

# Future directions for ACIAR's animal health research

September 2006



**Australian Government**

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**Australian Centre for  
International Agricultural Research**

The Australian Centre for International Agricultural Research (ACIAR) operates as part of Australia's international development cooperation program, with a mission to achieve more-productive and sustainable agricultural systems, for the benefit of developing countries and Australia. It commissions collaborative research between Australian and developing-country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

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In order to monitor the effects of its projects, ACIAR commissions independent assessments of selected projects. This series reports the results of these independent studies.

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*Future directions for ACIAR's animal health research*

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# Foreword

To meet the escalating demand for animal protein in the Asia–Pacific region, ACIAR’s challenge is to underpin the sustainability of increased livestock and fisheries production for poor farmers and consumers. This can be progressed through research that helps the animal food sector of developing countries. Smallholder producers require cost-effective production technologies, appropriate infrastructure and policies, and better market access. Poor consumers require lower-priced products that are higher in quality and with minimal food safety risks.

For more than 20 years, animal health has been a significant program in ACIAR’s research portfolio. Much has been achieved both in capacity enhancement in partner countries and Australia, and in the improvement of productivity.

The importance of animal health management to achieving economic, environmental and biosecurity outcomes is increasing in the Asia–Pacific region. ACIAR is proactively addressing developments by continuously monitoring and reviewing our priorities to meet new challenges. The centre is also developing suites of coordinated projects with clusters around common themes.

In line with this management emphasis, our evaluation and impact assessment program is selectively undertaking thematic evaluations and reviews. In late 2005, the Animal Health Review was undertaken by external consultants. The review comprised:

- a broad (meta type) analysis of a range of animal health projects
- a more detailed cluster analysis of two of ACIAR’s important animal health project areas—Newcastle disease and internal ruminant parasites, with two case studies on transboundary diseases
- a review of the changing environment
- the development of a framework to assist in developing and evaluating future animal health research program clusters and projects.

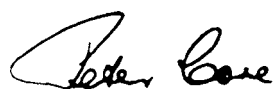
In the light of this important review, the ACIAR Board reflected on the strategic directions of the program. It has now concluded that the direction of ACIAR’s Animal Health program should, in summary, be as follows:

1. a primary focus on Indonesia, Cambodia and Laos, with a secondary emphasis on underpinning biosecurity cooperation in Papua New Guinea and Timor Leste
2. concentration on transboundary diseases, and those diseases affecting human health and trade
3. underpinning efforts by international agencies working in the Asia–Pacific on animal health matters.

Further details are set out at section 1 of this publication. No policy is ever rigid, but the directions set out in section 1 should help the ongoing dialogue between ACIAR and its partners in this important area.

The full review report is set out in section 3, including 24 specific recommendations. ACIAR’s responses to these recommendations, in the form of a Management Action Plan for Animal Health Research, are given in section 2.

The action plan is designed to respond positively to the review recommendations and recognises the imperative for changes to this research field to align with current and prospective regional and Australian strategic and operational priorities. In particular, the need for future programs to be more focused, more integrated with overall development efforts, and sufficiently flexible to respond and contribute to the immediate and emerging needs of partner countries is recognised.



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# Acknowledgments

ACIAR gratefully acknowledges the role of Dr Ian Patrick (ARECS Pty Ltd) and Dr David Kennedy (AusVet Animal Health Services Pty Ltd) who managed and undertook the review and impact analysis of ACIAR's Animal Health research program. They also developed a range of recommendations to guide ACIAR's future directions in selecting and designing animal health clusters and projects.

Simon Hearn, Peter Rolfe and Jeff Davis at ACIAR headquarters worked closely with the authors in addressing the review terms of reference, and preparing the subsequent Action Plan and Future Strategy responses to the review.

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## **SECTION 1**

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# The role of ACIAR in animal health in the region

# Executive Summary

The following directions are proposed for the program over 2006–2011.

## Geographic focus

The program's geographic focus would be:

- Indonesia
- Mekong region with primary focus on Cambodia and Laos
- Papua New Guinea and Timor Leste, to assist existing biosecurity programs and institutions build capacity
- strategic support to regional animal health programs in the Asia–Pacific supported by international agencies.

Other countries may be considered on a high-priority basis as agreed by the ACIAR Executive, and based only on strong approaches from the partner countries.

## Disease focus

In the abovementioned countries, the diseases that would be the focus of the program would be:

- those of regional significance, and the focus of efforts of the World Organisation for Animal Health (OIE) program in Asia and the Pacific using, where appropriate, the Australian Animal Health Laboratory (AAHL)—the AAHL is an OIE reference laboratory for avian influenza, Newcastle disease and bluetongue disease

- those affecting trade and market access
- those zoonotic and newly emerging diseases infectious to humans
- to a lesser extent, the management of diseases significantly affecting production (endemic).

The themes are not exclusive—some diseases have impacts in more than one area. Avian influenza, for example, is an important transboundary disease that affects production (severely), and is a zoonotic threat.

## Subsectoral focus

Considering the subsectoral issues in animal health, the program would:

- shift from production-related diseases to those of national and regional importance (usually rapidly spreading viral diseases) and those affecting trade and human health
- include the social, policy and regulatory constraints for effective disease management, notably in Indonesia and the Mekong region
- identify the incentives for adoption of outcomes and assist where these are clearly defined
- engage where appropriate with emerging small commercial producers where this is justified by a positive analysis of the economic and social environment for development of the industry concerned
- evaluate priorities for food safety research and implement appropriate project activity.

The following will be primary features of the approach to project design and management.

- Project clusters will be developed under themes that deliver the necessary tools, technology or knowledge to manage animal disease and contribute to solutions for the appropriate stakeholders.
- Key diseases within themes and issues will be identified. For transboundary diseases, which include avian influenza, classical swine fever and foot-and-mouth disease, the main issues are effective disease-surveillance systems, prompt and accurate diagnosis of disease, effective and timely control programs, and adequate institutional, regulatory and policy support to implement controls.
- Within each theme, topics that address gaps in the successful management of a disease will be identified. This may include defining the disease issue or problem, understanding the biology of the disease, assessment of the ability to detect diseases, application of diagnostic tests to disease-surveillance systems and refinement of these systems, and development and application of control measures by individual farmers and in government/donor-supported programs.

The proportion of budget devoted to each country will be Indonesia (65%); the Mekong, with emphasis on Cambodia and Lao PDR (25%); and Papua New Guinea and Timor Leste (10%).

The proportions of indicative budget by predominant theme will be transboundary (51%), endemic disease (20%) and zoonotic disease (29%).

# Background

## Livestock in the Asia–Pacific region

The character of livestock production in the region is changing. Population growth, urbanisation and income growth are fuelling an increase in the demand for animal protein in human diets. This ‘livestock revolution’ is demand-driven and there are considerable opportunities for the poorer communities in developing countries to benefit. Demand for poultry meat is expected to increase by 4% annually, and demand for other animal products will likely increase by 2–3% annually by 2020. Most of this demand will be met by developing countries and will result in more-intense production methods and a higher geographic concentration of farms.

The increase in livestock production will place a heavy demand on resources. The recent expansion in demand for animal protein in developing countries has so far been met mainly from increased off-take rather than increases in productivity. The structural change that is occurring in the livestock sector is based on greater utilisation of traditional feed resources as well as an increased use of feed grains. There has also been a major increase in urban livestock production, degradation of rural grazing areas, clearing of forests and a change from the production of livestock based on surplus and waste resources to one seeking new resources for intensification of production.

## The animal health environment

There are many challenges in animal health in the region. Intensification of livestock systems has increased the risks of disease and disease transmission. Supportive policies and regulatory and institutional frameworks for effective disease control are limited, while social barriers for effective disease control are often poorly understood. Increasingly, the interface between humans and livestock is closer, leading to greater risks of transfer of zoonotic disease. The movement of disease with trade in livestock increases the risk of diseases in entering countries that were formerly free of them. The benefits of previous advances in control of endemic diseases have often not been captured due to lack of incentives in ‘harvest’ systems.

These trends have led to ‘old’ diseases continuing to be spread in the region, and new diseases emerging. Infectious viral diseases have been the most prominent. The old diseases include foot-and-mouth disease (FMD), classical swine fever (CSF) and bluetongue, which still cause significant losses in some countries despite progress in control programs. New infectious diseases have emerged, such as pathogenic avian influenza in poultry and Nipah virus in pigs. These diseases not only cause direct losses but inhibit trade within and between nations. All of these are direct threats to the livestock industries in Australia. Of great concern is that many of these diseases also affect humans. There are many other diseases that are less infectious but are still important and widespread. They can seriously affect production, a circumstance that will become increasingly important as demand for animal protein increases. Many of these diseases can be controlled by methods that are already available but which need to be adapted to local situations once the incentives for adoption are in place.

# ACIAR's role

Animal health projects supported by ACIAR will help deliver the necessary tools, technology and knowledge to manage animal diseases and deliver the solutions to the appropriate stakeholders. Within focus countries there will be several themes—controlling diseases of regional significance (transboundary diseases), zoonotic and newly emerging diseases, management of diseases affecting livestock production (endemic disease) and diseases affecting trade and market access. Increasingly, the emphasis will shift from production-related diseases to those of national and regional importance (usually rapidly spreading viral diseases) and those affecting trade and human health.

ACIAR will selectively develop projects that are considered to be important for the successful management of diseases and, in consultation and cooperation with other partners, particularly agencies addressing regional disease control (e.g. the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization (FAO)). Issues that may be addressed include: defining the extent of the disease problem; understanding the biology of the disease; developing the ability to detect diseases; application of diagnostic tests to disease surveillance systems and refinement of these systems; the social, policy, economic and regulatory environment for disease control; and development and application of control measures by farmers and government-supported programs. Increasingly, the social, policy and regulatory environment are constraints in some countries, as demonstrated recently for avian influenza. Options to overcome these constraints will be developed. The institutional capacity of the partner organisation and the incentives (social, economic or regulatory) for the adoption of outcomes of research will be defined at the outset.

Projects aimed at endemic disease control will be directed at farmers who have or will move from being livestock 'keepers' to livestock 'rearers'—in other words, where incentives exist for marketing in small-scale commercial operations. This activity will be justified by economic and social evaluation. Projects will develop 'systems'-based approaches that will be packaged with other livestock interventions (e.g. nutrition, genetics and marketing) in partnership with local communities—a 'toolbox' approach in which individual farmers will choose their own approach, based on their view of risk and the worth of the solutions after they have been demonstrated.

In this complex environment it will be important to identify the immediate and future stakeholders in project activity. These may be regional disease initiatives, government agencies, development agencies, private-sector veterinarians, paraveterinarians, commercial partners, industry organisations, non-government agencies and individual farmers. Partnerships with industry in Australia and partner countries will be encouraged, and are often critical in areas such as vaccine delivery. The impacts of the research will be assessed in economic and social terms within and beyond the life of the projects. It is noted that impacts are often delivered through a cluster of projects although it is expected that individual projects will deliver impacts. The impacts of projects addressing regional disease issues will often be longer term.

The value of the research to Australia and Australia's ability to contribute are critical issues. Many infectious diseases are a serious threat to livestock production in Australia, and ACIAR activity will link with the priorities of Australian industries and be part of the initiatives to control diseases in Australia's near neighbours. The ability of Australia to correctly identify risks in livestock and livestock products is important for the national interest. There is also significant ability for

ACIAR project involvement to increase capacity among Australian scientists and institutions in management of serious diseases. Additional integration will occur with whole-of-government priorities and activity, and specifically include AusAID, the Department of Agriculture, Fisheries and Forestry (DAFF; including Biosecurity Australia, the Australian Quarantine Inspection Service (AQIS) and the Office of the Chief Veterinary Officer), Animal Health Australia and the governments of the states and territories. These agencies have livestock activity in Indonesia, the Mekong region and Papua New Guinea.

# Geographic focus

The country focus has been defined by the importance of livestock and diseases, level of rural poverty and Australia's advantage and interest, and the need to focus the program given available resources. Tables 1, 2 and 3 detail the key issues for Indonesia, the Mekong region, and Papua New Guinea and Timor Leste.

## 1. Indonesia

Indonesia is ACIAR's largest partner, and an important agreed priority is to improve incomes from livestock production. Animal disease is a major constraint to the development of livestock industries and improvement of the income of village and small commercial enterprises. Indonesia has a strategic position for Australia in transboundary disease given its closeness, particularly the eastern provinces.

Future ACIAR activity will build on the themes of controlling diseases of regional significance and those affecting humans. The most important issues relate to transboundary disease. Projects will value, develop and test surveillance systems that have applicability for all livestock diseases but with most application to highly infectious viral agents (FMD, CSF and highly pathogenic avian influenza (HPAI)), and help to develop rapid and appropriate responses once diseases are detected. Targeted research will provide the knowledge base to use tools such as vaccines most effectively (notably against HPAI and CSF). Research will be conducted into control programs (value, strategy, pilot implementation and assessment of success). Increasingly, the impediments to effective disease control are the regulatory and policy environment, particularly barriers to the development of the cooperation needed to undertake regional initiatives. Opportunities to overcome these will

be explored. The knowledge gained will be used by provincial and central governments to implement wider control programs.

Endemic diseases (notably those causing sudden death, reproductive loss and parasitism) will also be targeted where there are clear production losses affecting incomes, and a clearly defined pathway to utilisation of research results. In some areas, basic understanding of what diseases are present is poor and studies will be conducted to provide this knowledge and improve the capacity to detect diseases in the future.

It is unclear to what extent zoonotic diseases are present except for the well-publicised cases of avian influenza. Many other diseases, such as anthrax, rabies, Japanese encephalitis and cysticercosis, can and do cause serious illness and deaths. The impacts of these will be assessed and interventions identified and tested as appropriate.

## 2. Mekong region with emphasis on Cambodia and Lao PDR

These countries represent the more vulnerable countries in the greater Mekong region and share many of the lowest development indicators. Livestock are important in both economies (20% and 30% of total and agricultural GDP, respectively) and are predominantly in the smallholder sector (94%). Research will assist in the control of infectious diseases that continue to affect livestock populations within and across countries (transboundary diseases). The work will be done in partnership with the regional disease-control initiatives such as the OIE South-East Asian FMD Control Program. Improved risk assessment of disease transmission that occurs with trading and movement of livestock, disease surveillance systems and application of these to disease-control programs will be important

priorities. Projects may include cooperation with neighbouring countries that are involved in trade. Vaccines are an integral part of control of infectious disease, but their sustainable use has been problematic. Attitudes of farmers to vaccines are often not well understood. Increased use of vaccines will rely on generating increased demand through farmer education and local champions of vaccines, such as village animal health workers. Improved supply chains and manufacture of quality-controlled vaccines are an important contribution. There are opportunities to evaluate and intervene in critical areas to improve access and affordability. The developing cattle, buffalo, poultry and pig-meat industries will be an important focus, and projects will be framed in collaboration with other development agencies. There are opportunities in each country to improve village-based and small-scale commercial enterprises by limiting important constraints, one of which is disease. An activity will be justified by a positive analysis of the economic and social environment associated with the species concerned.

In Laos there is an indication that the quality of vaccines needs to be improved for CSF and other diseases of cattle, pigs and poultry and where there are limited sources of affordable vaccines. An analysis of the viability of government facilities, the capacity for commercial delivery and incentives for vaccine use by farmers will justify subsequent investment. The policy and regulatory environment for regional disease control is limiting organised disease-control efforts. Dependent on other donor activities, research may be undertaken to investigate what options are available for improvement.

### 3. Papua New Guinea and Timor Leste

Papua New Guinea and Timor Leste have limited capacity to sustain animal disease control activities. Pigs and poultry are important village animals in both countries, and cattle are produced in Papua New Guinea and Timor Leste, with some live exports. With the strong strategic interest for Australia, ACIAR will assist in the development of capacity to detect and manage infectious disease in the wider context of biosecurity arrangements and in collaboration with other Australian agencies such as the Northern Australia Quarantine Strategy of AQIS.

### 4. India

Any animal health activity in India will be determined after wider consultations on the role and priority of ACIAR activity in that country.

