor explaining that storage duration is the documentation procedure length: otherwise they would move straight away the animals</p> <p>Pigs are collected in farms and moved straight away to VTE (documents are done in advance for pigs). Otherwise they are moved directly to the slaughterhouse and stored in pens in the</p> |

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| | | | slaughterhouse. |
| Khammuane | <p>Already done for pigs coming from pig farms. They proceed to the documentation before and then move them directly from farm to final destination.</p> <p>Could be done for CB if the trader has a pasture land isolated from local herds (case of 2 traders present at the meeting)</p> | | Generally CB are stored at the trader home for less than 1 week: time necessary to collect the animals to fulfil the truck (documentation takes only 2 hours here) |
| Savannakhet | <p>Difficult for the animals slaughtered locally: they are stored around the SH in a pasture area where they can be in contact with local herds.</p> <p>Not possible for The animals for VTE: they are stored at home at the traders cannot dispose of an individual land for storage.</p> <p>Can be done if isolated storage area provided by authorities.</p> | | The villagers in the traders villages never complain about the animal trade activity even in terms of animals diseases introduction risks. |
| Saravane | <p>Could be done.</p> <p>It is already implemented for the Thai CB imported.</p> <p>The traders trading CB to VTE, Vietnam etc. declared having each a fenced area to store the animals where they provide rice straw for them (as practice by all farmers raising CB in the province during the dry season). The storage duration is 1 to 2 weeks. No loss of weight during that period. The fenced area is located in their own village: contact with local herds possible</p> | | No villager complains about their animal trade activity as a risk of animal disease introduction for their own village. |

CONCLUSION for the measure 6

The measure is nearly achieved for pigs trade. Generally pigs are brought to their final destination (slaughterhouses) straight away after collection. They can be stored for some days but generally it is done in pens located in the slaughterhouse and the pigs are not sold out from there.

The situation for the cattle and buffalos trade is much difficult to implement such measure. The traders that must store the animals before selling them out, generally do it at home in the public pasture area of their village. This is difficult to change because the traders generally cannot afford to possess individually a piece of land fenced and isolated from local herds to store the animals and there is no pressure of the other villagers on them to change such practice. The risks of introduction of animal diseases due to the animal trader activity in the village seem not to be considered by the villagers.

When the final destination of the large ruminants is slaughtering at the local slaughterhouse, the situation could be changed more easily if a isolated storage area is provided at the slaughterhouse.

Some interesting measures have been implemented in Saravane province for the importation of cattle and buffalos from Thailand. This could be maybe replicated in Sayabuli province which is now the main Thai cattle and buffalos importing province.

3.3.7. Measure 7

Fastening the trade: facilitation of the administrative procedure: only at one point in one time and points situated on the main trade routes

Purpose of the measure:

- Reduces time of storage of animals by traders
- Reduces the duration of the risk of diseases' spread from the animals trade in the area they pass by

Discussions results

| Province | Realism | Impact | Comments |
|---------------|---|---|--|
| Luang Prabang | Very difficult to get the different offices involved to agree together and organize this together | <p>Would be very good for traders</p> <p>At present time, they need 3 to 4 days to proceed the documents (1 day per office)</p> <p>But the costs due to delay is not so important for them. They use their own money for trading. No loan.</p> | |
| Sayabuli | Could be done | Small impact. The procedure takes here 1 to 2 days. | Would like that everything would be done at checkpoints in once |
| Xieng Khouang | If possible, they would like to proceed the documents at the checkpoint located at the origin of the animals, a checkpoint open 24/24 | <p>Very good idea</p> <p>Would be happy to pay for such service</p> <p>The time limiting factor for the trade (explaining the storage duration) to Vietnam is not the documentation procedure but the time needed to find the buyers for the animals.</p> | <p>Cost of day of trade delay:</p> <p>Some traders borrow money: generally is short term credit from relatives with no or very small interest rates, otherwise it is usually 5% per month.</p> <p>For example, they go to buy animals from traders but delay the payment to them of 5 days. If they don't manage to sell the animals within the 5 days they have to borrow the money to pay the farmers as agreed.</p> |
| Huaphan | | Impact limited for traders because they proceed already quickly for the documents (buy only small batch of animals): only 1 | |

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| | | day necessary and they generally trade animals produced within the province | |
| Oudomxay | Can be difficult Officers of each office concerned must be present together for providing the documents | Would be perfect if can be done because presently there is no trust between officers of different offices so if they have proceed to documents in one office, they still have to prove the number of animals they really move etc... the officer always think that they underdeclared and bribed the previous office Presently one day is necessary for documents | Officers of each office concerned must be present together for providing the documents |
| Luang Namtha | Difficult to implement because the different offices would need to agree together. | Good idea according to traders and officers | If possible, the checkpoints would be the best locations to proceed the documents |
| Bokeo | Problem of localisation for the points where to get all the documentation done in once: there is no checkpoints in every districts of the province. | Good idea Presently documentation procedure length is 1 entire day | |
| Bolikhamxay | | Would be a very good idea No time lost for getting the documentation like for the traders located in Thaphabat district and who have to come to Paksan. No storage would be necessary anymore if could be implemented (animals moved straight away): would reduce the trade process duration from 3-4 days to one day. | The districts on the way of movements but far from the provincial capital must be allowed to proceed the documents for exporting animals out of the province |

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| Khammuane | | No big impact because the procedure is already quite fast: 2h and Takhec is located on the way of movements. | |
| Savannakhet | It is planned to be implemented at every district level, the administration office will do it: deliver papers and collect taxes and fees. This will be done only once and then animals/products could be moved within all the province and out. It takes time to implement it (need for creating special human resources) | | |
| Saravane | Will need signature at provincial or even central level to be implemented (officer) | Very good idea according to the traders Presently, the documentation requests them to go to Saravane town which quite far and not in the same direction than the trade. | |

CONCLUSION for the measure 7

The measure is seen as a good potential measure by the traders. The impact of such measure on the trade would be limited, but it could be quite important for the provinces where the provincial capital is located far from the main route of trade. In the cases where the time limiting factor for animal trade is the documentation procedure, such measure could reduce significantly the storage duration of cattle/buffalos by traders to nearly nothing, so this will reduce the risk of disease introduction and spread associated to the storage period of the trade process.

The implementation of such procedure would require collaboration of the offices of Agriculture, Commerce and Finance. This appears quite challenging and it is seen as very difficult by the officers and traders. Some interesting initiatives exist within the country that go on the same direction as in Savannakhet and Khammuane provinces for example.

3.3.8. Measure 8

Total prohibition of movements in area affected by diseases outbreaks

Purpose of the measure:

- Reduces diseases' spread risks from outbreaks' areas

Discussions results

| Province | Realism | Impact | Comments |
|---------------|--|---|---|
| Luang Prabang | Possible only if officers really implement the prohibition | Not so important for them if the prohibition concerns only one source they use. They have many alternative source (they haven't though that the prohibition could concern their own district of location) | |
| Sayabuli | Can be done The prohibition of movement is really implemented in the affected districts of the province | | |
| Xieng Khouang | Can do but depends on the authorities implementation. If there is no strong enforcement by authorities they won't follow the prohibition. | | |
| Huaphan | Already achieved for Lao traders Very difficult to achieve with Vietnamese traders | Traders didn't admit that they trade sick animals: the impact couldn't be discussed | Vietnamese traders buy anything even dead animals |
| Oudomxay | Ok can be done Already done: for example in 2005 there were an outbreak human cases of trichinellosis in Oudomxay town: slaughtering and neat retailing (for pork meat) were prohibited during 1.5 month. | Impact but bearable | |
| Luang Namtha | It is possible It is already achieved in that | | Last year, prohibition of mvt due to FMD: no trade of CB but OK for |

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| | <p>province according to them: because there is a lot of checkpoints on the road (strong control enforcement within the province)</p> | | <p>pigs. The supply for the demand of CB meat was from other local sources than the area with prohibition. The amount of meat at the market was insufficient to supply the demand at that period.</p> |
| Bokeo | <p>They already manage to do it:</p> <p>Last year 3 districts affected by FMD, they prohibited the movements of animals from that districts. The source was mainly Tongpeung dist at that moment. Animals from other districts not affected were allowed to enter the affected dist to supply the demand.</p> | | |
| Bolikhamsay | <p>Already implemented in the province: letter of prohibition from district sent to villages but no officers are sent on the field to implement or control that prohibition. The usual checkpoints of agriculture and police are implementing the control.</p> <p>But the traders are informed of the prohibition only when they arrive in the village or sometimes they are informed by their contact persons located in villages. They trust their contact persons for informing them about such temporary regulations, about diseases occurring.</p> | | |
| Khammuane | <p>It is implemented in case of outbreaks generating high mortality rate.</p> <p>Letter of prohibition from district level is sent to villages and to traders groups and big traders. The letters are delivered by officers.</p> | | |
| Savannakhet | <p>Difficult to implement:</p> | | <p>The traders are informed about</p> |

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|----------|--|--|---|
| | Letter of prohibition is sent by district level No control implemented on the field. There is still people going to buy. | | prohibition areas by the village cluster administration when they phone them. |
| Saravane | Cf point2 | | |

CONCLUSION for the measure 8

In most of the provinces, people said that the prohibition of movements in areas affected by animal diseases outbreaks is actually implemented. In fact the prohibition is effectively declared by district governor and letters sent generally to village heads only. But generally there is no special enforcement or control of the movements done on the field. Some traders declared that they cannot stop by themselves trading from such areas because the profit that can be done from suspected animals is too attractive for them. A strong control must be implemented. In other provinces where the only destination of the animals is the local slaughterhouse with a strong control implemented at the slaughterhouse by officers plus a high sensitivity of the consumers about animals' disease outbreaks and food safety, the traders generally seem to follow the prohibition.

