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**Australian Centre for  
International Agricultural Research**

# Project final report

*project*

## **Improved diagnostic and control methodologies for two major livestock diseases in Lao PDR and Yunnan province, China**

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## 1 Abbreviations used

FMD	-	Foot and mouth disease
FMDV	-	Foot and mouth disease virus
CSF	-	Classical swine fever
CSFV	-	Classical swine fever virus

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## 2 Objectives

### *Original project objectives*

Objective 1. To develop field and laboratory methodologies for the diagnosis and control of priority diseases in Lao PDR.

Objective 2. To establish ELISA tests in the National Veterinary Diagnostic Laboratory, Vientiane and Yunnan Province, PR China for the detection and identification of virus and antibodies to FMDV and CSFV and in particular for detection of group-specific antibodies to FMDV strains.

Objective 3. To undertake epidemiological studies based on representative population samples to obtain accurate and reliable information on the prevalence and significance of diseases, and in particular FMD and CSF, in village production systems.

Objective 4. Study and validate the effectiveness of the Lao PDR HC vaccine when administered in the field.

Objective 5. Examine the susceptibility of local strains of pigs in Lao PDR to a standard challenge dose of virulent CSFV to determine whether these pigs have innate resistance to the disease compared to conventional white commercial pigs.

Objective 6. Transfer any improved tests, reagents and products from AAHL to Lao PDR and Yunnan province of PRC if they are thought to be beneficial and appropriate and require field-testing. Likewise, unusual CSFV strains detected in the field in Lao PDR will be transferred, if possible, to AAHL for more detailed study.

### *Additional objectives of project extension.*

Objective 7. Implement CSF preventative and control strategies in village production systems combined with longitudinal studies to measure their effectiveness and sustainability.

Objective 8. Conduct training and refresher courses for district animal health staff involved in the field investigations of CSF vaccination and refresh the diagnostic sample submission network (DSSN) where appropriate.

### 3 Outputs against described objectives

#### ***Objective 1: To develop field and laboratory methodologies for the diagnosis and control of priority diseases in Lao PDR.***

As part of this objective a significant adjunct activity was the establishment at the AHD laboratories from an empty space of a functional, well equipped laboratory, and implementation of the working procedures and protocols to guide the staff. Diagnostic assays for the viral and serological diagnosis of the priority diseases CSF and FMD have been established. Field methodologies for the collection and submission of diagnostic samples have been established via the Diagnostic Specimen Submission System (DSSS). Training programs were established for field officers in the diagnosis and epidemiology of CSF and FMD and these programs implemented by the project counterpart. The establishment of the laboratory has had a significant impact on the Department of Livestock and Fisheries (DLF) because it has enabled more positive interaction with various farmer clients, has enabled the DLF to strengthen activities and networks with the provincial administrations and to increase the role played in the regional OIE FMD control program (SEAFMD). The implementation of the field methodologies has enabled collection of a valuable serum bank that can be and has been used to other studies (see below). There will be a need for the DLF to maintain the laboratory into the future but there will be some challenges in this regard as reagents are relatively expensive.

#### ***Objective 2: To establish ELISA tests in the National Veterinary Diagnostic Laboratory, Vientiane and Yunnan Province, PR China for the detection and identification of virus and antibodies to FMDV and CSFV and in particular for detection of group-specific antibodies to FMDV strains.***

Diagnostic assays for CSF and FMD have been established at the AHD laboratory and at the laboratory in Yunnan province. International standard antigen detection ELISA for both CSF and FMD were established, providing frontline diagnostic capability for both these important diseases. Serological assays for detection of antibodies to both diseases were similarly established. Detailed laboratory methods written in English and Lao have been documented. Staff from both laboratories have been trained in the laboratory procedures were able to carry these out with a minimum of supervision. Cell culture was established at the AHD laboratory for diagnostic and research confirmation purposes but was not continued as a routine service because maintenance costs would not allow this to be sustained in the long term. YTSTAVDL has established cell culture capability. The impact of this diagnostic technology when linked to the DSSN established under objective 1 is that the studies carried out under objective 3 were possible. In addition the serology tests have been used by semi-commercial farmers to monitor both FMD and CSF immune status in more valuable livestock.