**Table 1.** Key animal health issues for Indonesia

Country	Theme	Disease(s)	Priority/issues/gaps	Justification	Australian benefit
Indonesia	Transboundary diseases	Classical swine fever (CSF), highly pathogenic avian influenza (HPAI), foot-and-mouth disease (FMD)	1. Appropriate disease surveillance systems for early detection and response (includes capacity to diagnose by testing) 3. Defining the economic and social cost of diseases and value of effective animal disease surveillance and control	Variable ability of provinces to detect, confirm and control new incursions e.g. CSF, HPAI  Devolution of budgets has disrupted the decision-making and budget allocation process. Need to justify costs of disease control among competing priorities (central, provincial and district).	Knowledge base to appraise regional threats, trade implications and improved knowledge and capacity of Australian scientists  Effective government efforts will limit threats to Australia.
		CSF, HPAI, FMD	4. Implementing disease control programs in a complex and evolving government structure	Complex and evolving government relationships have hindered a number of programs (HPAI, CSF, rabies). Policy and regulatory structures and lack of cost sharing arrangements and preparedness in government limit disease control efforts.	Effective government efforts will limit threats to Australia.
		CSF	5. Effective and targeted regional disease control programs	Control is being implemented but lacks an informed, structured and progressive framework to best use available resources.	Effective Indonesian Government efforts will limit threats of CSF to Australia.
		CSF, HPAI, FMD	6. The inability to detect and manage risks of disease transfer with movement of livestock has led to rapid spread of some diseases (CSF in pigs).	Government is limited in its ability to assess the risks of disease through livestock trade—notably for internal trade between provinces and potentially for export.	Knowledge of disease risks will assist Australia's own risk assessment for disease incursions. Australia has good capacity in this area.

Table 1. <continued>

Country	Theme	Disease(s)	Priority/issues/gaps	Justification	Australian benefit
	Zoonotic	HPAI	2. Basic understanding of virus behaviour in ducks, village and commercial poultry, with and without vaccination	The behaviour of the HPAI virus has and will continue to change and affect the efficacy of vaccine, and the potential of the virus to transmit disease to poultry and humans.	Indonesia has had limited success in controlling the disease especially in villages. This is an ongoing threat to Australia. There is capacity for Australia to contribute and benefit by gaining further expertise.
		Rabies, anthrax, Japanese encephalitis and cysticercosis	8. The relative important of zoonotic disease generally is unclear as are the research issues.	Zoonotic disease is identified as an issue in Indonesia, but there are few data and analyses to support this view.	
	Diseases of production (endemic)	Reproductive disease in cattle, including brucellosis	10. Eradication of <i>Brucella</i> has been achieved in some provinces; but the success of wide-scale vaccination in some areas is uncertain. The presence of other diseases is uncertain.	<i>Brucella</i> is an important cause of abortion in cattle and does infect humans. Government control programs have been very successful in some areas of low incidence but not in others. The extent of the control needs to be clarified, as do the reasons for successes and failure, and new approaches tested.	
		Best practice animal health in livestock systems	11. Adoption of currently available tools for disease control is limited in many areas. The target species are to be determined, but possibly one of poultry, pigs or cattle.	Previous investment by ACIAR has not resulted in adoption and benefits. The most appropriate commercial systems to focus will be determined and followed by project activity.	

**Table 2.** Key issues in animal health for the Mekong region, with emphasis on Cambodia and Lao PDR

Theme	Disease(s)	Priority/issues/gaps	Justification	Australian benefit
Mekong region Emphasis on Cambodia and Lao PDR	CSF, FMD, HP AI	1. Control of movement of livestock, often in an 'informal' trading environment is difficult and threatens disease control programs; requires a strong socioeconomic focus.	Risk assessment of livestock movements is fundamental to national and regional disease control. Governments are limited in their ability to assess and manage the risks of disease with livestock trade—zoning approach internally in the country and integral to regional initiatives (OIE SEA FMD Control Program) to manage these diseases.	Knowledge of disease risks will assist Australia's own risk assessment for disease incursions and develop Australian capacity to manage the same. Australia has good capacity in this area.
	CSF	2. Vaccine from Laos (government) facility not adequate quality for use in disease control	Vaccine quality is highlighted as an issue in current projects. There is anecdotal evidence that other vaccines are also suspect.	Knowledge base to appraise regional threats, trade implications and improved knowledge and capacity of Australian scientists
Endemic disease and production	General disease control in a 'system'	3. Application of current tools and knowledge to disease control in 'systems'—extension and adoption	There is considerable knowledge and ways to implement adoption are known, but need to be applied in a systems approach—smallholder poultry, cattle. A similar approach in pigs may be undertaken, but subject to a market analysis.	This activity would capture the benefit of previous research in this area as well as the strong Australian capacity.
Zoonotic disease		4. The key animal diseases affecting humans are unclear except for HP AI despite a range of anecdotal reports. Severe and widespread infections with <i>Trichinella</i> have been noted.	It is likely that the 'traditional' zoonotic diseases are present, but there effect is poorly defined. Surveys to define the issues, if any, are an important first step before any activity.	Benefit will accrue depending on the diseases that are identified.

**Table 3.** Key issues in animal health for Papua New Guinea and Timor Leste

	Theme	Disease(s)	Priority/issues/gaps	Justification	Australian benefit
Timor Leste	Transboundary diseases	CSF, FMD, HP AI	1. Disease survey and diagnosis to monitor diseases and establish surveillance for early detection and response in association with Biosecurity Australia and AQIS	There is limited veterinary capacity at present but it is being developed with AQIS/ AusAID and FAO resources. Project activity should follow this immediate capacity building.	Knowledge base to appraise regional threats, trade implications and improved knowledge and capacity of Australian scientists
Papua New Guinea	Transboundary diseases	CSF, FMD, HP AI	1. Disease survey and diagnosis to monitor diseases and establish surveillance for early detection and response in association with Biosecurity Australia and AQIS	Most provinces have little information or capacity to detect important diseases of strong and strategic (disease) interest to Australia. Pigs and poultry are of variable importance domestically. Cattle are increasingly important as live trade to Indonesia.	Knowledge base to appraise regional threats, trade implications and improved knowledge and capacity of Australian scientists

## **SECTION 2**

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# ACIAR's action plan for animal health research arising from the external review

The thematic review of ACIAR's Animal Health research program provided 24 recommendations that have been considered in the process of developing a plan for future action. These recommendations were not mutually exclusive and, accordingly, ACIAR's responses are grouped under eight categories of recommendations. In developing this action plan, ACIAR has given consideration to lessons learnt from animal health research in its developing-country partners over 20 years. We have also recognised the imperative for changes to this research field to align with current and prospective regional and Australian strategic and operational priorities, including compatibility with the draft ACIAR Corporate Plan 2006–2010. In particular, the need for programs to be more focused, more integrated with overall development efforts, and sufficiently flexible to respond and contribute to the immediate needs of partner countries is recognised. Supportive policy, regulatory and institutional frameworks are increasingly emphasised as prerequisites for the adoption and utilisation of scientific and technological improvements in animal health knowledge.

ACIAR will facilitate and fund animal health research with the following approaches:

- Project clusters will be developed under themes that deliver the necessary tools, technology or knowledge to manage animal disease and contribute to solutions for the appropriate stakeholders.
- Key diseases within themes and issues will be identified. For transboundary diseases, including avian influenza, classical swine fever and foot-and-mouth disease, the main issues are effective disease-surveillance systems, prompt and accurate diagnosis of disease, effective and timely control programs, and adequate institutional, regulatory and policy support to implement control activity.
- Within each theme, topics that address gaps in the successful management of a disease will be identified. This may include defining the disease issue or problem, understanding the biology of the disease, assessment of the ability to detect diseases, application of diagnostic tests to disease-surveillance systems and refinement of these systems, development and application of control measures by individual farmers and in government/donor-supported programs.

The proposed actions are outlined below.

## 1. Project management

**Recommendation 1:** ACIAR should consider a project information system for all animal health projects including two new types of summaries to replace the current 100 and 600-word formats. A short interim summary should include: budget information, project objectives, partner roles and expected technical outcomes, capacity building, economic, social and environmental benefits, and discussion of what other activities will be required to ensure that expected benefits accrue to the target stakeholders. A long, final summary should include: final budget information, partner strengths and weaknesses, actual technical outcomes, measurement of capacity building, economic, social and environmental impacts, summary of review, and details of linkages with other projects and areas of future work.

### Action

ACIAR's current processes, including those for animal health projects, incorporate a significant amount of information along the lines of recommendation 1. This recommendation, however, includes commentary on partner strengths and weaknesses, linkages with other projects (in final report) and areas of future work. The in-house review process does consider these matters in assessing projects and final project reports are also expected to comment in these areas. It is intended at subsequent in-house review meetings to consider means of ensuring these matters are consistently addressed in the future.

Measurement of capacity building, economic, social and environmental impacts are addressed in the next section of this action plan.

## 2. Impact assessment and evaluation

**Recommendation 2:** ACIAR should place more emphasis on social impact of animal health projects. Short and long summaries should include sections on expected and actual social/community impacts. Expected outcomes should describe only those that the project itself can realistically expect to deliver and against which it can be fairly evaluated.

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

**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.

**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.

**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.

## Action

ACIAR has a significant investment in impact evaluation, managed by the Policy Linkages and Impact Assessment (PLIA) program. How to demonstrate impacts arising from project investments remains a challenge common to aid donors. In addition to economic returns, ways of measuring poverty reduction, along with social and environmental benefits, are areas where refinement is needed. As mentioned in this review, ACIAR is working with external analysts to provide improved means of measuring ex-post social and community impacts in addition to economic benefits.

The need to give greater attention to the measurement of capacity-building results is acknowledged. This is a challenging area, elaboration of which has not been considered possible in the past. In association with the Crawford Fund, ACIAR is funding an activity on the feasibility of quantitatively measuring capacity-building benefits. It has used literature in the area to suggest a framework for this and is applying it to two case studies. In addition, ACIAR has introduced a qualitative assessment process to assess these capacity-building impacts in the annual adoption studies.

At present, informal ex-ante assessments are included during the project development stages and in the project proposal document. At the individual project level, these assessments have largely been descriptive but have covered economic, environmental and social impacts. As the review has correctly pointed out, more rigorous quantitative ex-ante assessments can add considerably to identifying clearer research objectives and focusing research. To be effective and eliminate moral hazard concerns, they need to be undertaken by independent analysts. This can be expensive if done for all projects. ACIAR will selectively commission these studies for major potential investments. To this end, it is developing an ex-ante quantitative impact assessment analysis for the next set of animal health research activities in Laos and Cambodia using independent analysts. It will assess the effectiveness of this strategy and adapt it to other situations if it is successful.

In light of comments in this and other reviews, the impact assessment methods used in impact assessment studies will be formally reviewed in the coming year and a consistent set of guidelines developed. The framework for monitoring and evaluation presented in this animal health study will be used as resource material for this wider review.

### 3. Research clusters

**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.

**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.

### Action

Over the past three years, ACIAR has been moving towards program strategies that embrace the use of project clusters to achieve results. ACIAR's Animal Health program will increasingly use this approach to focus on improving the health of livestock in mixed smallholder farming systems to increase their efficiency-production and to underpin biosecurity. This will include:

- the development of health programs for country, species and disease combinations where clear institutional pathways for the adoption of the results of research by smallholders exist and where Australia has experience of comparative advantage—government and regional disease control initiatives (such as OIE and FAO) are important stakeholders

- improvement of food safety and postharvest aspects of livestock production
- livestock biosecurity relevant to domestic and international trade of Australia and partner countries.

The design of program activities in each country will incorporate an assessment of institutional capacity in that country, its limitations and how current impediments may be alleviated within the project or in partnership with other funding agencies.

### 4. Institutional and community development

**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.

**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.

**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.

**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.

## Action

Following the recent aid white paper, a more active consideration of regional projects and institutional partnerships is being instigated in collaboration with AusAID and other agencies.

Attention to social capital parameters is an emerging element in ACIAR's animal health projects, and involves cross-disciplinary linkages between the Animal Health program and the Agricultural Development Policy program in particular. An economic component of the social capital concept includes the development of market incentives and the capacity for participation in both domestic and overseas markets. In the first instance, the focus will be on local markets. While this focus is not on production-limiting diseases, many of the important zoonotic and transboundary diseases do affect production and also have income-generation consequences. This market-driven approach will be emphasised to provide the incentives and benefits from improved animal health management procedures.

## 5. Vaccine research systems

**Recommendation 10:** ACIAR should not undertake further basic research in developing Newcastle disease (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 ND 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.

## Action

ACIAR is unlikely to undertake basic research in developing ND vaccines or others in the foreseeable future. For both ND vaccines and other vaccines, it is intended that ACIAR will give greater attention to the socioeconomic as well as the scientific aspects of vaccine quality and utilisation. An improved comprehension of incentives for vaccine production and usage will pervade future work in this area. A current ACIAR project will identify constraints in the supply chains of veterinary, medicinal and vaccines generally and, from that analysis, identify opportunities to address those constraints. A primary aim will be to improve the supply of vaccine at village and smallholder levels. The facilitation of market opportunities by the commercial sector will be very important for the achievement of results. This will include work with commercial vaccine and processing companies to improve the supply chain of veterinary medicines as an essential component of adoption.

## 6. Endoparasite control

**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.

### Action

The Animal Health program has previously facilitated a range of investigative projects on endoparasites. It is now intended to move the emphasis more definitively in the direction of adoption.

This emphasis will necessitate an approach to secure adoption pathways through examination of incentive structures and institutional and policy prerequisites. Animal health research in ACIAR will develop a program of activity that will help deliver the necessary tools, technology and knowledge to manage animal

disease and deliver the solutions to the appropriate stakeholders. Within each focus country, work will be under one or more themes—control of diseases of regional significance (transboundary diseases), zoonotic and newly emerging diseases infectious to humans, management of diseases affecting production (endemic disease), and diseases affecting trade and market access. Increasingly, the emphasis will shift from production-related diseases to those of national and regional importance and those affecting trade and human health. Within each theme, the gaps in the successful management of a disease will be addressed. These may include defining the extent of the disease problem, understanding the biology of the disease, improving the ability to detect diseases, application of diagnostic tests to disease surveillance systems and refinement of these systems, and development and application of control measures by individual farmers and in government/donor-supported programs.

Many infectious diseases are a serious threat to livestock production in Australia, and ACIAR activity will link with the priorities of those industries directly concerned and, by helping control diseases in Australia's near neighbours, seek to be part of the initiative to prevent their introduction into Australia. The capacity of Australian research scientists to address the issues as well as to increase the capacity within Australia for its own purposes will be important determinants.

Specific action to be taken on endoparasites will include:

- collating the scientific achievements and presenting them as best-practice guidelines for use by extension practitioners
- incorporating this scientific knowledge into adaptive research investments to demonstrate and achieve best-practice approaches to animal health interventions.

## 7. Departmental consultation

**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 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.

### Action

ACIAR is already part of the AusAID consultative group on avian influenza and the emerging and resurging zoonotic disease initiative. ACIAR will further develop its animal health linkages by establishing an animal health advisory group to provide advice on proposed animal health activities. It is intended that the group include key stakeholders and specialists in government and industry. Expertise will cover epidemiology, diagnosis, vaccine delivery, disease-control approaches, social and economic evaluation, extension and policy settings.

In the light of this review and the aid white paper, ACIAR is moving to further define the partnership potential with AusAID and other government agencies. Partnership meetings have been held with DAFF and associated agencies including the Australian Bureau of Agricultural and Resource Economics, the Bureau of Rural Sciences, Biosecurity Australia, and the Office of the Chief Veterinary Officer. The purpose is to achieve joint activities where this can add to the execution and implementation of research in animal health and other areas of endeavour. Animal Health Australia and appropriate state departments will also be included in this renewed partnership mode.

## 8. Research capacity building

**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 that are exotic to Australia.

**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 NGOs 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.

**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.

## Action

ACIAR will give greater attention to capacity building at the institutional, research and farmer levels in future as an intrinsic element in achieving adoption and sustainable improvements in animal health. The details on how best to secure enhanced capacity will differ at the country level, but the working partnerships with governments, industry, NGOs and educational institutions will be actively continued. ACIAR is also examining ways of securing more commercial partnerships particularly for near-market research.

In this context, the PLIA will also work in tandem with the Animal Health program to achieve the fullest possible synergies between scientific and policy research, given the increasingly apparent interdependence between achieving scientific results with the appropriate country or regional policy settings.

ACIAR will also be giving more attention to both the research and extension systems to fill an important gap that currently exists in a number of Asia-Pacific countries. The expansion of the John Allwright Fellowships will also make an important contribution by investing in people. The Animal Health program will actively participate in these initiatives, and will also be addressing on-the-job training where developing-country scientists visit Australia or Australian specialists visit partner countries to work together. The tools to measure capacity enhancement are limited and subjective, but a number of indicative measures such as workshop attendance, formal training numbers, adoption rates and sustainable follow-on activities in recipient countries will be used.