The enforcement and controls of the prohibition of movements by the local authorities depend on the perception by the authorities of the problems due to the disease. Generally strong controls and enforcement is implemented on the field for high mortality rate outbreaks (HS, etc.) and not for long lasting disease with small mortality rate as FMD.

The long distance traders generally don't buy animals from outbreaks areas.

3.3.9. Measure 9

Certification of traders (good trade practices)

- Special storage zone totally isolated from local herds
- Cleaning and disinfection of trucks after each animals transportation
- Quarantine of the animals for 15 days without any contact with other trade animals or local animals before introducing the animals to local herds for fattening or raising purpose

Purpose of the measure:

- Reduces diseases' introduction to local herds of traders' villages

Discussions results

| Province | Realism | Impact | Comments |
|---------------|--|---|----------|
| Luang Prabang | <p>If special areas of storage provided by authorities this could be done. Otherwise they cannot afford to buy some. Before they used a special area around the SH.</p> <p>The idea of delivering license only if biosecurity measures followed can be done only if areas provided by government</p> | | |
| Sayabuli | <p>Difficult even impossible because no area isolated from local herds available for each of them</p> <p>For disinfection, the service must be available</p> | | |
| Xieng Khouang | <p>No possible because they have no fenced pasture area to store the animals isolated from local herds</p> <p>Can be done for pigs because they trade only for slaughtering and the pigs are moved straight away to the SH.</p> | | |
| Huaphan | <p>Could be done if forced by regulations (according to PAFO chief)</p> <p>Very difficult (traders)</p> | <p>Traders cannot follow that biosecurity measures because they have no funds available for investment in separated land area , disinfection (very low profit for this activity for them)</p> <p>Could be done only if land and disinfection is provided to them for free</p> | |
| Oudomxay | <p>Already discussed during previous points</p> | | |
| Luang Namtha | <p>It could be done only if area for storage and area for quarantine</p> | | |

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| | provided by local authorities | | |
| Bokeo | Difficult to implement: the traders cannot follow all the criteria Maybe implementable if very strong enforcement with license deliverance | Quarantine criteria are too difficult to achieve for individual trader: no special area available to do so. | |
| Bolikhamsay | Very difficult for the traders to follow the rules for that kind of certification Not possible for individual trader but could be done if a land for isolating the trade animals is provided by the authorities. | The profit for traders is already small. They cannot bear additional costs as disposing at individual level of a fenced land for storage. If they would use a fenced land provided by the authorities for isolating the trade animals, the costs for using it must be bearable. | No fattening practices by traders |
| Khammuane | Could be done | They could follow the criteria for certification | |
| Savannakhet | Would be possible only if a special storage area and cleaning facilities provided by authorities | | |
| Saravane | Could be done | | |

CONCLUSION for the measure 9

When the traders need to store the animals for some times before selling them out, the certification of traders according to the good trade practices listed cannot be applied. The traders who buy and move straight away the animals to their final destination declare to be able to follow those rules if cleaning/disinfecting service provided at delivery point.

The certification of the traders could be linked to the license deliverance.

3.3.10. Measure 10

Implementation of good biosecurity measures at village and farm levels:

- Cleaning and disinfection of traders trucks before entering the village/farm

- Quarantine of the animals for 15 days without any contact with other animals before introducing the animals to local herds
- Disinfection of the materials used with quarantined animal

Purpose of the measure:

- Reduces diseases' spread

Discussions results

| Province | Realism | Impact | Comments |
|---------------|---|--|----------|
| Luang Prabang | Very difficult to implement at village. Could be possible at big farms level. | | |
| Sayabuli | More possible for a village than for an individual trader Quarantine is already implemented in some pig farms but not at village level in Sayabuli province Need of awareness campaigns and small project to start by training etc. Otherwise very difficult to start at village level without | | |
| Xieng Khouang | Easier to implement at village but strong support is necessary to establish such practices. | | |
| Huaphan | Difficult to do because of traditional behaviour | No village do quarantine in the province at the moment | |
| Oudomxay | May be difficult to implement at village but it is already done at big farm level (pig farms) Could be done at village only if strong enforcement, support by awareness campaigns, training, etc. Traditional behaviour can be changed: example before pigs were raised by free ranging system, now some villages raise pigs in pens. | | |
| Luang Namtha | Difficult to implement at village level Would need strong support by project help for information-awareness campaign, providing materials | | |

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| | and organising at the village. | | |
| Bokeo | For the farm, this is possible It is more difficult at village level. | | |
| Bolikhambay | Can be done at big farm level. Could be done at village level but the villagers won't do it by themselves, it must be enforced by regulations and controls | | |
| Khammuane | Not really possible Cannot avoid the risky trucks entering the village Isolation of introduced animals not possible | | |
| Savannakhet | Difficult to implement Villagers not scared by animal diseases Too many people must agree and organised together. | | |
| Saravane | It would be possible for villages located in the countryside because there is land available to organised a quarantine, but not for villages located in urban areas. Difficult because the villagers don't really care about animal diseases introduction risks for the moment. | | |

CONCLUSION for the measure 10

The awareness of the villagers on the risks of animal diseases introduction through the movements of animals seems to be quite low. Or at least it is not consider as important. The implementation of such measure at village level could be done in terms of organisation and availability of the place for storage but this would require a high willingness of the villagers and the village authorities to be done. According to the traders and officers, the concern about risks of animals' disease introduction within village is very low and so the implementation of such measure would require strong awareness campaigns and trainings for villagers.

These measures could more easily be implemented at pig farm level. It is already done at some extends. Awareness campaigns seem to be necessary to enforce the understanding of the diseases introduction risks at pig farms level (especially due to the movements of trucks).

3.3.11. Measure 11

Legalization of the informal existing animals movements: facilitation of the formal procedure if following good practices

Purpose of the measure:

- Reduces time of storage
- Improvement of the storage conditions in terms of isolation from local herds
- Reduction of the risks of diseases' introduction by fastening the trade and by checking the animals by officers

Discussions results

| Province | Realism | Impact | Comments |
|---------------|---|---|--|
| Luang Prabang | Up to officers . If they are strict and transparent | | Difficult to answer because there is no borders with other countries in LP prov. |
| Sayabuli | <p>Could be done but need politic enforcement</p> <p>Official quota of importation of CB have been distributed: so the movements are mainly formal now. The big trader from Phonehong (Mr Oudom) got quotas for supplying VTE at the seagames but he still ahs quota to use now and at least three local traders of the province got quota too: each imports around 300 heads per month from Thailand mainly for supplying VTE.</p> | Could be good for traders | Would like when they have pay the import tax not to pay other taxes for moving the animals out of the province |
| Xieng Khouang | Already implemented at some extends in the province: new fees for moving animals have been implemented. The fees and taxes for exportation is now the same than for moving animals between district and more bearable by the traders than the export taxes and fees existing before. | <p>Impact of the fees and taxes implemented presently:</p> <p>Bad impacts for the traders that trade between districts but not for exportation: the amount of fees is the same that for exportation but they make less profit already per head than trade for export: would like a difference of fees and taxes</p> | |

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|--------------|--|---|--|
| | | <p>between the 2 kind of trade.</p> <p>Bad impact due to the duration of the movement permit: only 3 to 5 days, they applied for it at the origin of the animals (so at the purchase time) but if they cannot sell the animals in such short period, they need to repay everything again to move the animals out.</p> | |
| Huaphan | Very difficult to legalize the informal movement to Vietnam existing in the province: political reluctance | | If caught people trading illegally: 1 st time they charge 30% of the animal value, 2 nd time they charge 50% and 3 rd time they keep the animal |
| Oudomxay | | Could be good for trade if can be done | Not concerned by informal movement |
| Luang Namtha | | | No idea- no concerned by this situation in this province |
| Bokeo | Already achieve by the allowance of transit from Thailand to China (direct transit) | | |
| Bolikhamxay | | Would be good for traders | Costs of informal importation? No idea but the maximum amount charge by village head for trading a head of CB is around 200 Bath |
| Khammuane | | Problem of the costs of legal importation: taxes and fees for import | |

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|-------------|--|-----------|---|
| Savannakhet | Problem of conflict with the policy position about protecting the local production by prohibiting the importations. Conflict of interests between traders/farmers | Idea good | Now production is not enough for the demand |
| Saravane | | | Presently they think that there are no informal movements. The prices in Thailand are not interesting for both pigs and CB. |

CONCLUSION for the measure 11

The measure is seen as a good one by the traders in general when they are concerned by informal movements. The costs of official taxes and fees collected after legalization must be quite similar to the costs of informal movements. This measure has been already implemented in some provinces since last year: Bokeo, Sayabuli.

