Future directions for ACIAR's animal health research

September 2006

Australian Government
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.

ACIAR seeks to ensure that the outputs of its funded research are adopted by farmers, policy makers, quarantine officers and other intended beneficiaries.

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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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.

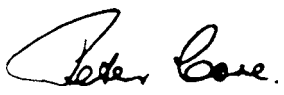
In the light of this important review, the ACIAR Board reflected on the strategic directions of the program. It has now concluded that the direction of ACIAR's Animal Health program should, in summary, be as follows:

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.



Peter Core
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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.

Contents

SECTION 1

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)	Variable ability of provinces to detect, confirm and control new incursions e.g. CSF, HPAI	Knowledge base to appraise regional threats, trade implications and improved knowledge and capacity of Australian scientists
		CSF, HPAI, FMD	3. Defining the economic and social cost of diseases and value of effective animal disease surveillance and control	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).	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 *Brucella* 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.	*Brucella* 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	Transboundary diseases	CSF, FMD, HPAI	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 HPAI despite a range of anecdotal reports. Severe and widespread infections with *Trichinella* 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, HPAI	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, HPAI	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

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

Review of ACIAR-funded Animal Health Research — February 2006

A REPORT TO ACIAR BY

AusVet Animal Health Services Pty Ltd and ARECS Pty Ltd

Contents

Abbreviations

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

Recommendation 11

ACIAR should undertake economic, community and institutional research in key countries where its ND research has been undertaken to determine why adoption of HR vaccines has been poor and what initiatives would result in benefits to smallholders. (Page 3-61)

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)

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. (Page 3-64)

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. (Page 3-66)

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. (Page 3-66)

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). (Page 3-66)

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. (Page 3-66)

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. (Page 3-67)

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. (Page 3-67)

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. (Page 3-67)

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[a]
		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

