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Evaluation of village-based livestock biosecurity in Laos and Cambodia



6

ACIAR OUTCOME
EVALUATION SERIES

Evaluation of village-based livestock biosecurity in Laos and Cambodia

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ACIAR

2024

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Suggested citation: Gimelli F, Campbell J, Chamberland G, Stempel A, Mienmany S and Zalcman E (2024) 'Evaluation of village-based livestock biosecurity in Laos and Cambodia', *ACIAR Outcome Evaluation Series* No. 6. Australian Centre for International Agricultural Research, Canberra.

ACIAR Outcome Evaluation No. 6 (OE006)

ISSN 2653-6811 (print)

ISSN 2653-682X (pdf)

ISBN 978-1-922983-72-5 (print)

ISBN 978-1-922983-73-2 (pdf)

Editing and proofing by: The Write Path

Design by: Redtail Graphic Design

Cover Image: Cambodian cattle farmer Nhem Baen carrying grass cut from his forage field.

Photo: Majken Soegaard

Foreword

The Australian Centre for International Agricultural Research (ACIAR) is mandated under the ACIAR Act (1982) to work with partners across the Indo-Pacific region to generate the knowledge and technologies that underpin improvements in agricultural productivity, sustainability and food systems resilience. We do this by funding, brokering and managing research partnerships for the benefit of partner countries and Australia.

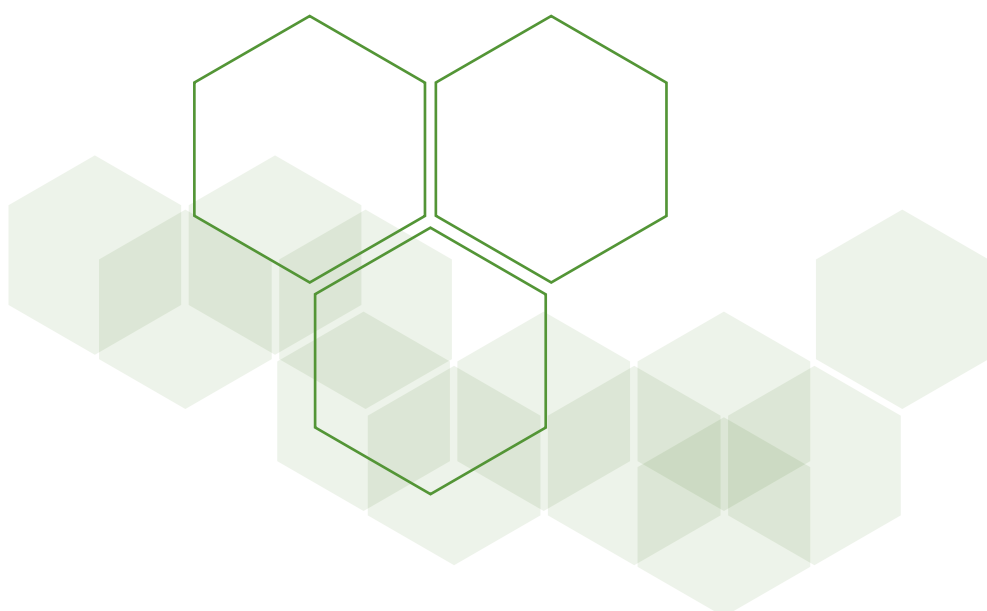
Between 2007 and 2020 ACIAR funded a series of projects in Laos and Cambodia focussing on the management of livestock disease at the village level, with the goal of improving smallholder livelihoods by reducing livestock mortality and morbidity through capacity building and better policy and practice. This evaluation reviews the short-term and medium-term outcomes of these 6 projects, and the extent to which the ACIAR projects contributed to these outcomes.

Additionally, this evaluation series draws together the longer-term impacts and lessons learned from these 6 projects to inform future program development. As a learning organisation, ACIAR is committed to understanding the diverse outcomes delivered by the research collaborations we develop, to demonstrate the value of investment of public funds, to continuously improve research design, and to increase the likelihood that ACIAR-funded research improves the lives of farming households and communities in our partner countries. An important mechanism for achieving our aims is to work closely with the wider Australian aid program to develop promising research into improved agricultural practices and profitable enterprises at scale.

This evaluation found that the ACIAR projects contributed to positive biosecurity, animal health and reproduction outcomes in participating villages over the duration of the projects. The highly participatory approach was the strongest contributor to this success. The participatory approach enabled farmers and extension workers to build their knowledge and capacity, contributing to lower livestock morbidity and mortality and improved financial security for smallholders. Along with these successful outcomes, the evaluation highlights opportunities to improve the design and delivery of future ACIAR projects to improve the potential for impact and sustainable development outcomes.



Prof Wendy Umberger
Chief Executive Officer, ACIAR



Acronyms

ACIAR	Australian Centre for International Agricultural Research
FMD	Foot-and-mouth disease
HI	High intervention
HS	Haemorrhagic septicaemia
KEQ	Key evaluation question
MI	Medium intervention
OECD	Organisation for Economic Co-operation and Development
OIE	Office International des Epizooties (now the World Organisation for Animal Health)
PDR	[Lao] People's Democratic Republic

Acknowledgements

The authors would like to thank all those individuals who generously gave their time to meet with the evaluation team and share their insights during interviews and workshops. We also thank ACIAR Laos-based and Canberra-based staff for their support of the evaluation.

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Summary

This report presents the findings of the evaluation of the cluster of research projects funded by the Australian Centre for International Research (ACIAR) focused on transboundary livestock biosecurity in Laos and Cambodia between 2007 and 2020.

This evaluation sought to:

- understand and account for science, capacity-building, biosecurity and livelihood outcomes that ACIAR research catalysed
- understand what it was about the design of the projects that enabled and hindered their ability to achieve their intended outcomes
- understand the suitability and effectiveness of village-based approaches in addressing transboundary livestock biosecurity risks.

This evaluation also assessed the consistency of the projects with the program logic for this cluster (see Figure 1).

Evaluation evidence

The evidence guiding this evaluation included a desktop review of 50 documents associated with the cluster of projects, including project reports and independent end of project reviews. Eighteen interviews with participating farmers and on-ground delivery partners (including extension workers, district officers and village animal health / veterinary workers) were completed in Cambodia and Laos. A further 8 interviews were completed with lead and supporting researchers.

Key findings



Contribution to outcomes

The projects in this cluster **generated useful information about the prevalence of certain diseases in participating villages and confirmed the usefulness of vaccination as a strategy to address some key livestock biosecurity challenges**. However, the projects did not generate original scientific insights into the factors that motivate smallholder farmers to practice good biosecurity or the opportunities and challenges for smallholder farmers to participate in local value chains. As a result, the **projects did not contribute to knowledge of how to improve biosecurity practices and access livestock value chains among smallholder famers**.

The projects **broadly built the capacity of participants, whether farmers, delivery partners (such as village animal health workers, village veterinary workers, district officers and extension workers), or participating researchers**. Stakeholders gained new knowledge, skills and confidence to implement improved biosecurity practices through participation in project activities. Farmers learned about modern reproduction techniques and the importance of vaccination, as well as how to apply these. However, the **projects did not sufficiently engage or build the capacity of local research partners and institutions**, focusing instead on engaging research partners from Australia. It is likely that this limited the diffusion of project knowledge and practices among local researchers and institutional actors.

Projects in this cluster **contributed to positive biosecurity, animal health and reproduction outcomes in participating villages**. Farmers and delivery partners became more adept at identifying when animals might be sick, applying medication and vaccinating. They also separated animals more consistently, implemented the use of forages to improve animal nutrition, and applied modern reproduction techniques to improve the health and productivity of their livestock. However, this evaluation found that **biosecurity, animal health and reproduction outcomes were primarily realised during the lifetime of the projects and did not always endure among participants**.

Projects in this cluster contributed to diverse positive livelihood outcomes. Farmers reported having **larger herds that provided them with greater financial security in times of need**. They also reported **being able to sell livestock more easily and for better prices**. Improved practices also **freed up time from having to manage livestock, including for children**. In such cases, the improved practices contributed to children being able to attend school and university because they had the time to do so and because their families could spend money on their education.

2

Design of the projects (including appropriateness of village-based approach)

Projects **could have been more effectively designed to understand and address the non-technical** (such as cultural, economic and political) **factors enabling or hindering farmers from practicing good biosecurity and accessing the livestock value chain**. Institutionally, the projects also **needed to engage local research, government and other partners more consistently and deeply to build local capacity for biosecurity research and practice**. The lack of these 2 components in the design of the projects meant that little was understood about the individual and institutional barriers and opportunities to best practice biosecurity management and engagement by smallholder livestock farmers in value chains. This likely **limited the likelihood of any biosecurity and market access improvements becoming embedded and institutionalised in-country**.

This evaluation also found that **projects did not evaluate and iterate**, meaning that **later projects did not know what did and didn't work well in earlier projects and therefore adapt their design**.

Projects were primarily **designed as traditional research projects, rather than research projects to support the delivery of development outcomes**. This led to the production of considerable scientific outputs but not to the translation of such outputs into development outcomes for participants.

This evaluation found that a village-based approach was appropriate for building capacity and to effect practice changes among participating farmers. The village-based approach was **appropriate to engage smallholder farmers and delivery partners in consistent theoretical and practical learning**. However, it was not so much the geographical focus on the village that led to practice changes, but rather the participatory engagement of farmers and delivery partners in 'learning by doing'. It is therefore **more accurate to state that it is a highly participatory approach that enabled farmers and delivery partners, such as extension workers, to build knowledge and capacity, and this contributed to a decrease in livestock morbidity and mortality**.





Introduction

This publication presents the findings and recommendations resulting from the evaluation of the cluster of research projects funded by the Australian Centre for International Research (ACIAR) focused on transboundary livestock biosecurity **in Laos and Cambodia** between 2007 and 2020.

The projects were characterised by their focus on **village-based transboundary disease management in cattle**. These 6 projects were:

- **‘Enhancing transboundary livestock disease risk management in Lao PDR’ (AH/2012/067)**. This project aimed to enhance disease risk management and increase public awareness of biosecurity through village-level disease mitigation strategies, particularly through establishing foot-and-mouth disease (FMD)-free zones.
- **‘Development of a market-driven biosecure beef production system in Lao PDR’ (AH/2012/068)**. This project aimed to support the development of a large ruminant livestock industry in Laos through applied research on current pressures to supply chains.
- **‘Village-based biosecurity for livestock disease risk management in Cambodia’ (AH/2011/014)**. This project aimed to develop and test a village-level biosecurity system in Cambodia to address priority constraints to improved livestock productivity.
- **‘Domestic and international market development for high-value cattle and beef in South-East Cambodia’ (AH/2010/046)**. This project conducted economic and value chain analysis and testing of on-farm interventions to support the development of a large ruminant market chain for smallholders in south-east Cambodia.
- **‘Best practice health and husbandry of cattle and buffalo in Lao PDR’ (AH/2006/159)** and **‘Best practice health and husbandry of cattle, Cambodia’ (AH/2005/086)**. These projects used a village-based approach to implement and test interventions and build the capacity of smallholder farmers, village chiefs, village veterinary workers, local traders and government staff across 16–32 villages to manage and market cattle and buffalo.

Although these projects dealt with different issues, focused in diverse geographic areas and sought to achieve diverse outcomes, they shared a common intent of using research to catalyse tangible practice change to equip local actors to engage with and respond to system-level dynamics (whether markets, a changing climate, regional biosecurity, and others) in their local contexts.

Program logic for cluster

At the time of their design, the projects evaluated here did not have program logics. To clarify the intended approach of these projects and their desired outcomes, the evaluation team facilitated a process to develop a program logic for the cluster during the planning phase of this evaluation. The outcome of that process is a program logic model (Figure 1) and accompanying narrative describing the cause-and-effect relationships underlying the logic model for the research cluster. This evaluation tested the accuracy of this logic model.

Program logic narrative

The **broader goal** is that ‘smallholder farmers achieve secure livelihoods within a sustainable and profitable farming system’. This is an ambitious, society-level goal that the projects are not expected to achieve on their own – rather, the program logic describes how the projects will *contribute towards* this broader goal.

The projects within this cluster contribute to this broader goal through 3 **ultimate outcomes of the research**, which are:

1. Policy, practice and capacity improvements fostered by the research and supporting activities are institutionalised and thereby continue to provide benefit beyond the life of the research projects.
2. Livestock morbidity and mortality decreases.
3. Smallholder livestock producers achieve improved livelihoods.

These outcomes are expected to be a direct result of the projects in the cluster. Although they may not have been fully achieved within the life of the projects, it is expected that the projects will have affected the conditions for these outcomes to occur.

Diverse **intermediate outcomes** contribute to the achievement of the ultimate outcomes. The third outcome is primarily achieved by establishing an evidence base for best practice development models to appropriately target markets and communities, and by the embedding and institutionalisation of capacity improvements and practice changes engendered by project activities.

Livestock morbidity and mortality rates decrease by fostering the ability of target communities to better prevent key endemic, exotic and emerging diseases in these areas and manage livestock production.

Last, smallholder livestock producers achieve improved livelihoods by transitioning from being 'livestock keepers' to 'livestock producers', indicating that they have become more active managers of the health and reproduction of their livestock, which they can then leverage to improve their livelihoods. This ultimate outcome is also achieved by smallholder farmers engaging more competitively in the livestock market and through the more effective operation of livestock markets and value chains. The program logic model in Figure 1 outlines a more detailed set of intermediate outcomes that contribute to the cluster's ultimate outcomes, though these are not included in this narrative for the sake of succinctness.

The cluster's intermediate outcomes are achieved through a set of **influence activities** presented towards the bottom of the program logic model. These are chiefly:

- fostering of partnerships with local researchers, institutions, universities and government agencies to conduct technical research and deliver and evaluate diverse interventions
- using a village-based approach to pilot biosecurity, animal health, livestock reproduction and market and value chain interventions
- providing policy advice and capacity-building support to government and development agencies
- engaging market stakeholders and brokering connections between them and producers.

These influencing activities are underpinned by a series of **foundational activities**, which do not in themselves lead to change, but which must be in place before the influence activities can be done. These include:

- the analyses of market and supply chains, knowledge, attitudes and practice assessments
- the establishment of any other relevant baselines to measure change
- scientific and technical assessments
- the design of the interventions to be piloted
- the selection of participants
- the review of previous initiatives and relevant literature.

The program logic model also presents a set of **principles** that are expected to underpin and be advanced by the projects in the research cluster.

An assessment of the consistency of the projects with this program logic and its causal pathways against the evidence collected in this evaluation is provided on page 17.