**SECTION 3**

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# Review of ACIAR-funded Animal Health Research — February 2006

A REPORT TO ACIAR BY

AusVet Animal Health Services Pty Ltd and ARECS Pty Ltd

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# Abbreviations

<b>ACIAR</b>	Australian Centre for International Agricultural Research	<b>I2</b>	I2 strain of Newcastle disease virus
<b>ADB</b>	Asian Development Bank	<b>IAEA</b>	International Atomic Energy Agency
<b>AI</b>	avian influenza	<b>IAP</b>	Impact Assessment Program (ACIAR)
<b>APHCA</b>	Animal Production and Health Commission for Asia and the Pacific	<b>IFAD</b>	International Fund for Agricultural Development
<b>ASEAN</b>	Association of South-East Asian Nations	<b>ILRI</b>	International Livestock Research Institute, Kenya
<b>ASWGL</b>	ASEAN Sectoral Working Group for Livestock	<b>IRR</b>	internal rate of return
<b>AusAID</b>	Australian Agency for International Development	<b>ISO</b>	International Standards Organization
<b>BCR</b>	benefit–cost ratio	<b>NAQS</b>	Northern Australian Quarantine Strategy
<b>CIAT</b>	International Centre for Tropical Agriculture	<b>NGO(s)</b>	non-government organisation(s)
<b>CLMV</b>	Cambodia, Laos, Myanmar and Vietnam	<b>ND</b>	Newcastle disease
<b>CSF</b>	classical swine fever (hog cholera)	<b>NPV</b>	net present value
<b>CSIRO</b>	Commonwealth Scientific and Industrial Research Organisation (Australia)	<b>OIE</b>	World Organization for Animal Health (Office International des Epizooties)
<b>DAFF</b>	Department of Agriculture, Fisheries and Forestry (Australia)	<b>PANVAC</b>	Pan African Vaccine Centre, Ethiopia
<b>EEU</b>	Economic Evaluation Unit	<b>PDR</b>	(Lao) People’s Democratic Republic
<b>EU</b>	European Union	<b>QC</b>	quality control
<b>GMS</b>	Greater Mekong Sub-Region	<b>SANDCP</b>	Southern Africa ND Control Program
<b>HR</b>	heat resistant	<b>SEAFMD</b>	South-East Asian FMD control program
<b>FAO</b>	Food and Agriculture Organization of the United Nations	<b>SWOT</b>	strengths–weaknesses–opportunities–threats (analysis)
<b>FMD</b>	foot-and-mouth disease	<b>UMB</b>	urea-molasses blocks
<b>GMS</b>	Greater Mekong Sub-region	<b>UN</b>	United Nations
<b>HPAI</b>	highly pathogenic avian influenza	<b>V4</b>	V4 strain of Newcastle disease virus
<b>HRV4</b>	Heat-resistant V4 Newcastle disease virus		

# Executive summary

## Introduction

Livestock play a vital role in contributing to the livelihood of 70% of the world's rural poor. Livestock not only provide protein, cash income and draft power but are also valuable assets and a form of savings. They also play a central role in most rural communities' social and cultural life. In most environments, animal diseases impact on the productivity of livestock, the quality of their products and their marketability. In recent years, the importance of animal diseases in relation to human health has increased globally.

ACIAR has taken a leading role in initiating and supporting animal health research in developing countries in Asia, the Pacific and Africa for over 20 years, during which time the organisation has invested A\$44 million in this program area. The focus of this research has been on basic and applied research and scientific capacity building because of the generally low technical capacity in most partner countries.

This emphasis has been changing recently as more partner countries, including Thailand, Malaysia and the Philippines, develop the required skills to become self-sufficient in assessing their priorities and implementing their own research and extension programs. This increasing maturity of partners has implications for ACIAR with regard to how it works with partner institutions and countries, other multilateral and bilateral research organisations and project implementation institutions, such as AusAID. ACIAR is now reviewing its past performance with a view to aligning itself with the demands of the changing political, economic, social and institutional environments.

ACIAR commissioned this report to review the effectiveness of its past animal health projects (excluding tick-borne diseases) and to provide a framework for assisting the organisation to determine the most appropriate investments in animal health research in the future. ACIAR requested that the study focus on South-East Asia where much of the past work has been undertaken and where it is proposed that animal health research will concentrate in future. The review comprised:

- a broad (meta) analysis of the impact of a range of ACIAR animal health projects
- a more detailed cluster analysis of two of ACIAR's animal health research programs: Newcastle disease (ND) and internal parasites of ruminants (excluding blood parasites) and two case studies on important transboundary diseases
- a review of the changing environment
- the development and testing of a framework that will assist in developing and evaluating future animal health research program clusters and projects.

## Key findings

- 1. Nature of the animal health research program.**

The ACIAR animal health research program includes approximately 100 projects undertaken in more than 25 countries. The great majority of these projects were either basic research, which increased knowledge and understanding of the animal health issue, or applied research that developed tools and strategies for disease surveillance and control. Only 5 of the 57 projects that were reviewed included objectives to implement disease control. The

majority of the research projects had no means of implementing the results in the communities for which they were developed.

## 2. **Benefits of the animal health program.**

Extrapolating from the economic evaluations undertaken within project reviews it is estimated that the NPV of total animal health project benefits is A\$100 million. The BCR used in this analysis is 2.3:1 and the IRR is 27%. Animal health research projects provided significant capacity building and good will (although this has not been measured). The economic benefits of many projects are inconclusive and the social and environmental factors have not been sufficiently incorporated into either the project design or impact assessment processes.

## 3. **ACIAR's position as an animal health research provider.** ACIAR, in focusing on the role of research in agricultural development, has developed a considerable profile in the Asia-Pacific region in supporting 'cutting-edge' animal health research and scientific capacity building. It is a well-respected research agency and has a comparative advantage in delivering high-quality animal research in association with partners.

## 4. **Nature of the animal health research environment.**

There is a shift in demand among the more developed partners and regional groupings towards research that will enhance biosecurity, trade access and public health rather than improve productivity. This shift is spurred on by the need for control of trade-limiting, transboundary diseases such as foot-and-mouth disease (FMD), classical swine fever (CSF) and, more recently, highly pathogenic avian influenza (HPAI). An opportunity exists for ACIAR to develop closer ties with regional agencies involved in animal health research and animal disease control. While there is demand for ACIAR to expand this role in certain partner countries, such as Cambodia, Laos, Vietnam, Myanmar and East Timor, there is still an ongoing need for research projects aimed at improving community welfare and building scientific capacity.

## 5. **Information audits/stocktake.** Measuring the impact of ACIAR's animal health projects was constrained by the data available. Cost-effective methods of maintaining information on the technical, economic, institutional and social

environments within which projects and clusters are being implemented would facilitate more effective project design, monitoring and evaluation. Investment in updating this information should be rewarded in the medium to long term by improved understanding of project environments and hence more targeted and effective projects.

## 6. **The animal health research assessment**

**framework.** A framework has been developed to assist ACIAR's decision-making within the animal health program. The framework has been developed taking into account the changing regional demands, environments and priorities and the need for the animal health program to develop stronger relationships, not only with other ACIAR programs but also with other bilateral and multilateral research and development agencies. It facilitates consideration of the relevant technical, institutional, economic and social factors that should then lead to the development and implementation of demonstrably effective and sustainable projects and project clusters. It is designed to focus ultimately on improved community welfare through the development of sustainable livestock systems, both at the smallholder and commercial levels.

### **Meta and cluster analyses**

The meta analysis considered the broad effectiveness of ACIAR's animal health projects. It attempted to evaluate them with regard to the community (economic, social and environmental) and scientific outcomes, but the data were generally quite limited. Project summaries and reviews often reported excellent scientific relations among the project participants and progress in capacity building. Although it could not be measured in this study, it is very likely that most projects made a significant contribution to the scientific knowledge and the capacity of partner scientists and the development of tools for disease diagnosis and control.

The cluster analyses were of research into *Newcastle disease (ND)* and *endoparasites* of grazing livestock. For the control of ND in village poultry, a heat-resistant (HR) vaccine was an elegant technical solution with the potential to reduce chicken deaths and result in increasing both income and protein consumption among

the poor. Despite this and the early involvement of partners in many countries in Asia, the technology was not widely used in Asia. In Malaysia and Vietnam, local vaccine manufacturing companies embraced the vaccine. However, in other countries, the technical benefit of a heat-stable vaccine has not been sufficiently attractive to encourage both vaccine producers and smallholders to change their practices. Institutional, economic and social factors effectively caused the technology to disappear from these countries. More recent success in realising the potential of HR ND vaccines has occurred in southern Africa where a specific AusAID project, based on ACIAR research results, has addressed many of these issues.

The ND experience shows that sustainable technology adoption and smallholder benefit is unlikely without effective institutional support.

The *endoparasite* cluster has been very successful in improving the capacity of researchers in partner countries. This improvement in skills has, and will, benefit these countries through improved endoparasite control programs that increase livestock productivity, and through spillover effects into other programs that require these skills and institutional capacities.

The direct benefits of the research projects to smallholders, however, are difficult to determine and probably varied between the different projects in the cluster. Where smallholders could see a significant problem, such as toxocariasis killing young buffalo and cattle, the relatively simple solution provided through a single treatment appears to have been well received. Where losses like those caused by liver fluke in cattle or nematodes in small ruminants are less visible, there is less demand among smallholders for the technology. The solutions for these parasites were also less attractive as they required changes to grazing management practices and treatments that were, or were perceived to be, expensive. Decreasing government interest in endoparasites as a productivity issue has seen limited support for extension and adoption.

While endoparasites do cause significant economic loss in livestock systems, appropriate social, economic and institutional policy background research was not undertaken to increase the likelihood of successful uptake of the research outcomes. There is potential in the future for these outcomes to be integrated with other livestock production clusters/projects and within bilateral and multilateral rural development assistance projects.

## Animal health research assessment framework

The results of these analyses and findings from consultations in Asia and Australia have been used to develop a framework to help ACIAR design and evaluate future clusters and individual projects that will meet and address the changing priorities of Australian policy and partner needs. It provides a list of technical, institutional, economic and social factors that need to be considered, assessed and included in the cluster and project design, implementation and evaluation processes. Clusters may include projects from various ACIAR programs and projects may fall within more than one cluster. Decisions on which clusters to pursue should be based on technical, institutional, economic and social audits and the expected returns to the end users.

The *technical* assessment determines if the animal health issue has been clearly identified, its importance evaluated and whether or not the research solution is technically feasible and appropriate to the environment in which it is proposed. 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. This process will identify particular niches within the issue where Australian researchers have a comparative advantage.

The *institutional* assessment defines institutional strengths and weaknesses, policy issues, relevant farming systems and their impact on the research agenda. 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 Cambodia, Laos, Myanmar and Vietnam (CLMV) still require more basic assistance to develop national disease surveillance and control programs. Institutional support includes not only research agency capacity but also the policy environment, the linkages between extension (both government

and private), distributors of animal health products and livestock producers, the efficiency of input and output markets, and the role of the country within regional groups (e.g. ASEAN).

ACIAR has traditionally been strong in utilising *economic* methodologies to justify and evaluate projects. The type of economic analysis will depend on the type of research being undertaken and the level at which the benefits will accrue (i.e. market and/or smallholder). Economic analysis has been constrained in the past by poor impact estimates and social analysis.

The *social* assessment defines 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. All projects must have a clear understanding of not only the likely 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 social and community aspects that will need to be included in the implementation stage. Basic and applied research projects need to ensure that adequate community development skills are available during all projects.

The framework should be used to also help implement the following recommendations of this review.

# Recommendations

The following recommendations are made to guide ACIAR in selecting and designing clusters and projects to be evaluated using the framework for animal health research assessment.

## **Recommendation 1**

ACIAR should consider a project information system for all animal health projects including two new types of summaries to replace the current 100 and 600 word formats. A short interim summary should include: budget information, project objectives, partner roles and expected technical outcomes, capacity building, economic, social and environmental benefits and discussion of what other activities will be required to ensure that expected benefits accrue to the target stakeholders. A long final summary should include: final budget information, partner strengths and weaknesses, actual technical outcomes, measurement of capacity building, economic, social and environmental impacts, summary of review, details of linkages with other projects and areas of future work. (Page 3-22)

## **Recommendation 2**

ACIAR should place more emphasis on social impact of animal health projects. Short and long summaries should include sections on expected and actual social/community impacts. Expected outcomes should only describe those that the project itself can realistically expect to deliver and against which it can be fairly evaluated. (Page 3-23)

## **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. (Page 3-51)

## **Recommendation 4**

ACIAR should develop quantitative, as well as qualitative, methods by which scientific capacity building can be measured. (Page 3-55)

## **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. (Page 3-56)

## **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. (Page 3-56)

## **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. (Page 3-57)

## **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. (Page 3-57)

### **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. (Page 3-57)

### **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. (Page 3-61)

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### **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. (Page 3-61)

### **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. (Page 3-64)

### **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. (Page 3-64)

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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. (Page 3-64)

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**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. (Page 3-68)

**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. (Page 3-68)

# Introduction and scope of the study

## 1. Study setting

### 1.1. Livestock as a driver of development

Livestock play a vital role in contributing to the livelihood of 70% of the world's rural poor. Livestock not only provide protein, cash income and draft power but are also valuable assets and a form of savings. Livestock also play a central role in most rural communities' social and cultural life.

In rural communities in Asia, different livestock types have different roles. Village poultry are generally regarded as a source of protein, with eggs and meat consumed as required. They are not raised intensively and are not a major source of income although smallholders are increasingly involved in contract growing of chickens. Small livestock such as pigs and goats are used as both a source of protein and an important source of cash income. Management systems tend to be more intensive with smallholders prepared to invest time and money to ensure healthy and productive animals. Cattle and buffalo are highly prized and in most communities their management is the responsibility of the men. They provide draft input for cropping activities and are regarded as a status symbol and indication of wealth. Large ruminants are only consumed at the local level during religious or community festivals and are sold as required through the existing marketing channels.

### 1.2. Objectives of the report

ACIAR has been involved in supporting and initiating animal health research in developing countries for over 20 years. During that time the nature of the relationship between Australia and many developing countries has evolved from that of Australia providing assistance to recipient countries, to Australia entering into partnerships with neighbours. As countries develop the required skills and experience they have become self-sufficient in assessing their priorities and implementing research and extension programs and projects. Emphasis is changing from a concentration on skill development and capacity building among researchers to poverty alleviation and biosecurity. This shift has implications for a research organisation such as ACIAR with regard to how it interacts with partner institutions and countries, other multi- and bilateral research organisations and project implementation institutions, such as AusAID. As the political, economic, social and institutional environments change, it is opportune for ACIAR to assess past performance and align with future realities and demands. The specific 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—on Newcastle disease of poultry and internal parasitic infestations of ruminants
- establish principles to guide the direction of future ACIAR investments in animal health.

### 1.3. Scope

ACIAR has commissioned this report to review the effectiveness of its past animal health projects (excluding tick-borne diseases) and to provide a framework for assisting ACIAR to determine appropriate animal health investments in the future. ACIAR requested that the study focus on South-East Asia where much of the past work has been undertaken and where it is proposed ACIAR will concentrate in future.

The current review, therefore, comprises three main components:

- broad (meta) analysis of the impact of the range of animal health projects that have been supported by ACIAR
- the development of a framework that will be used to prioritise future animal health research programs and projects
- using the framework to make a detailed analysis of the impacts of research in two important areas: virulent Newcastle disease (ND) of poultry, and endemic and production limiting internal parasites of ruminants (excluding blood parasites).

ACIAR has in the past supported large research programs in these two animal disease areas and some steps have been taken in extending the research findings and products to the appropriate stakeholders. Through the development and application of the framework the review investigates the delivery and uptake of these findings, the factors affecting uptake and the impact that they have had on the health and wellbeing of these communities.

The review is based on analysis of ACIAR project reports and reviews. The reviewers also consulted with local authorities and scientists in three partner countries (Thailand, Indonesia and Laos) who have had inputs into, and support from, ACIAR animal health projects. The three countries visited were selected as they represent different stages in their relationship with ACIAR and their level of animal health sector development. Projects and project impacts were also discussed with relevant Australian researchers and stakeholders.

# Description of ACIAR's past activities

## 2. ACIAR and animal health research

### 2.1. Brief history

ACIAR has been assisting animal health research in developing countries since 1983. Research and support in this area have been regarded as a vital means of providing developing countries with the skills and means to improve the welfare of the rural poor. Animal health research can improve smallholder welfare in a number of ways. The most obvious is that it can lead to an increase in livestock productivity. Productivity can be increased by increasing reproductive, survival and growth rates and by increasing production of animal products such as milk and wool. There are also significant opportunities in developing countries to improve farm income through better product quality and access to new or more valuable markets. While reducing animal disease control costs can also increase returns, disease control that adds costs without obvious returns will be unattractive to smallholders.

Early ACIAR assistance centred on the development of basic research and diagnostic skills that could assist in increasing the productivity of livestock. While support has continued in these areas, the success in developing partner country capacity is now leading to a potential change of emphasis in animal health research. As the technology is developed to vaccinate for brucellosis, foot-and-mouth disease (FMD), ND and other significant infections, the priorities in some Asian partner countries have shifted from productivity and the development of research institutions to the implementation of regional programs that have a broader market focus rather than a smallholder welfare focus. ACIAR and other multilateral research agencies are now required to include basic research and capacity

building in poorer partner countries, with adaptation of existing technology activities and the development and implementation of transboundary biosecurity priorities. The role of ACIAR's animal health research program has expanded since the early basic research demanded in the early 1980s.

