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Scoping Study: 2014

Evaluation and Targeting of Formal and Informal Capacity Building in ACIAR Training and Research Programs

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Scoping Study: Evaluation and Targeting of Formal and Informal Capacity Building in ACIAR Training and Research Programs

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Contents

List of Acronyms

AARES	Australian Agricultural and Resource Economics Society
ACIAR	Australian Centre for International Agricultural Research
AIDAB	Australian International Development Assistance Bureau (predecessor to AusAID
AUD	Australian Dollars
BCR	Benefit Cost ratio
CB	Capacity Building
CGIAR	Consultative groups of International Agricultural Research Centres
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFAT	Department of Foreign Affairs and Trade
EDG	Effective Development Group
ESDPP	Extra Short Duration Pigeonpea
FAO	Food and Agriculture Organisation
FSIV	Forest Science Institute of Vietnam
GIS	Geographical Information System
HPP	Hybrid Pigeonpea
IAS	Impact Assessment Series
Indobeef	ACIAR collaborative research program to strengthen Indonesia's community-based beef sector and improve the livelihoods of Indonesia's rural poor
IRR	Internal Rate of Return
ISNAR	International Service for National Agricultural Research
JAF	John Allwright Fellow
JD	John Dillon (Fellow)
NPV	Net Present Value
NWRCP	National Wheat Rust Control Program
OJT	On-the-job Training
PARDI	Pacific Agribusiness Research for Development Initiative
PC	Partner Country
R&D	Research *and* Development
R4D	Research *for* development
RIA 1,2,3	Research Institute for Aquaculture Nos 1, 2 and 3 (of Vietnam)
RPM	Research Program Manager (of ACIAR)
SDPP	Short Duration Pigeonpea
SRA	Small research Activity
UNITECH	University of technology, Lae, PNG
UQ	University of Queensland
USAID	United States Agency for International Development

1. Executive Summary

Investments in training are reviewed, some approaches to quantifying investments and assessing change in partner countries, institutions and individuals are identified, and options for further action are discussed. Throughout the study there was extensive consultation and feedback within ACIAR and with project leaders and other stakeholders.

The overall program of ACIAR since its inception was scanned for elements of training and capacity building. Both are central to the success of ACIAR with activities across all Research and the Training & Education Program. The Independent Review of the Training Program (1998) recommended integrating the reporting of formal and informal training. There have been tentative steps undertaken to report on informal training, however, it is incomplete, difficult to summarize and to analyse. The addition of a Part I in the budget of project proposals (1998-2002) and the elaboration of a Student Register (2006-2009) are the most easily identified initiatives. Project and review reporting of capacity building inputs, outputs and outcomes both in project reports and project review reports is variable with some good examples in the series of adoption studies. A significant gap is the failure to explicitly report on the overall objective of the Capacity Building Program: *to build research capacity of agricultural research institutions,* despite there being substantial anecdotal evidence that it has occurred.

The literature on the relationship between capacity building and impact from R4D projects has been reviewed with reference to research in agriculture, health and education. Three countries were considered for inclusion the study: Timor Leste, Myanmar and Vietnam on the basis that ACIAR had a long and continuous presence (Timor Leste and Vietnam), a program of work that encompasses may research areas (Myanmar and Vietnam) and that among research donors, Australia (and ACIAR) is recognised as a significant investor (all three countries). Vietnam was selected on the basis that it ranked highly on all three criteria.

Formal training was documented and projects with significant capacity building components were identified from the Forestry and Fisheries programs in Vietnam, with a focus on two institutions: Research Institute for Aquaculture No 1 (RIA 1) and Forest Science Institute of Vietnam (FSIV)[1]. Both institutions have had several fellows and projects, providing the sufficient numbers for further analysis: 17 research projects, and 15 John Allwright fellows (12 PhD and 3 Masters).

Of the 32 fellows who have graduated from the JAF program in Vietnam (across all ACIAR programs), 8 are women, and of the 20 fellows currently studying for their degrees, 4 are women. Of the 64 scientists originally identified for participation in the projects subjected to further analysis in Fisheries and Forestry programs, 12 were women but data on the gender of project staff both during and after the project are incomplete. Without more accurate data it is neither possible to draw conclusions on the actual participation on project staff of either gender, nor to discern trends over the study period.

Informal training components of research projects were identified and a standard procedure developed to calculate the proportion of project expenditure that can be attributed to capacity building. The two institutions in Vietnam: RIA1 and FSIV are also appropriate institutions for further study based on continuous engagement, numerous projects, JAFs and observable change. It was as well observed that different methods may have to be applied to bilateral and multilateral projects.

Based on an analysis of the Vietnamese Institutions and the projects they have implemented, in-project investment in CB is in the range 10% to 40% of total ACIAR investment.

Capacity building and research activities in projects are so interlinked that it is not possible to separate either their impacts or even their costs, in a theoretically sound and empirically tractable

[1] *The name of this institution has changed through the period of its support by ACIAR, initially being the Forest Science institute of Vietnam (FSIV), now the Forestry Research Academy of Vietnam (FRAV). For simplicity FSIV is used throughout this report.*

way. More subjective ways of assessing the impact of capacity building were applied in deriving our estimates above. The way in which capacity building influences the impact pathway is discussed with an objective of strengthening how the links between capacity building and its utilisation are identified and described as objectively as is possible. Our approach has been to build from existing methods for the attribution of research impact to capacity building as described by Gordon and Chadwick (2007)

Tracer studies have been reviewed and a process for further studies on individuals whose training has been supported by ACIAR, more explicitly linking capacity building with capacity utilisation, is recommended.

Methodologies for assessing institutional change with respect to R4D are reviewed and a protocol is suggested for further investigation.

It is proposed that the findings of this study are further elaborated to focus on the short- and medium-term impacts on the effectiveness of the ACIAR Research and Training programs, with a longer view to better understand the relationship between capacity building and impact. Further efforts could usefully be to:

- Improve understanding of the medium and long-term benefits of formal and informal capacity building in institutions, with a continued focus on FSIV and RAI1 in Vietnam
- Collate data on the career paths of ACIAR-funded scholars with an initial focus on scholars who were based at FASIV and RAI1 during their training.
- Add value to impact assessments already published by ACIAR with a complementary section on capacity building which had not been fully considered in the original assessment.
- Collaborate with the design teams of selected pipeline projects to improved their capacity needs assessment, project planning and M&E for capacity building, with Forestry and Fisheries in Vietnam, Indobeef in Indonesia and PARDI in the Pacific being candidate projects.

The skills required for further study would include agricultural economics, technical knowledge of ACIAR programs and operations, knowledge of Vietnamese institutions and expertise in organisational behaviour and assessment.

2. Background, Terms of Reference and Study Process

Capacity development is a major component of all research projects funded by ACIAR and other Australian investors (CSIRO, DFAT) in agricultural R&4D. The structure of capacity development (See Box 1 below) varies from institutional strengthening, informal individual on-the-job training, including mentoring and 'learning by doing' to formal individual qualifications from Australian and partner country institutions.

ACIAR attempts at describing and reporting at the project level, at the point of final report, and subsequent *ex-post* adoption and impact studies has been variable with a real risk of being undervalued. This has implications at program and ACIAR corporate levels and the understanding of our stakeholders of what ACIAR uniquely delivers, in terms of capacity building through our investments.

A number of studies have identified this aspect of R4D projects as highly valuable in two respects: 1) it is essential to achieve the immediate objectives of the project or the overall program to which the project belongs and 2) it is of longer term strategic importance in achieving the R4D goals of partner institutions and countries, including Australia. Capacity development is an important component of the bilateral programs of ACIAR where Australian institutions are directly engaged with partner countries, and in the multilateral program where the primary interaction is with international agencies of the CGIAR. Clearly it is the primary focus of ACIAR's program to build research capacity.

ACIAR has a strong record in evaluating the economic impact of its research activities. The recent IAS report by Lindner et al. (2013) reiterates that the returns to ACIAR's bilateral research activities have been high. However the contribution of institutional and individual capacity development within bilateral projects has rarely been separately identified. The case studies by Gordon and Chadwick (2007) suggest that perhaps half of total benefits may be attributed to the capacity building components of traditional bilateral research projects. Additionally the 'spillover' benefits of capacity building to later R&D activities have at best been identified qualitatively. Ignoring these 'spillover' benefits means that unless they are reflected in subsequent impact assessments, the economic gains from R&D activities are likely to be understated. Even econometric studies of returns to agricultural R&D at a sector level understate economic gains because the future flows of benefits from capacity building are not captured in historical measures of productivity.

Investment in capacity building can be thought of in much the same way as investment in R&D more generally. Typically economists model expenditure on R&D as adding to a stock of knowledge and skills. This knowledge has been found to have an impact on productivity for 35 – 50 years. Our expectation is that the duration of benefits associated with capacity building are of similar length.

ACIAR has identified the need to improve reporting of its capacity building:

1. to satisfy the needs of the Australian Government's new development policy Australian aid: promoting prosperity, reducing poverty, enhancing stability and the new performance framework *Making Performance Count*: enhancing the accountability and effectiveness of Australian aid;
2. to meet it own internal targets of continuous assessment and improvement;
3. to enhance project design and resource allocation;
4. to find new ways to better target capacity building in line with the changing needs of projects and the increasing ability of partner country institutions to provide formal training.

ACIAR has published relevant studies that create starting points for the proposed work. The 2007 study by Gordon and Chadwick examined capacity building from two perspectives. First from a survey of literature, some 'rules of thumb' were recommended allowing estimates of the value of capacity building to be made from the income levels of scientists and the value of agricultural production. Second the study suggested good practice in mapping the pathway from capacity building to on-farm efficiency gains which would allow some part of the estimated economic impact of the total research programme to be attributed to the capacity building components of the

program. Gordon and Chadwick applied their approach in two case studies of ACIAR projects and also identified a set of ACIAR projects where capacity building was identified as being an important outcome. Their quantitative approach was used in a limited number of later case studies (Fisher and Gordon, 2008; Longmore et al., 2007) There is a need to be able to capture and report on ACIAR's capacity building activities in a more systematic and comprehensive manner even if it means a heavy reliance on more qualitative indicators.

Gordon and Chadwick (p.15) described capacity building as building human capital in the form of 'the understanding, skills and knowledge base of individuals and institutions'. They point out that 'evaluation of capacity-building generally stops at assessing the capacity built (such as skills gained) and only occasionally goes on to measure capacity utilised'. Because human capital is used jointly in research with other inputs such as machinery, chemicals, labour etc, it is difficult to identify and measure the contribution of capacity building (an attribution problem).

To address the issue of utilisation and change resulting from capacity building, in 2011 a simple tool was developed and tested for assessing capacity building within projects (Dugdale et al., 2012), which concluded that the 'snapshot tool' had merit but required 'road-testing' in projects which are committed to its use. Other approaches attempted in ACIAR and CGIAR centres to assess capacity include Impact Analysis (Palis et al. 2013) and Graduate Tracer Studies[2]. The John Allwright Fellowship scheme was studied in 2004 (Harvey and Skerritt, 2004) and 2008 (Muller and Morton, 2008; Flowers, Harvey and Skerritt, 2008) and with no recent update.

Box 1 - Capacity Development: A common understanding

Capacity Development is at the core of ACIAR work and is implicitly or explicitly part of all ACIAR activities. As part of this project, the impact of capacity development is assessed at two levels (FAO, 2010):

- At individual level: Capacities developed at the individual dimension lead to changes in skills, behaviours and attitudes among ACIAR project partners and collaborators. Formal and informal training, knowledge sharing, and networking are ways of strengthening capacities at this dimension. In this context, informal training includes mentoring and learning by doing dimensions.
- At Institutional level: Strengthening capacities at the organizational dimension consists of taking measures to improve the overall functioning and performance of an organization. This dimension has a direct impact on how individuals within the organization develop their competencies and use their capabilities. In the case of ACIAR, the impacts at organisational level should be considered a spill over of the individual capacity developed. Trained individuals returning to their institution might play a stronger role in priority setting or provide leadership in other research areas for example.

Further research is required to capture in the short term the full spectrum of ACIAR's inputs into training and capacity building to strengthen the justification for its training programs and if necessary modify these programs.

The overall intent of this new initiative (hereafter referred to as a project encompassing a scoping study and a phase of field assessment) is to advance how ACIAR captures and more confidently evaluates capacity building outcomes. A method, framework or approach to capture and describe capacity building outcomes and estimate impacts will contribute to better planning of future R&D projects and to more efficiently deliver capacity outcomes and report outputs and outcomes within the ACIAR M&E framework which currently evaluates projects at multiple stages: approval, mid term, final, adoption and impact.

Hence the objectives of this project are:

[2] *www.uni-kassel.de/wz1/proj/edwork/mat/handbook_v2.doc*

- Demonstrate that ACIAR's investments in capacity development, particularly in its fellowship schemes has likely delivered high returns;
- Provide guidelines for monitoring the outcomes of capacity development not only from the fellowship program but also from tradition bilateral research programs ;
- Provide guidelines for developing capacity development programs likely to deliver strong gains in economic welfare (including poverty reduction) in partner countries.

These objectives will be pursued by :

- Describing and quantifying full Scope of CB supported by ACIAR - scholarships, training, on-the-job training (OJT) and mentoring;
- Adapting traditional tracer study questionnaires to allow a more rigorous identification of the impact pathway for CB activities and likely final outcomes
- Applying and evaluating the 'rules of thumb' for estimating the impact of CB that were derived by Gordon and Chadwick from their review of the literature on CB both for the agricultural sector but also for other large sectors like health and education;
- Conduct country/institution level assessments of the impact of ACIAR's CB investments to complement traditional project level assessments with a view to capturing more of the 'spillover' benefits of CB that go unrecorded and unmeasured in project level analyses, (taking account of the possibility that benefits should not be counted more than once in a single analysis).
- Reviewing proposals and reviews, and adoption and impact assessment studies so as to better recognise the role of capacity building, based on the findings of this study.

The objectives of the Scoping Study are to provide an overview of previous studies, update these studies, and develop a process for ex-post monitoring and assessment of formal and informal capacity building in the ACIAR portfolio.