#### ***Objective 3: To undertake epidemiological studies based on representative population samples to obtain accurate and reliable information on the prevalence and significance of diseases, and in particular FMD and CSF, in village production systems.***

Staff were trained and participated in active and passive serological surveillance techniques (serum collection and data analysis) so a significant capacity was built to enable DLF to conduct similar surveillance for other diseases. Some of the skills available were a carry-over from a previous ACIAR project and this project relied heavily on the ACIAR publications arising from previous project. Large scale (more than 3000 sera collected) serological surveys were undertaken using active surveillance techniques to determine the sero-prevalence of FMD and CSF in Vientiane Municipality, Luang Prabang, Savannakhet, Champassak, Khammouane, Borikhamxay (phase 1) and Luang Namtha and Oudonxay (phase 2). These have enabled a greater understanding of FMD

and CSF epidemiology in Lao PDR. Abattoir surveys from more than 2500 animals in seventeen provinces have also been used to build a picture of CSF and FMD prevalence. The results have shown that FMD is not endemic in some parts of Laos and that the predominant serotype causing disease is serotype O. Classical swine fever is present in all provinces but the prevalence varies. A significant collection of sera from specified locations has been catalogued and stored. These findings have changed the understanding of regional FMD epidemiology and have made a contribution to the formulation of the regional strategy to control FMD by establishment of the Upper Mekong Disease Control Zone that will involve cooperation between Lao PDR, China PR, Myanmar and Thailand. Lao national FMD control thinking has been influenced by the findings of the project as they indicate that movement of livestock into the country has a greater impact on the disease situation than expected, and that stronger links with neighbouring countries will be necessary to prevent epidemics in Lao. The intensive studies of disease outbreaks have showed the importance of local animal movement but also possibly movement of animal product in spreading FMD outbreaks. The prevalence of CSF is relatively uniform and so national control activities must take this into consideration.

***Objective 4: Study and validate the effectiveness of the Lao PDR CSF vaccine when administered in the field.***

In pen trials pigs vaccinated with locally produced CSF vaccine produce an immune response to CSF infection that persists for at least 9 months. Department staff associated with the project have undertaken monitoring of CSF vaccination in semi-commercial piggeries. However the performance of the vaccine in these settings has been less than expected. A pen trial was carried out to monitor the transfer of antibodies from vaccinated local breed sows to the litter. This experiment indicated that on average the decay of maternal antibodies is sufficient to allow successful vaccination of piglets at 6 weeks of age, although there is litter to litter variation. An 'in-village' study was attempted to monitor the transfer of antibodies from vaccinated sows to piglets. It was possible to enrol only 2 sows in the study, but the results showed that about 80% of the litter in both cases had maternally derived antibodies to CSF. However these data show that the level of antibody transferred is probably similar in native pigs to that in commercial pigs, that sow vaccination will result in immunity of piglets that successfully suckle and in general most of the piglets in the litter receive sufficient colostrum to be protected for about 6 weeks. This information generated in Lao is important for the DLF to use in extension messages regarding disease control and increases the confidence that a properly conducted vaccination campaign using local vaccine is likely to be effective in controlling disease on native breed pigs.

***Objective 5: Examine the susceptibility of local strains of pigs in Lao PDR to a standard challenge dose of virulent CSFV to determine whether these pigs have innate resistance to the disease compared to conventional large white pigs.***

One native pig breed (Moo laat) and one imported pig breed (large white) were compared with a standard challenge strain of CSFV. Comparing the two breeds, the local pig breed were somewhat refractory (death at 17 days post-inoculation for native breed and 9-10 days for imported breed) to the disease although death was still the final outcome. One of the native breed pigs survived and was persistently viraemic up to 35 days post-inoculation indicating that such animals may play a role the spread of the disease. A second study was carried out using another local breed (Moo daeng) and the results indicated this breed was also susceptible to CSFV. The impact of this study was that it has clearly showed that CSF prevention is required in village pigs as they are fully susceptible to CSF and not resistant as some national animal health officials believed. The finding that one pig survived and remained viraemic is an important finding as it suggests that the disease may be maintained and spread by outbreak survivors. The

impact of such animals on disease management in the village environment must be studied further.

***Objective 6: Transfer any improved tests, reagents and products from AAHL to Lao PDR and Yunnan province of PRC if they are thought to be beneficial and appropriate and require field-testing. Likewise, unusual CSFV strains detected in the field in Lao PDR will be transferred, if possible, to AAHL for more detailed study. FMDV genomic material may also be transferred for molecular epidemiological examination.***