### 2.2. Partner selection

Since 1983 a total of A\$44 million (in 2004 value) has been invested in 23 countries (Table 1). The largest recipient partner has been Indonesia which has participated in projects worth over A\$9 million (20% of the total project spending). China has received 14% of the funding with the next largest recipients being Malaysia and the Philippines. China has been a primary partner in seven projects but the last of these was completed in 1998, similarly in Malaysia, cooperation ceased in 1997. In terms of partnerships in Asia, India became the major beneficiary during the 1990s, but there was only one project remaining there in 2005.

Apart from a long-standing partnership with Indonesia, there has been, and is continuing to be, a noticeable shift in ACIAR's partner countries. Early projects tended to be centred in the more developed Asian countries such as China, Malaysia and Sri Lanka (Figure 1). Thailand was also a partner in some projects during the 1980s and 1990s. As these countries have developed the need for capacity building and poverty alleviation support has been reduced.

The emphasis is now in South-East Asia, with Indonesia clearly the country where ACIAR invests the majority of its projects. Its early involvement was as a joint partner with Malaysia but, as Malaysia developed and the capacity in Indonesia improved, Indonesia has become the major recipient/partner in ACIAR research programs. Its proximity to Australia and strong trade links also has ensured its importance as a partner.

**Table 1.** ACIAR animal health program budget allocation by country and region

Region	Country	Value of projects		No. of projects <sup>a</sup>
		2004 A\$	%	
Africa		\$5,530,919	12.4	22
	Burundi	100,600	0.2	1
	Kenya	693,550	1.6	6
	Malawi	37,280	0.1	1
	Mozambique	622,905	1.4	2
	RSA	31,500	0.1	1
	Tanzania	132,100	0.3	2
	Zambia	100,600	0.2	1
	Zimbabwe	3,812,384	8.6	8
Asia		\$12,705,224	28.6	22
	Bhutan	178,700	0.4	1
	China	6,193,286	13.9	8
	India	2,483,933	5.6	5
	Nepal	1,000,500	2.3	2
	Sri Lanka	2,848,805	6.4	6
SE Asia		\$22,884,641	51.5	50
	Cambodia	821,266	1.9	2
	Indonesia	9,001,088	20.3	16
	Laos	1,056,675	2.4	3
	Malaysia	3,841,445	8.6	9
	Myanmar	618,715	1.4	2
	Philippines	1,575,148	3.5	6
	Thailand	3,807,390	8.6	5
	Vietnam	2,162,914	4.9	7
Pacific		\$3,159,700	7.1	7
	Fiji	1,014,533	2.3	2
	PNG	233,287	0.5	2
	Pacific (general)	1,911,880	4.3	3
Global		\$166,000	0.4	1
TOTAL		\$44,446,641	100	102

<sup>a</sup> There are a total of 73 ACIAR animal health research projects included in this analysis; many of these are implemented over multiple countries.

ACIAR's assistance has begun to change, with greater emphasis given to the less developed countries in South-East Asia such as Vietnam (cooperation began in 1992), Laos (1997) and Cambodia (1998). The newest partner country is Myanmar, which began cooperating with ACIAR on one project in 2003. These four countries are recognised as having special development needs within ASEAN as the CLMV group. While significant basic research has been done in many areas which may be applicable to the developing countries in South-East Asia, these CLMV countries still require basic institutional development support to ensure that the benefits accruing to other countries can also be appreciated by themselves.

There now seems to be two types of potential partners:

- developed Asian countries that have the ability to work with Australia on biosecurity issues in the Asia-Pacific region
- less developed countries that require the more traditional capacity-building and productivity research, largely aimed at smallholders and poverty alleviation.

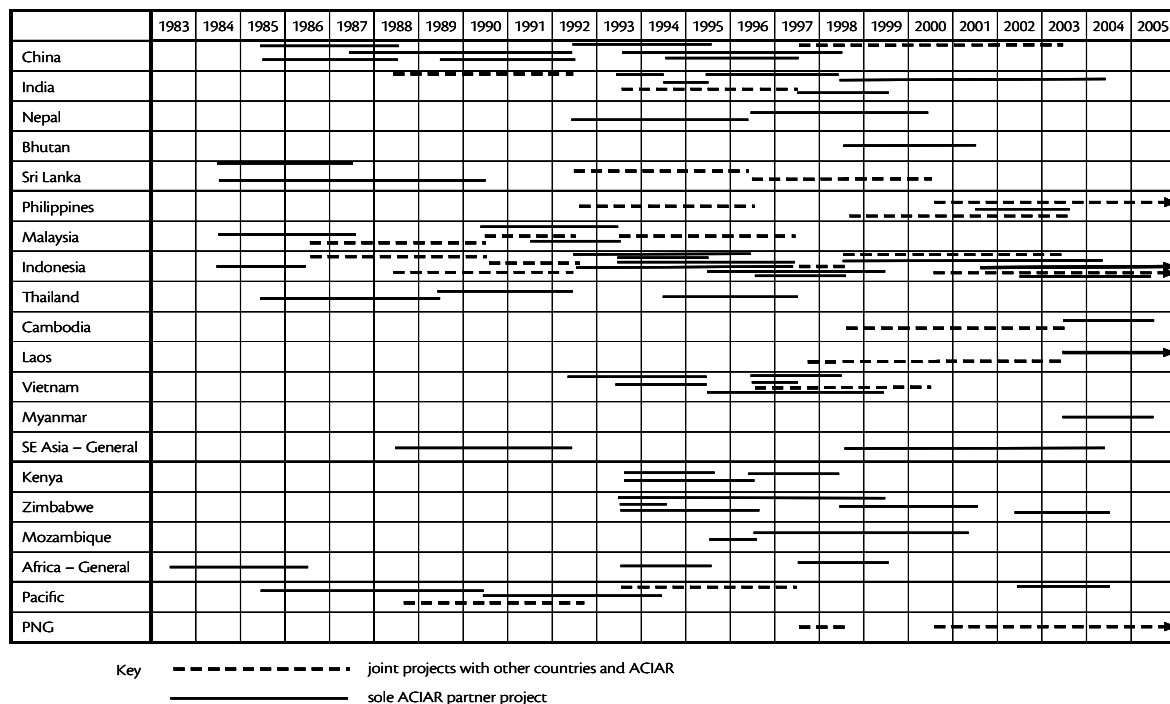
This shift in emphasis will continue as ACIAR's partners achieve greater self-sufficiency and confidence in animal health research.

### 2.3. Issue selection

Initial ACIAR decision-making was undertaken with regard to program managers' consultations with partner countries and subjective scoring systems (Lubulwa et al. 2000). This moved into the development of a framework to act as a guide for program and project assessment. This framework included, in a more formal sense, key elements such as:

- regional priorities
- potential spillovers
- capacity of national research systems
- Australian comparative advantage.

In 1992, the Economic Evaluation Unit (now the Policy Linkages and Impact Assessment Program) was formed. It developed a 'commodities priorities table' which was based on regional groupings. The importance of poverty alleviation as a driver of projects increased through the 1990s and to a certain extent began to affect the



**Figure 1.** Distribution of projects between countries over time

rationale for research. While it became important to identify the potential poverty alleviation benefits of the proposed research a detailed methodology for ensuring this occurred was difficult to implement.

Menz et al. (2000) identified that ‘judgements are made about poverty alleviation aspects of potential research projects’. Target groups are identified within ‘poor’ countries and target commodities identified as those consumed by groups within these areas. It was, however, a ‘subjective poverty framework’ within which ACIAR prioritised projects using economic tools in ex-ante analysis. The conundrum being that the ‘poorest of the poor’, those who may benefit the most from the research, were the most difficult group to actually consult with and reach with extension programs. They were the group which generally does not have the ability or resources to adopt new management techniques and technologies.

In terms of project identification it has been important that ideas originate in partner countries and are developed in consultation between animal health authorities and researchers in Australia and partner countries. They can be justified by detailing:

- the perceived need to control a disease in the country or region
- the perceived threat that the disease presented to Australia

- the specific scientific capacity within Australia and ability of Australian research institutions to work with institutions in partner countries.

The areas or animal health issues in which ACIAR has been involved with have largely been determined by regional priorities and importance. For example, in Africa research has concentrated on tick-borne disease with over 80% of research partnerships being in this area (Table 2). Research in the Pacific has concentrated on endoparasite projects.

Research has ranged from investigating the occurrence and epidemiology of disease through to developing advanced diagnostic techniques at the molecular level. As well as attempting to synthesise the impacts of this large program of work, this review concentrates on two clusters of projects, ND and internal parasites of ruminants.

In addition, the review considers less intensively the research experience of two other infections of international trading significance, FMD and classical swine fever (CSF), the profiles of which were evident during consultations in Asia. Along with highly pathogenic avian influenza (HPAI), these two transboundary diseases have assumed greater importance in regional animal disease control in South-East Asia, the primary region of interest for ACIAR.

**Table 2.** ACIAR budget allocation by region and issue (2004 A\$)

	Africa	Asia	Global	Pacific	SE Asia
Bacterial disease		2,253,573			1,954,533
Diagnostic techniques	197,370	570,675	166,000	415,000	4,104,685
Endoparasites	151,300	4,326,977		2,511,413	7,434,723
Exoparasites					845,630
Newcastle disease	622,905	213,715			2,328,550
Other poultry		2,031,244			2,476,012
Ticks	4,559,344	833,600			160,400
Trypanosomiasis				233,287	375,999
Virus diseases		2,475,440			3,204,109
Total	5,530,919	12,705,224	166,000	3,159,700	22,884,484

## 2.4. Project evaluation/impact

ACIAR has used a range of report series to publish both ex-ante and ex-post evaluations. Initial evaluations were undertaken as a specific series of 12 reports and a summary. They were the Economic Assessment Series. As a result of the formation of the Economic Evaluation Unit (EEU) in 1992 the EEU Working Paper series was introduced to publish research impact activities. A suite of evaluations and papers discussing evaluation techniques and methodologies were published through this Working Paper Series, with most authors being ACIAR staff. In 1998 the EEU changed its name to the Impact Assessment Program (IAP) and began the Impact Assessment Series which tended to be external consultant project evaluations. The Working Paper and Impact Assessment series are both still used. The Impact Assessment Series is used primarily for completed project impact evaluations. The Working Paper series (latest papers were 2004) includes some completed project evaluations that are judged to be lower quality and papers on other evaluation issues which do not fit the Impact Evaluation Series objectives.

Project reviews are expected to use both qualitative and quantitative techniques. Mauldon (1998) and Menz et al. (2000) ranked projects with regard to technical success, human research capacity and community impact. The emphasis has since shifted to a greater requirement for projects to demonstrate poverty alleviation benefits rather than focusing largely on technical merit. ACIAR's evaluators are now required to detail the impact of the project in both the partner country and in Australia with regard to research capacity, producer (commercialisation and farmer/regulator/natural uptake) and consumer benefits (community welfare/environment).

Mauldon (1998) and Auld (1990) summarised a broad evaluation of projects including 28 animal health projects but unfortunately the raw data providing individual rankings against the criteria are not available. Pearce (2002) described a framework to measure the poverty alleviation effects of ACIAR projects. It illustrated the shift in priority from general definition of potential benefits to more specific impacts on the target poor. It also stressed the shift from simply estimating the household and national income benefits to determining the potential welfare benefits, which include equity, environmental and gender benefits, among other things. Project evaluation needs to continue to develop methods of measuring total impact on community, capacity building and rural incomes.

## 3. Meta analysis

In its formal sense, meta analysis is a statistical analysis of a large collection of analyses from individual studies on a particular issue for the purpose of integrating the findings (Glass 1976). Many of the individual studies have quite different results and the meta analysis aims to synthesise these variable outcomes. In this review such a formal approach is not appropriate as the ACIAR portfolio of approximately 70 animal health research projects has not only covered different animal health issues but had varying objectives and expected outcomes. The dataset for this 'meta analysis' is summarised in Appendix 2. For the majority of projects (apart from the clusters) the reports used in developing this dataset were 100- and 600-word project summaries.

Table 3 provides an overview of the analyses undertaken of animal health projects. It summarises the impacts of the projects on partner capacity, domestic producers and consumers, Australia and spillover affects into other countries. These are the impact measurement criteria used by ACIAR. The following discussion highlights the general impacts of the animal health program.

### 3.1. Community impacts

#### 3.1.1. Economic

Measuring community impacts traditionally has been an evaluation of the changes in smallholder income levels that would accrue through a change in input costs or returns from outputs. This has generally centred around a commodity, whole-farm or market analysis which estimates flows of benefits to different sectors of the economy (e.g. producers and consumers). This emphasis has been because there are quantitative techniques readily available that can use research data to produce an objective economic measure of potential or realised returns to research.

Table 4 provides an overview of the project evaluations within the animal health program. There have been 10 formal evaluations undertaken of animal health projects, these include 19 (or 26% of the) projects. Within these evaluations, however, two did not include economic analyses and one could not be costed. Therefore, these were not included in the analysis.

**Table 3.** ACIAR evaluations undertaken of animal health research projects

Project code/s	Project title/s	Report reference	Target country			Australian benefits	Third country benefits	Economic analysis
			Research capacity	Producer	Consumer			
AS1/1983/034	Vaccination of Malaysian village poultry with an avirulent Australian Newcastle disease virus.	Control of Newcastle disease in village chickens with oral V4 vaccine (EAS7)	Large. The major benefit was in the development of research and vaccine production capability.	Modest. Expected benefits were high but adoption by village chicken producers did not occur. Production for commercial producers did occur in Malaysia.	Small. No significant non-producer benefits	Small. There has been no natural uptake by participant or neighbouring countries	Economic surplus. NPV=AS\$144m, BCR=45:1 IRR=50.7%.	
AS1/1987/017	Control of Newcastle disease in village chickens with oral V4 vaccine.							
AS1/1983/003	Ticks and tick borne diseases	Estimates of realised and potential impacts of three ACIAR projects on the ecology, epidemiology and control of ticks and tick-borne diseases in Sub-Saharan Africa (WPS23)	Significant	Significant	Modest	Significant. Not measured	NPV=AS\$1.9 IRR=25%	
AS2/1990/047	Genetic variation, resistance to acaricides and immunological cross-reactivity in ticks that infest cattle in Zimbabwe and Australia		Modest	Significant	Modest	Significant. Not measured	NPV=AS\$112 IRR=33%	
AS2/1991/018	Improved methods for the diagnosis and control of bovine babesiosis and anaplasmosis in Zimbabwe and Australia		Significant	Modest	Small	Significant. Not measured	NPV=AS\$338 IRR=40%	
AS1/1994/022	Prolific worm-resistant meat sheep for Maharashtra, India and Australia	Project development assessment: prolific worm-resistant meat sheep for Maharashtra, India and Australia (WPS24)				Modest. Expected but not valued	NPV=AS\$19m IRR=24% Does not include potential spillovers	
AS2/1989/013	Ecological and host-generic control of internal parasites of small ruminants in the Pacific Islands	A qualitative assessment of the research capacity and community impacts of 3 randomly selected ACIAR-sponsored projects (WPS33)	Large	Small	nn	Modest	na	

Note: Impact is ranked as – not noticeable (nn), small, modest, significant, large

Table 3. <continued>

Project code/s	Project title/s	Report reference	Target country			Austrian benefits	Third country benefits	Economic analysis
			Research capacity	Producer	Consumer			
AS1/1990/001	Improved management for the production of honey and pollination of tropical forests by bees in Indonesia	Research capacity and general community impact of five ACIAR-sponsored projects (WPS34)	Small	Modest	Small	Modest	nn	na
AS1/1987/017	Control of Newcastle disease in village chickens with oral V4 vaccine.	Assessment of 25 ACIAR supported projects in the Department of Agriculture in the Philippines (WPS42)	nn. While vaccine was effective, institutional issues limited uptake. Institutional problems ruined potential experiments	nn	nn	nn	nn	NPV = A\$171.7m IRR = 60% However, no uptake in Philippines. No economic analysis of AS2/1991/016
AS2/1991/016	Fowl cholera; vaccines for Asia							
AS1/1983/034	Vaccination of Malaysian village poultry with an avirulent Australian	Control of Newcastle disease in chickens (IAS1)	Large	Significant	Small	Small	Small	Based on EAS7 but including different potential partner countries. Discounted BCA. NPV = A\$211m, BCR = 68:1
AS1/1987/017	Newcastle disease virus.							
AS1/1993/222	Control of Newcastle disease in village chickens with oral V4 vaccine.							