The tasks associated with the Scoping Study will include:

- Review literature and methods cognisant of the nature of the data that is available within the developing agriculture context (Task 1).
- Examine the previous attempts of capturing and evaluating capacity building within ACIAR projects target purposeful capacity building activities such as the Fellowship programs well as elements of capacity building with in projects (Task 2).
- Provide opportunity to engage with interested RPMs as to how an impact assessment task might be designed to derive a framework that would be relevant to ACIAR projects that more effectively captures capacity building outcomes (Task 3)
- Description of the tangibles that will be delivered at completion of Phase1 (Task 4).
- Identify, summarise and review completed surveys and other reviews of the Allwright and Dillon fellowships, including an update on recipients and graduates (Task 5).
- Develop a procedure to better capture in project reports, project reviews, adoption studies and impact assessment studies the capacity building outcomes in ACIAR-funded projects including training courses and workshops, mentoring of staff, resources used for degree and other qualifications, and other gaps and grey areas (Task 6).
- Review how the 'rules of thumb' identified by Gordon and Chadwick might be employed in ACIAR where the possible areas of application include the aggregate data in the CIE database and in the two meta- analyses where Lindner has been a key investigator (IAS 35 and 86); project level studies and the JAF surveys (Task 7).
- Based on the conclusions from the above, identify countries or technical programs on which detailed ex-post analyses can be undertaken using quantitative and qualitative approaches. This broader perspective may capture capacity building impacts on both individuals and institutions that arise from 'spillovers' not pursued in project level evaluations (Task 8)

- Identify a selection of past quantitative case studies, such as the Indian pigeon pea and Vietnam water management case studies, from which further insights may be gained about capacity building and its evaluation after another decade (Task 9)
- Consult with RPMs and others in ACIAR, DFAT, CSIRO and other agencies as appropriate (Task 10)
- Prepare a single stand-alone report following the IAS template. This report will outline all assumptions, methodologies employed, results from the analyses and conclusions. In addition, it will highlight any remaining data gaps and uncertainties that may exist. The report will be provided to the primary researchers and ACIAR for comment. The report will be revised following receipt of comments and a final report will be prepared and submitted in electronic format. A spreadsheet of the results in the required format will also be submitted at the same time as the final report. This process will guide later phases of the project (Task 11)

3. Brief History of ACIAR support for Training and Capacity Building

ACIAR's investments in training and capacity building have developed from being an essential but mostly unreported activity in the first few years of the organisation, through various statutory and policy changes in the 80s and 90s, to being an explicit and diverse component of ACIAR strategy today. The ACIAR model of participatory R4D is built upon research that is conducted *for* national research objectives *with* national research partners who are the immediate beneficiaries and next users of the research undertaken. From the early days there has been significant informal training in the technical and organisational aspects of this R4D and high demand from PC organisations and individuals for formal training through short courses, Masters and PhD programs. Evolution of the formal training has involved negotiation with AIDAB and AusAID to distinguish ACIAR-related fellowships from the broader aid program while retaining and adding to the character and value of an Australian-awarded degree. Masters classes funded by ACIAR became a pillar of the Crawford Fund created in 1996. John Dillon Fellowships were created to respond to demand for skills development among scientists taking on research management responsibilities in their home institutions.

The informal component of training and capacity building has always been recognised but the difficulty of separating out CB as a separate component of applied research support by ACIAR has proved difficult and elusive. In the annual report of 2004/5 it was stated the 'majority of training provided by ACIAR takes place within projects'. Hard evidence to support this bold statement is hard to come by, as will be demonstrated once again in the current study, and it was not repeated is subsequent reports. The creation of a 'Part I' of the budget *proforma* was a short-lived attempt to monetise the training component in projects.

A further dimension to the ACIAR portfolio is the number of students who undertake their formal training as part of or associated with an ACIAR project using stipends granted by other donors or their own government. This represents a substantial additional value to projects that is only briefly reported in project documentation. To record these students and degrees awarded a register of such students was created in 2009. The register gave substance to the impression that this is a significant outcome of the ACIAR program with 227 students being awarded a Masters or PhD degree in the 3 year period 2006-2009, approximately three times the number of graduates funded directly by ACIAR through the JAF program. The register is no longer being maintained but even this one-off exercise has highlighted the significance of these students,

Since 2000/2001 under the broad heading of 'Building Research Capacity' ACIAR has reported on the JAF and John Dillon schemes, master classes funded through the Crawford Fund and volunteers attached to projects. These represent substantial investments with well-documented outcomes but do not meet one of the challenges laid down by the review recommendation (Falvey et al. 1998) that the substantial informal training undertaken within projects becomes part of the purview of an overall Training Committee which would produce a consolidated report and analysis. Various attempts have been made to create this linkage of which the current study is the latest.

The overall objective of the Capacity Building Program has not changed since 1998/99 despite some minor rewording and is currently:

> *To build research capacity of agricultural research institutions in PCs by providing discipline-specific and broader training opportunities*

In the course of the current study no information has come to light that describes institutional change in a systematic way.

A brief summary of the major milestones on training and capacity building by ACIAR is in Table 1.

Currently ACIAR provides training through:

- Mentoring: personal interaction between scientists during the lifetime of the project
- Workshops: practical training on a specific topic of interest to a project or a group of projects within a program.
- Seminars: Theoretical and practical training on a specific topic of interest.

- Master Classes: theoretical training with practical exercises conducted in partnership with the Crawford Fund
- John Dillon Fellowships: Research Management training and exposure to agricultural R4D institutions and industry partners in Australia
- John Allwright Fellowships: Masters and PhD studies in R4D topics closely related to ACIAR Country Programs.

The current ACIAR website (http://aciar.gov.au/page/jobs-and-awards) lists the two fellowships but not other aspects of capacity building.

Table 1: Major Milestones in the history of training and capacity by building by ACIAR from information contained in ACIAR Annual Reports

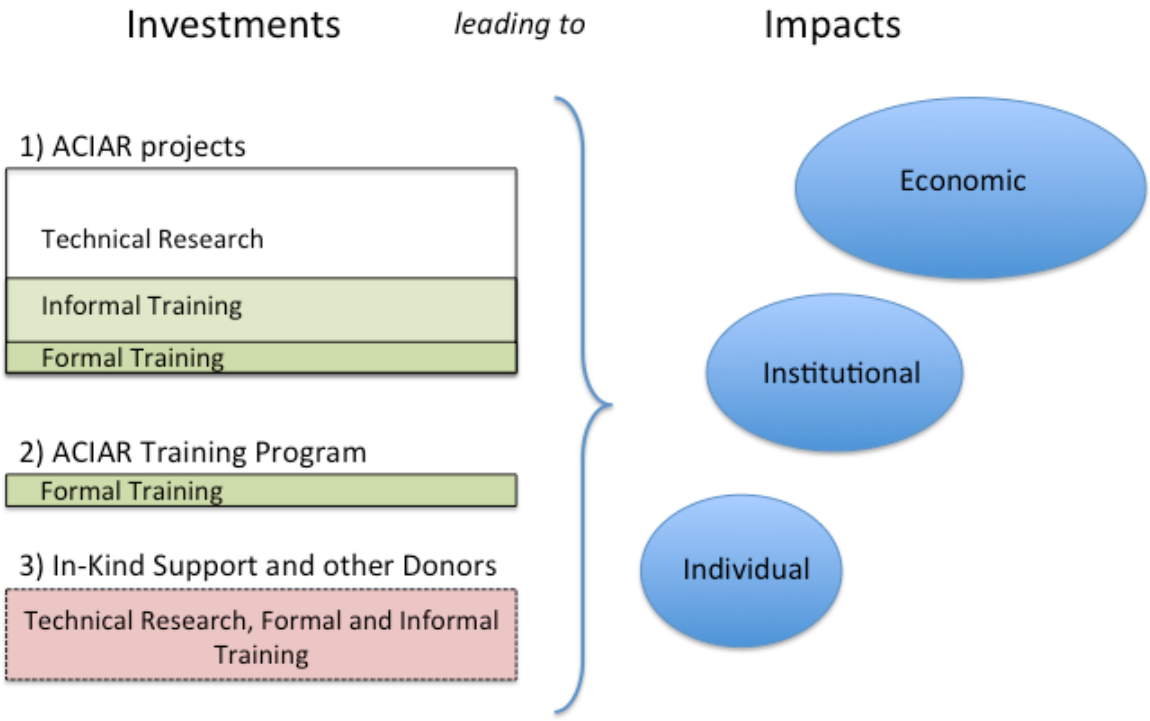
Annual Report	Milestone
82/83	No mention of training or capacity building in early reports.
87/88	Introduction of the ACIAR Associated Fellowship Scheme.
88/89	Fellowship scheme re-named *AIDAB-ACIAR Associated Fellowship Scheme.*
92/93	ACIAR Act amended to include 'development' and Joint Committee of DFAT recommended an *ACIAR Fellowship Scheme*.
93/94	Report against performance indicators
94/95	First *Training Report* and training strategy being developed. Fellowships re-named *John Allwright* Fellowships
95/96	Explicit objective for Training and Capacity Building: *to provide training for PC researchers and thereby build the research capacity of their institutions*
96/97	Crawford Fund training reported.
98/99	Review of Training Program (Falvey et al. 1988) Revised Objective: *To build research capacity of agricultural research institutions in PCs by providing discipline-specific and broader training opportunities* Part I of budget *proforma* introduced to extract the training component of projects ACIAR act amended to include 'training related to research project activities'
99/00	Alumni, returnees, and volunteers are part of reports on the Training/Capacity Building program
00/01	*Training* replaced by *Building Research Capacity* in reports.
02/03	John Dillon Fellowships introduced On-the-job training referred to. Part I of the budget *proforma* dropped
04/05	Annual report includes the statement *'the majority of training provided by ACIAR takes place within projects'.* First JAF Survey completed (Harvey and Skerritt 2004)) Adoption Studies introduced to include reports on capacity building
06/07	JAF Returnee survey completed (Flowers and Skerritt 2008)
08/09	Tracer Studies of JAFs completed (Muller and Morton 2008)
09/10	Student register established: 227 graduates 2006-2009 'associated' with projects

4. Framework for Analysis

A conceptual framework for the study (Figure 1) describes three distinct sources of investment in ACIAR-funded research:

- ACIAR project expenditure which, together with in-kind contributions from partner and collaborating institutions is the core investment by ACIAR. A significant but poorly-defined part of that investment is informal capacity building.
- Formal investment on degree courses and short courses through the Allwright, Dillon and Crawford Schemes.
- Investments by other donors, governments and the private sector that increase the overall research investment

Figure 1: A schematic illustrating the sources of investment (left hand) in R4D by ACIAR and others in ACIAR projects, and the impacts (right hand) on individuals, their institutions and the broader regional or national economy. Investment are 1) through ACIAR research projects in technical research, formal and informal training 2) through the formal ACIAR training programs in postgraduate research and master classes .and 3) by other donors and partner institutions who contribute in-kind and with additional research and training funds.



These investments are known to have impacts in three areas:

- On individual scientists and others whose capacity is enhanced and who have opportunities to make use of that capacity to their own direct benefit (but with indirect benefits on the following),
- On the institutions where these scientists work and where projects have been undertaken with a positive impact on the organisation to fulfil its national or international mandate,
- On the livelihoods of farmers, the agricultural sector and the national economies of the partner countries.

5. Literature Review

The linkage between the above diverse investments in capacity building, from multiple sources over the lifetime of a research projects or series of projects, and the subsequent impacts on individuals, institutions and the broader community is the intended focus of this report. Given the complexity of the interconnections between capacity building and impact it is appropriate to review the published literature on the topic, for agriculture and related fields in natural resources, health and education.

Generally, capacity building activities like training are not distinguished from other activities when investment in research is under discussion. While the empirical issues of separately identifying investment in capacity building are intractable, there are useful insights to be had from thinking conceptually about how training activities enjoyed by scientists are finally reflected in farm productivity and profitability and these are presented below. Then various empirical approaches have been reviewed. Noting that training is likely to have long lags before final impacts, the econometric findings that investment in research (including training) has high returns are relevant. Gordon and Chadwick (2007) demonstrated a process of attributing some share of total welfare gains from new technology to capacity building. Tracer study attempts to identify capacity built have led us to think about how these studies might be extended to ask respondents to specifically relate how they used capacity built during training to their later research and extended it to their institutions.

Some theoretical considerations

Research institutions like ACIAR typically invest in activities across a spectrum including pure and applied research, policy research and development, extension and human capacity building in pursuit of economic, social and environmental benefits. Many of these activities are directed at improving productivity. Productivity growth provides little advantage to a farm business unless it results in increased profitability. So a starting point is to understand the relationship between farm productivity change and productivity.

Profitability, the ratio of growth in income to growth in costs, can be represented as (O'Donnell 2010):

$$PROF \quad = \quad \frac{P}{W}\frac{Q}{X} \quad = \quad TT \times TFP$$

Intuitively this equation equates an index of value, *PROF,* with a quantity index, *TFP*, times a price index, *TT*, the terms of trade, the ratio of *P* prices received for outputs to *W* prices paid for inputs[3]. Growth in productivity only translates directly into growth in profitability if the terms of trade are constant. Further, changes in the terms of trade induce changes may lead to changes in farm enterprise mix and scale as described below. All types of economic shocks impact on the terms of trade but more relevant to our purposes, research activities that lead to price changes from say a change in policy or long run improvements in productivity also have an impact on the terms of trade and hence on profitability.

Turning to total factor productivity, research and extension activities add to various stocks of capital which provide annual flows of services which impact on final output alongside conventional inputs such as labour and chemicals. These joint changes in these stocks might be represented heuristically in a production function (adapting Alston et al. 1995) as:

1. $$\left(IK_t, \mathrm{IC}_t, \mathrm{IL}_t, \mathrm{IJ}_t, IZ_t \right) = \quad i\left(R_t, ..., R_{t-L_R}, E_t, ..., E_{t-L_E}; \quad K_t, C_t, \mathrm{L}_t, J_t, Z_t \right)$$

Where R_t and E_t are lagged series of research and extension investments where according to usual accounting procedures, R_t includes many activities including training. K_t is the stock of knowledge or new technologies available to farmers, C_t is the stock of human scientific capacity

[3] *P and W are aggregate prices defined such that PQ is total revenue and WX is total costs.*

gained through formal training and learning by doing, L_t is the stock of scientific knowledge not immediately available in the form of technologies available to farmers, J_t is the stock of knowledge available to farm policy makers and Z_t is the stock of knowledge and experience of science managers in allocating research funds. The 'I' notation on the right hand side of this relationship denotes an increment in time t to these four capital stock. The relationship says that as a result of past investments in research and extension there will be increments to these four capital stocks in time t and the size of these increments will depend not only on the level of investments but on the existing size of the capital stocks. Note that stock of physical capital in the form of laboratories and other research inputs has been omitted in the interests of simplicity.