The project supplied some diagnostic kits for evaluation, but in general the kits are too expensive for sustainability of application. Studies were completed with bovine brucellosis and paratuberculosis and porcine pseudorabies ELISA kits. FMD antigens for serology were supplied to the laboratory in Laos from a commercial source and antisera supplied from the World Reference Laboratory for FMD. Primary molecular epidemiological analysis were undertaken at the laboratory in Vientiane with the transfer of DNA for nucleotide sequencing to AAHL. Results indicated the Lao strains of CSF can be typed geographically from this type of examination. There are two distinct genogroups of CSF virus in Lao PDR. Genogroup 2.2 was detected only in the southern part of the country, while genogroup 2.1 was detected in the northern part. This information provides some insight into the regional epidemiology of CSF viruses. Publications have been prepared on this aspect of the work. FMD viruses collected as part of project activity were submitted to the world Reference Laboratory for FMD. Samples of type O confirmed the incursion of the Pan Asia strain of FMD serotype O into Lao PDR showing the importance of transboundary movement of livestock in triggering FMD epidemics in Laos.

***Objective 7: Implement CSF preventative and control strategies in village production systems combined with longitudinal studies to measure their effectiveness and sustainability***

The project instituted a longitudinal study to develop a picture of the productivity of Lao pigs and to study the impact of any outbreak of CSF that might occur in study villages. The study showed that there was considerable heterogeneity among the villages in respect of productivity and husbandry practices. There was a significant lack of understanding about breeding, as young males were often mating their mothers, and inbreeding was a problem. No significant disease outbreaks were experienced up to the point of a meeting was held with the farmers in the villages to feedback the information on the data gathered by the project. Generally speaking, the attitude of the farmers to the project was very positive because they had equated the project activity with a lack of disease. However two villages experienced an outbreak of CSF close to the end of the study period (in May 2003). Data were collected by the Village Veterinary Workers engaged with the project, but the report of the disease outbreak was not received early enough such that a proper investigation could be carried out.

***Objective 8. Conduct training and refresher courses for district animal health staff involved in the field investigations of CSF vaccination and refresh the diagnostic sample submission network (DSSN) where appropriate***

Establishment of the DSSN was a significant output from the project activity. The principles of the DSSN were applied to the intensification of the project activities in the 8 selected villages in Borikhamxay. A refreshment of the DSSN was carried out with assistance from the EU project 'Strengthening livestock services and extension activities in Lao PDR' (SLSEAL project). This output demonstrated that with a little financial input it is possible to utilise local animal health workers effectively in a disease control program. It appeared that the annual meetings of the participants were important for maintaining interest and motivation. The DSSN provide some financial incentive for the local officials to conduct field investigations as costs associated with collection and sample submission were reimbursed by the project. The system was appropriate for the conditions prevailing



during the project and indicated the importance of increased funding for such services from government sources.

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### 3.1 Additional outputs and impacts

Additional Output 1: Funds were procured from the Australian Embassy through AusAID (US\$100,000) following a request from DLF and a successful large-scale FMD vaccination campaign was administered in southern Lao to arrest a large FMD outbreak. This was a significant result for the DLF as there was significant political concern about the severity and speed of spread of the outbreak. A report on the control program was provided to the AusAID office in Lao PDR and the technical aspects were described at the OIE SEAFMD Sub-Commission and documented in the meeting reports.

Additional Output 2: The animal health staff developed proficiency in assessment of vaccination programs and the follow-up investigations vaccination efficiency in the field has provided improved confidence in the delivery of vaccination programs. This is important as it has clearly demonstrated that ring vaccination with movement control is an effective disease control tool that can be confidently applied if well managed and monitored.

Additional Output 3: The results of project work in respect of FMD have been reported at meetings of the OIE sub-commission for FMD in Southeast Asia and significantly support the Lao contribution to this program. This is an important outcome of the project for the DLF.

Additional Output 4: Investigations of FMD outbreaks in the some remote parts of Lao PDR suggest that the disease is not endemic in these locations and outbreaks of disease are the result of disease introduction. The project has as a result provided informal training in disease outbreak investigation principles. One of the larger investigations resulted in a publication in the *Revue Scientific Office International des Epizooties*.

Additional Output 5: At the recommendation of the review of the project in 1999 a number of additional studies were carried out on the cattle, buffalo and pig serum bank built up by the project. The result was that a report on the prevalence of bovine brucellosis, bovine paratuberculosis and Aujeszky's disease of swine was provided to the DLF. The study showed that the Lao village cattle population appears to be free of bovine brucellosis and bovine paratuberculosis. It also appears that Aujeszky's disease is prevalent in pigs in some parts of the country. The findings with brucellosis and paratuberculosis mean that in the future DLF can rightly apply a quarantine measure to prevent these diseases from being introduced into the country, especially by dairy cattle imports. The finding with Aujeszky's disease was surprising as there has never been a clinical diagnosis of the disease and it has not been suspected. This finding requires further investigation to determine if the aspects of recognition and control should be incorporated in pig health extension programs.