Table 3. <continued>

Project code/s	Project title/s	Report reference	Target country			Australian benefits	Third country benefits	Economic analysis
			Research capacity	Producer	Consumer			
AS2/1991/017	Management of footrot in small ruminants in hill districts of Nepal	Control of footrot in small ruminants of Nepal (IAS16)	Modest	Significant. Footrot was eradicated in Nepal, significant benefits to poor	Small	Small	Modest. Not evaluated	NPV=A\$2.8m BCR=2.9:1
AS2/1996/021	Control of footrot in small ruminants in Nepal – vaccination and ser-surveillance							
AS1/1983/067	Research and development of foot-and-mouth disease diagnostic methods in Thailand	Improved methods in diagnosis, epidemiology and information management of foot-and-mouth disease in South-East Asia (IAS21)	Significant	Small Potentially a small benefit	Small Potentially will assist but needs to be declared disease free	Significant Development of skills to control disease outbreak	Modest May reduce risk of disease outbreak in other countries	NPV=A\$6.5m BCR=1.7:1 Benefits to be realised on when disease free
AS1/1988/035	Diagnosis and control of foot and mouth disease in Thailand							
AS1/1992/004	Improved methods in diagnosis, epidemiology, economic information management in Australia and Thailand							
AS1/1994/038	Improved diagnostic and control methodologies for livestock diseases in Lao PDR and Yunnan Province (PRC)							
AS1/1984/055	Epidemiology of ephemeral fever in China	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 (IAS23)	Moderate	Significant. Chinese cattle producers will capture 90% of the benefits	Modest. No bluetongue since 1997, potential for the rationalising of testing in the future	nn Could be high in the future, but no benefits estimated in this analysis	Small	NPV=A\$4.6m BCR=2.3:1 IRR=13%
AS2/1990/011	Improved methods for the diagnosis and control of bluetongue in small ruminants in Asia							
AS2/1993/001	Studies of the epidemiology and control of bluetongue in China							

The ND program has, in fact, been the subject of three evaluations<sup>1</sup>, only the results of the latest are included (IAS1).

ACIAR has invested a total of A\$12.3 million (in 2005 dollar terms) in these 16 projects with an estimated NPV of benefits of approximately A\$36.4m. The average BCR of 18.7:1 indicates that for each dollar invested there is a return of A\$18.70. However, this is heavily influenced by a high expected return for the ND projects. When the ND result is excluded the benefits are reduced to a NPV of A\$11.4 million and a BCR of only 2.3:1.

Using the BCR of 2.3:1 the return on investment of all ACIAR's animal health research projects (total investment of A\$44.5 million) is estimated to be over A\$100 million. The small BCR indicates that actual returns per dollar are also low. This estimate does not include the required inputs of both partner countries and other research providers, nor does it include an estimate of the significant spillovers within partner countries and Australia (see Section 3.2) of improved researcher capacity and institutional strength.

**Recommendation 1:** ACIAR should consider a project information system for all animal health projects including two new types of summaries to replace the current 100- and 600-word formats. A short interim summary should include: budget information, project objectives, partner roles and expected technical outcomes, capacity building, economic, social and environmental benefits and discussion of what other activities will be required to ensure that expected benefits accrue to the target stakeholders. A long final summary should include: final budget information, partner strengths and weaknesses, actual technical outcomes, measurement of capacity building, economic, social and environmental impacts, summary of review, details of linkages with other projects and areas of future work.

### 3.1.2. Social and environmental impacts

The social and environmental impacts are, however, much more difficult to estimate and most projects do not make attempts to measure them. While economic improvement is important, it is becoming increasingly important to include the effects on distribution of income and the social implications of changing farming systems. The information available to be used for this meta analysis did not provide any mention of social or environmental objectives or impacts.

**Table 4.** Summary of animal health program economic evaluations

	Project value (A\$m)	No. of evaluations	NPV		IRR		BCR	
			No. of values	Average (A\$m)	No. of values	Average (%)	No. of values	Average
All evaluated projects	12.3	16	8	36.4	5	27	4	18.7:1
Without ND projects	10.2	13	7	11.4	5	27	3	2.3:1

1 These are discussed in more detail in Section 4.1.2.

**Recommendation 2:** ACIAR should place more emphasis on social impact of animal health projects. Short and long summaries should include sections on expected and actual social/community impacts. Expected outcomes should only describe those that the project itself can realistically expect to deliver and against which it can be fairly evaluated.

### 3.2. Scientific characteristics and outcomes

The technical characteristics of the animal health research portfolio are summarised in Table 5. As well as the tick-borne disease projects, two projects have not been included in this table as they were quite different to other projects (project AS2/1993/727 aimed to build a animal facility in Kenya and AS1/2001/025 aimed to develop a global compendium on animal health and production). This information is collected from the relevant 100- and 600-word project summaries. Additional project reports and reviews were used to identify outcomes for ND and endoparasites.

This analysis illustrates that the great majority of ACIAR projects were either basic research that increased knowledge and understanding of the animal health issue, or applied research, developing tools and strategies for disease surveillance and control. Only 5 of the 57 projects had objectives to implement disease control.

The basic research projects were heavily biased towards epidemiological studies that investigated the occurrence of a disease of interest or of various strains of causative agent, such as FMD virus types. This probably reflects that the aetiology, basic epidemiology and pathogenesis of these diseases were already well understood and the need was to describe their presence in the partner countries to evaluate their importance and allow appropriate diagnostic and control tools to be developed. This is well illustrated by the objectives of the bacterial group of projects on ovine brucellosis, haemorrhagic septicaemia and foot infections (see Appendix 2). In addition to this basic research, the endoparasite group of projects investigated the life cycles and epidemiology of various parasites and a small number of projects investigated more fundamental topics, such as pathogenesis and immunogenesis and genetic resistance.

**Table 5.** The stages and types of research undertaken in ACIAR's animal health projects (excl. tick projects)

Stage of research <sup>a</sup> :		Basic		Applied				Implemen- tation	Outcomes reported <sup>d</sup>
Type of research <sup>a</sup> :		Disease occurrence <sup>b</sup>	No. of projects	Tests develop- ment	Vaccine develop- ment	Control strategies	No. of projects	No. of projects	No. of projects
Project group	No.								
Bacterial diseases <sup>c</sup>	5	5	5	3	2		5		1
Diagnostic techniques	8	1	2	6		1	7	1	2
Endoparasites <sup>c</sup>	15	2	10	1	1	8	11	1	10
Exoparasites	1		1		1		1		
Newcastle disease	5			1	5		5	2	5
Other poultry and pig projects	8	1	3	1	5		7		
Trypanosomiasis	2		1	2		1	2		1
Virus diseases	13	7	10	6	6		10	1	1
Total	57	16	32	20	20	10	48	5	20

a A project may include more than one stage and type of research.

b Disease occurrence includes studies that investigated different strains of infectious agents.

c Objectives and outcomes not summarised for one project in each of the bacterial (AS2/1991/017) and in the endoparasite groups (AS1/1992/044).

d Additional project reports and reviews were used to identify outcomes for ND and endoparasites.

Describing the impacts of the full animal health research program is difficult as data on the outcomes of the projects in the 100 and 600 word summaries used for most projects in this analysis were quite variable. The summaries reported actual outcomes, rather than expected outcomes, for only five projects other than those in the ND or endoparasite clusters. The outcomes of the ND and ruminant endoparasite clusters are discussed in greater detail in the next section of this report. On the basis of the foregoing analysis of the levels and types of proposed research, the ACIAR evaluations summarised in Table 3 and discussions with researchers and animal health authorities, it is apparent that the impacts of the research were largely confined to increasing scientific knowledge and tools and capacity building.

In most cases the expected outcomes were appropriately couched in terms of increased understanding of the disease in the partner country, improved diagnostic techniques and improved vaccines. However, a significant number of projects optimistically foresaw higher level outcomes resulting from the longer-term use of the knowledge and tools developed by the research. These included improved control programs and increased production, trade and farmer incomes. Understandably, the great majority of the research projects (i.e. basic or applied projects) had no means of implementing this and delivering the benefits that they hoped for.

Given the nature of the projects, the standing of the collaborating institutions and Australia's comparative advantage in the research areas, it is very likely that most of the projects had a significant impact on the scientific and research capability in the partner countries. Actual outcomes were summarised for 20 projects and 9 of these specifically reported enhanced scientific capacity and/or collaboration in the partner country, and one of the trypanosome projects reported enhanced capacity Australia. In the other projects, the actual outcomes reported also reflect increased capacity (for instance, in the ND projects).

This view was supported by discussions with researchers and animal health managers in Indonesia, Laos and Thailand. ACIAR was recognised as a significant contributor to capacity building and collaboration with Australian scientists was valued. Many of the researchers were extremely grateful for the opportunities and training that they had experienced when working on

ACIAR projects. As well as on-the-job training, formal academic qualifications were attained. The capacity to publish in peer-reviewed journals in English and present papers at international conferences allowed scientists to contribute to animal health globally. These 'champions' were important not only to the success of projects but facilitated the improvement in research capacity within their home country. One prominent Asian scientist felt that one of the most important outcomes of successful ACIAR projects in Thailand was respect for the scientific approach within government and that this was now critical to the regional management of transboundary diseases and especially HPAI. Although implementation of research results was not an outcome for most projects, ACIAR can claim some share of the credit for contributing to the scientific capacity on which regional disease control programs are now being developed in South-East Asia.

## 4. Cluster overview

### 4.1. Newcastle disease

#### 4.1.1. Overview

ND is a viral disease of poultry, primarily of chickens. Its causal agent, Newcastle disease virus (NDV), is endemic globally as a variety of strains that range from non-pathogenic (lentogenic) strains through to highly pathogenic (velogenic) strains. The latter are endemic in Asia and Africa and cause high mortalities in young chickens. Control of pathogenic ND is by vaccination, and attenuated live vaccines have been available for many years, mainly the La Sota strain. Like most live vaccines, these are sensitive to heat and depend on rely on the existence of a 'cold chain' from vaccine producer to vaccinator to maintain their viability and immunogenicity. Catching and handling young chickens twice to vaccinate them effectively is also difficult to achieve in the village situation where chickens roam freely and roost in trees.

ACIAR supported Dr Peter Spradbrow's team at the University of Queensland and Dr Ibrahim's team at Universiti Pertanian Malaysia (now Universiti Putra Malaysia) to develop a vaccine for application at the village level with two innovative features its resistance to

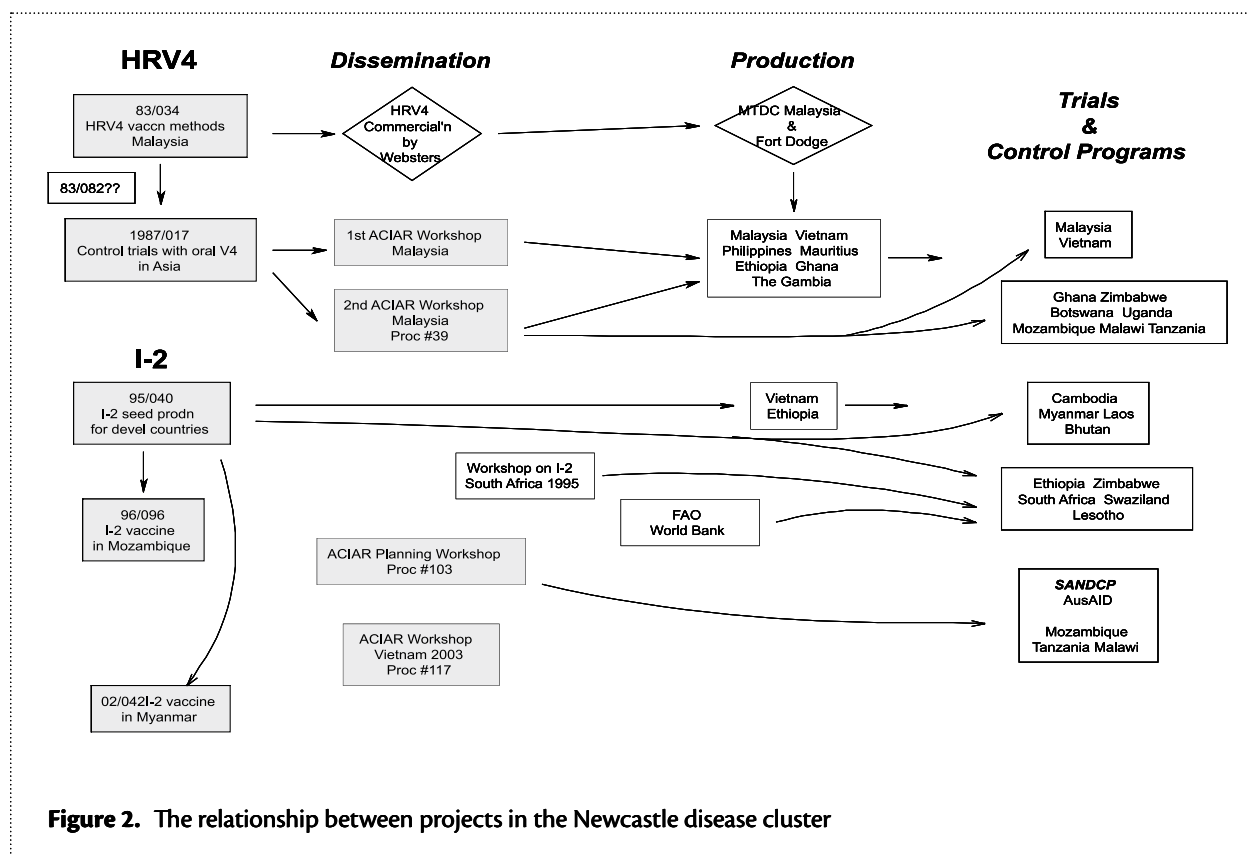
heat and its ability to be administered in feed. The result was a heat-resistant variant of a lentogenic Australian virus, V4. The process of development and dissemination and use of heat resistant V4 (HRV4) vaccine is summarised in Figure 2. HRV4 was commercialised by an Australian vaccine company, Websters, which was subsequently taken over by American companies. This complicated the process of distributing the seed strain to developing countries and increased the cost so ACIAR again supported the Queensland team to develop another effective, heat-resistant strain, I2 (or I2). This seed strain has been freely available to developing countries since the mid-1990s (Spradbrow 2004).

### South-East Asia

The dissemination of information on these vaccines and their uptake by producers and programs in various countries is illustrated in Figure 2. In summary, in Asia there has been good uptake in Malaysia (where HRV4 was developed) and Vietnam, and more recently in Myanmar (AS1/2002/042), but there has been little or no interest or uptake in most other Asian countries.

In Malaysia, the initial ACIAR project (AS1/1983/034) started in 1984 when a large proportion of the chicken population belonged to villagers and mortalities of 50% were not uncommon in ND outbreaks. The requirements to maintain vaccine viability by cold chains and to handle individual birds to vaccinate them did not facilitate effective protection of village chickens. The project successfully developed HRV4 for application on feed and demonstrated its effectiveness in protecting village chickens.

Since that time, a large integrated chicken industry has been developed in Malaysia and, by 1998, relatively large semi-intensive flocks of chickens were reported in village environments (ACIAR IAS1, 1998). HRV4 is manufactured by a commercial company and has continued to be produced in a freeze-dried form for mixing with feed or drinking water at the village level. However, it appears not to be a major tool in the overall management of ND, with about 40 different imported ND vaccines being used in Malaysia in the late 1990s. In 2004, 85 million doses of monovalent V4 vaccine and 31 million doses of a combined vaccine were sold. To put this in perspective, 460 million doses and 567 million



**Figure 2.** The relationship between projects in the Newcastle disease cluster

doses of similar ND vaccines were imported in that year. The price for V4 vaccines is similar to that for other vaccines (Roshidah, pers. comm. 2005).

The application of HR ND vaccines has been reported to have been best applied in Vietnam (Spradbrow 2004; Meers et al. 2004 – ACIAR Proceedings No. 117) where ND had been a major cause of losses in chickens with morbidity of 25–30% and high case fatality rates. Laboratory trials of eyedrop and feed-based I2 vaccine were undertaken in the late 1990s and found high levels of antibody and protection after three months (Duong Nghia Quoc 2004).

In 2001 and 2003, ACIAR seminars (Alders and Spradbrow 2001 – ACIAR Proceedings No. 103; Meers et al. 2004 – ACIAR Proceedings No. 117) reported that, in the late 1990s, trials and demonstrations had been undertaken in four provinces involving large numbers of villages and chickens and found that I2, initial dose by eyedrop with booster on feed or in drinking water, was at least as effective as other vaccine strains. Freeze-dried vaccine was stable at room temperature for at least 3 weeks and was supplied in containers that were more suitable for village chickens (25, 50 and 100 doses). This work was supported by AusAID and other funders such as NOVIB from the Netherlands.