The measure could be very difficult to be implemented when the informal movement legalization is contradictory with the politic view of the production and trade of the area concerned: generally protection of the local production or protection of the local sufficiency.

3.3.12. Measure 12

Quarantine of the animals imported from or exported to other countries at border area: batch of animals quarantined with no risk of contact with other batches for 15 days

Purpose of the measure:

- Reduction of risks of movement of infective animals

Discussions results

| Province | Realism | Impact | Comments |
|---------------|-----------|---|--------------|
| Luang Prabang | No answer | | Notconcerned |
| Sayabuli | Could be | Loss of weight during the quarantine period | |

| | | | |
|---------------|---------------------------------------|--|--|
| | implemented | <p>Fees to be paid per day of quarantine for the service (food etc.)</p> <p>Presently the duration between purchase and selling is around 1 week.</p> <p>They use their own money for trading in general.</p> <p>If they borrow: from bank interests rate for credit=15% per year, if from other traders: 3% per month.</p> | |
| Xieng Khouang | | <p>Costs:</p> <p>Direct expenditure (food, vaccination, testing, etc.)</p> <p>Weight loss: estimated at 1 kg of meat yield per day because the animals don't like their environment changes, so they usually don't eat well during quarantine</p> <p>Cost due to delay: actually the traders trading to Vietnam generally trade 2 batches of animals per month (2 weeks between the moment they go to find animal and the moment they sold all the animals) so if the quarantine implemented, the time to trade one batch could be extended to 1 month, so the profit per month divided per two.</p> | |
| Huaphan | | <p>Sometimes traders borrow money for buying animals, the rate interest is around 2.5 % per month</p> <p>In average between the moment the animal are purchased and the moment they move to Vietnam, the duration is less than 2 or 3 days (collection of animals during one or two days and then move animals)</p> | |
| Oudomxay | | <p>Traders never borrow money for their trade activity</p> <p>Cost of storage at the slaughterhouse: 2000LAK/day for CB</p> <p>2 to 3000LAK/day for pigs (food costs)</p> | |
| Luang Namtha | Not possible because of the costs for | At present time: duration between buying and selling is around 3 days or less. A quarantine would increase that duration to 18 days. So potentially it would reduces the trade activity per | |

| | | | |
|-------------|--|---|--|
| | traders | <p>6 times.</p> <p>Plus there would be the costs of expenditure per day at the quarantine for feeding the animals.</p> <p>Plus there would be the diminution of value of the animals during quarantine duration: estimated to 20kg of meat yield for an animal of a initially meat yield of 100kg, according to the traders.</p> | |
| Bokeo | | <p>Officers: would be good idea</p> <p>Traders: nobody would want to do it.</p> <p>If animals going to China are stopped in a quarantine station for 15 days this will increase the risks of spreading disease and also animals are more likely to be stolen or trade for supplying the local demand which means more risks of diseases introduction.</p> | |
| Bolikhamxay | If importation allowed maybe it could be done. | <p>Weight losses expected: unknown</p> <p>They can borrow money for trading: annual term credit from Bank: 14% per year</p> <p>Short term credit from villages funds: 5% per month</p> | |
| Khammuane | | <p>Loss of weight: depends on the origin of the animals (what kind of food they received before)</p> <p>Cannot estimated the costs due to delaying the trade</p> | <p>Average profit:</p> <p>CB: 100 000LAK/head</p> <p>Pig: 100Bath/head</p> |
| Savannakhet | | <p>Not good.</p> <p>Actual average duration between the moment they start to find the animals and the moment they sell them (to VTE or Vietnamese): around 2 weeks.</p> <p>Implementing quarantine will increase the trade time of 100%.</p> | |
| Saravane | | <p>Before when they imported CB from Thailand, they stored the animals for 1 week (duration for proceeding the documentation). So keeping them</p> | |

| | | | |
|--|--|--|--|
| | | one extra week wouldn't impact a lot the trade. If prices interesting and quarantine must be done, they would do it. | |
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CONCLUSION for the measure 12

The measure is generally considered as bad by traders because of the costs generated and also because of some potential risks (cf. in Bokeo for the animals transiting from Thailand to China: worries about the potential sell out of the animals in quarantine for the local market). The traders of long distance trading continuously animals, batch after batch would be quite impacted by such measure that would delay the trade time per batch. The traders importing animals not continuously but from time to time would be less impacted.

The costs for traders generated by quarantine implementation would be:

| Costs | Amount | total |
|--|---|--|
| Costs charged for storage, feeding, vaccination, etc. (estimated by the costs charged in Thai quarantine station in Thai border) | 100 Bath/day 15 days | 1 500 Bath (around 40 USD) |
| Weight loss | Could be 20 kg of meat yield for an high breed animal of initially 100kg of meat yield | Up to 20% of the animal value |
| Cost due to delay because of interests for money borrowed | If money borrowed: Rate interest=5% per month =0.16% per day 15 days | 2.5 % of the animal value |
| Costs due to delay because of augmentation of the time for trading one batch of animals | Normal trade length is from 3 days up to 2 weeks. Extend of 15 days: Augmentation of 2 to 5 times of the length | Diminution of 50 to 80% of the number of animals that can be trade per month by a trader |

These costs are not bearable by the traders.

3.3.13. Measure 13

Only trade of vaccinated and identified animals: vaccinated against CSF and HS if from Lao PDR, and against also FMD if from Thailand, Vietnam or China

Purpose of the measure:

- Reduces risks of trading infective animals

Discussions results

| Province | Realism | Impact | Comments |
|---------------|--|---|----------|
| Luang Prabang | Depends on who allow to move the animals But not realistic for the moment (not enough animals vaccinated & identified) False certificate of vaccination would be used. | Only 20% of the animals within the prov are vaccinated. The measures would reduce too much the sources to be implemented. | |
| Sayabuli | | Only 25% of the animals are vaccinated in the province This will decrease too much the sources of local supply. | |
| Xieng Khouang | Not possible: no animals identified in the province Difficult to find vaccinated animals (this would create false vaccination certification). | Only less than 20% of the animals are vaccinated within the province: very difficult to find vaccinated animals | |
| Huaphan | Not possible | Only less than 20% of the animals are vaccinated in the province | |
| Oudomxay | not possible cannot know if animal vaccinated | Only 25% of animals are vaccinated within the province with big difference between areas (more vaccination around the town) | |
| Luang Namtha | Could be done only if 100% of | At present time the rate of | |

| | | | |
|-------------|--|---|---|
| | the animals vaccinated. | vaccination is around 30% in the province (CB & Pigs) | |
| Bokeo | <p>People laugh at this proposition.</p> <p>Not possible for animals from lao PDR</p> <p>Maybe possible for animals coming from other countries</p> | <p>The vaccination rate in Bokeo province is around 60% of CB (because a lot of projects working on that)</p> <p>For pigs: exotic breeds in farms: most of them vaccinated but local breed pigs very few vaccinated</p> | |
| Bolikhamxay | <p>Difficult: in a lot of villages the animals that have just been vaccinated are not allowed by the village authorities to be sold during 2 months because they would be a risk for consumers: this may be a misunderstanding of the information provided by VVW or vet officers about the time before the effectiveness of the vaccine and about the delay after AB treatment before slaughtering.</p> | | <p>Axelle comment: this could explain why the farmers were reluctant to vaccinate for cheap price their animals against FMD in the zones affected already by the disease.</p> |
| Khammuane | <p>Could be done for the vaccination criteria for pigs coming from pig farms (all vaccinated)</p> <p>Not possible for CB because very difficult to find vaccinated CB.</p> | | |
| Savannakhet | | <p>For the moment, they never care about the vaccination status of the animals they trade</p> | <p>Vaccination campaigns are organised but not all the animals are vaccinated. For pigs in farms, nearly 100% vaccinated. Pigs from smallholders : low rate of vaccination.</p> |

| | | | |
|----------|--------------|--|--|
| Saravane | Not possible | Only 40% of the animals vaccinated within the district. They don't care about animal vaccination status for trading them. | |
|----------|--------------|--|--|

CONCLUSION for the measure 13

In general, the traders don't care about the vaccination status of the animals they trade. In Bolikhamxay province, in some villages, the vaccination even limits the possibility of trade. Implementation of such measures is not possible for the Lao animals because the rates of vaccinations are in general around 20% so the sources would be too much reduced. An exception is the situation in the pig farms where generally the animals are vaccinated (at least against CSF). Such implementation would just create the production of 'vaccination certificates, at village level so create a new fee for traders or farmers.

3.3.14. Measure 14

This measure has been presented and discussed only in the two last provinces visited.

