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Final report

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1 Acknowledgments

Guidance and advice in prioritising work activities under circumstances imposed by the twin pandemics of African Swine Fever and COVID-19 that required extreme adaptability was provided by Dr Anna Okello, Dr Joanita Jong and Dr Felisiano da Conceicao. Henriqueta da Silva was instrumental in the research. The project activities benefited from collaboration with the Menzies School of Health Research Fleming Fund Animal Health antimicrobial resistance research group (Shawn Ting, Abrao Pereira and Steve Davis) and the University of Queensland (Tamsin Barnes, Dominic Smith and Tarni Cooper) and TOMAK (Alfons Urlings).

The activities of this project were successful due to the engagement and enthusiastic participation of veterinary and livestock technicians in the participating municipalities. Similarly, village leaders and farmers in selected sucos in Bobonaro, Aileu and Liquica ensured the success of this activity.

2 Executive summary

"Improved animal health surveillance in Timor-Leste" was proposed as a 15-month exploratory research activity to help strengthen passive animal disease surveillance in Timor-Leste using pigs as case study. The activities were redesigned to meet the objectives in response to the substantial and ongoing impact of two pandemics which impacted Timor-Leste immediately after the start of the research. African Swine Fever (ASF) caused high mortality of pigs throughout Timor-Leste and became the focus for pig health as it threatened the viability of small-scale pig production. Meanwhile, COVID-19 had far reaching impacts including reduced routine animal health activities and research was restricted without access to international and some local travel.

The redesigned project activities focused on building capacity in the veterinary service for emergency and emerging animal disease detection. The project benefited from close collaboration and involvement with staff from the Ministry of Agriculture and Fisheries (MAF) to focus on the high priority need for improved animal health surveillance. This is a recognised priority for the development of robust livestock production systems. Livestock production is culturally important and contributes to the alleviation of poverty and food insecurity. The role of community engagement by field veterinary technicians to improve pig health was identified as a key area to support farmers and to improve disease surveillance. Case studies were developed in which veterinary technicians were empowered through training and resources to engage closely and build trust with pig farmers and subsequently to undertake diagnostic investigations of disease reports. These activities were received favourably by both the technicians and the communities.

Key benefits of the community engagement included dissemination of information for improved pig production, particularly nutrition, and reproductive management. Additionally, preventative health advice included construction of pig housing compatible with biosecurity practices and integrated parasite management, albeit with the cost constraints. Diagnostic workups for cases of pig mortality were facilitated by the community engagement resulting in investigation of 27 cases of pig mortality in Bobonaro over a period of 4 months. This confirmed the ongoing high impact of ASF following the initial outbreak as well as a variety of background health issues that were limiting pig production. These clear benefits of reliable community engagement to support to animal health achieved here have highlighted the need for additional resources as an important challenge. From the perspective of veterinary and livestock technicians, workshops for continuing education were identified as important to help provide best practice advice to pig farmers in addition to the resources to access and support farmers regularly. Similarly, from the perspective of farmers, building trust required knowledge technicians. Accurate and pragmatic pig health and management advice was particularly important given the high cost of quality diets and secure pig housing. It will also be important for technicians to be supported by a diagnostic service equipped for general disease investigations and able to supply results that can be rapidly communicated to farmers and interpreted as preventative health advice.

The project was designed to identify opportunities and challenges for improving the passive animal health surveillance system in Timor-Leste. The network of veterinary and livestock technicians is a valuable resource with capacity for an expanded role in improving animal health. Community engagement approaches can mobilise the animal health technician network to support production on small scale farms. This will also realise the benefits of improved detection of animal disease. Case detection requires support from laboratory diagnostics and integration with a national animal disease database to provide a powerful animal disease surveillance system.

3 Background

There is an impetus for improved animal disease surveillance through global approaches to disease control. Each Member Country of the World Organisation for Animal Health (OIE) reports on the animal diseases present in its territory and this information underpins trade in animals and animal products (OIE, 2021). The OIE identified several areas where the veterinary service can be improved in Timor-Leste through the 'Provision of veterinary services gap analysis mission' in 2014 (Weaver et al., 2014). At the same time, the Ministry of Agriculture and Fisheries (MAF) Strategic Plan for 2014 – 2020 identified development objectives that included improving rural income and livelihoods and reducing poverty, improving household food and nutrition security, and supporting the transition from subsistence farming to commercial farming. Smallholder pig production is a culturally important livestock industry with potential for development to improve food security in Timor-Leste (Hunter et al., 2021; Smith et al., 2019). Pigs are an important livestock species for smallholders with high household level ownership (72% of households nationally). They contribute to financial security and are a critical component of cultural practices. Underpinning the growth of the livestock production sectors, including pigs, is development of an effective veterinary service which concurrently provides support to farmers and effective disease surveillance.

For Timor-Leste to meet the animal disease surveillance obligation, the national animal health surveillance system must develop capacity to implement both active surveillance (to determine prevalence and distribution of endemic diseases and evaluate disease control programs) AND passive surveillance (to detect and respond to occurrence of endemic and new emerging diseases). There are clear priorities to improve the veterinary service at the completion of the 5-year implementation period for the OIE PVS analysis for Timor-Leste. A key component is to strengthen programmes for disease surveillance, diagnosis, emergency preparedness and response for priority exotic and endemic diseases (Weaver et al., 2014). Emergency and emerging infectious disease including African swine fever (ASF) were identified as a threat to expansion of livestock production in the region. Classical swine fever (CSF) was identified as a priority endemic disease, although the impacts on pig production and the efficacy of a control strategy based on vaccination were unclear. Collaborations between MAF with Australian and international partners involve training of field and laboratory veterinary technicians to conduct active surveillance activities. For example, the capacity building undertaken by the Department of Agriculture's pre-border program under the recently concluded 2017-2019 Biosecurity White Paper. The need to mitigate the risk of animal disease incursions, including high risk exotic diseases, such as rabies and foot and mouth disease, is an essential function of MAF that can only be achieved if an incursion is detected early by a functional passive surveillance system. The present activity will identify efficiencies and limitations that need focus in developing improved passive surveillance.

The present activity was originally proposed as a 15-month exploratory research activity to help strengthen the passive animal disease surveillance system in Timor-Leste using small holder pig production as a case study. Immediately after the project began it was impacted by the outbreak of African Swine Fever in Timor-Leste as the pandemic spread through Asia (Mighell & Ward, 2021). This issue dominated pig health and production to the point of threatening the viability of pig keeping throughout Timor-Leste (Barnes et al., 2020; Smith et al., 2019). It also became a focus of animal health research and control efforts in this country (Mee et al., 2020; Mileto et al., 2021). Similarly, the project activities were severely impacted by the COVID-19 pandemic which prevented international travel after the initial project meeting in February 2020 and caused unpredictable restrictions on local travel at different times during the project. Consequently, planned laboratory capacity building activities designed to provide timely feedback to farmers on diagnostic investigations were not possible. The focus of activities switched to enabling and evaluation best practice community engagement to support pig production and enhance case detection for disease surveillance.

4 Objectives

This SRA addressed the following research questions:

(1) What are the incentives and disincentives for farmers to report disease and for MAF paraveterinarians to act on these reports?

(2) What are the key opportunities and challenges for accessing reports of pig disease and to obtain accurate data and diagnostic samples from the farm?

(3) How can more timely delivery of specimens to the laboratory be realised and what are the limitations for diagnostic investigations?

(4) What is the best feedback loop for communication of disease diagnostic outcomes and recommendations to farmers by the MAF veterinary technicians?

The case study approach focused on improving disease reporting and diagnostic processes for a single disease syndrome in pigs to provide the opportunity to better understand the current system and investigate best practice passive surveillance. The activities conducted in Bobonaro, Aileu and Liquica included baseline evaluations and analysis of the outcomes of community engagement and disease diagnostic activities after training and development of fit-for-purpose best practice activities in selected sucos. These enabled us to examine and test factors leading to the motivation or reluctance of farmers to report disease and for the technicians to obtain accurate data and diagnostic samples. The objectives of this study were:

1. To identify limitations and opportunities to improve case detection and investigation of pig diseases based on the experiences of village leaders, farmers, and veterinary technicians.

2. To improve community engagement for improved pig production and disease surveillance through training and enabling trial activities by veterinary and livestock technicians

3. To determine the relative importance of ASF, CSF and other diseases in the mortality of pigs after ASFV has become endemic and the CSFV vaccination program is maintained in the target municipalities of Bobonaro, Aileu and Liquica.

4. Offer practical recommendations to strengthen passive surveillance for pig disease in Timor-Leste by developing best practice protocols for case detection with enhanced community engagement by veterinary and livestock technicians.

5 Methodology

The project activities were conducted in the three target municipalities of Bobonaro, Aileu and Liquica. These municipalities were identified at the initial project meeting in consultation with senior MAF staff and reflected the need for capacity building for livestock and veterinary technicians, plus each selected municipality had a relatively large pig population and known outbreaks of ASF in 2019/20. Two villages were selected per municipality (one close to and one remote from the district centre) with farmers that had not been involved in previous support activities.

Qualitative studies provided baseline knowledge of management of pig production and health. Interviews and focus group discussions (FGD) were held in the study villages and with the MAF technicians at municipal offices in each location. Without the option for international travel, the Australian project team participated remotely and Henriqueta da Silva was employed to undertake the research with the in-country project participants.

Knowledge gained in the first activity informed adjustments to the project activities and directed the plans to provide training in community engagement (CE) for MAF technicians to support small holder pig farmers in production and health management. This was observed to be important for improved passive disease surveillance. Training in community engagement involved an interactive workshop for technicians led by Olavio Morais and Joanne Millar (remotely) that was repeated in each municipality. The learning was reinforced by designing and implementing a CE activity. This required the technicians to identify a target suco where they would build trust and relationships with farmers through regular visits and training workshops. The technicians were supported by Olavio to provide knowledge and learn the skills required to support farmers in improved pig farming. A qualitative study to evaluate the CE initiatives was conducted involving interviews and FGS by Henriquetta da Silva.

A case study to determine the important causes of pig mortality when infectious disease was suspected to be the cause was undertaken. To equip the MAF technicians for this activity a training workshop on field surveillance and collection of diagnostic specimens was conducted by Olavio Morais and Dr Felisiano da Conceicao. They designed data collection forms and method to collect and preserve a full range of diagnostic specimens by the technicians when they were notified of pig deaths. The activity was conducted concurrent with the enhanced community engagement to increase reporting of pig disease by farmers. The project funded 27 disease investigations. Preserved samples were assessed by histopathology and real-time PCR assays at Berrimah Veterinary Laboratory (NT, Australia).

Methodological details are provided in Section 7, accompanying the specific results and discussion.

Ethics approval for the qualitative study was obtained from the University of Sydney Human Research Ethics Committee (Project number 2020/122). An information sheet was provided and verbally explained to all participants for each interview or focus group discussion. Informed consent was obtained from participants through either a written signature or thumbprint. Participants were able to decline to participate or withdraw from the study at any time.

