ACIAR and animal health research into the future

6. The new environment

6.1. Livestock and development

6.1.1. Livestock revolution

There is an increasing demand for higher quality livestock products in Asia. Unlike the green revolution which was a supply-driven increase in crop productivity, the so-called 'livestock revolution' is a more demand-driven productivity increase influenced by rising rural populations, increasing urbanisation, increasing incomes and changing dietary preferences. From 1970 to 1995, developing countries increased their consumption of milk and meat by 175 million tonnes; more than twice the increase in developed countries. The market value of this increase was US$153 billion (Delgado et al. 1999). Development of livestock industries is likely to increase rural incomes and significantly improve the nutrition for villagers and urban dwellers. In South-East Asia, poultry and pork consumption in particular have increased. Livestock development can also result in more efficient use of land and crop residues but at the risk of environmental degradation. Risks to human health can also accompany the development of livestock industries including zoonotic infections, microbial contamination of food, toxic residues and over-consumption (Delgado et al. 1999).

The growth in livestock numbers in selected Asian countries is illustrated in Figures 3–5. Indonesia is the major chicken producer in the region with 70% of the chicken population. Most South-East Asian countries showed strong growth in bird numbers until 2002–2003. The countries in the region that have been affected by highly pathogenic avian influenza (HPAI) (http://www.fao.org/ag/againfo/subjects/documents/ai/AVIbull033.pdf) have experienced falls in chicken populations. The only country where chicken numbers have continued to increase significantly over the past three years has been Malaysia.

The trend in pig numbers has varied between countries. Vietnam and the Philippines are the major producers and both have experienced significant growth in pig numbers. The presence of CSF in Indonesia and Malaysia led to a population decline in those countries from 1998, but overall pig numbers in South-East Asia have increased by an average of 33%, from 48 million to 64 million. The highest population increases have been in Myanmar, Vietnam and the Philippines.

Cattle numbers have been more variable. There has been a dramatic decline in cattle numbers in Thailand since 1995. Excluding Thailand, cattle numbers have increased by 15% in the last 10 years, a significant increase in a large-animal population. The most dramatic increases have been in Vietnam (42%), Philippines (34%) and the largest cattle producer in the region, Myanmar (23% increase). Myanmar with a cattle population of 11.9 million has now surpassed Indonesia with 11.1 million.

Increasing livestock populations and the resulting attempts to increase production and productivity have resulted in:

- more intensive livestock systems
- pressure on available feed and forage and environmental resources
- increased demand for processed animal feeds
- demand for improved marketing and support institutions
- increased animal and human disease risk.

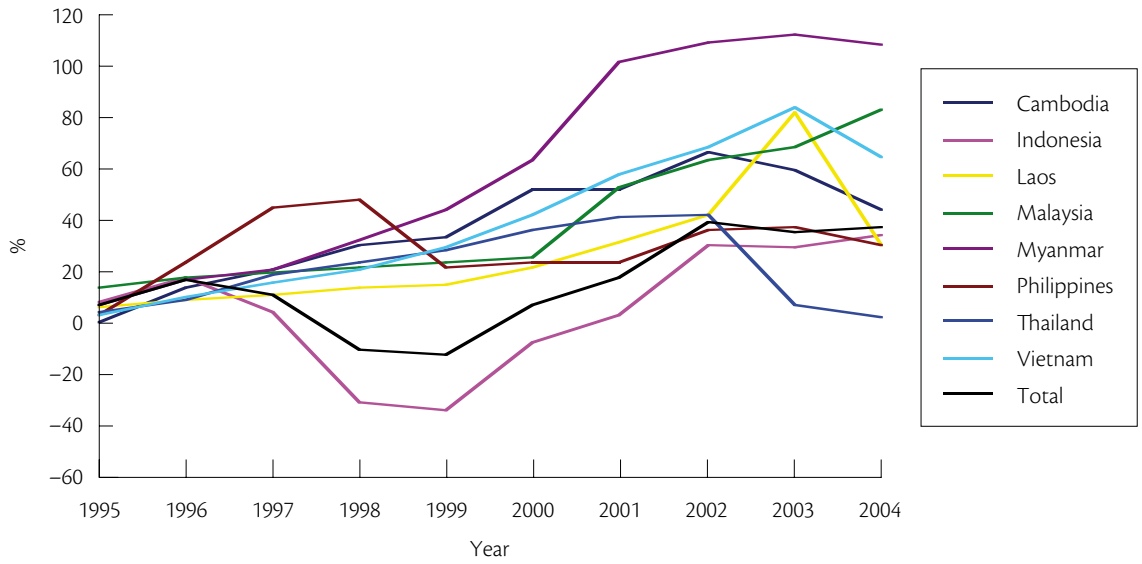

Figure 3. Percentage change in chicken numbers (1994 base). Source: http://faostat.fao.org/

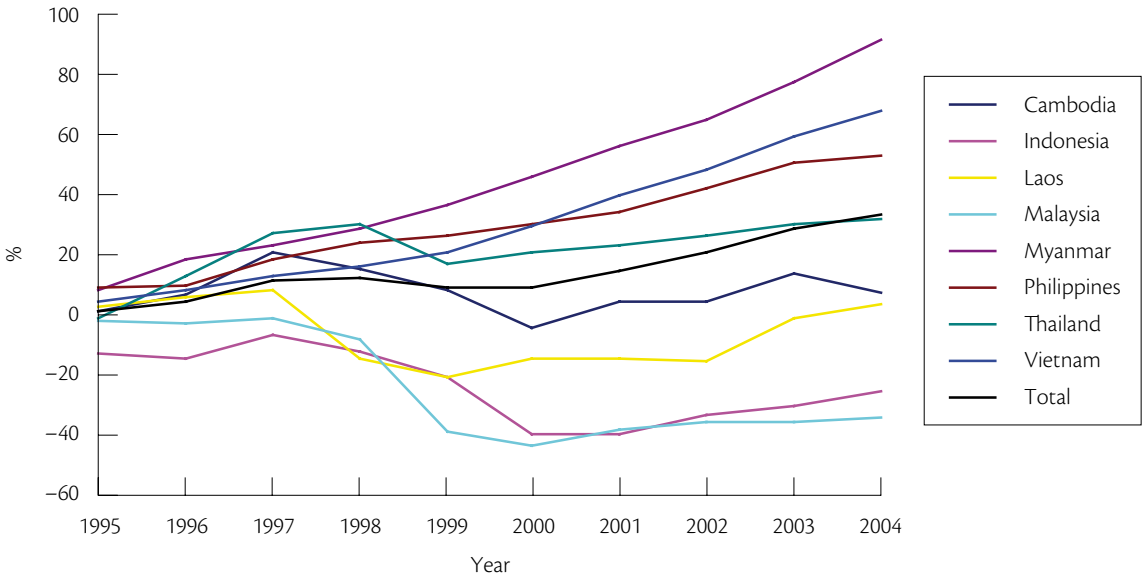

Figure 4. Percentage change in pig numbers (1994 base). Source: http://faostat.fao.org

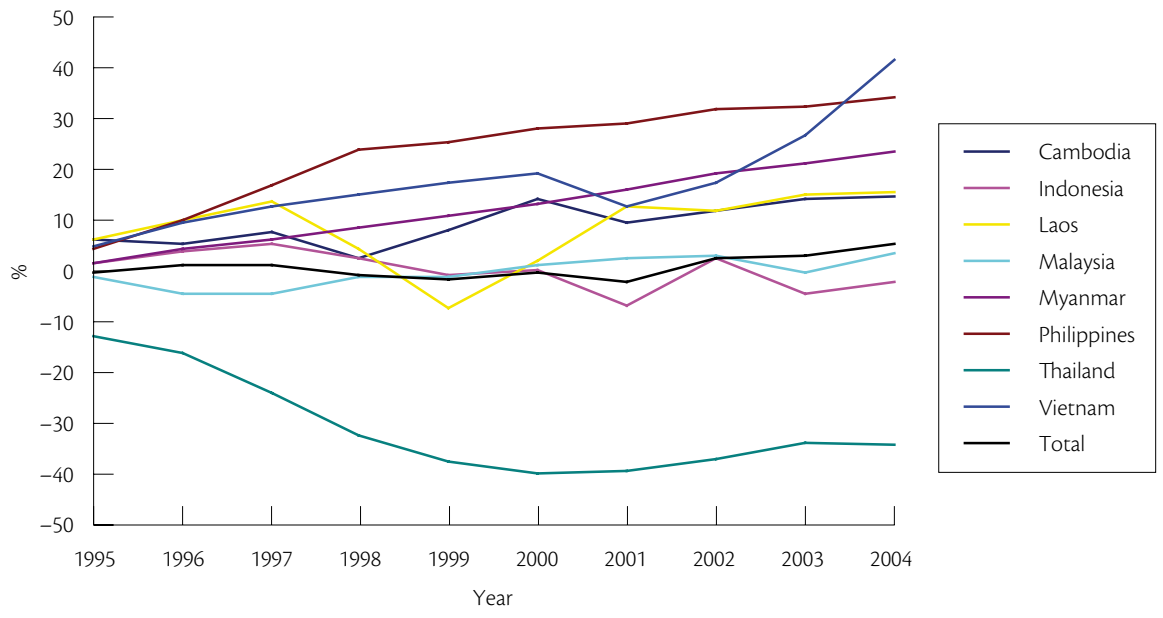

Figure 5. Percentage change in cattle numbers (1994 base). Source: http://faostat.fao.org/

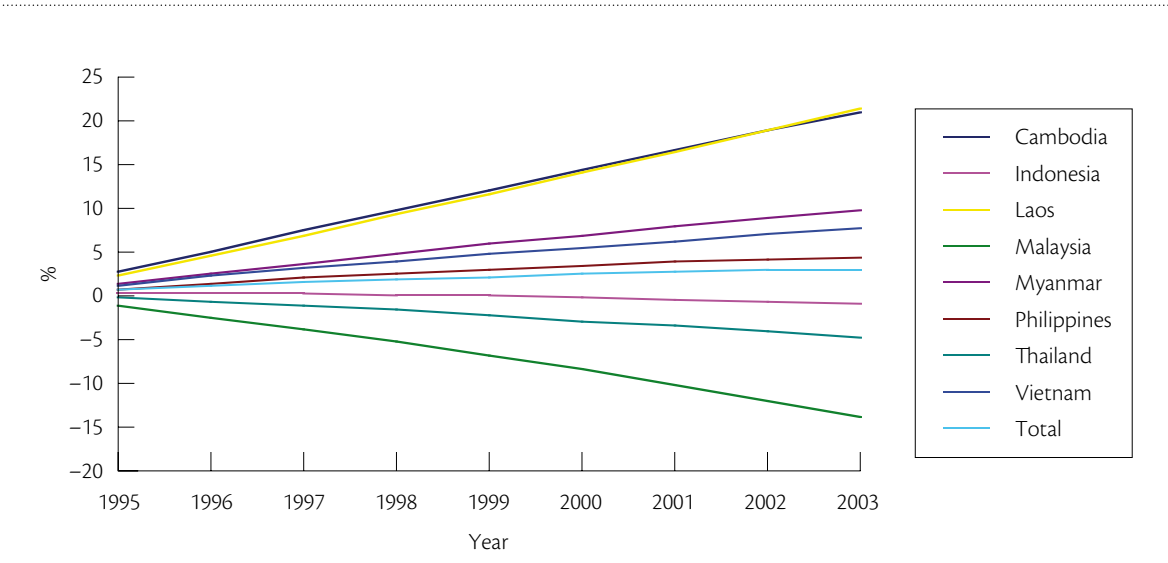

Figure 6. Change in rural population (1994 base). Source: http://faostat.fao.org/

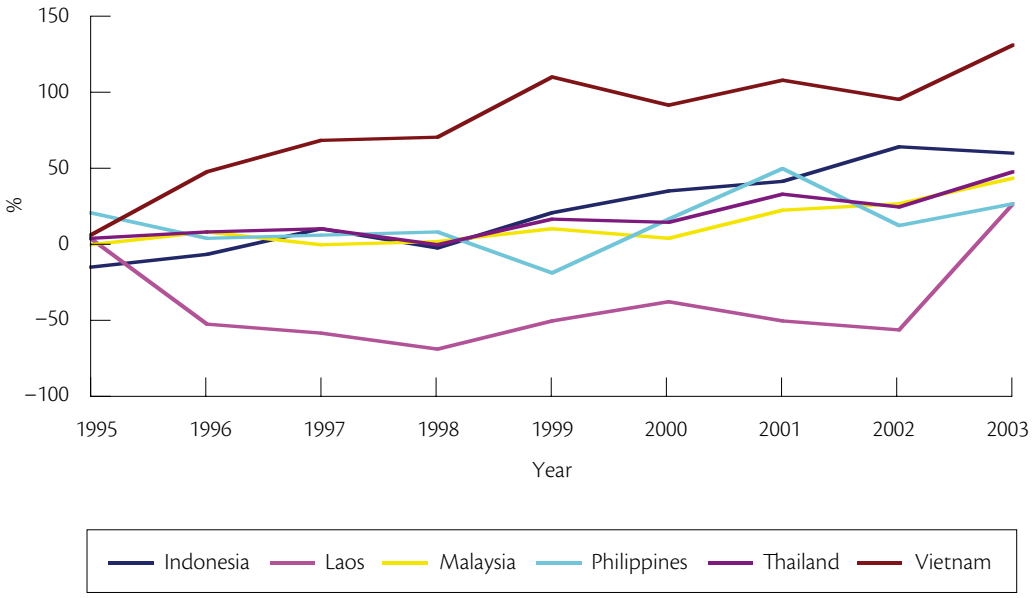

Figure 7. Change in export of agricultural products (1994 base). Source: http://faostat.fao.org/

The importance of the revolution cannot be understated; it has the power to transform the social and physical landscape of the developing world. With appropriate institutional support it may play a vital role in alleviating rural poverty through increased production, increased employment opportunities and improved opportunities to link with global markets (Delgado et al. 1999). The issue becomes how to ensure the benefits of this increasing demand will flow through to the smallholders who at present manage 90% of the developing world's livestock. Institutional support must keep pace with demand.

6.1.2. The future of livestock in Asia

There is no one future for livestock in Asia as each country has a unique set of social, historical, environmental, economic and political factors that will determine the role that livestock is playing and will play in the development process. Countries such as Thailand and Malaysia have a decreasing rural population (Figure 6) and are classified as more developed than Laos and Cambodia.

Smallholder livestock systems play a more important role in alleviating rural poverty in the poorer South-East Asian countries. In their more developed neighbours, intensive production systems to satisfy booming domestic and high-value export demand are becoming increasingly common. Time will tell whether or not increasing standards of living in some countries result in domestic consumption outstripping supply so that exports become less attractive.

What unites many of these countries is their locality; they share common borders. Therefore, the ability of Thailand to open trade opportunities will be dependent on its ability to work with Myanmar, Laos, Vietnam and Cambodia to control disease and improve transboundary institutions. Likewise the ability of the members of the CMLV group to attain poverty reduction objectives and develop a viable smallholder livestock management system will be dependent on their ability to use the skills and resources of Thailand, Malaysia, the Philippines and, to a lesser extent, Indonesia.

Thailand, Malaysia and Indonesia are the three major agricultural product exporters, but the biggest increase in exports recently has been from Vietnam, which has increased its value of agricultural exports by 131% since 1995 to US$2,400 million. The value of Thailand's agricultural exports is US$6,800 million. There are no statistics for Cambodia, and Laos is still operating at a very low base (although some exports may be going into Thailand illegally) with exports of only US$73 million in 2003, up from $US26 million in 2002.

6.2. Australia's research assistance objectives

ACIAR's Draft Corporate Plan 2006–2010, released in 2005, plays a major role in focusing the review. It outlines the environment and principles within which ACIAR's future programs will function. Australia's aid program (of which ACIAR is a part) is focused on the primary objective of advancing 'Australia's national interest by assisting developing countries to reduce poverty and achieve sustainable growth'. This objective could be partially addressed by ACIAR's role in assisting regional partners to control exotic livestock diseases through increasing technical capacity and disease monitoring expertise.

As well as these biosecurity benefits in both partner countries and Australia, the corporate plan also emphasises the need to achieve sustainable community impacts in the Asia–Pacific region. ACIAR programs and projects must be aligned with stakeholder priorities and achieve a demonstrable and timely impact on poverty. The plan proposes six strategies to achieve its goals:

To have a greater focus on achieving community impacts:

1. 40% of projects will deliver benefits within 5 years of completion
2. give greater weight to adoption pathways
3. have a demonstrated track record of sustainable impacts.

To align with stakeholder priorities:

4. meet country/regional needs
5. match Australian priorities and capabilities.

To focus investments in areas with a high probability of sustainability

6. invest for sustainable development.

It recognises that science and technology alone cannot drive agricultural productivity, alleviate hunger and foster economic growth unless there are 'supportive policy, regulatory and institutional frameworks'. To achieve this, ACIAR proposes that it will link more of its projects to partner initiatives and larger development programs that should provide a foundation for uptake of research outcomes. It also proposes concentrating more on programs, or clusters of projects, with a common theme that have a high priority and a higher probability of being adopted. Pathways for adoption of technology will have to be identified at the start and the people involved in adoption engaged from project inception. People's capacity to adopt technology without serious resource and policy restrictions will also be an important factor in determining priorities.

Sustainability is seen to be ensured by programs and projects that help agricultural sectors, including smallholders, participate actively and fairly in product markets both domestically and internationally. The management of major diseases of livestock and fish is seen as a key strategy in satisfying the increasing demand for animal protein in developing countries.

The Minister's opening statement and ACIAR's proposed corporate mission and outcome emphasise that Australia's wellbeing is also a primary consideration in ACIAR's work. Therefore, animal health issues where Australia stands to gain from better disease control in partner countries and better understanding and capacity in Australia should continue to be well regarded in future. From this perspective, animal diseases in South-East Asia's animal populations that threaten livestock and aquatic animal productivity and marketability in Australia may be expected to be accorded higher priority than diseases in southern or north-eastern Asia or the Pacific.

6.3. Transboundary diseases

The focus has also been influenced by the increasing importance of infections diseases of international significance in South-East Asia. Transboundary animal diseases (TADs) are highly transmissible epidemic diseases that can spread quickly among countries and regions. They can cause high morbidity and mortality, and some can impact on human health. Because of these characteristics, they also can have a significant effect on the trading capacity of affected countries with

respect to animals and animal products, which in turn can seriously affect a national economy and community development. FAO currently classifies seven infections as global TADs (http://www.fao.org/ag/againfo/programmes/en/empres/diseases.asp):

- African swine fever
- avian influenza,
- contagious bovine pleuropneumonia
- foot-and-mouth disease
- haemorrhagic septicaemia
- Rift Valley fever
- Rinderpest.

These are formally included by the FAO and OIE in their Global Framework for Transboundary Animal Diseases (GF-TADs) but other highly infectious diseases, such as CSF, also have significant capacity to spread quickly and disrupt animal health and production.

The long-standing presence of several of these infections in the South-East Asian region, close to Australia, has made them a natural focus for animal health research. The South-East Asian FMD control program (SEAFMD) has been the first program to tackle one of these diseases on a regional basis and is seen as an appropriate model for regional programs for other infections. The recent spread of HPAI (caused by H5N1 virus) in Vietnam, Thailand, Laos, Cambodia and Indonesia has heightened both ASEAN's and Australia's concern with animal disease control across national boundaries in the South-East Asian region.

6.4. Characteristics of partner countries

As the agricultural sectors in partner countries develop and the influence of globalisation expands so will the type of assistance and partnership required. For this reason three countries were selected to be visited as part of this review: Indonesia, Laos and Thailand. Thailand has developed to the point where it can be responsible for its own animal health management but is still interested in regional transboundary issues and research. Indonesia is a close geographic neighbour and the recipient of the largest proportion of assistance. It requires continued capacity-building support and needs to be involved in transboundary issues. Laos is the least developed of the three countries and still needs significant assistance to develop its animal disease management systems. Through discussions with animal health researchers and administrators, there was a clear indication, especially in Indonesia and Thailand, that future priorities involved strengthening institutions in order to facilitate increasing intensification of livestock production systems, control and potentially eradication of transboundary diseases and national and regional biosecurity.

Each country visited had unique institutional environments that were influencing animal health priorities and policy. These are discussed below in order to illustrate that each country in the region will have a unique set of issues and priorities.