Legalization of the fees collected at the Agricultural checkpoints: would be a fixed amount per vehicle with a bill like for road fees

Purpose of the measure:

- Diminution of the stop time per checkpoint
- Diminution of the length of transportation
- Diminution of the unofficial fees collected
- Augmentation of the official fees collected that can be devoted to promoting trade or animal production

Discussions results

| Province | Realism | Impact | Comments |
|-------------|---------|--|----------|
| Savannakhet | | Very good if it is official (with bill) and the amount fixed like for road fees. | |
| Saravane | | Would be good because they have to pay at every checkpoints along the road to Vientiane. | |

3.4 Needs about diseases information

In most of the provinces, the traders were interested in receiving more information on animal diseases. They even asked for training courses. They also pointed out the fact that the villagers/farmers need some too. The interest of traders is emphasized when there is strong enforcement to detect sick animals or at the meat inspection in the local slaughterhouse because in these cases they tried to avoid buying animals which carcass could be destroyed by officers.

In some provinces the traders declared they don't need more information about disease but if information material available they would like to get it (Luang Prabang, Bokeo, Saravane).

The information material preferred is a small booklet with only technical information presented very simply and illustrated with a lot of pictures.

4 Conclusion

Some interesting initiatives facilitating the animal trade and in the same time reducing the risks associated with it already are implemented or are going to be implemented in some provinces concerned by importation or transit of animals from Neighbouring countries: legalization of existing movements, fasten importation, transit, facilitation of the documentation procedures, isolation of the animals imported before being sold, etc.

These initiatives must be followed up by the project and evaluated in terms of impact for the trade and for the disease control. These experiences must be specifically shared, discussed with the other provinces. The project could support DLF for organising such exchanges.

Some basic measures for preventing animal disease spread still need to be pushed for implementation. This concerns especially the cleaning and disinfection of the traders trucks after animals' delivery. This must be implemented at every slaughterhouse and also at the border gate when the animals are downloaded. This could be quite simple to implement if the local authorities are more concerned by such problems. The water supply facilities still need to be improved in a lot of slaughterhouse. The risks due to the trucks are not sufficiently understood and quantify.

The improvement of the management and the use of the slaughterhouses is necessary and could play an important role in reducing the animal diseases' spread risks at the local scale: proper cleaning and disinfection of the trucks after delivery, isolated areas of storage for the animals destined to be slaughtered (isolation from local herds), proper waste management.

The quarantine of animals coming from or to other country seems to be not possible to be properly implemented. In many cases, the quarantine stations are more often a continuous system where the animals of different batches are mixed, and the storage duration too short to detect the incubative animals. In such cases, quarantine increases the risks of diseases spread. According to the discussion conducted with the traders, proper quarantine represents an unbearable cost for most of them. The actual position of the regional countries seems to go in the same direction. The quarantine at Thai border is already cancelled for the animals with health and vaccination certificates.

The most realistic measures that can reduce the risks of diseases spread are presently the measures that fasten as much as possible the movement of the animals from their origin location to their final destination which is mainly slaughtering for the meat demand wherever it is in Lao PDR, Vietnam or China. So reducing as much as possible the stops and storage during movements by allowing all internal movements, the importation and the transit through official ways, by fastening the documentation procedure seems to be an effective and realistic approach. This could be even improved by a competent, conscientious and systematic check of the animals by officers.

Awareness about the risks of spread and introduction of animal diseases and about prevention measures is strongly necessary for farmers and even for traders, slaughterhouses managers and local authorities. This seems to be an imperative first step before trying to implement any bio security measures at any level.

Appendix 12. Non-regulatory interventions to reduce risk of disease spread

Biosecurity education for traders to reduce the spread of animal diseases in Lao PDR and Cambodia

James Kerr, Malcolm Anderson, Phouth Inthavong, Kate Blaszak, Axelle Scoizec and Socheat Sieng

Abstract

When designing ACIAR Project AH/2006/025: *Understanding livestock movement and the risk of spread of transboundary animal diseases*, the project partners recognised that regulation alone had limited potential for controlling transboundary diseases in the Greater Mekong Sub-region (GMS). Consequently, the project aimed to investigate novel non-regulatory methods of reducing the disease risk associated with livestock movements. Throughout 2008 and 2009 the project conducted meetings and interviews with livestock traders throughout Cambodia and Lao PDR. Whilst this research identified a number of trading practices that carried a high risk of spreading disease, it also suggested that many traders were keen to receive education about prevention of disease spread. Consequently, early in 2010 the project began the development and trial of educational materials aimed at improving the biosecurity practised by livestock traders in these two countries. Traders requested that information about prevention of animal diseases be presented in a colour booklet with plenty of pictures and a minimum of text. In order to expand the audience to include those with limited literacy, it was decided to produce a digital story in addition to the booklet, as digital stories deliver their message by spoken word commentary accompanying video or DVD images. This technology had been developed and trialled with Lao PDR villagers by ACIAR Project ASEM/2005/125: *Extension Approaches for scaling out livestock production in Northern Lao PDR (EASLP)*, and represented a cheap and accessible source of information that could be easily distributed throughout Lao PDR and Cambodia. English (template), Lao and Khmer language versions of the booklet and digital story were trialled in 2010 and further refined during 2011 and 2012. The disease prevention message has been distilled into a '5-step' approach to biosecurity for traders to routinely apply on all buying trips. This simple '5-step' message also proved suitable to feature on posters and leaflets, which have consequently been produced for distribution in Laos and Cambodia.

Introduction

Transboundary animal diseases including foot-and-mouth disease (FMD) and Classical Swine Fever (CSF) cause significant losses in Southeast Asia. These diseases cross national borders and spread to new areas primarily through livestock movements. Lao PDR and Cambodia feature prominently in regional animal movement pathways and livestock trading networks involving China, Vietnam, Myanmar, Thailand and Malaysia. The long, shared borders allow easy unofficial passage for animals, making livestock disease control a challenging regional

issue. In order to support regional efforts to reduce the spread of transboundary diseases in the Greater Mekong Sub-region, an ACIAR project was initiated in 2006 to '*understand livestock movement and the risk of spread of transboundary animal diseases*' (ACIAR Project AH/2006/025).

Aim

The objective was to understand the drivers of livestock movement patterns to enable the development of strategies to reduce the risk of regional disease spread.

Methods

Meetings and interviews with livestock traders were conducted in most provinces of Lao PDR and Cambodia during 2008 and 2009 to understand the drivers, networks, practices, pathways and impediments that determine trade patterns within these countries and across their borders. In Cambodia, trader information was collected by questionnaire in confidential one-on-one interviews from which department officials were excluded. In Lao PDR, trader information was obtained using a less rigid checklist approach, with Department of Livestock and Fisheries (DLF) staff present as translators. The Cambodian questionnaire, in particular, specifically sought sociological information about traders, as well as assessing their understanding, recognition and attitude towards several important livestock diseases.

After analysing the information gathered from livestock traders, a nation-wide series of feedback meetings was conducted for traders and other stakeholders throughout each country early in 2010 to present our research findings and canvass trader opinion about possible measures to reduce the risk of disease spread associated with livestock trading. Educational materials designed to teach traders how to prevent disease spread (biosecurity) were subsequently produced in Lao PDR and trialled with trader focus groups in Xieng Khouang province during mid-2010. The Australian and Lao PDR staff from ACIAR Project ASEM/2005/125: *Extension Approaches for scaling out livestock production in Northern Lao PDR (EASLP)* greatly assisted by training our own project staff in digital story making and guiding the production of the initial version. Feedback about the draft educational materials was also sought from project partners at a project meeting in Siem Reap in August 2010, and from DLF representatives of all Lao PDR provinces in September 2010. Ongoing trial and feedback-driven refinement of these materials continued during 2011 and 2012, with large numbers of the Cambodian versions printed for distribution by ACIAR Project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia*.

Research Outputs

Project research during 2008 and 2009 identified a number of trading practices that carried a high risk of spreading disease, including the common and profitable practice of buying FMD-affected livestock at discounted prices during times of disease outbreak. Fortunately, many traders were keen to receive education about disease epidemiology and biosecurity (i.e. how disease spreads, and how to prevent it spreading). Consequently, the project

decided to develop and trial educational materials aimed at improving the biosecurity practised by livestock traders in these two countries. These activities were conducted in collaboration with the project's partners in South-East Asia, the Lao PDR Department of Livestock and Fisheries (DLF) and Cambodian Department of Animal Health and Production (DAHP).

Biosecurity education for traders

The project began developing trader educational materials in mid-2010, using feedback collected from Lao PDR traders in 2009 and early 2010. Traders requested an information booklet that featured plenty of pictures and excluded all unnecessary and technical information. It was determined that the most effective way to teach traders about the biosecurity measures that they should apply in the course of their work was to structure the biosecurity message in a step-by-step format which followed a typical buying trip.

Step 1 Before you go

Step 2 On arrival at the village/farm

Step 3 Before buying animals (inspecting animals and questioning owners)

Step 4 When moving between farms and villages

Step 5 When you return home

It was decided to develop a digital story in addition to the requested booklet, as a digital story had the advantage that it could deliver the educational message by spoken word to illiterate traders (and other villagers), and could be produced (and modified, if necessary) much more cheaply than a colour booklet. It was considered that a reasonable proportion of the target audience would have access to a VCD player, which is required to view digital stories.