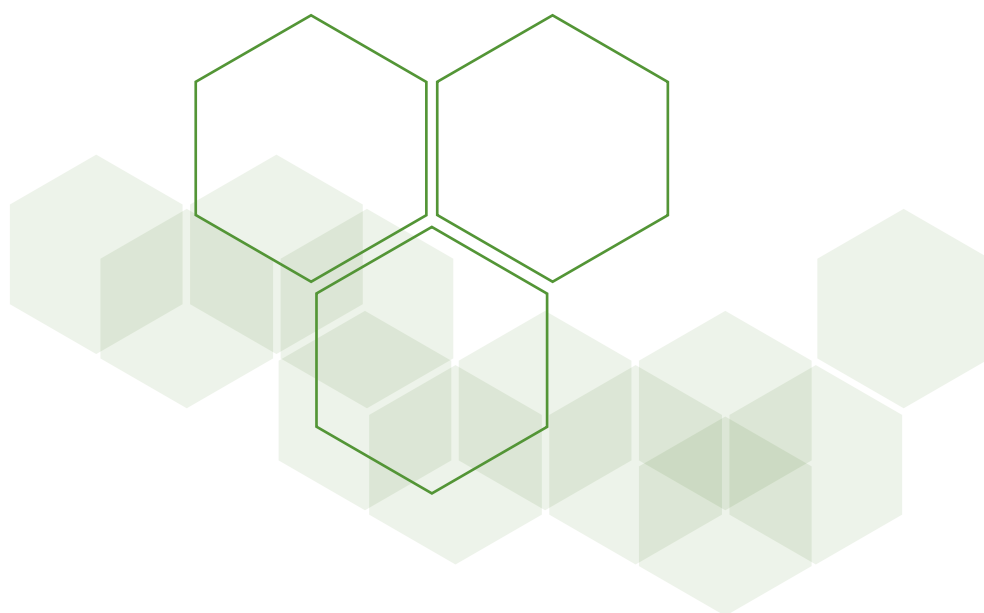




Figure 1 Program logic model for livestock biosecurity research cluster

Purpose and approach

This evaluation covered 6 research projects using a village-based approach focusing on smallholder farmers, village chiefs, village veterinarian workers and local traders in Laos and Cambodia between 2007 and 2020. The evaluation considered how well the research projects contributed to intended short- and medium-term outcomes.

The evaluation was commissioned specifically to:

- Understand and account for outcomes that ACIAR research catalysed, and more specifically:
 - the extent to which the project contributed to livestock management capacity outcomes and to the improvement of transboundary biosecurity and livelihoods
 - the extent to which the project engaged with issues of gender equity and social inclusion in the resource system they were studying and whether this influenced the engaged partners and community-level project outcomes
 - the extent to which the project contributed to intended medium-term development outcomes such as improved village-level biosecurity systems, improved connections to market and decreased transboundary biosecurity risk/ disease outbreak

- the extent to which the project activities have delivered outcomes for communities beyond project sites and who specifically within those communities benefited as a result.
- Understand the suitability and effectiveness of village-based approaches in addressing transboundary livestock biosecurity risks, and more specifically:
 - understand, with comparison to provincial or regional-based approaches to transboundary biosecurity, how appropriate the village-based approach was in effectively managing transboundary livestock disease in the project contexts at scale
 - generate lessons on effective and appropriate strategies to transboundary livestock disease management in South-East Asia.

Approach

This evaluation sought to answer a set of 3 focused key evaluation questions (KEQs) that are shown in Table 1. These were finalised during the planning meeting for this evaluation on 17 February 2022.

Table 1 Key evaluation questions

Key evaluation questions	Sub-questions
Outcomes	
1. To what extent, and how, did the project deliver on science and development outcomes?	a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to? b. To what extent have these been enduring? c. Were there any unintended outcomes from the project activities? d. To what extent did the project activities deliver outcomes for communities and stakeholders beyond project sites? e. To what extent did the projects engage with issues of gender and social inclusion? f. What, if any, were the outcomes of any engagement with issues of gender equity and social inclusion for communities?
Design	
2. How appropriate was the design of the projects?	a. To what extent were the projects designed consistently with the program logic? b. To what extent was the village-based approach to transboundary biosecurity appropriate for the project contexts?
Learning	
3. What can ACIAR learn from the implementation of village-based approaches to transboundary biosecurity in the project contexts?	a. What enabled the success of the village-based approaches applied in the projects? b. What hindered the success of the village-based approaches applied in the projects?

Methodology

Expert review

The biosecurity components of this evaluation (documentary evidence, interview evidence and findings) were reviewed by a qualified veterinarian. The outcomes of this expert review are integrated into this report.

Evidence collection and analysis

Table 2 outlines the evidence collected and analysed to inform this evaluation's findings and recommendations.

On-ground delivery partners and participating farmers were selected through a combination of purposive and convenience sampling. An effort was made during the planning stage of this evaluation to identify participating farmers and delivery partners across the project. As records of participants were not kept across any of the projects, these efforts only led to the identification of one farmer, for whom no contact details were available. This made it necessary for in-country data collection subcontractors to identify participating stakeholders based on limited information, through a combination of convenience and snowball sampling. In both countries, this typically entailed contacting the heads of villages that participated in the projects, as these stakeholders generally remember such projects and who participated in them. This approach led to the identification of sufficient numbers of participants to achieve the evaluation's target sample.

The data collected was analysed using the following methods:

- **Documentary evidence** was analysed using an evidence table structured according to the KEQs.
- **Qualitative evidence** collected through interviews was thematically analysed using the Dedoose qualitative data analysis software suite.

- All evidence was synthesised against the KEQs in a **results pack**. A **sense-making workshop** was held to collaboratively review and validate the evidence, test the key findings and begin formulating relevant recommendations. The outcomes of this workshop are reflected in this report.

Limitations

It is important to acknowledge factors that may have limited the comprehensiveness and rigour of the findings of this evaluation. These limitations were:

- The scope of this evaluation included projects that commenced as far back as 2005. Stakeholders that were involved with some of these earlier projects could not always recollect project details and outcomes with clarity. Stakeholders recognised this limitation and typically qualified their responses in such cases. However, this results in less certainty around the outcomes of some of the projects.
- The projects within the scope of this evaluation did not include any ongoing monitoring or follow-up activities. This made it more challenging (and in some cases impossible) to assess the degree to which project activities and their benefits endured.
- The documentary evidence that this evaluation had access to (particularly project reports) primarily documented project outputs rather than project outcomes. Coupled with the 2 limitations listed above, it was not always possible to assess the extent to which project outputs led to intended or unintended outcomes or the degree to which such outcomes may have endured.
- The necessary reliance on convenience and snowball sampling likely limited the ability of this evaluation to reach out to participants who were most substantially involved with the projects. It is highly recommended that comprehensive records of project participants be kept in future projects to facilitate evaluation activities.

Table 2 Evidence collected as part of this evaluation

Data collection method	Stakeholders	Number of documents reviewed / interviews
Document review (See Appendix 2: Publications produced by each project)		50 project documents, for example project reports
Semi-structured interviews	Lead researchers and supporting researchers	8 researcher interviews
	On-ground delivery partners (including extension workers, district officers, village animal health / veterinary workers)	9 on-ground delivery partner interviews (4 in Cambodia and 5 in Laos)
	Participating farmers	9 participating farmer interviews (4 in Cambodia and 5 in Laos)
Total number of interviews		26

Findings

The evaluation findings are structured according to the key evaluation questions (KEQs) and sub-KEQs shown in Table 1. Illustrative quotes are provided throughout the section and participant codes are provided to indicate the stakeholder type: **R#** represents a researcher, **D#** a delivery partner and **F#** a participating farmer. The number of interviewees that spoke to a point is also provided.

It should be noted that project documentation such as project annual and final reports primarily report outputs, rather than outcomes. This evaluation makes a distinction between scientific outputs and scientific outcomes. Scientific outputs are understood in terms of publications, whereas scientific outcomes are understood as original contributions to knowledge. Stakeholder interviews conducted during this evaluation sought to gather insight into the science, capacity, livelihood and biosecurity outcomes of project outputs such as training manuals, workshops, the provision of vaccines and scientific publications. As this evaluation assesses project outcomes and not outputs, the latter are not listed exhaustively.



1. To what extent, and how, did the project deliver on science and development outcomes?

Science outcomes [KEQ 1a]

Key findings

The projects in this cluster had **limited scientific outcomes in terms of original contributions to knowledge**. However, they generated **information with practical value** through activities focused on the consolidation and updating of existing knowledge about the prevalence of certain diseases in project areas, and current knowledge, attitudes and practices relating to biosecurity and animal health.

The projects in this cluster had **minimal scientific outcomes in terms of original contributions to knowledge**. In part, this appears to have been the result of inadequate research design (R1; R2; R6; R8). This included inadequate work to establish baselines in participating villages (R1; R5; R6) and inadequate consideration for how projects should progressively build on one another to refine scientific knowledge (R3). This latter point appears to have led to projects that were essentially repetitions of one another; later projects did not consider the findings of earlier projects and adjust their approach and activities accordingly. Had projects built on one another's findings and experiences, they may have generated additional knowledge that could have been useful to determining how to manage transboundary security more effectively. Instead, later projects limited themselves to essentially confirming the findings of earlier projects.

... all these projects, these millions of dollars spent and some of them had the same project teams that were implementing it. In what sense did they actually try to build on? Because it appeared to me, they were doing the same kind of things over different years, different projects, but there's no build-up on that.

– (R3)

The lack of scientific outcomes was also due to **insufficient initial understanding of the evidence for what motivates farmers to practice good biosecurity** in the context of the project countries and villages (R1; R4; R6). This was likely due to the **lack of integration of social scientific expertise such as sociology and human geography into the projects at the design stage** (R1; R6). This led to projects that were either not aimed at addressing a clearly articulated gap in current knowledge and practice, or which focused on technical questions where consideration of social scientific factors such as motivations for behaviour and the role of culture might have been more relevant.

Another factor that likely contributed to this lack of contextual understanding was **insufficient or no community consultation** to inform project design (R6). Inadequate integration of social science and of community consultation in the design of the projects contributed to projects generating scientific evidence on the relative merits of technical approaches (mostly vaccinations). However, it **did not generate insight into the interaction between social and technical factors and how these determined approaches to biosecurity management in target villages**. This likely limited the usefulness of any scientific insights generated by the projects towards the achievement of improved and enduring biosecurity outcomes.

I think that is because it was very much a Western lens of what we think would work, your basic biosecurity measures that you should be implementing. But I don't feel like there was that ... I don't think that there was adequate consultation with each of those individual communities to work out what was going to be realistic for them and what wasn't. And I think if we did much more of that in-depth focus group discussion with the communities from the beginning, then we could have really tailored biosecurity activities and really measured what works and what doesn't.

– (R6)

The projects contributed to **updating existing knowledge about the prevalence of certain diseases in project areas and current knowledge, attitudes and practices relating to biosecurity and animal health** (R2; R5; R6). Evidence from this scientific work was consistently published (R1; R5; R6) and thus represented the production of scientific outputs. The project documentation reviewed as part of this evaluation emphasises the cluster's considerable output of scientific publications, which included 111 publications of diverse types, including journal publications, conference papers, PhD theses and technical reports (though not all publications occurred in quality journals [R1; R6]). The projects valued the production of scientific papers, which can provide useful input into biosecurity management practice. However, scientific publications in themselves do not directly contribute to development outcomes. **More consideration should have been given to how published findings could be translated into practice change to achieve intended development outcomes.**

Project documentation indicates that the cluster generated knowledge on biosecurity, animal health and reproduction, especially insights into the usefulness of applying a change management framework to achieving sustainable farmer behaviour changes. However, project documentation does not include any evidence on the sustainability of this behaviour, as the projects did not include any ongoing monitoring of activities beyond their formal completion. This challenge was compounded by the difficulty of identifying project participants. While it can be appropriate to collect evidence of outcomes after the completion of projects (as is the case in this evaluation), the limited evidence found by this evaluation on the continuity of behaviour changes indicates that similar projects might benefit from targeted monitoring of behaviour changes beyond the formal completion of projects. This would generate evidence useful for evaluations.

Capacity-building outcomes [KEQ 1a]

Key findings

Projects consistently **built the capacities of farmers and delivery partners** to manage biosecurity and improve animal health and reproduction. However, the **capacities of local researchers could have been built more substantially** by involving them in project activities more consistently.

Capacity is understood as 'the ability of people, organisations and society as a whole to manage their affairs successfully' (OECD 2005). Capacity building (or capacity development) is the process by which individuals and organisations obtain, improve and retain the skills, knowledge, tools, equipment and other resources needed to do their jobs competently or to a greater capacity (such as larger scale, larger audience, larger impact). These are the definitions of capacity and capacity building that were used in this evaluation, and which are discussed in this section.

This evaluation broadly found that **projects in this cluster built the capacities of participating farmers, delivery partners and research partners in diverse ways**. The documentary evidence indicates that projects enhanced the capacity of farmers, district staff and other extension workers in animal health and biosecurity management through the production of materials in language, workshops and other training opportunities. However, this claim in the project documentation is underpinned by an assumption that training materials and activities (such as training workshops, demonstrations and train-the-trainer activities) in themselves result in enhanced capacity. There is limited evidence for this claim. While project documentation indicates that projects resulted in the uptake of project technologies and farm management practices by farmers, there is mixed evidence for the extent of these changes and their sustainability beyond the lifetime of the projects.

Nevertheless, this evaluation found that projects consistently contributed to **farmers gaining new knowledge about biosecurity, animal health and reproduction** (D1; D7; D8; F1; F2; F4; F6; F8; F9; R1; R2; R3; R4).

This project came to support our village and was a great thing. The project trained us on livestock rearing. In the past, we conventionally raised our livestock, and we didn't know how to diagnose livestock diseases or treat them. We have raised cattle traditionally since our parents' generation and some households had a few animals because people were afraid that they would die when diseases spread. Since the project arrived in the village, they [the project team] supervised us: first, the calves need to have medicine to prevent/treat them from Toxocara vitulorum. So, the animals will be healthy and have better reproduction. Second, when animals get sick, we use/have medicine to treat them, so they don't die.

– (F1)

While projects may not always have provided guidance on how to translate such knowledge into practice (F4), overall, **projects consistently provided information that enabled farmers to better feed cattle, facilitate their reproduction and house them in ways that enhanced biosecurity, animal health and reproduction** (D1; D5; F7; F1; F2; F3; F4; F5; F6; F8; R5; R6; R7). Several projects also provided farmers with information that **improved their capacity to monitor the health of their livestock**. This made it easier to detect diseases earlier and to apply treatment more quickly, leading to less morbidity and mortality (F3; F4; F9).

... they told me how to follow up with the disease, when they are not feeling well, how do we know that, when they are coughing, what's the cause, so when they are not feeling well, we can give them medicines accordingly.

– (F9)

Project activities that engaged farmers in 'learning by doing' (F1; F2; R2; R3; R6) and that leveraged farmers' existing capacities to provide simple, fit-for-purpose solutions (D1; R7) were most successful in building farmer capacities. Undertaking direct, practical and participatory tutorials on biosecurity, animal health and reproduction practices that were appropriate for the resources and skills of participating farmers contributed to the translation of knowledge into practice, including practices that have endured and diffused to stakeholders and communities who did not directly participate in project activities.

Some of [the mineral molasses blocks] had some antibiotics in them as well but they were really good because the cattle loved it, the farmers loved it because the cattle came back home, and it did really help with improving weight gain and things like that. I think once farmers see that their cattle condition is improving, then there is a bit more of an imperative to protect them so then they might – vaccination would then hopefully and biosecurity measures, would become a little bit more important to them.