6.4.1. Indonesia

Indonesia has a very large rural population, with 95% of the livestock still owned by smallholders. Poverty alleviation is the first of seven priorities in the Indonesian Government's 2005–2006 Annual Plan. Improving smallholder livestock production is part of a national strategy to improve farmers' incomes, but implementing national programs has been constrained by the move to regional autonomy started in 2001. Indonesia is undergoing an important adjustment process that involves the national government divesting budget allocation decisions to the provincial and district (*kabupaten*) governments. Provincial and district governments, in general, have not placed a high priority on animal health issues at this stage. Hence, staff and programs at district level and activities at the village level, including vaccination programs, have generally been curtailed. In the eastern islands, capacities increased through projects such as the Eastern Islands Veterinary Services Project (EIVSP, AusAID 1989–1996) have been lost as equipment, skills and basic supplies have not been provided.

The lack of central management of animal health programs is a major concern among senior animal health personnel. The Directorate General Livestock Services (DGLS) is presently working with both government and private stakeholders to develop a strategy to identify national priorities for adequate funding and legislative support. While, in the longer-term, provincial level decision-making might lead to substantial benefits in accountability and local implementation, in the short-term animal health programs in many provinces are being reduced.

The lack of ability of local livestock producers to meet local demand reduces the incentive to be concerned about opening export markets and, therefore, the incentive to control major transboundary trade-related diseases. However, Indonesia, being an archipelago, is in a position to control these diseases on a regional or zonal basis and reduce their domestic impact. For example, Bali has been declared free of rabies and after an initial minor spread, has been able to restrict the spread of Jembrana disease to other provinces. Likewise Lombok has been recently declared free of brucellosis (A.A.A.G. Putra, pers. comm., August 2005) which will allow it to begin exporting live cattle to other areas of Indonesia.

6.4.2. Laos

Laos is one of four ASEAN countries that are recognised as requiring significant development assistance. Animal health programs in Laos are still heavily funded by multi- and bilateral partners. At present, there is assistance from Germany, Luxembourg, Belgium and Australia as well as multinationals such as CIAT and FAO. OIE has included Laos as an important part of the SEAFMD program and is assisting in building a viable animal health surveillance and control system.

Laos has the benefit of having a relatively small population (approximately 5 million) with a strong central government. The Lao Government's five-year plan is focusing its livestock development on cattle and buffalo production to improve smallholder incomes by supplying live animals into the large markets in Thailand and Vietnam. Production improvement is based on improved forages developed by CIAT's Forage and Livestock System Project (FLSP) that is now being extended by the Asian Development Bank (ADB). Cooperatives and group farming schemes are being encouraged to facilitate technology transfer and improve management and marketing. It is important for Laos to be able to continue to become an integral part of the ASEAN region animal health system and to control trans-boundary diseases. To this end, it is working with neighbours in the new ADB/FAO Transboundary Animal Disease Project for the Greater Mekong Sub-region (GMS).

While Laos is developing a comprehensive network of paraveterinary staff and assistants (village veterinary workers), a significant constraint facing the Lao Government is the scarcity of veterinarians in the country. No new graduates have entered the animal health system since 1996 and none are currently in training. Lao had significant support from the USSR with training but has had limited support for graduate training since then. Animal health staff are largely local agriculture graduates with an interest in animal production and health who are being trained as paraveterinarians on the job. In the short-term there is a requirement to train graduate veterinarians in order to move toward a self-sustaining animal health system.

6.4.3. Thailand

Thailand has more effective animal management systems than its neighbours. While Thailand is probably capable of eradicating diseases such as FMD within its own livestock populations, long land (and river) borders with other countries such as Myanmar, Laos and Cambodia, and short distances to China in the north and Vietnam in the east have made livestock movement control difficult. Cattle are also moved from further west, through Myanmar and into Thailand. Thailand's priorities, therefore, are to support regional biosecurity efforts which will assist Thailand. The Thai Government believes that, by assisting its neighbours to control disease and improve animal health surveillance, it will lessen its own problems. Thailand is a strong supporter of regional FMD control with the SEAFMD program coordinated from Bangkok and the national veterinary laboratory at Pakchong in the process of being recognised as the regional reference laboratory and supplying reagents to other laboratories in the region through an IAEA project.

At present the Thai Government provides vaccines such as FMD and ND and anthelmintics for worm control free of charge to identified high-risk areas in Thailand. The ND and anthelmintic programs aim to demonstrate to smallholders the benefits of disease control so that they will be encouraged to continue treatment voluntarily. The government is negotiating with livestock cooperatives and associations to take responsibility for the selling of FMD and other vaccines in its process of encouraging private investment and participation in animal health control.

7. A framework to assist resource allocation

7.1. Purpose of the framework

The framework has been developed as a tool to assist ACIAR to:

- determine its overall research strategy in the short to medium term
- identify likely areas in which to support research
- evaluate programs or individual projects before commencement, during implementation and after completion.

Specifically, ACIAR has requested that the principles should reflect the projected changes in the livestock sectors in developing countries over the next decade, increased emphasis on trade and accompanying biosecurity issues, the increased profile of zoonotic diseases, and relevance of this work on smallholder livelihoods. The principles should also address the strategy for and balance of ACIAR's future investments, based on:

- alignment with ACIAR priorities
- likelihood of impact of the research
- disease/species and farming system emphasis
- type of research.

7.2. Factors considered in framework development

ACIAR and other international development organisations have been reviewing means by which their programs can have greater development impacts, particularly on poor communities. ACIAR is concerned with impacts at the community level (such as socioeconomic and environmental change), in scientific practice outside the project itself and in research capacity of the project personnel (McWaters and Templeton 2004).

In developing the framework, recent studies have been reviewed that have attempted to identify factors associated with projects that had significant community impacts and develop guidelines for assessing propose of agricultural research in developing environments. These included, Menz et al. (2000), Pearce (2002), Perry et al. (2002) and a recent review of twelve ACIAR projects (none of which were animal health projects) by McWaters and Templeton (2004).

Pearce (2002) maintained that measuring impacts on poverty required a more complex approach than a benefit–cost analysis as indirect effects of programs and interactions between different groups of beneficiaries are likely to be involved. Noting that increased income did not necessarily equate with improved human welfare, Pearce outlined the following qualitative criteria that should be used in evaluating the impacts of projects on poverty:

- improved income for poor producers
- benefits such as lower prices for rural and urban consumers
- healthier households
- improved environmental benefits that contribute to future income increases
- empowering of poor people in a more favourable policy environment
- reduced risk of income deprivation by reducing impact of unforeseen events.

Animal health research is understandably focused on *technical* advances. Perry et al. (2002) outlined that research in this area had the potential to alleviate poverty through improvements in technology that facilitated:

- prevention of disease by artificially induced immunity and by enhancing genetic resistance
- treatment
- disease recognition by better diagnostic tools
- understanding of the dynamics (epidemiology) of diseases and their relative importance (socioeconomic)
- delivery and adoption of disease control technologies.

They considered that *technical* criteria for selecting animal health research priorities. These should include: research products being delivered within 15 years; medium to high probability of success; and significant opportunities for research in the area and significant capacity to undertake the research. Workshops conducted as part of their study defined the areas where most technical opportunities existed for successful

animal health research. These were in the delivery and extension of technologies and in better understanding the epidemiology and impact of important diseases, especially in small ruminants, small-scale pig production and village poultry production systems. McWaters and Templeton (2004) considered that it was important to use a varied and comprehensive range of communication and dissemination methods to be successful.

Although it is obvious that poor *technical* outcomes would have little impact, it is notable that relatively few of the critical factors identified by various studies were of a technical nature. This may reflect that the technical outcomes of research are usually delivered. In reviewing nearly 20 years of experience with a technology specifically designed for village use in the ND program, Copland and Alders (2005) emphasised that it was important to understand the *social* and *economic* factors in communities. The impact of technically successful research will also be affected by *institutional* factors.

Institutional factors play an important role in determining whether the products of research projects can be adapted and implemented to deliver community benefits. The various studies highlighted the importance of:

- a supportive socioeconomic, political and legislative environment
- translating research outcomes into policies, strategies, extension messages and useable products
- adequate resources for enhancing skills, for equipment and to run trials and demonstrations
- ongoing participation by a core group of in-country scientists
- sustaining the veterinarians and paraveterinary assistants who promote and deliver the technology
- encouraging collaboration between programs and different donors.

From a social perspective, it is important that technology transfer be appropriate to the skills and understanding of the target audience. This would be assisted by involving farmers in identifying, prioritising and undertaking research and by presenting and delivering the technology in appropriate forms for the particular production system and cultural environment.

As well as potential projects having a high potential impact on the poor through increased productivity, Perry et al. (2002) proposed that three other *economic* impacts be considered when prioritising animal health research in developing countries:

- improving asset security
- enhancing market opportunities
- facilitating livestock based intensification of farming systems.

The cost of adoption is an important economic factor that could influence the uptake of agricultural research. Menz et al. (2000) identified a number of other challenges to measuring economic impact:

- poor farmers may derive only part of their income from agriculture and improvements in any one area may be small compared with overall income
- if research improves production, falling prices may dilute effect on income
- adoption may be slow and impacts only realised slowly
- research outcomes may prevent an unforeseen and uncosted potential problem developing.

This wide variety of factors affecting the impact of research on poor communities has been considered in developing the Animal Health Research Assessment Framework. In addition to these community impact issues, the benefits of research identified in ACIAR's current draft corporate plan have also been included.

7.3. A cluster approach

ACIAR is shifting its emphasis to a cluster approach where different projects build on, and are related to, other projects. This is not only in the specific ACIAR programs within which they are grounded but also across other ACIAR programs. An animal health cluster would be a suite of complementary projects that may start with basic research and lead to implementation and community benefits. A cluster need not, however, commence with basic research. An existing solution may be applied to a problem and basic research may either not be required or may be undertaken later to refine the technology in the particular environment.

Considering the analysis of the ND and endoparasite clusters, the FMD and CSF case studies, the studies outlined above and discussions with stakeholders in Asia, this review concurs with this approach and recommends that ACIAR further develops its concept of 'time-to-impact' as a more significant part of its decision-making criteria. Figure 8 provides an overview of the cluster approach. A cluster consists of a suite of projects over time that aim to:

- define the problem
- undertake appropriate technical, economic and social research
- facilitate adoption of acceptable, sustainable technologies and/or management practices that reduce poverty by decreasing costs, increasing productivity, protecting assets and/or increasing access to markets.

All projects within a cluster would have a common long-term goal and know where they fit on the 'impact pathway' within the cluster. For instance, basic research (e.g. Project 1 in Figure 8) may be required initially to define a problem and begin to understand the scientific issues to be confronted. Such a project would not of itself have an impact on poverty but the institutional, social and economic characteristics of the environment within which the solution will be adopted should be described and understood. With this emphasis on linking research with implementation, it is critical that the institutional arrangements that are required to support this are identified at each step on the program. These may include extension capacity and tools, rural policy issues and markets.

In this example, other projects would then build on this initial research and move to more empirical/case study type projects. There will be an expectation that that there is an adoption impact within these later projects, with results and cooperation expanding to other regions and with the support and integrated inputs of multi- and bilateral development institutions.

A cluster need not begin at the basic research stage. It may be more appropriate to undertake applied research which provides some simple and effective benefits and which may in turn lead to more basic research questions being raised or results directly implemented in neighbouring regions.

The critical factor is that a cluster must be based on a common understanding of the environments within which the projects will operate and a clear understanding of the expected cluster outcomes.

Recommendation 3: ACIAR should develop and manage a relatively modest number of clusters of animal health projects. Projects may be situated within more than one cluster and clusters can include projects being undertaken by other funding agencies.

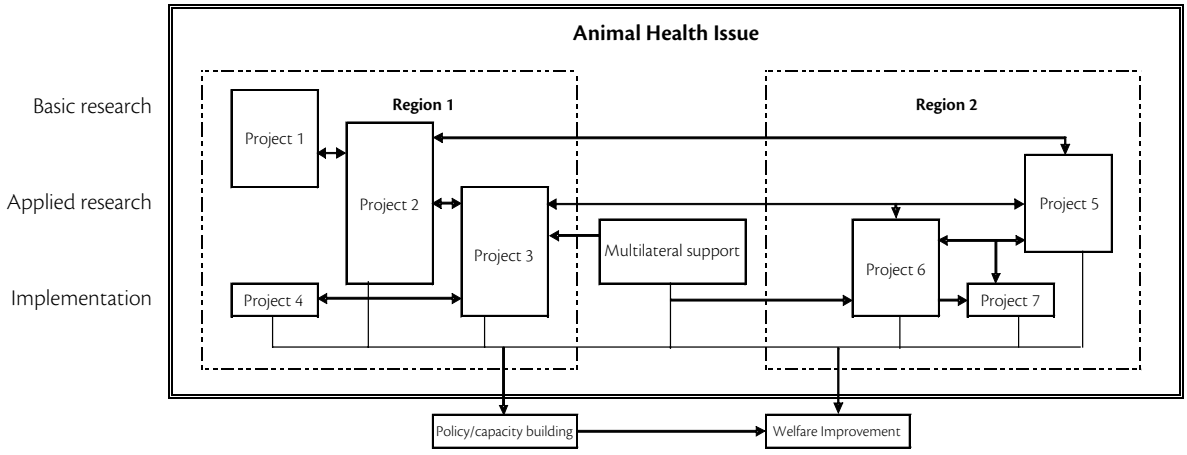

Figure 8. The cluster approach for animal health program delivery

7.4. The assessment criteria

7.4.1. Introducing the framework

Traditionally, proposals for animal health projects have developed largely through collaboration between ACIAR, Australian research institutions and partner country research institutions. It is envisaged that cluster identification be undertaken through consultation between ACIAR and the relevant partner government or industry sectors that have to capacity to implement research outcomes and effect changes, together with the research institutions. Projects must be consistent with Australian and partner animal health priorities and provide mutual benefits to both donors and partners.

The Animal Health Research Assessment Framework outlined in Table 11 provides a framework against which clusters and individual projects within clusters can both be developed by research institutions and evaluated by ACIAR. It has been summarised from a more complex matrix (Appendix 6) which details the importance of these issues at the various stages of the cluster life cycle.

The framework is a tool to assist ACIAR address the recommendations in this report. It provides a checklist of issues that should be considered while identifying, designing, implementing and evaluating animal health research projects. These questions are categorised in terms of technical merit, institutional capacity, and economic and social factors. It does not provide a detailed chronology of when activities should take place, nor does it attempt to rank the importance of particular issues. The relative importance of social versus technical issues in selecting projects, for example, will vary depending on the stage within the cluster life cycle that the project is situated. Social factors may be more important with implementation stage projects while technical feasibility etc. more important during the basic research phase.

The framework does provide an indication of who is responsible for providing specific information or ensuring that particular issues have been addressed. Generally, ACIAR is responsible for cluster development and management and ensuring the more macro issues are considered. It is also required to provide assistance with linking partner and Australian researchers and assisting researchers with descriptions/audits of the relevant social, economic, institutional environments within which the projects will operate. Partner institutions are responsible for project identification and the provision of local knowledge, while Australian partners are responsible for individual project development and implementation ensuring milestones and capacity-building and poverty alleviation benefits are met.

7.4.2. Technical

The technical assessment aims to determine if the animal health issue has been clearly identified, its importance evaluated in consultation with appropriate stakeholders and whether or not the research solution is technically feasible and appropriate to the environment in which it is proposed to be applied.

It is also necessary at this stage to ensure Australian counterparts have technical expertise in specific areas and the technical capabilities of potential partners are understood. Accurate definition of the technical issue will lead to an appropriate identification of the relevant stakeholders. For instance, production/animal health issues in some of the poorer South-East Asian countries will need consultation with smallholders while issues of biosecurity will require consultation on a broader level. This process will identify particular niches within the issue that Australian researchers have a comparative advantage.

The need for basic research will depend on the nature of the issue. In the early years of ACIAR animal health research this was certainly the most important type of research required as partner countries developed their research capacities. Although ACIAR should maintain a role in basic research, the need is probably less than it once was (this is reflected in ACIAR's expectation of 20% of research budget being allocated to these types of projects) with a greater demand for adaptation of research and a shift to transboundary and biosecurity priorities. Basic research may still be technically risky and a positive research outcome might be the reduction in the potential solutions to a problem or an understanding that a technique may not be appropriate in certain instances.

Scientific capacity building has been and should continue to be substantial and significant outcomes of ACIAR animal health projects.

Table 11. An overview of the Animal Health Research Assessment Framework

Checklist	Checklist questions	Principal responsibility		
		ACIAR	Partner country	Australian partner
Technical				
Define the nature and extent of the issue or problem	Are there researchable questions?	■	■	
	What is the prevalence/incidence and geographic distribution of the problem?		■	■
	Which communities/sections of animal industry affected and would benefit from research outcomes?		■	■
Define potential technical solutions	Are the potential solutions technically feasible?	■		■
	Have the advantages and limitations of this and similar technology been assessed?		■	■
Potential for technology transfer and uptake	Is the pathway for implementation and realisation of benefit described, realistic and understood?		■	■
	Is there a moderately high probability of success in implementing the tools?		■	■
Level of Australia's capacity and comparative advantage	Do the Australian partners have demonstrable scientific capacity in the proposed area of animal health research?	■		■
	Are they the most appropriate group to undertake the research in the environment?			
Potential for scientific benefit for Australia	How would the research benefit Australia in:			
	• enhancing of skills, available tools and/or knowledge?			■
	• enhancing biosecurity of Australian animal industries?			■
Risk of failure of technical solution	How well are constraints and risks identified and understood?		■	■
	Is there an appropriate risk management strategy?		■	■
Expected time frame for delivery	Solutions should be developed within 3–10 years and benefits commence flowing within 10 years.	■	■	■
Institutional				
Institutional priorities	Is the cluster/project consistent with ACIAR's Corporate Plan?	■		■
	Is the project consistent with partner government/ institutions' medium and long-term priorities?		■	■
Institutional, infrastructure and technical capacity	Is the capacity required to support the research defined?	■		■
	Are plans and processes included to ensure an enabling environment?	■		■
	Are the organisations that have the authority, structure and resources to implement outcomes partners in the project?	■	■	■

Table 11. <continued>

Checklist	Checklist questions	Principal responsibility		
		ACIAR	Partner country	Australian partner
Institutional <continued>				
Level and type of stakeholder inputs	Have research partners been identified?	■	■	■
	Have research partners contributed to cluster/project identification?	■		
	How does the cluster or project complement other animal production/marketing/health projects in the region?	■		■
	Have opportunities for collaboration in research and implementation been considered?	■		■
	Is the proposal consistent with regional practices and standards?	■		■
Potential for policy outcomes	Are the animal health policy environment and potential issues understood?	■		■
	Is an appropriate pathway described for encouraging any necessary policy changes?		■	■
Understanding of input and output markets	Are the appropriate markets equitable and efficient?	■		
	Are the likely impacts on the market from successful implementation understood?		■	■
Economic				
Potential for public and private benefit	What flow-on effects have been identified to other sectors/communities?		■	■
	Are links established or proposed to encourage private sector investment?		■	■
Potential for livestock owner welfare improvements	In what areas will benefits be realised by livestock owners:			
	• securing assets?			■
	• reducing constraints to intensification?			■
	• improved access to and involvement in the market?			■
Type of evaluation and monitoring required	Are baseline and later studies proposed to measure smallholder benefits ex-post?	■		
	Are ex-ante analyses of regional/national/local benefits provided or proposed?	■		■
Potential for economic benefit to Australia	How significant are potential benefits to Australia in terms of improved capacity, biosecurity and trade?	■		

Table 11. <continued>

Checklist	Checklist questions	Principal responsibility		
		ACIAR	Partner country	Australian partner
Social				
Level and type of social/ community analysis	Are target communities identified?		■	■
	Are target communities structure, social capital, leadership and decision-making processes understood?		■	■
	Are community leaders adequately involved to develop ownership of the solutions?		■	■
Potential for community benefits	How well are potential community benefits described and understood?		■	■
	Are appropriate baseline studies planned to allow ex-ante and ex-post evaluations?	■		
Role and priorities of livestock in the social system	Is the role and relative importance of different livestock species in the community described?		■	
	To what sections of the community are the target livestock species a high priority?		■	
	Are there gender and equity issues that need to be specifically addressed?	■		
Type of evaluation and monitoring required	Has a social audit been undertaken to help understand the targeted farming system?	■		
Risk of not fulfilling community objectives	Has adequate social analysis been undertaken to allow a risk assessment?	■		
	Are the social implications of the proposed solution understood and manageable?		■	■

Recommendation 4: ACIAR should develop quantitative, as well as qualitative, methods by which scientific capacity building can be measured.

7.4.3. Institutional

The institutional assessment aims to define institutional strengths and weaknesses, policy issues, relevant farming systems and their impact on the research agenda. The review has found that institutional factors have a great influence on translating animal health research into benefits. The outcomes of projects that have a good appreciation of the institutional environment and how to work within it and, where appropriate, how to help enhance it, are more likely to be successfully implemented.