This research had also determined that many traders and farmers were far more interested in learning about prevention of haemorrhagic septicaemia (HS) than prevention of FMD, because HS is often fatal, whereas FMD is not. Consequently, information about HS prevention was included in the biosecurity materials as a 'hook' to create audience interest, with the overall biosecurity message designed to teach a standard approach which should routinely be applied by traders on a daily basis. In order to have any hope of trader adoption, the biosecurity measures proposed needed to be simple, easy, low- or no-cost, and have an appreciable benefit to traders. The decision to advocate a generic approach to biosecurity was based on the following considerations:

- Traders (and others) needed to understand that biosecurity precautions should always be applied, not just when HS, FMD or similar are suspected.
- Traders can not be expected to possess a diagnostic knowledge of numerous diseases and an associated understanding of when biosecurity is more or less important.
- Traders can not always expect to know when they will encounter diseased animals during their work, so always need to be prepared.

- Even a well-trained trader will be unable to detect an incubating or convalescing (but infectious) case of disease.

Project research also suggested that separate, but similar, educational materials needed to be developed for traders dealing in different species of livestock. Pig traders buy, transport and sell their animals in a fashion that differs from the operations of those dealing in cattle and buffalo, and will consequently require biosecurity educational materials specific to their needs.

The project elected to develop prototype materials for cattle/buffalo traders in Lao PDR and Cambodia as our first initiative because our research had also highlighted the particularly high risk of transboundary disease spread that these traders represent within the GMS, particularly with respect to FMD. The following features of the cattle and buffalo trade in these countries contribute significantly to the regional disease risk:

- FMD and other livestock diseases are endemic within Cambodia and Lao PDR, where application of control strategies such as vaccination and movement control is limited or absent.
- Cambodia and Lao PDR are exporters of cattle and buffalo to neighbouring countries, as well as acting as transit pathways for ruminants travelling from Myanmar and Thailand to Vietnam and China.
- The transboundary trade routes for cattle and buffalo in Cambodia and Lao PDR feature rapid, long-distance road transport of livestock, preceded and followed by mixing of consignments from different origins in export depots, on trucks, and in the process of walking/swimming these animals across the 'green' borders with neighbouring countries.

A booklet and digital story were developed and trialled with Lao PDR cattle/buffalo traders and with provincial animal health staff in the second half of 2010. These materials were refined in 2011 after consideration of audience feedback. The project team in Cambodia also received training in digital story making from ACIAR Project ASEM/2005/125 during 2010, and subsequently collaborated with the Lao PDR project staff during 2011 to develop equivalent Khmer-language biosecurity materials for Cambodian traders using the same '5-step approach'.

Biosecurity education for village-level animal health workers

When first planning to develop biosecurity educational materials for livestock traders early in 2010, the project conducted a review of existing animal health publications in Cambodia and Lao PDR. This review included an assessment of the field manuals available for the village-based para-veterinary workers known as Village Veterinary Workers (VVs) in Lao PDR and Village Animal Health Workers (VAHWs) in Cambodia. This research identified that these publications contained inadequate advice about the biosecurity precautions that VVs and VAHWs should take when sampling and treating sick livestock, meaning that these frontline animal health workers represented a clear risk of spreading of animal diseases within and between villages in the course of their work. An opportunistic case study

undertaken by the project during the widespread FMD outbreak that occurred throughout Cambodia during the second half of 2010 provided further support for the proposition that VAHWs play an unintentional role in spreading disease during outbreaks (see Appendix 11)

The project consequently developed biosecurity training materials for VAHWs in Cambodia and VVWs in Lao PDR during 2011-2012, again in the form of a simple colour booklet with a digital story included in a pouch inside the back cover. In addition to planned distribution among their specific target audience (VVWs and VAHWs), village-level feedback suggests that café and restaurant owners will be happy to play these digital stories as background entertainment for their patrons.

Discussion

Feedback from DLF and PAFO (Provincial Agriculture and Forestry Office) staff in Lao PDR in late 2010 indicated that they believed non-regulatory methods alone would be unlikely to change trader behaviour, and needed to be combined with a legislative approach. This sentiment seems particularly valid in the case of those livestock traders who presently view FMD-affected livestock as an opportunity for greater-than-normal profit (45 % of Cambodian traders interviewed admitted to trading in FMD-affected livestock). However, the DLF and PAFO staff nevertheless agreed that development of simple biosecurity educational materials for traders would be a useful initiative which should be broadened in scope to create similar materials for other participants in the livestock market chain, including farmers and slaughterhouse operators.

ACIAR Project ASEM/2005/125: *Extension Approaches for scaling out livestock production in Northern Lao PDR (EASLP)* found that digital stories should be short and simple to effectively deliver a message to low literacy audiences. This limitation is a useful restraint for those creating educational materials, and echoes the feedback from traders and departmental staff that educational materials should contain plenty of pictures and eliminate all technical information. Specific challenges confronting biosecurity education as a means of changing behaviour include the following;

1. Identifying appreciable benefits for those being advised to changed their behaviour

The greatest obstacle that we have faced, and not satisfactorily surmounted, is the lack of convincing reasons why traders, farmers and others should make an effort to prevent livestock diseases, particularly FMD. Whilst the literature features numerous studies purporting to demonstrate the benefits associated with FMD control and eradication, smallholder attitudes may still reflect the 1997 FAO finding that in Cambodia and Lao PDR 'the financial effects of FMD in low productivity systems are small and the benefits of control are less than the cost of vaccination' (FAO, 1997). FMD, in particular, appears not to be viewed as a terribly serious disease by many farmers, traders and officials because it is generally not fatal. Disruption to draught power at times of rice cultivation is generally felt by smallholders to be its most serious consequence, although discounted sale prices during outbreaks can certainly represent a financial loss for affected farmers. In general, biosecurity measures to prevent FMD might be difficult to sell to many farmers and local-level traders, who requested instead that we provide information about protecting against HS. We

consequently attempted to tie the biosecurity message for cattle/buffalo traders to prevention of HS rather than FMD alone.

As noted earlier, some livestock traders reportedly made their greatest profits by buying and selling infected animals during FMD outbreaks. It may consequently seem that traders would resist educational initiatives aimed at preventing FMD outbreaks as an attack on their income. However, our research also suggested that trader attitude to FMD varied according to the level at which they operated, as did their interest in our biosecurity message. The traders who profit from buying and selling diseased animals tend to be local-level operators, with most of the affected livestock destined for prompt local slaughter. This group of traders is important in the spread of FMD within and between villages, and requires biosecurity training aimed at their particular operating environment. Because a change in their high-risk trading practices would represent greater benefits to their community than to themselves, it may require disease and biosecurity education of the other members of their communities to achieve that change by means of community pressure.

Whilst such a community educational task would be a considerable undertaking if attempted on even a district scale, it may be feasible to educate influential community members such as village Chiefs and Headmen to drive such a change. Censure of traders who trade in diseased livestock would be an inappropriate and counterproductive strategy, given that purchase of these animals for slaughter will continue to be an important salvage option/service required by farmers. Educational initiatives aimed at these traders and their communities should attempt to modify trading practices so that sale of diseased livestock for slaughter can contribute to disease control rather than disease spread.

As opposed to local-level traders, traders who deal in long-distance inter-provincial and especially international livestock trade are anxious to avoid disease within their consignments, as disease results in price discounting and delayed or cancelled transactions. Traders operating at this level are influential participants in the transboundary market chains and the associated risk pathways for diseases including FMD. Their feedback suggests that biosecurity education will be a welcome initiative.

This finding highlights the importance of the project's research that demonstrated that traders are not a homogeneous group with identical interests. We succeeded in identifying within their ranks a group for whom biosecurity education held considerable benefits.

Another approach to the challenge of achieving biosecurity benefits for the livestock industry is to find ways in which biosecurity improvements can be obtained from initiatives aimed at delivering other outcomes. For instance, *ACIAR Project AH/2003/008: Improved feeding systems for more efficient beef cattle production in Cambodia* encourages farmers to grow forage crops at home, allowing animals to be housed in pens and fed cut-grass from these forage plots. In addition to the desired weight-gain benefits, pen-feeding production systems offer distinct biosecurity advantages over the communal grazing systems that are otherwise the norm in Cambodia and Lao PDR. Communal grazing and watering of livestock ensures maintenance of parasitic diseases such as liver fluke, and encourages rapid disease spread within and between villages during outbreaks of FMD. Interestingly, even the appreciable production advantages offered by pen-feeding systems are of secondary

importance to some farmer converts, for whom the labour-saving benefits have been the most highly valued outcome. Time previously spent cutting grass in distant locations or managing livestock in communal grazing areas is now available for farmers to pursue other income-generating activities, and for children to attend school.