[a] 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

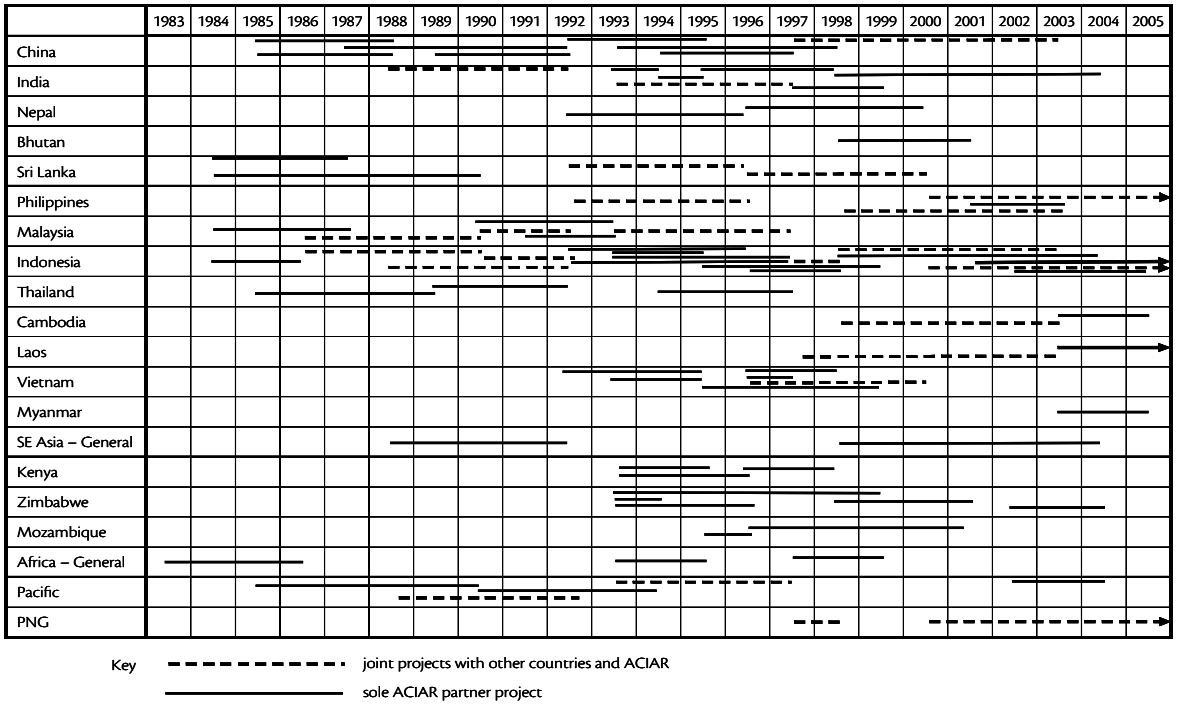

Figure 1. Distribution of projects between countries over time

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	Small. There has been no natural uptake by participant or neighbouring countries	Economic surplus. NPV=A$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	Modest	Significant. Not measured	NPV=A$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	Modest	Significant. Not measured	NPV=A$11.2 IRR=33%
AS2/1991/018	Improved methods for the diagnosis and control of bovine babesiosis and anaplasmosis in Zimbabwe and Australia		Significant	Modest	Small	Small	Significant. Not measured	NPV=A$33.8 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=A$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	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			Australian 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[1], 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[a]:		Basic		Applied				Implementation	Outcomes reported[d]
Type of research[a]:		Disease occurrence[b]	No. of projects	Tests development	Vaccine development	Control strategies	No. of projects	No. of projects	No. of projects
Project group	No.								
Bacterial diseases[c]	5	5	5	3	2		5		1
Diagnostic techniques	8	1	2	6		1	7	1	2
Endoparasites[c]	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

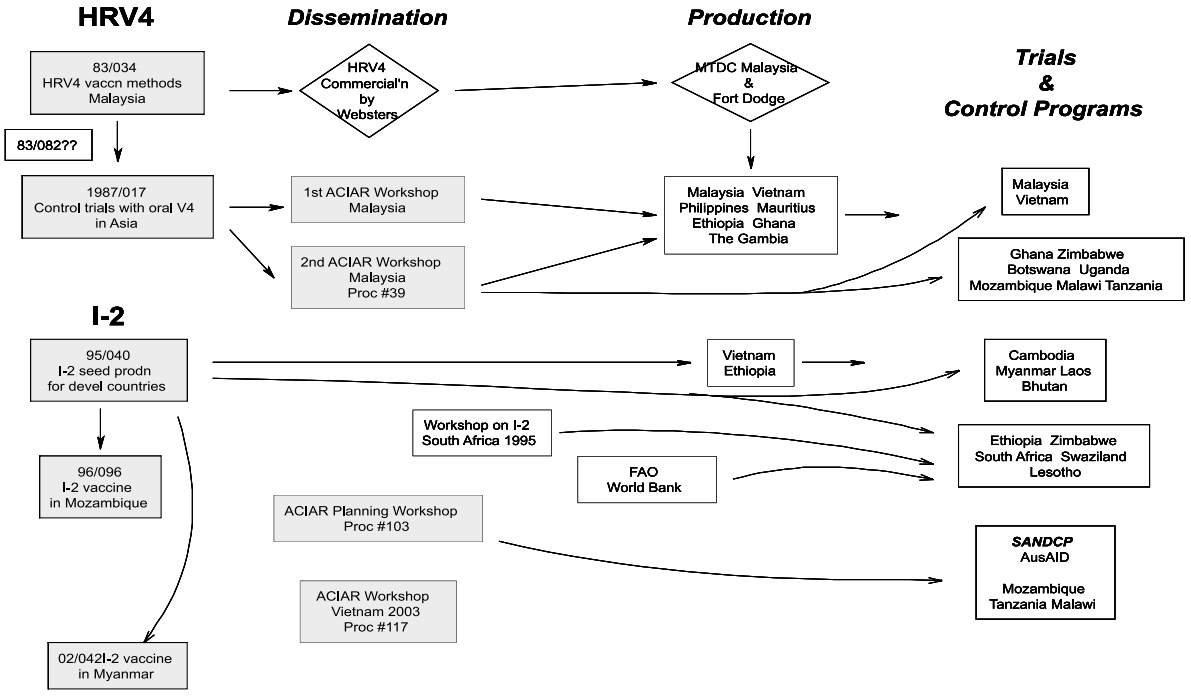

Figure 2. The relationship between projects in the Newcastle disease cluster

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 will 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 it 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 at 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[2] 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