– (R6)

One project among this cluster – 'Domestic and international market development for high-value cattle and beef in South-East Cambodia' (AH/2010/046) – also sought to build the capacity of farmers to engage more effectively in the livestock market and value chains. This evaluation found **no improvement in farmers' capacity to engage in the livestock market and value chains**. The lack of progress towards achieving this outcome was likely the result of **projects mapping but not critically analysing value chains** (R1; R3). Without this critical analysis, the project did not have a clear understanding of what the challenges and opportunities were for enhancing smallholder farmers' participation in livestock value chains.

Definitely in the space of improving maybe farmers' orientation towards the market and, therefore, times they're selling cattle for a better price or whatever, the project I don't think really tackled that. I think that there was talk about having some training to orient people in how to be market oriented, but I don't think it had any real legs to it and it was not a deep capacity-building activity.

– (R3)

The projects in this cluster also built the capacities of delivery partners, including the **capacity of staff supporting the delivery of projects and district and provincial staff (including veterinarians) to understand, detect and respond to disease outbreaks** (D5; D6; D7; D8). Projects imparted new knowledge to delivery partners on best practice disease detection and management through workshops, written material and demonstrations. Because this knowledge was generic rather than village-specific, delivery partners could – and did – apply it to other villages and districts they were working in (D5; D7; D8). While this evaluation found that the project broadly enhanced the capacities of delivery partners, there are indications that **excessive reliance on one-off training limited the extent to which projects built the capacities of village veterinary workers and village animal health workers**.

The project positively impacted the capacity of people working and participating in the project, such as project staff, district and provincial staff and farmers. Everyone learned new techniques and was involved in disease management and livestock treatment research. The collaboration between the village, district and provincial levels created new knowledge that can be adapted and applied to real situations.

– (D5)

Last, this evaluation assessed the extent to which projects built the capacities of local research partners, such as students, PhD candidates and other researchers. While **some projects engaged local researchers and students in project activities** (R5; R7), **projects disproportionately engaged Australian students, likely at the expense of opportunities for participation by local students** (R1; R2; R6; R8). As a result, any capacity built among local research partners was likely minimal.

I think there could have been more [focus on building capacity of in-country researchers] across that whole gamut of projects. Since 2005 to 2018 or whenever, 2019, whenever we [undertook these projects], how many Masters and PhDs did we get at our Lao universities, for example, or Lao institutions? Again, a lot of Sydney students got stuff out of those projects, but in-country capacity I felt was really not a focus to this team as much as it probably should have been.

– (R1)

Biosecurity, animal health and reproduction outcomes [KEQ 1a]

Key findings

Projects in this cluster led to **consistent improvements in livestock vaccination** among farmers and delivery partners **during the projects**. Project **participants also applied project practices** such as modern reproduction techniques and the use of forages to **achieve improved animal health and reproduction outcomes**.


The projects in this cluster contributed to positive biosecurity outcomes among village-level participants, but did not target institutions at broader – district, regional, national and international – scales that hold key roles in *transboundary* biosecurity management. As a result, the **projects had no discernible impact on biosecurity management across boundaries**.

This evaluation set out to investigate the extent to which the projects in this cluster contributed to biosecurity outcomes. However, the evidence indicates that the projects also targeted broader animal health and reproduction outcomes, which often, but not always, overlapped with the projects' focus on biosecurity. For this reason, this section of the report discusses findings across biosecurity, animal health and reproduction areas.

The **projects in this cluster contributed to positive biosecurity outcomes**. Project reports highlight that no outbreaks of foot-and-mouth disease (FMD) or haemorrhagic septicaemia (HS) arose in 'high intervention' villages despite widespread occurrence of these in surrounding villages. Projects in this cluster consistently contributed to improved vaccination for prevention of disease and medication when animals were diagnosed with a disease (D6; D7; F2; F3; F4; F5). The expert review indicated that to fully assess the outcomes of improved disease management, it would be important to consider which medications are administered to animals; it is not uncommon for a range of medications to be simultaneously administered that do not address the underlying disease. This was not within the scope of this evaluation.

In the past, I vaccinated my livestock, but it was not continuously, but when I participated in this project, I continued to vaccinate livestock regularly.

– (F2)



Projects also contributed to more rigorous separation of livestock (F8) and improved protocols in response to disease outbreaks in some participating villages (D8). Overall, the evidence indicates that the **projects achieved biosecurity outcomes through improved vaccinations and biosecurity practices during the projects**, though only some of these outcomes and their supporting practices endured (see findings relating to KEQ 1b on page 13).

Projects also contributed to improved animal health and reproduction outcomes. Stakeholders consistently drew attention to the **impact that being taught how to grow forages for animal feed had on the health of their livestock** (D2; F3; F6; F8) and to the **healthier and subsequently more productive and profitable animals resulting from the introduction by projects of artificial reproduction methods** (F5; F6; F8). This evidence is consistent with that presented in the project documentation, which reports instances of improved body conditions for adult large ruminants and of better disease management.

I learned about artificial breeding; if I have good female cows, then I can artificially breed them with the right males ... if the baby grows well, then I can also get a good price when I sell it and by doing this, it can also increase my livelihood as well.

– (F9)

While the projects had discrete biosecurity outcomes, this evaluation also assessed the extent to which projects may have influenced biosecurity policy and practice beyond the village level. Project reports highlight that one project may have had some policy influence, with the World Organisation for Animal Health (formerly Office International des Epizooties (OIE)) regularly promoting the benefits of the FMD research conducted in Laos in their policy development. However, this evaluation found **no evidence of systemic changes to transboundary biosecurity management because of the projects' activities**. To achieve this, **projects needed to better understand regional, national and transnational factors impacting biosecurity**, such as the realities of porous borders [R1], lack of government oversight [R5], and inadequate and slow disease management processes and protocols [R4; R6].

The projects' focus on the village scale led to these factors falling outside the scope of project designs (see discussion of findings against KEQ 2b on page 17). What's more, **project teams may have missed some readily available opportunities to influence biosecurity policy at broader scales** (R3). Better understanding multi-scale factors influencing transboundary biosecurity management and availing themselves of available opportunities to influence policy may have enhanced the capacity of projects to trial and articulate approaches and policies to catalyse multi-scale improvements in transboundary biosecurity management.

The Lao Government [Government of Lao People's Democratic Republic] was saying, 'We want more evidence-based or evidence-driven policy discussions within the ministry.' That was good and then [the Vice Minister of Agriculture] asked for 4 policy briefs (fish passage, agroforestry and teak plantations, groundwater and biosecurity) ... A lot of projects produce policy briefs because it's part of their outputs, but this is different because the government was asking ACIAR to go back into the suite of work that they do and come up with: 'Okay, what's the science, the message that's coming out and then how can it impact on policy discussions within the government.' Out of the 4, we were able to produce 3, but not livestock ... it's a lost opportunity. All these projects under the evaluation, there's so many resources, a lot of scientific outputs, but there's no cohesive message that we can share with the Lao Government [Government of Lao People's Democratic Republic] for them to use in their policy system. They said they were not in a position to do that.

– (R3)

Livelihood outcomes [KEQ 1a]

Key findings

The improvement of biosecurity, animal health and reproduction during the projects led to healthier and more productive livestock, which **increased the income of participating farmers** and the **profitability** of their participation in local livestock markets. Furthermore, more effective and efficient livestock management practices introduced by the projects contributed to **freeing up more time** for villagers to participate in either **other income-generating activities or leisure activities**. The extra free time among children and additional income from livestock contributed to **young people being able to attend school and university**, thus enhancing their **opportunities to secure improved livelihoods in the future**.

Project activities consistently increased and/or made it easier for farmers to make an income from their livestock (D1; D2; D3; D5; D6; D7; D8; D9; F1; F3; F4; F5; F6; F8). This was almost always found to be because animals were more productive due to effective disease prevention and management. Other factors contributing to the achievement of this outcome were **increased herd sizes** (F1; F4) and farmers using their newly established forages to sell seedlings, thus contributing to **diversified income streams** (R7). The role of seedlings in the diversification of farmers' income streams is also consistently documented in project reports.

Forages established through the projects also meant that farmers could **more easily feed their animals in times of drought and scarcity** (F2). As a result, some farmers did not feel the need to sell their livestock at lower prices during these times of stress. Because livestock act as a financial security in many rural communities, having healthier, more productive livestock (including in times of drought and scarcity) resulted in some farmers experiencing **a sense of greater financial security as a benefit of project activities** (F2; F3; F6).

My life has changed because we can use them [buffaloes]. When we do not have money, we can sell them. The Lao slang mentioned that 'a money bag hangs on the trees'; so, when we look after our livestock, we will benefit from them, but people may steal them if we do not look after them well. So, my life has improved positively.

– (F2)

Other livelihood outcomes included **freeing up time for other income-earning and leisure activities** (D1; D3; D5; F4; F5; F6), including for children with traditional responsibilities for livestock care. This is also attested to by project reports. Because children had more free time and households generated more and/or easier income from livestock, **some young people from participating families were able to attend school and/or university, either for the first time or more consistently** (D1; D3; F4; F5; F6; R4; R6).

And from the increased income that they were receiving by improving the way that they were producing, not only were they able to expand into those other enterprises, but they were sending their daughters to university in Phnom Penh and they were getting a university education and then having employment options.

– (R4)

It should be noted that the **extent to which these livelihood outcomes were realised across participating villages and the extent of the contribution of project activities to its achievement is unclear**. Other factors beyond the projects may have contributed to improved economic conditions. Measuring the extent of this contribution would require more extensive investigation than possible within the scope of this evaluation.

Extent to which outcomes were enduring [KEQ 1b]

Key findings

Some project participants have continued to apply improved knowledge, capacities and project practices for biosecurity, animal health and reproduction where they had the resources to do so and project practices had not been superseded by new knowledge and approaches. However, farmers **often stopped vaccinating their animals against non-lethal diseases** such as FMD when they viewed the cost of vaccinating as greater than the productivity benefit gained from preventing the disease.

Because projects did not give much consideration to how the practices and approaches they introduced could be maintained (including investigating the barriers and motivators to change), **project practices and resulting positive outcomes did not endure consistently across project sites.**

Farmers continued to apply their new capacities for biosecurity, animal health and reproduction in cases where they could. Factors that determined whether farmers continued to do so included being convinced of practices' ongoing value, having the resources to continue applying them (for example, by being able to pay for vaccines or access these for free through government schemes (F3; D3; D8; R4; R6; R7)) and the presence of appropriate vaccine storage chains (R4; R6). The same is true for the endurance of village forages: **farmers that could continue accessing and buying seeds (either through their own initiative or through subsidies and other schemes) maintained the use of forages to enhance animal nutrition** (D1). It is important to acknowledge (as the note from the expert review indicated in the findings for KEQ 1a on page 8) that farmers may have continued to vaccinate and/or medicate their animals *incorrectly*, though this evaluation did not assess this.

Some farmers did not maintain project practices, such as vaccinating animals against non-lethal diseases such as FMD and enclosing animals in pens because some farmers thought that the cost of vaccinating for non-lethal diseases outweighed any productivity benefits of enhanced animal health (R5). The **extent to which biosecurity outcomes endured is directly linked to the ability and willingness of farmers to continue applying what they learned through the projects.** The practices introduced to participants through the projects contributed to enduring positive livelihood outcomes only in cases where participating farmers were able to continue implementing the animal health and reproduction practices introduced by these and other projects (D5; D7; D8). **Some delivery partners continued to apply the knowledge and skills gained through participation in the projects unless these were superseded by new knowledge and/or practices** (D6; D8).

When the project was here, the vaccination was convenient because the project came to help with this. After the project ended, we encountered difficulties because farmers had to buy vaccines, so some people met challenges and did not vaccinate their livestock.

– (F3)

Unintended outcomes [KEQ 1c]

According to the documentation reviewed, the projects in this cluster had a range of environmental outcomes. Most notably, the establishment of forages, manure collection, more widespread housing and restraint of cattle, and reduced free grazing. Among these environmental outcomes were reduced soil erosion, reduced pollution of both land and waterways and the planting of trees.

It should be noted that the evidence for these outcomes is anecdotal. No investigation of the extent and quality of these outcomes, and the contribution of projects in this cluster to achieving them, was undertaken during or after the projects. There is insufficient evidence to claim that these were project outcomes, though it is possible that projects contributed to their achievement.

Outcomes for communities and stakeholders beyond project sites [KEQ 1d]

Key findings

In some cases, **project practices diffused through word-of-mouth and informal knowledge-sharing** activities initiated by villagers. The training of delivery partners such as village animal health workers and village veterinary workers contributed to the diffusion of project practices as these stakeholders often worked in both participating and non-participating villages.

While the projects in this cluster may have contributed to positive biosecurity, animal health and reproduction outcomes of stakeholders beyond project sites, the presence of diverse projects funded by agencies other than ACIAR in neighbouring areas means it is **not possible to assess the contribution of this cluster of projects to these outcomes.**

Project **activities to train village veterinary workers, village animal health workers and extension officers had a 'ripple effect'** in that these stakeholders were able to, and in many cases did, take new knowledge, skills and capacities gained through participation in the projects into other villages that they served (R4; D6). **These delivery partners helped diffuse improved transboundary biosecurity, animal health and reproduction practices to other villages** (D5; D6; D7). Project practices and knowledge also diffused through informal knowledge sharing and demonstration of project activities by farmers from participating villages (F1; F2; F3; F4; F9; R4). However, it is not possible to definitively establish the extent and causes of diffusion of project approaches and practices because of 2 factors:

1. The evaluation did not interview farmers from non-participating villages.
2. Neighbouring villages often participated in similar initiatives run by organisations other than ACIAR (R6).

For these reasons, it is reasonable to conclude that this cluster of projects *may have* contributed to positive biosecurity and other outcomes for communities and stakeholders beyond project sites.

The nearby villages came to learn from this village and then they vaccinated their livestock by themselves. People came to ask this: 'Why are cattle in your village not dead?' I told them that because the project provided vaccines and medicine ... We mostly share this information when we go to the paddy fields. Furthermore, other villages also came to learn how to forage from our village ... Now they have forage for their livestock.

– (F4)



Engagement with issues of gender and social inclusion [KEQ 1e] and outcomes of any such engagement [KEQ 1f]

Key findings

Projects had **limited engagement with issues of gender and social inclusion**. The choice to focus on large ruminant livestock may itself have limited the capacity of some projects focusing on animal biosecurity to provide benefits to women and ethnic minorities, which in some project areas only keep smaller animals. **No specific gender and social inclusion outcomes were identified** through this evaluation.

The projects in this cluster were not designed to explicitly engage with issues of social and gender inclusion. Nevertheless, this evaluation assessed the extent to which any such issues were identified through the projects and how projects responded to these.

Some of the later projects in this cluster started to engage with issues of gender, as this became more of a focus in ACIAR work (R6). Project progress reports indicate that this led to a focus on ensuring that female household members were included in project training and data collection activities. However, the **limited involvement of research staff with social scientific expertise likely contributed to insufficient attention being given to gender considerations** (R1; R6). While such involvement may have led to the conclusion that gender and/or ethnicity were not significant factors in the project villages (D5; D6; D7; D8; R7), their consideration would have helped ensure that projects could address any barriers to female and ethnic minority smallholder farmers benefiting from project activities. Because of the minimal engagement with gender and social inclusion in the projects, no specific outcomes in this area were identified through this evaluation.