Although I2 has been shown to be effective and was considered to be the vaccine of choice for village chickens in Vietnam, vaccination coverage appears to still be low. CIE (ACIAR IAS1, 1998) reported that 75% of the 120 million chickens were village chickens, leaving approximately 30 million commercial poultry. In 1998, Navetco produced a total of 30 million doses of vaccine (which would vaccinate 15 million birds with two doses annually). At that stage, only 10% of this production was I2 vaccine although the expectation was that I2 would become the major vaccine. By 2000, Navetco had increased its annual I2 production to about 14 million doses (Spradbrow 2004). Between 1998 and September 2005, Navetco had produced about 68 million doses of I2 vaccine (of which five million doses had been exported to Africa). As it is packaged in relatively small batches of 25 and 50 doses primarily for village use, the price is a little higher than other ND vaccines (Tran Xuan Hanh, pers. comm., October 2005).

Myanmar has recently taken up I2 vaccine use for village chickens in a dramatic manner with government support. The central vaccine production laboratory started

producing I2 in 2000 with 15 million doses of freeze-dried vaccine but has since changed to increased production of a wet form of which it has produced 60 million doses in each of the past 3 years in 300-dose containers. This level of production is expected to be maintained. Much smaller quantities (1 million doses each) of Cairo F strain and Komarov strains are also produced and are sold at several times the price of the I2 vaccine for use in semi-commercial chicken farms, and other vaccines are imported for large-scale chicken production.

Two vaccination programs are undertaken in Myanmar, one by the FAO and UN High Commission for Refugees in the north and the main program supported by a significant government animal health service (J. Meers, pers. comm., October 2005). I2 vaccine has also been used in community-based animal health projects in Cambodia and Bhutan (Alders 2003)

### **Other Asian countries**

During this study we visited animal health authorities in Indonesia, Thailand and Laos. In the first two countries, there was no known use of either vaccine and little awareness of them although Indonesia had conducted trials during a 3-year project in the 1980s. The national vaccine manufacturer, Pusvetma, is currently investigating I2, prompted by a conversation with the ACIAR program director.

Laos' National Vaccine Production Centre started to produce I2 vaccine in 2004, but sold only 13% of the 120,000 doses produced. In comparison, the proportions sold of the two main ND vaccines produced in Laos in 2004 were 70% of each of 1.2 million doses of F strain and 1.6 million doses of M strain. In the same year, about 70% of the 3 million doses of fowl cholera vaccines were sold. Given that the chicken population of Laos is about 10 million birds, of which 90% are estimated to be owned by villagers, the overall vaccination coverage is very low and probably heavily biased towards commercial broiler growers. Better communication of the heat resistance advantages and potential savings in cold-chain costs would probably increase the uptake of I2 in intensive poultry production.

In Laos, the smallholders lack of interest in I2 in its first year may largely result from a lack of awareness or understanding of its advantages but may also be affected by its higher price relative to the alternative M/F strain combination and to the perceived inconvenience of the

recommended vaccination of the whole multi-age flock (in feed) every 3 months. Packaging of ND vaccines in 50- or 100-dose containers would also not suit many smallholders and wastage would make the vaccine more expensive.

In Thailand, the government vaccine centre at Pakchong distributed 188 million doses of La Sota and F strain vaccine for government programs or for sale in 2003. The vaccines are distributed in 100- or 200-dose packages. Just over half of that vaccine was used in government programs to prevent ND occurring in smallholder flocks in the commercial poultry producing regions from which broilers are exported. These multi-age smallholder flocks are vaccinated four times a year. Most of the vaccine sold by the government laboratory is also used by smallholders or small commercial producers. Large scale commercial poultry companies use imported vaccine, none of which is V4 or I2.

*Trials had been undertaken in the Philippines but Mangabat et al. (2002) attributed much of the failure of HR vaccines to bureaucratic and resource constraints at the level of government. The transfer of a key person from the project may have also contributed significantly to a failure to take up V4 vaccine.*

#### **Reasons for uptake of HR vaccines in Asia**

*Since 1998, there have been a variety of training workshops and courses conducted by the University of Queensland in association with ACIAR, AusAID, the European Union and/or FAO to transfer I2 vaccine production technologies. In Asia, these have been run in Vietnam, Laos, Cambodia, Myanmar and Bhutan.*

The comparative success in uptake of HRV4 and I2 vaccines in Malaysia and Vietnam appears to have been due to:

- local champions to demonstrate its effectiveness
- government support for vaccination of village chickens
- good dissemination of information of the technology through workshops
- successful demonstration trials
- production by local vaccine manufacturers
- appropriate container sizes.

In Malaysia it should be noted, however, that the initial government programs in the early 1990s took little advantage of the vaccine's heat resistance, relying on a cold chain to keep the 50 kg batches of HRV4-inoculated feed at 4°C.

*In Myanmar, it appears that the technical capacity developed following an initial in-country training workshop and the training of a laboratory scientist at the University of Queensland in production and quality control techniques, has been successfully complemented by government policy and funding to effect widespread application of I2.*

In comparison, although the advantages of oral administration to village chicken was recognised, its apparent 'marketing failure' in Indonesia, Thailand, the Philippines and other countries appears to have been due to:

- initially variable and unconvincing field trial results in project 1987/017 (for instance, see Spradbrow 1992 – ACIAR Proceedings No. 39: papers by Jackson, Urasri et al. in Thailand; Fontanilla and Silvano in the Philippines)
- small market opportunities for commercial manufacturers
- lack of institutional support from government
- familiarity and comfort with existing vaccines by producers and main users.
- requirement for registered vaccines in commercial industry
- inadequate communication of the technology to decision-makers at several levels including national and regional animal health authorities and industry
- village poultry's low value and importance compared to pigs, cattle and/or buffalo
- ND's relatively low priority on national and FAO disease program lists
- expanding commercial poultry industries' having to source additional vaccine by importing other strains and their ability to maintain the required 'cold chains'
- smallholders aversion to voluntarily vaccinating multi-age village flocks every 3–4 months.

## Africa

Concern about the impact of ND on poor African villagers and interest in the use of HRV4 were raised at the ACIAR workshop in Kuala Lumpur in 1991 (Spradbrow 1992 – ACIAR Proceedings No. 39). Malawi had started using HRV4 in commercial poultry flocks, and African countries had requested the Pan African Vaccine Centre (PANVAC) in Ethiopia to coordinate pilot trial of HRV4 in village chickens.

HRV4 and subsequently I2 were distributed from Australia to PANVAC for vaccine production and independently to several countries in Africa. Commercial HRV4 was also imported to other African countries from the USA and Malaysia.

Poultry production and health in Africa and the role of ND and vaccination were reviewed in ACIAR's Maputo workshop in 2000 (Alders and Spradbrow 2001 – ACIAR Proceedings No. 103). The use of HR vaccines was very variable. In Mauritius, a freeze-dried thermostable V4 vaccine has displaced other vaccines with about 2.5 to 3 million doses produced annually during the 1990s. South Africa uses several types of vaccine including a V4 vaccine but in other countries such as Angola, Botswana and Zambia, no HR vaccines were used and vaccination using La Sota and Hitchner B1 continued to rely on cold chains. In Tanzania, Zimbabwe and Mozambique, HRV4 and/or I2 vaccine is used but delivery on feed was found to be ineffective and discontinued in favour of eye-drop administration. In a review of ND vaccines presented at the Maputo workshop (ACIAR Proceedings No. 103, 2001), Bell noted that although feed application of the HR vaccines was easier than eye-drop application, 'the variable results obtained and the variation in feed in different places argue against this route of application.'

The longer term uptake and impact of HR vaccines in controlling NDV in Africa has not been published but activities were presented at a seminar in Tanzania in October 2005. Factors mitigating against the uptake of ND vaccination in Africa villages include:

- small numbers of chickens in villages
- multiple ownership of the chickens
- large dose packaging of vaccines that increased cost and wastage (typically 1000 doses)
- cost of vaccine

- accessibility of vaccine
- need to individually handle chickens
- limited economic and political influence of village chicken owners (who are largely women)
- use of traditional medicines
- fears that vaccinated birds would die of other causes or succumb to other fatal diseases or theft.
- inadequate extension personnel, training and aids.

The Southern African ND Control Program (SANDCP) has implemented a coordinated approach to preventive ND vaccination programs in southern Africa. This is an AusAID-funded extension of the ACIAR projects (Figure 2). SANDCP aimed to assist the governments in three countries—Mozambique, Malawi and Tanzania—to improve food security and an livelihoods for their rural poor. It promoted local production and quality control of I2 vaccine and coordinated administration on a village level by community vaccinators. The program also undertook successful village demonstrations and established a workable cost-recovery system for village people (Alders et al. 2005).

In Mozambique, trials in which village chickens were vaccinated every 4 months with I2 found that participants' chicken numbers increased approximately 2.5–3-fold and that consumption and sale of chicken meat and eggs increased (Langa et al. 2001; Woolcock et al. 2004). The success of these field projects appears to have been largely due to:

- a more urgent need to improve smallholders' protein nutrition and livelihoods, especially in Mozambique
- the inability to develop alternative livestock raising options in many African villages
- dissemination of the information through scientific workshops
- committed staff working in southern Africa
- active extension to explain vaccination programs
- support and active encouragement by FAO and other agencies.

In two contrasting regions in Tanzania surveys that were undertaken over three years during 2003–2005 found that chicken flock sizes numbers increased and mortalities decreased significantly in households that vaccinated regularly compared to those that did not

vaccinate (Alders et al. 2005). This was particularly evident in the region where people had few cattle and were more heavily dependent on chicken production. During this study, participation rates increased and people were willing to pay for the vaccine suggesting that ongoing ND management was commercially viable.

Despite the well-recognised and serious impact of NDV on smallholder welfare and the demonstrable benefits of controlling ND, the availability of a cost-effective thermostable vaccine for village chickens has not resulted in widespread uptake of the technology. While HRV4 and I2 have advantages over other vaccines in price, thermostability and potentially ease of application in some circumstances, the resulting immunity is less persistent and requires more frequent boosting than the traditional vaccines like La Sota. However, choosing a HR vaccine or not is only a minor factor in determining the success of a control program. As well as the factors discussed above, achieving successful control of ND that produces widespread and ongoing community benefits is a complex task. Alders outlined the challenges and proposed means of dealing with them in the Maputo proceedings (Alders and Spradbrow 2001 – ACIAR Proceedings No. 103). She identified high-level factors such as organisational infrastructure, community involvement, effective communication and extension, and economic sustainability as critical elements. In 2003, Alders proposed that commercialisation of vaccine production and its delivery and markets for surplus chickens are also essential to sustain successful vaccination programs. The commercialisation chain involves vaccine producers, distributors, vaccinators and farmers. Apparently, this process is working well in Mozambique.

AusAID's mid-term review of SANDCP in May 2004, also identified high-level factors that would be critical to sustainable and effective control of ND in southern Africa after the project finished. These included:

- taking an organised campaign approach to vaccination
- integrating ND control into national priorities and programs
- developing national strategies that are appropriate for and consistent with the country's budgetary situation, legal frameworks and regional goals and inputs

- increasing the vaccine market to sustain economical vaccine production and distribution.

ACIAR has supported a series of high-quality dedicated research projects on the control of ND utilising technology that is appropriate to smallholder/village chicken production. It has not only supported dissemination of its research through workshops, international conferences, scientific papers and field demonstrations but also has published a suite of comprehensive and complementary manuals to assist livestock and animal health authorities in developing countries to successfully implement ND control programs:

- Field manual on controlling Newcastle disease in village chickens—a field manual (Alders and Spradbrow 2001).
- Controlling Newcastle disease in village chickens—a training manual (Alders et al. 2003).
- Controlling Newcastle disease in village chickens: a laboratory manual. (Young et al. 2003).

Additional extension material has been published in English, Portuguese and local languages (e.g. in southern Africa under AS1/96/96 and in Myanmar under AS1/2002/042).

There is still, however, considerable scope for uptake of these technologies for successful control of ND. Several projects, funded by a range of agencies (including FAO, IAEA, Danida and others) have been undertaken to improve village chicken production in parts of Africa and Asia (see Alders and Spradbrow 2001 – ACIAR Proceedings No. 103). FAO noted in 1998 that 'Newcastle disease, which is the major constraint identified by farmers, should be given priority at all stages'. However, successful control of ND on a broad scale and the resulting positive impact on smallholder welfare are unlikely to be achieved unless ND control is incorporated as one component of an integrated approach to improving village poultry management, marketing, nutrition and disease control. How ACIAR integrates its research with complementary extension and training activities in such programs will have a significant effect on achieving the desired impacts on human welfare.

As developing countries improve their vaccine standards, I2 vaccines will be challenged to comply with good manufacturing practice and registration requirements in each country. This will also require higher standards of

quality control such as growing the virus in eggs derived from SPF chicken flocks. Only Vietnam has registered its I2 vaccine to date. Whether other developed countries follow suit will influence the availability and use of I2 in the medium to long term.

#### 4.1.2. Past economic reviews

There have been a significant number of analyses undertaken to evaluate both success of the ACIAR projects in developing ND vaccines and the effects that ND vaccination has had on smallholder welfare. An impact study as part of the SADC project in Africa (Alders et al. 2005) indicated that vaccination had increased dramatically between 2003 and 2005 and chicken mortality from ND had declined as had forced sale and consumption of chickens due to fear of ND.

Woolcock et al. (2004) estimated that by controlling ND household income derived from chickens would increase by 42% and if this vaccination program was accompanied by other initiatives (e.g. improved husbandry and management, measures to reduce predation and theft) income from chickens could increase by 82%. They base their analysis on the limiting factor of low-input feed availability and argue that ND control allows smallholders to manage a typical flock-size (10 hens in Mozambique) more efficiently and hence increase income. In a country with a GDP per capita of US\$210 per year, they estimate that through ND control smallholders can increase the cash income by US\$23—over 10% of GDP. This increase of approximately 40% per year is supported by the analysis undertaken by ACIAR in 1998 (ACIAR IAS1, 1998).

The ND control program has been undertaken in three phases: the development of the HRV4 vaccine and subsequent commercialisation; the development of the I2 vaccine made available for village-level chicken producers; and the shift in focus to Africa. During each of these phases economic analyses have been undertaken.

An analysis (ACIAR IAS1, 1998) of the I2 vaccine development program (AS1/1983/034 and AS1/1987/017) estimated potential production increases of 47% and annual returns of A\$640,000 per year. These translated into discounted benefits of A\$144 million for the 20-year period between 1990 and 2010 (Table 6). This study was undertaken with the expectation of adoption not only in Malaysia, but also in other ASEAN countries.

They estimated that adoption of the V4 vaccine would begin in 1996 and increase throughout the 20-year impact time frame. The economic analysis based on these assumptions indicated significant benefits across Asia. A benefit/cost ratio (BCR) of 45:1 and internal rate of return of 51% certainly high enough to show the value of the ACIAR research.

Adoption, however, did not follow as anticipated (for more detail see Section 8). Even now there has been no uptake in Thailand, the Philippines, Indonesia and Sri Lanka. Uptake in Malaysia has also proved difficult to measure. Replication of this initial analysis assuming an adoption rate only in Malaysia of 30% by 2010 changes the results significantly. An investment with high expected payoffs declines to barely break-even when a more realistic adoption figure is used.

A further review (ACIAR IAS1, 1998) included further work undertaken to develop the I2 vaccine and estimate uptake of the vaccines in Asia and Africa. This review deleted Indonesia, Thailand and Sri Lanka from the analysis as it had become clear that uptake had stalled in these countries. This new analysis introduced Vietnam and Tanzania as countries which were beginning to use the ACIAR-developed vaccines.

More recent discussions indicate that the uptake of these vaccines has now shifted significantly from Asia to Africa. Work stalled in the Philippines and data on the impact are not easily available for the two main users of HR vaccines, Vietnam<sup>2</sup> and Malaysia. The AusAID-sponsored project in Mozambique, Malawi and Tanzania has shown that there is significant benefit to smallholders but uptake at the national level is still not available to the reviewers. The final project workshop was held in October 2005 and the proceedings may provide some information in this regard in 2006.

The difficulty in evaluating a program such as this is that the major benefits accrue when new consumers are introduced to the technology. While this is acknowledged in ND evaluations (ACIAR IAS1, 1998, p. 21) it is not adequately included in the sensitivity analysis. The benefits of substituting existing vaccines with I2 or V4 will only be marginal. The other issue which may have led to overestimation of impacts is that controlling ND may not necessarily lead to expected chicken mortality

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2 A total of 68 million doses of I2 vaccine have been produced in Vietnam since 1998.