Appropriate basic research can only be undertaken if ACIAR and partner governments have not only a detailed understanding of institutional capacity but also what human and institutional capacity needs to be developed and supported to ensure research is rigorous and applied research and extension skills are also available. The institutional capacity of a partner country will influence the types of projects within a cluster that can be implemented. For example, countries such as Thailand, Malaysia and, to a lesser extent, Indonesia and the Philippines are now able to undertake their own basic and applied research programs, but need assistance to continue to develop institutional capacity for both national and regional biosecurity responses and programs. Countries such as the CMLV countries still require more basic assistance to develop national disease diagnosis and control programs.

An institutional audit needs to be undertaken to determine what types of projects are appropriate for a particular level of institutional development. Institutional support includes not only research agency capacity but also the policy environment, the linkages between extension (both government and private) and livestock producers, the efficiency of input and output markets, and the role of the country within regional groups (e.g. ASEAN). All these issues need to be accounted for when deciding what types of projects are appropriate to what clusters in what countries.

Recommendation 5: As clusters and projects are developed and implemented, ACIAR should initiate and maintain institutional audits in the particular partner regions and countries. These audits will detail and analyse the institutional environment within which a project and subsequent projects will be implemented.

Recommendation 6: Projects in Cambodia, Laos, Myanmar and Vietnam (CLMV), and other developing countries such as East Timor, should include institutional development as an objective.

7.4.4. Economic

The outcome of the analysis of economic impact will be an understanding of the regional, national, community and livestock producer economic environment within which the projects will be implemented. It will require collection of detailed baseline data on the basis of which projects will be designed, implemented and evaluated. Economic success of the cluster will be largely influenced by the ability of the group of projects do deliver demonstrable gains to the target stakeholders, usually livestock producers but also consumers and the service sector and government. This baseline data will be updated through project design as required. In order to ensure that economic analysis is consistent with technical, institutional and social factors it is imperative that it is based on sectoral (production system) analysis rather than species.

The type of economic analysis undertaken will depend on the stage of the program cycle and the type of project benefit. During program planning a detailed economic audit of both macro- and micro-level benefits and costs must be undertaken. This will involve:

- economic surplus methodologies that will not only estimate benefits but also the distribution between producers and consumers
- measurement of the expected effects on markets of changing production and cost structures
- detailing public benefits such as human health as opposed to private consumer and producer benefits
- estimation of farm-level benefits and costs using activity and whole-farm gross margins as well as discounted farm cash flows. Farm-level analysis can also be used as baseline data in subsequent ex-post evaluations.

A major challenge for ACIAR is to appropriately estimate the 'without assistance scenario'. It is simple to assume that the benefit of eradicating a disease will be a reduction in mortality (or morbidity) equal to that caused by the disease. This, however, does not adequately take into account other management, social and economic factors that would come into play if the disease was controlled, or what may have occurred in the absence of the intervention. For example, reduction in ND may mean an increase in other animal health or production issues, such as an increase in the incidence of Gumboro disease or predation. It may mean the maintenance of village chicken numbers and an increase in large animal numbers as smallholders use the increased income to purchase a different range of assets (as is happening in Myanmar). An accurate and realistic understanding of the 'without project' scenario is necessary before program approval.

The technical nature of the project will determine where in the cluster life cycle a particular project will fit. If it is defined as basic research (more than 10 years to implementation) the following economic analysis must be undertaken. Basic project proposals should include the following information:

- Definition of where the project fits in the cluster. This is the 'time to impact' criteria used by ACIAR in the project proposal stage.

- Definition of the economic loss. This will include use of the analysis done at the cluster level updated as appropriate for basic research.
- Definition of public versus private benefit. The nature of the cluster will influence the nature of the benefits. Clusters/animal health issues such as AI, FMD and brucellosis control will have more public benefits (human health, market access) than would endoparasite and ND control. It will be necessary for each project within the cluster to identify what type of benefits the particular project will influence.
- Definition of partner country and institutions. Country selection will be based on the potential benefits to the particular country and the potential for spillovers to neighbours. In projects with an emphasis on transboundary/biosecurity issues the partner country selection becomes secondary to the selection of the partner institution. For example, FMD research and program implementation may be based out of Thailand due to availability of skills and location but assistance is not being provided to Thailand per se.

As research moves through the project cycle the economic analysis needs to become more precise and with a greater focus on the welfare of the livestock owners. Analysis should include market level, whole farm and per head/production unit effects. Data from the economic audit should continue to be used and updated.

Recommendation 7: Ex-ante economic analysis should be undertaken for each potential project. This should include estimates of market-level economic loss (economic surplus) and smallholder (whole-farm cash-flow) effects.

Recommendation 8: An economic audit of potential partner regions and countries should be undertaken in order to provide baseline information on which to estimate cluster/project impacts. Baseline data will include market, community and individual economic information.

7.4.5. Social

The social assessment aims to define the communities in which the research outputs will be used, the current and future role and importance of the relevant livestock species in those communities, the factors affecting the uptake and impacts that the application of the research outputs would have in the community and how these would be evaluated.

Social and community considerations dominate at the applied research and implementation stages of the cluster life cycle. This does not mean, however, that they should not be included in basic research projects. All projects must have a clear understanding of not only the effects of their research on producers, but also of how the research will be adapted and adopted by the target stakeholders. A major issue for ACIAR animal health research in the past has been the lack of consideration of downstream social and community aspects in the implementation stage. Basic and applied research projects need to ensure that adequate community development skills are available during all projects.

Recommendation 9: Community analysis must include an understanding and measurement of target stakeholders' social capital. Social capital will play a role in the community's ability and desire to both adopt research recommendations and link with development agencies and agribusiness.

8. Testing the framework

ACIAR requested that its clusters of research projects on Newcastle disease in chickens and internal parasites in ruminants be analysed in more detail. Both have had a significant range of projects undertaken in the past 20 years and they cover quite different animal industries. The following sections describe these programs and factors that have affected their success. The programs are then evaluated using the assessment framework.

8.1. Newcastle disease

The ND cluster comprised applied research and implementation projects that largely took existing knowledge about lentogenic ND viruses in Australia to develop suitable vaccines to use in the village environment. The following discussion focuses on the impact of HR ND vaccines on smallholders in Asia to whom significant benefits were expected to flow. As previously described, many of these issues have been addressed in the AusAID program in southern Africa.

8.1.1. Technical

Technically, the ND cluster succeeded. The Australian project team had a high level of expertise in the technology and with partners had a clear understanding of the nature and extent of the issue and of what the proposed solution could achieve in a relatively short time frame. At the start of the projects, ND was a high priority animal health issue in the partner countries. The technological solution of a heat-resistant oral vaccine that could be easily applied in the target environment was highly suitable and targeted the village chicken farmer as the end user and beneficiary. There were no alternative tools that could be readily applied to that user. Scientific capacity in vaccine production was developed initially in Malaysia and then in other countries by in-country workshops and training of technical staff in Australia. Regional workshops further disseminated knowledge of the technology, and manuals have been developed that, when translated from English, will be valuable resources for future control of ND. There was also excellent collaboration between the dedicated leadership group and other scientists in the countries where the technology was successfully applied.

The areas where the projects failed technically were in not demonstrating the effectiveness of the vaccine in some field trials and in the vaccine's viability being affected by long periods of exposure to high temperatures. These technical issues probably contributed to a loss of confidence in the technology in some countries. Despite the technical successes the adoption of HR vaccines has not been widespread.

8.1.2. Institutional

Many of the factors contributing to the lack of impact appear to have been institutional. The institutional support in national animal production and animal health services that would have been required for eventual widespread application of the technology at the village level was not initially appreciated and was not developed in most partner countries. Managing ND in village poultry populations was not a national priority and supportive policies and programs were not developed, except in Vietnam and more recently in Myanmar. In the latter, other organisations such as AusAID and FAO supported implementation. Even in Malaysia, there appears to have been limited uptake at this level. This left the use of the technology very much in the hands of the dedicated proponents demonstrating its use at the village level to achieve widespread voluntary uptake. In countries like the Philippines, Indonesia and Thailand, initial enthusiasm was not maintained and the technology effectively disappeared.

Commercial stakeholders were also significant institutional factors that affected delivery of the HR vaccine technology. In Malaysia and Vietnam, commercial vaccine companies were recruited to the projects and produced the HRV4 and I2 vaccines, respectively. The early commercialisation of HRV4 and subsequent costs and licensing issues have resulted in only one country using that vaccine. In Malaysia HRV4 is now simply one of the suite of ND vaccines used in the commercial sector.

In other countries that produced or could access I2, vaccine producers had existing profitable investments in other ND vaccines with which the developing commercial poultry industry was apparently familiar and satisfied. Very large volumes of other vaccines were also imported and this trade has grown as the commercial poultry sector has grown. So there was limited commercial opportunity for a new product

aimed at a relatively small and cost-sensitive market. This market also had constraints in the distribution network and less-cost-efficient small packaging that would be required for village use.

Although significant numbers of poor chicken farmers still exist in South-East Asia, this shift in the relative importance of village poultry production to large-scale industrial production, sometimes using village growers, has seen their importance decrease in the national priorities. The successes with ND in Vietnam and southern Africa not only reflect the personal dedication of the teams and AusAID's SANDCP but also the relative importance of chickens in human nutrition and welfare in those regions and the resultant higher level support.

8.1.3. Economic

The economic evaluations of the ND cluster have been well researched and professionally undertaken. However, the expected levels of adoption used in these analyses have never been realised. Although there appeared to be significant smallholder benefits and opportunities for smallholders to introduce a commercial style of chicken management process, this did not happen. The expected economic benefits to consumers and producers did not eventuate. The process of defining economic loss, measuring smallholder and market benefits and evaluating through ex-post analysis was appropriate, but the data used in the analysis were insufficient.

If there was a problem with the economic analysis it was that researchers and evaluators did not (or were not able to) work closely with extension and community analysts. More assistance should have been provided to more accurately estimate adoption figures. The major benefits of ND control in village chickens are felt at the smallholder level but there was no baseline farming system developed that would allow accurate on-farm benefits to be estimated. While per-bird benefits were estimated these were not included sufficiently into a whole-farm model to correctly interpret these benefits to the farmer. To adequately undertake this process it would have been necessary to understand the role of chickens in the farming system and have a good understanding of other potential causes of chicken deaths if in fact ND could be reduced.

The two economic evaluations undertaken in 1991 and 1998 both used adoption data that led to a significant overestimate of the actual benefits of the program. A more in-depth understanding of the social and institutional requirements for successful adoption was needed. This review has used the same economic analysis framework (see Section 4) as these two earlier reports and may well be guilty of using the same level of overestimation for final adoption in Myanmar and other new potential markets.

8.1.4. Social

A major reason that the V4 and I2 vaccine development cluster has not delivered the expected outcomes is that the vaccination programs developed have not been extended effectively to the smallholders and the solutions have not fitted into the smallholder social and livestock management systems. Initially, the social factors affecting uptake and implementation of HR vaccines were not adequately described and appreciated. Early researchers did not fully understand the role that village chickens play in the smallholder farming system. While the V4 and I2 vaccines had the very important factor of being heat stable, other important issues such as the role of chickens as a low-input, scavenging source of protein were not properly included in the research. Farmers were not prepared to invest in a different technology which they were not convinced would be economically viable and required a different chicken management structure. Where there does seem to have been some success in Myanmar, increasing income from chickens is not increasing chicken numbers but rather increasing large-animal numbers as smallholders sell more chickens and eggs and purchase larger assets.

It was necessary to research the success, or lack thereof, of existing ND vaccines in the village system; for example, when and how were they used and how were they funded. This was not adequately considered until Woolcock et al. (2004) considered the household benefits of ND control. The perceived positive aspects of the existing vaccines needed to be retained with heat resistance added. What in fact happened was that some of the characteristics that smallholders accepted in some areas and were comfortable with such as two vaccinations per bird and evidence of symptoms after vaccination were perceived to have been lost.

HR vaccines were successfully demonstrated at the village level in many areas but factors such as the need to regularly revaccinate multi-age, multi-owned village flocks, difficult access to the product and price have discouraged and frustrated many potential users. Equitable means by which individuals can pay for vaccine in a communal environment are essential facilitators for long-term implementation but, even then, fears persist of investing scarce cash on one disease while their chickens remained at risk of other causes of disease and death. Finally, the relative importance of different animal species is changing in most South-East Asian countries and villagers are increasingly looking to access systems for more profitable livestock such as pigs, cattle and buffalo.

8.1.5. Outcomes

Combined with institutional and economic factors, community/smallholder factors have mitigated against the use of a technology designed specifically for them. The very attractive technical benefit of a heat-stable vaccine has not been sufficient incentive to encourage both vaccine producers and smallholders to change their practices in most circumstances.

The outcomes of the ND program have been mixed. It is clear that the introduction of heat-stable ND vaccines has the potential to reduce chicken deaths, thereby increasing both income and protein consumption among the poor, but this has not been sufficient to see widespread use throughout Asia. The ND experience shows that implementing technology widely and impacting community welfare in a sustainable way at the smallholder level is extremely difficult without institutional support throughout the government animal production and health service.

In discussions with animal health staff, commercial producers and academics in Indonesia, Thailand and Laos the perception is that while there may be benefits in using these vaccines there are several factors which have limited the adoption, as follows:

- ND control is not a national disease control priority in Indonesia and Laos. In Indonesia it is not one of the 14 livestock diseases on the government's 'strategic list'. In Thailand, ND is regarded as under control with the commercial producers accessing a wide range of viable vaccine strains. Village production systems have vaccines available but the uptake generally is low.
- There have been insufficient field level demonstrations of the technology. Staff, private enterprise[5] and farmers just do not know about the vaccine. While there may have been initial interest in V4, its purchase by a commercial company (Websters) made it relatively inaccessible. These countries were then out of the loop with I2 and using alternative vaccines.
- Many smallholders expect that if chickens are vaccinated against ND some other disease will kill them anyway so why bother.
- The management system requiring a general feed or water-based vaccine every 3 months is not regarded as appropriate as vaccinating with eye-drops twice in the first 3 weeks after birth.
- The heat-stable benefit is not sufficient incentive to encourage both vaccine producers and smallholders to change their practices.
- There are doubts concerning the ability of V4 and I2 to maintain efficacy for more than 3 months.
- The I2 vaccine produces no symptoms of ND, so farmers are unsure whether or not it has worked.
- In Laos it was more expensive to use the I2 vaccine than it was to use a combination of M and F vaccines. It cost $US16 to purchase I2 vaccine for 1,000 birds for the year and only US$6 for the M and F vaccines which were both applied once per chicken per year. The reduction in transport costs and potential wastage due to the heat resistance of I2 will reduce this difference.

The positive outcome has been that a vaccine has been developed that can provide a cost-effective solution to the ND problem in village chicken farming systems. The negative outcome, however, is that the vaccine has only been adopted after significant inputs to demonstrate its efficacy in the field. There has not been a natural dissemination or diffusion of results to the smallholders via either public or private agencies.

5 The authors met with Drh Hartono the Chairman of the Indonesian Poultry Information System. He was unaware of the I2 vaccine but very interested to find out more about it.

Recommendation 10: ACIAR should not undertake further basic research in developing ND vaccines but should continue to support the supply and quality control of I2 and, if possible, V4 seed vaccine to interested commercial and government-owned vaccine producers.

Recommendation 11: ACIAR should undertake economic, community and institutional research in key countries where its ND research has been undertaken to determine why adoption of HR vaccines has been poor and what initiatives would result in benefits to smallholders.

Recommendation 12: Depending on the results of the research (Recommendation 11) ACIAR should work with commercial vaccine and poultry companies and NGOs to capitalise on the products and lessons of its ND projects to develop sustainable adoption of ND prevention programs in the communities and farming systems with market opportunities and high potential economic return. These projects will complete the ND cluster.

8.2. Ruminant endoparasites

In contrast to the ND cluster that pursued the development and adoption of a single technological advance in one animal species progressively over many years, the endoparasite cluster is considerably more diverse involving all stages of research for several different parasites and the development of more complex control strategies in a range of production environments and countries.

8.2.1. Technical

Studying the epidemiology of internal parasites and developing cost-effective integrated strategic parasite control programs in a variety of environments is technically very difficult, particularly in an environment where the parasites are developing resistance to the main chemical treatments. In supporting research in this cluster, ACIAR utilised Australia's considerable technical skills and experience with these challenges within Australia.

In comparison with the *Fasciola* and small ruminant projects, the *Toxocara* project was less complex. The issues of high death rates in important and expensive livestock (buffalo and cattle calves) in Sri Lanka and in other countries and of costly and largely ineffective worm control in the face of these losses appeared to be well appreciated by both scientists and the potential end users of the research—the animal owners. Scientific capacity was high from the start and maintained by strong project leadership in Sri Lanka. Basic epidemiological and parasitological research successfully described the problem and identified an effective existing anthelmintic, which was then applied and successfully demonstrated through a simple strategic program of a single treatment. The dissemination of this strategic approach between countries and extension of this strategy to villagers was facilitated by a simple message and eager audiences. The fact that it replaced a more costly use of drugs for worms that were found not to be a problem was a bonus.

The technical assessment for the *Fasciola* projects is not as clear cut. Australia again had considerable expertise in the parasitology and epidemiology of a *Fasciola* species but in a very different environment. The disease was ranked by the Indonesian Government as a high priority animal health issue when the first project started, but it is uncertain that the importance and extent of the issue was well understood. Because its effects on productivity were largely subclinical, it is not likely that villagers would have seen it as a priority and were probably not involved in developing the early projects. Hence there was probably little demand for a solution among the end users.

Overall, the projects have been focused on research products rather than implementation. There has been a very strong laboratory focus with an emphasis on basic research in epidemiology, genetic resistance and molecular biology. The scientific capacity of the team at Bogor has increased significantly during the course of the cluster and basic research findings have been disseminated to the scientific community. The high-risk molecular research did not lead to a vaccine and genetic resistance identified in indigenous sheep has not been applicable to the target species, cattle and buffalo. An outcome of this research, however, did raise a potential benefit for Australia in the possibility of utilising genetic resistance in controlling internal parasites in sheep.

A strategic control program integrating management and chemical treatment was developed and demonstrated in pilot areas in Indonesia but there has apparently been no significant uptake outside the demonstration villages. There is no campaign to promote the program within Indonesia and little uptake elsewhere at this stage.

As internal parasitism was threatening the survival of small ruminant grazing systems in the Pacific and South and South-East Asia, the importance and extent of this issue should have been well appreciated at various stakeholder levels. Again scientific capacity was developed and collaboration with extension workers was excellent. In a challenging environment of increasing anthelmintic treatment and resistance, the basic and applied research projects successfully defined the epidemiology of the important parasites and developed strategic approaches to control that integrated resistant breeds, grazing management, nutritional supplementation and anthelmintic treatment.

However, successful basic and applied research was not complemented by an implementation assessment and strategy in most of the projects and this has contributed to limited adoption. Other agencies are now collaborating to adapt and implement appropriate strategic programs at village level.

8.2.2. Institutional

An understanding of the past and current institutional arrangements in Indonesia helps explain the lack of impacts of the *Fasciola* projects. Although fascioliasis had been a national priority 10 years ago, the lack of strong central animal health management in a decentralised Indonesia makes it difficult to implement broad-scale programs, even for priority diseases. Its demotion in national importance during the course of the cluster effectively removed any chance of significant government support for parasite control programs. The institutional links between the research institution, Balitvet, and other branches of the national animal health service are also circuitous so that collaboration between the different branches is not automatic.

Effectively, this institutional environment left the implementation of strategic *Fasciola* and small ruminant parasite control in the hands of the informed villager and the seller of the chemical, neither of whom appear to have had a close involvement or taken ownership of it. While strong links developed between research institutions, there was generally little transfer of the technology.

8.2.3. Economic

There have been 19 projects with a potential impact on endoparasite control. The first began in 1983 and there have been ongoing linked projects since then. This project developed a low cost anthelmintic and stated that there was a 'good chance that the new method for control will have a significant impact…'. Adoption, however, did not follow.

AS1/1990/049 built on this project to develop control systems for fascioliasis in Indonesia. The benefit of this project was in the capacity building of Balitvet and Balitnak in Indonesia. There was no economic evaluation undertaken. Fascioliasis ceased to be a priority animal health issue for Indonesia and a private company, Ciba-Geigy, lost interest in pursuing commercial opportunities. A complementary project (AS1/1991/023) did attempt to develop formal links with an AusAID project (Eastern Islands Universities Project) to encourage further research and adoption. Once again no economic analysis was undertaken of this project.

Further key projects continued in this vein with AS1/1996/160 concluding that:

> … the project team had used knowledge…to develop rational, appropriate control strategies for its [fascioliasis] control. However, the cost effectiveness of these strategies and their effectiveness throughout South-East Asia have not been fully evaluated. ACIAR had, however, created the world premier body of knowledge [on] the biology of *Fasciola gigantica.*

AS1/1997/027 was a basic research project which made no attempt to measure its benefits.