Additional Output 6: An international workshop on classical swine fever in Southeast Asia was convened in Laos and a set of proceedings published by ACIAR (ACIAR Proceedings No.94 "Classical swine fever and emerging diseases in SE Asia."). This workshop provided a platform for the various participants in the project to present findings at an international meeting and brought a number of international experts whose ideas on classical swine fever diagnosis and control were a valuable input to the project.

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## 4 Communication and dissemination activities

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### 4.1 Project reports

An emergency vaccination program to control Foot and Mouth Disease in Southern Lao PDR funded by AusAID. -Final report. Report compiled by ACIAR project AS1/94/38 and the Department of Livestock and Fisheries, Ministry of Agriculture and Forestry, Lao P.D.R. April 2001

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### 4.2 Conferences

An International conference on classical swine fever and emerging viral diseases in Southeast Asia. September 1999. 90 delegates of whom 40 were international. Proceedings published by ACIAR.

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### 4.3 Thesis dissertations

Blacksell, S.D. (2001) Classical swine fever in the Lao People's Democratic Republic: Virological, Clinical and Epidemiological aspects. PhD thesis, Department of Microbiology and Parasitology, University of Queensland.

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### 4.4 Publications submitted/pending

B.D. Perry, L.J. Gleeson, S Khounsy, P Bounma and SD Blacksell. The dynamics and impact of foot and mouth disease in smallholder farming systems in Southeast Asia: a study in Laos. *Rev sci tech Off int Epiz.* 2002 21: 663-673

Blacksell, S.D., Khounsy, S. and Westbury, H.A. The effect of tropical climatic conditions on sample decomposition and the diagnostic performance of a Classical Swine Fever virus RT-PCR and ELISA. *Journal of Virological Methods* (Accepted for publication).

Stuart D. Blacksell, Syseng Khounsy, David B. Boyle, Laurence J Gleeson, John S. Mackenzie, Irene Greiner-Wilke and Harvey A. Westbury (2003) Phylogenetic analysis of the E2 gene of classical swine fever viruses from Lao P.D.R. (submitted)

Stuart D. Blacksell, Syseng Khounsy, David B. Boyle, Laurence J. Gleeson, Harvey A. Westbury and John S. Mackenzie. Genetic identification of classical swine fever viruses from Lao PDR by analysis of the 5' non-coding region (manuscript under review).

Blacksell, S.D., Khounsy, S. and Westbury, H.A. Comparative susceptibility of South-East Asian indigenous breed and Large White crossbred pigs to Classical Swine Fever Virus infection. *Tropical Animal Health and Production* (forthcoming).

A number of the publications remain incomplete as the project leader from the Australian Commissioned Agency retired before the project was completed and the main in-country scientist working on the project (Mr (Dr) Stuart Blacksell) resigned from the commissioned agency to seek employment elsewhere. Since he resigned Dr Blacksell has submitted 3 papers for publication.

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### 4.5 Conference Proceedings

#### 1999

S. Vongthilath, and S.D. Blacksell,. Classical swine fever in Lao PDR. In: S.D. Blacksell (ed). Classical swine fever and emerging viral diseases in South-east Asia. Proceedings

of an international workshop held in Vientiane, Lao PDR, 19-22 September 1999. Canberra. Australian Centre for International Agricultural Research proceedings No. 94. pp 122-125. 2000.

S Khounsy, S.D. Blacksell, M. Phouraravanh, K. Douangphachanh, CJ Morrissy, C.J. and HA Westbury. Classical swine fever virus sero-epidemiology in Savannakhet province of Lao PDR. In: S.D. Blacksell (ed). Classical swine fever and emerging viral diseases in South-east Asia. Proceedings of an international workshop held in Vientiane, Lao PDR, 19-22 September 1999. Canberra. Australian Centre for International Agricultural Research proceedings No. 94. pp 82-88. 2000.

SD Blacksell. Genetic characterisation of classical swine fever isolates from Lao PDR collected during 1997 and 1998 In: S.D. Blacksell (ed). Classical swine fever and emerging viral diseases in South-east Asia. Proceedings of an international workshop held in Vientiane, Lao PDR, 19-22 September 1999. Canberra. Australian Centre for International Agricultural Research proceedings No. 94. pp 57-61. 2000.

S. Vongthilath, S. Khounsy and S.D. Blacksell. Classical Swine Fever in Lao PDR – Country Report. Proceedings of an international workshop held in Vientiane, Lao PDR, 19-22 September 1999. Canberra. Australian Centre for International Agricultural Research proceedings No. 94. pp 57-61. 2000.