2. Identifying biosecurity measures which are simple, practical, and no- or low-cost

For livestock traders operating with very low profit margins, it is vital to promote biosecurity initiatives that are genuinely feasible for them to apply. As soon as the biosecurity suggestions become onerous or unrealistic in terms of time, labour or cost, the audience will become disenchanted. The same imperative should guide the creation of future educational materials for farmers, VVWs/VAHWs and others. For instance, whilst our biosecurity stories advocate that traders should preferentially buy livestock that have recently been vaccinated against important livestock diseases including FMD, HS and CSF, the very low rates of vaccination in Cambodia and Laos mean that it would presently be very difficult for most traders to do so.

It is also important to note that well-intentioned 'biosecurity' measures don't inadvertently increase the disease risk that they are intended to reduce. For instance, washing and disinfecting trucks may well be ideal practice after transporting livestock, especially if the consignment included diseased animals. However, whilst our research suggested that wash-down of trucks that have been used for carrying livestock in Cambodia and Lao PDR is reasonably common, especially if the truck is subsequently required to carry a non-livestock cargo, we could find no evidence that disinfectants were ever used in the process. Disinfectants, after all, cost money and can be corrosive. Consequently, washing trucks may inadvertently create a greater risk of vehicle contamination by creating an infectious slurry puddle of run-off, which is far more likely to subsequently stick to the tyres and undercarriage of the washed vehicle and all other vehicles that subsequently pass through that area.

Rather than promoting unrealistic western images of people clad in rubber boots and overalls performing high-pressure wash-down of trucks, our trader education message concentrates on advising traders to ***avoid*** the arduous process of vehicle decontamination by taking the simple biosecurity measure of parking outside farms until disease checks have been performed on the prospective purchase stock.

It is also important to emphasise to our audience that in tropical environments close contact between animals is the main method of spread of FMD, HS and CSF, meaning that biosecurity measures to keep infected and uninfected animals separate are far more important than efforts to clean every inch of a truck. Given that the disease-causing agents for FMD, CSF and HS dislike desiccation and exposure to sunlight, a no-cost biosecurity measure that we have suggested is merely to park the stock-carrying part of the truck in the sun when the truck is not in use.

It is recognised that some traders will continue to intentionally trade in FMD-affected cattle and buffalo, which they often store at their own home prior to slaughter or re-sale. As most traders possess household livestock of their own and are obviously well aware of the

reduced value associated with FMD infection, our intention is to at least help them avoid infection of their own livestock (and those in their home village) by describing sensible separation distances and precautions to take between handling infected and uninfected animals. We will also continue to suggest to national and regional disease control strategists that primary targets for strategic allocation of FMD vaccine supplies aimed at risk-reduction should include the livestock owned by traders and VVWs/VAHWs, whose work with sick livestock provides their own livestock with a high risk of infection and of becoming a source for further disease spread throughout the village and beyond.

3. Measuring whether the biosecurity message has been understood, and whether it has succeeded in changing high risk trading behaviours

ACIAR Project AH/2006/025 has laid the groundwork for this risk-reduction intervention to be carried on by ACIAR Project AH/2010/046: *Domestic and international market development for high-value cattle and beef in South East Cambodia*. Continued field research with depot operators occurred in the second half of 2011 with that specific intention. The ongoing development, trial and printing of biosecurity educational materials and guidelines for livestock traders and VAHWs during the first half of 2012 in a no-cost project extension was intended to ensure that these initiatives do not falter before ACIAR Project AH/2010/046 begins. These biosecurity education initiatives will then be further developed and expanded for a broader audience, which will include Cambodian farmers.

Conclusion

The creation and distribution of educational materials about livestock diseases and biosecurity remains a worthwhile research and development activity. It will help those individuals in the livestock market chains seeking to protect their animals and their incomes from the effect of livestock diseases. However, because regulation cannot realistically be expected to effectively support biosecurity initiatives by farmers and traders in the near future, biosecurity improvements in the regional livestock market chains are unlikely to be rewarded and gain momentum until there is a market demand for safer / lower-risk livestock.

References

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Appendix 13. An investigation of vaccination effectiveness in two Cambodian villages facing an outbreak of Foot-and-Mouth Disease

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Figure A11.1: Farmer management of FMD-affected cattle (Kampong Cham)

Introduction:

An outbreak of Foot-and-Mouth Disease (FMD) was first reported in Cambodia's Kampong Cham province late in July 2010. Kampong Cham province is located in the South-east of Cambodia, adjacent the border with Vietnam. A limited amount of Type O FMD vaccine had been donated by the Vietnamese government to provincial authorities in Kampong Cham province prior to the outbreak in order to help with FMD control in this border area. Of this vaccine, 375 doses were administered to cattle and buffalo in Prey Chhor district by the District Office of Animal Health and Production (DOAHP) for protective use in selected villages not yet affected by the outbreak.

The Australian Centre for International Agricultural Research (ACIAR) funded a research project in Cambodia and Laos titled *ACIAR Project AH/2006/025, 'Understanding livestock movement and the risk of spread of transboundary animal*

diseases'. With the assistance of the Cambodian Department of Animal Health and Production (DAHP), *ACIAR Project AH/2006/025* gathered information from 7 villages in Kampong Cham province which were affected by the FMD outbreak. Our aim was to record information about the introduction, progress and outcome of the outbreak for affected livestock and their owners.

Two of the selected study villages in Prey Chhor district, Chrey Vien and Tropeang Ampil, received some of the donated FMD vaccine, although only enough to vaccinate a portion of the cattle and buffalo population. These villages had negligible pig populations, and none of the donated FMD vaccine was used on pigs.

Vaccination in Tropeang Ampil village took place on 2nd August 2010, at which time 147 animals (35% of the cattle and buffalo population) were vaccinated. Vaccination in Chrey Vien village occurred on 3rd August 2010, when 140 animals (47% of the cattle and buffalo population) were vaccinated. The first case of FMD was subsequently reported in Tropeang Ampil on 27th August, 25 days after vaccination took place. The first report of FMD in Chrey Vien village occurred on 25th August, 23 days after vaccination.

Materials and Methods:

Researchers from *ACIAR Project AH/2006/025* made several visits to seven villages in Kampong Cham province during and in the months following the widespread 2010 FMD outbreak. These research visits were facilitated by the Cambodian DAHP and the Provincial Office of Animal Health and Production (POAHP) in Kampong Cham. Information was obtained from the records of village animal health workers (VAHWs) and district and provincial veterinary authorities, and from interviews with VAHWs, villagers, village chiefs, and district and provincial veterinary officers.

In those two study villages which had received a quantity of donated FMD vaccine to use as a protective measure against the advancing FMD outbreak, our research from August to November 2010 allowed us to record reported FMD morbidity in the vaccinated and unvaccinated livestock, and to perform a crude assessment of the effectiveness of the vaccination effort.



Figure A11.2: Collecting information from villagers (left) and the village chief, VAHW and affected livestock owners (right) in Chrey Vien and Tropeang Ampil villages

Results

Table A11.1: Chrey Vien Village

| | Disease State | | Total | Attack rate (morbidity) | Relative risk | Attributable risk (AR) | Attrib. fraction (AF _{exp}) |
|------------------|---------------|------------|------------|--------------------------------|---------------------------------|---|---------------------------------------|
| | + | - | | | | | |
| Exposed (unvacc) | 113 | 45 | 158 | 113/158 = 0.715 = 71.5% | $\frac{113/158}{72/140} = 1.39$ | 113/158 – 72/140 = 0.715 – 0.514 = 0.201 | 0.21/0.715 = 0.28 |
| Non-exp. (vacc) | 72 | 68 | 140 | 72/140 = 0.514 = 51.4% | | | |
| Total | 185 | 113 | 298 | | | | |

Table 2: Tropeang Ampil Village

| | Disease State | | Total | Attack rate (morbidity) | Relative risk | Attributable risk (AR) | Attrib. fraction (AF _{exp}) |
|------------------|---------------|------------|------------|--------------------------------|------------------------------|------------------------------|---------------------------------------|
| | + | - | | | | | |
| Exposed (unvacc) | 168 | 105 | 273 | 168/273 = 0.615 = 61.5% | $\frac{0.615}{0.578} = 1.06$ | 0.615 – 0.578 = 0.037 | 0.037/0.615 = 0.06 |
| Non-exp. (vacc) | 85 | 62 | 147 | 85/147 = 0.578 = 57.8% | | | |
| Total | 253 | 167 | 420 | | | | |

Interpretation of results:

In Chrey Vien village there was a statistically significant difference ($p = 0.000565$) between the proportion of vaccinated (51.4%) and unvaccinated (71.5%) animals showing signs of FMD. The unvaccinated animals were 1.4 times more likely to show clinical signs of FMD than the vaccinated animals. The Attributable Risk ('Risk Difference') associated with lack of vaccination was 0.201, representing the increased probability of FMD in the unvaccinated group due to not being vaccinated. (i.e. 20% of FMD cases could be attributed to lack of vaccination). The Attributable Fraction (AF_{exp}) amongst the unvaccinated animals in this village, which is commonly calculated as an estimate of vaccine efficacy, was 0.28, meaning that only 28% of FMD cases amongst the unvaccinated animals would have been prevented by vaccination.