Equation 1 is a general form of a multi-output, multi-input production relationship where complex product transformation and input substitution possibilities are deliberately left implicit. This heuristic representation reflects the inherent jointness in the relationship where, for example, research activities not only might add to K_t but also add to C_t and L_t and training activities which add to C_t through skills gained might also add to L_t through the development of new data analysis techniques and might also, through the development of new technology, add to K_t. No accounting system can overcome this inherent jointness.

How these four capital stocks grow can be represented as follows using K_t as an example:

2. $$K_t = K_{t-1} + IK_t - DK_t$$

Where DK_t is the depreciation of the knowledge stock in the present period, perhaps as a technology is replaced or becomes obsolete. Similar relationships hold for the other three capital stocks. This representation is perhaps too simplistic in not explicitly reflecting the jointness between the four stocks.

The extent to which K_t is utilised on-farm depends on P_t, relative factor prices and the human capital held by farmers, H_t and can be represented as:

3. $$F_t = f(K_t, P_t, H_t)$$

The production function for final output can be represented as:

4. $$Q_t = f\left(X_t, \mathrm{F}_t, W_t, A_t, \mathrm{J}_t\right)$$

where current agricultural output (supply), Q_t, depends on a flow of conventional inputs, X_t, a flow of services from a stock of knowledge (or technologies) that are available to farmers, F_t, uncontrolled factors such as weather and pests, W_t, a flow of services from publicly provided infrastructure in the form of education, transport and communications for example, A_t, and farm policy setting, J_t. This representation abstracts from issues like biased technical change but suits our purposes in this report. Note that Q_t and X_t are vectors of multiple outputs and inputs at time t.

Hence the stream of investments made by the ACIAR has an impact on the research production function in some combination of the following ways:

- sometimes directly through increments to the stock of knowledge and technologies available to farmers, K_t, through advancing the rate of technology development and adoption;
- indirectly through additions to the stock of human scientific capacity, C_t, through training programs and to the stock of scientific knowledge, L_t, through the development of new techniques which later impact on other capital stocks;
- directly through rural policy settings reflected in J_t but perhaps more through changes in the terms of trade;
- indirectly through gains in efficiency in the use of research resources, Z_t through better priority setting for example which are later reflected in K_t.

O'Donnell pointed out that the TFP index can be disaggregated into technical change (movement of the production frontier in response to R&D say), technical efficiency (movement towards the production frontier in response to extension, say), scale and mix efficiencies (movements around the production frontier in response to price changes). While acknowledging the importance of profitability and the policy implications evident from O'Donnell's disaggregation of TFP, we have chosen concentrate on the Alston et al. research production function in the first instance.

Gordon and Chadwick (2007) defined human capital, C_t, as 'the understanding, skills and stock of knowledge applicable to the particular environments of the workers and decision-makers (p.15)' and capacity building as 'encompassing training and all other forms of learning that enhance the knowledge, understanding and competencies (skills) of individuals (p.18)'. They distinguished human capital from the stock of knowledge from research activities arguing that the potential impact of human capital is potentially larger because it is better able to influence the institutional environment in which research is undertaken[4]. In terms of the representation of the research production function above, K_t, is the stock of knowledge already available to farmers whereas the stock of knowledge, skills and experience in scientists, C_t, is not yet available to farmers.

While we might be able to conceptually distinguish capacity building from research activities, the literature does not really examine the practical implications for measuring these activities. Under the Frascati convention used by most statistical agencies, no distinction is made except that capital expenditure, tangible capital, is distinguished from operating expenditure. The capacity building literature does not provide a clear definition of the outcome of research activities as distinct from capacity building activities. Perhaps the outcome of this residual is the accumulation of the knowledge stock.

The practical difficulties of applying this distinction were explicitly recognized by Gordon and Chadwick:

> 'The complementarity of human capital …..with investments in research, technology, physical capital and institutional infrastructure, make evaluation of just the capacity-building investment difficult (p. 15)'.

This complementarity (jointness) applies at both the input and output levels. At the output level it is hard to imagine a research activity that does not add to both the stock of knowledge and the capacity of scientists. While perhaps we can conceive of training activities that build up human capacity without adding to the knowledge stock, training activities that are part of an overall research programme most likely do add to the stock of knowledge. As we shall see in reviews of empirical applications below, subjective judgement is required to apportion outputs between additions to the stock of knowledge and additions to human capacity. Similarly, at the input level, apportioning a budget between these components requires judgement. Perhaps the Frascati protocol was designed to avoid these difficulties.

The capacity building literature recognises the links between capacity building and research. Brennan and Quade quoting Ryan (1999) and Maredia and Byerlee (2000) noted that investment in capacity is an important component of total research investment because it enhances the productivity of research resources. While research and capacity building activities are substitutable to some extent in their impact on agricultural productivity, a critical mass of capacity is required for research activities to be productive. They recognised that the decisions about R&D and capacity building investments were inter-related and pointed out that little was known about the returns to investment in capacity.

Within a project, research activities may add to both the stock of knowledge and the stock of human scientific capacity (through learning by doing). In some case research activities may not add to the stock of available knowledge (their findings are not useful to farmers) but do add to the stock of scientific capacity which may well add to the stock of knowledge in future projects (the efficiency of research resources in later projects is enhanced because they are cooperating with a higher level of human capacity). An attraction of informal training within a program or training

[4] Further insights may be gained from a formal microeconomic exploration of the substitution between stocks of knowledge and human capacity in the production of new technology.

related to a program of research (as in the John Allwright fellowships) is that capacity gains are likely to be reflected sooner in gains in the stock of knowledge. Shorter lags in adding to the knowledge stock have an economic value. On the other hand formal training through post graduate study may add more to the stock of human scientific capacity because of its greater breadth.

A key insight from the general model of research impact and related empirical work is that research activities might not have an immediate impact on agricultural productivity but that their impact may persist for many years. Extension activities in contrast have a more immediate and shorter lasting impact. In a similar vein we might expect that human capacity building might add to a stock of human capital (accepting the views of Gordon and Chadwick that the stock of human capital is different to the stock of knowledge). However this stock of human capital would be similar in impact to the stock of knowledge occurring over decades.

A Review of empirical studies

First we briefly review econometric work estimating the return to investment in agricultural research drawing out implications for the human capacity building component. Then we focus on specific capacity building analyses.

Typically total factor productivity (Q/X) is typically regressed against weighted sums of past investments in research (with lags as long as 35 or more years), weighted sums of past investments in extension (with shorter lags of say three years), and variables controlling for seasonal conditions and trends in the farmers' human capital in the form of years of schooling for example (Sheng et al. 2011)[5]. Econometric analyses of this type in Australia (Sheng et al. 2011) and the US (Alston et al. 2000, Alston et al., 2010) for example, have estimated high rates of return to public investment in agricultural research supporting the findings of project level impact assessment studies such as those conducted by ACIAR (Lindner et al., 2013). In none of these analyses was a distinction made between research and capacity building activities.

Given the aggregated nature of the data, the estimated returns to investment reported in these analyses are effectively returns to the range of research and capacity building activities. In the absence of a sensible way of attributing benefits and costs between these alternative activities, one approach is to accept that they earn the common estimated rate of return. Given that stocks of knowledge and of human capacity are likely to have similar long impact profiles this may be a good approximation. Perhaps an argument could be made that the returns to capacity building may be a little higher than the returns to research because it is likely that even research projects that add little to the knowledge stock might add to the stock of human capacity but against this is the likelihood that lags associated with capacity building may be longer.

However since research funders like ACIAR have to make investment across this range of activities, it is important to attempt reassurance that capacity building is a good investment and to devise means of monitoring and evaluation capacity building activities. So now we turn to reviewing analyses of the impact of human capacity building.

There are four broad classes of analysis of the impact of capacity building. First, so called 'tracer studies' survey the participants in training programs, following their careers since 'graduating' to identify capacity built and utilised from their training. Second, following an evaluation framework designed by Gordon and Chadwick (2007), are analyses that attempt to disaggregate total welfare gains estimated using traditional impact assessment processes between a capacity building component and a residual research component. Third is the approach developed by Brennan and Quade (2004, 2006) to synthesise a (constrained) research production function relating output to changes in capacity. Fourth are studies typified recently by Bartel et al. (2014) and Obst (2014), which econometrically relate productivity outcomes to capacity building activities.

Tracer Studies

A qualitative approach to assessing the impact of capacity building is through the use of 'tracer studies' to follow the careers of those who have had capacity building opportunities usually in the form of formal training. An attraction of focussing on formal training programs is that their impacts

[5] This general form can be derived by substituting equations 1.2 and 1.3 into 1.1.

are likely to be predominantly in the form of additions to the stock of human capital, less 'contaminated' by additions to the knowledge stock and the severe attribution issues that brings.

At ACIAR the chief vehicle for formal training has been through the John Allwright Fellowship scheme (and to a lesser extent the John Dillon Fellow scheme). ACIAR has conducted four surveys of John Allwright Fellows (1998, 2004, 2006 and 2008). Typically respondents are asked to comment in a general way about whether their capacity building opportunities have resulted in greater career progression and promotion. Questions about capacity utilised and actual impact are either missing or couched in ways that are not discriminating.

The design of these surveys is such that, while supportive, they provide little convincing evidence of the impact of training activities.

A study designed to establish a more evidence-based link between training and productivity outcomes was that by Kumar and Nacht (1990). USAID/Nepal had supported the overseas training of over 4,000 Nepalese in the United States, India, and other countries and Kumar and Nacht were commissioned to assess the impact of this program.

Their study was in three parts. First they surveyed a sample of those who had participated in training programs. One of the questions asked was:

"Could you give examples of any changes you were able to introduce in your work which can be attributed to your training?"

They were aware that some who received training never gained from the experience and so they asked questions about the existence of institutional barriers preventing the utilization of training.

Second they focussed on several institutions in Nepal where a significant percentage of staff had been selected for training. The general areas of contribution included:

- Performing technical activities closely related to their training well;
- Establishing new units in existing organisations or even founding organisations;
- Newly acquired knowledge and skills were applied in their role as educators.

Third, they conducted in-depth interviews with key decision makers across Nepalese society about their impressions of the impact of the training program.

They concluded:

'The net effect of the infusion of thousands of trained personnel into a poor and struggling society is to inject considerable life into the country's institutions, which, in turn, has created important multiplier effects far beyond the aggregate efforts of the individuals involved…..

In short, the dominant conclusion is that Nepalese economic development -- as modest as it has been in national terms-- would have been far less without the massive participant training programs supported by USAID/Nepal over the past three decades (from report summary)'.

In a similar vein to Kumar and Nacht is a study by Effective Development Group (EDG, 2006) of Vietnamese participants in training programs provided by the Crawford Fund. A feature of the EDG approach was that it attempted to establish a pathway from capacity built to capacity utilised. The Gordon and Chadwick case study on water management in Vietnam (2007, described in more detail below) used survey data from the EDG study. The EDG questionnaire was used in the Longmore et al. (2007, IAS 48) and Fisher and Gordon (2008, IAS 52) studies of capacity building discussed more fully below. It will serve as a good starting point for any evaluation of capacity building undertaken later in this project.

The EDG study involved 73 scientists from Vietnam who had undertaken one of the 21 capacity building activities sponsored by the Crawford Fund over the ten years prior to 2006.

A two-step process was used. The first step involved a survey questionnaire to 132 people (73 responded) consisting of multiple choice and open ended questions to gather quantitative and qualitative data. The questionnaire led respondents in a structured way through their perceptions of the quality of training, the capacity they developed through to how they personally and their organisation used and benefited from the capacity built. In a second stage some of those who

rated their training highly and some of those who rated it poorly were personally interviewed to gain more insight into their different experiences.

In general the respondents were very positive about the relevance of the courses, the adequacy of training material and the skills of the trainers. About 90% proffered that their performance and work improved and about 30% suggested that their organisation had changed as a result of the training programmes.

The EDG questionnaire is an important starting point for our work because of its emphasis on linking capacity building and capacity utilisation. However the views gathered about capacity building and utilization as still general in nature presumably deriving from the nature of the questionnaire. Perhaps we will have an opportunity to gather more specific information about skills developed and specific examples of how these skills were applied both by individuals and organisations and evidence of on-farm adoption. This will require experimenting with different survey instruments.

One of the key recommendations of the EDG report was that the Crawford Fund set up a process to monitor and evaluate capacity building activities. This has not been done for either the Crawford Fund or ACIAR and would be an important component of further studies.

ICRISAT is planning a similar review of the capacity building activities of the VLS project by 'tracing' the career paths of those who have undertaken training within the VLS program. This study is expected to establish strong causal pathways between their VLS training experience and the use of this training in their subsequent career to effect efficiency gains.

By design, 'tracer' studies do not provide a quantitative estimate of the value of human capacity building. Nevertheless, given the subjective nature of alternative quantitative approaches, well designed 'tracer' studies of individuals and the institutions where they work, have the potential to identify strong causal pathways between training and efficiency gains for at least a sample of individuals, which lend support to the findings of more quantitative studies. The tracer studies might be useful in identifying case studies for more intensive quantitative analysis.

Qualitative information about within project capacity building can be found in ACIAR's Adoption Studies series and many impact assessment reports make general statements capacity built. Generally these observations do not go as far as providing specific examples of capacity built and the technologies to which it was applied. The impact pathway process recommended by Gordon and Chadwick (see next) has rarely been followed.

Disaggregating estimated total welfare gains

Gordon and Chadwick (2007) were commissioned by ACIAR and the Crawford Fund to develop a methodology to evaluate capacity building investments. They proposed a framework for tracing out the impact of capacity building activities (Figure 1 which was specifically developed for the pigeonpea breeding case study discussed more fully below) .

The key steps in applying this framework are:

- 'identifying the links along the pathway from the capacity-building activities to the measured benefits;
- substantiating each significant link using appropriate measures, such as indicators and expert opinions;
- taking into consideration external inputs influencing the outcomes;
- measuring the benefits with the ACIAR capacity building contribution against the most likely scenario without the ACIAR contribution.(p.66)'.