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%	3.6	1.8	1.5
			East Malaysia	144	45	51	0.86	50%	4.0	2	1.7
			Thailand	144	45	51	0.86	50%	90.0	45	38.7
			Philippines	144	45	51	0.86	50%	43.0	21.5	18.5
			Indonesia	144	45	51	0.86	50%	174.0	87	74.8
			Sri Lanka	144	45	51	0.86	50%	2.0	1	0.9
								Total	316.6	158.3	136.1
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%	90.0	20.7	24.4
			Philippines	211	68	31	0.79	15%	76.6	11.5	9.1
			Tanzania	211	68	31	0.5	10%	20.1	2.0	1.0
								Total	193.2	36.5	38.6
Program Review	2005	V4, I2	Malaysia[1]	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		5%	18.0	0.9	1.1
								Total	7.2	4.6	6.2

[1] 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[3] 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[4] 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 and 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

4 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
- utlilise 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.

ACIAR and animal health research into the future

6. The new environment

6.1. Livestock and development

6.1.1. Livestock revolution

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

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

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

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

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

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

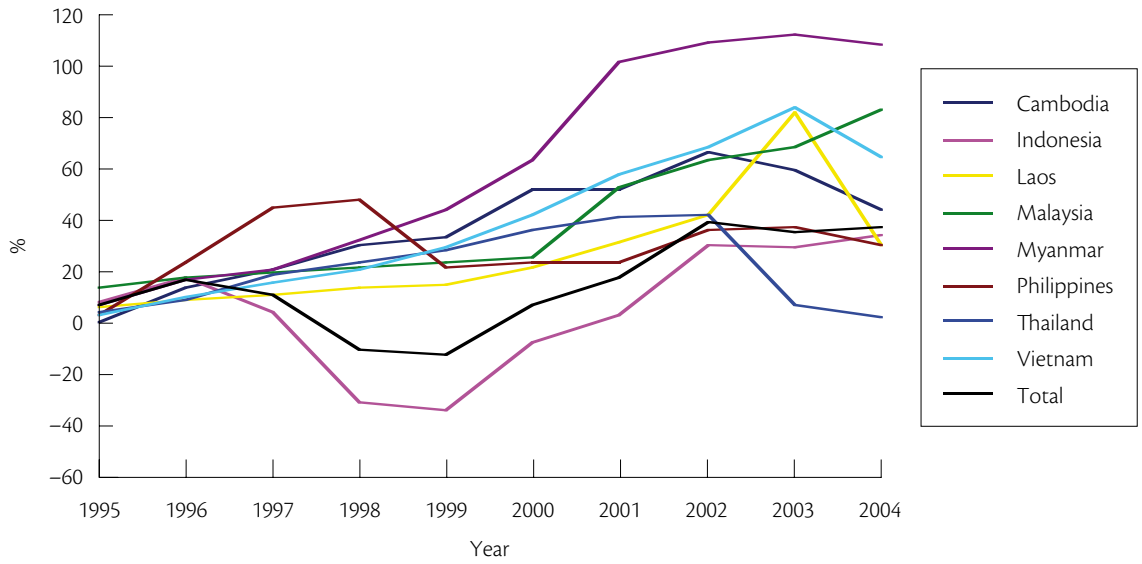

Figure 3. Percentage change in chicken numbers (1994 base). Source: http://faostat.fao.org/