In Tropeang Ampil village, the difference in FMD attack rates between vaccinated (57.8%) and unvaccinated (61.54%) animals was **not** statistically significant at the 5% significance level ($p = 0.524$). In this village the relative risk of disease (1.06) was not significantly different (95% CI 0.901, 1.258) for the unvaccinated and vaccinated animals. Likewise, the Attributable Risk ('Risk Difference') was small (0.0372), and the 95% confidence Interval for the Risk Difference (-6.66, 14.09) spans zero, providing further evidence that there is no significant difference in morbidity between the vaccinated and unvaccinated groups. The Attributable Fraction for unvaccinated animals in Tropeang Ampil was 0.06, suggesting that only 6% of FMD cases among the unvaccinated livestock would have been prevented by vaccination *as it was applied in this village*.

Other significant findings:

Several factors were identified as being important in the rapid spread of the disease during the outbreak, including:

- Communal grazing of livestock throughout the outbreak
- Uncontrolled movement, trade and slaughter of sick animals during the outbreak
- Inadequate understanding and application of biosecurity measures by the para-veterinary workers responsible for examining and treating sick animals (Village Animal Health Workers - VAHWs).



Figures A11.3 – A11.5:

The common practice of tethering livestock along the roadside (pictured top) and walking them daily through the village to communal grazing areas (pictured middle and bottom) results in the rapid spread of FMD during outbreaks, and provides considerable infection challenge even for vaccinated animals.

The reporting and investigation of disease (including sample submission) at village, district and provincial level (crucial for effective response) lacked urgency and a standardised approach throughout the outbreak.

Discussion:

Clearly, this simple comparison of morbidity in vaccinated and unvaccinated animals can not be considered to be a proper trial of vaccine efficacy. The ‘attributable fraction’ figures featured in the *Results* section, commonly calculated as an indicator of vaccine efficacy, need to be interpreted in light of the following facts.

It should be acknowledged that the diagnosis, reporting and recording of FMD in these villages is likely to have been imperfect, subject to recall and misclassification bias, and was not supported by laboratory testing. Less than half the cattle and buffalo population in each village was vaccinated, meaning that the protective effects of herd immunity could not have been expected to operate in this situation, given that the immune proportion of livestock populations necessary for herd immunity to offer protection against clinical FMD is reported to be 80% (Chamnanpood, Gleeson and Robertson, 1993; Jori et al., 2009).

23 days (Chrey Vien) and 25 days (Tropeang Ampil) appear to have elapsed between vaccination and index case dates in each village, meaning that the vaccinated animals in each village seem to have had 2-3 weeks to generate immunity prior to challenge. However, disease reporting and recording is not always accurate in Cambodia, and the vaccinated animals may well have faced infection challenge sooner than the recorded index case dates suggest. Attempts to age lesions in order to calculate the likely date of disease introduction were not described.

The infection challenge facing the vaccinated animals may have been continual and overwhelming due to the practices of roadside tethering of livestock and communal grazing. These two practices, which represent significant opportunity for FMD spread

between households within villages, and between villages, continued throughout the outbreak and probably explain why the outbreak reportedly erupted simultaneously throughout the villages, rather than exhibiting any directional spread from a starting point.

Reports from the Village Animal Health Workers (VAHWs) suggest that the clinical signs in vaccinated animals may generally have been milder than those in unvaccinated animals.

While these factors may have affected the validity of our results, our crude assessment of the collected data may nevertheless be of value to those planning FMD response measures in Cambodia, where more accurate data is seldom available.

It could reasonably be argued that the lack of protection offered by FMD vaccination in Tropeang Ampil village, and the minimal advantage offered by vaccination in Chrey Vien village, might merely reflect failures in the vaccination process as applied in Kampong Cham province in August 2010, rather than impugning the value of vaccination as a means of controlling FMD outbreaks in general. Possible reasons for the poor results include:

- poor planning on the part of those determining where and when the donated vaccine would be used, hampered by inadequate surveillance data and poor understanding of FMD epidemiology. Consequently, the populations chosen for vaccination may have been too close to the margin of the advancing outbreak, particularly as no movement controls were attempted within or between villages.
- poor execution, including cold chain weaknesses and poor vaccination technique. It has also been reported that those paid to administer vaccine sometimes reduce the dose that is given in order to vaccinate more animals, as they are paid a vaccination fee per animal.

If, however, the implied weaknesses in the planning and application of FMD vaccination in Kampong Cham province are typical of how FMD vaccine will be used in response to future outbreaks in Cambodia (and possibly elsewhere), it seems likely that a lot of donor vaccine could be used during future FMD outbreaks with little effect. Consequently, it might be prudent to allocate a portion of the proposed donor investment in regional FMD vaccine banks to ensuring that the responsible authorities in each recipient country are well prepared and genuinely willing to manage vaccination programs in a manner that is likely to be effective.

The results presented in this report are intended to provide some 'real world' balance to the impressive level of protection reported in some other FMD vaccination trials in the Mekong region. It is possible that the disappointing results recorded in Kampong Cham demonstrate what happens in situations where FMD vaccination is not applied in the controlled environment of a research project, highlighting the need for monitoring (as opposed to managing) the future application of vaccine in Cambodia in order to identify where the weaknesses exist in the vaccination process.

The importance of vaccination failures should not be underestimated, as they are likely to discourage farmer cooperation with future FMD vaccination programs. Because farmers are still required to pay a fee for administration of 'free' donated FMD vaccine, they are unlikely to participate in future vaccination programs if they have learned that vaccination fails to protect their livestock. Consequently, achieving adequate vaccination coverage to produce herd immunity within Cambodian villages is likely to become an entrenched problem, leading to ongoing vaccination failures. Cambodian farmers perceive FMD as being far less important than highly fatal diseases such as Haemorrhagic Septicaemia (HS). FMD vaccine in Cambodia is presently far more costly and far less available than HS vaccine. If it is also viewed as far less effective, farmer cooperation with FMD vaccination programs will obviously suffer.

The 2010 FMD outbreak in Cambodia emphasised that disease reporting and investigation in Cambodia remains a critical weakness in any disease control efforts. Our research in Prey Chhlor district discovered that although the district animal health authorities had collected and collated outbreak data into a report dated 3rd August 2010, the report had still not been forwarded to the Provincial Office of Animal Health and Production (POAHP) by 31st August. This lack of urgency in FMD reporting suggests that either FMD is not viewed as a serious disease by many stakeholders, including animal health staff, or that reporting of disease is considered unlikely to achieve a useful response from the authorities further along the reporting pathway.

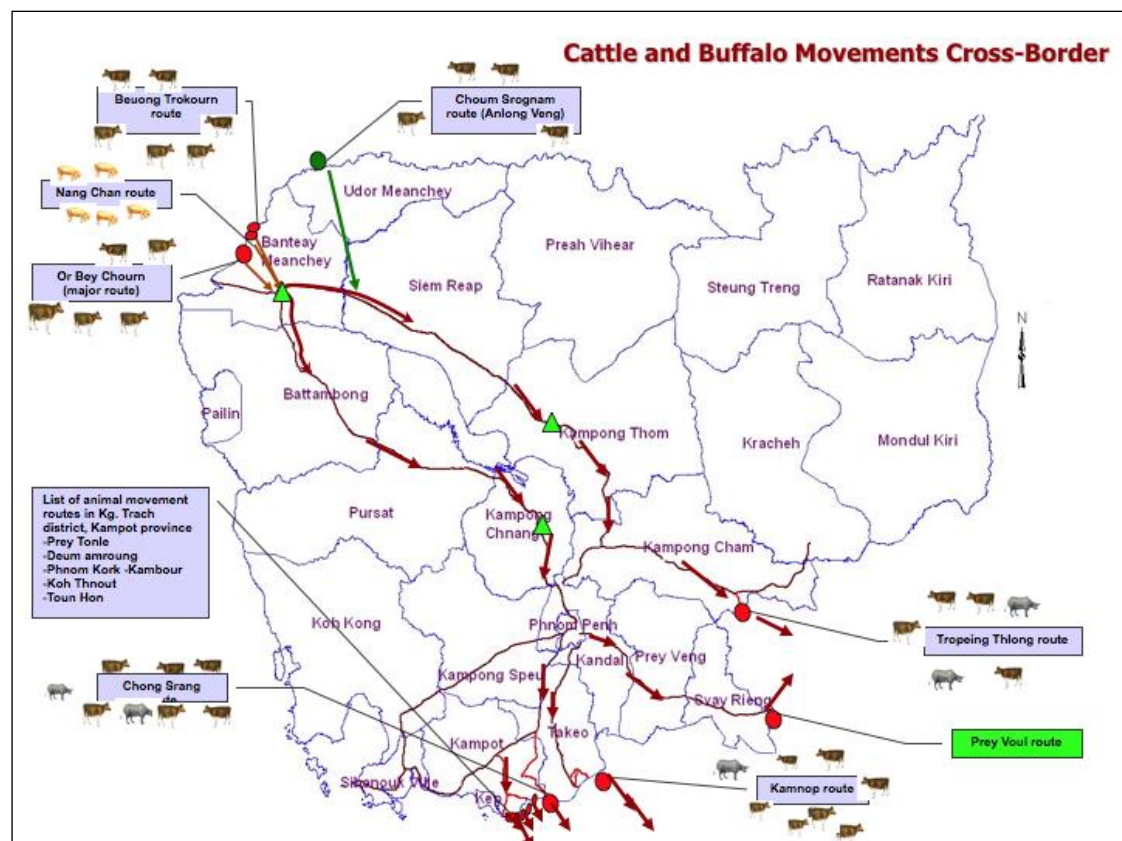


Figure A11.6: Transit routes for cattle and buffalo moving from Thailand through Cambodia into Vietnam

As shown in Figure A11.6 (above), Kampong Cham province is located on a major livestock trade route running from Thailand (and possibly Myanmar) to Vietnam. Considering that a Serotype A FMD outbreak was recorded in Myanmar in September 2010, it was possible that the 2010 FMD outbreak in Cambodia may not have turned out to be Serotype O, in which case the donated Type O vaccine used in Kampong Cham would have been inappropriate. Consequently, sampling of FMD cases for serotyping should presumably have been a priority. To obtain good value for donor money, urgent sampling and submission should precede the distribution of donated vaccine, if possible.