6 Achievements against activities and outputs/milestones

Objective 1: To identify limitations and opportunities to improve case detection and investigation of pig diseases based on the experiences of village leaders, farmers, and veterinary technicians.

no.	activity	outputs/ milestones	completion date	comments
1.1	Initial project meeting (PC)	Refined project plans	February 2020	Coordinated with final meeting of LS/2017/102 (Identifying husbandry options for smallholder pig farmers in Timor-Leste) for broad consultation. Adjustment of plans according to the recent high impact of ASFV in Timor-Leste.
1.2	Qualitative study: Identification of barriers and opportunities for improved surveillance for pig disease (PC)	Research report Publication, Ting et al., (2022)	November 2020	The results and outputs directed the adjustment of the SRA activities. Collaboration with Menzies School of Health Research and Fleming Fund. Qualitative study: Survey of Knowledge and Practices on Antibiotic Use and Antibiotic Resistance Among Smallholder Pig Farmers (PC). This farmer survey was conducted during the field visit to each study village

PC = partner country, A = Australia

Objective 2: To improve community engagement for improved pig production and disease surveillance through training and enabling trial activities by veterinary and livestock technicians

no.	activity	outputs/ milestones	completion date	comments
2.1	Community engagement workshops for veterinary and livestock technicians (PC	Activity report Plans to trial enhanced CE	July 2021	Led by Olavio Morais, repeated in the 3 target municipalities, 31 participants in total.
2.2	Case study: enhanced community engagement activities. (PC)	Final report	December 2021	Selected sucos in 3 target municipalities participated, designed and led by local technicians with guidance and support from Olavio Morais
2.3	Qualitative study: evaluation of community engagement (PC)	Final report	April 2022	Farmer and technician experiences evaluated by Henriqueta da Silva.

PC = partner country, A = Australia

Objective 3: To determine the relative importance of ASF, CSF and other diseases in the mortality of pigs after ASFV has become endemic and the CSFV vaccination program is maintained in the target municipalities of Bobonaro, Aileu and Liquica.

no.	activity	outputs/ milestones	completion date	comments

2.1	Field surveillance workshop for livestock and veterinary technicians. (PC)	Activity report Standard operating procedures for data and sample collection from sick pigs	Feb 2021	Hosted in Liquica, led by Olavio Morais and Dr Felisiano da Conceicao there were a total of 28 participants trained from 3 target municipalities.
2.2	Case study: Improved passive surveillance for pig mortality	Activity report/final report	April – July 2021	In conjunction with enhanced community engagement activities, MAF technicians implemented improved case detection, reporting and collection of diagnostic samples
2.3	Advanced laboratory diagnostic tests (A)	Activity report/final report	April 2022	Due to the impacts of COVID-19 and to provide access to the widest range of tests, diagnostic work up of 27 cases of pig mortality completed at Berrimah veterinary Laboratory, NT.

PC = partner country, A = Australia

Objective 4: Offer practical recommendations to strengthen passive surveillance for pig disease in Timor-Leste by developing best practice protocols for case detection with enhanced community engagement by veterinary and livestock technicians.

no.	**activity**	**outputs/ milestones**	**completion date**	**comments**
4.1	Final project meeting (PC)	Trip report by Jo Millar Final report	April 2022 May 2022	Cumulative assessment of previous activities in consultation with senior MAF staff. Attended by Dr Millar from Australia

PC = partner country, A = Australia

7 Key results and discussion

7.1 Identification of barriers and opportunities for improved surveillance for pig disease

7.1.1 Introduction

The objective of this study was to:

Identify barriers and opportunities to improve case detection and investigation of pig diseases based on the knowledge and experiences of village leaders, farmers, and veterinary technicians.

The following research questions were developed:

(1) What are the incentives and disincentives for MAF paraveterinarians to report and act on reports of disease from farmers?

(2) What are the key opportunities and challenges for accessing disease reports from farmers and to obtain complete and accurate data from the farm?

(3) What is the best feedback loop for communication of disease diagnostic outcomes and recommendations to farmers by the MAF veterinary technicians?

The study findings were used to inform the pilot case investigation and design a community engagement process to improve relationships and farmer capacity in biosecurity and pig husbandry. The full study report is reported in Appendix 1.

7.1.2 Methods

Sucos selected for study

Three municipalities were selected (Liquica, Aileu and Bobonaro) based on having a relatively high number of pigs and known outbreaks of ASF in 2019/20. Two villages per district were selected (one close to and one remote from the district centre) to compare pig raising methods, disease incidence, contact with MAF staff, access to animal health treatments, and information networks. COVID-19 prevented international travel so the conduct of interviews and focus group discussions (FGD) were restricted to in-country researchers with support from Joanne Millar by video call. The location of the selected sucos is indicated in Figure 1. Background on each suco can be found in Appendix 1.

Liquica: Suco Leorema (Far village) and Suco Dato (Near village)

Ailieu: Suco Aço-mau (Far village) and Suco Seloi Malere (Near village)

Bobonaro: Suco Gildapil (Far village) and Suco Ritabou (Near village)

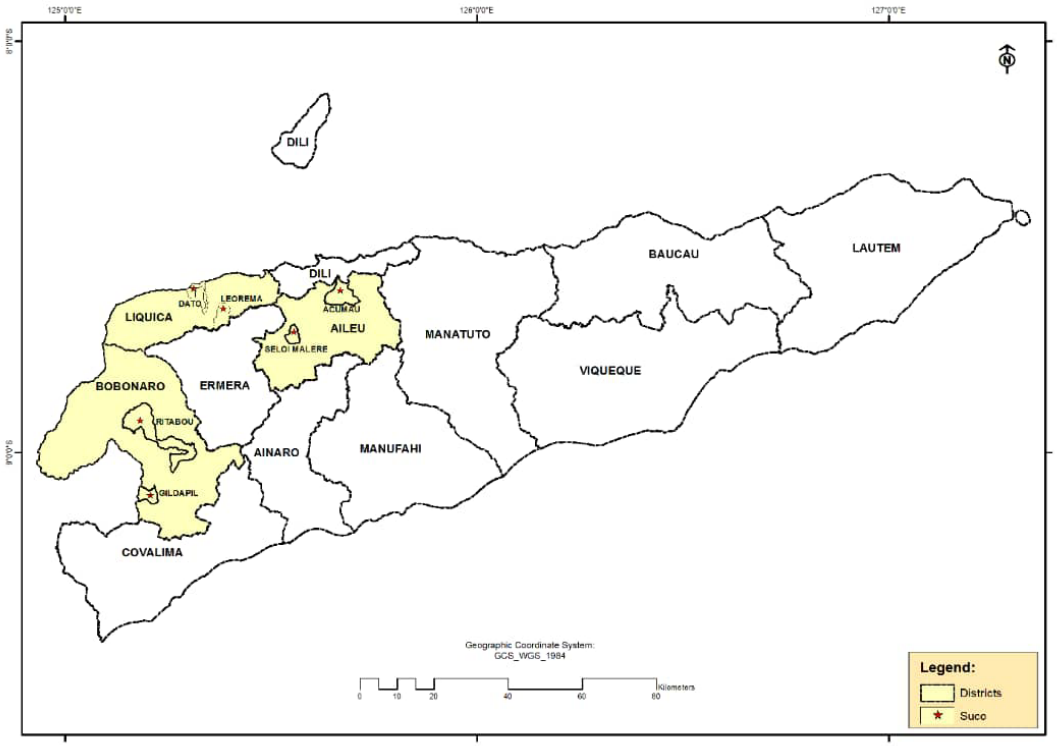


Figure 7-1 Map of selected suco locations in Timor-Leste for consultation on pig disease knowledge.

Data collection

The research methodology was qualitative using semi structured interviews with 6 village leaders, 15 veterinary technicians, and 133 farmers. Two focus group discussions (FDGs) were held each village (one with women, one with men). Three Timorese researchers conducted the study (Henriqueta da Silva, Abrao Pereira, and Olavio Morais). The team started by briefing the MAF directors at each district animal health centre about the proposed program. The study was conducted in December 2020.

Village leader interviews

Interviews with village leaders (chef de sucos) were conducted by Henriqueta da Silva. There were 20 questions including several open-ended questions relating to their own pigs, village pig keeping methods, information sources, disease reporting, frequency and nature of MAF visits, collection of samples from pigs, impact of ASF outbreak, and pig disease surveillance in general. Interview guide is included in Appendix 1.

Focus group discussions with pig farmers

A total of 133 people attended the three gender segregated focus group discussions (71 women, 62 men). Participants were selected and organised by the village leaders based on pig raising experience. The aim was to invite around 12 people to each FGD but it depended on who was available at the time. Sessions were held in Suco halls took around 2 hours and were audiotaped. Basic demographic information was obtained by a short interview with each participant Henriqueta was moderator and Abrao was note taker who occasionally participated in the discussion to probe for clarity and in-depth understanding. A research assistant was master of ceremony and assisted with photo taking, recording and consent forms.

There were five sections for each FGD related to 1) benefits and challenges of pig raising, 2) pig disease identification, importance ranking and treatments, 3) impacts of ASF, 4)

reporting to MAF and level of satisfaction with MAF services, and 5) information sources and delivery preferences. The FGD guide is at (Appendix 1).

Interviews with veterinary technicians

Interviews were conducted by Henriqueta da Silva at MAF municipal offices. A total of 15 vet technicians were interviewed: Liquica (4), Aileu (4) Bobonaro (7). There were 37 predominately open-ended questions relating to experience with pigs, their role as vet technicians, challenges to working with pig owners, frequency of visits and reporting, pig disease identification and treatment, confidence with taking samples and doing post-mortems, and suggestions on how to improve animal health services. Interview guide is included in Appendix 1.

7.1.3 Results

Village leader knowledge and experience with pig diseases

Village leaders were mostly male (5) with one female. Ages ranged from 30 to 59 years (average 45 years). Three leaders had secondary school education and three had postsecondary education. Length of time as village leader ranged from 13 months (female) to 17 years with most around 3 to 10 years. Main income source was leader salary plus agriculture (cropping, livestock) or a small local business.

Reporting pig diseases.

All village leaders said they report to MAF if farmers report dead pigs to them. However, the Acumau village leader explained that some farmers don't bother reporting to them or MAF because they know there will be little response due to lack of field staff and resources. The Gildapil village leader summed up several responses with the following quote:

"*Some people report directly to MAF, some report through Village leader, some people did not report either to Village leader or MAF. Some people are reluctant to report because even if their pigs get vaccine or treatment they still died."*

Reported visits by vet technicians in 2019-20 varied from twice a year (Leorema), once with national team (Dato), no visits (Acumau), twice a week (Seloi Maralae), twice a year (Gildapil) and visit from livestock technician from Acumau in Ritabou. It would appear that remote villages get less visits although may also depend on where staff are based. Reasons for the visits varied from regular inspection of livestock/ part of officers planned visits, a UNTL internship program, and community request for assistance.

Information sources and assistance

When asked who people go to for information about pig raising, three leaders said they were the first point of call for farmers about pig diseases and would then coordinate with livestock technicians about treatment including vaccinations. The other three leaders tended to contact family members and friends to get advice on how to resolve pig diseases as well as village leaders and field technicians. One of these leaders was more specific in stating that 40% of the time they relied on relatives, 30% on village leaders, friends 15% and technicians 15%. One person mentioned learning from TV and radio about ASF. When a pig gets sick or dies, most village leaders said that farmers try to treat the pigs with traditional medicines first. If that doesn't work or pigs die, then they might inform village leaders or livestock technicians or just bury the pig.