On the basis of an exacting process of qualitatively identifying the impact pathway for capacity building activities, Gordon and Chadwick made an ultimately subjective assessment of the share of project benefits that could be attributed to capacity building. They also made an assessment of the share of project costs that could be attributed to capacity building. This share data was used to quantify benefits and costs of capacity building. Our impression from their case studies is that less attention was devoted to deriving the cost shares. In some cases the cost and benefit shares were assessed to be the same, in which case the returns to capacity building would be very similar to

the returns to the total investment. Confidence in estimates of the value of capacity building using the Gordon and Chadwick approach depends on the quality of the initial impact assessment and on the subjective assessment of benefit and cost shares attributable to capacity building.

The Independent Review of ACIAR (ACIAR, 2013) noted anecdotal evidence of the importance of ACIAR's capacity building activities, acknowledged the Gordon and Chadwick framework (and its subjective basis) and recommended that ACIAR continue with its impact assessment processes.

From their literature review, they also identified three rules of thumb that might be applicable in assessing agricultural capacity building. Quoting from their report:

'While the empirical evidence is very patchy on most of the pathways from capacity building to benefits, some very tentative rules of thumb emerge.

1. A worker's lifetime income is higher, on average, by around 10% for each additional year spent in formal education.
2. The firm captures around half of the benefits of their investment in specific training for their workers, the workers capturing the other half, and the individuals trained around a third.
3. Improvements in human capital explain around 30% of the increase in total factor productivity
4. Some 50% of increases in (agricultural) productivity can be attributed to interstate or international R&D spillovers (p.30).'

They applied their framework in two case studies. One way to apply the framework is to work forward from the capacity building activities to efficiency gains attributable to them. A second way, used by them, is to work back from estimated total welfare gains to arrive at an estimate of the contribution made by capacity building to these gains. Their case studies built on two ACIAR impact assessment analyses, one by Ryan (1998, using material from a paper by Bantilan and Parthasarathy (1997)) of pigeonpea breeding in India and one by Harris (2006) on the management of public irrigation systems in Vietnam.

Dr K.B. Saxena, a pigeonpea breeder at ICRISAT spent a three-year postdoctoral visit to the University of Queensland (UQ), supported by ACIAR, to work with pigeonpea breeders there who had already a strong association with ICRISAT's program. This visit took the form of professional collaboration rather than formal training. According to Gordon and Chadwick (p. 67), 'Dr Saxena described three elements of capacity building, in order of relative significance:

1. Learning by doing:

   Collaboration with experts in the practical application of knowledge, which led to effective on-the-job training.

2. Access to knowledge/knowledge transfer concerning:

   plant breeding techniques developed during earlier UQ projects

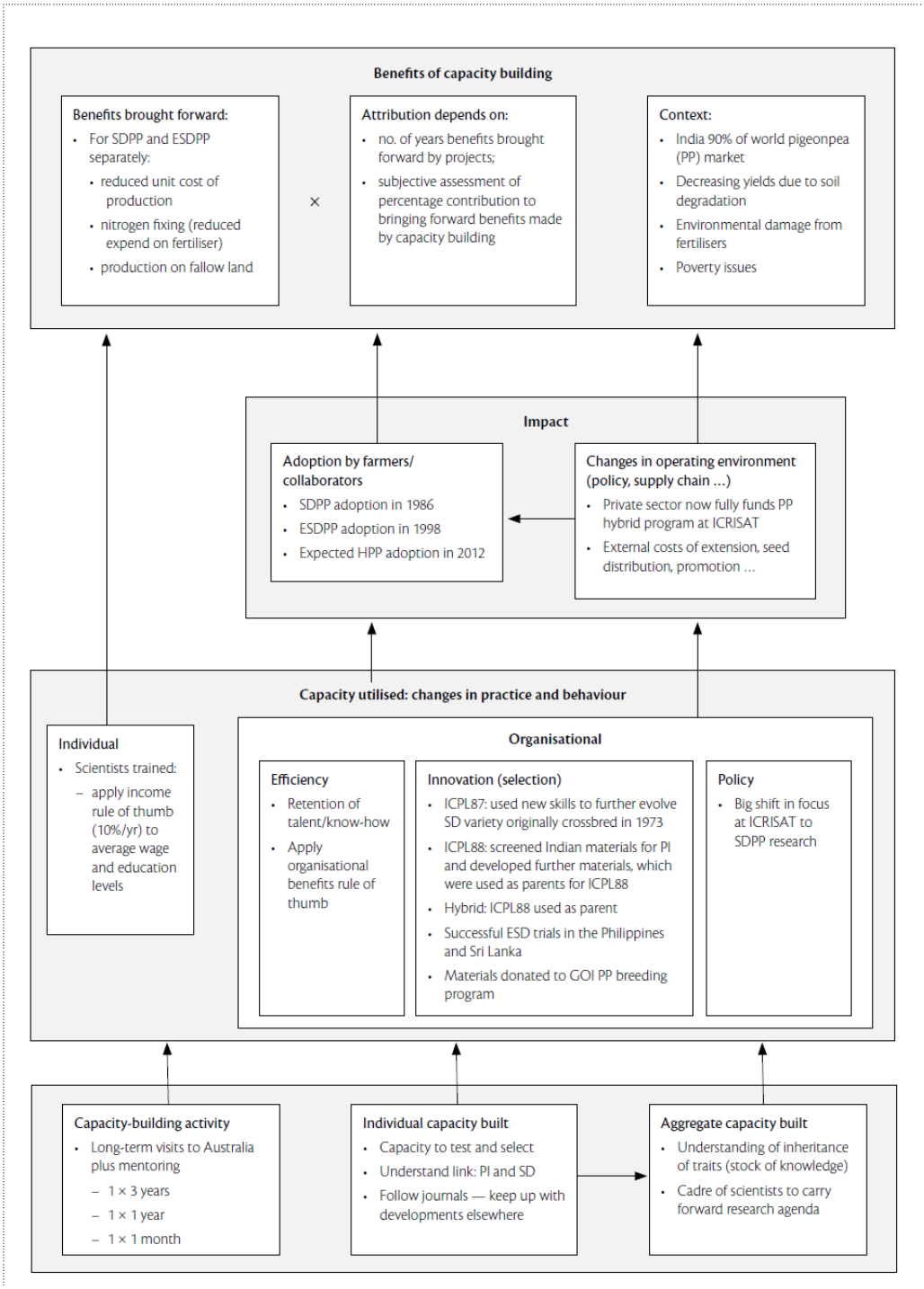
   the concept of photo-insensitivity and its link with early maturation

   the viability of high-density cropping in semiarid environments.

3. Working with experts:

   contact with plant breeding scientists from different organisations and experts in other disciplines promoted the benefits of a multidisciplinary approach and established a network of scientists, working collaboratively on related topics and sharing knowledge.

Figure 2: Pathway to benefits from pigeonpea capacity building from Gordon and Chadwick (p.68)



The gains in scientific capacity by Dr Saxena on this visit allowed him to expedite:

- the release and on-farm adoption in India of SDPP genotypes
- the identification, development, release and adoption in India of ESDPP genotypes
- the identification, development, field-testing and on-farm trials in India of hybrid pigeonpea (HPP) genotypes.

Gordon and Chadwick described in some detail how Dr Saxena's visit to UQ influenced pigeonpea breeding at ICRISAT for many years both through him personally and through the enhanced skills and knowledge of the group of scientist working with him. This description took the form of an impact pathway from the Australian visits through to specific new varieties released (and other

inputs in the form of publications and networks for example) with a clear link to the capacity building program through to on-farm adoption. The impact pathway is set out in Gordon and Chadwick (p.68) and Figure 2.

After identifying capacity built, they described how this capacity was utilised at ICRISAT and then how they determined on-farm impact. They carefully identified the varieties whose breeding was at least partly attributable to the ACIAR projects. In determining on-farm impact they largely followed Ryan with updated parameters from Bantilan. They also extended Ryan by considering ESDPP and lengthening the period of analysis to 2011.

They estimated the welfare gains, following Ryan, as the benefits from advancing the adoption of the new varieties related to ACIAR activities by three years (using used a model developed by Lubulwa and McMeniman (1997)).

They assumed that any benefits in countries showing promise like Sri Lanka and Philippines (from variety ICPL 88039) were yet to emerge. They also did not attempt to value the environmental benefits from reduced nitrogen fertiliser requirements arising from the increased area of pigeonpea nor did they value any reduction in poverty additional to the estimated economic impact.

The NPV from the 3 year advance in development and adoption of new SDPP and ESDPP varieties from 1982 to 2011 in 2005 dollar value discounted back to 1982 was $131.8m giving a BCR of 16.75 and an IRR of 19%.

The contribution of Gordon and Chadwick was to develop and apply a framework for valuing capacity building. In the case of pigeonpea, on the basis of their exacting elucidation of the impact pathway of Saxena's capacity building experiences and expert opinion (largely that of Dr Saxena it would appear) they attributed 50% of benefits to capacity building. There was a short discussion of the basis of this still subjective assumption (p.73). They also estimated again with little transparency that the share of project costs attributable to capacity building was 30% and therefore the BCR rose to 27.92 and the IRR to 23% (based on an NPV of $70.1m).

In addition Gordon and Chadwick applied the rules of thumb to the pigeon example. Applying the 10% per year of training rule to average income in India for 3 years of training over a further 30 years of working life gave a benefit of A$5,841(nominal). Then they estimated that the benefits of capacity building to the organisation based on the $5,841 gains to the individual amounted to $8,762, a total of $14,603, much smaller that the benefits attributable to capacity building from the on-farm efficiency gains.

In a second case study Gordon and Chadwick (2007) assessed the benefits from a 3-week training program in an aspect of GIS which was linked to efficient water management projects in several public irrigation schemes in Vietnam funded by ACIAR. These projects were the subject of an impact assessment by Harris (2006). The water management rules developed during the two projects resulted in efficiency gains in the form of higher crop yields and an increase in water available for sale to urban water users. Early in the second project a gap in GIS capability in Vietnam was identified. This GIS capability was essential to the successful outcomes from the second project.

Gordon and Chadwick estimated the benefits of this GIS capacity building as the same share of project benefits as the costs of training were of total project costs. The training only benefited the second project. The benefits from training were assessed as a share of the benefits from the second project. The total investment necessary achieve the benefits from the second project was assessed as the cost of the second project and a 20% share of the cost of project one (recognising the costs of model development in project 1 used in project 2). The costs of the training program were 0.58% of these total costs and this was the share applied to total benefits from the second project to arrive at the benefits of capacity building. Gordon and Chadwick estimated a benefit cost ratio of 13.3 and an IRR of 28%. They were unable to estimate benefits in years after the two projects because the 'trainee' was unable to participate in a tracer study by the Effective Development Group of capacity building activities in Vietnam funded by the Crawford Fund.

The Gordon and Chadwick framework understates the returns from capacity building activities to the extent that no attempt is made to estimate 'spillover' benefits to research projects conducted after the projects under evaluation.

In their Appendix 3 Gordon and Chadwick identified 9 IAS reports (no's 1,3,6,7,18,24,25,26 and 33) where capacity building was a significant component of the projects[6]. They reviewed 18, 25 and 33 in a little more detail in their Chapter 5. No attempt was made to value capacity building in these studies but its importance was often noted. Generally projects are selected for impact assessment because their economic impact is expected to be significant. It is likely that some ACIAR projects with significant capacity building outcomes were not selected for impact assessment because their economic impact was expected to be small.

Since Gordon and Chadwick there have been two impact assessments where, judging by the titles of the reports, assessing capacity building has been an important component of the analysis. These are "Assessment of capacity building: overcoming production constraints to sorghum in rainfed environments in India and Australia" by Longmore et al. (2007, IAS 48) and "Breeding and feeding pigs in Vietnam: assessment of capacity building and an update on impacts" by Fisher and Gordon (2008, IAS 52). We have not followed Gordon and Chadwick in reviewing all IAS reports since their study for the significance of the capacity building component.

The objective of the sorghum projects was to develop and use biotechnology techniques to develop strains of sorghum resistant to stem borer and shoot fly in India and Australia. In Australia the projects were assessed as bringing forward the development and adoption of a new variety by five years and increasing the probability of its adoption. All Australian benefits were treated as economic gains from traditional research processes (additions to the stock of knowledge available to farmers). In India no new strains were immediately available but prospective economic gains were estimated and attributed wholly to capacity building. The rationale for this attribution was not clear but if this approach was widely adopted then a large proportion of benefits from ACIAR research projects would be attributed to capacity building. Longmore et al. conducted a 'tracer' study similar to the EDG study to make as explicit as possible the pathway from capacity built to capacity utilised in India. They found that only for one of the three subprograms could a strong argument be mounted that capacity built had indeed been utilised. Nevertheless the benefit cost ratio in India was 81:1 and the IRR was 19.2%.

The ACIAR funded projects on breeding and feeding pigs in Australia and Vietnam were originally the subject of an impact assessment by Tisdell and Wilson (2001, IAS 17) and assessed again with a focus on capacity building by Fisher and Gordon (2008, IAS 52). It would seem that the project was multi-dimensional in having technology transfer, research adding to knowledge stock and capacity building components. Capacity building in Vietnam allowed further research into 'genetic improvement, nutrient digestibility, AI, chemical analysis and computer-aided diet formulation (p.9)'. Capacity building was assessed as having maintained the improved genetic base after the ACIAR project finished. It also attracted external funding for further research continuing the ACIAR work and Fisher and Gordon extended the stream of benefits (and costs) over a longer period than Tisdell and Wilson to partly capture the 'flow on' benefits of capacity building.

Of total economic benefits from the breeding and feeding components, 40% were attributed to capacity building (the same as its share of the total R&D budget) giving an IRR of 24.5% and a benefit cost ratio of 256:1. Again participants in training programs were surveyed based on the EDG approach to trace out the pathway from capacity built to capacity utilised. The respondents reported high scores for both. Fisher and Gordon estimated the personal benefits to scientists from capacity building but found them to be very small relative to industry benefits.

The Brennan and Quade Studies

Brennan and Quade (2004 and 2006) assessed the impact of two ACIAR funded projects whose objective was to investigate and enhance the sources of rust resistance in wheat in India and Pakistan by providing training for Indian and Pakistani rust scientists at the National Wheat Rust Control Program (NWRCP) at the University of Sydney in the late 1980s and early 1990s. Brennan and Quade (2004) contains a detailed description of the projects that were part funded by ACIAR.