Shanyi Naichun, Li Chundi, Zhang Yinguo, Zhang Wendong, Wan Jiaju, Gao Huafeng, Liu Yin Wu, Li Xinrong and Du Jian The monitoring of CSF antibody lever in vaccinated swine. Proceedings of an international workshop held in Vientiane, Lao PDR, 19-22 September 1999. Canberra. Australian Centre for International Agricultural Research proceedings No. 94. pp 57-61. 2000.

Li Chundi and Zhang Yinguo Developments and advances in the prevention and control of CSF in Yunnan province. Proceedings of an international workshop held in Vientiane, Lao PDR, 19-22 September 1999. Canberra. Australian Centre for International Agricultural Research proceedings No. 94. pp 57-61. 2000.

S. Vongthilath, S. Khounsy and S.D. Blacksell. (1999) Foot and Mouth Disease in Lao PDR: Establishment of laboratory facilities, outbreak diagnosis and serological surveillance. Fifth Meeting of the OIE Sub-Commission for FMD in South-East Asia, Phnom Penh, Cambodia, 22-26 February 1999

## 2000

S. Vongthilath, S. Khounsy and S.D. Blacksell. Foot and Mouth Disease in Lao PDR: Sixth Meeting of the OIE Sub-Commission for FMD in South-East Asia, Hanoi, Vietnam, 20-24 February 2000.

Khounsy, S. and Blacksell, S.D. Sero-epidemiology of Foot and Mouth Disease in Lao PDR: Sixth Meeting of the OIE Sub-Commission for FMD in South-East Asia, Hanoi, Vietnam, 20-24 February 2000.

Blacksell, S.D. and Khounsy, S Aspects of the AusAID-sponsored Foot and Mouth Disease program in Lao PDR: Sixth Meeting of the OIE Sub-Commission for FMD in South-East Asia, Hanoi, Vietnam, 20-24 February 2000.

## 2001

Blacksell, S.D. and Khounsy, S Outcomes of the AusAID-sponsored Foot and Mouth Disease program in Lao PDR: Seventh Meeting of the OIE Sub-Commission for FMD in South-East Asia, Yangon, Myanmar, 24-28 February 2001.

S. Vongthilath, S. Khounsy and S.D. Blacksell . Foot and Mouth Disease in Lao PDR: Seventh Meeting of the OIE Sub-Commission for FMD in South-East Asia, Yangon, Myanmar, 24-28 February 2001.

## **4.6 Workshop participation**

OIE workshop on establishment of FMD surveillance program in Lao PDR (1998)

Workshops on establishment of diagnostic submission network for provincial animal health officers (annual workshops in 1998, 1999 and 2000)

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## **4.7 Farmer meetings**

Meetings with pig raisers in 8 villages in Borikhamxay to communicate findings of the project survey work (April 2003)

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## 5 Farmer-level, community or policy impacts (economic, social and/or environmental)

In general terms the reviews of the project have been positive in respect of the project meeting its objectives and the relevance of the objectives to the livestock sector in Lao PDR. The project team would submit that the project findings have supported or reinforced policy directions for the DLF in its role to provide technical advice for the development of the livestock sector. The DLF view was that investments in research of important pig diseases would support policy development in matters related to upland agricultural pursuits, especially environmental impacts of traditional agricultural practices, and also make a contribution to providing livelihood support to rural smallholder farmers. These are regarded as key policy objectives of the Government of Lao PDR. In investigations at the village level it appears that women do have a key role in pig production, but they are not necessarily influential in all communities in decision making about livestock raising.

The project would submit that adoption of the findings of the project will be a long-term process and linkages to other projects and development approaches will be essential for the government to derive full benefit from the investments already made. This is an active process and does require a long term vision and plan for the sector. There is a real danger that if the government does not put a significant value on what has been achieved then it will be lost as attention is shifted away to the focus and activities of other international donor organisations. The project will prepare for a further extension of the work with a focus on delivery of the current research findings into a system of pig health delivery in the field, and to more clearly demonstrate the social benefits of improved disease control in village pigs.