The expert review of this evaluation highlighted that large ruminants are typically the responsibility of men and are kept only by those who are relatively wealthy. In some project contexts, women and ethnic minorities do not have primary responsibility for, or do not keep, large ruminants. For example, in some areas, women might oversee chickens, while ethnic minorities might only be able to afford to keep chickens. So, by choosing to focus on large ruminants, some projects may have improved conditions for relatively wealthy and powerful individuals in the village. This may have fostered and/or entrenched inequalities in some participating villages. It is important to note that this is an expert opinion; no evidence of negative gender and social inclusion outcomes was uncovered during this evaluation.

2. How appropriate was the design of the projects?

Key findings

The design of projects **did not adequately account for the social, cultural, economic and institutional context of target communities.**


The evaluation found that projects were **not designed to build on one another**, but instead tended to be repetitions of each other. Projects were primarily **designed as research, rather than research-for-development projects.** They were **not designed to have enduring / sustainable benefits** in target communities.

The **village-based approach was appropriate** to influence farmers to improve their biosecurity practices. However, the projects' **focus on the village scale precluded their ability to account for and influence institutional factors** that often determine how biosecurity is managed.

The **projects in this cluster were not designed to build on one another's knowledge and experience** but were essentially 'doing the same kind of things over different years' (R1; R2; R3). This limited the capacity of projects to realise cumulative scientific outcomes. Furthermore, **projects were not designed with consideration to local social, cultural and economic characteristics** (R5; D5; F3). This limited the ability of the projects to identify approaches and interventions that would be most appropriate to local contexts.

Another shortcoming of the projects' design was that **the projects were designed as research projects, rather than development projects** (R7). The result was that projects were primarily focused on producing scientific outputs and validating research findings, with **little attention given to how such outputs and findings might be translated into concrete development outcomes for participants** (refer to findings under KEQ1). Only in the later stages of the work in this cluster did a shift occur towards considering development outcomes, by which point it was too difficult to change direction and/or sufficiently adapt projects to achieve such outcomes (R1; R7).

This evaluation also assessed the extent to which project activities contributed to systemic changes in the management of transboundary biosecurity issues in the target countries. As discussed in the findings for KEQ 1a, this evaluation found no evidence of such changes. This appears to have been because there was **limited consideration for how to make project outcomes enduring and institutionalised at the design stage** (R3; R6; R7) and because of the limited geographical coverage of the projects. This decreased the likelihood of projects having enduring and diffused biosecurity outcomes because most smallholder farmers surrounding participating villagers did not have adequate impetus to changing their livestock management practices (D5; D7).



Consistency of the project cluster with the program logic [KEQ 2a] and the appropriateness of the village-based approach [KEQ 2b]

The program logic for this cluster of projects (see Figure 1) represents how the approach and activities across the projects were expected to achieve specific development outcomes, namely that:

1. Policy, practice and capacity improvements fostered by the research and supporting activities are institutionalised and thereby continue to provide benefit beyond the life of the research projects.
2. Livestock morbidity and mortality decreases.
3. Smallholder livestock producers achieve improved livelihoods.

In this section, the accuracy of the causal pathways leading to these 3 outcomes is assessed considering the evidence collected and analysed through this evaluation. This section also discusses the appropriateness of the projects' focus on the village scale (answering KEQ 2b of this evaluation).

Ultimate outcome 1: Policy, practice and capacity improvements endure beyond the life of research projects

One of the ultimate outcomes that program staff indicated the projects in this cluster sought to achieve was that policy, practice and capacity improvements realised by participants in the project would endure beyond the life of the project. Multiple causal pathways in the program logic for the cluster – developed retrospectively at the planning phase of this evaluation – were assumed to contribute to the achievement of this outcome. This section discusses the extent to which these causal pathways were realised through the cluster of projects.

According to the program logic, if projects partnered with local researchers, institutions and universities to conduct technical research, and with in-country research institutions, government agencies and other organisations to deliver and evaluate interventions, local researchers and institutions would build scientific, agribusiness and collaborative research capacity.

The projects in this cluster did not sufficiently engage local individual and institutional research, government and other partners to either build local capacity for transboundary biosecurity management or deliver and evaluate village-based interventions. Instead, projects prioritised the involvement of researchers and institutions from Australia. As a result, **the projects did not build scientific, agribusiness and collaborative research capacity among and with local partners.**

The program logic refers to collaboration being instrumental to conducting 'technical research'. As discussed in the findings for the cluster's science outcomes (KEQ 1a), treating these projects as 'technical' appears to have led to projects that were not designed with the input of relevant social sciences such as sociology, anthropology and economics. The result was that **projects did not understand or address the non-technical (such as cultural, economic or political) factors enabling or hindering farmers from practicing good biosecurity and accessing the livestock value chain.** As one senior member of one of the project teams explained, delivery of a vaccination program is '... not just a technical thing; it's a policy, social, governance and technical issue' (R1). This part of the program logic should therefore refer to 'technical *and* social research' to better capture the breadth of disciplinary expertise and factors requiring investigation to deliver more impactful and enduring transboundary biosecurity management development projects.

The program logic also assumes that local partner engagement would contribute to delivering and evaluating interventions, and using a village-based approach to pilot biosecurity, animal health, livestock reproduction, market and value chain interventions. These interventions were in turn expected to contribute to identifying the most appropriate strategies for improving farmer and stakeholder knowledge, attitudes and practices, while also identifying opportunities and constraints for smallholder participation in the livestock market.

Because of the limited engagement with local partners, there is **no evidence of collaborative identification of either the most appropriate strategies for improving farmer and stakeholder knowledge, attitudes and practices, or of opportunities and constraints for smallholder participation in the livestock market.** Project staff did provide training to local PhD students and researchers on science communication (for instance, publication of research findings and participation in research conferences). This training enhanced scientific communication capacities among local researchers. However, there is no evidence that this contributed to the embedding and institutionalisation of capacity and practice improvements realised by the projects. Although local students may have been better able to communicate research to relevant audiences, their **insubstantial involvement in the projects meant that local research partners were not in a strong position to promote the outcomes of the projects.** Though it is not possible to speculate on whether greater involvement of local partners may have contributed to the embedding and institutionalisation of capacity and practice improvements realised by the projects, several senior project staff thought that the projects should have involved local researchers more substantially (R1; R2; R6; R8).

The logic also assumes that if projects evaluated their activities and iterated, this would contribute to an understanding of the relative value of the different interventions being piloted. In turn, this would contribute to establishing an evidence base for best practice development models that support target markets and communities. While the reasoning underpinning this pathway is sound, this did not take place in this cluster of projects. As discussed in the findings for the cluster's science outcomes (KEQ 1a), the projects were essentially repetitions of one another. No evidence of evaluative activities in the projects was found. **Without any evaluation, later projects did not know what did and didn't work well in earlier projects and did not therefore adapt their design.**

A further assumption evident in the program logic is that if projects adopted a village-based approach to pilot biosecurity, animal health, livestock reproduction, market and value chain interventions, this would lead to knowledge, attitude and practice changes taking place across all levels of the village farming system – to the adoption of successful interventions by other farmers, extension workers and village communities, and to farmer and extension workers building knowledge and capacity.

Broadly speaking, the 'village-based approach' (as confirmed by key research staff during the planning phase of this evaluation) entails a geographic focus on the village scale, rather than at a district, regional, national or other scale. The projects' focus on the village scale was appropriate to promote biosecurity practice changes among participating farmers and maximised the consistency of biosecurity practices across whole villages. Therefore, the **program logic accurately assumes that focusing on the village level will lead to positive changes in biosecurity knowledge, attitudes and practices. However, such changes can only be confirmed for 2 participating groups:** farmers and delivery partners.

Focusing on the village level meant that projects did not consider broader systemic, institutional barriers to improved biosecurity and access to markets for smallholder farmers (for example, the realities of porous borders [R1], lack of government oversight [R5], inadequate and slow disease management processes and protocols [R4; R6]) that were more evident at the district, national and international scales. What's more, the logic assumed that providing policy advice and capacity building to government and development agencies would help build the knowledge, skills and capacity of government and sector stakeholders. Though this is a reasonable assumption, there is **no evidence that the projects engaged with government and sector stakeholders.** In fact, there is evidence that **some of the projects in this cluster may have failed to seize tangible opportunities to engage high-level government stakeholders and influence national policy outcomes.** Alongside projects not explicitly recognising and trying to address the complex set of social *and* technical factors determining the feasibility of farmers sustainably adopting such practice changes at multiple scales, this inability to seize relevant opportunities meant that the **likelihood of any biosecurity and market access improvements becoming embedded and institutionalised in-country was low.**

Ultimately, this evaluation found no evidence of such embedding and institutionalisation across the cluster of projects, though this was an expected outcome of all the pathways in the program logic. While vaccination, animal health and reproduction practice and capacity improvements *among farmers and delivery partners* endured in cases where these stakeholders had the resources and motivation to continue applying these, no policy improvements were realised by this cluster of projects in these areas. The result is that the institutional environment that farmers and delivery partners continued to work within may not have been conducive to the maintenance of practices and capacities learned through the projects.

Ultimate outcome 2: Livestock morbidity and mortality decreases

One of the ultimate outcomes that the cluster of projects sought to achieve was a decrease in livestock morbidity and mortality. According to the program logic, using a village-based approach to pilot interventions relating to biosecurity, animal health, livestock reproduction, market and value chains would enable farmers and extension workers to build knowledge and capacity that would contribute to a decrease in livestock morbidity and mortality.

KEQ 2b sought to answer how appropriate the village-based approach was to achieve the project's outcomes. This evaluation found that focusing on the village level had some benefits and drawbacks. Among the benefits, a **focus on the village level was appropriate to effect practice changes among participating farmers** who may otherwise have been more reluctant to implement changes if directed from government or other actors (R4; R5). **Focusing project activities on the village scale was also appropriate to maximise the consistency of biosecurity practices across whole villages** (R6; R7). This is because focusing on the village level likely enabled more intensive and consistent engagement with village actors, such as farmers and delivery partners, than would otherwise have been possible had projects been focused on other, or multiple, scales.

Focusing on the village level also enabled farmers from more remote villages to access vaccines when they may have been overlooked if the projects had been run at the district level (D6; D7). The village-based approach also appears to have facilitated information / knowledge exchange among smallholder farmers (D5), which this evaluation found to be a factor contributing to the diffusion of project knowledge and practices.

This evaluation also found numerous drawbacks from a village-based approach. The **focus on the village scale meant that projects did not acknowledge or address systemic, institutional factors** (often national and even international, such as trade policies and treaties, biosecurity regulations) **to improved biosecurity and access to livestock markets for smallholder farmers** (R1; R3). Focusing on the village level at the expense of the district level or above may also have limited the achievement of biosecurity outcomes. This is because the institutions and actors responsible for disease control are often found at the district level and above. Local farmers should not always be expected to act on disease outbreaks – they may lose income if they report them and biosecurity measures are taken by the competent authorities (D5).

Addressing transboundary biosecurity issues requires a district, regional and/or national focus, as these are the scales at which the key determinants of biosecurity and appropriate expertise to respond to biosecurity issues can be found (R2). This multi-scale focus can be complemented with village-based activities to build the capacities of farmers and local delivery partners. Such a focus would likely increase the probability that improvements will be embedded in relevant institutions and endure.

Addressing transboundary biosecurity issues requires interventions at the district, regional and/or national level, reference to – or conduct of – research on biosecurity management at these scales, and approaches to pilot interventions at multiple scales. The projects in this cluster did not undertake such activities. The result was a cluster of projects that decreased livestock morbidity and mortality in participating villages for the duration of projects but did not decrease livestock morbidity and mortality through improvements to the way that biosecurity is managed across boundaries.

One illustration of why more engagement with systemic factors impacting livestock markets and biosecurity was provided by one researcher (R5), who pointed out that at the same time as some of the projects in this cluster were trying to improve farmers' market access, the Australian Government started exporting 'huge numbers' of cattle into the region that 'completely swamped the local market'. This may have undercut local smallholder farmers, whose animals could not compete in the market with animals of Australian standards. The same researcher indicated that because of the project's focus on the village level, this systemic factor with a potentially large impact on village-level activities was not foreseen. According to one interviewee (R1), ACIAR may need to foster more partnerships with policy-level actors and promote the design of more research responding to their insights if its projects are to respond to broader, systemic factors and have an impact at this level.

Ultimate outcome 3: Smallholder livestock producers achieve improved livelihoods

The third ultimate outcome that the program logic looked to achieve was improved livelihoods for smallholder livestock producers. One pathway for achieving this outcome was assumed to be smallholder farmers engaging more competitively in the livestock market and the more efficient operation of the livestock market and value chain. According to the logic, this would be achieved by providing policy advice and building the capacity of government and development agencies, engaging market stakeholders, brokering connections that would cultivate opportunities for public-private partnerships, and building relationships with key domestic and international market stakeholders. This evaluation found that the projects in this cluster did not undertake these activities. Instead, the projects with a focus on livestock markets and the value chain focused their attention on mapping, but not critically analysing, the market and value chain (see discussion on capacity-building outcomes under KEQ 1a). **The evaluation found no evidence of achievement of engagement with government and development agencies, of market stakeholders, or of new connections being brokered between key domestic and international actors.** The result is that the assumptions outlined in this paragraph may be theoretically accurate but were not tested as part of this cluster of projects.

Another way that the program logic sought to achieve improved livelihoods for smallholder livestock producers was by transitioning smallholder farmers from being 'livestock keepers' to 'livestock producers'. In fact, this assumption is underpinned by another assumption: that farmers would benefit from – or want – this transition, which entails more competitive engagement with the livestock market and value chain, and the use of livestock as an income stream. This evaluation found that this may not always be the case. Smallholder farmers, by their very nature, need to aggregate their efforts to be able to compete with more efficient, industrial producers. Individual smallholder farmers are thus likely to be less competitive in larger markets and may lose out from participation in them (R1; R6).

Furthermore, farmers often treat livestock not as an economic resource, but as a resource to help configure social relationships (for example, through marriage or in building trust). Many farmers also consider their livestock as a form of savings, rather than as an income stream. **It may have been more appropriate for the projects in this cluster to aim to make livestock a more 'useful' resource for farmers,** rather than a more profitable one. This degree of openness would have demanded a better understanding of farmers' motivations, needs and aspirations and suggested interventions and approaches that could address these.

The projects impacted the health, productivity and profitability of livestock, which made it easier for farmers to make an income from livestock. Higher income security and more efficient management of livestock health and reproduction contributed to more time for leisure activities and greater opportunities for schooling for young people. However, the **extent to which these outcomes endured after the projects concluded was directly linked to the ability and willingness of farmers to continue applying what they learned, therefore leaving it solely in the farmers' hands to maintain improvements to livelihoods.** Had the project generated more of an understanding of the factors hindering or enabling the institutionalisation and ongoing application of project practices, activities and approaches could have been piloted to achieve this outcome and increase the likelihood of livelihood and other outcomes enduring.

In conclusion, the logic underpinning this cluster was only partially accurate. Broadly speaking, its accuracy seems to have been limited by not engaging target communities to understand their motivations, needs and aspirations.

3. What can ACIAR learn from the implementation of village-based approaches to transboundary biosecurity in the project contexts?