[6] It is not clear why in Harris (2006, IAS 43), one of their case studies was not included in their Appendix 3 list. Perhaps it had not been published at that time.

No doubt the training component of these projects added substantially to human capacity in India, Pakistan and Australia but there were also additions to tangible capital in these countries in the form of facilities for the safe handling and multiplication of wheat infected with rust and, even if no new varieties were immediately developed, there was a clear addition to the stock of knowledge in the form of a book, *Wheat rusts – an atlas of research genes* (McIntosh et al. 1995) disseminating information about rust resistance genes.

The distinguishing feature of their study was an attempt to synthesise a relationship between human scientific capacity and productivity based on an imposed logistic functional form:

$$(0.0) \quad y = a \Big/ \left[1 + e^{-(b+cx)} \right]$$

where *y* is the level of production and *x* is the level of human capital (of the scientists)[7]. This is a logistic function where production is bounded below by the level of production, *d*, allowed by 'spill-ins' of technologies from neighbouring regions when 'local' human capacity is zero, such that *y=d,* and above by the maximum level of production when human capacity and other forms of capacity are at a maximum, represented by a. These upper and lower bounds are derived from the expert views of scientists and from trial results. When human capacity is zero their assumption is that the productivity of other research inputs is also zero and gains can only come from spillins. The maximum level of productivity is dependent of the level of other capacities. Their preferred scenario is when these other capacities are not limiting but recognise that if they are limiting then the maximum level of productivity possible is reduced, modelled by varying a. The current levels of capacity and productivity growth provided an observation to 'fix' the location of the logistic function (similar to Scobie et al. 1991).

The narrowing of the gap between a and *d* is explained wholly by human capacity and the value of the training is estimated as the difference in *y* with and without the years of training funded by the projects. To make the model empirical Brennan and Quade had to measure human capacity in wheat pathology in India and Pakistan. The alternative measures they used included[8]:

- Total years of experience;
- Total years in study and years in experience;
- Weighted years of experience with MSc less valuable than PhD experience.

Further, they had to apply subjective assumptions about how human capacity changed with the Australian training undertaken by the Indian and Pakistani pathologists. The value of the training was estimated as the difference in the value of output 'with' and 'without' the training.

Brennan and Quade (2004) estimated that the benefit cost ratio for the capacity building delivered through the ACIAR projects was 17.3:1 for their preferred scenario. Some key assumptions underlie this estimate. They charged all project costs of $A1.6m (2003 $s) against their measure of benefits[9] even though some costs were not associated directly with training activities and delivered other outcomes such as changes in tangible capacity and the stock of knowledge. Their estimated benefits are hypothetical rather than observed and are based on the assumption that all other inputs into increasing rust resistance are unchanged.

Brennan and Quade called for further research to explore the relationship between human capacity and productivity and into how human capacity is measured. They provided valuable insights into our understanding of capacity building and their empirical work confirmed the findings of other analyses, using different methodologies, that the returns to capacity building are high.

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[7] To simplify the discussion we have expressed this relationship in terms of levels but Brennan and Quade noted that the units of measurement need to be appropriate to the application.

[8] Perhaps Brennan and Quade could have considered a stock of human capital measure based on lagged investment in training were data available.

[9] The derivation of costs is not detailed and hence it is unclear whether the costs of partners in India and Pakistan have been included.

We doubt that there are many easy gains to be had from continuing research in this area as suggested by Brennan and Quade.

Econometric analyses

It is beyond the scope of this study to exhaustively review all attempts to measure the impact of capacity building in sectors outside agricultural research. However two recent studies are briefly reviewed to give a more complete picture of the range of quantitative methods that have been applied to assessing the impact of capacity building. Ost (2014) found that the capacity of teachers and consequent measures of student performance improved not only with general teaching experience but also with grade specific experience. Bartel et al. (2014) found that the training of nurses and the length of their experience in particular hospital units, both dimensions of their human capital, contributed significantly to patient outcomes.

The common feature of these studies is that both had access to large data sets with cross section components (linking particular teachers with particular students for example) and over several years. In these studies inputs in terms of measures of capacity built and outcomes in terms of patient or student performance were relatively easy to measure and relate econometrically. It is hard to imagine these happy circumstances arising from the small projects that typify agricultural R&D and capacity building (although the World Bank has attempted to apply such techniques in some of the multi-million dollar development programmes it has funded).

Procedures

Gordon and Chadwick (2007) conclude their report saying:

> *'Applying quantitative techniques to capacity-building investments presents many empirical challenges. But it is important to persevere in trying to quantify the impacts in order to understand the relative benefits of the capacity-building investments ……. The simple process of thinking through capacity built, how capacity is utilised and what the impact of this has been or will be will raise the quality of these investments in the future and allow better recognition of the value added by capacity building in the future.(p.97)'*

We agree with this view and from our experiences during this scoping study, make the following recommendations.

There is a need for a clearer identification at the project planning stages of the resources intended for capacity building and an articulation of an impact pathway to the utilisation of this capacity. At planning stages the question of available capacity in partner countries must be formally addressed and the pathway for filling gaps in capacity and consequent efficiency gains clearly articulated. Project reports should clearly document capacity built and subsequent project reviews, adoption studies and impact assessment studies should all explicitly identify capacity built and seek evidence of the utilisation of this capacity. This is likely to require some modification of project proposal documents.

We anticipate that this greater attention to explicitly accounting for capacity building activities can be achieved without greatly increasing the project design and reporting burdens because project leaders are likely to have implicitly considered these issues.

While the resources devoted to some capacity building activities will be easily identified, the fact that research and capacity building activities are both likely to deliver additions to the knowledge stock and the stock of human scientific capacity means that no simple accounting process can be devised to separately identify the inputs and outputs from research and capacity building activities.

Conclusions from the Literature Review

One implication of this intractable jointness problem is further research into developing methodologies to assess the impact of capacity building is not a high priority in our view. However valuable experience (and more robust results) can be gained by further applications the Gordon and Chadwick framework. A theoretical development of a research production function that adequately represents how research and capacity building activities (and other inputs) flow through to changes in stock of knowledge available to farmers and human scientific capacity and thence to changes in output and productivity would also be valuable.

It is important to maintain the focus on robust measures of total welfare gains in traditional impact assessment studies because the Gordon and Chadwick framework involves attributing these total welfare gains between research and capacity building activities. As Gordon and Chadwick pointed out, deriving shares of investments and estimated welfare gains attributable between research and capacity building remains highly subjective. Those using their framework have often employed the EDG tracer study processes as a basis for these subjective judgements. The objective in these tracer studies is to develop evidence based links between capacity building activities, capacity utilised and efficiency gains. In our view future analyses using tracer study processes could experiment with questions seeking specific examples of capacity built and specific examples of the technologies to which it was applied. At present tracer study questions seem to encourage uncritical responses to these issues.

In our view while all impact assessment studies should be more explicit in identifying capacity built and utilised, the further step of applying the Gordon and Chadwick framework to elicit budget and outcome shares to allow an estimate to be made of the size of capacity building benefits and the rate of return to capacity building investments should only be required for selected studies, perhaps those where the contribution of capacity building is likely to have been particularly noteworthy in some respect.

On this basis the following is concluded and recommended:

1. Research funders like ACIAR invest in several different types of activity across the research spectrum including human capacity building;
2. It is sensible to ask if these investments are earning a rate of return comparable to investments in other activities;
3. It is sensible to monitor and evaluate capacity building activities;
4. There is a growing literature on evaluating the impact of capacity building which so far has not been linked with the literature on modelling the impact of research activities more generally;
5. Four different approaches to assessing the impact of capacity building have been reviewed;
6. Each provides valuable insights into capacity building;
7. The empirical analyses all find that the returns to capacity building are high;
8. Empirical analyses of the impact of capacity building is bedevilled by jointness at both the input level with other research activities and at the output level between stocks of knowledge and human capital;
9. While not a priority for this project, a theoretical exploration of the links between research activities, the stock of knowledge available to farmers and the stock of human scientific capacity in the context of a richer representation of the research production is likely to provide valuable insights.
10. The insight that critical masses of various capacity components such as human capital are essential to the productivity of research activities is an important one, as is the insight that some projects might not add to the knowledge stock but do add to the capacity stock which likely adds to the knowledge stock some years hence;
11. Before investing in a country ACIAR needs to be confident that the social and institutional capital exists to support agricultural research. At a project or programme level ACIAR needs to be confident that the human capital in the form of knowledge and skills exist to work with Australian scientists or that the projects contains capacity building components to build up these skills and experience.
12. CB should be more explicitly addressed in IAS and adoption studies – a section dropped in recent reports– requires adaptation of project proposal documents

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Evaluating the impact of capacity building by ACIAR

Mullen, JD, Gray, GD and de Meyer, J

Research funders like ACIAR typically invest in activities across a spectrum including pure and applied research, policy research and development, extension and human capacity building in pursuit of economic, social and environmental benefits. Ideally they allocate their resources such that the returns from these activities at the margin are similar but information about marginal returns is scarce. ACIAR has a strong record in using traditional welfare analysis to estimate the impact of research leading to new technologies which typically shift industry supply curves. Similarly there is some experience in evaluating the impact of policy research. There is much less experience in valuing the impact of research activities that add to human scientific capacity through either discrete training programs or the 'learning by doing' component of every research program. ACIAR commissioned Gordon and Chadwick (2007) to review the literature, devise an evaluation framework and apply their approach in two case studies. The limitation of their approach is that in practice they partitioned an estimate of total welfare gains from a new technology between a capacity building component and a research component, only qualitatively recognising 'spillovers' to later technology development. Here we review the literature on evaluating capacity building in a research production framework, we assess the significance of capacity building activities within the total ACIAR program and we propose a tracer study of ACIAR trainees (Allwright Fellows) and partner institutions to develop a strong evidence based pathway from investment in ACIAR funded capacity building activities to identifiable specific changes in research outcomes.

6. Capacity Building in ACIAR-funded Projects

During this scoping exercise various discussions we held in ACIAR with senior managers, and ACIAR Research Program Managers (RPMs) to discuss the results expected from *Task 6* and *Task 8,* respectively to develop a procedure to better capture the capacity building outcomes in ACIAR-funded projects and identify countries or technical programs on which detailed ex-post analyses can be undertaken.

As a starting point for this scoping study, we decided to focus on a limited number of countries over a defined timeframe to set geographical and historical boundaries around our preliminary analysis. Following discussion in ACIAR, it was decided that the following criteria should be applied:

1. Analyse a suite of projects that were either ongoing or completed after 2003
2. Focus the preliminary analysis on three countries: (i) Vietnam, as a country with a well established research program complemented with many capacity building activities and a long partnership with ACIAR, (ii) Myanmar, as a newly established partner with broad needs in capacity building and (iii) Timor Leste as a relatively small countries where spill over of capacity building activities could be more readily observed.

In the period between 2003 until today, a total of 165 ACIAR projects fit the defined criteria. The data of this suite of projects were extracted from the ACIAR database (*PISA)* and broadly categorised by termination year and research program to have an overall picture of ACIAR activities in these three countries (See Table 1 below).

Table 1. Total number of project in ACIAR portfolio with an end date between 2003 and 2018 and implemented in the Vietnam, Myanmar and Timor Leste

Project ending in	ADP	AGB	AH	AS2	ASEM	CIM	CP	CS2	FIS	FST	HORT	LPS	LWR	LWR1	PC	PHT	PLIA	SFS	SMAR	SMCN	Total
2003	-	-	-	-	-	-	-	1	-	2	-	-	-	1	-	2	-	-	-	-	**6**
2004	3	-	-	-	-	1	2	-	-	2	-	1	-	-	-	1	-	-	-	1	**11**
2005	-	-	1	1	-	2	3	-	3	2	1	2	-	-	-	1	-	1	-	1	**18**
2006	4	-	-	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-	-	1	**8**
2007	-	-	-	-	1	-	5	-	3	1	-	1	-	-	-	-	3	-	-	1	**15**
2008	1	1	2	-	-	1	3	-	5	-	-	-	-	-	-	-	1	-	-	1	**15**
2009	-	2	-	-	-	-	-	-	3	4	1	4	-	-	-	-	1	-	-	-	**15**
2010	1	-	1	-	-	2	-	-	1	-	-	1	1	-	-	-	-	-	-	1	**8**
2011	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	2	**5**
2012	-	2	1	-	-	-	-	-	4	1	1	-	-	-	-	-	-	-	1	1	**11**
2013	1	2	2	-	-	-	-	-	2	-	1	1	-	-	-	-	-	-	-	1	**10**
2014	-	3	-	-	-	1	-	-	1	3	-	-	1	-	1	-	-	-	1	-	**11**
2015	-	3	-	-	-	1	-	-	1	1	-	2	-	-	-	-	-	-	-	1	**9**
2016	1	-	1	-	1	1	-	-	2	1	-	-	-	-	-	-	-	-	-	1	**8**
2017	-	-	1	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-	-	2	**6**
2018	-	4	1	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	1	**9**
Total	**11**	**17**	**12**	**1**	**2**	**11**	**13**	**1**	**30**	**19**	**4**	**14**	**2**	**1**	**1**	**4**	**5**	**1**	**2**	**15**	**165**

The total budget allocated to these 165 projects amount to Australian Dollars (AUD) 152 Million, where a majority of the funds (57%) were allocated to projects with activities in Vietnam (See Table 2). Myanmar and Timor Leste were included in this preliminary analysis as countries which had a relatively new and small programs respectively. In further discussion with various RPMs, we then decided that for the purpose of this scoping study, we would first focus in Vietnam as it was the country with the biggest sample of projects to select from and where ACIAR capacity building activities were likely to have had visible impact that could be used to further define the methodology.

Table 2: Total value in AUD of the portfolio per country

Project Type	Myanmar	Timor Leste	Vietnam
Projects	5,980,091	49,367,019	63,142,984
Medium Projects	950,585	1,499,879	5,832,848
Small Projects		9,621	207,642
Restricted Grant (Large)	4,714,117	601,800	14,553,983
Restricted Grant (Medium)		397,912	
Restricted Grant (Small)		147,000	534,226
Small R&D Activity	121,000	1,069,521	3,016,410
TOTAL	**11,765,793**	**53,092,752**	**87,288,093**

Themes, programs or institutes?