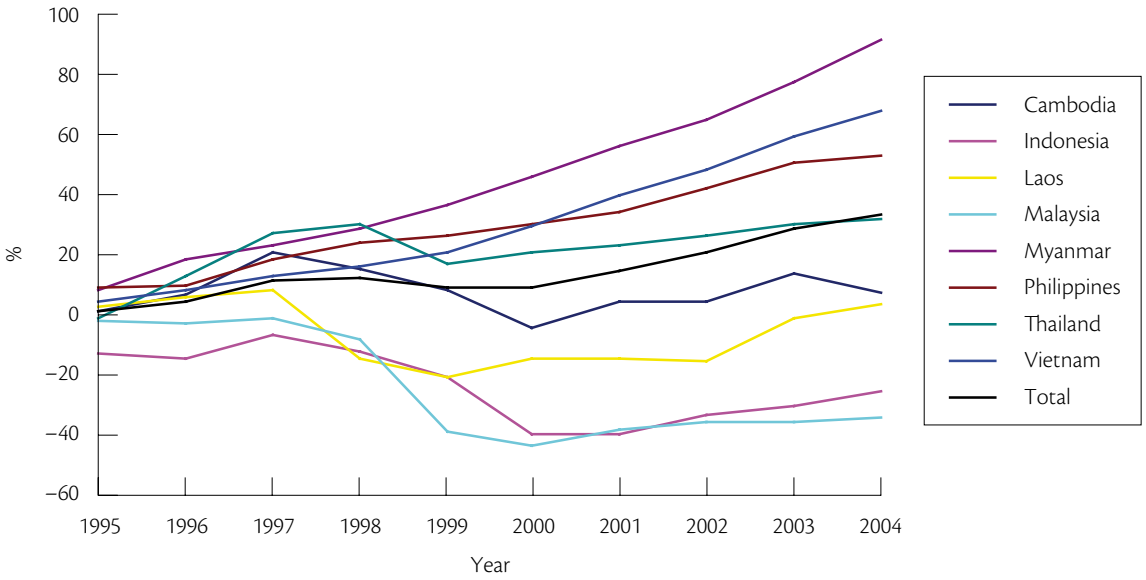

Figure 4. Percentage change in pig numbers (1994 base). Source: http://faostat.fao.org

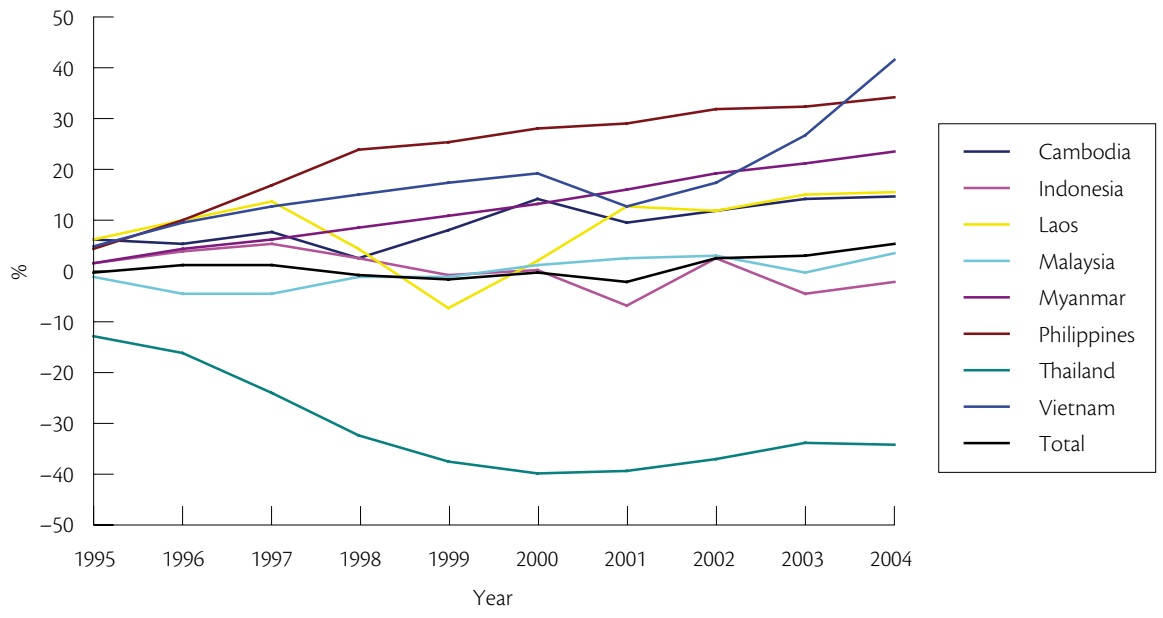

Figure 5. Percentage change in cattle numbers (1994 base). Source: http://faostat.fao.org/