Key findings

The evaluation found that direct participation by farmers in **'learning by doing' activities at the village level helped to translate knowledge into capacity outcomes.**

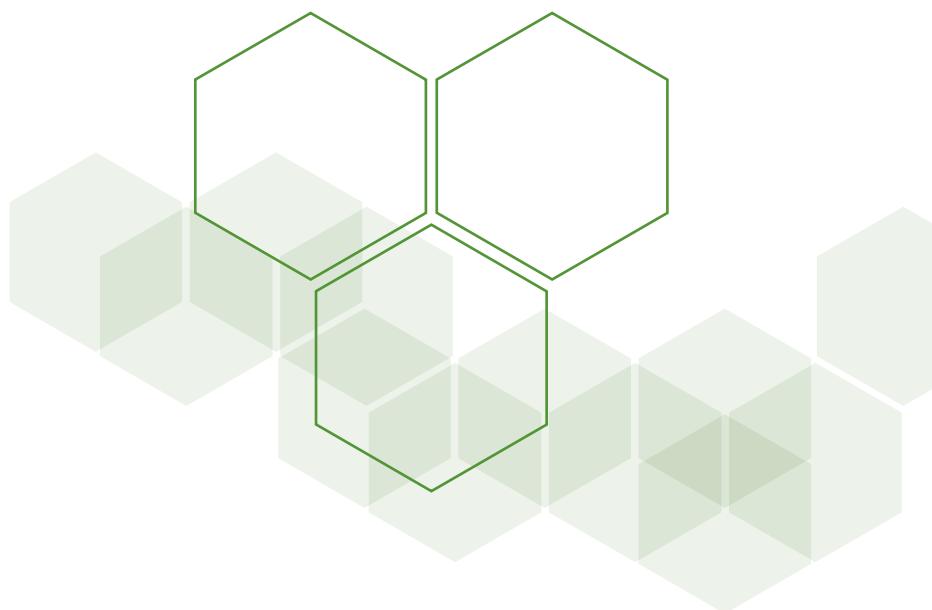
However, a focus on the village level meant that projects could **not account for or respond to systemic, institutional determinants** of biosecurity management.

Factors hindering the success of the village-based approaches adopted [KEQ 3b]

As discussed in response to KEQ 2b, the village-based approach could not by itself address the systemic, institutional factors that often determine biosecurity outcomes. Without a focus on broader, national and international factors, the projects in this cluster were unable to respond to and/or address such systemic and institutional factors.

Factors enabling the success of the village-based approaches adopted [KEQ 3a]

What appears to have enabled the success of the village-based approaches applied in the projects was the direct participation of farmers in 'learn by doing' activities. This enabled the projects to directly translate theoretical knowledge about biosecurity, animal health and reproduction approaches into practice. As discussed in response to KEQ 1a, demonstration appears to have been a key determinant of project success in enabling practice change leading to improved biosecurity, animal health and reproduction outcomes.







Conclusion

The projects in the cluster evaluated achieved a range of scientific outcomes. Projects generated useful information about the prevalence of certain diseases in participating villages and confirmed the usefulness of vaccination as a strategy to address some key livestock biosecurity challenges. However, the projects did not generate original scientific insights into the factors that motivate smallholder farmers to practice good biosecurity, nor in the opportunities and challenges that smallholder farmers may have to participate in local value chains. In part, this was because the projects did not build on one another; projects appear to have been repetitions of one another. Overall, this evaluation found that the projects in this cluster either did not carefully consider how to translate knowledge generated into practical outcomes, or only started doing so towards the end of the projects, making it less likely this translation could be successfully achieved.

The projects broadly built the capacity of participants, whether farmers, delivery partners (such as village animal health workers, village veterinary workers, district officers and extension workers), or participating researchers. Capacity comprises several ingredients, including skills and knowledge and the confidence to implement a practice. This evaluation found that through participation in project activities, stakeholders gained new knowledge, skills and confidence to implement improved biosecurity practices. Farmers learned about modern reproduction techniques and the importance of vaccination, as well as how to apply these through hands-on 'learn by doing' activities. Such activities were instrumental in building farmer and delivery partner capacity. There is evidence that such capacities have been maintained by some farmers and delivery partners. However, the extent to which this is the case is influenced by several factors, including farmers having the resources available to continue implementing project practices.

This evaluation also found that projects in this cluster contributed to positive biosecurity, animal health and reproduction outcomes in participating villages. Farmers and delivery partners became more adept at identifying when animals might be sick, at applying medication and at vaccinating them. They also separated animals more consistently, implemented the use of forages to improve animal nutrition and applied modern reproduction techniques to improve the health and productivity of their livestock. The evidence indicates that such outcomes were primarily realised during the lifetime of the projects. This evaluation found that this was broadly because there was little consideration for how to make project outcomes endure in the design of the projects. In some cases, for example, farmers stopped vaccinating for non-lethal diseases such as FMD because they perceived the cost of vaccination to be higher than any productivity losses from the disease. Some researchers interviewed put this down to insufficient investigation and understanding of farmer motivations and the contextual (cultural, economic and other) factors that might impact on the sustainability of improved biosecurity, animal health and reproduction practices.

Nevertheless, the projects in this cluster contributed to diverse positive livelihood outcomes. Farmers that implemented improved animal reproduction, health and biosecurity practices reported having healthier and more productive livestock. The benefits of this are manifold. Farmers reported having larger herds that provided them with greater financial security in times of need. They also reported being able to sell livestock for better prices and more easily. Improved practices also freed up time from having to manage livestock, including for children. In such cases, the improved practices contributed to children being able to attend school and university because they had the time to do so and because their families had sufficient money to fund their education. Such benefits have flow-on effects on other dimensions of livelihood, such as employment opportunities.

This evaluation also assessed the suitability of focusing on the village scale to achieve transboundary biosecurity outcomes. The evaluation found that this scale is appropriate for diverse reasons and less appropriate for others. On the one hand, focusing on the village level was appropriate to provide farmers with the knowledge and skills necessary for biosecurity management. This focus may also have enabled the projects to reach more remote and generally less serviced villages, thus providing equitable access to improved biosecurity. On the other hand, a focus on the village level did not allow projects to engage with institutional factors that largely determine how biosecurity is managed in countries. This lack of engagement with institutional factors appears to have limited the capacity of the projects to contribute to catalyse systemic change in how biosecurity is managed.

Overall, this evaluation found that a simultaneous focus on the village level and district or national levels may have worked better because the expertise and responsibilities for biosecurity management do not primarily exist at the village level. Awareness of larger scales may also have enabled some of the projects to identify national or international factors such as trade policies that could limit the projects' effectiveness at achieving its intended outcomes.



Appendices

Appendix 1: Evidence table for document review

KEQs	Findings	Evidence
Outcomes		
1. To what extent, and how, did the project deliver on science and development outcomes?		
a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to?	<p>Science outcomes</p> <p>Knowledge on issues being investigated was confirmed and consolidated (AH/2005/086), including the usefulness of applying a change management framework to achieving sustainable farmer behaviour changes (AH/2011/014).</p> <p>Several scientific outputs were produced, such as new evidence, knowledge and data to advance outcomes, including increasing cattle production, developing local management strategies and better control of disease (AH/2011/014, AH/2005/086, AH/2006/159).</p> <p>Some of these outputs included educational materials (such as a biosecurity education booklet) (AH/2010/046) and scientific publications (AH/2005/086, AH/2006/159, AH/2010/056, AH/2011/014, AH/2012/067) to disseminate knowledge, as well as contributions to international meetings to share the findings and impacts of research in developing policy and extension programs (AH/2011/014).</p> <p>The project also led to the uptake of technologies with evidence of improved productivity (AH/2006/159).</p>	<ul style="list-style-type: none"> • AH/2005/086, AH/2006/159, AH/2010/046, AH/2011/014, AH/2012/067, AH/2012/068. • Knowledge on issues being investigated was confirmed and consolidated (AH/2005/086 2012 Annual Report), including the usefulness of applying a change management framework to achieving sustainable farmer behaviour changes. Such a framework entails consideration/ understanding of: <ul style="list-style-type: none"> - motivators for change by understanding socioeconomic impacts - resistance to change by identifying barriers for intervention adoption - knowledge management and transfer to improve education of farmers by providing a variety of extension options - cross-cultural dimensions that can enable or inhibit progress - farming systems that ensure integration of livestock health with productivity and livelihood gains - communication and veterinary leadership dimensions to improve awareness and reporting and achieve sustainable change, from village farming communities through to international donor agency levels (AH/2011/014 Final Report - DO NOT PUBLISH, page 69). • Evidence that forage development is a key entry point for biosecurity and animal diseases control (ibid.). • Additional data collected on the relative value of interventions aimed at increasing cattle production (AH/2005/086 2012 Annual Report; AH/2012/067 Final Report). • ACIAR Monograph and a Khmer Best Practice Cattle Production in production in 2012 (AH/2005/086 2012 Annual Report). • A biosecurity education booklet was created specifically for Cambodian farmers (livestock owners) to add to the Khmer-language ACIAR series already featuring biosecurity booklets for village animal health workers and livestock traders (AH/2010/046 Final Report, page 50; not certain that this is different from other extension materials referenced in other projects). • Thirteen scientific publications published in journals or presented at conferences for AH/2005/086 2012; 23 publications for AH/2006/159; 6 for AH/2010/056, plus 5 PhD theses and 8 technical reports; 5 journal publications and attendance at 15 research and practice conferences for AH/2011/014; 5 journal articles and 20 conference publications for AH/2012/067; 11 journal articles and conference papers for AH/2012/067; 6 journal articles. • Results from the knowledge, attitudes and practices survey indicate that farmers that now grow forages and have been educated on vaccination, biosecurity and nutrition wish to continue with these interventions (AH/2005/086 Final Report, page 73). • Best practice program of multiple interventions leads to higher cattle productivity that is incremental but very likely to be exponential (AH/2005/086 Final Report, page 74).

Appendix 1: Evidence table for document review (cont.)

KEQs	Findings	Evidence
<p>a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to? (cont.)</p>		<ul style="list-style-type: none"> • Enhanced control of FMD through improved vaccination and biosecurity strategies (AH/2006/159 Final Report, page 41). • Knowledge on the significant and widespread prevalence and clinical impact of <i>Fasciola gigantica</i> and <i>Toxocara vitulorum</i> in large ruminants in northern Laos, providing the base information needed to develop local management strategies (ibid.). • Effective uptake and adoption of technologies for forage establishment, maintenance and conservation with evidence of improved productivity through fattening trials (ibid.). • Local production and wider use of the locally developed weight band to provide more accurate assessment of live weight, providing farmers and traders with a tool to assess values and monitor growth and weight gain more accurately (ibid.). • Identification of needs for improved reproductive management to address the rapidly developing deficiencies in supply of large ruminants in the region (ibid.). • Behavioural changes of livestock stakeholders as recorded in the studied smallholder farming systems (AH/2011/014 Final Report - DO NOT PUBLISH, page 69). • Contribution to Southeast Asia and China FMD campaign and numerous other international meetings to share the findings and impacts of research in developing policy and extension programs (ibid.). • 'While knowledge has generally improved, the obstacles to biosecurity implementation include lack of farm-level infrastructure to implement quarantine areas' (AH/2012/067 Final Report, page 55). • '... improved understanding of marketing and biosecurity challenges for regional trading for cattle and buffalo, the baseline reproductive performance and diseases information, new strategies for improved nutrition and parasite control, plus a range of health, production and meat processing constraints', with particular insights resulting from project, including (AH/2012/068 Final report, pages 64–65): <ul style="list-style-type: none"> - markets were found to be small and poorly connected across trading nodes, with instances of some traders having complete control over their local supply chain - the main factor influencing price is the high demand for beef in China and Vietnam - farmers were found to sell at the 'farm-gate' and negotiated a price based on previous sales, neighbours' sales and sometimes the general price for the district - discrepancies in livestock values between farmers and traders reflect that traders base their prices on the estimates of kilograms of meat yielded that they can sell; this results in estimates lower than those of farmers who mostly use visual estimates, despite the availability of weigh tape data generated in AH/2005/086 that provides more accurate estimates of weight of Lao cattle and buffalo - identification that 'Slaughter practices in Laos need urgent attention, with investigations identifying that overall knowledge scores of participants were low and there was no significant difference between knowledge, attitudes and practice scores of employees from slaughterhouses and slaughter points' (ibid., page 65).

KEQs	Findings	Evidence
<p>a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to? (cont.)</p>	<p>Capacity-building outcomes</p> <p>The documentary evidence indicates that projects enhanced the capacity of farmers, district staff and other extension workers in animal health and biosecurity management through the production of materials in language, workshops and other training opportunities (AH/2005/086, AH/2006/159, AH/2010/046, AH/2012/067, AH/2012/068). Project documentation also indicates enhanced research capacity of students, in-country professors and extension officers (AH/2012/068, AH/2012/067, AH/2005/086, AH/2006/159). Projects resulted in the uptake of project technology/approach by farmers, including for some that were not part of the project due to both farmer training and word-of-mouth (AH/2010/046). One project (AH/2012/067) may also have had influence at the regional international level, with OIE regularly promoting the benefits of the FMD research conducted in Laos on policy development.</p>	<p>The project enhanced the capacity ('knowledge and understanding', AH/2005/086 and AH/2006/159 End of Project Review, page 18) of farmers, district staff and other extension workers in animal health and biosecurity management through the production of materials in language, workshops and other training opportunities (AH/2005/086 Project Extension; AH/2005/086 2012 Annual Report; AH/2005/086 and AH/2006/159 End of Project Review; AH/2005/086 Final Report, pages 76-78). More specifically:</p> <ul style="list-style-type: none"> • Training on biosecurity, forage and reproduction (see AH/2005/086 2012 Annual Report, page 20 for more details; AH/2005/086 and AH/2006/159 End of Project Review, page 18). • 'Forages and Forage Cultivation Techniques' publication, in Khmer (3,000 copies) (AH/2005/086 Final Report, page 83) – examples of booklet distribution on pages 83-84. • Participatory 'applied field research' consisting of project-enrolled farmers presenting their cattle and buffalo on 10 occasions over a 3-year period between December 2008 and 2011 for weighing, vaccination, sample collection and recording of additional health and production information (AH/2006/159 Final Report, page 39). • 'Formal training' for AH/2006/159 conducted between June 2011 and April 2012 for Village Animal Health Workers and 25-35 farmers in high intervention (HI) villages; involved 2 days of training and half-day discussion, plus various farmer 'cross visits' and meetings. Training covered: <ul style="list-style-type: none"> - prophylaxis for controlling major diseases - basic biosecurity measures (quarantine and separation of sick animals) - basic information on parasitic disease management in cattle and buffaloes - forage cultivation and management - farmer group meetings and cross visits (AH/2006/159 Final Report, page 39; also valid for AH/2011/014). • Delivery of 6 one-day training schools (one in each village) in cattle production, biosecurity and marketing (AH/2010/046 Annual Report 2015, page 9). • Considerable improvement in farmer knowledge. At the baseline survey, the farmers responded correctly to an overall average of 24-28% of the knowledge questions. By 2018, farmers were responding correctly to an overall average of 65-98% of the knowledge questions, with the HI farmers scoring significantly higher in the disease ($P < 0.001$) and nutrition ($P = 0.005$) questions. • The University of Sydney team strongly focused on training project staff and district partners in animal health and biosecurity management plus applied animal production principles, encouraging these staff to implement project interventions and train farmers in HI villages (AH/2005/086, DOC53, page 77).