During the period under study, a total of 127 projects were and are still being implemented in Vietnam. The research programs with most projects were Fisheries with 27 projects, Forestry with 18 and Agribusiness with 16 (see Table 3 below).

Table 3. Total number of projects per program in Vietnam with an end date between 2003 and 2018

Project ending in	ADP	AGB	AH	AS2	ASEM	CIM	CP	CS2	FIS	FST	HORT	LPS	LWR1	PC	PHT	PLIA	SMAR	SMCN	Total
2003	-	-	-	-	-	-	-	1	-	2	-	-	1	-	2	-	-	-	**6**
2004	3	-	-	-	-	-	2	-	-	2	-	1	-	-	1	-	-	1	**10**
2005	-	-	-	1	-	-	3	-	3	1	1	1	-	-	1	-	-	1	**12**
2006	3	-	-	-	-	1	-	-	1	1	-	-	-	-	-	-	-	1	**7**
2007	-	-	-	-	1	-	5	-	3	1	-	1	-	-	-	3	-	1	**15**
2008	1	1	1	-	-	-	3	-	5	-	-	-	-	-	-	1	-	1	**13**
2009	-	2	-	-	-	-	-	-	3	4	1	2	-	-	-	1	-	-	**13**
2010	1	-	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	**5**
2011	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	**3**
2012	-	2	-	-	-	-	-	-	4	1	-	-	-	-	-	-	-	1	**8**
2013	1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	**6**
2014	-	3	-	-	-	-	-	-	1	3	-	-	-	1	-	-	1	-	**9**
2015	-	2	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	1	**6**
2016	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	**2**
2017	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	1	**4**
2018	-	4	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-	1	**8**
Total	**10**	**16**	**4**	**1**	**1**	**1**	**13**	**1**	**27**	**18**	**2**	**9**	**1**	**1**	**4**	**5**	**1**	**12**	**127**

The fisheries and forestry research program were finally selected for further analysis in this scoping study and within these programs, we then decided to analyse the investment in capacity building in specific institutes rather than by research topics for the following reasons:

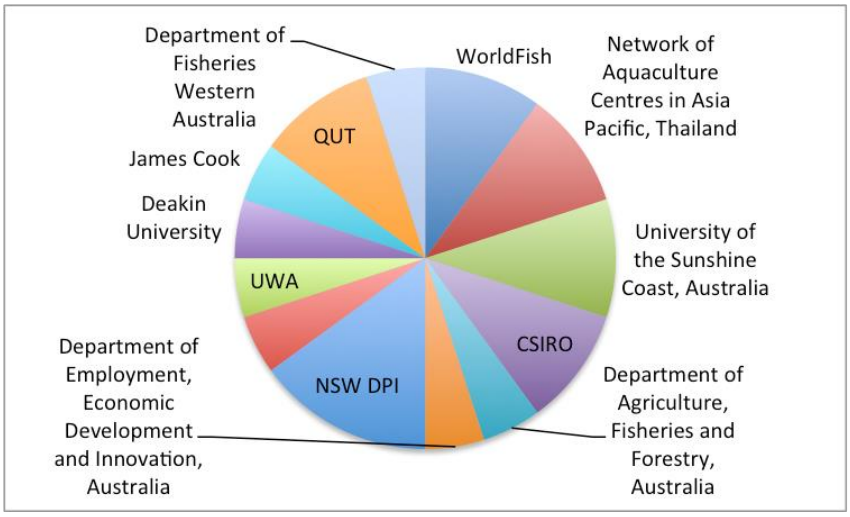
a. It was difficult to discern technical themes that involved multiple projects from project titles and summaries.

b. The process of identifying institutions where projects have been located was much more straightforward and require little technical expertise (see Figures 3a & 3b).

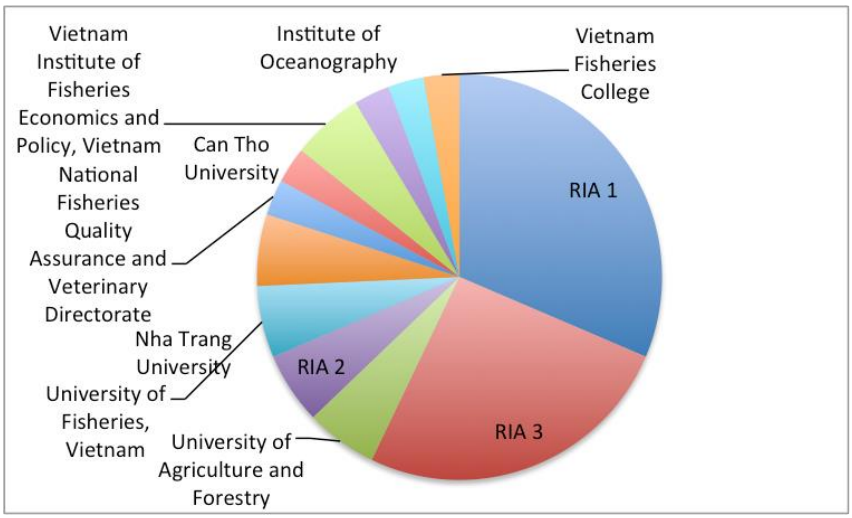
c. Institutional strengthening *per se* is of interest to ACIAR and thus analysing capacity building efforts per institution was a relevant approach for the agency.

Figure 3: Percentage of Fisheries project implemented by partners in a) Australia and in b) Vietnam

a)



b)



In Fisheries and in Forestry, ACIAR projects seemed to be commissioned evenly between various research institutes in Australia, regional bodies such as NACA and international research centres such as ICRAF and WorldFish. However, in Vietnam, the situation is different: some institutes (such as RIA1 and RIA3) are participating in many more projects relative to other Vietnamese institutes (See Figures 3a & 3b above). This observation will be further analysed in the second phase of this study to investigate the cause and consequences of this type of project concentration.

Gender of trainees and project staff.

Of the 32 fellows who have graduated from the JAF program in Vietnam (across all ACIAR programs), 8 are women. Of the 20 active fellows, 4 are women.

In the projects of the Fisheries and Forestry programs included in the analyses, the original project documents were examined to identify the gender of scientists involved in the project. Little or no gender-disaggregated information was included in the project annual reports, final reports or reviews although some could be inferred when individuals were named. In the original project documents some roles were identified but the person to take that role had not been identified or had yet to be appointed. Of the 64 scientists identified for project participation 12 were women.

Without more accurate data is neither possible to draw conclusions on the actual participation on project staff of either gender, nor to discern trends over the study period. The inclusion of gender disaggregated data, including an updated list of personnel in annual reports, final reports and reviews would enable these type of analyses. In the short term, further interrogation of project documents, project leaders and RPMs may yield sufficient data for a retrospective study.

Investment and value of capacity building

An exploratory exercise was undertaken to develop a set of indicators to evaluate the investment and value of capacity building included in ACIAR projects. This was an iterative process and the methodology and criteria for data inclusion changed as the exercise continued. The overall objective was to place a monetary value on the capacity building.

Three elements were investigated:

- Specific training activities funded by the project and identified in the project budget
- Informal training including on-the-job training and mentoring. The 'reciprocal travel budget' - travel by Australians to Vietnam and Vietnamese scientists to Australia - was agreed to be a good proxy indicator for the Capacity Building effort except for the circumstances where expatriate project scientists are located in or near the PC, as is the case in many 'multilateral' projects funded through the CGIAR.
- Formal training supported from the John Allwright or John Dillon fellowship scheme.

Training and other capacity building support funded from other sources than ACIAR were not included at this stage.

Source of data

ACIAR reports are well documented, with the most consistent and most readily available being a) the Project Document and b) Project Budget on which the legal agreements between ACIAR and the Commissioned Organization are drawn up. These two documents are committed as 'registered'; that is they are archived within ACIAR as official government documents which are legally required to be kept indefinitely. These documents are thus a publicly available and valuable source of data. The project final report - a further legal requirement of the project - is also a good source of data. The availability of data and consistency of its presentation is an important consideration to a conduct large retrospective study of ACIAR projects covering a long time scale of 10-20 years.

Process to extract data

The best replicable way to collect the data needed is to follow a stepwise process described below:

a) Extract the registered Project Budget from the ACIAR Meridio records system.

b) Identify and record the Commissioned Organisation in Australia and the Project leader

c) Identify the partner country (PC) organisation involved in the project. Several countries and several institutions in one country may be involved.

d) In Part C of the Project Budget identify and record the reciprocal budget allocated to training.

e) Identify in all parts of the Project Budget, funds specifically allocated to training.

f) In the Project Budget parts A2, B2, C2 and others if they apply, identify and record the amount of travel (fares plus subsistence) by Australia scientists to the PC. In some cases the travel and subsistence of PC scientists may be recorded here. The total of this value provides the reciprocal travel budget of the project.

g) Identify and record from the Project Document travel tables, the number of days that the project leader or other Australian scientists are expected to travel to Vietnam. Each day is

then valued at AUD 800 for a project leader and AUD 600 for a scientist. The total provides a value to the mentoring and on the job training provided within this project[10].

h) Identify the total project budget provided by ACIAR from Part D Summary. Some projects identify substantial in-kind contributions for the commissioned and collaborating organisations, For the present study, these contribution have not been added to the ACIAR cash budget.

i) Identify and record the percentage split between the PCs to calculate the specific percentage of the budget allocated to Vietnam

j) Tabulate all data to produce estimates of investment and value of capacity building.

k) Review project final reports and project reviews document for evidence of these capacity building activities. (See Appendix 1).

Vietnam forestry program

The 18 Forestry projects have a total ACIAR budget of AUD 14 Million and have nominated 13 JAFs during the study period. 10 Institutions in Vietnam and 10 Institutions in Australia were involved as partners in these projects. The Forestry Science Institute of Vietnam (FSIV) was a partner in 10 projects and those projects were then analysed in detail following the methodology described above (See Table 5 below).

The total value of the suite of projects in which FSIV was a partner is AUD 8.5 Million. During the analysis of the project budgets, we were surprised to notice that in a majority of cases, no money was specifically allocated to capacity building activities (step d and e above). In two cases only, a budget line was allocated to fund workshop and/or seminars.

The value of the reciprocal budget representing the financial effort to bring scientists together to discuss, exchange and learn was recorded (step f). Then following step g above, we took in consideration the value of mentoring done by the project leader and other scientists during their various stays to Vietnam. We then obtained a total value of informal capacity building implemented in these projects ranging from AUD 27,000 to AUD 65,000 accounting for between 7% and 30% of the budget allocated to Vietnam (see Table 5).

We also observed that when projects were commissioned to a multilateral or a regional institution with offices based in Vietnam or in a neighbouring country the travel budgets were small, and there were only relatively few days allocated for in-country travel by the project leader and or scientists. This was due to these mentors and on the job trainers living in or relatively close to Vietnam. In these cases, the data extracted from step f and g were not appropriate to estimate the effort of capacity building in these cases. This will be further analysed during the second phase of this study. Two projects were omitted for the analysis on this basis.

If we take in consideration the 9 PhD and 2 MSc grants that were awarded to scientists from FSIV during the defined period of this analysis and attributing a value of AUD 300,000 to a PhD and 150,000 to an MSc, the total value of capacity building effort since 2003 in FSIV is worth AUD 4.5 Million.

[10] *This is only a proxy value and it underestimates the true value of mentoring and on the job training as it does not consider the value of the PC on-the-job training to the commissioned organisation.*

Table 5: Analysis of 10 ACIAR projects in Vietnam implemented with FSIV

Project Id	ACIAR Contribution in AUD	PhD	MSc	Total Reciprocal Travel Budget in AUD	Days in Vietnam Project Leader	Days in Vietnam Scientists	Budget in AUD for Workshops, Seminar, Part I, etc…	Total Value in AUD of Informal Training	% of Vietnamese allocation in the Budget
FST/2002/112	386,083	1		12,300	5	6	7,633	27,533	7%
FST/1999/095	682,611	2		15,260	11	28	-	40,860	9%
FST/2010/034	1,643,437			33,010	24	24	-	66,610	11%
FST/2008/007	1,102,344	1		171,280	39	249	-	351,880	12%
FST/2001/021	519,932			37,670	34	17	-	75,070	13%
FST/2008/039	1,101,028	1		87,240	120	145	-	270,240	16%
FST/1996/005	572,857			41,340	7	7	-	51,140	20%
FST/2003/002	506,054		1	38,840	20	102	-	116,040	26%
FST/1997/024	1,145,013		1	12,093		31	73,726	104,419	29%
FST/2006/087	927,862	4		99,850	154	238	-	365,850	30%
10 Projects	$8,587,221	9	2		46	85		$1,469,642	17%

Vietnam fisheries program

The 27 Fisheries projects have a total budget of AUD 15 Million and have nominated a total of 9 JAFs during the analysed period. 12 institutions in Vietnam and 8 in Australia were involved as project partners in these projects. The RIA 1 was a partner in 10 of those projects (see Figure 3b). We then analysed in detail the 10 projects where RIA 1 was a partner. Three of those 10 projects were small research activities (SRA) and as such had little capacity building activities. Thus we focused our analysis on the 7 remaining projects (see Table 6 below).

Table 6. Analysis of 7 ACIAR Fisheries projects in Vietnam implemented with RIA 1

Project Id	ACIAR Contribution in AUD	PhD	MSc	Total Reciprocal Travel Budget in AUD	Days in Vietnam Project Leader	Days in Vietnam Scientists	Budget in AUD for Workshops Seminars etc… or Part I	Total Value Informal Training	% of Vietnamese allocation in total Budget
FIS/2005/114	395,850	2		71,580	7	27	-	93,380	3%
FIS/2002/068	711,460			43,289	72	36	-	122,489	15%
FIS/2006/141	1,504,713		1	189,600	97	163	16,000	381,000	16%
FIS/2012/101	1,673,000			111,550	224	0	-	268,350	23%
FIS/2000/018	341,126	1		41,150	56	12	14,400	107,550	32%
FIS/2002/077	989,214			43,760	10	25	-	66,760	36%

FIS/2001/013	382,060		48,000	55	56	24,400	150,000	39%
7 Projects	$5,997,423	3 1		74	46		$1,189,529	15%

The total value of the suite of projects where RIA1 was partner since 2003 is approximately AUD 6 Million. 3 projects had a budget for capacity building to fund workshop and seminars. Using the same procedures as described above and implemented to analyse the Forestry program, we obtained a total value of informal capacity building implemented in these project ranging between AUD 66,000 to AUD 381,000 accounting for between 3% and 39% of the budget allocated to Vietnam (Table 6). Adding to this the value of the 3 PhD and 1 MSc awarded to scientists of RIA 1, the total value of the capacity building since 2003 is worth AUD 2.2 Million.