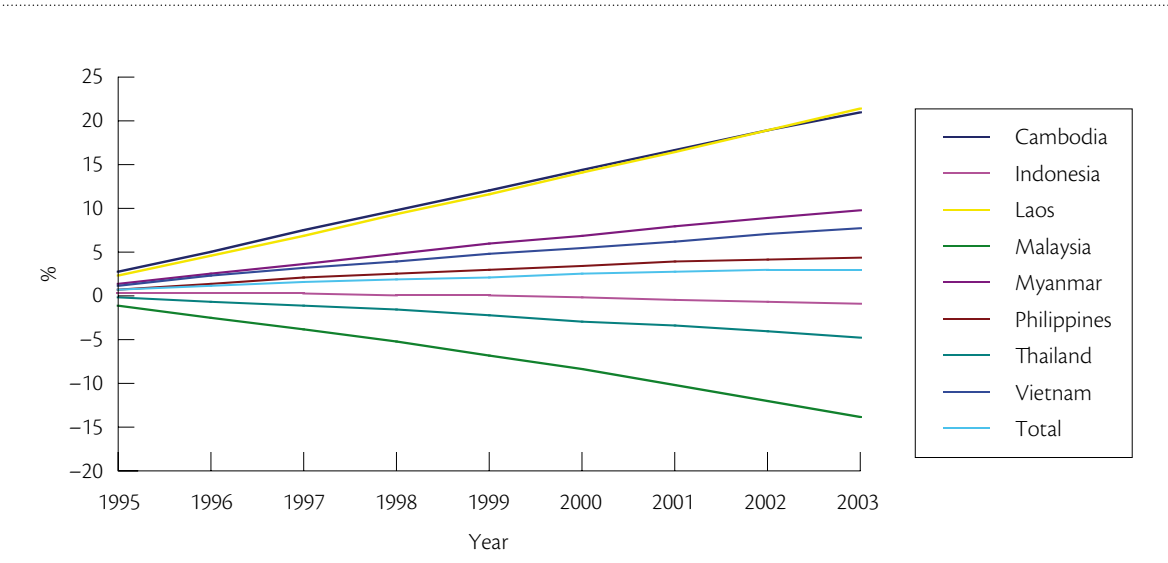

Figure 6. Change in rural population (1994 base). Source: http://faostat.fao.org/