Impacts of ASF

For those villages that had ASF outbreaks such as Leorema, Dato, Acumau, Gildapil and Ritabou, the impacts were income loss, psychological distress, potential health impact from consuming dead pigs, pig meat loss for cultural celebrations, and reluctance to raise pigs.

Village leaders held the view that farmers would agree to MAF staff taking skin and blood samples from a live pig or organ and blood samples from a dead pig if laboratory analysis could identify the causes. However, the purpose would have to be explained well and results delivered which is not common due to lack of field service.

Suggestions on how to provide information to communities

1. Train farmers in animal husbandry because pigs have high socioeconomic value.
2. Government should establish local animal health services centres.
3. Share information directly with community through regular meeting at Suco level, at Church after Sunday mass or via Television and local Radio.
4. The field technicians should come and share information directly to Aldeia level. Information also can be provided through Community Radio because some hamlets do not have electricity for TV.
5. Use social Media, WhatsApp (village leader and hamlet leaders). Provide information Board in the Suco or provide through church (During Mass or Church Public Board).
6. Government-MAF need to increase number of field tech staff and ensure the field technicians are well informed and have resources needed to visit famers so to provide a better service.
7. MAF staff continue conducting public awareness particularly about animal diseases and how to prevent and treat them. Consider establishing farming groups to be a pilot/example for others.

Farmer knowledge and experience with pig diseases

A total of 144 farmers were interviewed prior to or after the focus group discussions to get the following background information (Table 3). Eleven of these farmers did not end up attending the FDGs. Ages varied from 17 to 71 years. The more remote villages in Aileu and Bobonaro had greater proportion of people with no schooling or primary education only. Liquica farmers had higher education levels, probably due to proximity to Dili and shorter distances between towns. Most farmers were middle aged with Dato having the youngest group.

Table 7-1 Gender, ages and education of farmer respondents.

	Men	**Women**	**Ages (years)**	**Mean Ages**	**Education level**
Leorama	7	5	21 to 61	39.5	**81% secondary school** 8% post-secondary 8% primary school 3% no school
Dato	6	8	17 to 40	25.6	
Acumau	18	20	19 to 71	43	**42% no school** **31% primary school** 21% secondary school 5% post-secondary
Seloi Marele	11	9	24 to 59	42	
Gildapil	9	11	19 to 52	34	**27% no school** **33% primary school** 27% secondary school 12% post-secondary
Ritabou	11	17	25 to 68	44	

Income sources were mainly cropping and livestock especially in the remote areas. Income was more diversified in sucos closer to town centres where opportunities for salaried jobs and small businesses was greater.

Pig keeping, herd composition, deaths and disease symptoms

Pig keeping methods varied within districts and between sucos (Table 2).

Table 7-2 Methods for keeping pigs (data are a count of the number of responses).

Method	Leorema (far)	Dato (near)	Acumau (far) *	Seloi M (near)	Gildapil (far) *	Ritabou (near)
Free roaming all the time	0	0	0	0	0	0
Tethered all of the time	3	0	20	2	0	5
Housed all the time	4	14	10	5	19	16
Housed with some free roaming or tethering	5	0	8	12	0	3

*traditional law to confine pigs

Pig herd composition in each district was similar with mostly sows, more castrated boars than full boars and more piglets at 4-12 months than 0-3 months. The average number of pigs per household was highest in Dato and lowest in Gildapil. Pig deaths in the last year totalled 328 amongst 42 FDG participants, affecting all pig age groups. Symptoms were similar across all districts with some variation depending on farmer observations. The sucos near towns had a higher proportion of households with pig deaths.

Problems with raising pigs

Lack of pig fodder and pig diseases were the most mentioned problems (11 out 12 groups). Lack of water supply and labour/materials to make good pens were listed by 7 and 6 groups (men and women) respectively. Lack of veterinary drugs and assistance from field technicians, lateness of responses and lack of information or knowledge on pig raising were also brought up by several groups, mostly men.

Groups were asked to allocate pins to the most challenging problems. Animal health issues were the highest ranked problems including 1. Pigs dying, 2. No vet drugs and 3. Disease incidences. Interestingly, mostly mens groups chose pigs dying whereas womens groups were concerned about lack of veterinary medicines. The high labour requirement of pigs was ranked fourth and mostly by womens groups. Medium ranked issues included lack of animal health services (men only), late responses from field technicians (women) and lack of knowledge amongst farmers about pig diseases and how to build pens (women only).

Pig disease, clinical signs

Farmers were unable to name exactly which diseases were affecting their pigs, so they described symptoms only. There appear to be two main groups of symptoms; ones related to viruses (CSF and ASF) and parasites (external and internal, Appendix 1). There was no difference between men and women group responses.

The disease symptoms that occurred after September 2019 were more acute with groups reporting sudden death or after showing signs for only 1-2 days. Several groups commented that the disease spread quickly. However, Gildapil had few deaths during this period. Both men and women groups from Gildapil said all pigs are confined and they don't trade outside.

Pig disease ranking

From the previous list of disease symptoms, participants were asked to choose the five most severe diseases by allocating pins according to level of importance. The symptoms associated with ASF were considered the most severe, particularly sudden death.

Most groups talked about “Tatoha” which refers to hypersalivation, difficult breathing, and coughing. Body changes such as red spots, swollen head, fever, lameness/lying down all the time and loss of appetite were often associated described in addition to Tatoha. Less severe symptoms related to parasites (itching, diarrhoea, weight loss) as they did not kill pigs and occurred over a longer timeframe.

Table 7-3 Ranking activities with women and men at focus groups at Gildapil, Lolotae, Bobonaro.

Impact of ASF

Impacts of ASF expressed by households were economic, social, emotional, public health and technical. All groups mentioned feeling sad and stressed, income loss and shame at not being able to provide pigs for ceremonies as shown in the quotes below. Five groups said it was more expensive to buy pigs now. Farmers from three groups said they did not want to keep pigs anymore. People explained that they now use goats, cattle and money as gifts.

Leorema women- *We feel sad and lost because we kept the pigs until adults then they died. (We have lost our energy and the feeding investment).*

Leorema men- *We are unable to attend or respond to cultural activities (funeral and other cultural purposes). We feel socially ashamed because we should bring pig but we have no pig.*

Dato women- *It really affected our household income because we have no more money to sell and respond our needs.*

Acumau women- *We feel scared to eat pork and are really careful because it will affected our health (transmitted).*

Ritabou men- *Pig prices are expensive compared to before outbreak so it really impacts our cultural needs (price of young pig 6-8 weeks is USD 25-50 but now increase to USD 100-200) The price increase is crazy because many pigs died due to ASF. For the adult pig now have a same price to compare with cattle and buffalo price.*

Changes that some farmers have made to pig management as a result of the ASF outbreak included:

- Confine and upgrading pens (L women, D women and men, S women, R women)
- Tethered tightly and under canopy (L women, D women, A women,
- Relocate to a safe area (L women)
- Keeping pen and pigs clean if water available (L men, D men)
- Not allow family member to bring pork form sick or dead pig to home (L men)
- When pig die we should bury, if anyone bring pork from unknown place then all the leftover should be buried. (L men, A women, A men,
- We avoid consuming pork from other place because we worry it will kill our pig when we feed the pig with leftover. (D women)

- Try to coordinate and communicate with the field techs (D men,
- Provide proper diet (D men)
- Try to minimise number of pigs (S men)

At the Acumau men focus group, they summarised the following lessons learnt:
"Good lessons we take from this outbreak is we should confine or tether pigs to ensure they don't jump to destroy each other and eat leftover and get sick".

Reporting to MAF
Only 25 people (10 women and 20 men) out of 133 attending the FGDs had reported to MAF (18.8%). The reasons given for not reporting include:

- If we contact MAF it would be hard for them to come because we are far away from their place/office (2 groups) and sometimes they just don't come (1 group) and they don't have schedule (1 group)
- Farmers do not know the technicians and don't have their contact numbers (4 groups).
- We try to use traditional medicines
- Farmers don't trust the field technicians because pigs die after vaccination (2 groups)
- Farmers don't understand diseases and wait for pig to get very sick.
- Not enough technicians (1 group)
- We never get information from government (2 groups).
- No need to contact MAF because our pigs are healthy. If they do get sick we do inform.

Of those that did report to MAF, the reasons for reporting to were to; get assistance, treat sick pigs, attend to our request, inform us about disease prevention, get support for ongoing disease like ASF, tell us what to buy and give us drugs. Farmers said that technicians treated their sick pigs, gave injections, took samples, advised on how to build pig pen and asked about symptoms. However, seven groups said results of diagnosis did not come and three groups said they did receive results. One group explained the test result did not come as technicians have no transportation or operating funds. Hence most groups were not satisfied with the frequency or quality of animal health services.

All groups said they wanted animal health services to improve. They put forward suggestions on how to do this. Most farmers agreed with diagnostic sampling and post-mortems if it meant knowing what was wrong with their pigs and how to prevent further illness or death. There is some reluctance to euthanize pigs if the reasons for post-mortem are not clearly explained to them, and when there is still hope that treatments may work.

Suggestions on how veterinary services could be improved included:

- They should come and observe directly. We suggest that field technicians need to come and assist, advise and lead us in the field on how to raise animal and control animal health carefully (2 groups).
- We suggest that the government should give adequate operational support fee for the field technicians to reach all aldeias in a suco (1 group).
- Need additional staff because one person unable to covered whole area (3 groups).
- They should have a schedule to visit farmers not wait for us to call them and contact through local authorities (2 groups).

- Need to visit minimum of once every 3 months or 3 times per year or monthly and do vaccinations (3 groups).
- Field technicians need to deliver public awareness sessions so communities can understand and know who to contact if they have cases (4 groups).
- Farmers need technicians to be in the field for 75% of their time and only 25 % at office. Don't waste time at office or just visit at the Suco level, they need to serve at the aldeia level.

Information sources and communication preferences

Table 3 shows that most people rely on family, friends and neighbours for advice on treating sick pigs. It is easy and convenient to contact them at the time. Technicians are consulted less often either by phone or if visiting the village. Mass media and social media gives sporadic information on raising and treating pigs.

Table 7-4 Information sources and delivery methods for pig health and husbandry.

Information source	Type of pig information	How often	Delivery method
Family/relatives	Traditional medicine		Contact directly
Friends	Traditional and modern medicine	When pig get sick	Contact directly
Neighbour	Traditional medicines	When pigs died	Telling (verbal)
Vet Technician	How to treat sick pig and prevent diseases	Every 3 months	Directly face to face or by phone
Livestock extensionist	How to treat sick pig		
Television	Information on raising pig, pig diseases, how to prevent/treat.	One a year	Announcement on TV
Ministry of Health	About pig diseases	Not regularly	
Chief of Suco or Aldeia	Medicine/ disease prevention	When pig getting sick	Telling directly or by phone call
		Not regularly	Community meeting
Those who studied animal health	Medicine and how treat	When we have a link	Via phone call
Social Media and Community radio	Pig diseases, how to prevent diseases, Confining pigs	Sometimes.	Radio, facebook and WhatsApp

All groups said they need information on how to raise pigs, prevent diseases and treat sick pigs. Preferred communication was village visits, community meetings, scheduled programs, mass media, use of posters and pictures. More specific suggestions are in Appendix 1.