The other key project was AS1/1997/133 which attempted to bring together the research and develop adoption strategies with assistance from ILRI (funded by ACIAR and IFAD). It highlighted the major impediments to adoption being:

- acceptance by smallholders as a minor problem to be lived with
- initial investment required in order to change management practices (e.g. improved fencing)
- cost of medicated blocks inhibitive to smaller farmers

- inability of smaller farmers to introduce grazing management practices.

Project evaluation was unable to identify immediate community benefits and the formal review (2001) had no brief to do an economic evaluation. This project concluded that:

> … one area of concern… was the absence of tools to do a justifiable analysis and assessment of the local impact of the project … Some economic arguments advanced were not compelling. The reviewers felt that this approach should reasonably be included as part of the planning process and responsibility of the original project, but it did not appear to be. This 'grey' area should be addressed, because it could result in research being pursued which has little chance of a useful practical outcome.

The conclusion is that the only economic data elicited to justify the endoparasite cluster were some estimates of broad economic loss across Asia. There has not been sufficient economic justification of the economic benefits of endoparasite control. Before the cluster was selected it would have been necessary to detail the wider economic effects of endoparasite control on smallholders in order to ensure their support. Whole-farm analysis which includes effects on draft power and longer-term farm income needed to be undertaken with livestock producers convinced before the project started of the potential benefits. As with ND control endoparasite control benefits accrue largely to the local producer and potentially the consumers and hence consultation with livestock production groups and extension services was necessary before initial cluster implementation.

Impacts of the endoparasite program have mainly been the improved capacity of partner research organisations. This needs to be measured. There does not appear to be significant economic benefit to smallholders in the project or spillover areas. The program has not led to measurable poverty alleviation benefits because:

- initial baseline economic data were not collected
- smallholders were not convinced of the economic benefits of control
- although the benefits of control are mainly private, adoption pathways were not included adequately in research projects
- monitoring and evaluation of the relevance of research results to the market was not undertaken.

8.2.4. Social

Severe parasitism and deaths are obvious and usually prompt a tactical response but reflect a failure of strategic control. One of the major challenges to implementing strategic effective parasite control is that most of the impacts are subclinical and not obvious to animal owners. The potentially severe economic impact of toxocariasis and a simple technical solution were factors that favoured villager recognition of the issue and implementation of the research solution. This was not the case for *Fasciola*.

Given the threat that nematodes presented to the survival of sheep and goats, it would no doubt have been assumed by project leaders that end users would adopt strategic programs developed for small ruminants. However, this was not the case. There was still apparently inadequate understanding of the problem among villagers and of the management of small ruminants among researchers. Grazing management options were not appropriate and the nutritional supplementation by blocks and anthelmintic treatment using blocks was perceived to be too costly. The assessment of social factors and impacts is now being undertaken through IFAD's related project (TAG443) and its participatory approaches to developing integrated programs that are appropriate to particular communities.

In general, the social benefits were described as perceived improvements in relationships between researchers, extension staff and smallholders. These were stated only in the projects which could be defined as having an implementation component. For example, in the project AS1/1990/160 (ACIAR review report) the only mentions of community or social impacts were through comments such as:

> … to educate animal owners and increase income from animal production

> … relationship of trust and friendship between the livestock owners, researchers and government extension workers

> … bridge the relationship between Christians and Moslems in the community.

There had been no baseline social audit undertaken during cluster/project design and hence there has been no qualitative or quantitative social/community welfare evaluation completed.

8.2.5. Outcomes

The endoparasite cluster has been very successful in improving the capacity of researchers in partner countries. This improvement in skills has and will, no doubt, benefit these countries not only through improved endoparasite control programs that increase livestock productivity, but also through spillover effects into other programs that require these skills and institutional capacities.

The direct benefits of the research to smallholders, however, are difficult to determine. Smallholders did not and do not have a strong demand for the technology. Issues such as the required livestock grazing management changes, lack of clear problem definition, low government and smallholder cattle selling practises needed to be considered earlier in the cluster life cycle and in basic project design. While endoparasites do cause significant economic loss appropriate social, economic and institutional (particularly) policy background research was not undertaken. Anthelmintic drug producers and distributors have a commercial interest in sustainable application of their products and should be involved in developing and extending SPC programs. In less developed environments, NGOs may be important 'clients' in implementing SPC with smallholders.

Recommendation 13: New basic research into endoparasites should be delayed until a better understanding of the institutional and smallholder production and marketing environments within partner countries is gained.

Recommendation 14: Further applied research into and implementation of sustainable endoparasite control should then be undertaken in association with commercial partners, NGOs and/or government agencies, depending on the roles of each in the partner country.

Recommendation 15: Implementation of research results from the endoparasite cluster should be integrated with livestock production clusters/projects and within bilateral and multilateral rural development assistance projects.

9. Implications for the ACIAR Animal Health Program

Communities, livestock industries and animal health priorities and capabilities are changing rapidly in the traditional regions of ACIAR's animal health research. At the same time, Australian's relationship with countries in South-East Asia in particular are maturing and presenting new challenges. Closer economic partnerships, more competitive trade in animal products and current concerns about HPAI and other emerging zoonoses are some of the factors that impinge on ACIAR's future animal health program. The following discussion focuses on South-East Asia or the ASEAN region as the principal area in which ACIAR is expected to operate during the next 5 years.

9.1. Animal health issue selection

Of the ten ASEAN countries, four are recognised as requiring special assistance to bridge the development gap between them and the more developed countries. These four are the so-called CLMV group of Cambodia, Laos, Myanmar and Vietnam. In these countries there is still significant potential to improve productivity in smallholder animal production systems. There is also considerable opportunity to increase scientific capacity and application in these countries. As noted previously, however, projects that aim to address poverty and improve community welfare must take an integrated approach from research design through to product implementation. From this perspective the CLMV countries have strong central planning systems that are well placed to see projects through to implementation. Although implementation projects may be supported by other development agencies and integrated with animal production projects, ACIAR may have a valuable role in helping partner countries sustain the quality of the scientific tools and programs that are implemented.

The other six ASEAN countries have considerable economic development and scientific capacity. Overall more of their people are becoming less dependent on small-scale livestock production for income and nutrition although significant numbers of people may still be smallholders. Opportunities are opening up for these producers to participate in commercial livestock production, sometimes in association with large commercial partners such as integrated chicken producers. As this process advances, poor smallholders run the risk of becoming less 'visible'. Governments become more interested in larger scale development and satisfying increasing domestic consumer demand and the possibility of exporting more livestock and animal products.

In this relatively developed environment, animal health interest is more likely to be on biosecurity and controlling or eradicating diseases that restrict their export trade or threaten the health of their consumers. As these interests are similar to Australia's, there is greater opportunity for more mature animal health relationships based on true scientific partnerships and increased mutual benefit. Australia shares a deep interest with these countries in understanding and developing effective tools and strategies for controlling transboundary diseases and other significant exotic pests and infections that could enter Australia. Access to biological materials, diagnostic capacity and knowledge of disease occurrence and trends will continue to be valued in Australia.

Although the contribution of smallholders to national livestock industries is falling, they still present a significant animal health risk. As outlined in this report, implementing effective disease control in this sector is not easily achieved but investigating and developing means of managing animal health at the community (village) level rather than at the individual (smallholder) level may be more effective and more attractive to governments in these more developed countries. Such work may also lead to village biosecurity models that can be applied to improve animal health in less developed countries. These changes also present some challenges as developed ASEAN countries increasingly compete for trade in animal products where Australia has an advantage because of its animal health status. This could lead to commercial interests and governments perceiving Australia more as a competitor in animal health and less as a scientific collaborator. This could result in more difficult access to people, information and materials in some of these countries. A future challenge for ACIAR and Australian researchers may be to preserve trusting scientific relationships in increasingly competitive commercial livestock sectors.

A specific area of animal health in which Australia will want to maintain involvement will be monitoring the occurrence and trends of important exotic diseases in eastern Indonesia, East Timor and Papua New Guinea. ACIAR may consider supporting research aimed at improving specific surveillance and control tools that these countries can employ in collaboration with Australia's northern biosecurity and border protection program (NAQS).

Recommendation 16: ACIAR should establish a formal consultative mechanism with AusAID and with the International Division and Transboundary Issues Program in DAFF to assist in identifying and prioritising Australian interests in animal health research.

Recommendation 17: ACIAR should support: in the CLMV countries, capacity building for both researchers and research institutions through basic and applied research with the objectives of increasing livestock health, productivity and biosecurity, and to facilitate involvement of these countries in regional disease control and biosecurity projects; in more advanced countries, applied research to enhance mature scientific relationships between Australian and partner countries to maintain high standards of laboratory diagnosis and disease surveillance in regional transboundary disease control and assurance programs, such as those for foot-and-mouth disease, avian influenza and classical swine fever; research to improve surveillance and control techniques for important animal diseases in eastern Indonesia, East Timor and Papua New Guinea and which are exotic to Australia.

9.2. Institutional arrangements/partnerships

The collaborators in partner countries on most animal health projects in the past have been government research institutions and universities with some involvement of government animal health services. Government authorities and institutions will remain major partners in some ASEAN countries and especially the CLMV countries. However, as commercial livestock production increases and the private sector's role increases in servicing this change, the opportunities will increase for ACIAR to engage with commercial partners and potential users of research products, such as integrated chicken and pig producers. There may also be opportunities to work with smallholder production and marketing groups.

The other increasingly important groups are the regional animal health programs for transboundary diseases such as SEAFMD and the GMS program. In addition to these, the ASEAN Sectoral Working Group for Livestock (ASWGL) works with the Animal Production and Health Commission for Asia and the Pacific (APHCA) and FAO in identifying regional programs. Member countries pay annual dues to APHCA which are held by FAO in trust for regional projects.

As well as a shift toward working with more regional authorities, ACIAR should encourage researchers to become vertically integrated with policy and extension institutions. Cluster/project success will be dependent on the project teams' abilities to ensure that solutions and new technologies are supported by regional, national and local-level policy. This policy development will feed through into enduring training for extension staff and the availability of resources to disseminate information. The expertise required (extension, community and economic) must be included in the cluster and project development process.

Recommendation 18: In the more advanced partner countries, ACIAR should increasingly take opportunities to work with commercial partners and potential users of research products (including NGO's and semi-commercial producer groups).

Recommendation 19: In less-developed countries, ACIAR projects must be consistent with government policy and capacity at a national and/or local level and integrated with other research institution priorities and extension expertise.

9.3. Research delivery

This report has detailed and stressed the importance of developing the concept of project clusters, both within and between ACIAR programs. This needs to be further developed with both horizontal (including other bilateral and multilateral research institutions) and vertical (extension, policy and implementing institutions) integration. ACIAR should be closely involved in working with research teams to progress through the stages of a cluster. Proposals for future directions within a cluster should largely come from completed projects through partner and research institutions and project reviews. These would then be assessed using the framework.

Recommendation 20: ACIAR needs to continue facilitating cooperation between research institutions which benefits researchers in both Australia and partner countries. Capacity building in poorer countries should continue to be a high (and measurable) priority.

9.4. Research versus adoption

There are advantages to Australia and its partners in ACIAR maintaining its niche role as a leading facilitator of international agricultural research. It has developed a strong reputation in the area that should be protected and enhanced. A major challenge, however, is to create an appropriate balance between its planning and facilitating adoption within the research cluster while not taking direct responsibility for adoption. As discussed above vertical and horizontal integration with other research and implementation agencies will assist maintain focus on its role as a facilitator of research.

In terms of research evaluation and monitoring, the type of processes used will depend on the stage of the cluster life cycle. As well as sound technical assessment, basic research should assess the economic and social environment within which the research will be adopted. All projects should be assessed by evaluating their role and impact within the cluster and the linkages and dependencies with other projects. Projects should be selected understanding the next steps that might follow depending on the results of the research.

Recommendation 21: ACIAR should support animal health research that can result in benefits to communities through active participation in markets that will allow the realisation of benefits from reduced disease control costs, improved animal productivity or improved product quality.

Recommendation 22: ACIAR should maintain its primary role and reputation as a provider and facilitator of high quality, demand-driven basic and applied animal health research.

9.5. Bilateral and multilateral relationships

Delivering community impacts from animal health research requires implementation of appropriate technology in a cost-effective and sustainable manner. While ACIAR may have a strong interest in seeing its research achieve these impacts, it is doubtful that it is the correct agency to fund and manage implementation projects. ACIAR is the research arm of Australia's agricultural aid program. AusAID is the Australian implementing agency and, as such, has implemented research in ND in Africa and FMD in Thailand in recent years. Therefore, at the very least there should be strong formal links between these two agencies. Where there are common interests, identifying priorities and research and implementation projects should be undertaken in partnership. It is understood that AusAID has recently drafted a white paper on overseas agricultural aid that would be of direct relevance to ACIAR. In the area of Australian biosecurity, DAFF's recently formed International Division and Transboundary Issues Program, are also important partners. The Australian Biosecurity Cooperative Research Centre also has common interests in this area. Internationally, ACIAR may need to engage with other development agencies at an early stage to determine joint priorities and to scope the implementation stages that are expected to arise from research projects.

Other organisations' priorities in the ASEAN region are largely directed at transboundary diseases and notably HPAI. The FAO–OIE Global Framework for Transboundary Animal Diseases (TADs) supports

the SEAFMD program and is currently sponsoring development of the Greater Mekong Sub-Regional program to control FMD, CSF and HPAI with the Asian Development Bank (ADB). Since 1999, the ADB has been aiming at poverty alleviation through, among other things, sustainable economic growth based on policies and programs that facilitate income generation for the poor. The International Atomic Energy Association (IAEA) is also involved in the region in projects related to improving laboratory technology and may be an appropriate partner in projects aimed at sustainable scientific support. The International Centre for Tropical Agriculture (CIAT) is also active in livestock development programs in the region.

In addition to these multinational agencies, the European Union and individual European countries, the United States, Japan and Canada have all recently contributed to animal health projects in the region.

It is not envisaged that ACIAR would try to compete with these agencies but could use its high reputation for research and Australia's skills to teams with other agencies that are more interested and experienced in implementation.

> **Recommendation 23:** ACIAR should work more closely with AusAID and other bilateral and multilateral agencies to plan for the implementation of the outcomes of its research projects.

9.6. Project evaluation

Project evaluation needs to continue to evolve and attempt to measure not only technical outcomes and economic benefits but also social and capacity-building benefits and costs. Within past project evaluations there have been inconsistencies between their objectives. Different reviews have had different emphases when it comes to economic, technical and community impact assessment (e.g. Bates (2000) and Mauldon (1999) – ACIAR IAP 34). The Impact Assessment Series is an appropriate tool for the presentation of evaluations, but there is still a need for a more consistent framework for evaluating (both ex-ante and ex-post) animal health projects. This needs to be formalised using a specified set of measurement criteria which should be used for each project during project design, project completion and project evaluation (5 years after project). At present the ex-post analyses tend to be an ex-ante style evaluation completed after project completion. They have tended to rely on poor estimates of adoption and future impact rather than the measurement of actual adoption.

This confusion between ex-ante and ex-post evaluations is exemplified in the Newcastle disease cluster evaluations. The first ex-post impact assessment (Johnston and Cumming 1991 – ACIAR EAS7)) stresses the success of the projects in developing an appropriate vaccine for use in village chicken systems and how adoption will lead to high BCR and IRR. These predictions were made ex-post. However, in reality, the successful development of a HR vaccine has not led to significant poverty alleviation benefits in the project areas. It has led to considerable capacity building and uptake as an additional ND vaccine in the Malaysian commercial chicken industry but it appears that this has not translated to improving the welfare of the majority of village chicken producers. The second evaluation (ACIAR IAS1, 1998) updated these adoption estimates but these have also proved to be inaccurate. Future analyses (see the update in Section 4) face the same risk of overestimation of the adoption expectations.

> **Recommendation 24:** ACIAR should develop a consistent framework for evaluating (both ex-ante and ex-post) each project during project design, project completion and project evaluation.

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Economic Assessment Series (discontinued)

No.	Author(s) and year of publication	Title
EAS5	PD Chudleigh (1991a)	Tick-borne disease control in cattle
EAS7	J Johnston, R Cummings (1991)	Control of Newcastle disease in village chickens with oral V4 vaccine
	K Menz (1991)	Overview of Economic Assessments 1–12

Impact Assessment Program – Working Paper Series

No.	Author(s) and year of publication	Title
12W	G Lubulwa, J Davis (1996)	Collaboration between ACIAR and other research institutions in research evaluation: Experience in the Asia, Pacific & African regions
13W	G Lubulwa, J Davis (1996)	Inclusion of environmental and human health impacts in agricultural research in agricultural research evaluations: Review and some recent evaluations
15W	J Davis, G Lubulwa (1996)	An overview of ACIAR's economic evaluation activities with an Animal Sciences program focus
17W	J Davis, G Lubulwa (1996)	Integration of research evaluation analysis into research institution decision-making: An overview of progress at ACIAR
32W	G Lubulwa, S McMeniman (1999)	ACIAR economic impact model for use in project development (ex-ante) and completed project (or ex-post) evaluations: a user's manual

No.	Author(s) and year of publication	Title
43W	T Paris, N Carambas, S McMeniman, G Lubulwa (2002)	Impact assessment of twenty-one ACIAR-supported projects based at the University of the Philippines (1983–1995)
44W	P Winters, B Hardaker, I Patrick (2002)	Defining practical guidelines for evaluating long-term, smallholder decision-making in developing countries
IAP23	G Lubulwa, S Hargreaves (1996)	Estimates of realised and potential impact of three ACIAR projects on the ecology, epidemiology and control of ticks and tick-borne diseases in sub-Saharan Africa
IAP24	G Lubulwa, D Gray, K Patten, C Minbkar (1996)	Project development assessment: prolific worm-resistant meat sheep for Maharashtra, India and Australia
IAP25	P Suzuki, S Isvilanonda, C Khaoparisuthi, W Supakalin (1996)	A preliminary evaluation of 54 ACIAR supported projects in Thailand (1983–1995)
IAP26	G Lubulwa, S McMeniman (1997)	An economic evaluation of realised and potential impacts of 15 ACIAR biological control projects (1983–1996)
IAP29	R Mauldon (1998)	An assessment of the success and impact of ACIAR projects: Based on independent reviews of 111 ACIAR projects (September 1990 to September 1997)
IAP31	R Mauldon (1999)	An assessment of ACIAR-funded IARC special and restricted grants projects
IAP33	R Mauldon (1999)	A qualitative assessment of the research capacity and community impacts of three randomly selected ACIAR-sponsored projects
IAP34	R Mauldon (1999)	Research capacity and general community impacts of five ACIAR-sponsored projects: a qualitative assessment of five projects completed in 1994
IAP35	K Menz, G Lubulwa, P Lal (2000)	Poverty alleviation through agricultural research – the ACIAR experience
IAP36	W Bates (2000)	Research capacity and general community impacts of five ACIAR-sponsored projects: a qualitative assessment of five projects completed in 1994
IAP37	A Lubulwa, K Menz, D White et al. (2000)	Determining international research priorities
IAP38	S Isvilanonda, S Praneetvatakul, C Sangkapituk, A et al. (2001)	Impact assessment of forty-nine Thailand/Australia collaborative projects funded by ACIAR during 1983–1995
IAP39	D Hill, C O'Donnell, R Piggot, G Griffith (2001)	The dual approach to research evaluation: a simplified empirical illustration
IAP42	M Mangabat, N Yanson, E Sanguyo, et al. (2002)	Assessment of twenty-five ACIAR-supported projects in the department of agriculture in the Philippines
IAP46	Asia Research Centre, Murdoch University (2002)	Understanding the socioeconomic significance of livestock disease with particular reference to surra (trypanosomiasis) in selected communities in Indonesia

Impact Assessment Series

No.	Author(s) and year of publication	Title	ACIAR project numbers
IAS1	CIE (1998)	Control of Newcastle disease in village chickens	AS1/1983/034 AS1/1987/017 AS1/1993/222
IAS16	R McLeod (2001)	Control of footrot in small ruminants in Nepal	AS2/1991/017 AS2/1996/021
IAS19	D Pearce (2002)	Measuring the poverty impact of ACIAR projects – a broad framework	Not applicable
IAS21	R McLeod (2003)	Improved methods in diagnosis, epidemiology, and information management of foot-and-mouth disease in Southeast Asia	AS1/1983/067 AS1/1988/035 AS1/1992/004 AS1/1994/038
IAS23	R McLeod (2003)	Improved methods in for the diagnosis and control of bluetongue in small ruminants in Asia and the epidemiology and control of bovine ephemeral fever in China	AS1/1984/055 AS2/1990/011 AS2/1993/001
IAS26	J Mullen (2004)	Impact assessment of ACIAR-funded projects on grain-market reform in China	ANRE1/1992/028 ADP/1997/021
IAS31	D Pearce (2005)	Review of ACIAR's research on agricultural policy	

ACIAR Books

Year	Author(s) and year of publication	Title	Type
1999	P Sharma and C Baldock (eds)	Understanding animal health in Southeast Asia	Monograph 58
1995	G Gray, R Woolaston, B Eaton	Breeding for resistance to infectious diseases in small ruminants	Monograph 34
1999	M De Alwis	Haemorrhagic septicaemia	Monograph 57
2002	R Alders et al.	Controlling Newcastle disease in village chickens; a training manual	Monograph 86
2002	R Alders et al.	Controlling Newcastle disease in village chickens; a laboratory manual	Monograph 87
2002	R Alders, P Spradbrow	Controlling Newcastle disease in village chickens; a field manual	Monograph 82
2004	R Sani, G Gray, R Baker (eds)	Worm control for small ruminants in tropical Asia	Monograph 113
2003	K Alpin (et al)	Field methods for rodent studies	Monograph 100
2004	V McWaters, D Templeton	Adoption of ACIAR project outputs: studies of projects completed in 1999–2000	

ACIAR Proceedings

No.	Year	Author(s)	Title
AP39	1992	P B Spradbrow (ed)	Newcastle disease in village chickens – control with thermostable oral vaccines
AP51	1993	J Copland, L Gleeson, C Chamnanpood	Diagnosis and epidemiology of foot and mouth disease in Southeast Asia
AP66	1995	T St George, P Kegao	Bluetongue disease in southeast Asia and the Pacific
AP74	1996	L Le Jambre, M Knox	Sustainable parasite control in small ruminants
AP94	1999	S Blacksell (ed)	Classical swine fever and emerging diseases in Southeast Asia
AP103	2001	R G Alders and P B Spradbrow (eds)	SADC Planning workshop on Newcastle disease control in village chickens
AP117	2004	J Meers, P Spradbrow, T Tu	Control of Newcastle disease and duck plague in village poultry

Appendix 1: Terms of reference

Evaluation of ACIAR's investments in animal disease epidemiology and control, including research on diagnostic tests and vaccines

Background

ACIAR has made a significant investment in animal health research over the last two decades, averaging at about A$1.5–2 m annually in recent years. These investments include a number of projects directed at improving the application of diagnostic tests to assess disease presence and incidence, development and application of vaccines and research on epidemiology and management of livestock diseases. The work has covered poultry, pigs, cattle, goats, sheep and buffalo and has been conducted in countries throughout the Asia–Pacific and African regions.