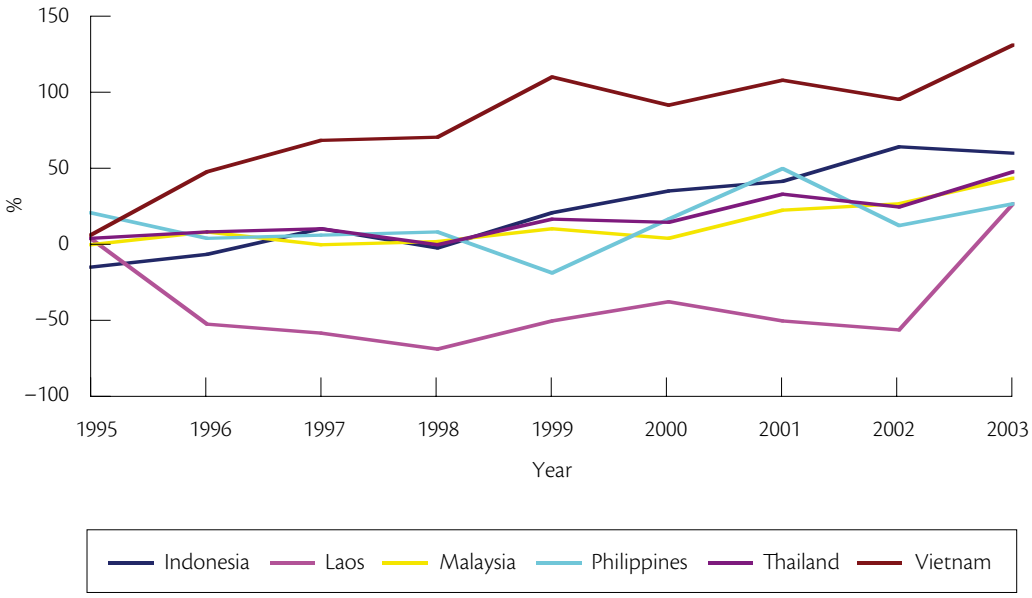

Figure 7. Change in export of agricultural products (1994 base). Source: http://faostat.fao.org/

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

6.1.2. The future of livestock in Asia

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

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

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

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

6.2. Australia's research assistance objectives

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

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

To have a greater focus on achieving community impacts:

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

To align with stakeholder priorities:

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

To focus investments in areas with a high probability of sustainability

6. invest for sustainable development.

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

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

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

6.3. Transboundary diseases

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

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

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

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

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

6.4. Characteristics of partner countries

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

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

6.4.1. Indonesia

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

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

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

6.4.2. Laos

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

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

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

6.4.3. Thailand

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

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

7. A framework to assist resource allocation

7.1. Purpose of the framework

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

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

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

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

7.2. Factors considered in framework development

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7.3. A cluster approach

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

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

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

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

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

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

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

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

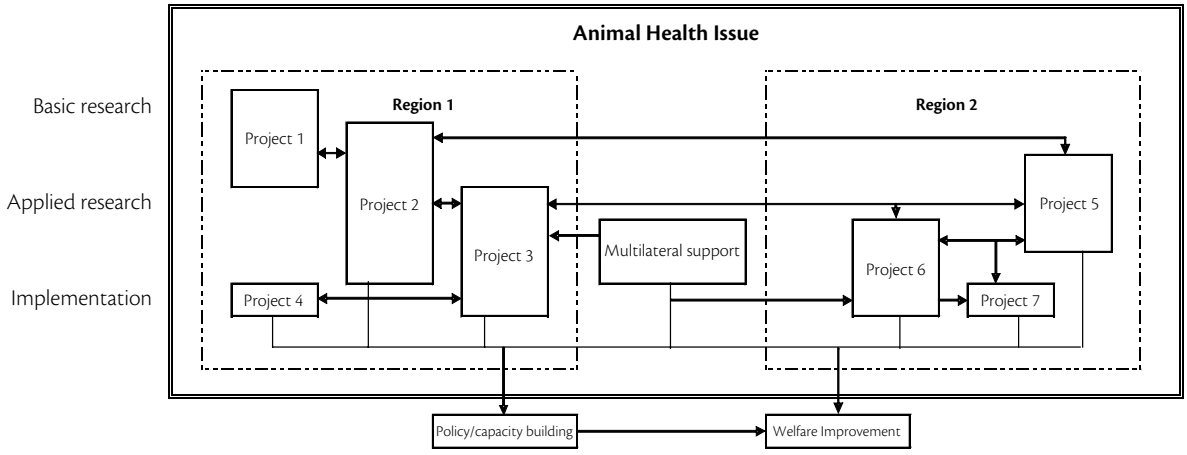

Figure 8. The cluster approach for animal health program delivery

7.4. The assessment criteria

7.4.1. Introducing the framework

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

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

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

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

7.4.2. Technical

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

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

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

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

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

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

Table 11. <continued>

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

Table 11. <continued>

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

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

7.4.3. Institutional

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

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

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

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

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

7.4.4. Economic

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

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

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

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

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

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

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

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

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

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

7.4.5. Social

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

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

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

8. Testing the framework

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

8.1. Newcastle disease

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

8.1.1. Technical

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

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

8.1.2. Institutional

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

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

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

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

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

8.1.3. Economic

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

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

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

8.1.4. Social

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

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

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

8.1.5. Outcomes

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

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

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

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

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

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

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

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

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

8.2. Ruminant endoparasites

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

8.2.1. Technical

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

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

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

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

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

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

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

8.2.2. Institutional

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

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

8.2.3. Economic

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

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

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

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

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

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

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

- inability of smaller farmers to introduce grazing management practices.