Veterinary technician knowledge and experience with pig disease diagnosis, reporting and treatment

Veterinary technicians were mostly male (11) and five females. Ages ranged from 27 to 48 years (average 32 years). Four technicians had secondary school education and twelve had postsecondary education. Length of time as a veterinary technician ranged from 4 to 17 years with average of 13 years.

Recognition of pig diseases, diagnosis and treatment

Most technicians could identify Lice, Parasites, Diarrhoea, and Scabies symptoms but only two people mentioned they could identify Screwworm fly. About half of the technicians said they recognised CSF and half said ASF, indicating there is probably confusion between the two viruses. However, a couple of technicians were definite with describing the symptom differences. All technicians could describe disease symptoms and how to treat pigs for each condition, although antibiotics were suggested by 10 staff for ASF and CSF.

Frequency and confidence in sampling and post-mortem in the last 12 months

Most staff had no or little experience with sampling or post-mortems (Table 4). A few older staff had more experience which was reflected in higher confidence levels (Table 5). Staff were more familiar with taking faecal samples than blood or skin. Only one person was very confident with post-mortems.

Table 7-5 Frequency of use and confidence with sampling activities for disease investigation reported by veterinary technicians (data are the count of the number of responses).

Sample type	Not at all	1- 4 times	5-10 times	11-20 times	>20 times
Blood	6	5	1	0	0
Faecal	4	5	2	1	0
Skin	7	2	0	2	1
Post-mortem	8	4	0	1	0

Sample type	Not confident	Not very confident	Quite confident	Moderately confident	Very confident
Blood	5	2	4	0	0
Faecal	2	4	2	0	4
Skin	4	3	0	0	4
Postmortem	8	0	3	0	2
Total	19	7	9	0	10

Difficulties in getting samples, sending to Dili and how to improve the process

Only two technicians had experience with taking samples and sending them to Dili. Reasons given for not taking samples and/or sending them to Dili Laboratory included 1) lack of equipment, 2) no skills and 3) results never coming back even if sent. The following quotes highlight staff and farmer disillusionment with lack of results.

“Samples were sent to Dili but until now we did not get result from the lab to confirm to our farmers (samples taken many times but never send back the result to us).”

Suggestions on how the system could be improved included 1) making sure results were returned to technicians and farmers, 2) provide necessary equipment and training for collecting samples, 3) increase number of technicians and 4) provide better operational support.

Challenges of visiting and working with farmers

One of main challenges raised by technicians related to farmers not trusting or accepting them for the following reasons:

- Pigs die even after treatment, so farmers think technicians have killed their pigs
- Frequent delays with getting vaccinations to farmers due to not enough staff, not enough vaccines/drugs and lack of operating budget
- Young people not interested in being farmer and don't take information or advice.
- No treatment for ASF so we can't help the farmers
- Hard to identify diseases and farmers don't understand about treatment

Other challenges related to limitations of farming communities such as:

- Farmers have no money to call MAF
- Hard to find good food for pigs due to covid 19
- Farmers sometimes not present when technician arrives

The following quote summarises the challenges faced by technicians working with farmers:

"Sometimes I went to the location but when I arrived the farmers were going to doing another activities, sometimes they report that their animal were sick but when I arrived their animals are free roaming so hard to treat. Distance of location sometimes difficult to reach. No freezer to storage the vaccine so I have to go to Aileu town and get the vaccine and go to field. No operational support (fuel and per diem)."

Challenges for farmers reporting to technicians

The main reasons farmers tend not to report sick or dead pigs to MAF technicians included:

- Farmers say they have no time to report to MAF immediately
- Farmers don't really have knowledge regarding animal health.
- Some people were told that field techs will charge every visit so will not report to MAF.
- Distance from technician residence to the suco is too great so many people do not care if their pigs died.
- Farmers hear that ASF has no effective treatment or vaccine, so they are not interested to report it.
- Farmers do not report sick or dead pigs because their pigs die suddenly.
- Farmers do not know how to report a case to field techs so lack interest to do it.
- Because most pigs are free roaming, so it is quite hard for farmers to observe the symptoms or clinical signs and pass it on to the field techs. Farmers just report when they lose their pigs not beforehand.
- Sometimes farmers directly report cases to MAF but then they do not get a response.
- Many times the cases reported by farmers are not clear.

Challenges for technicians to report to MAF

Nine of the 16 technicians said there was no problem with sending reports to MAF. However, some people expressed the following challenges to reporting cases directly to MAF.

- Treatment forms are big and heavy to bring whilst visiting the farmer.
- Sometimes the drugs run out, so we did not provide treatment report.
- Farmers just come to office asking for information when their pigs died, and it is hard to treat the animal because most farmer keep their animal free roaming.
- We did not get a real number of cases from farmers.
- When we are able to report the cases to national office, the response is always late.

Ways to work with pig keepers regarding disease surveillance, reporting and treatment

Four technicians suggested it would be easier and more effective if they could provide information and assistance to small groups of pig owners. Several technicians said that regular meetings with farmers was needed and good coordination between technicians and farmers on how to raise pigs using simple technical language. One person mentioned the need to strengthen cooperation between field technicians for information sharing on ASF outbreaks.

Two people emphasised the need for all technicians to encourage farmers to confine their pigs. Three technicians said that getting results back to farmers was important. One person thought that field technicians need to be trained regularly to update information related to their profession.

Information for pig farmers

Most technician responses were general in nature stating that farmers needed information on animal husbandry and animal health. There were three main suggestions on how to deliver information to pig farmers; 1) regular farmer training and 2) providing a visual design of technical module or brochure that is easy to understand, 3) video and pictures, radio, television, local radio and posters. One person suggested providing farmers with an example to follow.

How to be a more effective technician

To be more effective in their role as veterinary technicians, seven people said they needed more operational support (transport, equipment, drugs, PPE, cool box), six said they needed more capacity building in animal health services, two staff said there should be more staff and one person suggested permanent contracts.

7.1.4 Discussion and Conclusions

This study, the first in this small research activity project, sought to learn from village leaders, farmers and veterinary technicians about barriers and opportunities for case detection and investigation of pig diseases in three municipalities in Timor-Leste.

Across the three, we found large agreement on the barriers to farmer reporting and about suggestions to overcome these. Some gaps in farmer knowledge about pig diseases and requests for training on issues ranked as important to farmers offer opportunities for engagement between farmers and technicians. Interaction that is regular and valued by farmers are key to building relationship and trust, which are prerequisites for reporting. In

order to provide this service, all recognised that the technicians need training themselves and to be provided with resources to enable scheduled visits to villages.

The main barrier to effective pig disease surveillance, reporting and treatment that was identified relates to loss of trust between farmers and MAF staff. The lack of trust stems from weaknesses in the surveillance system, limited capacity for staff and farmers to diagnose and treat diseases, and lack of a structured extension program to facilitate ongoing learning, relationships, and capacity building.

Other barriers in the surveillance system include lack of operating budget and distance to visit remote villages, lack of timely reporting (if at all) by farmers/village leaders, lack of timely response by MAF staff, and lack of diagnostic outcomes feedback to district staff and their farmers. These issues act as disincentives for both farmers and MAF staff to report cases.

Communities are not satisfied with animal health services provided by MAF, and would like more regular visits by more staff, proper diagnosis and feedback. They would also like well-designed education programs to be delivered using multiple communication channels.

Veterinary and livestock technician skills need upgrading for disease diagnosis, treatment and reporting, and more operating support to enable them to visit farmers more regularly and provide educational programs. This would help to rebuild trust between MAF and farming communities.

This study led to design of a pilot community engagement program in 2021.Technicians were trained in community engagement theory and methods in March 2021. Each district chose one suco to run a structured farmer learning program on pig diseases, biosecurity and husbandry in November/December 2021. An evaluation was conducted in February 2022. The outcomes of these activities are described in next report section.

7.2 Community engagement training and trial activities

7.2.1 Introduction

Community engagement (CE) for veterinary technicians was identified from the qualitative study as a key action to improve pig health and passive disease surveillance. Progressing this priority was possible due to the change in project activities under COVID restrictions.

Building trust between veterinary technicians and pig farmers is essential for improved animal health and disease surveillance. The purpose of this activity was to provide training and field experience in CE and then evaluate short term outcomes in terms of changes in farmer/staff knowledge, skills, confidence, and motivation as well as improved pig health and husbandry practices.

7.2.2 Materials and Methods

Community engagement workshop

A two-day community engagement workshop for 31 livestock and veterinary technicians was conducted at the Municipal Centres of Agriculture Services in the three target municipalities (Aileu, Bobonaro and Liquica) during July 2021 (See report at Appendix 2). There were 8 females and 23 males of which 14 staff were livestock technicians, 13 veterinary technicians, 3 official livestock and veterinary officers, 2 administrative staff and one agronomist.

The purpose of the workshops was to increase staff capacity to effectively engage with communities for the purposes of 1) identification and reporting of pig diseases and 2) providing preventative health and husbandry advice. The expected outcomes were for veterinary technicians to:

- be proactive in applying CE methods in their daily work
- build / rebuild trust with the community
- work more effectively individually or as group in collaboration with various communities
- have ability to confidently identify a diagnostic approach to pig health problems, and
- design village plans for livestock and veterinary services in the

Topics, activities and discussions covered at the workshops included 1) understanding community engagement (aims and methods), 2) staff experiences with community engagement, 3) suco analysis exercise 4) selecting one suco and designing an enhanced CE program, 5) how to monitor learning outcomes. From the suco analysis conducted at each training workshop, each district team selected one suco to trial a 3 month program of community engagement and farmer learning. Selection criteria for the suco were 1) not been recipient of previous livestock project activities, 2) not close to the municipal office 3) a high level of pig problems and 4) high willingness to learn and work with MAF staff. The selected sucos were Gildapil (Bobonaro), Laodahar (Liquica) and Maumata (Aileu).

Figure 7-2 The training workshops for improved community engagement for pig health were repeated at Aileu, Bobonaro and Liquica for a total of 31 participants.

Trialling community engagement approaches for improved pig health and husbandry

A structured learning program for pig farmers was delivered over 4 weeks by the veterinary technicians that covered: 1) general introduction, 2) pig nutrition and feed formulation, 3) sow, piglet and boar management, 4) disease identification and treatment, 5) biosecurity protocols including building and cleaning secure pens, and how to report sick or dead pigs. Around 15 households attended each 3-hour session, often sending different family members to sessions depending on their availability. In the Gildapil session, some farmers from adjoining villages asked to join as they had not had pig training before.

Staff visited every 1-2 weeks after the training to motivate farmers and monitor practice changes. Staff reported weekly to the project manager (Olavio Morais) on progress, farmer practice change and any problems arising.

Prior to the farmer training, MAF staff underwent refresher training by Olavio on pig feed formulation according to growing and lactating stages. Olavio also conducted parasitology training for field technicians including performing a faecal flotation test and analysis using microscopy for worm eggs.