ACIAR also supports a significant number of other livestock projects, encompassing animal production (genetic improvement, nutrition and crop–livestock systems), livestock product processing and livestock economics and industry policy. Along with aquatic animal health these are excluded from the proposed analysis. The objectives of this Review are to:

- Provide a broad analysis of the community impacts of past ACIAR animal health investments
- Provide a more comprehensive analysis of impacts of two particular clusters of past ACIAR animal health projects – proposed to be on Newcastle disease of poultry and parasitic infestations of ruminants.
- Establish principles to guide the direction of future ACIAR investments in animal health.

Expected outputs of the review

The principal output of the Review will be a report that provides:

A broad analysis of community impacts of past and current ACIAR-funded animal health projects.

The analysis will comprise three parts:

- The establishment of a framework for analysing the impact of animal health projects.
- A meta-analysis of the animal health portfolio, applying the framework.
- A primary analysis of two clusters of ACIAR animal health projects – proposed to be on Newcastle disease of village poultry and parasitic infestations of ruminants.

Establishes principles to guide ACIAR's future priority setting in animal health

These principles for priority setting should reflect:

- Changes in the livestock sector in developing countries over the last decade and into the future.
- Increased emphasis on trade and accompanying biosecurity issues.
- Increased profile of zoonotic diseases, and relevance of this work on smallholder livelihoods.

Methodology

Analysing the community impacts of past and current ACIAR-funded animal health projects

(Note that this work should not include analysis of projects on tick-borne diseases. An assessment of this work, carried out largely in Africa, may be commissioned by ACIAR at a later stage).

Establishing a framework for analysing the impact of ACIAR animal health projects.

This framework can be derived with reference to the work done in several other recent studies, particularly the ILRI–DFID (2002) study (see References). Relevant work should be identified and drawn on in an overview of where and how animal health research impact analysis is taking place in other agencies and research institutions.

A meta-analysis of the animal health portfolio, applying the framework

The meta-analysis will draw upon information from various impact assessment studies, project leader statements, end-of project reviews, and other analysis of the portfolio as agreed (Appendix 2). ACIAR's Impact Assessment Unit and its predecessors have commissioned a number of studies of ex-ante and ex-post impacts of small groups of animal health projects. These are shown in Appendix 1, and have had a particular focus on Foot and Mouth Disease projects in South-East Asia. A full list of animal health projects supported by ACIAR is shown in Appendix 2.

A primary analysis of two clusters of ACIAR animal health projects

This activity will consider two clusters of ACIAR animal health projects for deeper analysis of their impacts, and to extract lessons learnt for subsequent project prioritisation and planning. The proposed clusters include

- one on monogastric livestock (management of Newcastle disease, including application of vaccines). The earlier impact assessment, published in 1998 (see Appendix 1) was largely prospective and focused on Africa and the first generation vaccine (most ACIAR-supported work on Newcastle Disease has been based in South-East Asia)
- one on ruminants (cluster of projects on management of endoparasitic diseases).

This activity will require reviews of annual and final reports and end-of project external review documents and visits to 2–3 partner countries, probably in South-East Asia. (The particular project clusters to be reviewed and countries to be visited will be negotiated with the contract manager. ACIAR would support meeting arrangements for these visits).

Establishment of principles to guide ACIAR's future priority setting in animal health

Issues of particular interest to ACIAR are the balance of future investment in work on epidemiology, health policy and technical investments in disease management (through interventions such as husbandry, culling and vaccines). In addition, ACIAR is particularly interested in establishing guiding principles on the necessary institutional, policy, social and farming system preconditions required for investment in development or use of livestock vaccines and other health strategies in developing countries, in order to have a high likelihood of project impact.

Overall, principles for priority setting should reflect:

a. Projected changes in the livestock sectors in developing countries over the next decade, including:

- growth in consumption of livestock products in Asia;
- change in industry structure, particularly intensification/commercialisation of pig, poultry, dairy and cattle production alongside village-based systems, and how this affects targeting of ACIAR-funded research to smallholders;
- the broader implications of controlling disease outbreaks in a distributed smallholder sector on the general economy (trade, tourism, etc) and co-existence with a commercial sector;
- move away from draft livestock use in most ACIAR partner countries;

- greater involvement of the private sector in provision of extension services and animal health products, including vaccination;
- move away from use of therapies such as vaccines and drenches to encouraging disease freedom or containment strategies.

b. Increased emphasis on trade and accompanying biosecurity issues

- how to balance investment in these higher order issues against support for smallholder livestock for food security or domestic markets;
- the need for trading countries to be able to identify field strains and establish whether diseases are endemic;
- mutual benefit for Australia and partner countries for two-way trade and protection of Australia's trading advantage with third-party countries.

c. Increased profile of zoonotic diseases, and relevance of this work on smallholder livelihoods

The principles should address the strategy for/ balance of ACIAR's future investments, based on:

- Alignment with ACIAR Priorities
  - need for the work to require external (Australian) assistance in research;
  - impact pathway, giving particular attention to the balance of investments that will achieve a poverty reduction impact in the short, medium and longer term. Most earlier ACIAR investments in animal health have been of a long-term nature. Analysis of the options to redress this balance should be carried out, given the rapid changes in the livestock sectors in developing countries and new biosecurity and zoonotic disease threats;
  - Australian comparative advantage in the area of research;
  - potential for Australian mutual benefits, such as in the development of diagnostic and management skills for Australian institutions for major exotic disease threats or benefits from the establishment of FMD-free and other future 'diseases of trade' zones in neighbouring countries;
  - ability to complement (or not duplicate) other major bilateral or multilateral donor initiatives.
- Likelihood of impact of the research
  - where is the impact on poverty reduction likely to be greatest in ACIAR's mandate countries and regions (particularly South-East Asia, PNG and Pacific);
  - economic benefits remain the predominant form of assessing the impact of animal health investments, whether they be for the control of non-zoonotic disease for increased productivity and/or market access, or management of zoonotic diseases for the same reasons plus limiting the affects on the rural and non-rural populations;
  - how to balance investment in biosecurity versus production losses ;
  - factors affecting delivery of disease control, adoption by and impacts on livelihoods of smallholders such as: whether and when individual farmers or Government services or donors will pay for diagnostic screening services, vaccinations or use the results of epidemiological studies;
  - *ex ante* projection of potential impacts must pay particular attention to the likelihood of adoption of technologies (i.e. recognising the social, economic and livestock species settings) and the capacity of the public or private sector to sustain delivery of the technology. Historically, the potential benefits of livestock research in general, and animal health research in particular, have been exaggerated because they have not taken these factors sufficiently into account;
- Disease/species and farming system emphasis.
  - whether ACIAR should focus more overtly on health intervention for a small number of the major diseases or disease/species combinations.

  It may be useful to classify livestock disease in the report as:
  - Endemic diseases, which may have greatest impact at the farm or farming community level (including vector-borne hemoparasitic diseases, helminth diseases, diseases causing reproductive failure)

- Epidemic (trans-boundary) diseases – although several are endemic to particular developing countries, such as viral diseases affecting local marketing, smallholder and commercial production as well as international trade (including foot and mouth disease, classical swine fever/ hog cholera, Newcastle disease, rinderpest and livestock influenzas).
- Zoonotic diseases (including avian influenza, meat-borne helminth zoonoses, brucellosis/ tuberculosis, rabies, rift valley fever).
- Food-borne diseases (including bacterial infections, cysticercosis, and trichinellosis).

Over the last 20 years, ACIAR has mainly invested in the first two areas. Reference to the DFID/ILRI study and OIE rankings on disease importance and severity may be useful. The report should also analyses which livestock farming systems (e.g. rangeland based, mixed crop–livestock systems and landless (shifting or peri-urban)) or smallholder sectors (e.g. smallholder poultry versus semicommercial poultry and pig production) ACIAR should target in its animal health projects.

d. Type of research

The potential balance of ACIAR's investment on different animal health approaches should be analysed. Different approaches could be categorised as:

- development of new diagnostics and vaccines (the relevance of on-site diagnostic tests as opposed to herd or population surveillance tests and improvement of technologies to distinguish between vaccinated and infected animals should be assessed; along with an analysis of the relative merit of local production versus importation of vaccines);
- modification of existing technologies (e.g. pen-side diagnostic tests, heat stable or oral vaccines);
- delivery of services and technologies (transferring knowledge and available tools);
- other approaches such as vector control, nutrition, genetics;
- epidemiology and disease management policy research. Standard methodologies should be used for assessing the economic impacts of protection from exotic diseases to Australia, and in establishing disease-free zones in partner countries.

Terms of reference components

The assessment will require expertise in both animal health and economics. The output of the consultancy will be a report suitable for in-house use within ACIAR and web publication. A presentation to ACIAR staff and/or Board of Management will be required.

Upon receipt of the draft report ACIAR will consult separately with key stakeholders before working with the consultants on a final report. The consultancy should be started in June 2005, a draft report submitted by the end of November 2005, and the final report submitted by the end of December 2005.

Appendix 2: Animal health research project summary information

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS1/1984/064	Brucellosis of sheep in China	China	B	1985	1988	766,500	• Determine prevalence of brucellosis in sheep. • Develop tests to differentiate vaccinated and infected animals.	• (Identify brucellosis free rams)	• CSIRO Animal Health • Chinese Academy of Agricultural Sciences	
AS2/1985/065	Development of an improved haemorrhagic septicaemia vaccine	Malaysia	B	1990	1993	805,060	• Identify best antigens and adjuvant. • Identify local strains of Pasteurella.	• (Highly effective HS vaccine)	• CSIRO Animal Health, • Veterinary Research Institute Malaysia	• AS1/1983/082 • AS1/1985/015 • AS1/1985/046
AS2/1992/002	Diagnosis and control of haemorrhagic septicaemia in Indonesia	Indonesia	B	1993	1997	841,600	• Determine prevalence. • Improve ELISA. • Identify Pm strains.	• (Improved knowledge of HS in eastern Indonesia.)	• VIAS, Aust • Res Inst Vet Sci, Indonesia	• AS1/1983/082 • AS1/1989/007
AS2/1991/017	Management of footrot in small ruminants in hill districts of Nepal	Nepal	B	1992	1996	421,500				
AS2/1996/021	Control of footrot in small ruminants in Nepal – vaccination and sero-surveillance	Nepal	B	1996	2000	579,000	• Surveillance to detect benign footrot. • Develop ELISA capacity.	• (Eliminate mild footrot)	• Uni Sydney • Lumle Ag Res Centre, Nepal • NSW Agriculture	
AS1/1998/049	Lameness in sheep and other ruminants in Bhutan	Bhutan	B	1998	2001	178,700	• Determine distribution of virulent footrot. • Characterise strains for vaccine. • Establish ELISA for flock diagnosis	• Distribution and severity established. • Specific vaccine successfully trailed. • ELISA successfully trialled.	• Uni Sydney • Min Ag Crop and Livestock, Bhutan	• AS2/1996/021
AS1/1983/082	Establishment of improved methods for the diagnosis and control of livestock diseases in South-East Asia using enzyme linked immunosorbent assay (Elisa)	Indonesia, Malaysia	Dx	1986	1990	1,073,700	• Utilise modify and develop ELISA diagnostic systems for important diseases in governments labs in Indonesia and Malaysia	• (Allow design of practical disease control programs in SE Asia)	• Vic Dept Ag Rural Affairs, • Uni Pertanian Malaysia, • Res Inst Vet Sci, Indonesia	• AS1/1983/033 • AS1/1983/034
AS2/1989/007	Establishment of improved methods for the diagnosis and control of livestock diseases in South-East Asia using enzyme linked immunosorbent assay (ELISA)	Indonesia, Malaysia	Dx	1990	1992	951,860	• Refine and further develop ELISAs for major diseases. • Assess efficacy. • Use ELISAs in control and eradication programs. • Extend existing cooperation.	• (Increased diagnostic capability in Asia and Australia. • Increased livestock productivity. • Increased research capability and cooperation.	• Vic Dept Ag Rural Affairs, • Res Inst Vet Sci, Indonesia, • Uni Pertanian Malaysia, • CSIRO An Health	• AS119/87/017 • AS2/1985/065
AS1/1994/038	Improved diagnostic and control methodologies for livestock diseases in Lao PDR and Yunnan Province, PRC	China, Laos	Dx	1997	2003	957,550	• Establish ELISA techniques for FMD and CSF.	• Functional field disease investigation network. • Operational virology lab in Lao PDR. • Strengthened lab capacity in Yunnan.	• CSIRO Animal Health • Dept Livestock & Fisheries, Lao PDR. • Aust Volunteers Int. • Yunnan Vet Gen Stn, China.	• AS1/1983/067 • AS1/1988/035 • AS1/1992/004

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS2/1996/086	Latex agglutination systems as alternative technology to ELISA for seroepidemiology in developing countries	Vietnam	Dx	1996	1998	85,050	• Explore feasibility of using cheaper and more robust test for important diseases.		• Uni Melbourne • Nat Inst Vet Res Vietnam. • CSIRO An Health	• AS1/1992/004 • AS1/1994/038
AS1/1992/004	Improved methods in diagnosis, epidemiology, economic and information management in Australia and Thailand	Thailand	Dx	1994	1997	1,347,400	• Improved diagnostic tests. • More representative sampling. • Better data management	• (Improved quality of animal health and production information for decision makers)	• QDPI. • North Vet Res and Diag Centre, Thailand. • Uni Queensland. • CSIRO An Health	• AS1/1983/016 • AS1/1987/017 • AS1/1988/035 • AS1/1989/007 • AS1/1991/019
AS1/1996/083	Development of field survey and information management techniques for animal health priority setting in Lao People's Democratic Republic	Laos	Dx	1996	1998	172,900	• Design and validate field survey techniques. • Develop a computer information management system.	• (Establish priorities for livestock disease management)	• Uni Queensland • Dept Livestock Vet Services, Laos	• AS1/1992/004 • AS1/1994/038
AS2/1993/727	Construction of a biologically secure research animal containment facility at ILRAD (ILRI), Nairobi, Kenya	Kenya	Dx	1993	1996	197,370	• Build a secure animal facility to trial vaccines	• (Assessment of potential East Coast Fever vaccine)	• ILRI Kenya	
AS1/2001/025	Global Animal Health and Production Compendium	Global	Dx	2000	2001	166,000	• Develop and publish a comprehensive compendium.		• CentreAg Biosciences, UK	
AS1/1994/113	Antigenic competition and vaccine failure in small ruminant vaccines in India: A preliminary investigation	India	Dx	1995	1998	91,900	• Define immunology of and investigate occurrence of antigenic competition in vaccinated small ruminants.		• Uni Sydney • Indian Vet Res Inst	
AS1/2001/054	The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific	Pacific	Dx	2002	2004	415,000	• Develop and validate tests for specific zoonoses. • Survey of occurrence. • Investigate pathogenesis of Trichinella in ruminants.	• (Understanding of extent of important zoonoses)		• AS1/2000/009 • LWR2/2000/038
AS1/1985/023	Self-medication of ruminants in tethered husbandry systems	Fiji, India, Indonesia	Endo	1988	1992	1,597,270	• Develop a medicated block using non-patent drugs for treating parasites.		• CSIRO An Health • Min Ag Fish Forests, Fiji • Nat Dairy Dev Board, India	• AS1/1986/001 • AS1/1984/018 • AS1/1985/046
AS1/1983/016	A study of the life-cycle of the important buffalo parasite Toxocara vitulorum to provide a basis for control procedures	Sri Lanka	Endo	1984	1987	845,244	• Understand life cycle. Develop appropriate control procedures for village and rural environment.	• Simple control strategy of single treatment of calves. Successful extension program. Extended to Philippines and Indonesia.	• Uni Peradeniya • CSIRO Animal Health. • National Livestock Devel Board (Sri Lanka)	

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS1/1984/018	Epidemiology and control of gastrointestinal nematodes in small ruminants in the Pacific Islands	Fiji, Vanuatu	Endo	1985	1990	968,680	• Determine larval development. Measure population dynamics and effect of suppression. Describe Haemonchus species and anthelmintic resistance. Investigate genetic resistance.		• CSIRO An Health. • Min Primary Ind, Fiji.	
AS1/1985/055	Effects of helminths and nutrition on sheep production in northern China	China	Endo	1987	1992	1,089,700	• Determine significance of trichostrongyles and poor nutrition on wool production. • Identify and assess management changes to increase Merino sheep production.	• (Provide information on epidemiology and effects of helminths and nutrient supply. A suitable management system.)	• CSIRO An Production. CSIRO An Health. • Chinese Academy Ag Sci	• AS1/1984/054 • AS1/1984/056 • AS1/1984/064
AS2/1989/013	Ecological and host-genetic control of internal parasites of small ruminants in the Pacific Islands	Pacific	Endo	1990	1994	528,200	• Adapt Fiji control methods to other Pacific countries. Define epidemiology in 4 countries and validate computer model to develop and test sustainable parasite control programs. Evaluate economically	• (Slow development of resistance, reduce costs of control, develop resistant lines of goats and sheep requiring little or no anthelmintic treatment)	• CSIRO An Health. • Min Ag and Lands, Solomon Islands. • Min Ag, Tonga. • Min Ag Fish, Samoa. • Dept Ag, Vanuatu. • Uni South Pacific. • Min Ag Fish Forests, Fiji.	• AS1/1984/018 • AS1/1985/025 • AS1/1988/017
AS1/1992/044	Variation in resistance to nematode parasites and viruses among sheep breeds in Northwest India	India	Endo	1993	1994	64,500	n.a	n.a.	n.a.	n.a.
AS2/1993/724	Development of phenotypic markers for resistance to gastrointestinal nematodes in African small ruminants	Kenya	Endo	1993	1995	151,300	• Investigate mechanisms of resistance to identify phenotypic markers.	• (Improved understanding of immune mechanisms.) • Collaborative links and immunological assays.	• ILRI Kenya. • Kenya Ag Res Inst. • CSIRO An Health.	
AS2/1993/799	PCR assay for benzimidazole resistance in Haemonchus contortus	Malaysia	Endo	1994	1995	57,250		• More sensitive method of detecting BZ resistance. Surveyed resistance.	• CSIRO An Health. • Uni Malaya.	• AS1/1985/023 • AS2/1991/032
AS1/1991/023	Control of fasciolosis in cattle and buffalo in Indonesia	Indonesia	Endo	1992	1996	533,300	• Determine life cycle of F. gigantica. Evaluate methods of reducing snail populations. Assess control by chemotherapy. Evaluate field control methods.	• Significant component of epidemiology defined. Capacity building. (Expect practical control program.)	• James Cook Uni. • Res Inst Vet Sci, Indonesia,	• AS1/1983/016 • AS1/1985/015 • AS1/1990/049
AS1/1990/049	Evaluation of antigens for vaccination against liver fluke in cattle and buffalo in Indonesia	Indonesia	Endo	1992	1997	927,896	• Develop vaccine.	• (Basis of a commercial vaccine) • Evaluated antigens but failed to develop vaccine. • Raised possible genetic resistance.	• Vic Inst An Sci, • Monash Uni, • Dept Ag Rural Affairs Victoria, • Res Inst Vet Sci, Indonesia	• AS1/1984/018 • AS1/1985/023 • AS1/1985/055