Assessment of reported and estimated expenditure in capacity building

We extracted from ACIAR Annual Reports the following data, starting in 2002: Total ACIAR expenditure, Research Program[11] expenditure and Education and Training[12] expenditure. We used a deflator to convert the reported amounts to 2013 AUD to allow comparison of data in real terms. During the period analysed, the ACIAR budget increased from AUD 47 Million to AUD 104.7 Million. The research program expenditure accounted for 70% (AUD 32.9 Million) of the total ACIAR expenditure in 2002, and for 78% (AUD 81.6 Million) in 2013. The Education and Training budget accounted for 5% (AUD 2.7 Million) of the total ACIAR budget in 2003 and increased to a 10% (AUD 7.1 Million) in 2008 and then decreased to 6% (AUD 6.9 Million) in 2013.

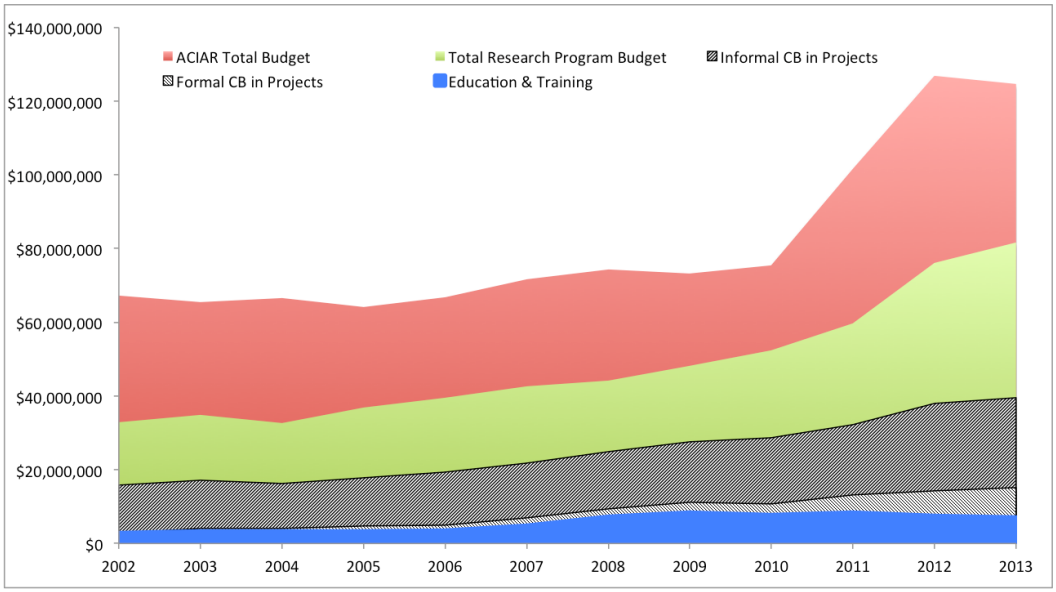
During a presentation in July in ACIAR we discussed the relative reduction of expenditure in Education and Training. The trend can be explained by the fact that since 2005, ACIAR is allocating funds for some postgraduate scholarships directly in project budgets, thus some of the expenditure allocated to the research program is actually for formal capacity building activities. The projects where such funding is important, include, but are not limited to: ACIAR - University of the South Pacific post graduate scheme (CIM/2007/114), Improving dry land crop production in Iraq. (CIM/2004/024, CIM/2008/027), the Postgraduate Scholarship Scheme for UNITECH, University of Lae, Papua New Guinea (ASEM/2004/077), and others such as the suite of fisheries projects in Indonesia to develop the capacity to monitor, analyse and report on Indonesian tuna fisheries (FIS/2009/059, FIS/202/074). Such in-project formal capacity building amounted to a total of AUD 3.5 Million during the analysed period. As it is currently a difficult exercise to identify all the projects with a formal capacity building component, we estimate that this value actually is below the real value. In the figure 4, we have represented in light grey, an estimation of the likely gradual increment of this type of investment.

It was not possible to exactly identify the total expenditure for informal capacity building in projects for the various reasons defined above. However, based on the data collected and presented in Tables 5 and 6, anecdotal evidence presented in the annual reports (See Appendix 1), in Adoption Studies (Appendix 2), in Impact assessment and expert opinion, we estimate that the expenditure in informal capacity building in project accounts from 10% to 40% of the research program expenditure, the highest percentage of this expenditure is represented in dark grey in Fig. 4. The range of informal capacity building activities recorded in project reports (See Appendix 1) varies from language courses in English, to short technical training courses including mid level management training.

[11] *Representing all bilateral and multilateral research grants.*

[12] *Representing the budget to fund the John Allwright and John Dillon fellows.*

Figure 4. ACIAR Expenditure in 2013 Dollars. The area in light and dark grey are estimated expenditures in formal and informal capacity building in projects.



7. Domains for Further Assessment

Priorities for further research

Further research on the relationship between capacity building and the successful implementation and long-term impact of R4D is warranted. It may be that the impacts derived from capacity building and technical development are inextricably linked, and to separate them has no practical value in the design and implementation of research. On the other hand, further elucidation of the relationship may assist in assigning priority to capacity building at different stages of a research program and in assessing its impact *per se* when future assessments are conducted.

Nevertheless we conclude that such research is of uncertain value in the short term and may be a suitable topic for an in-depth study by a doctoral student with interests in the cognitive and behavioural sciences and economics, with access to a range of data sets that embrace the scope of R4D in developed and developing countries. It would not be a trivial task.

Of more practical and of immediate benefit is to shed light on the overall objective of the formal and informal capacity building program of ACIAR: *to build research capacity of agricultural research institutions.* Few data are available to indicate the extent to which ACIAR has achieved this objective and methodologies to do so are under-developed. Further, to improve both capacity building and project implementation in new and ongoing projects using an action research approach would, in turn, improve the design of current pipeline projects. Better understanding of the trajectories of Allwright and Dillon fellows and research project scientists would assist the current work of the Training Committee and the review of Country Programs.

The design of an action research project should be driven by the desired or expected outcomes of the investment. On the basis that results would have applicability across a wide range of R4D programs in Australia and overseas, and that access to ACIAR projects is most readily available, we propose the following outputs as high potential to add value to the ACIAR research portfolio.

1. **Improved understanding of the medium and long-term benefits of formal and informal capacity building in institutions.** The most obvious targets would be FSIV and RIA1 which have been assessed in the current study. These two case studies of institutional change and ACIAR influence in Vietnam would make use, in the first instance, of the ISNAR framework for institutional assessment (Figure 5). Not all aspects of capacity would be of immediate concern to ACIAR and indeed, inquiries into some aspects of the organisation would be inappropriate and possibly unwelcome. The third quadrant (Organisational Capacity) is central to the benefits that would be expected as a result of training within projects and by the JAF and Dillon programs.
2. **Data on the career paths of ACIAR-funded scholars.** Case studies of 12 JAFs, 1 JDF and other project scientists associated with FSIV and RIA1 would form a core sample of scholars. This could be extended to other Vietnamese institutions and other countries if resources permitted, and would make use of the tracer study methodology used by the Effective Development Group and discussed in the literature review. A feature of this work should be to include the *utilization* of capacity, linking the skills gained during the training period to research, policy or other work that has been undertaken since training was completed.
3. **Value added to published impact assessments**. Two impact assessment studies have been made of projects in the forestry group Fisher and Gordon (2007, IAS 47) assessed the impact of ACIAR's FST/1993/118 and FST/1998/096 projects which were directed to improved tree species for Vietnam. Lindner et al. (2013) rated this impact assessment as being convincing (falling in their group of most credible studies). The IRR from these projects was estimated to be 32% and the benefit/cost ratio was 79:1. A significant training program was documented in the IAS report but the authors chose not to estimate the value of capacity building activities seemingly because they were of the view that the benefits of these activities were likely to accrue in later years.

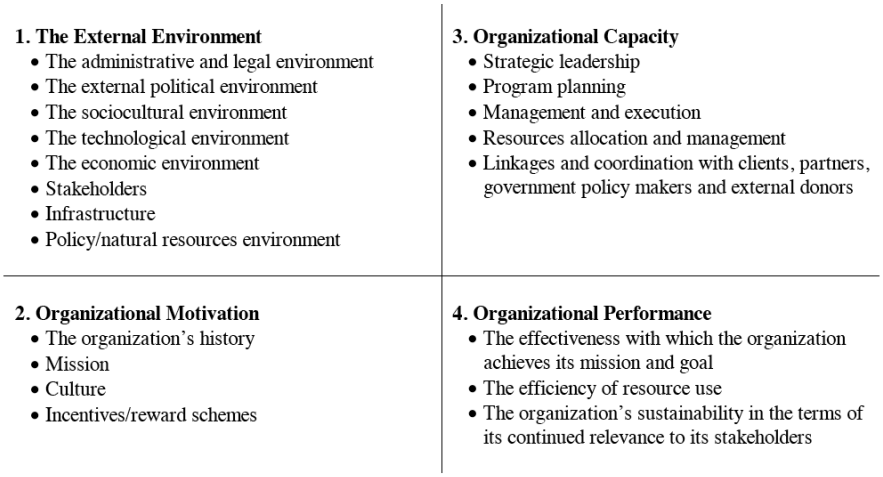
   The second study was by van Bueren (2004, IAS 27) of ACIAR's FST/1986/030 project dealing with Acacia hybrids in Vietnam. This analysis was also highly credible (Raitser et al.

2005, IAS 35). Van Bueren estimated a benefit-cost ratio of 145:1 from the contribution of the ACIAR project in bringing forward in time the commercial release of Acacia varieties in Vietnam. Unfortunately in this study no attempt was made to identify capacity building activities.

A component of the proposed second stage of our study is to revisit these two highly credible impact assessment analyses of ACIAR funded forestry projects in Vietnam and using the findings from the tracer surveys of Vietnamese scientists engaged in these projects and personal interviews with them, apply the Gordon and Chadwick framework to apportion a share of total estimated benefits (from I 27 and IA47) to capacity building activities.

4. **Design of selected pipeline projects improved**. The CB planning and monitoring tool as road-tested by the University of Canberra team and further considered in the current study can be implemented in collaboration with a sample of (around) five pipeline research project teams, leading them through the steps of needs assessment, monitoring and evaluation, and impact assessment. A discrete output would be a tightly defined capacity building strategy and plan built into their *Full* project proposals. The Indobeef project in Indonesia and PARDI project in the Pacific would be priority projects in design, and to include Forestry and Fisheries projects in Vietnam would build on this and other studies[13]. The incentives for project teams are that their projects will be better designed, better implemented or better evaluated as a result of their participation.

Figure 5: Four Dimensions of Organisational Assessment as adapted by ISNAR (from Horton and McKay 1998)



Source: Lusthaus, Anderson and Murphy (1995).

Dimensions of further studies

An indicative timeline, team and other resources required will be developed in consultation with ACIAR staff. The current authors consider that a study of 6 months would be required to undertake the necessary preparation of methodologies, time in country (Vietnam) for data collection, for interaction with developing project teams, analysis of results and report writing. We suggest that the highest priority is to follow up on the individual and institutional pathways and changes in Vietnam.

The current team has expertise in economic impact assessment, ACIAR research project management, and partner country program implementation. For the proposed work the team can

[13] Of particular interest will be the completed doctoral research of Tony Bartlett, RPM for the Forestry Program who has studied what constitutes 'success' in forestry projects in Vietnam. The authors of the current study benefited greatly from conversations with him, and his completed work will provide a further platform for ongoing work on capacity building.

be supplemented by more intimate knowledge of Vietnamese institution and expertise in organisational behaviour and assessment.

8. Conclusions

- Existing methods for the attribution of research impact to capacity building will be a starting point to enrich ACIAR's impact assessment process by more explicitly describing in the impact pathway how capacity built during projects has been utilized in later projects and within institutions.
- Two institutions in Vietnam: Research Institute for Aquaculture No 1 (RIA1) and the Forest Science Institute of Vietnam (FSIV) in Vietnam are appropriate institutions for study based on continuous engagement, numerous projects, JAFs and observable change.
- Based on an analysis of the Vietnamese Institutions and the projects they have implemented, in-project investment in CB is in the range 10% to 40% of total ACIAR investment. Due to issues of "jointness" and underreporting it is difficult to obtain an exact number. The second phase of this study will attempt to define reporting processes that might allow a more objective assessment of investment in capacity building.
- Published reports on the JAF program are based on mail-out surveys and case studies and do not analyse long-term impacts on individuals, or impacts on the institutions to which they have contributed their capacity. Rarely have these studies asked about how capacity has been applied. The organizational framework developed by ISNAR for agricultural R&D is a good starting point for measuring institutional change.
- The Independent Training Program Review (1998) recommended integrating the reporting of formal and informal training. Although there have been tentative steps undertaken to report on informal training it has been piecemeal, incomplete and difficult to summarize and analyse. The addition of Part I in project budget (1998-2002) and the elaboration of a Student Register (2006-2009) are the most easily identified initiatives. Project reporting of Capacity Building inputs, outputs and outcomes is variable. Some examples are found in the adoption studies (Appendix 2). However only rarely are specific examples identified.
- ACIAR projects have a unique combination of research activities and capacity building efforts, thus the capacity building and scientific impacts can be the most significant legacies of ACIAR projects (See Appendix 2, AAS 003). Sometimes capacity building is an explicit and essential part of the technology transfer from the project (See Appendix 2, AS 005). In other cases, ACIAR projects establish productive networks of exchange and develop a soft infrastructure that then becomes productive in the years to come (See Appendix 2, AS 006). A conclusion of this scoping study is that a monitoring framework for CB is warranted.

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Appendix 1 Reporting of Capacity Building in Project Annual, Final and Review Reports.

Extracts of the available Final and Review reports of the projects analysed earlier in Vietnam are provided here to illustrate the variety of approach, depth and analysis of capacity building undertaken

An example of the criteria that could be used to mark an organisation as capable of acting as a regional research centre was provided in a review report of FIS/2002/077

- Available to answer technical questions related to their field of expertise.
- Provide a contact point for national / provincial interest in the development of sustainable marine finfish aquaculture.
- Assist network in development of extension materials and related documents
- Support distribution of extension materials locally.
- Provide an annual summary of developments in their field of expertise.
- Assist the development of NACA's annual work program in regard to marine finfish aquaculture activities.