The development of a functioning diagnostic laboratory and the implementation of diagnostic tests for CSF and FMD has had an impact on the capacity of the Department to meet international disease reporting responsibilities, has strengthened the contribution of Lao PDR to the regional OIE FMD control program and has resulted in generation of data that can be used to assist disease control policy, strategy and activities. However there are considerable constraints on the delivery of the benefits of the laboratory work because of the general structure of the livestock sector and the animal health services in Lao PDR. There is a possibility at the policy level the Govt of Lao may pursue a larger project to strengthen the livestock sector and in this case the skills and facilities developed by this ACIAR project will be an important contributor to the animal health component of such an initiative. Such a project would also necessarily invest into the animal health service and this should decrease risks associated with the sustainability of the outcomes of the current project.

The development of the diagnostic submission network and the development of a transport container using available local materials have greatly increased the confidence in the Department that it is possible to obtain meaningful data with minimal inputs and has given a sense of purpose to the national diagnostic laboratory. The project considers that the outcome will be a more focused and positive impetus for active disease investigation into the future.

The establishment of the surveillance activities and the diagnostic submission network has resulted in an increased awareness of CSF and FMD and the importance of reporting disease incidents to the national authorities. In the longer term this will be of benefit at the farmer-level, as it is a first step in developing and implementing better disease control strategies. The extensive serosurveillance carried out by the project has established that in large parts of the country FMD is probably not endemic in Lao PDR but is introduced by animal movements either from neighbouring countries or by movement of animals from endemically infected areas. At a regional level this finding is important as it has resulted in

the establishment of the Upper Mekong FMD control zone, and it provides Lao PDR with some additional support in regional discussions about animal disease control. The project contends that it is important from an ASEAN policy development perspective for Lao government officials to be aware that diseases are more likely to be introduced to Lao by illegal trade than to originate in Lao and for the national herd to be a source of disease for the ASEAN partner countries.

The project has contributed to the strengthening of relationships and dialogue on disease control matters between animal health authorities of Lao PDR and Yunnan Province PR China. This dialogue is regarded as important by the Lao and Chinese counterparts, and by the SEAFMD RCU, since there is a need to exchange information about important transboundary animal diseases such as FMD.

A subjective assessment suggests that the animal health officers in DLF with responsibility for animal health extension have found the findings of the project very useful as the outputs are practical but importantly they relate directly to the Lao situation. The information about the virulence of the local strain is seen by the project counterpart as very important practical information, as it is now clear that the local strains will kill both imported and native breeds of pigs. This knowledge contributes to and strengthens extension messages about CSF. Similarly the information about the geno-groups and the geographic distribution of the CSF strains is Lao specific and contributes to an understanding both nationally and internationally how CSFV might move about the region. Findings suggest linkages with neighbouring country pig production systems and provides an important baseline for any changes that might be observed in the future. There is a move to establish a regional network of laboratories undertaking CSFV monitoring and this project has built a useful foundation for Lao to participate in that network. For the government to make full use of such findings it is important that officials participating in regional discussions about biosecurity are familiar with them. To ensure this it is necessary for the Lao counterparts to produce a report on the state of the disease in Lao and highlight the practical issues raised above.

In respect of the vaccination activities, the ability of the project staff to run the AusAID FMD vaccination programme limited the impact of a severe epidemic of FMD on draft animal availability and subsequent rice paddy production. The report to AusAID detailed the operational aspects but there was no economic impact assessment of the benefit of controlling the outbreak. Most of the benefit is at the smallholder and household level and so is difficult to evaluate. However the publication by Perry et al of a later outbreak and the assessment of the OIE review team indicated that at the village household level the FMD outbreaks did have considerable impact. Therefore it is very probable there was a positive impact from the project efforts.

The project showed that the local strain of vaccine produced by the Department generates an immune response that is likely to be protective. This impact will be transferred from the government sector to the farmer sector as there is more confidence about the efficacy of the vaccine. Implementation of CSF of a well managed CSF vaccination program is a development that is required for increasing the output from the village production system and this project has laid the foundation for such a development. The data gathered from the CSF outbreak in Ban Namtha has provided hard data for policy makers that CSF outbreaks result in considerable loss of potential household income for small holder farmers.

Australian impacts have been a continued activity with FMD diagnosis and epidemiology that has maintained an awareness of contemporary strains of FMD circulating in SE Asia. This knowledge contributes to national discussion about such issues as strain selection for the national vaccine bank. Collaboration with international agencies such as OIE and the International Livestock Research Institute (ILRI) have also has long term impact on CSIRO AAHL participation in global disease control networks. Visits by CSIRO diagnostic scientists allowed further understanding of the application of diagnostic techniques for CSF. The RNA preservative trailed in the project provided practical information about the

deterioration under tropical conditions of samples for molecular diagnosis (molecular diagnostic procedures are becoming a cornerstone for rapid diagnosis in the Australian animal health network). Evidence of the low levels of CSF vaccination in rural areas compared to urban and peri-urban areas has indicated the vaccination programmes require considerable additional inputs to make any significant impact on CSF incidence. This suggests that the DLF and international donors need to evaluate the priorities for vaccine production and delivery.