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS2/1991/032	Strategies for sustainable control of gastrointestinal parasites of ruminants using urea–molasses blocks	Fiji, India, Malaysia	Endo	1993	1997	1,446,330	• Evaluate parasitological efficacy of medicated urea–molasses blocks for optimal parasite control.	• (Increased incomes for small-holders and increased national production of meat and milk)	• CSIRO An Production. • Vet Res Inst, Malaysia. • Min Ag Fish Forests, Fiji. • Nat Dairy Dev Board, India	• AS1/1991/023 • AS1/1986/001 • AS1/1988/017 • AS1/1989/013 • AS1/1990/049 • AS1/1991/013
AS1/1994/022	Prolific worm resistant meat sheep for Maharashtra, India and Australia (not listed in ACIAR list)	India	Endo	1998	2002	1,313,900	• Evaluate efficiency of lamb production and parasite resistance. Develop suitable meat sheep breed for Maharashtra	• Identified prolificacy gene. • Useful in Indian and Merino breeds. • Capacity building	• Uni New England, • Nat. Chemical Lab, India, Uni of Melbourne • CSIRO Livestock Ind. • Nimbkar Ag Res inst.	• AS1/1989/013 • AS1/1991/017 • AS1/1991/032 • AS1/1993/018
AS1/1996/160	Control of fasciolosis in cattle and buffaloes in Indonesia, Philippines and Cambodia	Indonesia, Philippines, Cambodia	Endo	1998	2003	1,252,498	• Develop strategies for liver fluke control and extend to Philippines and Cambodia.	• (Control losses. Standardise extension and research skills.) • Control program developed. • Capacity building and network of researchers.	• Nat Vet Diag Lab, Cambodia • Res Inst Vet Sci, Indonesia. • Central Mindanao Uni, Philippines.	• AS1/1990/049 • AS1/1991/023
AS1/1997/027	Genetic and immunological characterisation of high resistance to internal parasites in Indonesian Thin Tail Sheep	Indonesia	Endo	1998	2004	2,043,526	• Identify genetic basis of resistance in ITT sheep. Identify genes.	• (Benefit control in buffalo and cattle. Increased scientific capacity). • Genes and killing mechanisms identified.	• Uni Sydney. Monash Uni. • Central Res Inst An Sci. • LIPI.	• AS1/1984/018 • AS1/1985/015 • AS1/1985/023 • AS1/1991/023 • AS1/1996/160
AS1/1997/133	Sustainable endoparasite control for small ruminants in Southeast Asia (with ILRI)	Indonesia, Malaysia, Philippines, Thailand	Endo	1998	2004	1,202,620	• Develop, test and implement sustainable control programs using medicated blocks. Identify resistant goat types.	• Research findings for IFAD implementation. Capacity building.	• ILRI • Uni Pertanian, Malaysia • Res Inst Vet Sci, Indonesia. • CSIRO An Health. • Vet Res Inst, Malaysia. • Philippine Council for Ag, Forestry and Nat Resources Res & Dev.	• AS1/1984/018 • AS1/1985/023 • AS1/1991/023 • AS1/1994/022 • AS1/1997/027 • AS2/1989/013 • AS2/1991/032 • AS2/1995/030
AS1/2002/099	Development of a model for the control of fasciolosis in cattle and buffaloes in the Kingdom of Cambodia	Cambodia	Endo	2003	2005	404,100	• Update, refine and validate risk model • Develop extension program to control fasciolosis	• (develop and promote a national fasciolosis control strategy)	• Dept Animal Health and Production, Cambodia • Cambodia Ag Res and Dev Institute • Ag Ext Dept, Cambodia • Office of Animal Health and Production Cambodia	• AS1/1996/160
AS1/1992/003	Identification and production of recombinant antigens for a vaccination against the screw-worm fly (Chrysomya bezziana)	Indonesia	Exo	1995	1999	845,630	• Identify antigens. • Test native and recombinant antigens	• (A vaccine against SWF)	• CSIRO Tropical Ag • Inter-uni Centre on Biotechnology, Indonesia. • Res Inst Vet Sci, Indonesia. • Agency Ag Res & Tech, Indonesia. • QDPI	• AS1/1990/049 • AS1/1991/023

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS1/1983/034	Vaccination of Malaysian village poultry with an avirulent Australian Newcastle disease virus	Malaysia	ND	1984	1987	854,975	• Cheap effective V4 vaccination for village chickens.	• Cheap heat-tolerant vaccine.	• Uni Queensland. • Universiti Pertanian Malaysia.	• AS1/1987/017 • AS1/1983/082
AS1/1987/017	Control of Newcastle disease in village chickens with oral V4 vaccine	Burma, Indonesia, Philippines, Sri Lanka, Malaysia, Thailand	ND	1988	1992	1,279,029	• Develop effective feed based V4 vaccine.	• Feed base vaccine effective but field response variable.	• Uni Queensland. • Res Inst Vet Sci, Indonesia. • Dept Livestock Devel, Thailand. • Bureau An Ind, Philippines. • Breeding and Devel Dept, Myanmar. • Vet Res Inst, Sri Lanka • Universiti Pertanian Malaysia.	• AS1/1983/034 • AS1/1983/082
AS1/1995/040	Production of a seed culture of heat resistant Newcastle disease virus suitable for producing in developing countries	Mozambique	ND	1995	1996	204,745	• Produce and supply heat resistant I2 live vaccine.	• Cheap effective vaccine used in several countries.	• Uni Queensland.	• AS1/1987/017
AS1/1996/096	Investigations into the control of Newcastle disease in village chickens in Mozambique	Mozambique	ND	1996	2001	178,972 418,160	• Produce and supply heat resistant I2 live vaccine in Mozambique. Train lab staff. Extend technology. Initiate programs.	• (Prevent large scale losses. Improve human nutrition) • Technology extended to several other countries.	• Uni Queensland. • Nat Vet Res Inst, Mozambique.	• AS1/1987/017 • AS1/1995/040
AS1/2002/042	Control of Newcastle disease and identification of major constraints in village chicken production systems in Myanmar Note: will be externally reviewed in May 2005.	Myanmar	ND	2003	2005	405,000	• Enhance I2 production and use. Develop extension material. Improve diagnostic capacity. Confirm efficacy of vaccine in Myanmar. Determine constraints on village poultry production.	• Progressing well 2005.	• Uni Queensland.	
AS2/1994/120	Breeding pigs for enhanced disease resistance in South-East Asia	Vietnam	Pi	1996	1997	60,532	• Breed pigs with enhanced immune responsiveness	• (Reduced reliance on chemicals. • Reduced production costs and risk of drug residues.)	• Uni New England. • An Husbandry Res Inst, Vietnam	• AS2/1994/023
AS2/1995/006	Control of pasteurellosis in pigs and poultry	Vietnam, Sri Lanka	Pi, Po	1996	2000	1,231,493	• Develop live vaccines, improve bacterins	• (Improved vaccine and disease control, improved staff and laboratories.)	• Uni Queensland • Vet Res Inst Sri Lanka • Nat Vet Co, Vietnam • Monash Uni	• AS2/1991/016
AS1/1991/019	Towards effective control of infectious bursal disease and infectious bronchitis in poultry	China	Po	1992	1995	705,416	• Research IBD and IB, establish laboratory network	• (Reduce losses –75m • Develop Chinese institute network.)	• CSIRO An Health • Harbin Vet Res Inst, China	• AS1/1987/017 • AS1/1992/005
AS1/2000/083*	Development of a vaccine for the control of Gumboro in village and small poultry holdings in Indonesia	Indonesia	Po	2001	2006	426,310	• Develop local vaccine for newly emerged vvIBD	• (Effective vaccine and vaccination process.)	• CSIRO An Health • Res Inst Vet Sci, Indonesia (Balitvet)	• AS1/1991/019

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS1/1992/005	Improved diagnosis and control of infectious coryza in China and Australia	China	Po	1993	1998	677,455	• Develop ELISA test, DNA probe and apply fermentation technology to produce antigen	• (Lead to development of cheap vaccines. Australian benefits of new diagnostic tools.)	• QDPI • In of An Husb Vet Sci, Beijing Academy of Ag & Forestry, China	• AS1/1991/019
AS2/1994/110	Fowl cholera in the Vietnamese poultry industry	Vietnam	Po	1992	1995	680,969	• Develop 2 types of vaccine; effective and economical killed vaccine and oral live vaccine	• (Locally produced vaccines. Benefits to village chicken growers. Potential export markets for Aust vaccine.)	• Uni Queensland • Bureau of Animal Industry, Philippines. • Vet Res Inst, Sri Lanka	• AS1/1987/017
AS2/1991/016	Fowl cholera. Vaccines for Asia	Philippines Sri Lanka	Po	1992	1996	681,000	• Develop improved vaccines; one killed, another live.	• (Locally manufactured vaccines to benefit village chicken growers and commercial breeders)	• Uni Queensland. • Bureau An Ind, Philippines. • Vet Res Inst, Sri Lanka.	• AS1/1987/017
AS2/1991/022	Duck plague: Improved diagnostic methods and vaccination	Vietnam	Po	1995	1999	659,828	• Identify local strains. Optimise the use of a vaccine.	• (Improved diagnostic techniques. • More effective vaccination regimes. Improve export potential.)	• Uni of Qld • CSIRO • Nat Vet Co Viet • AVI, Aust	• AS1/1987/017
AS1/1996/150	Diagnosis and likely spread of Trypanosoma evansi in Papua New Guinea, Indonesia and Australia	Indonesia, PNG	Tryps	1997	1998	181,150	• Investigate effectiveness of current serological tests. • Determine if T. theileriae indicates likely spread of T. evansi in Australia		• James Cook Uni. • Dept Ag Livestock, PNG. • Res Inst Vet Sci, Indonesia. • NT DPIF	• AS1/1990/049 • AS1/1991/023
AS1/2000/009	Development of diagnostic and control methodologies for animal trypanosomiasis (Surra) in Papua New Guinea, Indonesia, the Philippines and Australia	Indonesia, Philippines, PNG	Tryps	2000	2005	428,137	• Develop accurate diagnostic tests and more effective control methods. • Transfer technology to neighbouring countries.	• Serological diagnostic capability and improve infrastructure at partner institutions. • Enhanced capacity in Aust.	• Murdoch Uni. • Res Inst Vet Sci, Indonesia (Balitvet). • Dinas Peternakan, Irian Jaya. • Nat Ag QIS, PNG. • Uni Sthn Mindanao, Philippines. • Dept Ag, Region XI, Philippines. • Balai Penyidikan Penyakit, Sulawesi, Indonesia.	• AS1/1999/049
AS2/1983/033	Aetiology and epidemiology of malignant catarrhal fever in Indonesia and Australia	Indonesia	Virus	1984	1986	604,900	• Investigate agent and epidemiology.	• (Rapid diagnosis and control measures)	• James Cook Uni. • Res Inst Vet Sci, Indonesia (Balitvet)	
AS1/1984/055	Epidemiology of ephemeral fever in China	China	Virus	1985	1988	586,240	• Develop highly specific BEF antibody test. • Identify a specific BEF antigen probe. • Study pathogenesis in buffalo.	• (Evaluate and monitor disease)	• CSIRO An Health. • Chinese Academy Ag Sci.	• AS1/1984/064

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS2/1989/009	Immunity to bovine ephemeral fever	China	Virus	1989	1992	747,700	• Identify antigens in BEF critical to immunity. • Determine presence in Australian strains. • Identify suitable strains in Aust and China. • Produce a suitable non-living vaccine.	• (Suitable non-living vaccine to replace current live attenuated)	• CSIRO An Health. • Harbin Vet Res Inst, China	• AS1/1984/055
AS1/1983/067	Research and development of foot-and-mouth disease diagnostic methods in Thailand	Thailand	Virus	1985	1989	954,220	• Develop & apply improved FMDV typing and isolation techniques. • Determine antigenic variation in Thailand. • Improve antibody measurement and vaccine viability.	• (Regional diagnostic capability in Thailand.)	• CSIRO An Health. • Dept Livestock Devel, Thailand.	• AS1/1984/064 • AS1/1983/082
AS1/1988/035	Diagnosis and control of foot and mouth disease in Thailand	Thailand	Virus	1989	1992	991,400	• Improve diagnostic methods for field studies. • Improve strain differentiation. • Monitor distribution of virus types and antigenic variation. • Monitor efficacy of vaccination. • Assess benefits and costs.	• (Highly efficient diagnostic service. • Information on epidemiology of FMD in SE Asia. • Improved knowledge, skills and capacity for Australian.	• CSIRO An Health • Dept Livestock Devel, Thailand.	• AS1/1983/067
AS1/2003/001	Management of CSF and FMD at the village level in Lao PDR	Laos	Virus	2003	2006	405,000	• Develop, evaluate and implement a simple test for CSF. • Develop and validate system to use local vaccine in villages. • Measure impact of vaccination program. • Monitor epidemiology of CSF and FMD. • Communicate findings.	• (Increased diagnostic capacity. • Improved adoption of vaccination.)	• CSIRO Livestock Industries (AAHL). • Uni Melbourne. • Int Centre Trop Ag, Laos. • National An Health Centre, Laos.	• ASEM/2001/107
AS2/1993/875	Classical swine fever in Vietnam	Vietnam	Virus	1993	1995	65,789	• Establish effective laboratory techniques for the diagnosis of CSF at NIVR (Hanoi)	• (Study of significance of CSF and assessment of validity of current diagnostic techniques)	• CSIRO An Health • National Inst Vet Res, Vietnam.	–
AS2/1990/011	Improved methods for the diagnosis and control of bluetongue in small ruminants in Asia	Malaysia	Virus	1991	1993	114,900	• Isolate and characterise BTV. • Identify pathogenic isolates. • Investigate ecology of BTV. • Recommend action to reduce impact.	• (Ipoh laboratory capable in BTV research and diagnosis. • Malaysian authorities able to manage BTV in small ruminants.)	• Bureau Rural Sci. • Vet Res Inst, Malaysia. • CSIRO An Health. • QDPI	• FOG/1985/060

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS2/1993/001	Studies of the epidemiology and control of bluetongue in China	China	Virus	1994	1997	1,141,500	• Investigate epidemiology and pathogenicity of BTV in China. • Develop Yunnan laboratory as national and regional reference centre for BTV.	• (Regional diagnostic capability. • Trade facilitation.)	• NSW Agriculture. • Yunnan Tropical and subtropical An Virus Disease Lab, China. • DPIF, Australia.	• AS2/1990/011
AS1/1993/043	Jembrana disease in Bali cattle	Indonesia	Virus	1993	1995	67,900	• Utilise BIV to prepare an alternative Jembrana disease vaccine.		• Murdoch Uni. • Bali Cattle Disease Inv Unit, Indonesia.	
AS1/1996/046	Development of a safe and effective vaccine for Jembrana Disease in Bali cattle in Indonesia	Indonesia	Virus	1996	1998	58,100	• Produce recombinant antigens.	• (Improved vaccine)	• Murdoch Uni. • Bali Cattle Disease Inv Unit, Indonesia	
AS1/2000/029	Production of a vaccine for the control of Jembrana disease in Indonesia	Indonesia	Virus	2001	2005	1,123,400	• Improve diagnosis in DIC in Indonesia. • Develop safe, effective, lower cost vaccine.	• (Specific reliable diagnostic test. • Information on pathogenicity of BIV and JDV.)	• Murdoch Uni. • DIC Region VI Indonesia. • Res Inst Vet Sci, Indonesia. • Centre for Vet Biologics (Pusvetma)	• AS1/1996/046
AS1/1994/051	Development and standardisation of rapid diagnostic tests and vaccines for the control of sheep and goat pox diseases in India and Australia	India	Virus	1997	1999	181,500	• Define economic impact of sheep and goat pox in Maharashtra. • Develop and evaluate diagnostic tests. • Identify Indian isolates as a basis for a vaccine.		• CSIRO An Health. • BAIF Development Foundation, India. • Agriculture WA • Bureau Resource Sci.	• AS1/1994/022
AS1/1983/003	Ticks and tick borne diseases	Burundi, Kenya, Tanzania, Zambia, Zimbabwe	Z	1983	1986	503,000	• Continue and develop collaborative work. Adapt and apply Australian models	• (Provide specific guidelines for experimental trials to implement control strategies)	• CSIRO, Australia	
AS1/1983/021	Control of tick-borne diseases or ruminants in Sri Lanka with particular reference to babesiosis and anaplasmosis	Sri Lanka	Z	1984	1990	833,600	• Develop improved vaccines in Sri Lanka. Develop attenuated vaccines. Test for effectiveness	• (epidemiological study, aid in formulation of national control strategy	• Queensland DPI • Dept of Anim Prod & Health, Sri Lanka	• AS1/1983/003
AS2/1990/047	Genetic variation, resistance to acaricides and immunological cross-reactivity in ticks that infest cattle in Zimbabwe and Australia	Zimbabwe	Z	1993	1999	831,500	na	na	• Uni of Queensland • Vet Res Laboratory, Zimbabwe	• AS1/1983/021 • AS1/1990/046

Project code	Project title	Partner countries	Project group	Start year	Finish year	Budget 2004 (A$)	Objectives	(Expected) outcomes	Cooperators	Related projects
AS2/1991/018	Improved methods for the diagnosis and control of bovine babesiosis and anaplasmosis in Zimbabwe and Australia	Zimbabwe	Z	1993	1996	752,800	• Assist Zimbabwe develop protocols for production and distribution of live vaccine. Collaborate in field and lab studies	• (facilitate and expand collaborative approach. Wider adoption of strategic dipping. Improved cattle trade. Improved vaccines and disease control	• Uni of Queensland • Vet Res Laboratory, Zimbabwe	• AS1/1983/021 • AS1/1990/046 • AS1/1990/047
AS2/1993/714	Development of a computerised georeferenced decision support system for the control of tick-borne diseases in Zimbabwe (with ILRI)	Zimbabwe	Z	1993	1994	30,300	• Establish georeferenced decision support system	• Decision support system installed	• ILRI, Kenya • Vet Res Laboratory, Zimbabwe • Queensland DPI	• AS2/1990/047 • AS2/1991/018
AS2/1993/715	Validation of diagnostic tests for bovine babesiosis and anaplasmosis and studies on strain variation in Babesia (with ILRI)	Kenya, Malawi, Zimbabwe	Z	1993	1995	111,840	• Establish 'gold standard' serum bank. Assess feasibility of common approaches	na	• ILRI, Kenya • Vet Res Laboratory, • Zimbabwe • Nat Vet Res Centre Kenya • Central Vet Lab, Malawi	• AS2/1991/018
AS2/1996/014	Validation of the Australian model of the tick, Rhipicephalus appendiculatus, in Kenya and investigation of its use to facilitate collaboration with NARs	Kenya	Z	1996	1998	175,500	• Test a modelling Workshop Framework	• Developed and adapted models to identify risks of tick spread, to be used by policy makers, extension officers and farmers	• Intern Centre for Insect Phys & Ecology, Kenya • Kenya Ag Res Instit • Coop Res Centre for Trop Pest Mgt, Australia	• AS1/1983/003
AS2/1996/090	Bovine babesiosis and anaplasmosis: studies on field performance of live vaccines, diagnostic methods and host responses to infection	Zimbabwe	Z	1997	2000	1,319,400	• Support Zimbabwe in establishing sustainable methods for the delivery and filed monitoring of effective live vaccines	• Local, viable vaccine produced for local use	• Queensland DPI • Monash Uni, Aust • AVI, Aust • Dept Vet Sciences, Zimbabwe	• AS2/1991/018
AS2/1996/203	Studies on genetic constraints to protective immunity in cattle – IARC	Kenya, Tanzania, RSA, Zimbabwe	Z	1997	1999	126,000	• Advance the development of integrated control strategies. Enhance capacity to assess disease impacts	na	• ILRI, Kenya • Vet Res Lab, Zimbabwe • Nat Vet Res Centre Kenya • An Dis Res Inst Tanzania • Onderstepoort Vet Lab SA	• AS2/1991/018
AS2/1999/063	Tick-borne diseases: Delivery of user-friendly and effective vaccine and diagnostics	Zimbabwe	Z	2001	2004	709,000	• Develop more effective alternate vaccines. Field test vaccines	• (economic benefits by reducing losses due to ticks. Improve meat and dairy returns and export markets. Environmental benefits		• AS2/1991/018 • AS2/1996/090
AS2/2000/098	Bovine babesiosis and anaplasmosis in the Philippines: developing a research and diagnostic capability	Philippines	Z	2001	2004	160,400	• Build a diagnostic and epidemiological capability in the Philippines. Improve diagnostic tests. Conduct epidemiological studies	• Developed centres of expertise. Assisted establishment of dairy industry. Long term smallholder benefits	• Queensland DPI • Bur of An Ind Philippines	• AS2/1991/018 • AS2/1996/090 • AS2/1999/063