Figure 7-3 Training in pig feed formulation for veterinary and livestock technicians at Gildapil and Maumeta.

Figure 7-4 Biosecurity training at Gildapil and breeding training at Laodahar for veterinary and livestock technicians.

Evaluation of community engagement trial

Henriqueta da Silva was employed to conduct the evaluation with support from Olavio Morais during February and March 2022. Individual interviews were held with 27 farmers (54%) who had attended the pig health and husbandry training. Focus group discussions were held with each district team at their offices.

7.2.3 Results

Evaluation of community engagement activities: farmer interviews

Table 7-6 The district, gender, age and pig ownership breakdown of farmer interviewees for evaluation of the enhanced community engagement activities by veterinary technicians.

Sucu, Municipality	Maumeta, Aileu	Loidahar, Liquica	Gildapil, Bobanaro	Totals
Respondents	9	10	8	27
Genders	5 F, 4 M	7 F, 3 M	6 F, 2 M	18 F, 9 M
Ages (years)	21 to 75	18 to 60	19 to 26	19 - 75
Number of pigs	1 to 6	1 to 14	1 to 2	1 - 14
Confinement of pigs	5 farmers	9 farmers	8 farmers	22 (75%)

F, female, M, male

Most useful training sessions

Farmers thought that the feeding and biosecurity training was most useful (Table 7.6). Breeding and health management were seen as less useful possibly because farmers know how to breed pigs already. Feed formulation using uncooked feedstuffs and building biosecure pens are new practices for Timorese farmers.

Knowledge changes

Farmers were asked to rate if their knowledge had increased following the training sessions for each topic. Table 7-8 shows that Aileu farmers did not feel they had learnt much but this could be due to a lack of interest due to the older age of farmers in this group (Olavio pers comm). Liquica farmers thought their knowledge of feeding and disease management, biosecurity and pen construction had increased with only a small increase for breeding knowledge. Bobonaro farmers were similar in response to Liquica farmers with mostly moderate to high knowledge increases for feeding, disease management and biosecurity.

Table 7-7 The training sessions by veterinary technicians that were found most useful by pig farmers (n = 27).

	Feeding	Biosecurity/ Pen construction	Health Management	Breeding	All Topics useful
Maumeta	6	3	1	0	1
Loidahar	4	6	1	1	2
Gildalpil	7	5	0	0	0
Total	17	14	2	1	3

Skills changes

Skill increases varied greatly from no change where farmers had not adopted any new practices to moderate increases from changing feeding regimes or disease management. Pen construction provided farmers with new skills learning about how to build biosecure enclosures. Farmers need a longer period to practice these skills and become confident that they can help reduce disease incidence and lift productivity of their herds.

Table 7-8 Farmer reported changes in knowledge and skills from famer training sessions provided by veterinary technicians during the enhanced community engagement activity.

Topic	Change in knowledge / skills (count of responses)			
		Aileu	Liquisa	Bobanaro
Feeding	No change	0 / 0	1 / 0	0 / 1
	Small increase	5 / 3	1 / 2	2 / 2
	Moderate increase	1 / 2	4 / 5	4 / 2
	High increase	0 / 0	1 / 0	1 / 1
	Very high increase	0 /0	0 / 0	0 / 0
Breeding	No change	1 / 1	0 / 0	0 / 0
	Small increase	0 / 0	5 / 4	1 / 0
	Moderate increase	1 / 0	1 / 3	2 / 2
	High increase	0 / 0	0 / 0	0 / 0
	Very high increase	0 / 0	1 / 0	0 / 0
Diseases and health management	No change	1 / 1	0 / 0	0 / 2
	Small increase	0 / 0	1 / 2	1 / 3
	Moderate increase	1 / 0	5 / 6	3 / 1
	High increase	0 / 0	0 / 0	2 / 1
	Very high increase	0 / 0	0 / 0	1 / 0
Biosecurity	No change	1 / 0	0 / 0	0 / 2
	Small increase	0 / 1	1 / 1	2 / 1
	Moderate increase	0 / 0	6 / 5	4 / 3
	High increase	0 / 0	0 / 0	1 / 1
	Very high increase	0 / 0	0 / 0	0 / 0
Pen construction	No change	1 / 1	0 / 2	0 / 0
	Small increase	1 / 0	3 / 3	4 / 1
	Moderate increase	2 / 2	4 / 4	2 / 4
	High increase	0 / 0	2 / 1	1 / 1
	Very high increase	0 / 0	0 / 0	0 / 0

Practice changes and challenges

Eighteen of the 27 farmers interviewed (66%) said they had changed feeding practices. Changing to dry feed mixes using locally available ingredients appealed to many farmers as it reduces labour and avoids contamination. Only 7 households interviewed had built pens (26%) due to the prohibitive cost of materials. However additional households are keen to build biosecure pens if they can afford it or be subsided in the future. The main challenges to continuing biosecure practices were cited as: cost of building pens (16), finding feed (6), lack of time (5), and pigs getting sick (2).

Figure 7-5 a) Eta interviewing farmer; b) Mr Agus and farmers with demonstration pen for confining pigs and improved biosecurity; c) Mixing an improved feed ration.

Motivation to report sick or dead pigs to MAF

Farmer motivation to report to MAF has increased substantially as a result of learning about the importance of good disease management. Table * shows the change in motivation before and after the training sessions.

The reasons for being more motivated to report were: to prevent spread of diseases (6), gaining knowledge from training (3), getting information from the technician in Aileu (Anais) (5), realising there is a need to report (1).

Table 7-9 Change in motivation for farmers to report to pig diseases to MAF staff after involvement in the community engagement activities.

Motivation level	Before training	After training
Low	12	0
Medium	8	4
High	3	19

Future plans and assistance needed

Thirteen respondents (48%) wanted to build new pens for confining pigs, 9 respondents (33%) wanted to buy more pigs and 5 respondents (18.5%) had no plans. All farmers

wanted more regular training on pig husbandry especially diseases, materials for making pens, treatments for pigs, additional training on feed formulation, and to be provided with pigs.

Evaluation of community engagement activities: technician group interviews

Table 7-10 The profile of technicians interviewed to evaluate the community engagement activities (12 technician respondents, 42% of all technicians who attended CE training).

	Aileu	Liquica	Bobanaro
No. of respondents	3	4	5
Age range	32	30 - 52	32 - 36
Vet technician	1 male	2 males	4 males, 1 female
Livestock extension	2 males	2 males	0
Attendance at farmer training	Anaias, all Arthur, 2 Cirilio, 2	Attended all	Attended all

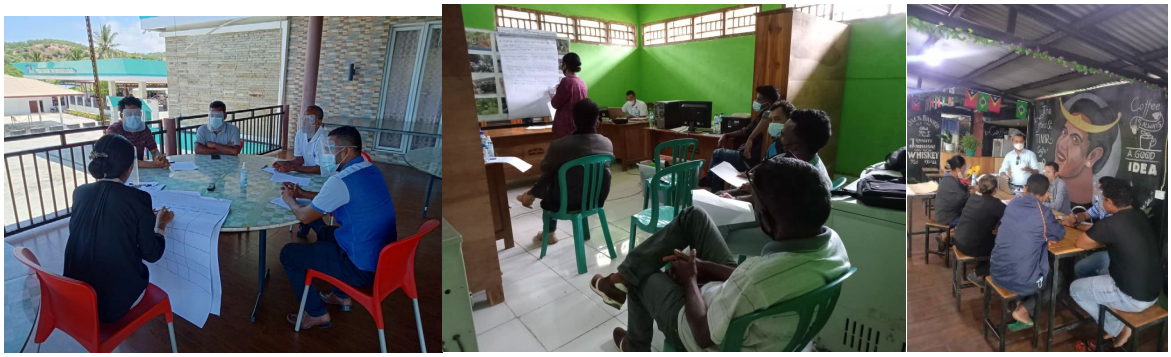


Figure 7-6 Focus group discussions with technicians at Liquica, Aileu and Bobonaro, respectively.

Positive aspects of farmer training

Aileu group said “farmers learnt how to build a pen, prevent disease, know when female ready to mate, how to formulate and prepare uncooked food, and which treatment to use for different diseases. Farmers learn how to change from traditional to more modern pig raising system.”

Liquica group said “farmers get knowledge about breed selection, feed formulation and preventive and treatment measures.”

Bobonaro group said “farmers learnt new feed management systems including how to formulate food and silage. They know how to identify disease symptoms, transmissions, how pigs get sick because fed the kitchen or garden scraps or people who carry diseases into their pen so that is why they really paid attention to biosecurity.”

Positive aspects of follow up visits

Aileu group said “We get to know farmers well with regular visits. We are able to reinforce message about sanitation. Farmer slowly learn about disinfecting and cleaning.”

“Farmers begin to understand role of MAF staff and identify veterinary technicians and livestock technicians with good communications between farmer and field staff.“

“Farmers can explain why they cannot adopt some practices. Farmers learn about their capacity and give feedback on limitations such as lack of money to buy pen materials or milling machine or expensive ingredients.

Liquica group said “We see that some farmers started confined their pig using local materials; some of them know how to prepare the food with available local ingredients including using silage, and the number of pigs increase.”

Bobonaro group said “We see that farmers really practice prepared silage or doing some combination of food for pig diet. They used boots when entering the pen; disinfecting pen; and before feeding pig they clean the pen. Some farmers from neighbouring village also willing to have a same program.”

Negative aspects of farmer training

Aileu group said “Many farmers did not apply learning from the training, e.g., biosecurity, feeds. They prefer to use traditional medicines and methods.”

“Some farmers attended the socialization session but did not attend other training. Some don’t pay attention during the training.”

Liquica group said “Some farmers not adopt biosecurity practices or pens. They were assuming that the project would offer pigs and materials for pen construction to all not just demo farmer (social jealousy).”

“Farmers have limited time to attend so different family members attended.”

“No cross visits to place with good example. No videos to show them.”

Bobonaro group said “Farmers think that all food will be given by MAF technicians but they did not get. Farmers become unmotivated to attend.”

“Only one member selected to have pen construction from 15 participants so they unhappy because they did not have a good pen.”

“Field staff felt that they need fuel support and accommodation when they provide training in the far distance village not just per diem”

Negative aspects of follow up visits

Aileu group said “Some farmers found regular visits were intimidating as if they were being coerced to build pens etc.”

“We found that some farmers not care about pigs as they free roam and often die.”

Liquica group said “We found that farmers not build pens because cannot afford materials. Farmers prefer to use traditional methods and medicines. Farmers not motivated to report sick pig as they just treat with traditional medicine and hope they recover.”

Bobonaro group said “Farmers want free pigs and biosecure pens. Some materials unable to buy in Maliana (nipple drinker) so they did not install.”

Support or activities farmers need now

Aileu group said 1) Cost benefit analysis training; 2) Design training to specific farmer needs/situation; 3) Continuation of training and 4) More training about feed formulations and housing management.

Liquica group said 1) Continue training about husbandry system and expand more biosecure pens. 2) Run cross visit for farmers, 3) Run cross visit for technicians, 4) Extend pilot to other village or another group not only in this village.