An important impediment to the adoption of project outputs is the availability of suitable staff to maintain a quality service. The number of veterinarians in the country is very limited and many of the animal health technicians have basic animal husbandry training to certificate level. While these individuals are willing participants in animal health programs they require a level of supervision from qualified persons to offset the lack of theoretical knowledge. A similar situation occurs in the laboratory system and so it is necessary to maintain some overall quality control. In gathering field data there is considerable variation in the quality and this may be a reflection of the difficulty in finding a sufficiently literate and committed individual in the village environment.



## 6 Training and capacity-building

At the commencement of the project a workshop conducted for national laboratory staff introduced the concepts of ELISA and provided practical experience to a number of staff within the national diagnostic laboratory. This was an important diagnostic advance for most of the participants, some of whom went on to provide technical support to the project. The laboratory staff were given on the job training in principles of laboratory and equipment maintenance and other practical issues such as water quality, glass wash, etc.

The structured surveillance methodology developed by the previous ACIAR project was further refined and implemented during field investigations. This greatly increased the understanding of local counterparts in the application of robust methodologies to obtain meaningful disease prevalence data. The Lao staff now appreciate the usefulness of applying cost effective and appropriate methods such as abattoir surveillance to this surveillance work. Most of the training was conducted by the counterpart and the previous ACIAR project scientist also participated in some of the training.

A number of national and provincial animal health staff participated in the implementation (planning and execution) as well as the monitoring of the emergency FMD vaccination program. This resulted in capacity building in disease control management through vaccination.

The project has introduced the practice of disease and production monitoring of provincial and district officers in Borikhamxay. The same practice has been introduced to village level veterinary workers. This has increased awareness at the village level of the importance and usefulness of practical disease prevention strategies, and has provided direct training to the animal health staff involved.

Presentations in SEAFMD meeting and workshops demonstrated that the project outputs were regionally significant and that the strengthened activities were contributing to regional disease control efforts. Project counterparts presented the reports at the regional commission meetings, providing a forum for developing experience in meeting presentation.

The project through the counterpart provided disease control advice to other development projects such as those operated by CARE (CSF vaccination in Xayabouly and a community development program using livestock banks involving pigs and chickens). This activity developed increased capacity in animal health technical services associated with these projects.

The project contributed to national animal health capacity building by participation on invitation by FAO in the Technical Cooperation Project (TCP) on implementation of the grass roots 'Animal Health and Productivity Improvement Module' (AHPIM).

The project has increased the disease awareness and skills in disease investigation for a large number of provincial and district animal health officers who participated in structured epidemiological surveillance. Some surveillance carried out in conjunction with EU project so that there was a synergy between the extension efforts of that project and the disease awareness development aspects of the ACIAR project. This synergy contributed to capacity building in the provincial projects where the surveillance was carried out.

A scientist from the Yunnan laboratory spent a year conducting research at CSIRO AAHL that contributed to his attainment of a PhD degree at a Chinese university. This opportunity contributed significantly to the development of research skills at YTSTAVDL.

Two Chinese scientists from the Yunnan Veterinary Station and two from YTSTAVDL travelled to Vientiane in March and May 1998 for 2 weeks training in CSF and FMD laboratory diagnostic techniques. This training reinforced the introduction of the basic ELISA techniques to the laboratory in Yunnan.



In May 1998 a further training workshop was held for 6 additional Chinese scientists at the YTSTAVDL and in June 1998 for 49 people from 8 prefectures in Yunnan Province participated in a training course in CSF ELISA techniques at the YTSTAVDL. This training was designed to increased CSF diagnostic capacity in Yunnan Province.

The laboratory scientists at YTSTAVDL received training in production of reagents for FMD diagnosis and this production was subsequently implemented by the laboratory to enable sustainability of the ELISA technique.

The resident project scientist contributed to two ACIAR-funded scientific writing courses for agricultural scientists conducted in Lao PDR IN 1999 and 2000 and the project provided English language training to the laboratory staff that has enabled more interaction with visiting scientists.

As a result of the research undertaken the project scientist obtained a PhD degree from Queensland University

The use of the serum bank to undertake national serosurveillance for paratuberculosis, brucellosis and Aujeszky's in pigs has also increased the capacity of the DLF to utilise the surveillance and serum bank approach to defining animal health status of the national herd.