**Table 6.** Summary of economic analyses undertaken for ND control program

Report title	Year	Vaccine	Country	NPV (A\$m 2005)	BCR	IRR (%)	Benefit/bird (A\$ 2005)	Adoption rate 2010 (%)	No. of village chickens (m)	No. vaccinated 2010 (m)	Total benefits 2010 (A\$m 2005)
ACIAR EAS 7	1991	V4	West Malaysia	144	45	51	0.86	50%	36	18	1.5
			East Malaysia	144	45	51	0.86	50%	40	2	1.7
			Thailand	144	45	51	0.86	50%	900	45	38.7
			Philippines	144	45	51	0.86	50%	430	21.5	18.5
			Indonesia	144	45	51	0.86	50%	1740	87	74.8
			Sri Lanka	144	45	51	0.86	50%	2.0	1	0.9
			Total								316.6
ACIAR IAS 1	1998	V4, I2	Malaysia	211	68	31	1.82	35%	6.5	2.3	4.1
			Vietnam	211	68	31	1.18	23%	900	20.7	24.4
			Philippines	211	68	31	0.79	15%	766	11.5	9.1
			Tanzania	211	68	31	0.5	10%	20.1	2.0	1.0
			Total								193.2
Program Review	2005	V4, I2	Malaysia <sup>1</sup>	12	4.8	29	1.82	30%	3.6	1.1	2.0
			Laos	12	4.8	29	1.18	5%	3.6	0.2	0.2
			Vietnam	12	4.8	29	1.18	5%	49.5	2.5	2.9
			Myanmar	12	4.8	29	1.18	5%	18.0	0.9	1.1
Total								7.2	4.6	6.2	

<sup>1</sup> Adoption for Malaysia peaks in 2001 and then V4 becomes part of many vaccine choices; I2 is not adopted in Malaysia

decreases, as freedom from this disease may allow greater losses from other sources such as rodents and other disease and management constraints. A base scenario for disease-free status may not be increases in productivity equal to those caused by ND mortality but rather a proportion of this. The most recent review estimates a discounted NPV of A\$211 million and an IRR of 31%, assuming a 40% increase in chicken productivity (Table 6). The majority (60%) of these benefits are estimated to be found in Africa. A 20% increase in productivity would provide a BCR of A\$47 million and IRR of 31%.

#### 4.1.3. Updating the economic analysis

In Laos, I2 vaccine was produced for the first time in 2004 by the National Vaccine Production Centre (NVPC). Of the 120,000 doses produced only 15,650 (13%) have been sold. This compares to 1.1 million doses of M-strain vaccine and 835,000 of the F-strain sold. No further I2 is being produced in 2005. Part of the reason for the poor uptake is the cost per dose of the I2 vaccine compared to the use of the M and F<sup>3</sup> strains (Table 7). While not including transport and storage costs (characteristics where the I2 will have significant cost advantages), it is clear that using the I2 vaccine is still more expensive than the present alternative in Laos.

The expectation of adoption in Asia has shifted to Laos, Vietnam and Myanmar. However, it appears that the vaccine produced is distributed mainly

through multilateral (AusAID in Vietnam and FAO and UNHCR in Myanmar) agency support. Actual adoption by smallholders, while unknown, is assumed to be minimal. Table 6 provides an updated scenario of returns to ACIAR research into ND. It is based on many assumptions of expected smallholder uptake in Laos, Vietnam and Myanmar. It also includes some benefits that did accrue in Malaysia, although I2 was not adopted and V4 has become just another vaccine option rather than a vaccine of choice to the commercial sector. While there is significant production being undertaken in Myanmar this is to support government programs rather than meet producer demand. When this support ends it is assumed that these vaccine production levels will also be reduced. Adoption in Myanmar is assumed to be the same as in Vietnam. Adoption in Vietnam began in 1998 while in Myanmar adoption did not begin until 2003. Adoption and spillovers into Africa and potential new (and renewed) markets in South-East Asia have not been included. The program costs include only the ACIAR vaccine development costs (A\$3.1 million) and the cost of the latest ACIAR project in Myanmar (A\$405,000). Cost estimates do not include any supporting multilateral or local government support programs being undertaken within these countries.

Using these data and based on the expected gains per bird as estimated in ACIAR IAS1 (1998), the NPV of the benefits of the ND cluster of programs is reduced significantly to A\$12 million with a BCR of 4.8:1 and an IRR of 29%. This economic analysis has highlighted

**Table 7.** ND vaccine costs in Laos (2005)

Vaccine	I2	Combined M & F strains
Doses/package	50	100
Price/package (US\$)	0.20	0.30
Price/dose (US\$)	0.004	0.003
Doses/bird/year	4	2
Total cost 1000 birds (\$US)	16	6

3 The I2 strain is provided with feed or in water four times per year to the flock. The M and F vaccines are provided as a package; M is used with DOCs and F at 3 weeks old, both distributed with eyedroppers.

the fact that previous expectations of adoption of the technology in Asia were overestimated. Even though the technology is a good one, the demand for the heat-resistant ND vaccine by smallholders and probably the commercial sector was, in fact, quite low. The challenges of technology uptake in smallholder chicken systems that are small-scale, low-input source of protein rather than market-oriented may not have been fully appreciated during the program development phase.

Stating that the expected smallholder economic benefits have not been realised does not detract from the other less measurable benefits of increased capacity of researchers throughout Asia and the benefits of the availability of an alternative type of vaccine. Improvements in capacity to research and the experienced gained in implementing chicken vaccination programs may also have significant spillovers as Asian countries attempt to minimise the impact of AI in their communities.

## 4.2. Endoparasites

### 4.2.1. Overview

Ruminant endoparasites comprise a broad range of roundworms (nematodes), flatworms (trematodes) and tapeworms (cestodes) that primarily inhabit the gut but can have intermediate or final stages in other parts of the body. The adult worms usually lay eggs that are expelled into the environment. There the parasites persist in the egg or as intermediate larval forms. The intermediate stages of trematodes parasitise snails and hence flukes (*Fasciola* spp.) are common in wet areas. In temperate livestock production systems in Australia, liver fluke and small gastrointestinal roundworms are significant pests, especially in sheep and goats. In tropical Asia, liver fluke and large roundworms are also major pests of cattle and buffalo.

Ruminant endoparasites have a relatively low profile in global and national animal health programs, as they have already occupied most or all their potential host and environmental ranges and are endemic in virtually all livestock production systems and environments to which they can adapt. Yet the damage they do to animal tissues or their blood sucking cause poor production, ill-thrift and deaths in livestock worldwide and billions of dollars are spent on preventive strategies and curative treatments. While animals that have evolved in

parasitised environments may have natural resistance to their pathogenic effects, introduced naïve animals may be severely parasitised.

ACIAR's endoparasite projects have extended over three main groups of parasites in a range of hosts and environments (see Table 8). The projects have focused on developing better control and prevention through improved understanding of the epidemiology of the parasites and the development of strategic control programs that integrated management and existing drugs. Potential genetic resistance to parasites and vaccination were also investigated.

### *Toxocara vitulorum*

Buffalo are a major source of meat and power in Asia. Buffalo calves are particularly susceptible to this large ascarid roundworm as they are infected directly from their dams during the first week of life. The mass development of large roundworms in the gut cause heavy mortalities, estimated at 20–30% in Sri Lanka before the project started.

The project successfully described the life cycle of this worm and evaluated the effectiveness of treatments using existing anthelmintics. The result was that a simple more effective and less costly regime of a single drug treatment replaced the existing regime. The study also demonstrated that treatment of other gastrointestinal nematodes in buffalo calves had no benefit, saving the cost that had previously been spent on 5–6 treatments to control these worms. The findings of the project were extended as they were attractive to both extension workers and farmers in Sri Lanka where the treatment was well adopted. It was proposed to extend the research and strategies to other countries, though ACIAR was not involved with this and it is not clear how effective this was. A comprehensive international review of *Toxocara vitulorum* was published by the principal investigator to improve global understanding and control (Roberts 1993). Discussions during this study indicated that, in both Laos and Thailand, toxocariasis was a recognised problem in young buffalo and the treatment of calves in their first month was recommended, but the level of voluntary uptake by farmers was not known.

Much of the success of the project was attributed to the principal investigator, Dr J. Roberts, whose enthusiasm and collaborative skills enlisted the support of others.

**Table 8.** ACIAR's projects on internal parasites of ruminants

Parasite	Animals	Years	Countries	Projects
Toxocara	Buffalo	1984–1987	Sri Lanka	AS1/1983/016
Fasciola	Cattle & buffalo	1992–1996	Indonesia	AS1/1991/023
		1992–1997	Indonesia	AS1/1990/049
		1998–2003	Indonesia, Philippines, Cambodia	AS1/1996/160
	(Thin-tailed sheep)	1998–2004	Indonesia	AS1/1997/027
		2004–2005	Cambodia	AS1/2002/099
Nematodes	Small ruminants	1985–1990	Pacific	AS1/1984/018
		1988–1992	Fiji, India, Malaysia	AS1/1985/023
		1990–1994	Pacific	AS2/1989/013
		1993–1997	Fiji, India, Malaysia	AS2/1991/032
		1993–1994	India	AS2/1992/044
		1993–1995	Malaysia	AS2/1993/799
		1998–2002	India	AS1/1994/022
		1998–2004	Indonesia, Malaysia, Philippines, Cambodia	AS1/1997/133
		1987–1992	China	AS1/1985/055
		1993–1995	Kenya	AS2/1993/724

It is worth recording the reviewer's opinion that 'had the project been confined to the University where it was based, it is unlikely that the aims would have been achieved'. The project also resulted in significant capacity building in parasitological research.

#### Fascioliasis (liver fluke)

*Fasciola gigantica* is a liver fluke that is endemic in rice-growing areas in Asia where its intermediate snail host is widespread. It causes chronic ill-thrift and reduced productivity that is often not obvious to farmers.

Two projects started in Indonesia in 1992 to address productivity losses in cattle and buffalo populations conservatively estimated at \$A100 million. At the time, fascioliasis was ranked the third most important animal disease in Indonesia. Project AS1/1991/023 successfully described a large component of the epidemiology of *Fasciola gigantica* and demonstrated that a single anthelmintic treatment could have a major impact on the parasite and that a fluke of ducks could compete with the intermediate stages in snails.

Outcomes of the project were largely increased knowledge and scientific capacity. Reviewers considered the scientific methodology and rigour in the laboratory to be excellent. However, an integrated control program was not developed and extended to farmers in this project. When discussing dissemination of the work, the reviewers noted in 1995 that extension would be conducted under the umbrella of the Indonesian livestock services department. They were concerned, however, that:

... nowhere in the project documentation or planning does there appear to be any allocation of budget, facilities or manpower to disseminate the recommendations. They will not be taken up by the farming community unless they are systematically and thoroughly presented in a formal program and it is not the responsibility of Balitvet to plan or conduct that program. Nor do they have the resources to do so. Unless the problem is addressed, the scientific community will be enlightened by the numerous quality publications which are certain to appear, but the intended benefactors will not.

They recommended that an extension program be developed and funded to underpin adoption of practical control procedures by rural communities.

The second *Fasciola* project was based on findings in Australian sheep with another liver fluke that there may be an opportunity to control the impacts of *Fasciola gigantica* in cattle and buffalo by vaccination was investigated in project 1990/049 in Indonesia. The high-risk project successfully evaluated the protective effects of several molecular antigens. However, none of these was sufficiently protective to be used in a vaccine. Although this was disappointing, the finding that Indonesian thin-tailed (ITT) sheep were resistant to *Fasciola* opened-up other possibilities for control by utilising genetic resistance. The possibility of integrating anthelmintic treatment with fodder management was also raised as an area of future work.

The project developed scientific capacity in molecular immunology and the results of this molecular research were well communicated in the scientific community with the final report of the project listing 12 refereed papers or book chapters and 15 presentations at international conferences.

The third *Fasciola* project in cattle and buffalo (AS1/1996/160) took on board the knowledge gained from earlier projects and the recommendations of reviewers to develop and extend an effective integrated control program in Indonesia and into the Philippines and Cambodia. It cleverly integrated the management of rice straw fodder (to reduce larval intake by animals), competitive inhibition of *Fasciola* intermediate stages in snails by chicken fluke larvae and a single strategic anthelmintic treatment.

Project reviewers in 2002 noted that the potential community impact to increase animal production had been limited to the farmers who participated in the demonstration projects. This integrated program was made available to extension services in Indonesia, Cambodia and the Philippines, and thence to Vietnam, Thailand and Laos. Reviewers noted the need to institutionalise *Fasciola* extension capacity within national organisations and projects to adapt and implement the programs were recommended for Mindanao in the Philippines and Cambodia. In 2005, a new project (AS1/2002/099) started in Cambodia but the security situation in Mindanao delayed consideration of such a project there.

It is uncertain as to how effective the further extension and uptake has been in other countries. Discussions during this study did not identify significant promotion of the integrated program in Laos, and Indonesian veterinarians and researchers indicated that strategic parasite control programs are not widely understood or promoted there. In Thailand, the Department of Livestock Development conducts mobile veterinary clinics that visit villages twice monthly and anthelmintic treatments may be given to animals at risk at this time. The central animal health service annually provides anthelmintic treatments that could cover about 10% of each province's ruminant population annually. In 2006, a program will be launched to help control liver fluke in cattle and buffalo in 19 north-eastern provinces (Chaweewan, pers. comm. 2005).

In summary, these *Fasciola* projects have identified the basic components of a sound and relatively inexpensive strategic control program integrating management with a single anthelmintic treatment. However, this is unlikely to be widely adopted without significant promotion from government livestock services. Internal parasite control is not a high national priority in most Asian countries and as their focus is increasingly on larger scale production and trade, it is unlikely to gain a higher profile.

In 1995, reviewers of AS1/1990/049 noted that fascioliasis, which had been considered the third most important disease in Indonesia in 1992, had slipped out of the government's high priority list to a status below the 14 major notifiable diseases that 'were of direct concern to Indonesia's increasing emphasis on meat quality and production for domestic consumption and particularly export'. This would be a contributing factor to the apparent lack of promotion of an integrated program in the country in which it was developed.

The final project in this group (AS1/1997/027) was a high level project aimed at identifying the genetic and molecular basis of the previously observed resistance to fluke and a nematode in ITT sheep, anticipating that this may lead to identifying novel ways of preventing and/or controlling the impact of *Fasciola gigantica* in cattle and buffaloes. This project experienced some managerial difficulties but made some very significant scientific findings in relation to sheep and their resistance and had significant collaborative and capacity-building benefits. As well as identifying a genetic basis

to resistance to a major sheep nematode, it also identified genetic factors associated with wool and carcass traits in sheep that may have benefits for the Australian sheep industry through further research funded by the Australian meat and wool research organisations. Findings have not been translated to *Fasciola* control in cattle and buffalo at this stage.

### Endoparasites of small ruminants

From the mid 1980s ACIAR undertook research to assist the control of gastrointestinal nematodes in sheep and goats. Apart from two projects in China and Kenya, the focus of this research was in South and South-East Asia and the Pacific where small ruminants were significant sources of protein. *Haemonchus* in particular was considered a major problem causing deaths of 25–50% of sheep and goats. Drenching was being done every 3–4 weeks in some environments. This approach was not only expensive but increased the prospect that small ruminant production would cease if costs became too high and/or when resistance developed and parasites could no longer be controlled.

Australia has an international reputation in the development of integrated parasite control programs in sheep and worked with partner countries on a series of projects aimed to:

- clarify the epidemiology and impact of the parasites
- deliver inexpensive anthelmintics and improved nutrition commercially via medicated urea–molasses blocks (UMB)
- develop programs to reduce the cost of treatment and impact of the parasites by integrating grazing management, genetic resistance in the animals and anthelmintic treatments.

These projects were generally successful in meeting their aims but were not well extended from their bases and appear to have had limited regional impact on parasite control among smallholders who owned most of the sheep and goats in South and South-East Asia. After most of the projects had been concluded, ACIAR held a major workshop on ‘Sustainable parasite control in small ruminants’ at Bogor, Indonesia, in 1996. Country reports confirmed both the importance of small ruminants as important sources of meat for smallholders in many Asian countries, the serious impacts of internal parasitism and the challenge of cost-effectively controlling losses, especially in an environment of increasing

resistance to anthelmintics. In many countries, parasite control was tactical rather than strategic and heavily reliant on chemical treatment only. Factors that were considered to be accelerating the development of anthelmintic resistance included frequent use of a small number of drugs, inappropriate timing and dosing, and dilution of drenches by resellers. In Fiji, the Philippines, Malaysia, Indonesia and southern Thailand researchers had successfully demonstrated more strategic approaches that included nutritional supplementation with UMB and medicated UMB, resistant local breeds and/or rotational grazing on research institutions or large farms. Some of the constraints to integrated sustainable parasite control (SPC) identified for smallholders included:

- little understanding of the effects of parasites on production and reproduction
- the unavailability of anthelmintics at village level in suitable pack sizes
- the inability to separate age groups and to implement rotational grazing management in communal environments
- the cost of treatment
- lack of confidence in the return on their investment.