Bobonaro group said 1) Vaccination and treatment for animal pig health 2) Extend training and demo pens to other farmers in the suco and to neighbouring sucos.

Suggestions on how we could improve pig husbandry training sessions and follow up visits

Ailieu group said 1) Determine target farmers with suco head, 2) Provide methods and use simple locally available material for farmers to apply in practice 3) Visit farmers twice a week will really show us good changes; 4) Involve local authorities visit farmers.

Liquisa group said 1) Farmers propose and ask MAF to provide pigs and construct pen for them, 2) Need to suggest to MAF to add more staff to support them because only 4 of them have to cover 23 Villages.

Bobonaro group said 1) Provide pig for all 15 farmers who participated the farmer training because they find hard to source the pig from other place due to ASF outbreak. 2) MAF need to continue this program not just depend on pilot project where after the project no continuation because government don't invest to their community.

Table 7-11 Reported changes in knowledge, skills of technicians during the community engagement training and activity.

Aspect	Technical team location	Observations
Knowledge	Ailieu	Mostly small to moderate knowledge increase for each topic. One technician had high increase for pen construction (knew topic) and another rated high increase for disease identification and sampling
	Liquica	Mostly small to moderate knowledge increase for all topics. One technician rated high increase for disease diagnosis and treatments
	Bobanaro	Rated moderate to high knowledge increase for all topics
Skills	Ailieu	had small to moderate increase in skills for all topics. One technician had high skills change for sow management and faecal sampling
	Liquica	had small to moderate increase in skills for all topics. One technician had moderate to high skills increase for most topics
	Bobanaro	rated moderate to high skills increase for all topics
Motivation to work with communities	Ailieu	2 technicians had moderate increase in motivation, 1 technician had high increase in motivation
	Liquica	2 technicians had small motivation increase, 2 had moderate increase
	Bobanaro	4 technicians had moderate motivation increase, 1 had high increase
Confidence to work with communities	Ailieu	2 technicians had moderate increase in confidence, 1 technician had high increase in confidence
	Liquica	3 technicians had moderate confidence increase, 1 had high increase
	Bobanaro	1 technician had moderate confidence increase, 4 had high increase

7.2.4 Discussion and conclusions

The CE trial showed that training technicians in how to engage with local communities and mentoring them as they worked closely with farmers on pig husbandry and biosecurity over several months, led to improved knowledge, skills, motivation, confidence of staff and farmers, and better pig husbandry practices by some farmers.

The process of engaging households in social learning (i.e. learning on the job with staff and other farmers) allowed more regular interactions which built relationships and trust. The credibility of MAF staff improved in the eyes of farmers and gave the technicians more confidence to work with communities.

By addressing all aspects of pig husbandry (feeding/nutrition, breeding, disease diagnosis, health management, biosecurity), farmers felt more supported and said they would be more willing to report dead or sick pigs to MAF. This is an important lesson for effective passive disease surveillance in Timor-Leste. Genuine community engagement and structured farmer learning in integrated pig husbandry are essential prerequisites for passive surveillance which relies on community reporting of diseases. It also provides more opportunities for MAF technicians to be in villages and be informed of sick or dead pigs.

The farmers and veterinary/livestock technicians involved in this SRA in Timor-Leste have taken positive first steps to improving pig biosecurity and husbandry in the hope of reducing the risk of ASF, CSF and other diseases whilst also producing more pigs and healthier pigs for ceremonies, income and consumption. Continuation of operating support from MAF and Australian government would enable these farmers and staff to build on their experiences and improve systems further. It would also create opportunities for expanding farmer learning within each suco and to other sucos if they are interested.

7.3 Case study: Improved surveillance and diagnosis of pig diseases in Timor-Leste

7.3.1 Introduction

Small-holder pig farming is ubiquitous in Timor-Leste where it has cultural importance as well as contributing to human nutrition (Hunter et al., 2021). The disease status of pigs in Timor-Leste has not been determined in detail due to limitations in the veterinary service for active and passive surveillance (Weaver et al., 2014). Classical swine fever (CSF) was first detected in Timor-Leste in 1997 and became the focus of a vaccination program to reduce impact of this disease on pig production (Weaver et al., 2014). Surveillance for CSF, as one of three high national priority animal diseases has relied on active surveillance and serological tests to detect antibodies from vaccination or natural exposure to CSFV. One such survey identified 16-20% seroprevalence, indicating sub-optimal vaccine coverage and a potentially large at-risk population (Sawford et al., 2015). However, in the presence of vaccination, the antibody ELISA used was not able to determine if CSFV was still actively circulating and causing disease in pigs. Information about the impact of CSF on pig health requires identification of suspect cases of disease and diagnostic methods to detect the presence of CSFV. Improved passive surveillance whereby cases of pig disease are reported, and the cause is investigated has multiple advantages in addition to monitoring the effectiveness of control of CSF by vaccination. For example, with application of suitable diagnostic tests, this would contribute evidence in support of national freedom from foot and mouth disease virus (FMDV). This is required to develop international trade including cattle to support rural livelihoods (Weaver et al., 2014). Additionally, improved passive surveillance for pig diseases will identify and quantify endemic diseases impacting pig health to inform targeted support for farmers to maximise pig production.

The pandemic spread of African swine fever (ASF) through Asia (Mighell & Ward, 2021) reached Timor-Leste in 2019 where it was rapidly identified, despite limitations in surveillance, due to extensive death of pigs (Barnes et al., 2020; Smith et al., 2019). Subsequent to the initial outbreaks, active surveillance for ASFV identified 22-48% village level prevalence and suggested spatiotemporal clustering of cases (Phillips et al., 2021). Improved passive surveillance can provide on ongoing measure of the relative importance of ASF compared to other diseases as pig farmers adapt in conjunction with national efforts to apply disease control measures. The veterinary service in Timor-Leste could support pig farmers by determining the relative importance of endemic diseases and detecting emergency diseases with subsequent advice to farmers to improve production. The need for adequate funding and resources is a challenge for providing the desired level of animal disease surveillance (Weaver et al., 2014). Effective resourcing needs to address the effectiveness of disease detection through farmer reporting, have a sufficient pathway for sample submission and laboratory tests available to characterise the disease and suitable national disease database.

In the present study, passive surveillance for pig diseases was assessed under enhanced conditions for disease detection and reporting. A case study in pig disease diagnosis in the target municipalities of Bobonaro, Aileu and Liquica was performed concurrent with community engagement activities and continuing education for veterinary technicians. It was expected that the enhanced community engagement would provide improved reporting of disease by farmers. A broad case definition was used to capture a wide range of diseases. Specifically, ‘mortality of pigs due to suspected infectious causes’. To maximise the effectiveness of the passive surveillance, veterinary technicians were provided with resources and training to respond to all reports of pig disease by attending the farm and collecting data and specimens suitable for a diagnostic investigation. Follow-up laboratory tests using preserved samples were undertaken at the Berrimah Veterinary Laboratory (Darwin, Australia) due to circumstances imposed by COVID-19 which limited access to capacity development and training at the Dili Veterinary Laboratory.

The objectives of this activity were to:

- Demonstrate the value of community engagement for improved detection and reporting of pig disease.
- Assess the relative importance of the high priority animal diseases classical swine fever (CSF) and African swine fever (ASF) compared to other diseases impacting pig health.
- Identify hurdles in the diagnostic process relating to sample collection, submission to the laboratory, availability of required diagnostic tests, reporting and interpretation of the results to provide meaningful disease control advice.

7.3.2 Materials and Methods

Field surveillance and case investigation workshop

A workshop was conducted with veterinary technicians in February 2021 to provide guidance on responding to reports of pig disease for optimal diagnostic outcomes. This included designing forms to guide collection of information about the animals and the farm. Guidance was provided on collecting diagnostic specimens and planning preservation methods that would enable a laboratory supported diagnostic investigation when rapid transport of fresh tissues was not possible.

The five-day workshop was hosted at National Institute for Fisheries and Aquiculture Research Centre, Maubara, Liquica Municipality. Veterinary technicians and livestock technicians from the 3 participating municipalities were invited to attend (Aileu, Bobonaro and Liquica). The opening of the workshop included addresses by Dr Joanita Jong (National Director of Veterinary Services), Dr Horacio (Fisheries and Aquaculture Research Centre Director), and Sr. Mario da Silva (Director Municipal Agriculture Services, Liquica).

Delivery of workshop content included presentations in Tetum with PowerPoint illustrations and open floor for discussion, practical sessions and role play activities. Participation of the project team in Australia was by Zoom and WhatsApp video call with Tetum translation (Dr Olavio Morais). The program outline was:

1. Recognising, diagnosing and preventative advice for ASF and CSF. Presentation by Dr Olavio Morais. More experienced participants shared stories of distinguishing these 2 high impact diseases in the field and indicated how they could provide advice to farmers in the face of an outbreak.

2. Biosecurity implementation for pig farmers. At a time when ASF was occurring at high incidence across Timor-Leste, this was a key area of knowledge for technicians to communicate to pig farmers to minimise the impact of the disease. The sessions were a mix of theory and demonstration activities (e.g. correct use of PPE). Participants from Malina had previous training in implementing biosecurity for confined pigs.

3. General management of pig health (care, welfare, and nutrition). The objective of this session was to equip technicians with knowledge to assist pig farmers by providing advice for improved pig health and production, independent of diagnosis of high mortality diseases. This was considered to be key to increasing community engagement and building trust.

4. Post-mortem examination and sample collection (theory and practical sessions). Dr Olavio Morais demonstrated and then assisted group work practical classes for all participants.

5. Laboratory diagnostic test and surveillance guidelines. Led by Dr Feliciano da Conceicao (Head, Veterinary Diagnostic Laboratory, Dili). The session provided insights into the function of diagnostic tests and the samples needed.

6. Antimicrobial usage and antimicrobial resistance. An awareness session with presentations, role-play and practical activities led by Dr Abrao Pereira and Amalia Alves was conducted in collaboration with the Fleming Fund antimicrobial stewardship project (Menzies School of Health Research).

7. Responding to reports of pig disease. Role play sessions for all the participants on implementation of disease surveillance activities. A case study scenario required the veterinary technician role to communicate diagnostic, treatment and preventative advice to farmers. The session was assessed by Dr Morais with small groups working on the case studies to determine the knowledge gained and provide further clarifications.

The objective of the workshop was to equip veterinary technicians with standard operating procedures to effectively respond to any reports of fatal pig diseases when engaging with animal health activities at their posts and during the community engagement activities. Assessment of the learning outcomes was made during the role play sessions (Figure 6.1) and by a 25-question quiz at the completion of the training sessions (Appendix 1).

Figure 7-7 Activities at the field surveillance workshop for veterinary and livestock technicians included (a) collection of diagnostic specimens and (b) development of disease data collection forms aided by role-play.

a) *b)*

Disease surveillance and diagnostic investigation of pig mortality

Veterinary technicians from the 3 target municipalities were provided with equipment to obtain samples and fuel for transport to attend farms whenever they became aware of a pig disease fitting the case definition (mortality without an obvious non-infectious cause). Equipment included tools for necropsy, personal protective equipment and disinfectants to maintain biosecurity. Sample collection pots with 10% neutral buffered formalin and 80% ethanol were provided to preserve a broad selection of tissue samples from affected pigs.