Appendix 1: Evidence table for document review (cont.)

KEQs	Findings	Evidence
<p>a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to? (cont.)</p>		<ul style="list-style-type: none"> • Training for AH/2010/046 across both ‘training the trainer’ and ‘integrated farmer training’ (AH/2010/046 Final Report, page 47), including: <ul style="list-style-type: none"> - training sessions for Department of Animal Health and Production (Cambodia) staff on farm management and marketing of cattle, including delivery of 2 courses on the subject - workshop on financial analysis of farm management scenarios for Department of Animal Health and Production and Royal University of Agriculture (Cambodia) students - training on cold chain management for vaccines for Department of Animal Health and Production staff and industry stakeholders - training of Royal University of Agriculture (Cambodia) students as enumerators to conduct surveys and field sampling and vaccination of animals - training for provincial and district staff on both technical and soft skills, including ‘... livestock disease identification, control and mitigation, livestock nutrition, livestock breeding and general livestock husbandry. The second day of the training workshop focused on training delivery skills enabling the project staff to practise their oral delivery and teaching skills’ – this training also provided material that would ‘help deliver extension activities on cessation of the project’ (AH/2012/067 Final Report, page 57) - ‘... farmer-training activities throughout the project’ (ibid.). • During the first year, training related to animal health, forage production and nutrition involved only the Department of Animal Health and Production (Cambodia) project team and district partners, but the following 3 training courses on ruminant nutrition, reproduction and cattle nutrition (3 days for each course) included other provincial and district staff, students from the Royal Academy of Agriculture and partners of the ACIAR project ‘Improved feeding systems for more efficient beef cattle production in Cambodia’ (AH/2005/086, DOC53, page 77). Enhanced research capacity of students and in-country professors, through (for both AH/2012/068 and AH/2012/067): <ul style="list-style-type: none"> • Interactive university workshop series at National University of Laos and Savannakhet University conducted together with AH/2012/068 for staff and students (average of 30 staff and students joining each session) (AH/2012/067 Final Report, p56). Series covered: <ul style="list-style-type: none"> - techniques for developing online learning modules based on case studies documented by the project (Russell Bush and Peter Windsor) - pathology training, including necropsy examination for improved diagnostic capacities, was delivered (Peter Windsor and Sonevilay Nampanya) and arrangements made for the donation of teaching equipment (20 microscopes surplus to needs at The University of Sydney) plus donation of numerous texts and other training materials - scientific writing and presentation skills (Francesca Earp and John Dillon Fellowship alumni Dr Malavan Chittavong of National University of Laos) and university staff member Mr Phonetheb Porsavathdy (Savannakhet University).

KEQs	Findings	Evidence
<p>a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to? (cont.)</p>		<ul style="list-style-type: none"> • University student conference, providing opportunities for students to present research through oral presentations and posters. Also, publication of conference magazine (included student, staff and project field reports and scientific papers from university students); the magazine included the following testimonial: 'Through the training, the students and professors who participated in the study gained a greater understanding of scientific research topics such as understanding issues about conducting research, sourcing information from sources such as Google Scholar, finding and understanding a journals impact factor and referencing using EndNote' (AH/2012/067 Final Report, pages 56–57). • Systems approach adopted 'proved very successful in engaging farmer cooperation' as a means to 'to facilitate smallholder cattle production in the Greater Mekong Subregion as a means of addressing both regional food security and rural poverty' (AH/2006/159 Final Report, page 6). • The 28 Lao livestock extension officers involved in AH/2006/159 'greatly improved their skills as documented in assessment of their large ruminant production training following attendance at the project' and also 'improved their research skills, particularly in interviewing techniques, faecal sampling and record keeping, by participation in and implementation of several surveys' (AH/2006/159 Final Report, page 41). • 'Both Australian and Cambodian staff and students increased skillsets in agricultural development and extension and research' (AH/2005/086, DOC53, page 78). <p>Uptake of project technology/approach by farmers that were not part of the project (diffusion of project approach), resulting from both farmer training and word-of-mouth (AH/2010/046 Final Report, page 47); free vaccination every 6 months against FMD and Haemorrhagic septicemia (HS) for all cattle and buffalo (approximately 700–900 per province) in the study villages during 2014 and 2015 (AH/2010/046 Annual Report 2015, page 9). Specifically:</p> <ul style="list-style-type: none"> • 'The project structure has resulted in many more farmers from villages being interested in growing forage and provides the opportunity for them to talk and share knowledge and information' (AH/2010/046 Annual Report 2015, page 9). • For AH/2010/046: 77 households <i>as of 2015</i> were working with the project and adopted forage and other aspects of improved management in the training (AH/2010/046 Annual Report 2015, page 8). • Adoption of new genetics through importation of animals and semen (AH/2011/014 Final Report - DO NOT PUBLISH, pages 69–70). • 'The project has had a major influence at the regional international level, with OIE regularly promoting the benefits of the FMD research conducted in Laos on policy development, particularly with strategic vaccination and biosecurity strategies, more effective surveillance programs and the role of goats in developing approaches to evidence-based zonal freedom' (AH/2012/067 Final Report, pages 55–56).

Appendix 1: Evidence table for document review (cont.)

KEQs	Findings	Evidence
<p>a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to? (cont.)</p>	<p>Biosecurity outcomes</p> <p>The projects contributed to biosecurity in intervention villages in different ways. For example, biosecurity education and vaccine use resulted in no outbreaks in HI villages of FMD or HS despite widespread occurrence of these in surrounding villages (AH/2005/086). Other outcomes include instances of improved body conditions for adult large ruminants and of better disease management (AH/2012/068).</p>	<ul style="list-style-type: none"> • Indication of capability to continue project activities once these cease ('Key challenges identified were access and cost of reliable FMD vaccines, preventing co-grazing and improving uptake of other biosecurity measures, water availability during the dry season and changing cultural attitudes toward livestock breeding') (AH/2012/067 Final Report, page 56). • '... development of a molecular diagnostic tool to enable rapid surveillance using faecal samples to detect for the presence of <i>Fasciola</i> spp eggs, plus improved knowledge of the particular species and/or hybrids present (Calvani et al., in-press)' (AH/2012/068 Final report, page 64). • '[Lao PDR Department of Livestock and Fisheries] staff were trained on improved faecal egg count and sedimentation techniques to enhance local capacity in the diagnostic laboratories in Luang Prabang and Vientiane' (ibid.). • A 2019 field visit to the Lao Quality Beef Initiative farms was held in Vientiane, attended by 50 farmers, district provincial staff and project staff from all 4 of the project provinces and consisted of seminars, farm tours and demonstrations on livestock nutrition, housing and husbandry techniques (AH/2012/068 Final report, pages 68–69).
	<p>Biosecurity outcomes</p> <p>The projects contributed to biosecurity in intervention villages in different ways. For example, biosecurity education and vaccine use resulted in no outbreaks of FMD or HS in HI villages despite widespread occurrence of these in surrounding villages (AH/2005/086 Final Report, page 75).</p> <p>Between 2008 and 2011 in all 6 villages, farmers, village veterinary workers and staff did not report any outbreaks of HS. However, there were numerous reports of HS outbreaks in July 2009 in northern provinces, causing more than 300 cattle and buffalo deaths in Hua Phan province alone (AH/2006/159 Final Report, page 24).</p> <p>'... the provision of high-quality molasses block nutrients and anthelmintic drugs within blocks, led to a reduction in calf mortalities (due to toxocarasis), with improved body condition and weight gain of adult large ruminants (due to reduced <i>Fasciola</i> species burden)' (AH/2012/068 Final report, page 64).</p> <p>A reduction of the incidence of bovine fascioliasis also has a positive One Health impact due to reduced zoonotic risk (ibid.).</p> <p>'Buffalo were identified as more susceptible to <i>M. caninum</i> infection, with cattle more susceptible to <i>L. interrogans</i>, suggesting co-housing of species may facilitate transmission' (ibid., page 65).</p>	<ul style="list-style-type: none"> • Biosecurity education and vaccine use combined resulted in no outbreaks of FMD or HS in HI villages despite widespread occurrence of these in surrounding villages (AH/2005/086 Final Report, page 75). • Between 2008 and 2011 in all 6 villages, farmers, village veterinary workers and staff did not report any outbreaks of HS. However, there were numerous reports of HS outbreaks in July 2009 in northern provinces, causing more than 300 cattle and buffalo deaths in Hua Phan province alone (AH/2006/159 Final Report, page 24). • '... the provision of high-quality molasses block nutrients and anthelmintic drugs within blocks, led to a reduction in calf mortalities (due to toxocarasis), with improved body condition and weight gain of adult large ruminants (due to reduced <i>Fasciola</i> species burden)' (AH/2012/068 Final report, page 64). • A reduction of the incidence of bovine fascioliasis also has a positive One Health impact due to reduced zoonotic risk (ibid.). • 'Buffalo were identified as more susceptible to <i>M. caninum</i> infection, with cattle more susceptible to <i>L. interrogans</i>, suggesting co-housing of species may facilitate transmission' (ibid., page 65).

KEQs	Findings	Evidence
<p>a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to? (cont.)</p>	<p>Livelihood outcomes</p> <p>One of the projects (AH/2005/086) resulted in the allocation of substantial areas of land to forage growing in villages. It is anticipated that expansion of cattle fodder production will result in significant time saving for household members. Projects also contributed to household incomes. Many farmers also experienced significant savings due to changes in farming practices (AH/2005/086, AH/2012/067), which allowed farmers to dedicate more time to off-farm income generating activities (AH/2011/014). AH/2012/068 found that by 2018, HI farms were deriving most of their income from off-farm employment, suggesting income from large ruminants had contributed to household income stability and time savings, enabling farmers to focus on off-farm income generating activities (AH/2012/068).</p> <p>Some projects also resulted in cattle increasing in value (AH/2005/086, AH/2006/159, AH/2011/014, AH/2012/068). Financial benefits for farmers also resulted from practice changes, including FMD vaccination (AH/2005/086), more effective marketing (AH/2010/046), providing forage seed, assistance with building cattle houses and training (AH/2012/068).</p>	<p>Substantial areas of land have been allocated to forage growing in the project villages, with approximate plantation sizes of:</p> <ul style="list-style-type: none"> • Takeo province 141,000 m² • Kandal province 21,000 m² • Kampong Cham 120,000 m². <p>In the latter half of 2011, a further 23,900 m² of forage plots were established by 195 smallholder farmers although the rate of increase slowed in 2012 due to severe flooding. It is anticipated that expansion of cattle fodder production will result in significant time saving for household members and the knowledge, attitudes and practice survey that is presently being analysed will capture these details (AH/2005/086 2012 Annual Report).</p> <p>Preliminary data analysis results relating to project financial impacts on households show that in HI villages, of the 60 farmers surveyed, 86% consider the project increased their household income, with 51% indicating this increase was twice or more than twice their usual household income (ibid.). Many farmers experienced significant savings in time for household members with forages due to reduced need for grazing and searching for native grasses for cut-and-carry (ibid.).</p> <p>Specifically:</p> <ul style="list-style-type: none"> • 'These time savings have allowed farmers to dedicate more time to off-farm income generating activities and therefore creating a positive economic impact on households and communities' (AH/2011/014 Final Report - DO NOT PUBLISH, page 72). • Participating farmers in AH/2012/067 were found to have experienced time-savings of 1.3 to 1.4 hours per day due to project interventions (AH/2012/067 Final Report, page 59) and were found to use this extra time for diverse purposes: <ul style="list-style-type: none"> - earning off-farm income, 'with extra income <i>potentially</i> re-invested into on-farm biosecurity and disease mitigation' (ibid.). • Cambodia: Increased value of cattle by USD61.29 over a 3-month period (AH/2005/086 Final Report, page 75). • Laos: The on-farm fattening trial demonstrated that increased values of cattle and buffalo by USD78 and USD123 per head, respectively, was achieved over a 4 to 6 month period (AH/2006/159 Final Report, page 44). • Increase in livestock income in Cambodia from USD768.5 in 2015 to USD1119.6 in 2018 for HI villages (AH/2011/014 Final Report - DO NOT PUBLISH, page 8); buffalo value increasing 81.9% and cattle value increasing 37.1% across the project in Laos (AH/2012/068 Final report, page 64). • Additional income generated by farms through the sale of grass and seedlings (AH/2011/014 Final Report - DO NOT PUBLISH, page 72). • Partial budget showed a net benefit of USD31.48 for twice yearly use of FMD vaccination (AH/2005/086 Final Report, page 75).

Appendix 1: Evidence table for document review (cont.)

KEQs	Findings	Evidence
<p>a. What science, capacity, livelihood and biosecurity outcomes did the research contribute to? (cont.)</p>		<ul style="list-style-type: none"> Forage technology (plantation, establishment, maintenance and use) was successful in enabling fattening in some HI villages (Luang Prabang HI and [low intervention] (LI) and Xiang Khong HI). However, 'scaling-out' is necessary to provide sufficient supplementary nutrition for achieving specific production targets, considering that up to 1,000 m² of forages are needed for fattening of one large ruminant (AH/2006/159 Final Report, page 24). Time saved and extra income available from marketing cattle more effectively (50% reduction in labour requirements and <i>potentially</i> a 40% increase in income from cattle) (AH/2010/046 Final Report, page 48). '... economic benefit to project partners by providing forage seed, assistance with building cattle houses and training' ... 'by the end of 2014, 56 households were growing 5.1 ha [of forage], of which 25 households growing 1.64 ha were newly enrolled' (AH/2010/046 Annual Report 2015, page 10); the forage plot sizes increased from 1,800 m² to 5,300 m² per farmer (AH/2012/068 Final report, page 64). 'Improved nutrition from forage development and feeding interventions as well as access to block supplements are likely to have contributed to the improved ability to maintain weight over the dry seasons (December – May) leading to better weight gain during the wet seasons (June – November)' (ibid.). '... sales from large ruminants were 28% in [medium intervention] (MI) farms compared to only 20% in HI farms indicating that time-savings from growing and feeding forages (1.3–1.4 hr/day) were utilised for other income generating activities' (ibid., page 69). 'By 2018, HI farms were deriving most of their income from off-farm employment (other), constituting 46% of household income compared to only 33% in MI farms. This suggests income from large ruminants has contributed to household income stability and the time-savings from current interventions enables farmers to focus on off-farm income generating activities (for example as a builder, government staff, driver or shop owner, or hired labour in Thailand). These farmers are expected to experience a future of stable economic growth more rapidly than those relying solely on farming activities' (ibid., page 70).
<p>b. To what extent have these been enduring?</p>		

KEQs	Findings	Evidence
<p>c. Were there any unintended outcomes from the project activities?</p>	<p>Environmental outcomes</p> <p>The projects in this cluster had a range of environmental outcomes. Most notably, the establishment of forages, manure collection, more widespread housing and restraint of cattle, and reduced free grazing had positive environmental outcomes. Among these included reduced soil erosion, reduced pollution of both land and waterways and the planting of trees.</p>	<ul style="list-style-type: none"> • Forage establishment, manure collection, more restraint and housing of cattle rather than free grazing are all likely to result in local environmental impacts, although analysis of this issue was not an objective of this project (AH/2006/159 Final Report, page 44). • 31 ha of land have been developed for use for forage growing. This land was previously used for other crops or covered by natural/native grasses (AH/2006/159 2012 Annual Report, page 14). • Nightly yarding of cattle/buffalo in Ban Nakud, Houaphan adopted by 44 households is reducing free roaming of cattle and buffalo in surrounding forest and crop land and allows collecting manure for fertilisation of crops (ibid.). • 'It is expected that increased productivity from large ruminant production at village level will assist some households to focus on intensive large ruminant production and reduce their 'slash and burn' cropping practices that are widely observed currently in northern Lao PDR' (AH/2006/159 2009 Annual Report, page 9). • Possible benefits from the removal of cattle from communal lands, 'Continuing to develop improved weaning and forage management systems will reduce pressure on communal land and reduce the potential for disease movement' – no direct evidence of this in the final report, though (AH/2010/046 Project Document, page 16). • By the end of 2017, there were 178 farmers planting 438,800 m² of forages in project sites (activity 2.2). These forages have reduced the need for farmers to forage for native grasses and for livestock to be herded to areas of grassland, forest or roadside. This will potentially lead to long-term positive impacts on the environment by reducing soil erosion and pressure on native vegetation (AH/2011/014 Final Report - DO NOT PUBLISH, page 73). • The manure from housed livestock can easily be collected and used as natural fertiliser for cropping systems or in biodigesters, reducing household's need for an external energy supply such as wood fires (ibid.). • '...changes to land use through forage development, reduced free-grazing and better water and animal waste management will result in positive long-term environmental impacts' (AH/2012/067 Final Report, page 60). • 'The utilisation of forages reduces the need for animals to free-graze, reducing pressure on native grasslands and forested areas, reducing soil erosion and minimising resource competition with native animals' (ibid.).
<p>d. To what extent did project activities deliver outcomes for communities and stakeholders beyond project sites?</p>		

Appendix 1: Evidence table for document review (cont.)