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

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

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

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

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

8.2.4. Social

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

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

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

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

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

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

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

8.2.5. Outcomes

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

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

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

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

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

9. Implications for the ACIAR Animal Health Program

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

9.1. Animal health issue selection

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

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

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

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

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

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

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

9.2. Institutional arrangements/partnerships

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

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

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

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

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

9.3. Research delivery

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

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

9.4. Research versus adoption

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

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

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

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

9.5. Bilateral and multilateral relationships

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

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

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

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

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

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

9.6. Project evaluation

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

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

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

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Economic Assessment Series (discontinued)

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

Impact Assessment Program – Working Paper Series

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

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

Impact Assessment Series

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

ACIAR Books

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

ACIAR Proceedings

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

Appendix 1: Terms of reference

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

Background

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

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

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

Expected outputs of the review

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

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

The analysis will comprise three parts:

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

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

These principles for priority setting should reflect:

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

Methodology

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

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

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

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

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

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

A primary analysis of two clusters of ACIAR animal health projects

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

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

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

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

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

Overall, principles for priority setting should reflect:

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

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

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

b. Increased emphasis on trade and accompanying biosecurity issues

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

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

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

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

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

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

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

d. Type of research

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

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

Terms of reference components

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

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

Appendix 2: Animal health research project summary information

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

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

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

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

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

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

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

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

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

Appendix 3: Indonesian livestock gross margins

Goat Breeding (self replacing) without endoparasite control

1. Assumptions

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

2. Capital Required

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

3. Variable Costs

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

4. Income

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

Goat Breeding (self replacing) with endoparasite control

1. Assumptions

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

2. Capital Required

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

3. Variable Costs

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

4. Income

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

Judul Gross Margin: Cattle Breeding without endoparasite control

Penerimaan

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

TOTAL PENERIMAAN TAHUNAN	2,205,680

Biaya Variabel

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

TOTAL BIAYA TAHUNAN	340,448

GROSS MARGIN/TAHUN	1,865,232

GROSS MARGIN/EKOR	186,523

Asumsi-asumsi

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

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

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

18 Struktur besaran usaha

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

Judul Gross Margin: Cattle Breeding with endoparasite control

Penerimaan

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

TOTAL PENERIMAAN TAHUNAN	3,077,360

Biaya Variabel

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

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

Asumsi-asumsi

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

11 berat badan

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

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

18 Struktur besaran usaha

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

Judul Gross Margin: Buffalo fattening with endoparsite control

Penerimaan

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

TOTAL PENERIMAAN TAHUNAN	1,110,800

Biaya Tidak Tetap

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

TOTAL BIAYA TAHUNAN	681,640
GROSS MARGIN	429,160

Asumsi-asumsi

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

Judul Gross Margin: Buffalo fattening without endoparsite control

Penerimaan

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

TOTAL PENERIMAAN TAHUNAN	743,776

Biaya Tidak Tetap

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

TOTAL BIAYA TAHUNAN	650,589
GROSS MARGIN	93,187

Asumsi-asumsi

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

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

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

22–24 June 2005
Discovery Suites
Pasig City, Philippines

Recommendations

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

        i. Bureau of Animal Industry, Philippines

        ii. Department of Veterinary Services, Malaysia

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

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

Appendix 5: People consulted

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

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

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

Appendix 6: The animal health research assessment framework

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

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

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

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

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

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

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

IMPACT ASSESSMENT SERIES

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

IMPACT ASSESSMENT SERIES <CONTINUED>

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

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