The activity had sufficient resources to complete a laboratory diagnostic investigation of the first 25 cases identified starting from April 2021.

Identification of cases

Any disease reports fitting the case definition, irrespective of the location within the municipality were eligible for investigation. Veterinary technicians were asked to undertake weekly visits to farmers in the target sucos and provide information sessions on nutrition and preventative health of pigs as part of the community engagement activity.

Diagnostic investigation

Veterinary technicians asked farmers to provide details about the affected pig, other pigs on the farm and the farm management to complete the disease information form. A necropsy was performed on dead pigs. Preserved samples were held at the municipal office until the project team organised transport to the Dili Veterinary Laboratory and then on to Berrimah Veterinary Laboratory, Northern Territory, Australia.

Figure 7-8 Veterinary technicians attended farms when disease consistent with the case definition were reported. (a) They obtained the case history and farm data and (b) necropsy was performed on dead pigs and tissue samples were preserved on 10% formalin and 80% ethanol.

a) *b)*

Histopathology

Formalin fixed tissues were prepared for histopathology according to standard methods, stained with haematoxylin and eosin and examined by a veterinary pathologist. The following tissues were examined from each case: heart, lung, spleen, kidney, liver, jejunum and tonsil.

Molecular tests

Ethanol fixed tissues from each case were prepared for molecular tests for ASFV, CSFV and *Pasteurella multocida* for all cases, and for other pathogens if indicated by the case history and histopathology. A 0.2 g portion of each tissue sample, spleen for ASFV and CSFV and lung for *Pasteurella multocida*, from each pig were added to PBGS solution and homogenised with 0.3 g of 0.5 mm Zirconia/Silica Beads (TissueLyser II, Qiagen) prior to extraction of total nucleic acids using a magnetic bead–based extraction kit (MagMax CORE Nucleic acid purification kit, Thermo Fisher Scientific, Austin, TX) according to the manufacturer's instructions, using a magnetic particle handling system (KingFisher 96, Thermo Fisher).

The qPCR assays for ASFV and CSFV were conducted according to the method described by Haines et al. (2013). Molecular detection of *Pasteurella multocida* used a modification of the assay described by Corney et al. (2007). In each case the reactions were prepared using a commercial master mix (AgPath-ID one-step RT-PCR kit, Thermo Fisher) with 5 µL of purified nucleic acid in a total reaction volume of 25 µL. The assays were run on a QuantStudio 5 realtime PCR machine (Thermo Fisher) in normal mode, under the cycling conditions specified by the manufacturer for Ag-Path master mix. The fluorescence threshold was set manually at 0.05 and background was automatically adjusted. Results of RT-qPCR assays were expressed as cycle threshold (Ct) values when positive or classified as negative if amplification was observed after 45 cycles. Positive and negative control samples were included on each plate for quality control according to operating procedures compatible with ISO17025 accreditation.

7.3.3 Results

Field surveillance and case investigation workshop

There 28 participants (6 female and 22 male) representing the three target municipalities, including 13 veterinary technicians and 15 livestock technicians. Participants rated the workshop highly for providing information that improved their knowledge (100% good or very good). An outcome of the training was all participants recognised the value of post-mortem for diagnosis of disease in the post-evaluation questionnaire when prior to the workshop they reported feeling under-equipped to undertake post-mortem examinations. (Appendix 1). Post workshop evaluation also identified the desire for continuing education for animal health technical staff, including requests for more training from the knowledgeable mentors (Drs Morais and da Conceicao). Despite university level training in animal health and previous up-skilling activities, most technicians expressed were appreciative of the need for ongoing training and particularly to improve practical skills.

Key outputs of the workshop were plans for the passive surveillance case study. This included a procedure for case investigation based on completing a data collection form and preparation of the equipment required to collect a full range of preserved diagnostic specimens.

Diagnostic outcome for pig disease in Bobonaro

The activity continued from April until July 2021 when a total of 27 cases of pig mortality with suspected infectious disease aetiology had been investigated. The cases were all from 5 subdistricts in Bobonaro municipally (Table 1, Appendix 3 i). Cases of fatal pig disease were not reported in Liquica or Aileu during the period of the activity.

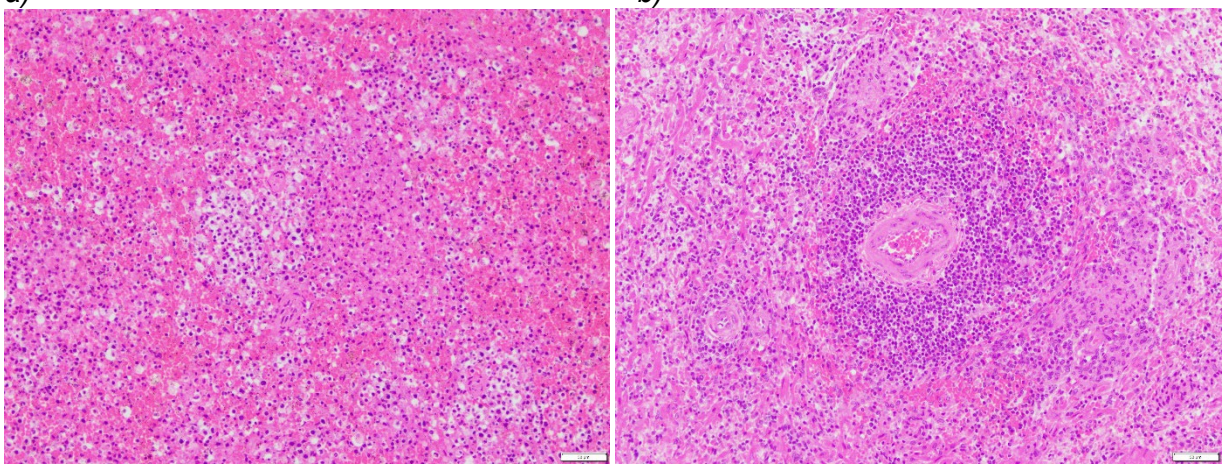
Cases were predominantly from farms with local or local-cross bred pigs, with less than 7 pigs in total, and adult or growing pigs were affected rather than piglets (Table 1, Appendix 3 ii). Most farms were confining the pigs and providing a diet derived from kitchen scraps.

The diseases that were seen were of short duration (median 4 days) and only 4 involved weight loss. There was a broad range of clinical signs with fever and lost appetite being most frequently observed (Table 1). Attempts at treatment were limited to 44% of cases with vitamin B being used most frequently or an antibiotic used in 8 cases.

ASFV was detected by qPCR in 70% of the cases whilst there was no evidence of CSFV. Tests for *P. multocida* were positive in 33% of the cases, and although this bacteria is part of the normal flora of pigs it is capable of causing significant potentially fatal disease, especially when other factors compromise the pigs health (Ross, 2006). Notably, all but one of these *P. multocida* positive pigs were also positive for ASFV, suggesting secondary bacterial colonisation of the lung following debilitation due to ASFV infection may have occurred. In regions free from the virus, ASFV introduction manifests as a severe peracute haemorrhagic viral infection of susceptible naïve pigs. Disease is characterised by marked pyrexia, cutaneous hyperaemia, and sudden death with morbidity and mortality approaching 100%. As ASFV establishes in a region, more chronic forms of the disease become increasingly evident, and this is characterised by recurring pyrexia, abortion, emaciation, growth retardation and other nonspecific findings (Salguero, 2020).Histopathology identified lesions consistent with acute to subacute ASF in each of the cases that tested positive by qPCR, confirming that this pathogen was a significant contributor to cause of death and largely consistent with the reported clinical signs. Histological evidence of ASFV infection included extensive necrosis of mononuclear phagocytic cells throughout lymphoid tissues, degeneration of renal tubules with cast formation, necrosis of periportal hepatocytes with infiltration of lymphocytes through portal regions of the liver, and degeneration of vascular endothelium and fibrinoid arterial change in various tissues. Splenic changes were the most obvious and consistent finding in the sampled pigs (Figure 6.3).

Figure 7-9 Histological examination of various tissues. (a) and (b) Pig spleens, 20x magnification, haematoxylin and eosin stain, demonstrating a periarteriolar lymphoid sheath. Note (a) is an image of an ASFV PCR positive spleen demonstrating severe necrosis and karryohexis of lymphoid tissue obliterating a periarteriolar lymphoid sheath, compared to (b) an ASFV PCR negative spleen with a normally populated periarteriolar lymphoid sheath.

a) *b)*



In the eight cases of pig death that were not associated with ASFV, the suspected disease aetiologies were bacterial and parasitic (verminous). Aside from the histopathological evidence of ASFV infection, 75% of pigs in all cases showed histopathological evidence of pneumonia. The majority of these were graded as being either moderate (13/27 cases) or severe (7/27 cases). This pathology was considered to have contributed significantly to the reported morbidity. Four of the cases that were not associated with ASFV had significant pulmonary lesions, and three of these were determined to be due to intralesional parasites. Pig lungworm (*Metastrongylus* sp.) were either observed in the pulmonary lesions or suspected given the pathology present. At least one pig demonstrated evidence of severe bacterial bronchopneumonia with subsequent bacterial septicaemia disseminated necrosis in several tissues. However, this lung sample returned negative PCR results for *P. multocida,* suggesting an alternative bacterial aetiology was responsible. Of the remaining four cases, three had mild to moderate hepatitis, likely due to parasitic migration through the liver, and one had no microscopic pathology noted.

Histopathological examination identified other disease process that were likely to be present as production limiting issues in other pigs at the farms, and which were amenable to improved preventative health care. For example, the evidence of infection with pig lungworm (*Metastrongylus* sp.) was found in 18/27 sampled pigs, with intralesional parasites observed in five of these. This nematode typically causes heavy infections in younger animals and can contribute to ill-thrift and secondary bacterial pneumonias of adult pigs, especially those with high exposure earthworms, the intermediate host of the parasite (Stewart & Hoyt, 2006).

Table 7-12 Summary data collected to describe cases of suspected infectious disease leading to death of young pigs in Bobonaro.

Farm Characteristics	**Number**	**Comment**
Subdistrict locations	5	
Number of pigs	1 - 18	30% kept 1 pig
Confinement of pigs	70%	Partially confined (11%), free roaming (19%)
Diet formulated specifically for pigs	33%	48% used kitchen scraps
Pig Characteristics		
Local breed	60%	
Older pigs affected	63% finisher	33% grower, 1 piglet
vaccinated for CSF	22%	

Clinical signs	**Present (%)**	**Absent (%)**
Lost appetite	81	19
Fever	63	27
Respiratory effort increased	48	52
Skin haemorrhage	30	70
Recumbency	19	81
Weight loss	15	85
Lameness	15	85
Necropsy observations	**Present (%)**	**Absent (%)**
Lesions observed in viscera	81	19
Parasites observed	37	63
Histopathology lesions	**Present (%)**	**Absent (%)**
Lesions consistent with ASF (spleen)	63	37
Evidence of kidney disease	44	56
Evidence of parasites (liver)	78	22
Lung pathology, predominantly parasitic	81	19

7.3.4 Discussion

The ongoing impact of ASF was evident in this study showing that after becoming endemic ASFV is likely to remain as a key impediment to small-scale pig production. Biosecurity measures to protect pigs is a challenge in the Timor-Leste setting but can be achieved as demonstrated in the community engagement and in previous SRA efforts (Barnes et al., 2020). Farmer education in maintaining biosecurity will be required to accompany national plans for reducing the impact of ASF, such as the safe-source, safe-destination program for pig restocking funded by DFAT and delivered by Agribio and MAF. Poor implementation of CSFV vaccination was identified. This leaves pig farmers vulnerable to CSF, another high impact disease which has recently remerged in Southeast Asia (Postel et al., 2019). Also noted in this study was a high prevalence of parasitic disease which provide examples of production limiting disease for which veterinary technicians can provide advice to improve the health and production of pigs.