KEQs	Findings	Evidence
<p>e. To what extent did projects engage with issues of gender and social inclusion?</p>	<p>Anecdotal evidence from interviews confirmed that smallholder farmers were empowered by their knowledge of animal production, disease management and forage technology (AH/2006/159). Time saving and enhanced income allowed households to undertake a variety of other community, economic and education activities (AH/2010/046, AH/2011/014, AH/2012/067). For example, there was anecdotal evidence that increase in livestock farming income and reduced requirement for young adults to tend to forage activities has enabled some families to send children to university in Phnom Penh (AH/2011/014). Across many of the projects, a key focus was the inclusion of female household members in project training and data collection activities (AH/2011/014, AH/2012/067, AH/2012/068).</p>	<p>Anecdotal evidence from interviews with farmers in the HI sites through the project consistently confirmed that smallholder farmers were empowered by their knowledge of animal production and particularly valued FMD and HS control, <i>Toxocara vitulorum</i> treatment plus forage technology (AH/2006/159 Final Report, page 44). Time saving and enhanced income allow households to undertake a variety of other community, economic and education activities (50% reduction in labour requirements and <i>potentially</i> a 40% increase in income) (AH/2010/046 Final Report, page 48; AH/2011/014 Final Report - DO NOT PUBLISH, page 8). Specifically:</p> <ul style="list-style-type: none"> • Reduced time spent feeding cattle from 5.8 to 2.4 hours per day (AH/2011/014 Final Report - DO NOT PUBLISH, page 8). • More children attending school for longer (ibid., page 72; AH/2012/067 Final Report, page 59). • Additional time for social activities such as visiting friends and family, neighbours, visiting pagodas for religious events, attending funerals and weddings, and helping build and maintain social and community networks (AH/2011/014 Final Report - DO NOT PUBLISH, page 71; AH/2012/067 Final Report, page 59). <p>Benefits of project shared with broader farming community (outside project participants) by providing education and biosecurity interventions for all livestock farmers in the study villages (ibid.).</p> <p>Children able to attend school and not having to spend large amounts of time tending cattle in the field (ibid., page 49).</p> <p>'... women running cattle breeding enterprises: grandparents fattening cattle while parents were working off-farm' (ibid.).</p> <p>'Longer term changes may [affect] land ownership and village structure. For example, the most successful farmer specialised in cattle production and was fattening 10 animals per year, resulting in income of approximately USD10,000. This was possible because he had purchased 2 adjacent farms' (ibid.).</p> <p>Anecdotal evidence that an increase in livestock farming income and reduced requirement for young adults to tend to forage activities has enabled some families to send children to university in Phnom Penh (AH/2011/014 Final Report - DO NOT PUBLISH, page 71).</p> <ul style="list-style-type: none"> • Some socioeconomic studies investigated gender roles within households alongside other variables (ibid., page 60). • Project training activities ensured there was appropriate inclusion of female household members (ibid., page 70). • Gender roles and participation in training workshops was tracked (ibid., page 72). • Francesca Earp speaking about the projects' gender initiatives on behalf of Ms Chanthalangsy, Dr Vannaphone (National University of Laos) and Mr Phonetheb (Savannakhet University) at the university student conference (AH/2012/067 Final Report, page 56).

KEQs	Findings	Evidence
<p>e. To what extent did projects engage with issues of gender and social inclusion? (<i>cont.</i>)</p>		<ul style="list-style-type: none"> • Recognition that ‘improving the female farmer’s time spent on social activities is important as she is often the most time-poor member of the community and household’ (ibid., pages 59–60). • ‘Due to the cultural perception of agriculture in Laos, there is currently a risk of unintentional female disempowerment as female farmers are rarely included in farm management conversations at both a household and village level. To address this, female farmer inclusion was a focus of training and data collection activities. The female-only focus group discussions and inclusive farmer training sessions invited females into a safe space to share values and opinions. The Lao project team members and provincial and district staff observed this and it is expected that female farmers will continue to be included in extension activities and farming dialogue on project completion’ (ibid., page 60). • ‘... female farmer inclusion was a focus of training and data collection activities, with female farmers invited into a safe space to share their values and opinions. By stressing the importance of female farmer inclusion to Lao project team members and provincial and district staff, it is anticipated that female farmers will continue to be included in these conversations after project completion’ (AH/2012/068 Final report, page 70).
<p>f. What, if any, were the outcomes of any engagement with issues of gender equity and social inclusion for communities?</p>		
<p>Design</p>		
<p>2. How appropriate was the design of the projects?</p>		
<p>a. To what extent were the assumptions underpinning the design logic accurate?</p>		<p>‘When village-level options were attempted to be implemented, key barriers were associated with who would be responsible for the maintenance and enforcement of the measures. Farmers currently require incentives and coordinated strategic assistance from the [Government of Lao People’s Democratic Republic] for consistent, effective and sustainable biosecurity measures to be implemented’ (AH/2012/067 Final Report, page 55).</p> <p>The project confirmed that several best practice interventions are required simultaneously to increase productivity, with a systems approach used to address multiple health and productivity constraints proving very successful in engaging farmers (DOC53, page 7).</p>
<p>b. To what extent was the village-based approach to transboundary biosecurity appropriate for the project contexts?</p>		



Appendix 1: Evidence table for document review (cont.)

KEQs	Findings	Evidence
Learning		
3. What can ACIAR learn from the implementation of village-based approaches to transboundary biosecurity in the project contexts?		
a. What enabled the success of the village-based approaches applied in the projects?		
b. What hindered the success of the village-based approaches applied in the projects?		



Appendix 2: Publications produced by each project

'Best practice health and husbandry of cattle, Cambodia' (AH/2005/086)

Publication

Peer reviewed journal publications

Windsor PA (2011) 'Perspectives on Australian animal health aid projects', *Transboundary and Emerging Diseases*, 58:375–386.

Nampanya S, Suon S, Rast L and Windsor PA (2012) 'Improvement in smallholder farmer knowledge of cattle production, health and biosecurity in southern Cambodia between 2008 and 2010', *Transboundary and Emerging Diseases*, 59:117–127.

Young JR, Suon S, Andrews CJ, Henry LA and Windsor PA (2013) 'Assessment of financial impact of Foot and Mouth Disease on smallholder cattle farmers in southern Cambodia', *Transboundary and Emerging Diseases*, 60:166–174.

ACIAR publications

Khounsy S, Varney G, Rast L and Windsor PA (2012) 'Delivery of research into development programs', proceedings 137, *OIE/AB-CRC/ACIAR Workshop on Biosecurity research in the Mekong region*, Siem Reap, 10–13 August 2010.

Windsor PA, Khounsy S, Sothoeun S, Nampanya S, Stratton J and Rast L (2012) 'Village-based approaches to biosecurity', proceedings 137, *OIE/AB-CRC/ACIAR Workshop on Biosecurity research in the Mekong region*, Siem Reap, 10–13 August 2010.

Young, JR (2012) 'Better livestock management behind a remarkable tale of success', ACIAR Blogspot: The official blog from the Australian Centre for International Research (ACIAR).

Conference papers

Bush RD and Windsor PA (10–14 August 2009) 'Investigating Fasciolosis in Cambodia and Laos', *International Symposium on Veterinary Epidemiology and Economics (ISVEE XII)*, Durban, Republic of South Africa.

Windsor PA (29 April 2012) 'Control of FMD in the Mekong region using village-based approaches to vaccination and biosecurity', proceedings of the *94th District Veterinarian's Conference*, Wollongong, pp 164–173.

Windsor PA, Nampanya S, Rast L, Richards J, Khounsy S (20–24 August 2012) 'Managing FMD hotspots in the Mekong region', *13th Conference of the International Society for Veterinary Epidemiology and Economics*, Maastricht, Netherlands.

Bush RD, Sothoeun S, Young JR, Rast L and Windsor PA (3–7 June 2012) 'Improving small-holder cattle productivity in Cambodia, through a combined health and production approach', *27th World Buiatrics Congress*, Lisbon, Portugal.

Windsor PA, Khounsy S, Sothoeun S, Nampanya S, Young J, Rast L, Henry LA and Bush RD (26–30 November 2012) 'Comparison of smallholder large ruminant systems and health and productivity interventions in southern Cambodia and northern Lao PDR', *The 15th Asian-Australian Association of Animal Production Animal Science Congress*, Bangkok, p 144.

Young JR, Rast L, Suon S, Bush RD and Windsor PA (26–30 November 2012) 'A longitudinal study on cattle health & production in southern Cambodia', *The 15th Asian-Australian Association of Animal Production Animal Science Congress*, Bangkok, p 268.

Young JR, Sothoeun S, Andrews CJ, Henry LA and Windsor PA (27–29 June 2012) 'Assessment of financial impact of FMD on smallholder cattle farmers in southern Cambodia' [poster], *FAO OIE 2nd Global Conference on FMD*, Bangkok, Thailand.

Smallholder farmer resource booklets

Forages and Forage Cultivation Techniques

Smallholder Cattle Best Practice Manual – a guide for smallholder farmers

Appendix 2: Publications produced by each project (cont.)

'Best practice health and husbandry of cattle and buffalo in Lao PDR' (AH/2006/159)

Publication

Journal and ACIAR publications

Khounsy S, Nampanya S, Inthavong P, Yang M, Khamboungheung B, Avery M, Bush R, Rast L and Windsor PA (2012) 'Significant mortality of large ruminants due to hypothermia in northern and central Lao PDR', *Tropical Animal Health and Production*, 44:835–842.

Nampanya S, Rast L, Khounsy S and Windsor PA (2010) 'Assessment of farmer knowledge of large ruminant health and production in developing village-level biosecurity in northern Lao PDR', *Transboundary and Emerging Diseases*, 57:420–429.

Nampanya S, Richards J, Khounsy S, Inthavong P, Yang M, Rast L and Windsor PA (2012) 'Investigation of foot-and-mouth disease hotspots in northern Lao PDR', *Transboundary and Emerging Diseases*, 60(4):315–329, doi:10.1111/j.1865-1682.2012.01350.x, accessed on 14 January 2022.

Rast L, Windsor PA and Khounsy S (2010) 'Limiting the impacts of foot-and-mouth disease in large ruminants in northern Lao PDR by vaccination: a case study', *Transboundary and Emerging Diseases*, 57:147–153.

Rast L, Lee S, Nampanya S, Toribio J-ALML, Khounsy S and Windsor PA (2012), 'Prevalence and clinical impact of *Toxocara vitulorum* in cattle and buffalo calves in northern Lao PDR', *Tropical Animal Health and Production*, 45:539–546, doi:10.1007/s11250-012-0256-4, accessed on 14 January 2022.

Conference papers

Bush RD and Windsor PA (10–14 August 2009) 'Investigating fasciolosis in Cambodia and Laos', *International Symposium on Veterinary Epidemiology and Economics (ISVEE XII)*, Durban, Republic of South Africa.

Bush RD, Khounsy S, Rast L, Henry LA, Nampanya S, Thomson PC and Windsor PA (23–26 August 2010) 'Capacity building in northern Lao PDR for improved feeding and marketing of cattle and buffalo', plenary paper, proceedings, *14th Animal Science Congress of the Asian-Australasian Association of Animal Production Societies*, Pingtung, Taiwan, Republic of China, pp 146–151.

Bush RD, MacDonald T, Khounsy S, Rast L, Henry LA, Nampanya S, Young J, Thomson PC and Windsor PA (26–30 November 2012) 'Developing a weight tape for cattle and buffalo in Lao PDR', *The 15th Asian-Australian Association of Animal Production Animal Science Congress*, Bangkok, p 615.

Khounsy S, Varney G, Rast L and Windsor PA (10–13 August 2010) 'Delivery of research into development programs', proceedings, *OIE/AB-CRC/ACIAR Workshop on Biosecurity research in the Mekong region*, Siem Reap.

Khounsy S, Varney G, Rast L, Nampanya S, Bush RD and Windsor PA (26–30 November 2012) 'Applied research for development: lesson learns from the livestock development project and its collaboration projects', *The 15th Asian-Australian Association of Animal Production Animal Science Congress*, Bangkok, p 499.

Nampanya S, Richards J, Khounsy S, Inthavong P, Yang M, Rast L and Windsor PA (27–29 June 2012) 'Understanding FMD 'hotspots' in northern Lao PDR', *FAO OIE 2nd Global Conference on FMD*, Bangkok, Thailand.

Nampanya S, Khounsy S, Inthavong P, Yang M, Khamboungheung B, Avery M, Bush RD, Rast L and Windsor PA (26–30 November 2012) 'Managing the impacts of unseasonal hypothermia events on smallholder large ruminant production in northern Laos PDR', *The 15th Asian-Australian Association of Animal Production Animal Science Congress*, Bangkok, p 452.

Rast L, Toribio JA, Lee S, Ambler V, Nampanya S, Khounsy S and Windsor PA (November 2011) 'Clinical and financial impact of *Toxocara vitulorum* and *Fasciola gigantica* in large ruminants in northern Lao', *Annual Veterinary Faculty Post Graduate conference*, The University of Sydney, Sydney.

Rast L, Toribio JA, Khounsy S, Nampanya S, Windsor PA (July 2011) 'Prevalence and clinical impact of *Toxocara vitulorum* in cattle and buffalo calves in northern Lao', [poster], *Annual conference of Australian Veterinary Parasitology Society*, Cairns.