Appendix 3: Indonesian livestock gross margins

Goat Breeding (self replacing) without endoparasite control

1. Assumptions

1	Herd Size	1	breeding goats
2	Number of participants	1	
3	Discount rate	10%	
4	Mortality rate- kids	25%	
5	Mortality rate- adults	11%	
6	Kidding rate-	120%	
7	Cull rate-	20%	
8	Price liveweight (Rp./hd)	60,000	
9	Kids sold at 9 months of age		
10	Sale price (Rp.hd)	80,000	

2. Capital Required

		Number	Price Rp.'000	Total	
1	Breeding Goats	1	60,000	60,000	
2	Males	0.2	60,000	12,000	
3	kandang			75,000	
	TOTAL CAPITAL COSTS				**147,000**

3. Variable Costs

1	Maintenance costs	5% of kandang			3750	
2	Vet costs		1.2	0	0	
3	Other		1.2	2,000	2,400	
4	Transport and marketing		1.1	5,000	5,700	
5	Replacements (female)		0.3	60,000	18,600	
6	Replacements (male)		0.04	60,000	2,400	
	TOTAL ANNUAL COSTS					**29,100**

4. Income

				Rp.		
1	Sale of Stock	cull females	0.20	30,000	6,000	
		cull males	0.04	40,000	1,600	
		kids	0.90	80,000	72,000	
				Total	79,600	
	TOTAL ANNUAL INCOME					**79,600**
	GROSS MARGIN					**50,500**

Goat Breeding (self replacing) with endoparasite control

1. Assumptions

1	Herd Size	1	breeding goats
2	Number of participants	1	
3	Discount rate	10%	
4	Mortality rate- kids	20%	
5	Mortality rate- adults	10%	
6	Kidding rate-	120%	
7	Cull rate-	20%	
8	Price liveweight (Rp./hd)	60,000	
9	Kids sold at 9 months of age		
10	Sale price (Rp.hd)	90,000	

2. Capital Required

		Number	Price Rp.'000	Total	
1	Breeding Goats	1	60,000	60,000	
2	Males	0.2	60,000	12,000	
3	kandang			75,000	
	TOTAL CAPITAL COSTS				**147,000**

3. Variable Costs

1	Maintenance costs	5% of kandang			3750	
2	Vet costs		1.2	2,000	2,400	
3	Other		1.2	2,000	2,400	
4	Transport and marketing		1.2	5,000	6,000	
5	Replacements (female)		0.3	60,000	18,000	
6	Replacements (male)		0.04	60,000	2,400	
				Total	31,200	
	TOTAL ANNUAL COSTS					**31,200**

4. Income

				Rp.		
1	Sale of Stock	cull females	0.20	30,000	6,000	
		cull males	0.04	40,000	1,600	
		kids	0.96	90,000	86,400	
				Total	94,000	
	TOTAL ANNUAL INCOME					**94,000**
	GROSS MARGIN					**62,800**

Judul Gross Margin: Cattle Breeding without endoparasite control

Penerimaan

					Rp.	
1	Penjualan persediaan	betina tua		1.0	483,200	483,200
		jantan tua		0.1	640,000	64,000
		anak betina		1.4	275,200	385,280
		anak jantan		2.4	355,200	852,480
2	Bajak		48hari	4.1dewasa	2000/hari	390,720
3	Pupuk			1,000kg	30/kg	30,000

TOTAL PENERIMAAN TAHUNAN	2,205,680

Biaya Variabel

1	Komisi	5%	dr. nilai			89,248
2	Pembelian pakan					0
3	Biaya drh.			10	0	0
4	Lain 2			20	2,000	40,200
5	Transport dan pemasaran			4.9	30,000	147,000
6	Penggantian (jantan)			0.1	640,000	64,000

TOTAL BIAYA TAHUNAN	340,448

GROSS MARGIN/TAHUN	1,865,232

GROSS MARGIN/EKOR	186,523

Asumsi-asumsi

1	besaran usaha	10	
2	tingkat diskont	10%	
3	tingkat kematian, anak sapi	20%	
4	tingkat kematian, dewas	5%	
5	tingkat kelahiran	60%	
6	tingkat sapi tua	10%	
7	harga berat hidup (Rp./kg)	3200	
8	anak sapi dijual pada (bln)	18	
9	bajak (% dewasa dipakai)	37%	
	untuk	48 hr/thn	
	pada	Rp. 2000	/hari
10	pupuk	1000 kg	
		Rp. 30	/kg

11 berat badan		
umur/tahun	jantan	betina
0-1	56	46
1-2	111	86
2-3	161	121
3 <	200	151

12	tingkat bunga	18%	
13	komisi	5%	
14	pembelian pakan		
15	biaya drh	Rp. 0	/ekor
16	lain 2	Rp. 2000	/ekor
17	transport dan pemasaran	Rp. 30000	/ekor

18 Struktur besaran usaha

	No.	%	satuan ternak
Betina	10.0	49.8%	1
Jantan	1.0	5.0%	1.2
Anak sapi	6.0	29.9%	0.25
Dara	2.0	10.0%	0.6
Sapi tua	1.1	5.5%	1.2
Jumlah	20.1	100%	15.2

Judul Gross Margin: Cattle Breeding with endoparasite control

Penerimaan

					Rp.	
1	Penjualan persediaan	betina tua		1.0	720,000	720,000
		jantan tua		0.1	960,000	96,000
		anak betina		1.4	409,600	573,440
		anak jantan		2.4	528,000	1,267,200
2	Bajak		48hari	4.1dewasa	2000/hari	390,720
3	Pupuk			1,000kg	30/kg	30,000

TOTAL PENERIMAAN TAHUNAN	3,077,360

Biaya Variabel

1	Komisi	5%	dr. nilai			132,832
2	Pembelian pakan					0
3	Biaya drh.			10	4,000	40,000
4	Lain 2			20	2,000	40,200
5	Transport dan pemasaran			4.9	30,000	147,000
6	Penggantian (jantan)			0.1	960,000	96,000

TOTAL BIAYA TAHUNAN	456,032
GROSS MARGIN/TAHUN	2,621,328
GROSS MARGIN/EKOR	262,133
GROSS MARGIN/SATUAN TERNAK	172,229

Asumsi-asumsi

1	besaran usaha	10	
2	tingkat diskont	10%	
3	tingkat kematian, anak sapi	20%	
4	tingkat kematian, dewas	5%	
5	tingkat kelahiran	60%	
6	tingkat sapi tua	10%	
7	harga berat hidup (Rp./kg)	3200	
8	anak sapi dijual pada (bln)	18	
9	bajak (% dewasa dipakai)	37%	
	untuk	48 hr/thn	
	pada	Rp. 2000	/hari
10	pupuk	1000 kg	
		Rp. 30	/kg

11 berat badan

umur/tahun	jantan	betina
0-1	83	68
1-2	165	128
2-3	240	180
3 <	300	225

12	tingkat bunga	18%
13	komisi	5%
14	pembelian pakan	
15	biaya drh	Rp. 4000 /ekor

18 Struktur besaran usaha

	No.	%	satuan ternak
Betina	10.0	49.8%	1
Jantan	1.0	5.0%	1.2
Anak sapi	6.0	29.9%	0.25
Dara	2.0	10.0%	0.6
Sapi tua	1.1	5.5%	1.2
Jumlah	20.1	100%	15.2

Judul Gross Margin: Buffalo fattening with endoparsite control

Penerimaan

				Rp.	
1	Penjualan persediaan		1.0	1,024,000	972,800
2	Bajak				138,000

TOTAL PENERIMAAN TAHUNAN	1,110,800

Biaya Tidak Tetap

1	Pembelian persediaan			1	563,000	563,000
2	Komisi	5%	dr. nilai			48,640
3	Pembelian pakan			1	0	0
4	Biaya drh.			1	15,000	15,000
5	Tenaga kerja			1	36,000	36,000
6	Transport and pemasaran			1.0	20,000	19,000

TOTAL BIAYA TAHUNAN	681,640
GROSS MARGIN	429,160

Asumsi-asumsi

1	besaran usaha	1		10	pembelian pakan	Rp. 0	/ kerbau
2	satuan ternak	1.15	/ek	11	biaya drh/medicin	Rp. 15000	/ kerbau
3	tingkat diskonto	10%		12	lain 2	Rp. 2000	/ kerbau
4	tingkat kematian	5%		13	transport dan pemasaran	Rp. 20000	/ kerbau
5	harga pembelian	Rp.563,000		14	tenaga kerja	Rp. 36000	/ kerbau
6	harga penjualan	Rp.1,024,000		15	bajak (% dewasa dipakai)	60%	
7	tingkat bunga	18%			untuk	2 pasang	
8	penyusutan	25%			harga	Rp. 115000	/pasang
9	komisi	5%					

Judul Gross Margin: Buffalo fattening without endoparsite control

Penerimaan

				Rp.	
1	Penjualan persediaan		1.0	686,080	651,776
2	Bajak				92,000

TOTAL PENERIMAAN TAHUNAN	743,776

Biaya Tidak Tetap

1	Pembelian persediaan			1	563,000	563,000
2	Komisi	5%	dr. nilai			32,589
3	Pembelian pakan			1	0	0
4	Biaya drh.			1	0	0
5	Tenaga kerja			1	36,000	36,000
6	Transport and pemasaran			1.0	20,000	19,000

TOTAL BIAYA TAHUNAN	650,589
GROSS MARGIN	93,187

Asumsi-asumsi

1	besaran usaha	1		10	pembelian pakan	Rp. 0	/ kerbau
2	satuan ternak	1.15	/ek	11	biaya drh/medicin	Rp. 0	/ kerbau
3	tingkat diskonto	10%		12	lain 2	Rp. 2000	/ kerbau
4	tingkat kematian	5%		13	transport dan pemasaran	Rp. 20000	/ kerbau
5	harga pembelian	Rp.563,000		14	tenaga kerja	Rp. 36000	/ kerbau
6	harga penjualan	Rp.686,080		15	bajak (% dewasa dipakai)	40%	
7	tingkat bunga	18%			untuk	2 pasang	
8	penyusutan	25%			harga	Rp. 115000	/pasang
9	komisi	5%					

Appendix 4: Regional workshop on classical swine fever (CSF)

FAO/OIE/JICA Regional Workshop on Classical Swine Fever (CSF) Control in Asia in collaboration with Bureau of Animal Industry

22–24 June 2005
Discovery Suites
Pasig City, Philippines

Recommendations

Recognizing Classical Swine Fever as a problem prevalent in the Asian region and acknowledging the need to work on baseline activities such as animal health policies, case definitions, vaccine accreditation, vaccination strategies, diagnostic methods and economic analysis of such a disease control program, the Workshop Participants agreed to endorse the following points and work for its implementation by reporting this to their respective veterinary services and getting them endorsed through regional bodies (ASEAN, SAARC and SPC).

A. CSF is a transboundary animal disease and control and eradication of this needs collaboration amongst countries and international organizations, thus following courses of action are identified.

1. Work for the establishment of a CSF surveillance network that would include harmonizing procedures on field surveillance, diagnosis, disease reporting, animal movement management and public awareness and education.
2. Conduct regional activities (with assistance from FAO, OIE, JICA and other international organizations) that would strengthen capacity of countries on CSF epidemiology and diagnosis. Wherever possible, these activities will be integrated with on-going activities with respect to FMD control/eradication programs.
3. Conduct specific research studies on CSF epidemiology, control and diagnosis, in coordination with other research agencies (international and national). Result of such research will be made public.
4. Request international organizations to assist countries in drafting animal health policies on CSF and other transboundary animal diseases
5. Request international organizations to coordinate the participation of the private sector in respective countries so they could assist or even lead in the control/eradication of CSF.
6. Invite contributions from government bodies, training centers and academic institutions within countries that could assist in the delivery of animal health programs.

B. Specific country needs were raised and addressed to international organizations and other developed countries. The following were identified:

1. Need to strengthen capacity in the area of laboratory diagnosis in terms of provision of equipment and manpower training.
2. Explore possible funding for operational needs such as provision of reagents, vaccines, fieldwork and validation of laboratory diagnosis.

3. Study the economic impact of CSF in the respective countries and assess the cost effectiveness of proposed CSF control measures.

4. Request governments to develop or formulate national policies with respect to CSF control and/or eradication.

5. Any vaccination scheme will include the provision to differentiate vaccinal from field virus isolate.

C. With the varying range of capacities in diagnosis and surveillance, the following factors were listed as necessary requirements for a country to be designated as a center for CSF control and diagnosis:

1. Geography – a sub-regional laboratory center and epidemiology center will be selected from the national veterinary institutes. The centers must be strategically located within the region or subregion for easy coordination and exchange of information and materials.

2. Laboratory center facilities must be at par with international standards and manned by trained staff. The laboratory should be able to perform the full range of diagnostic test as specified in the OIE manual.

    a. The host country must agree to their laboratory receiving samples from other countries.

    b. The following institutes have been identified as meeting the above requirements:

        i. National Institute of Animal Health, Thailand, (Southeast Asia)

        ii. National Veterinary Research and Quarantine Service, Republic of Korea (East Asia)

        iii. One of the Regional or the Central Disease Diagnostic Laboratory in India (South Asia).

3. Sub-regional center on epidemiology must be equipped with a working secretariat that would coordinate field surveillance activities and manage field and laboratory data with transparency.

    a. The following agencies have been identified as meeting the above requirements:

        i. Bureau of Animal Industry, Philippines

        ii. Department of Veterinary Services, Malaysia

4. Host country of either the epidemiology center or the laboratory or both must be willing to provide initial resources in maintaining the center.

The above recommendations will be submitted to regional bodies like APHCA, ASEAN, SAARC, SPC, JICA Thailand and OIE Tokyo for endorsement by the Chief Veterinary Officers attending the said regional meetings.

Appendix 5: People consulted

Name	Position	Organisation
Indonesia		
Dr Ir. Endah Murniningtyas	Director, Food and Agriculture	BAPPENAS
Dr Tri Satya Putri Naipospos (Tata),	Director of Animal Health	Ministry of Agriculture
Dr Heru Setijanto	Dean, Faculty of Veterinary Science	Bogor Agricultural University
Dr I Wayan Wibawan	Vice-Dean, Faculty of Veterinary Science	
Drh Agus Lelana	Head of Office, Office of Public Relations	
Dr Asep Saefuddin	Vice Rector for Planning, Development and Collaboration	
Dr Arief Daryanto	Director Cooperation and Development	
Dr Rina Oktaviani		
Dr Kusuma Diwyanto		ICARD
Ir. Atien Priyanti		Central Research Institute for Animal Science
Dr Abdul Adjid	Director	BalitVet
Dr Suhardono		
Dr Sri Muharsini		
Dr Lies Parede		
Dr Amir Hussain		
Dr Agus Wiyono		
Dr Yanti		
Dr Endang		
Dr Eny		
Ibu Endang Margawati		LIPI
Drh Hartono	Chairman	Indonesian Poultry Information Centre

Name	Position	Organisation
Laos		
Dr Ty Phommasack	Vice Minister	Ministry of Agriculture and Forestry, Dept of Livestock and Fisheries
Dr Boun Ay Nounouannavong	Director General	
Dr Sounthone Vongthilath	EU project leader	
Dr Syseng Khounsy	ACIAR Project Leader	
Mr Alistair Macleaen	Ambassador	Aust DFAT
Ms Anna Clancy		AusAID
Mr Michael Bosworth	Development Cooperation Section	AusAID
Dr Ronello Abila	Regional Coordinator	South-East Asia FMD Campaign
Dr Teng Moey Fah	Deputy Director (Animal Health).	Agri-Food and Veterinary Authority of Singapore
Thailand		
Dr Chaweewan Leowijuk	Deputy Director General	Department of Livestock Development
Dr Pornchai Chamnapond	Director, Veterinary Research and Development Centre, Phitsanulok	
Dr Wilai Linchingsubongkoch	Chief, Regional FMD Laboratory, Pakchong	
Dr Nimit Traiwanatham	Director	National Institute of Animal Health
Dr Wasana Pinyochon	Chief of Virology	
Dr Arunee Chaisingh	Senior Veterinary Scientists	
Dr DuangJai Sawancharoen		
Dr Monaya Ekgatat		
Dr Sujira Parchariyanon		
Dr Somporn Isvilanonda	Associate Professor, Agricultural and Resource Economics	Kasetsart University Faculty of Economics
Dr Somsak Priebrom		
Dr Prapued Aksornphan	Lecturer (Pig Health)	Faculty of Veterinary Science
Dr Nattavut Ratanavanichrojn	Veterinarian	Betagro Poultry
Dr Carolyn Benigno	Animal Health Officer	FAO Regional Office, Bangok
Dr Stuart Blacksell		Wellcome Foundation
Vietnam		
Dr Tan Xuan Hanh		
Malaysia		
Dr Roshidah	Operations Manager	

Name	Position	Organisation
Myanmar		
Dr Than Hla	Director, Research and Disease Control	Livestock Breeding and Veterinary Department
Australia		
Dr Peter Spradbrow		University of Queensland
Dr Joanne Meers		
Dr Peter Daniels	Australian Animal Health Laboratory, Geelong	CSIRO Livestock
Dr Lawrence Gleeson		
Dr Mike Nunn	Office of the Australian Chief Veterinary Office.	DAFF
Dr Peter Black		
Dr Tim Buick	Biosecurity Australia	

Appendix 6: The animal health research assessment framework

	Cluster life cycle			
	Initial cluster identification	**Basic research**	**Applied research**	**Implementation**
Technical				
Define the nature of the issue and the solution	• Essential • Clear understanding of the nature of the problem • Consistent with ACIAR Corporate Plan • Proposed research methods must be aimed at delivering benefits in the end.	• High • Must be a clearly defined, high priority area of research derived from stakeholder consultation and technical audit. • Clear understanding of expectations with regard future beneficiaries and information users.	• Case study, field research and demonstrations based on products of basic research. • Tools are appropriate to users' needs and abilities to implement.	• Research must meet stated welfare-increasing objectives
Define the extent of the issue	• High • Need to understand geographic distribution of the issue and users of the research outcomes (e.g. transboundary disease may be a regional issue while production research may be implemented at village level over a limited area,)	• High • Must understand areas to which results of basic research could be realistically applied.	• High • Must understand area and demographic characteristics in which aiming to use tools.	• Essential • Target areas and users must be well understood and characteristics taken into account..
Level of input by users to identify issues and solutions	• High. • Principal and secondary users are clearly defined and views considered. • End users (smallholders, commercial producers, government, private industry) need to have input into specification of the problem.	• High • Users of the products of the basic research (laboratories, government, private industry) need to be involved.	• High • Potential suppliers of the technology components to implementation need to be involved (e.g. vaccine and drug manufacturers)	• Essential • Delivery has to be appropriate to users' abilities, attitudes and environment.
Level of other stakeholder input	• High • Evidence of appropriate scientific consideration. • Must be consistent with and linked to other related programs run by ACIAR, AusAID and other research organisations	• Moderate • Link with similar work in partner countries and in other research programs	• High • Where complementary research is being undertaken, ensure tools are complementary or can be used in these programs.	• Essential • Implementation must work with complementary livestock and related programs and activities in user groups.
Level of comparative analysis of research solution.	• Clear definition of the animal health issue and the type of research to deliver a solution. • Literature review of technical issues must be completed highlighting knowledge gaps and target appropriate research. • Analysis of its appropriateness and applicability to the users and their environments (e.g. laboratories, disease control authorities, livestock industry, etc)	• Depending on the issue, research topic and approach may be novel.	• High • Must understand limitations and advantages of similar technology in similar environments.	• Essential • Audit of options for implementation including • Demonstrable cost-effectiveness relative to other solutions.