There was a strong appetite for information and training amongst livestock and veterinary technicians. They expressed a desire for continuing education and suggested that a similar workshop be made available to their colleagues in other municipalities. The need for extensive knowledge and training is a recognised challenge in expecting para-veterinarians to contribute to a national veterinary service (MacPhillamy et al., 2020). In some countries there is a role for private para-veterinary professionals (Kumar & Meena,

2021), for Timor-Leste there is a need for government support and resourcing of the system. The veterinary and animal technicians were enthusiastic to support animal production and requested reference information to take back to the field with them to help farmers with production advice in addition the resources needed to conduct the diagnostic activities. There are international guidelines for para-veterinary training which could be assessed for gaps to guide the continuing education needs for veterinary technicians (OIE, 2019). There is also promise for maximising the benefits of this network of animal health professionals through the development of peer networks with moderation by knowledgeable mentors which was modelled in the present study via WhatsApp communication for near real time feedback and advice to technicians in the field.

Laboratory support for passive surveillance is essential to characterise detected diseases. The need to conduct molecular tests and histopathology at a distant veterinary laboratory was a COVID adaptation to the original project and also reflected the physical limitations of the Dili veterinary laboratory to undertake molecular diagnostic tests. A limitation of this approach was the inability to provide a rapid turnaround time and the responsive disease advice which is needed to build community engagement. The advantage of fresh samples for bacteriology was also highlighted as it would have identified an aetiology in one of the cases of mortality that was not caused by ASFV. Development and validation of assays suitable for field use, or in a laboratory that is not equipped for molecular tests, provides options to improve turnaround time for some pathogens such as a LAMP assay for ASFV (Mee et al., 2020). Whilst such assays are effective for active surveillance, an effective passive surveillance system needs a suite of diagnostic methods. Even during an ASF outbreak, the present activity identified multiple causes of pig mortality. Histopathology provides a non-specific approach to diagnostic workups to characterise the full range of diseases encountered in passive surveillance. The long-term goal of training veterinary pathologists to support the veterinary service in Timor-Leste could be augmented by remote assistance as demonstrated in the present activity, either by sharing preserved material or equipping virtual microscopy.

The present activity demonstrated that veterinary technicians could engage with communities for enhanced animal disease surveillance. To sustain a functional and responsive passive surveillance system, an increase in veterinary technician activity arising from more disease reports to them must be integrated into a complete passive surveillance system that includes broad diagnostic capacity and a national animal health database. As the capacity of the veterinary service in Timor-Leste is increasing, community engaged veterinary technicians will provide a valuable resource. The animal health situation can be better understood through collection of syndromic data from enhanced disease reporting. This reporting is encouraged by the achievable goal of resourcing the technician network to build trust by providing ongoing support for farmers to improve pig production practices and in offering preventative health advice.

8 Impacts

8.1 Scientific impacts – now and in 5 years

The project had scientific impact in the following areas;

- Passive surveillance insights are novel in TL and the project identified important production limiting diseases that were also leading to secondary disease and mortality of pigs. For example, integrated parasite management and use of anthelmintics are likely to make big positive impacts on pig health and production. Meanwhile the need for CSFV vaccination remains unknown, although coverage is not meeting the planned intention.
- Mapping the disease profile for a time and place is new knowledge for TL. In particular, it provides insight on ASF occurrence, as this high impact disease progresses from epidemic spread through the TL pig population to endemic circulation, and on other diseases causing illness and pig losses in this context. This knowledge can inform changes in pig production methods in TL and helps to prioritise the diagnostic capability needed to support animal health services in the country.
- Preserved samples were suitable to add histopathology and advanced molecular diagnostics to disease investigations. This will assist a sustainable passive disease surveillance system whilst in-country capacity is being established.

8.2 Capacity impacts – now and in 5 years

The project achieved comprehensive capacity building of veterinary and livestock technicians involved in the case studies:

- Diagnostics and preventative advice for ASF and CSF, biosecurity practices, pig health management, post-mortem examination, laboratory diagnostic test guidelines, antimicrobial usage and antimicrobial resistance, and how to respond to reports of pig disease. Participants rated the workshop highly for providing information that improved their knowledge (100% good or very good). An outcome of the training was all participants recognised the value of post-mortem for diagnosis of disease in the post-evaluation questionnaire when prior to the workshop they reported feeling under-equipped to undertake post-mortem examinations. (Appendix 1). The knowledge and skills will only be maintained if refresher courses are held annually and staff get plenty of field practice.
- Community engagement methods that included technician learning and sharing knowledge on pig nutrition and feed formulation, breeding management, health management, disease diagnosis and treatment, biosecurity protocols and how to build biosecure pens. Staff rated their knowledge and skills increases as mostly moderate with feed formulation and disease management the most useful learnings. Staff also increased their motivation and confidence to work with farmers. To build on these initial impacts, staff need to be properly funded to visit farmers and help them improve pig raising for the long term. Olavio Morais also expressed appreciation for learning about community engagement methods and processes as most veterinarians do not receive training in these skills.

8.3 Community impacts – now and in 5 years

Farmers from the three sucos involved in this project, gained knowledge and skills in pig husbandry and health management. Qualitative responses during the evaluation from households indicated that their pigs were healthier and commanding good prices.

8.3.1 Economic impacts

The scale of activities of this project were not sufficient to have an economic impact. An expanded program that was sustained over time and in additional municipalities would enhance small-holder pig production and contribute to household livelihoods.

8.3.2 Social impacts

The motivation and job satisfaction of the MAF technicians involved in the case studies was demonstrably increased. Many farmers found the support for pig farming activities and opportunities to learn new techniques and practices to be positive and increased morale for keeping pigs at a time when ASF was a prohibitive threat.

8.3.3 Environmental impacts

The scale of activities of this project were not sufficient to have environmental impacts.

8.4 Communication and dissemination activities

The project was closely aligned with LS/2017/102 (Identifying husbandry options for smallholder pig farmers in Timor-Leste) which included overlapping the final project meeting of the former with the initial meeting of this activity and the orderly transition of Olavio Morais from one activity to the other to provide continuity which was evident as a huge knowledge resource with respect from the MAF technical staff and pig farmers.

Throughout the project the team has participated in multiple meetings to share knowledge on animal health research in Timor-Leste:

- Menzies Fleming Fund Animal Health AMR Committee – monthly meetings from involving Australian research groups stakeholders conducting animal health research and extension in TL
- Discussions with Agribio
- ASF-SELIA Forum 12 March 2020 in Canberra with Joanita Jong and other SE Asian partners for ACIAR-SRA *LS/2019/187 Developing a Regional African Swine Fever Socioeconomic and Livelihood Impact Analysis Fund*
- Final project meeting on 12th April 2022

Conference presentations:

- *Engagement to underpin passive surveillance in Timor-Leste*. Oral presentation at ANZCVS Science Week, Gold Coast, 23-25 June 2022.

Conclusions and recommendations

8.5 Conclusions

There are systemic barriers to animal health surveillance in Timor-Leste which relate to under resourcing of the system. Case studies over a short period of time demonstrated the potential for improved pig farming practices and improved disease reporting through improved community engagement between MAF technicians and pig farmers.

ASF is a high impact disease in Timor-Leste and will drive changes to pig farming practices as it becomes endemic. Many other disease processes were occurring concurrently in pigs even during an ASFV epidemic, highlighting the need for further attention to preventative health management of pigs though integrated parasite control, biosecurity practices, improved nutrition and breeding/herd management.

Passive animal disease surveillance benefits from engaged relationship between MAF technicians and farmers due to improved reporting of diseases. Community engagement was readily improved through offering support to farmers for improved pig production and preventative health. The benefits in improved production together with collection of syndromic disease data could be achieved with relatively small increases in resourcing for field technicians. Substantial increases in laboratory capacity are required to complete broad diagnostic investigations and emergency disease exclusions for the cases of disease that are detected. This requires a larger investment and provides advantages if the data are utilised through a national animal health database. The system can become sustainable when the disease information is communicated back to communities for improved disease preventative practices to develop long-term trust.

8.6 Recommendations

Animal disease surveillance requires passive approaches to augment active disease surveillance activities. This is essential to identify the range of diseases that occur and determine the relative importance of different diseases on animal health. It is also fundamental for the early detection of new, recently introduced emergency animal diseases across livestock species. This is urgent now for Timor-Leste with evolving animal biosecurity threats including the recent introduction of foot-and-mouth disease and lumpy skin disease to Indonesia.

Recommendation 1

Continued, coordinated investment to build a network of MAF veterinary and livestock technicians who are knowledgeable and trusted by the community.

This will help build sustainable and resilient small holder farmers to provide a source of livelihood and nutrition. There are many potential advantages in production of animal protein for human nutrition and to support the cultural importance of livestock, especially pigs. Knowledgeable and trusted MAF technicians can improve the feeding, breeding, and preventive health management to enhance pig production and reduce risks.

A low-cost platform that connects the MAF technicians with each other and facilitated by knowledgeable mentors would mobilise this network to share knowledge and experiences. This can enable them to solve problems as they are presented by farmers and increase motivation within the network and communities.

Increased trust and community engagement between MAF technicians and farmers can enhance reporting of diseases which is valuable if a coordinated national animal disease database is maintained to collect and analyse this syndromic data. Sufficient resources are required to equip the technicians to collect the diagnostic samples needed for more detailed investigations (fuel to get to farms, data for mobile devices, disposables for

maintaining biosecurity and diagnostic and therapeutic equipment). A rapid diagnostic service that allows results to be rapidly reported back to farmers and knowledge to interpret the disease information for improved preventative health practices are a prerequisite for a sustainable service.

Recommendation 2

Diagnostic capacity for disease investigation and reporting

An increased range of diagnostic methodologies and tests are required at the Veterinary Diagnostic Laboratory in Dili to support disease investigations. Currently the laboratory is equipped primarily for serosurveys. A short coming of which, for example, is the inability to determine if CSFV remains an important disease of pigs when vaccination is being used. Investment in infrastructure and a substantial increase in the operating budget is required as molecular diagnostics and culture for microbiology are essential in situations where multiple differential diagnoses are under consideration. Additionally, a veterinary pathology service is required to support the diagnostic investigations with histopathology. This might be achieved in the short term by an international mentor using digital and remote microscopy for diagnosis and training. Advancements in diagnostic capacity would better inform a national disease database. The insights from this require mechanisms for efficient communication to enable results and revised disease control strategies to flow back for the benefit of small holder farmers.

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