The workshop concluded that implementation of integrated SPCs was urgent, and identified research, training and collaboration and communication priorities to effect this.

The final ACIAR project in the series (AS1/1997/133) developed from these priorities. It aimed to develop a sustainable approach to endoparasite control in small ruminants, particularly in the Philippines but to Indonesia too to a lesser extent. The project concluded in 2004 having identified widespread anthelmintic resistance, a modest genetic basis for selecting genetically resistant goats and sheep and proposing integrated control approaches involving tethering and/or controlled grazing. The capacity building, collaboration and communication between the research scientists and their interested extension cooperators was reported to have been excellent through scientific publication and presentations, newsletters and a website. Adoption by smallholders was very limited as the original project had no implementation component. Also some of the recommended management changes may have been applicable to large farmers but still too expensive or

difficult for smallholders to implement. Involving the anthelmintic companies in delivering the strategies was recommended and an implementation strategy was to be developed during the two-year extension to the project, but this appears to have been undertaken mainly in the complementary A\$1 million IFAD project (TAG 443), 'Development and testing of an integrated approach to the control of gastrointestinal parasitism in south and South-East Asia'. ACIAR's final evaluation of its project in June 2005 noted that complementing ACIAR's research in two countries with IFAD delivery and implementation projects in these and another eight Asian countries was a potentially effective partnership.

The most recent lessons and outcomes of ACIAR's and IFAD's investment in SPC were reported in ACIAR Monograph 113, *Worm control for small ruminants in tropical Asia* (Sani et al. 2004). Although anthelmintic resistance has worsened, understanding of the problem and its control had improved greatly and TAG443 had been successful in some countries by developing village projects through participatory processes. The future of successful parasite control in small ruminants in Asia probably rests with farmers who understand the issues well enough to work with extension advisers to implement acceptable, practical and economic options from what is now a more comprehensive basket of SPC components, including:

- strategic de-worming using commercially available anthelmintics and possibly plants
- rotational grazing
- improved nutrition using forage crops and supplement blocks
- housing and stall feeding
- dung management
- biological control using fungi, earthworms and ducks
- genetic selection
- controlled breeding.

#### 4.2.2. Past economic reviews

Sani et al. (2004) provide a summary of the small ruminant endoparasite work undertaken by ACIAR and partners in Asia. Throughout the publication it provides evidence of both productivity increases in terms of weight gain and decreases in mortality. It is understood that the issue is not the potential benefits of endoparasite control but rather how to implement control

programs and encourage smallholders to invest in parasite control. The other aspect of improving uptake or measuring the benefits of the technology is that the livestock management recommendations will have other benefits to the smallholder apart from controlling parasites. Skills developed such as growing forage will provide more general nutritional benefits to livestock and removing manure from the grazing area may have extra benefits when used as fertiliser in the crops.

While there have been various estimates of economic loss caused by endoparasites there has been no economic evaluation of the cluster undertaken. The initial project (AS1/1983/016) estimated that *Toxocara vitulorum* commonly killed 25–30% of buffalo calves and sometimes up to 80%. In a population of 80 million buffaloes this was a significant loss of draft power and income. Later projects (AS1/1990/049, AS1/1991/023, AS1/1996/160 and AS1/1997/027) estimated losses caused by *Fasciola* of between A\$58 million and A\$300 million. McLeod (2004) estimates the production losses caused by roundworm parasites in selected Asian countries (Indonesia, Malaysia, Nepal, Philippines, Thailand and Vietnam) as approximately US\$20 million in 1999. Some US\$13 million of this is from losses in sheep and goats in Indonesia. Losses from roundworm in India and Australia have been estimated as US\$103 million and US\$111 million, respectively.

McLeod estimates that if 10% of Indonesian smallholders adopted the recommended management systems and increased productivity by 15% they would receive an annual benefit of US\$200,000. However, as the report concludes 'Studies have shown that improved parasite control generates financial benefits but adoption remains low'. No ACIAR project final reports have estimated the adoption of the technologies developed and no later evaluations are able to do this either. The control of endoparasites remains an economically beneficial objective but estimating the adoption of recommended management options and ACIAR's role in this continues to be allusive.

#### 4.2.3. An economic analysis

As there are no economic analyses to build on and no adoption data available, this analysis attempts to define the break-even numbers of both small and large ruminants that would be required to cover the costs incurred by the ACIAR endoparasite program. The analysis is

simplified because the major benefits of control are at the farm level (smallholder benefits) and there are no significant market or trade effects. Projects with a direct relevance to endoparasite control have been valued at A\$14.4 million in 2004 dollars.

Gross margins for goats, cattle and buffalo in the eastern islands of Indonesia are provided in Appendix 3<sup>4</sup> and summarised in Table 9.

The benefits to goat production are illustrated through a reduction in mortality rates, and an improvement in sale price due to increased weight. Work in Thailand (Saithanoo et al. 1997) estimated that 1% of adult goats and 5% of immature goats suffer nematode related mortality, these figures are used in this study. Extra costs incurred through use of anthelmintics costs A\$0.80 per breeding goat per year. The benefit, therefore, per breeding goat of nematode control is approximately A\$4 per year. In order, therefore, to fully cover the costs of the endoparasite program would require the effective treatment of 3.6 million breeding goats in which effective parasite control has not been previously undertaken.

Using data from the ACIAR supported IFAD project (TAG 443) in Vietnam and gross margin analysis as above, the benefit per goat will be A\$13 per head per year. Their results estimate the benefits as a decrease in mortality from 35% to 17% and a 23% increase in live weight. Using these data would require an increase of 1.1 million in the numbers of goats in which parasites are effectively controlled.

Likewise with cattle, there is the potential for significant savings per head from the control of *Fasciola*. ACIAR projects estimate the economic loss of A\$63 per animal per year. Some preliminary results from Cambodia (ACIAR project AS1/1996/160) estimated weight gain differences of 26 kg a year between cattle being treated with triclabendazole and those on a placebo. The economic loss in this analysis is through a 33% reduction in weight of all age stock; there are assumed to be no mortality effects. This analysis also does not include any losses that may be incurred in the cropping activities of the household through reduced draught power. The gross margins estimate the loss as A\$20 per breeding cow per year. To cover ACIAR costs would require treatment of an extra 720,000 breeding cows or, using the A\$63 per head rate, 230,000 extra breeding cows. In a population of approximately 40 million head (<http://faostat.fao.org>) or 20 million breeding cows this may well be a feasible result.

In a fattening enterprise when profit is decided basically as the difference between buying and selling weights, infestation with endoparasites can cause major losses. With regard to buffalo fattening (Table 9) the loss could be as high as A\$110 per head. This loss is caused by a 33% decline in expected sale price due to reduced weight and also a 30% decline in draught power. Once again, to break even with the ACIAR investment would require approximately 130,000 buffalo involved in fattening programs would have to be introduced to a treatment and management program.

**Table 9.** Gross margins per breeding animal with and without endoparasite control (A\$/head 1997)

	Goat (breeding)		Cattle (breeding)		Buffalo (fattening)	
	Control	No control	Control	No control	Control	No control
Variable costs	10.40	9.70	15.20	11.30	227.20	217.00
Gross income	31.30	26.50	87.30	73.50	370.27	248.00
Gross margin	20.90	16.80	72.10	62.20	143.07	31.00

<sup>4</sup> These gross margins were developed as part of the AusAID project 'Eastern islands veterinary services project' by Ian Patrick in April 1997. The exchange rate at the time was approximately Rp. 3,000 to A\$1.

## 5. Two transboundary disease case studies

ACIAR has funded research in the following two transboundary animal diseases that are endemic in South-East Asia: foot-and-mouth disease (FMD) and classical swine fever (CSF or hog cholera). The experience with these two groups of projects is relevant to the impact of ACIAR's work and hence a more detailed review of some aspects is presented here. The following discussion of these two current but contrasting situations complements the cluster analyses of ND and endoparasites and illustrates some important factors that are considered in development of the framework.

### 5.1. Regional approach to foot-and-mouth disease

FMD is a highly infectious viral disease that is endemic in South-East Asia. Indonesia and the Philippines have eradicated FMD with Australian support in the past 30 years. However, it has a very high profile especially in the countries on the Asian mainland and, in contrast to the other diseases on which ACIAR has worked, the control of FMD is the subject of an existing regional program (SEAFMD) and of another being developed currently.

FMD causes production losses and occasional deaths in young animals but it is not a disease that would have a serious direct impact on villagers. It is principally a disease that restricts trade in both live animals and their products, and its presence has a major impact on the development of livestock industries

Since the early 1980s, ACIAR has supported research into diagnostic methods and surveillance that are recognised as having had a substantial effect on capacity in scientific research, diagnostic methods, surveillance and disease control capability (ACIAR projects AS1/983/067, AS1/1988/035, AS1/1992/004 and AS1/1994/038). These were reviewed in IAS21 (McLeod 2003) which concluded that this increase in capacity would improve FMD control and have substantial economic benefit if the disease was eradicated. This would flow largely from access for unprocessed pig meat to the large developed markets of Hong Kong and Singapore.

Modern techniques have been successfully implemented in laboratories in the region, particularly in Thailand. Through the Thai Department of Livestock Development's main laboratories at Pakchong and Hangchat, FMD virus is now routinely isolated and typed from outbreaks to provide valuable epidemiological information to facilitate specific vaccination. For instance in 2003, virus was typed from half of the 209 outbreaks with two-thirds of the strains being Type A and one-third being Type O.

The Pakchong laboratory is nearly fully compliant with ISO standard 17025. It has been acting as the FMD reference laboratory for the region (including Myanmar and Vietnam) since 2004 and providing reagents and training for the country's laboratory network. The laboratory also operated a proficiency testing program for Thai laboratories in 2005 and plans to expand this role to include other SEAFMD countries' laboratories in the future.

Despite this capacity, the success of disease control has been variable in the region and Thailand has reported an average of 127 outbreaks of FMD annually over the past 6 years (Table 10). Another 70 outbreaks were reported to July 2005.

Thailand's trading status is affected by relatively uncontrolled livestock movements from neighbouring countries that introduce infection. In the ASEAN region, cattle move into Malaysia, Thailand and Vietnam and pigs tend to move out of those countries. For any country to realise the potential benefits of FMD freedom requires a collaborative and regional approach to FMD control such as is envisaged by the OIE's existing SEAFMD program and the 'Control of transboundary animal diseases in the Greater Mekong Sub-region (GMS)', funded by FAO and ADB in collaboration with OIE, for which an inception workshop was held in September 2005. The countries involved are Cambodia, China, Laos, Thailand and Vietnam.

A conflict could be perceived between ACIAR's greater emphasis on poverty alleviation and ASEAN's focus on regional program management for FMD control and trade enhancement, potentially to the detriment of Australian exporters. However, the relationship between ACIAR and scientists working on FMD in Australia and South-East Asia has developed to a mature partnership and Thai scientists are respected in Australia and internationally. We believe that there are continuing benefits

**Table 10.** Outbreaks of FMD reported in Thailand (1999–2004)

Year	1999	2000	2001	2002	2003	2004	Total
Outbreaks	75	128	147	82	209	119	760

Source: Thai Department of Livestock Development, 2005

to be gained, probably for a relatively small investment, by continued support of that scientific partnership by ACIAR and AusAID complementing the control programs in the region. These benefits include:

- enhanced capacity of reference, national and regional laboratories
- maintenance of scientific capacity enhances reputation of and confidence in modern technologies to Asian regional FMD control
- Australian scientists maintain access to viral material for training, test development and validation
- Asian scientists can access Australian expertise in diagnostic methods and laboratory quality control and security
- Australia maintains an understanding of trends in FMD epidemiology and control in Asia.
- professional communication is maintaining between Australian and Asian colleagues with increased mutual understanding of needs
- epidemiologically and scientifically sound approaches to FMD control are extended in the region.

Currently, AusAID is funding a project to upgrade security at the Pakchong laboratory. AusAID is also funding a three-year project to improve the FMD diagnostic capability of veterinary laboratory network in Vietnam.

## 5.2. Village approach to classical swine fever (CSF) or hog cholera

The second case study involves another highly infectious endemic disease in Asia that does have a significant impact on pig survival at the village level. At this stage there is no regional program, but it is one of the priority diseases (with FMD and avian influenza) earmarked for the new program, 'Control of transboundary animal diseases in the Greater Mekong Sub-region (GMS)'

ACIAR has supported two main projects on CSF in Asia: AS2/1993/875 in Vietnam and AS1/2003/001 in Laos, is the latter due to finish in 2006. It is aspects of the latter project that will be discussed here. The Lao PDR has approximately 1.7 million pigs of which about 70% are owned by villagers and 30% by semi-commercial smallholders. The project (that also includes FMD) focuses at the village level with a view to developing sustainable disease surveillance and vaccination programs that improve community welfare. It builds on another ACIAR project that developed surveillance and reporting systems (AS1/1996/083) and complements animal health projects by other funders especially the EU Livestock Strengthening Project. It also complements joint Lao programs with Belgium, Luxembourg, Germany (GTZ) and IFAD and the 'Forage and livestock systems' project managed by the International Centre for Tropical Agriculture (CIAT).

The ACIAR project has developed testing capacity at a modest laboratory in Vientiane. Structured surveillance is regularly undertaken and subsidised vaccination of young pigs for CSF is conducted monthly in 24 project villages in two provinces, with breeders receiving boosters annually. The project also includes activities to improve biosecurity, housing, feeding and the quality of boars in these villages. A network of government district veterinary assistants (paraveterinarians) and village veterinary workers has been trained and are active in these villages. In addition to being paid for project work the village veterinary workers can charge for vaccinating against other diseases such as haemorrhagic septicaemia in cattle and buffalo and for other animal husbandry work. The combination of rapid disease detection by surveillance and control by vaccination in these project villages has had a demonstrable impact on the incomes and welfare of the villagers. Pig owners in two villages that we visited claimed that CSF vaccination had almost doubled piglet survival so that about 12–16 pigs reared and sold per sow per annum. The surplus is sold as young growers to traders from Vientiane for about US\$8–10 per pig.

The following SWOT analysis highlights issues relevant to the success and sustainability of the impacts of this project. Many of these are relevant to other ACIAR projects.

**Strengths are:**

- a deliberate strategy to implement change at the village level
- well equipped and staffed laboratory
- sound tests
- QC support and problem solving available from Australia
- standard functional simple system for specimen submission
- standard data collection
- information system
- enthusiastic well-trained capable leader who facilitates collaboration between projects
- field services structure of district paraveterinarians and village veterinary workers
- strong links and regular interaction between leader and staff
- workplace training of field and laboratory staff
- telephone contact
- villagers recognise problem in high piglet mortality from CSF
- benefits of vaccination demonstrable
- simple solution in effective vaccine
- solution compatible with existing pig management
- vaccine subsidised in study villages
- revolving fund for payments for vaccine
- links with other livestock development activities and projects
- links with other funding for extension materials.

**Weaknesses are:**

- reliance on one or few (overworked) individuals
- lack of regional/local expertise to solve test problems and maintain laboratory standards and QC
- lack of epidemiological skills to check, manage and analyse surveillance data
- reliance on Australia for test reagents
- low budget for extension and complementary activities

- poor quality control of local 'lapinised' CSF vaccine
- heat sensitivity of vaccine – immunogenicity deteriorates
- inability to maintain cold chain, especially in remote areas.

**Opportunities are:**

- develop and extend concept of village population as a 'herd' for managing biosecurity and herd immunity
- develop regional test QC capacity
- develop a thermostable vaccine
- develop a market driven commercial vaccination program by extending methods and benefits to other villages
- extend cost recovery of vaccine using a revolving fund
- utilise trained village veterinary workers for other livestock development/animal health programs
- train project managers.

**Threats are:**

- scarcity of veterinarians and no obvious replacement leader at this time
- withdrawal of Australian (CSIRO/ACIAR) support
- Lao Government withdrawing support as increase proposed commitment to large ruminant production for export
- villagers perceive vaccine as too expensive if they are not used to paying.

Countries needs and the potential for regional control of CSF and were discussed at a joint FAO/OIE/JICA/BAI regional workshop on CSF control in Manila in June 2005. The recommendations of the workshop are a useful guide to needs in developing a regional animal health program. These may help identify the types of input that may be appropriate for ACIAR (and AusAID) within collaborative regional programs that may prove to be more effective than projects undertaken in areas that are not national or regional priorities (Appendix 4). With the development of the new GMS transboundary disease program, the potential exists for CSF control to be raised to similar level of regional sustainability as FMD. However, in the meantime there will be an ongoing to address issues raised in the Lao SWOT analysis in Laos and neighbouring countries.