Rast L, Windsor PA and Khounsy S (January 2010) 'Limiting the impacts of foot and mouth disease in large ruminants in northern Lao PDR by vaccination: a case study', *The 9th Upper Mekong Working Group (UMWG) Meeting*, Hanoi, Vietnam.

Rast L, Toribio JAT, Nampanya S, Khounsy S and Windsor PA (3–7 June 2012) '*Toxocara vitulorum* AND *Fasciola gigantica* in cattle and buffalo in northern Lao PDR', *27th World Buiatrics Congress*, Lisbon, Portugal.



Publication

Rast L, Toribio JA, Lee S, Ambler V, Nampanya S, Khounsy S and Windsor PA (November 2012) 'Clinical and financial impact of *Toxocara vitulorum* and *Fasciola gigantica* in large ruminants in Lao PDR', *Annual Veterinary Faculty Post Graduate Conference*, The University of Sydney, Sydney.

Windsor PA, Rast L and Khounsy S (12–14 April 2010) 'Vaccination limits the impact of FMD in northern Lao PDR, [poster]', *FMD Symposium 2010*, Melbourne.

Windsor PA, Khounsy S, Sothoeun S, Nampanya S, Stratton J and Rast L (10–13 August 2010) 'Village-based approaches to biosecurity', proceedings, *OIE/AB-CRC/ACIAR Workshop on biosecurity research in the Mekong region*, Siem Reap.

Windsor PA, Rast L, Nampanya S and Khounsy S (14–18 November 2010) 'Can improving large ruminant health and production enhance surveillance and biosecurity capacity in developing countries? The northern Lao PDR case study', *26th World Buiatrics Congress*, Santiago, Chile.

Windsor PA, Rast L, Nampanya S and Khounsy S (28 February to 3 March 2010) 'Village-level biosecurity for large ruminant transboundary disease risk management in northern Laos' *Global Biosecurity 2010*, Brisbane.

Windsor PA, Nampanya S, Rast L, Richards J and Khounsy S (20–24 August 2012) 'Managing FMD hotspots in the Mekong region', *13th Conference of the International Society for Veterinary Epidemiology and Economics*, Maastricht, Netherlands.

Windsor PA, Khounsy S, Sothoeun S, Nampanya S, Young J, Rast L, Henry LA and Bush RD (26–30 November 2012) 'Comparison of smallholder large ruminant systems and health and productivity interventions in southern Cambodia and northern Lao PDR', *The 15th Asian-Australian Association of Animal Production Animal Science Congress*, Bangkok, p 144.

Appendix 2: Publications produced by each project (cont.)

'Domestic and international market development for high-value cattle and beef in South-East Cambodia' (AH/2010/046)

Publication

Journal articles

Patrick IW, Sovann S and Socheat S (2017) 'Working towards consensus – the need for coordinating policies on emerging disease threats in South-East Asia', *OIE Scientific and Technical Review*, 36(1).

Hasnah, Patrick I and Smith RGB (2016) 'Household-level farming and marketing practices determining body condition score and economic value of cattle in Cambodia', *Livestock Research for Rural Development*, 28(116), <http://www.lrrd.org/lrrd28/6/hans28116.html>, accessed on 14 January 2022.

Marshall GR (2015) 'A social-ecological systems framework for food systems research: accommodating transformation systems and their products', *International Journal of the Commons*, 9(2):881–908.

Patrick I, Muniroth S and Smith G (2014) 'The changing beef industry in south-eastern Cambodia', in Robins L (ed) *A policy dialogue on rice futures: rice-based farming systems research in the Mekong region*, proceedings of a dialogue held in Phnom Penh, Cambodia, 7–9 May 2014, ACIAR Proceedings No. 142, Australian Centre for International Agricultural Research, Canberra, pp 84–87.

Sieng S, Walkden-Brown SW and Kerr J (accepted) 'Variation in storage temperatures for foot and mouth disease vaccine in Cambodia', *International Journal of Environmental and Rural Development*.

Sieng S, Walkden-Brown SW and Kerr J (under review) 'Effect of vaccine storage temperatures and dose rate on antibody responses to foot and mouth disease vaccination in Cambodia', *Veterinary Medicine and Science*.

Technical reports

Hoang N, Muniroth S, Patrick I and Smith G (2013) *ACIAR Project No. AH/2010/046 Working Paper No.1 Consumer Survey Summary Results Phnom Penh and Ho Chi Minh City*, http://www.une.edu.au/__data/assets/pdf_file/0006/88827/b4m-consumer-survey-report.pdf, accessed on 14 January 2022.

Hoang N (2015) *Ho Chi Minh City beef market demand and supply report*, Working Paper No.4, ACIAR Project No. AH/2010/046.

East M, Patrick I, Sieng S, Kouch Y and Muniroth S (2013) *Working Paper No.2 Household Survey Summary Results Kampong Cham and Pursat (AH/2010/046)*, http://www.une.edu.au/__data/assets/pdf_file/0007/88828/b4m-household-survey-report.pdf, accessed on 14 January 2022.

Muniroth S, Patrick I and Smith G (2014) *Working paper No 3. Cattle Market Chain in South-East of Cambodia (AH/2010/046)*, http://www.une.edu.au/__data/assets/pdf_file/0004/89716/Cattle-Market-Chain-in-SE-Cambodia.pdf, accessed on 14 January 2022.

Sieng S and Kerr J (2014) *Attitudes and practices toward on animal health and vaccination of village animal health workers in 2 study provinces*, project report.

Sieng S and Kerr J (2014) *Attitudes and practices toward on animal health and vaccination of smallholder cattle farmers in 2 study provinces in Cambodia*, project report.

Miranda P, Mom S, Kouch T, ViboI N and Tongheng S (2015) 'Knowledge, attitudes and practices towards public vaccination program in Pursat Province', Royal University of Agriculture (Cambodia) Working paper no 1.

Agile Development Group: From Supply Chain to Business Model, report on business model for a branded premium beef product (AH/2010/046) (Appendix 2).



Publication

Extension materials

University of New England Research+ magazine article (September 2016) Beef4market: changing the lives of Cambodian farmers.

Biosecurity measures for farmers (booklet in Khmer), http://www.une.edu.au/_data/assets/pdf_file/0005/88826/farmer-biosecurity-booklet.pdf, accessed on 2 February 2017.

Forage grasses making a difference in Cambodia (video in English), <https://www.youtube.com/watch?v=s75bzq5UWEE>, accessed on 9 June 2016.

Raising Cow and Grass Production (video in Khmer), <https://www.youtube.com/watch?v=sfRjTHycGbs>, accessed on 9 June 2016.

Student theses

Socheat S (2017) *An investigation into the efficacy of foot and mouth disease control programs in cattle in Cambodia* [PhD thesis], University of New England.

Robinson M (2016) *Cattle management practices of smallholder farmers in kampong Cham province and opportunities for direct beef marketing in Phnom Penh, Cambodia* [Bachelor of Animal Science Honours thesis], Charles Sturt University.

O'Connor C (2015) *Determinants of Income in Smallholder Farming Households in Southeast Cambodia* [Bachelor of Economics Honours thesis], University of New England.

Sokunthea T (2014) *Economic effects of introducing forage into crop-livestock production systems in Pursat Province* [Masters in Natural Resource Management thesis], Royal University of Agriculture, Cambodia.

Couch T (2017) *Market fluctuations in cattle pricing and condition* [PhD thesis], Royal University of Agriculture, Cambodia.

'Village-based biosecurity for livestock disease risk management in Cambodia' (AH/2011/014)

Publication

Journal articles

Ashley K, Wilson S, Young J, Chan H, Vitou S, Suon S, Windsor PA and Bush R (2018) 'Drivers, challenges and opportunities of forage technology adoption by smallholder cattle households in Cambodia', *Tropical Animal Health and Production*, 50(1):63–73.

Ashley K, Harrison H, Chan PH, Suon S, Young JR, Windsor PA and Bush RD (2018) 'Livestock and livelihoods of smallholder cattle-owning households in Cambodia: the contribution of on-farm and off-farm activities to income and food security', *Tropical Animal Health and Production*, 50(8):1747–1761.

Olmo L, Ashley K, Young JR, Suon S, Thomson PC, Windsor PA and Bush RD (2017) 'Improving smallholder cattle reproductive efficiency in Cambodia to address expanding regional beef demand', *Tropical Animal Health and Production*, 49(1):163–172.

Young JR, Suon S, Olmo L, Bun C, Hok C, Ashley K, Bush, RD and Windsor PA (2017) 'Investigation of smallholder farmer biosecurity and implications for sustainable foot-and-mouth disease control in Cambodia', *Transboundary and Emerging Diseases*, 64(6), doi:10.1111/tbed.12609, accessed on 14 January 2022.

Zhang A, Young JR, Suon S, Ashley K, Windsor PA and Bush RD (2017) 'Investigating the financial impact of porcine reproductive and respiratory syndrome on smallholder pig farmers in Cambodia', *Tropical Animal Health and Production*, 49(4):791–806.

Appendix 2: Publications produced by each project (cont.)

'Enhancing transboundary livestock disease risk management in Lao PDR' (AH/2012/067)

Publication

Journal articles

Burns RJL, Douangneun B, Theppangna W, Khounsy S, Mukaka M, Selleck PW, Hansson E, Wegner MD, Windsor PA and Blacksell SD (2018) 'Serosurveillance of Coxiellosis (Q-fever) and Brucellosis in goats in selected provinces of Lao People's Democratic Republic' *PLOS Neglected Tropical Diseases* 12(4):e0006411, doi:10.1371/journal.pntd.0006411, accessed on 14 January 2022.

Miller CAJ, Young JR, Nampanya S, Khounsy S, Singanallur NB, Vosloo W, Abila R, Hamilton SA, Bush RD and Windsor PA (2018) 'Risk factors for emergence of exotic foot-and-mouth disease O/ME-SA/Ind-2001d on smallholder farms in the Greater Mekong Subregion' *Preventative Veterinary Medicine*, 159:115–122, doi:10.1016/j.prevetmed.2018.09.007, accessed on 14 January 2022.

Nampanya S, Khounsy S, Abila R and Windsor PA (2018) 'Implementing large Foot and Mouth Disease vaccination programmes for smallholder farmers: lessons from Lao PDR', *Epidemiology and Infection*, 146(16):2086–2095, doi:10.1017/S0950268818002443, accessed on 14 January 2022.

Windsor PA, Nampanya S, Putthana V, Keonam K, Johnson K, Bush RD and Khounsy S (2018) 'The endoparasitism challenge in developing countries as goat raising develops from smallholder to commercial production systems: A study from Laos', *Veterinary Parasitology*, 251:95–100, doi:10.1016/j.vetpar.2017.12.025, accessed on 14 January 2022.

Windsor PA, Nampanya S, Tagger A, Keonam K, Gerasimova M, Putthana V, Bush RD and Khounsy S (2017) 'Is orf infection a risk to expanding goat production in developing countries? A case study from Lao PDR', *Small Ruminant Research*, 154:123–128, doi:10.1016/j.smallrumres.2017.08.003, accessed on 14 January 2022.



'Development of a market-driven biosecure beef production system in Lao PDR' (AH/2012/068)

Publication

Journal articles

Calvani NED, Ichikawa-Seki M, Bush RD, Khounsy S and Slapeta S (2020) 'Which species is in the faeces at a time of global livestock movements: single nucleotide polymorphism genotyping assays for the differentiation of *Fasciola* spp.', *International Journal of Parasitology*, 50(2):91–101, doi:10.1016/j.ijpara.2019.12.002, accessed on 14 January 2022.

Olmo L, Dye MT, Reichel MP, Young JR, Nampanya S, Khounsy S, Thomson PC, Windsor PA and Bush RD (2018) 'Investigation of infectious reproductive pathogens of large ruminants: Are neosporosis, brucellosis, leptospirosis and BVDV of relevance in Lao PDR?' *Acta Tropica*, 177:118–126, doi:10.1016/j.actatropica.2017.10.007, accessed on 14 January 2022.

Olmo L, Nampanya S, Nemanic T, Selwood N, Khounsy S, Young J, Thomson P, Windsor, PA and Bush RD (2020) 'Can fenbendazole medicated molasses blocks control *Toxocara vitulorum* in smallholder cattle and buffalo calves in developing countries? Studies from upland Laos', *Animal Production Science*, 60:2031–2043, doi:10.1071/AN19248, accessed on 14 January 2022.

Olmo L, Reichel MP, Nampanya S, Khounsy S, Wahl LC, Clark BA, Thomson PC, Windsor PA and Bush RD (2019) 'Risk factors for *Neospora caninum*, bovine viral diarrhoea virus and *Leptospira interrogans* serovar Hardjo infection in smallholder cattle and buffalo in Lao PDR', *PLOS ONE* 14(8):e0220335, doi:10.1371/journal.pone.0220335, accessed on 14 January 2022.

Thomas JC, Young JR, Schemann K, Chankhamthong P, Khounsy S, Nampanya S, Windsor PA and Bush RD (2017) 'Investigating baseline red meat slaughter operator capacity and directions for development in Lao PDR', *Tropical Animal Health and Production*, 49:1697–1708, doi:10.1007/s11250-017-1380-y, accessed on 14 January 2022.

Windsor A, Nampanya S, Kinnavong B, Phommasone P, Bush RD and Khounsy S (2019) 'Do triclabendazole medicated molasses blocks have a role in control of *Fasciola gigantica* in smallholder cattle production in Lao PDR?' *Animal Production Science*, 59(4):787–793, doi:10.1071/AN17255, accessed on 14 January 2022.

Appendix 3: ACIAR outcome evaluation series

No	Author(s) and year of publication	Title	ACIAR project numbers
1	Davis P (2022)	An evaluation of the ACIAR Agriculture Sector Linkages Program	ADP/2010/091 HORT/2005/153 HORT/2005/160 HORT/2010/001 HORT/2010/006 HORT/2012/002 LPS/2005/132 LPS/2010/007
2	Hanley C and Passfield L (2022)	An evaluation of the ACIAR Transformative Agriculture and Enterprise Development Program	ASEM/2014/095 FST/2014/099 HORT/2014/094 HORT/2014/096 HORT/2014/097
3	Davis P and Hanley C (2023)	A programmatic evaluation of the TADEP and ASLP programs	ADP/2010/091 ASEM/2014/095 FST/2014/099 HORT/2005/153 HORT/2005/157 HORT/2005/160 HORT/2010/001 HORT/2010/006 HORT/2012/002 HORT/2014/094 HORT/2014/096 HORT/2014/097 LPS/2005/132 LPS/2010/007
4	Campbell J, Gimelli F, Chamberland G, Stempel A and Breen J (2022)	An evaluation of fruit and vegetable market development research in north-western Vietnam	AGB/2006/112 AGB/2008/002 AGB/2012/059 AGB/2012/060
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6	Gimelli F, Campbell J, Chamberland G, Stempel A, Mienmany S and Zalzman E (2023)	Evaluation of village-based livestock biosecurity in Laos and Cambodia	AH/2012/067 AH/2012/068 AH/2011/014 AH/2010/046 AH/2006/159 AH/2005/086



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