	Cluster life cycle			
	Initial cluster identification	**Basic research**	**Applied research**	**Implementation**
Potential for technology transfer and uptake.	• Essential. • Must demonstrate that the research solution has a reasonable probability of being successful and implemented. • Describe pathway for implementation delivery of benefits.	• Moderate. • Inherently high risk in basic research.	• High • Means of delivery and technical constraints must be appreciated.	• Essential • Means of delivery must be appreciated. • Constraints identified and strategies planned to overcome them.
Level of current and required scientific capacity.	• May be low at this stage. • Potential to overcome limitations must be demonstrated	• Low to Moderate • Basic research may include substantial training of partner scientists.	• Moderate to High • Partner scientists should have reasonable skills to develop tools but research may include substantial training.	• Moderate • Main requirement here will be in program planning and delivery skills rather than scientific capacity. • May need high scientific skills in country or region to adapt tools and maintain quality control (e.g. of vaccines, laboratory tests)
Level of Australia's capacity and comparative advantage.	• Moderate to high. • Usually Australia will have high level skills and capacity for any particular cluster.	• High • Australian partners must have demonstrable high capacity in type of research proposed.	• Moderate • Must have skills that can be adapted to the specific research task.	• Low • Responsibility to manage and deliver outcomes must reside in region or country.
Potential for scientific benefit for Australia	• A cluster may provide opportunities for Australians to enhance skills (e.g. on laboratory methods for exotic agents) and to provide information on disease distribution and behaviour that assists animal health management in Australia.	• Depending on the issue, knowledge gained may have no apparent direct scientific benefit to Australia. • Some projects may provide very important outcomes (e.g. about disease distribution) that is valuable for Australia.	• Depending on the issue, tools developed may be able to be used in Australia.	• Outcomes that improve transboundary disease control and reduce risk of disease incursions would be of direct benefit
Risk of failure of technical solution	• Acceptable level will depend on both the consequences and likelihood of failing. • Risk management strategy. • Sound technical assessment should substantially reduce risks.	• Preferably low to moderate but potentially high depending on the particular project. • Risk management strategy.	• Low • Field testing will reduce chances of implementation failure. • Risk management strategy.	• Low • Economic, institutional and social factors more likely to affect risk.
Expected time frame for delivery	• N/A	• Less than 5yrs • Consider in light of complexity	• 3–10yrs • May be sooner if basic knowledge available.	• 5–10 years

	Cluster life cycle			
	Initial cluster identification	**Basic research**	**Applied research**	**Implementation**
Technical outcomes	• audit of technical requirements, • appropriate consultation with relevant private and government stakeholders leading to agreement on priorities and cluster objectives, • appropriate consultation and review of work being undertaken by other multilateral and bilateral research institutions, • list of potential niche areas where Australian researchers can provide benefits in terms of human capacity and institutional development that will lead to smallholder welfare improvement.	• Projects planned and implemented that build on existing basic research and create knowledge with assistance from relevant partner research institutions. • Projects implemented that are priorities for partner governments. • Projects implemented that satisfy Australia's priorities and skill sets and benefit Australian livestock industries.	• Project implemented that test basic research results in the field • Create appropriate techniques for applying technologies	• Technical outcomes adopted by smallholders and ensuing welfare improvements
Institutional capacity				
Level and type of institutional analysis/ development	• Descriptive analysis of type of institutional support that will be required to ensure research and adoption • Institutional audit of region and partner country • Assess whether national/regional priorities will support the adoption of research outcomes	• Partner institution selection determined by role of institution in national framework, capacity for HR development, ability to value add from capacity building • Assist national/regional and local governments develop appropriate capacity to adopt findings	• Assist national/regional governments and/or private sector implement findings through activities designed to increase livestock profitability and alleviate poverty • Activate national/regional/ multilateral funding for implementation and dissemination • Ensure partner has authority and structure to implement project • Ensure partner has appropriate resources for project implementation • Assist implementing agency develop and allocate appropriate resources	• Assist national/regional governments and/or private sector implement findings through activities designed to increase livestock profitability and alleviate poverty • Activate national/regional/ multilateral funding for implementation and dissemination • Ensure local partner has authority and structure to implement project • Ensure partner has appropriate resources for project implementation
Level of stakeholder participation	• Predominantly national and regional • ACIAR with policy makers and potential partner research institutions • Livestock owners consulted to assess farm level priorities	• Institution to institution negotiations • Involvement in project planning and implementation with relevant policy and stakeholder groups	• National policy makers included at all project phases • Local institutions/industry developed to assist and prepare for implementation	• Implementation of findings must be undertaken by local institutions in partner countries • Ensure benefits accrue not only to project participants • Selection of partners influenced by ability of partner to work with the target audience

	Cluster life cycle			
	Initial cluster identification	**Basic research**	**Applied research**	**Implementation**
Potential for policy outcomes	• Low, but understanding of the existing policy framework will be necessary • Will require understanding of the partner national priorities with regard to animal health issues • Begin negotiation of potential policy issues that will arise	• Low, but projects must understand the types of policies they will be influencing and their ability to influence • Include policy making institutions in planning and conclusion process • Begin negotiation of potential policy issues that will arise	• High. Define and estimate policy impacts • Work with partners to develop methods of implementing policy change	• High. Policies developed and implemented
Involvement of multilateral organisations	• Low, but should be consulted to find out what work has been done in the area and its more general applicability • Program fit with regional (e.g. ASEAN) not only national priorities • Understanding of opportunities for collaboration • Assess level of potential support (in-kind and financial)	• Medium, ACIAR projects should ensure they working with all relevant local and international agencies/NGOs • Multi-national or regional agencies should be consulted in project planning to ensure objectives meet regional objectives and standards • Collaboration if possible	• High. Informed about and if possible assist with validation and implementation of findings to other countries/regions • Collaboration as appropriate	• High. Required to assist with implementation of findings and disseminate to other countries/ regions • Collaboration necessary
Understanding of input and output markets	• Broad understanding of how market works • Defining levels of market failure and institutional development required at conclusion of process	• Assistance with development of input and output markets • Definition of training required to implement technologies	• Clear definition of how market will operate when project support is ended • Training of support staff to ensure technology adoption	• Functioning input and output markets • Trained support staff; government and private
Institutional outcome	• Audit undertaken • Knowledge of both the environment within which projects will be implemented and the institutional development that will need to be undertaken before adoption can occur	• Projects planned and implemented that both use existing capacity and build capacity in relevant partner research institutions. • Projects implemented that are priorities for partner governments. • Projects implemented that satisfy Australia's priorities and skill sets.	• Policies implemented in partner countries with support from national and multilateral agencies • Improved delivery of animal health services at local and national level	• Policies implemented in partner countries and disseminated to other regional partners with support from other multilateral agencies • Improved delivery of animal health services at local, national and regional level

	Cluster life cycle			
	Initial cluster identification	**Basic research**	**Applied research**	**Implementation**
Economic impacts				
Level and type of economic analysis	• Qualitative evaluation of impact on the poor • National BCA • Evaluate distribution of potential benefits between consumers and producers • Economic audit of livestock commodities at smallholder and national/ regional level	• Estimation of national (market) benefits • Estimation of smallholder (poverty alleviation) benefits; gross margins, cash-flow analysis • Project BCA	• Measurement of national (market) benefits • Measurement of smallholder (poverty alleviation) benefits; gross margins, cash-flow analysis • Project BCA • Estimation of distribution of benefits; equity	• Measurement of national (market) benefits • Measurement of smallholder (poverty alleviation) benefits; gross margins, cash-flow analysis • Project BCA • Estimation of distribution of benefits; equity
Potential for public and private benefit	• Evaluation of the effects of potential interventions, evidence of potential for welfare and market access improvements • Development of linkages may benefit both private and public institutions • Estimation of potential capacity-building benefits	• Evaluation of the effects of potential interventions from project outputs • Valuation of specific capacity-building benefits • Capacity-building flow-on to other animal health issues	• Evaluation of the effects of potential interventions from project outputs, predominantly smallholder benefits • Private sector involvement and investment potential • Sustainable capacity building of field staff	• Necessary private enterprise involvement to ensure sustainability. • Necessary incentives/budget to ensure public benefits and involvement • Sustainable capacity building of field staff
Potential for livestock owner welfare improvements	• Low. • Definition of nature of economic benefits; securing assets, reducing constraints to intensification and improving market opportunities • Define beneficiaries – smallholders (production) vs market (trade/biosecurity) vs consumer	• Low. • Field testing and trials to measure potential benefits to target group	• Medium. • Field testing and trials to measure benefits to project participants • High (in short term) if production orientated issue in less developed country. High (in the long term) if market benefits in more developed country. • Low if biosecurity issue	• High (in short term) if production orientated issue in less developed country. High (in the long term) if market benefits in more developed country. • Low if biosecurity issue
Type of evaluation and monitoring required	• Regular maintenance of audit; price and output (annual), disease and livestock prioritisation (3 year) • Assess extent of likely partner government budget support required to maximise adoption	• Base-line data collection and analysis at village level to be used in ex-post analysis • Ex-ante analysis of regional/national and local benefits	• Base-line data collection and analysis at village level to be used in ex-post analysis • Ex-ante analysis of regional/ national and local benefits	• Use base-line data to measure impacts of program/project (ex-post). • Type of analysis dependent on level (smallholder/market/nation) of benefits • Ex-ante analysis of regional/ national and local benefits

	Cluster life cycle			
	Initial cluster identification	**Basic research**	**Applied research**	**Implementation**
Potential for economic benefit to Australia	• Good potential to identify appropriate research partners • Definition of biosecurity and capacity-building benefits • Increased trade potential	• High. • Measurement of biosecurity and capacity-building benefits. • Improved knowledge of exotic disease management and control	• High. • Measurement of biosecurity and capacity-building benefits. • Improved knowledge of exotic disease management and control	• Medium. • Disease control in neighbouring countries
Potential for capacity-building benefits in partner country	• Using institutional audit of partner country evaluate areas with the most potential for capacity-building benefits to accrue. • Define economic benefits of specific capacity building	• High • Estimate benefits of improved scientific capacity and estimate spillover benefits to other issues/ sectors	• High • Estimate benefits of improved scientific capacity and estimate spillover benefits to other issues/ sectors	• High • Estimate benefits of improved scientific capacity and estimate spillover benefits to other issues/ sectors
Economic outcomes	• Regional/national animal health issues identified and prioritised • Nature, and ex-ante estimates, of program benefits undertaken • Poverty reduction • Programs selected with clear economic benefits to partners and Australia	• Detailed understanding of the potential benefits of disease control to producer, consumer and market. • Detailed baseline study completed to act as "before" project scenario	• Measurement of the potential benefits of disease control to producer, consumer and market. • Detailed baseline study completed to act as "before" project scenario • Undertake ex-ante analysis	• Poverty alleviation benefits through; improved productivity, reduced costs • National biosecurity benefits increasing market access • Undertake ex-post evaluation and impact assessment
Social impacts				
Level and type of social/ community analysis	• Introductory macro-level understanding of potential impact regions • Definition of community • Evaluation of community strengths and weaknesses and potential implications for development • Measurement of social capital, network and leadership structures, understanding of how community decisions are made	• Broad understanding of role of the issue in community. • Define how potential changes would influence community structure/practises • Include community leaders in project development	• Define target communities • Use communities as case studies • Learn from implementation issues in project groups • Define appropriate implementation plans with project participants • Through community leaders ensure community ownership of technology testing and adoption	• Village level social capital analysis, understanding village decision-making, asset distribution, leadership structures etc • Surveying and ex-post social analysis
Potential for community benefits	• Low. • Base line survey designed to provide basis foe ex-ante and ex-post evaluations • Define geographical location and extent of potential benefits	• Low • Estimates of community effects need to be provided	• Moderate. • Develop sustainable systems in project groups • Case studies and field trials designed to provide practical benefits to communities	• High. • If community are smallholders, technology should be appropriate with existing farming and community practises • Equity in income distribution and gender labour requirements must be positive

	Cluster life cycle			
	Initial cluster identification	**Basic research**	**Applied research**	**Implementation**
Role and priorities of livestock in the social system	• Community audit determining role of livestock in community farming systems • Evaluation of priority livestock species to the community • Understanding of gender and child roles in livestock farming systems	• Moderate. • Set up focus groups to link project with communities and other stakeholders	• Moderate. • Detailed social and community capital analysis and testing of recommendations • Set up focus groups to link project with communities and other stakeholders	• High • Adoption will not occur unless livestock technology or management recommendations are appropriate with village norms and priorities. • Ensure equity considerations are implementable
Type of evaluation and monitoring required	• Macro-level understanding of community characteristics required to assist adoption • Social audit undertaken to develop understanding of farming system within which technology will be adopted	• Stakeholder level, social audit • ex-ante estimates of community effects of technology adoption	• Case study monitoring qualitative and quantitative social capital analysis. • Define social constraints to adoption test ways of improving recommendations into and adoptable form	• Village/smallholder level. Use base-line data to monitor impact and changes in social capital; networks, external linkages etc.
Risk of not fulfilling welfare objectives	• Program identification designed to identify areas for research rather than provide welfare benefits	• High. Initial basic research is intrinsically risky, not directly aimed at welfare	• Moderate. This will be the first attempt to implement project recommendations. • Will need detailed social capital measurement and community support	• Low. Previous projects have fully integrated social and cultural aspects of adoption into implementation projects
Social outcome	• Cluster which understands the implications of the potential technology/ management changes on smallholder communities	• Project which understands the implications of the potential technology/ management changes on smallholder communities	• Projects which are testing the potential for adoption of improved technologies within the existing social/community systems. • Projects which show actual welfare improvements (e.g. health, housing, gender equity, education)	• Poverty alleviation • Increased community strength • Replicated programs and projects in other regions • Institutions and policy environments within partner countries maintaining and supporting ongoing projects. • Research capacity increased and benefits flowing on to other disease issues with local and multilateral support

IMPACT ASSESSMENT SERIES

No.	Author(s) and year of publication	Title	ACIAR project numbers
1	Centre for International Economics (1998)	Control of Newcastle disease in village chickens	8334, 8717 and 93/222
2	George, P.S. (1998)	Increased efficiency of straw utilisation by cattle and buffalo	8203, 8601 and 8817
3	Centre for International Economics (1998)	Establishment of a protected area in Vanuatu	9020
4	Watson, A.S. (1998)	Raw wool production and marketing in China	8811
5	Collins, D.J. and Collins, B.A. (1998)	Fruit fly in Malaysia and Thailand 1985–1993	8343 and 8919
6	Ryan, J.G. (1998)	Pigeon pea improvement	8201 and 8567
7	Centre for International Economics (1998)	Reducing fish losses due to epizootic ulcerative syndrome—an ex ante evaluation	9130
8	McKenney, D.W. (1998)	Australian tree species selection in China	8457 and 8848
9	ACIL Consulting (1998)	Sulfur test KCL–40 and growth of the Australian canola industry	8328 and 8804
10	AACM International (1998)	Conservation tillage and controlled traffic	9209
11	Chudleigh, P. (1998)	Post-harvest R&D concerning tropical fruits	8356 and 8844
12	Waterhouse, D., Dillon, B. and Vincent, D. (1999)	Biological control of the banana skipper in Papua New Guinea	8802-C
13	Chudleigh, P. (1999)	Breeding and quality analysis of rapeseed	CS1/1984/069 and CS1/1988/039
14	McLeod, R., Isvilanonda, S. and Wattanutchariya, S. (1999)	Improved drying of high moisture grains	PHT/1983/008, PHT/1986/008 and PHT/1990/008
15	Chudleigh, P. (1999)	Use and management of grain protectants in China and Australia	PHT/1990/035
16	McLeod, R. (2001)	Control of footrot in small ruminants of Nepal	AS2/1991/017 and AS2/1996/021
17	Tisdell, C. and Wilson, C. (2001)	Breeding and feeding pigs in Australia and Vietnam AS2/1994/023	
18	Vincent, D. and Quirke, D. (2002)	Controlling *Phalaris minor* in the Indian rice–wheat belt	CS1/1996/013
19	Pearce, D. (2002)	Measuring the poverty impact of ACIAR projects—a broad framework	
20	Warner, R. and Bauer, M. (2002)	*Mama Lus Frut* scheme: an assessment of poverty reduction	ASEM/1999/084
21	McLeod, R. (2003)	Improved methods in diagnosis, epidemiology, and information management of foot-and-mouth disease in Southeast Asia	AS1/1983/067, AS1/1988/035, AS1/1992/004 and AS1/1994/038
22	Bauer, M., Pearce, D. and Vincent, D. (2003)	Saving a staple crop: impact of biological control of the banana skipper on poverty reduction in Papua New Guinea	CS2/1988/002-C
23	McLeod, R. (2003)	Improved methods for the diagnosis and control of bluetongue in small ruminants in Asia and the epidemiology and control of bovine ephemeral fever in China	AS1/1984/055, AS2/1990/011 and AS2/1993/001
24	Palis, F.G., Sumalde, Z.M. and Hossain, M. (2004)	Assessment of the rodent control projects in Vietnam funded by ACIAR and AUSAID: adoption and impact	AS1/1998/036
25	Brennan, J.P. and Quade, K.J. (2004)	Genetics of and breeding for rust resistance in wheat in India and Pakistan	CS1/1983/037 and CS1/1988/014
26	Mullen, J.D. (2004)	Impact assessment of ACIAR-funded projects on grain-market reform in China	ANRE1/1992/028 and ADP/1997/021
27	van Bueren, M. (2004)	Acacia hybrids in Vietnam	FST/1986/030

IMPACT ASSESSMENT SERIES <CONTINUED>

No.	Author(s) and year of publication	Title	ACIAR project numbers
28	Harris, D. (2004)	Water and nitrogen management in wheat–maize production on the North China Plain	LWR1/1996/164
29	Lindner, R. (2004)	Impact assessment of research on the biology and management of coconut crabs on Vanuatu	FIS/1983/081
30	van Bueren, M. (2004)	Eucalypt tree improvement in China	FST/1990/044, FST/1994/025, FST/1984/057, FST/1988/048, FST/1987/036, FST/1996/125 and FST/1997/077
31	Pearce, D. (2005)	Review of ACIAR's research on agricultural policy	
32	Tingsong Jiang and Pearce, D. (2005)	Shelf-life extension of leafy vegetables—evaluating the impacts	PHT/1994/016
33	Vere, D. (2005)	Research into conservation tillage for dryland cropping in Australia and China	LWR2/1992/009, LWR2/1996/143
34	Pearce, D. (2005)	Identifying the sex pheromone of the sugarcane borer moth	CS2/1991/680
35	Raitzer, D.A. and Lindner, R. (2005)	Review of the returns to ACIAR's bilateral R&D investments	
36	Lindner, R. (2005)	Impacts of mud crab hatchery technology in Vietnam	FIS/1992/017 and FIS/1999/076
37	McLeod, R. (2005)	Management of fruit flies in the Pacific	CS2/1989/020, CS2/1994/003, CS2/1994/115 and CS2/1996/225

ECONOMIC ASSESSMENT SERIES (DISCONTINUED)

No.	Author(s) and year of publication	Title	ACIAR project numbers
1	Doeleman, J.A. (1990)	Biological control of salvinia	8340
2	Tobin, J. (1990)	Fruit fly control	8343
3	Fleming, E. (1991)	Improving the feed value of straw fed to cattle and buffalo	8203 and 8601
4	Doeleman, J.A. (1990)	Benefits and costs of entomopathogenic nematodes: two biological control applications in China	8451 and 8929
5	Chudleigh, P.D. (1991)	Tick-borne disease control in cattle	8321
6	Chudleigh, P.D. (1991)	Breeding and quality analysis of canola (rapeseed)	8469 and 8839
7	Johnston, J. and Cummings, R. (1991)	Control of Newcastle disease in village chickens with oral V4 vaccine	8334 and 8717
8	Ryland, G.J. (1991)	Long term storage of grain under plastic covers	8307
9	Chudleigh, P.D. (1991)	Integrated use of insecticides in grain storage in the humid tropics	8309, 8609 and 8311
10	Chamala, S., Karan, V., Raman, K.V. and Gadewar, A.U. (1991)	An evaluation of the use and impact of the ACIAR book Nutritional disorders of grain sorghum	8207
11	Tisdell, C. (1991)	Culture of giant clams for food and for restocking tropical reefs	8332 and 8733
12	McKenney, D.W., Davis, J.S., Turnbull, J.W. and Searle, S.D. (1991)	The impact of Australian tree species research in China	8457 and 8848
	Menz, K.M. (1991)	Overview of Economic Assessments 1–12	