Unfortunately, outbreak samples were not received by the Regional Reference Laboratory for FMD in Bangkok until 24th September 2010, and it was a further 18 days (12th October 2010) before the results of that serotyping (Serotype O) were available. Given that Vietnamese-donated FMD vaccine was used in the two study villages on 2nd and 3rd August, it is concerning that a delay of greater than 2 months occurred before laboratory confirmation of serotype was obtained. Consequently, it seems reasonable to suggest that a proportion of the funds donated for FMD control in the GMS should be directed toward understanding and addressing fundamental flaws in disease reporting and investigation before allocating them to ad hoc vaccination response efforts that may be doomed by serious weaknesses in the attitude and capability of those charged with managing the use of donated vaccine.

Recommendations:

- Further research is required to monitor and record the planning, storage, handling and administration of donated vaccine in response to an FMD outbreak to see if our study results represent an isolated incident, or the norm.
- This research could be attempted by attaching an observer (not an advisor) to future consignments of donated vaccine, in order that the planning and use of the vaccine, as well as farmer/VAHW/DOAHP/POAHP attitudes and willingness to cooperate can be recorded.
- The quality of vaccine at various points along the supply chain, and certainly at the time of actual administration (crush-side sampling), should also be monitored by laboratory examination of samples.
- Research is also required to record the timeliness and quality of disease investigation (including sampling) and reporting, as well as ongoing monitoring of outbreak progress by district and provincial authorities, as surveillance information is crucial in planning effective and justifiable response measures.

Figures A11.7 and A11.8: Village Animal Health Worker (VAHW) and helpers treating foot lesions during the 2010 FMD outbreak in Kampong Cham



- VAHWs require training in biosecurity measures that should be applied in the course of their work (**pictured above**). Unfortunately, the existing instruction booklet supplied to Cambodian VAHWs for investigation and treatment of FMD and Classical Swine Fever cases lacks adequate advice about personal biosecurity responsibilities. ACIAR Project AH/2006/025 is consequently developing generic biosecurity education materials for VAHWs, but improved biosecurity training for VAHWs will be a nationwide undertaking requiring input from government and development organisations.

As Cambodian custom dictates that neighbours, friends and relatives typically help in the restraint and treatment of sick livestock (**see Figures A11.7 and A11.8, above**), the consequent risk of vector- and fomite-borne spread of disease (via humans and their clothing and equipment) to livestock in other households is considerable. Biosecurity education for VAHWs consequently assumes particular importance so that they, in turn, can educate other villagers, and certainly those who help them when handling affected animals.

- The following disease control measures should be investigated for feasibility. The feasibility of measures such as these would clearly depend on the cooperation of villagers, meaning that a significant educational component would be required to explain the benefits they would derive from such measures (i.e. why they should cooperate):
 - movement restrictions during disease outbreaks, particularly as many villagers tether their cattle along the roadsides prior to walking them to communal grazing areas each day (meaning that animals from other areas walking through the village have an excellent opportunity to introduce diseases such as FMD)
 - alternative feeding strategies to communal grazing (especially at times of disease outbreak), including promoting household forage plots and pen-feeding systems (such as those trialled by ACIAR Project

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- control of trade in sick animals, seeking at least to prevent traders from tethering and grazing sick animals (purchased cheaply for slaughter or recovery and re-sale) in proximity to other village livestock

- education of traders and villagers about the disease risk associated with slaughter of infected animals and distribution of the slaughter products, promoting:
 - quarantine/isolation of sick animals purchased for slaughter
 - avoidance of slaughter in areas where livestock walk and graze
 - the need to clean equipment, hands, shoes and clothing after handling infected animals and animal products
 - the particular risk of disease spread that is posed by feeding infected slaughter products to pigs.

Figures A11.9 and A11.10: Slaughter of sick animals and sale of infected meat



References:

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Jori F, Vosloo W, Du Plessis B, Bengis R, Brahmhatt D, Gummow B & Thomson GR 2009, 'A qualitative risk assessment of factors contributing to foot and mouth disease outbreaks in cattle along the western boundary of the Kruger National Park', *Rev. sci. tech. Off. int. Epiz.*, 2009, 28 (3), pp. 917-931

Appendix 14. Biosecurity materials produced for traders and animal health workers

Figure A14.1. Biosecurity booklets for village animal health workers and livestock traders.

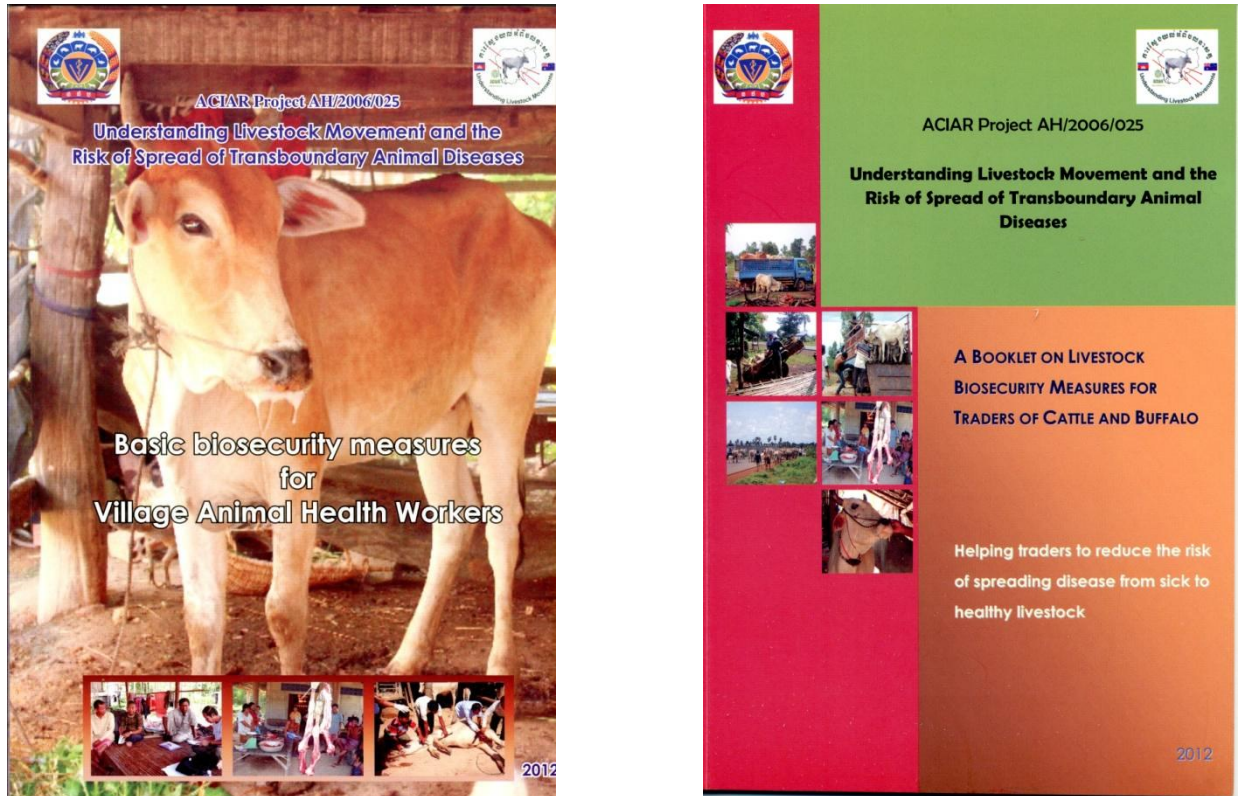


Figure A14.2 T-shirt for livestock traders



Figure A14.3 Example of poster for use with livestock traders.

These resources are available in full, and may be downloaded from the project website:

<http://ulm.animalhealthresearch.asia/>

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