Information about strains of FMD in the country has resulted in increased activity in respect of cooperation with animal movement control and transboundary diseases.

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## 7 Relationship to other activities

European Union Livestock Project: Ongoing links with the European Union (EU) livestock project have been maintained since the commencement of the project in 1998. Ongoing advice on diagnostic issues and virological matters is provided via formal and informal links with the project, and loose collaborations have been established to mesh some field initiatives. The EU livestock project provided veterinary input to assist with experimental transmission studies.

Office International des Epizooties (OIE): The Organisation International Epizooties (OIE) has a regional FMD co-ordination unit (SEAFMD RCU) based in Bangkok. The RCU has run training programs in Lao PDR on FMD awareness to which the project provided technical input and support. Furthermore, the project provides the link for monthly reporting of FMD incidence to the OIE and for submission of samples from Lao PDR to reference laboratories. The SEAFMD program was reviewed in 2000 with a field study in Lao and the project provided support to this review activity. More recently the SEAFMD program has used project information and local counterpart expertise to underpin the establishment of the Upper Mekong FMD control zone. The project counterpart is the national FMD coordinator and plays an active role in SEAMF coordination meetings.

Australian Agency for International Development (AusAID): The project had a substantial relationship with AusAID by assisting the implementation of the emergency FMD vaccination program in the south of Laos in 1999.

Food and Agriculture Organisation of the UN (FAO): The links with FAO have been strong. Since the commencement of the project, links with the FAO TCP RAS/66/11 on the establishment of regional diagnostic capability have been maintained. The project staff participated in the establishment of the AHPIM TCP in Laos.

The project provides technical support to the FAO/International Atomic Energy Agency (IAEA) coordinated research program on FMD diagnosis and use of non-structural protein ELISA for differentiation between vaccinated and infected animals. The project also provides a reporting function to this program.

CIAT Forages for Small Holders Project: There has been a strong interaction with this project in terms of exploring ideas about implementation of field projects in Lao villages and how the two projects might be able to collaborate in the future.

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## 8 Future project plans to build on project outputs / outcomes

The studies of classical swine fever have provided results that must be further built on to enhance uptake and impact of project findings. At present there are major constraints on implementation of findings because delivery mechanisms do not exist within the Lao system, or they are very under-resourced to follow traditional approaches. In respect to the advances made with CSF it is very important to maintain the quality of the laboratory service and to use the findings on vaccine potency to improve vaccine implementation in the field. These approaches could be explored in a further phase of this project activity and a project proposal has been submitted and agreed by ACAIR. It is planned that some of the participatory approaches followed by the CIAT project can be employed to encourage farmers to take up the technology of vaccines. It will be necessary to continue to monitor the performance of vaccines in the field and to also devise a cost effective approach to vaccine potency testing to continue to reinforce the extension messages both to the DLF and to farmers.

The costs of maintenance of the laboratory activity are tied up with reagent supply. One way to increase use of diagnostic services could be to simplify test configurations so that they are less reliant on electronic equipment and to produce some reagents locally. An attempt to produce reagent grade FMD antisera in the first phase was not successful. As the CSF vaccine strain is adapted to rabbits it might be possible to use the vaccine to hyper-immunise rabbits to produce a cheap laboratory reagent to replace one of the very expensive components in the ELISA formats. This sort of approaches would assist in the sustainable uptake of the diagnostic technologies in Laos.

To maintain the laboratory facility and the momentum of this project into the future there are a number of constraints that must be dealt with. A significant constraint is the lack of trained personnel in both the field and the laboratory. English language proficiency is a constraint on sending some of the staff to Australia. And most donor organisations are not enthusiastic about training veterinarians as the training period is too long (5 years). It would seem that an injection of new ideas and curriculum into a local agricultural or animal husbandry training centre might be a useful investment for Australia to make in Laos.

The FMD group-specific antibody ELISA has been assessed in collaboration with an FAO/IAEA project. Some technical problems have been encountered and these kits are too expensive for routine use in Lao PDR. Cell culture was established at the AHD laboratory for diagnostic and research confirmation purposes but was not continued as a routine service because maintenance costs would not allow this to be sustained in the long term. YTSTAVDL has established cell culture capability.

It will be important for the DLF to maintain and monitor the skills and performance of the persons in the laboratory, because at this stage the basic science and technical foundation of local laboratory staff is not sufficiently developed to solve problems related to quality control or conduct analyses.

In the longer term it should be possible for the DLF to provide technical support to other rural development projects interested in CSF control because of the recognised value of pigs in livelihoods of the poorer sections of community.