Forestry Program with FSIV

FST/1996/005	Development of domestication strategies for commercially important species of Meliaceae
Termination Report May 2002	Page 8 All key project field staff from collaborating countries attended a training course in experimental design and data analysis for tree improvement organized in Thailand in November 1999. There has been a considerable increase in this knowledge by project field staff. Two Lao scientists received a hand-on training in vegetative propagation in Vietnam in September 2000. This helped them to set up local facilities for cuttings propagation. One staff each from Lao PDR, Thailand and Vietnam attended a training course on domestication techniques in Australia in December 2000. The project also had an in-service training function, especially the development of the series of guidelines (seed collection, establishment of field trials, floral biology, seedling morphology). Technical advice was also provided during country visits by Australian project leader and project scientists. Overall collaborators have benefited greatly from these training activities. Page 20 The training provided by the project has in general increased the skills of project counterparts and helped in the overall project implementation. However, further training in data analysis and floral biology study will be useful. Page 27 Training of counterparts has been a major aspect of the project. Apart from three major trainings (experimental design and data analysis, vegetative propagation and domestication techniques), the project has also provided an in-service training function during project visits by Australia scientists and a number of guidelines and operational manual.

	<table><tr><th>Trainee</th><th>Location</th><th>Type of training</th><th>Cost* AU$ (approx.)</th></tr><tr><td>Workshop</td><td>Phisanulok, Thailand</td><td>Presentations and field trips</td><td>15000</td></tr><tr><td>Dr Nguyen Huy Son Mr Nguyen Duc Kien Mr Thongsavanh Keokane Mr Wiroj Rattanaporncharoen Mr Piset Luechanimitchit Mr Rattana Thai-ngarm</td><td>Sakaerat, Thailand</td><td>Hands-on and lecture, Tree breeding training course,</td><td>3000</td></tr><tr><td>Mr Saysana Inthavong Mr Somvang Soukhaphonh</td><td>Hanoi, Vietnam</td><td>Hands-on, Vegetative propagation</td><td>2000</td></tr><tr><td>Mr Khamphay Manivong Mr V. Luangviriyasaeng Mr Phi Quang Dien</td><td>Australia</td><td>Lectures and field trips Domestication techniques</td><td>9000</td></tr><tr><td>Coordination meeting</td><td>Hanoi</td><td>Presentations and field trips</td><td>10000</td></tr><tr><td>Total</td><td></td><td></td><td>39000</td></tr></table> * Cost does not include expenses for trainers and organisaiton
FST/1997/024	Insect resistance and silvicultural control of the shoot borer, Hypsipyla robusta, feeding on species of Meliaceae in Southeast Asia and Australia
Final Report 2002	*There is no section of this substantial report devoted to capacity building* per se Page 63. Report prepared by Nguyen Van Do, Forest Science Institute of Vietnam **Staff employed on the project** - Mr. Dao Ngoc Quang : Forest Science Institute of Vietnam - Mr. Mai Trung Kien : Centre for Forest Tree Improvement - Mrs. Nguyen Le Thu : Centre for Forest Tree Improvement - Mrs. Can Thi Lan : Centre for Forest Tree Improvement - Ms. Nguyen Thi Oanh : Centre for Forest Tree Improvement - Mr. Do Thanh Hai : Silviculture Centre of Hoa Binh - Mr. Bach Cong Nam : Silviculture Centre of Hoa Binh - Mr. Doan Son : Tropical Forest Research Centre - Mr. Ngo Van Cam : Tropical Forest Research Centre **Activities of the project in Vietnam** • Assessing *Hypsipyla* damage level and growth of tree at *Chukrasia* provenance trials in Ha Tay, Hoa Binh and Gia Lai provinces. • Assessing effect of pruning to improving tree form and reducing *Hypsipyla* damage level at *Chukrasia* trial in Ha Tay. • Assessing effect of mix planting (*Chukrasia* and *Acacia*) to limiting *Hypsipyla* attack on *Chukrasia* (at mix trial in Ha Tay). • Studying on respond of *Chukrasia* tree after *Hypsipyla* attack and biology of *Hypsipyla robusta.*

FST/1999/095	Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: Genetics and silviculture
Final Report 2009	Page 12 Objective 7: To build capacity in all project participants through formal and informal training in all aspects of the design and implementation of the project. Page 16 Objective 7 was to build capacity in project participants. This was achieved through a variety of methods including extensive involvement of scientists in planning and project management for particular experimental trials. Detailed training was undertaken in more formal topics including Non Destructive Wood Property Assessment, Wood Property Assessment Techniques; and Data Management and Statistical analysis. See appendix for further details. In addition four International Students have been involved in intensive educational training in Australia through their involvement with this project. These are Mr Le Son and Mr Dai Dang from Forest Science Institute of Vietnam, Mr Lan Jun from Dongmen Forest Farm, and Ms Ye Lu from Guangxi Forests Research Institute, who have completed or are completing post-graduate training at Southern Cross University. See appendix for further details. Pages 38 and 39 Table in Section 6.7 describes all activities. Achievements shown here Training Table included on page 20 of the Project Document was used as a basis for the training plan and revised as required in consultation with project partners, Given the general success of the training provided (described below at Activity 7.3) it would appear that this effectively delivered on the training required. 7.3 Conduct of specific training events Training conducted and assessed December 2005: Inception Workshop, Zhanjiang, Guangdong, China: Joint Inception Workshop (with FST2001/021) attended by participants from Australia (3), China (8) and Vietnam (2). December 2005: Assessment of trees using Pilodyn and FAKOPP: After the Inception Meeting held in Zhanjiang, Guangdong, training was provided at the Dongmen Forestry Farm on the assessment of trees using Pilodyn and FAKOPP (attended by staff from CERC, HFB, GFRI, CRIWI, FSIV) June 2006: Sawmilling Course Clayton, Victoria (undertaken in collaboration with Project FST2001/025): Peng Yan (CERC) and Li Bo Hai (HFB), as well as Chen Shaoxiong (CERC) who returned to China after falling ill. June 2006: Non Destructive Wood Property Assessment, NSW and Queensland, Australia: Peng Yan (CERC), Li Bo Hai (HFB) August/September 2006: Wood Property Assessment Techniques, Data Recording and Management, Dongmen, China: Numerous staff from CERC, GFRI and Final report: 9T8T7T5T4TImproving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: Genetics and Silviculture Page 39 Dongmen April 2007: Australian Forests Genetics Conference, Hobart, Tasmania (co funded by ATSE Crawford Fund): Luo Jiangzhong (CERC), Qin Li (CRIWI), Kien Duc Nguyen (FSIV) April 2007: ASREML Training Course, Hobart, Tasmania (co funded by ATSE Crawford Fund): Luo Jiangzhong (CERC), Qin Li (CRIWI), Kien Duc Nguyen (FSIV): May 2007: Non Destructive Wood Property Assessment, Data Management and Analysis,

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FST/2001/021	Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: sawing and drying
Final Report	Page 38 Scientists at the Forest Science Institute of Vietnam (FSIV), China Eucalyptus Research Centre (CERC), Guangxi University and the Guangxi Forest Research Institute (GFRI) have been trained in the scientific methods of processing and resource evaluation adopted in this ACIAR Project. • The FSIV have been successful in developing a parallel project in *E. urophylla* with funding sourced from MARD. Many of the methods adopted mirror those of the ACIAR project. • FSIV now utilize probes to continuously monitor kiln and air drying conditions. And monitoring equipment to do this is now owned by FSIV.

Review Report	Page 22 Scientists and technicians from CERC, FSIV, GFRI and GEEC, have been closely involved with the studies undertaken at Quy Nhon, Dongmen and Luizhou and they have attended several workshops. They have undertaken log and product grading, taken log and product measurements, assisted with monitoring timber drying and gained an appreciation of the principles of carrying out rigorous and scientifically based log conversion studies. They have participated in the various workshops held, as have the Directors, other scientific staff and students. In this regard, the project appears to have had a significant impact. Equally important has been the interest and collaboration shown by industry in all three countries. The project tour to Australia must also be regarded as a capacity-building exercise for the four key Scientists from Vietnam and China. They received sawmilling experience at the industry training facility at Creswick, Victoria, received training in undertaking sawmill recovery studies, one visited a small log sawmills in Western Australia and all toured the laboratory facilities at CSIRO in Clayton. Unfortunately funding for laboratory equipment appears to be very tight, particularly in Vietnam, but every encouragement must be given to their acquiring at least some basic equipment, so that an effective research and industry extension program can be developed (see Objective 3.4). It is disappointing that the post-graduate scholarship was not taken up, as discussed under Objective 5.1, and it is recommended that this still be pursued.

FST/2002/112	Domestication of Meliaceae species in Southeast Asia and Australia, particularly management of the problem of Hypsipyla robusta attack
Final Report	Page 8 Objective 3. Capacity building, communication and dissemination of project results. Knowledge and skills development and training in: • Data collection and management. • Pest management and forest health surveillance. • Vegetative propagation procedures. • Establish protocols for sharing and using germplasm. Page 15 Table of results 1. Laos. Training course in trial data collection and management presented in Laos by Vitoon Luangviriyaseng from Thai RFD. 2. Manon Griffiths worked with field staff from Vietnam and Thailand measured trials in Vietnam including shading levels. 3. guidelines on trial and pest management Through discussions between Vitoon (Thailand) and Dr Thinh (Vn) a working protocol was developed for exchange of germplasm. This was implemented under the project e.g. supply of vegetative cutting material rep. 11 clones from RCFTI to Thailand. Page 21 **7.3.1 Capacity building** *(1). Pest Management Training* It had been proposed that two people, one from Laos and one from Vietnam, attend a training course focusing on forest protection. This training was to have been included as part of a training workshop held in Brisbane, Australia as part of a separate ACIAR project on Establishing Pest Detection Systems in South Pacific Countries and Australia (ACIAR FST/2004/053) Forest Health Surveillance in the Pacific. However due to the delayed start of the current project this was not possible. Instead, seven staff from FSIV recently

	attended a Forest Health Surveillance training workshop in Brisbane funded by AusAID as part of the Cooperation in Agricultural and Rural Development (CARD) program. This nine day workshop included extensive training in forest health surveillance methods and applications as well as insect collecting and trapping techniques. A copy of the Workshop Program is attached (Appendix 5). The field work component of the workshop was to have included a visit to the Imbil Toona trial site and assessment of damage on-site. However due to flooding at the time of the visit roads to the site were closed and the site cut-off. Instead we inspected natural Toona ciliata regeneration in a nearby site where shootborer was active. *(2). Trial design and data analysis training, Laos* Due to the departure of Dr Emlyn Williams from CSIRO, RFD data analysis expert Mr Vitoon Luangviriyasaeng conducted the training which was organised in Luang Prabang province of Laos in October 2006 attended by 10 participants. Participants attended from National University of Laos, National Agriculture and Forestry Research Institute as well as two persons each from Thailand and Vietnam. Page 24 The technical capacity of a number of project staff has improved from participation in the project implementation and hands-on training.

FST/2003/002	Development and evaluation of sterile triploids and polyploid breeding methodologies for commercial species of Acacia in Vietnam, South Africa and Australia
Final Report 2009	Page 21 Objective C Staff from partner countries trained 2 FSIV staff at UTAS on John Allwright scholarships trained in all applications. Training workshop for CSIR and FSIV staff . Transfer of NIR technology and identification of cost effective local flow cytometry option for FSIV are objectives of FST/2008/007 Completed in 2005 and hosted by UNE and UTAS.Page 37 ***8.2.1 Capacity impacts in Vietnam*** The Project has contributed to the skill set of FSIV scientists in fostering best practice of seed orchard management, controlled pollination and seed collection. Particular benefit will be derived by 2 John Allwright scholars who have studied under the supervision of Project staff at UTAS and worked on studies closely associated with the Project objectives. The orchards established in Vietnam will continue to supply seed and breeding opportunities outside the scope of the Project Although CSIRO had previously assisted FSIV in acquiring capability to conduct molecular analyses in Hanoi, it did not prove practicable to genotype the Shell Clones as required under the project plans. We were able to make successful alternative arrangements with training provided by UTAS scientists and M.Sc. candidate Tran Duc Vuong has returned to Hanoi with this capability. New equipment purchased by FSIV will permit direct transfer of techniques learned in Hobart to all the tree species being bred by FSIV. Demonstration of the NIR application for differentiating 4x and 2x populations has triggered investment in this equipment by FSIV, who will therefore be able to participate in the expanding range of applications in tree breeding and wood resource characterisation. Assistance with the necessary training is built into the work program for new project FST/2008/007. A range of microscopy skills are necessary for quality research into mechanisms of reproductive biology. John Allwright scholar Qynh Chi Ngiem will return from UTAS with the tools to work not only on Acacias but on problems presented by all the other species which

	are bred by FSIV. A non-project MSc student Lieu Hong Phu, MSc student from Vietnam, working at UTAS completed a study of "Invitro polyploid induction in *Acacia mangium* by colchicine". Assuming he finds employment with another institution in Vietnam he will be able to apply knowledge and skills acquired through working closely with Project staff.

FST/2006/087	Optimising silvicultural management and productivity of high-quality acacia plantations, especially for sawlogs
Final Report May 2013	**6.4 Objective 4: To develop tools to support improved management, train Extension Officers to effectively disseminate information to foresters, and provide targeted training to FSIV staff** **8.2 Capacity impacts – now and in 5 years** *John Allwright Fellowships (JAF)* Four JAFs were awarded during the course of the project as follows: Final report: Page 59 2008 round: Tran Lam Dong (commenced studies at University of Tasmania in February 2010). Topic “Using *Acacia* as a nurse crop for establishing mixed native-tree species plantations”. 2009 round: Vu Dinh Huong (commenced studies at University of Tasmania in February 2012). Topic “Understanding the physiological basis for response to thinning and fertiliser application in short-rotation tropical *Acacia* plantations”. 2010 round: Trieu Thai Hung (commenced studies at University of Tasmania in February 2012). Topic “Optimising the economic and carbon values of *Acacia* plantations in Vietnam through silvicultural practice”. 2011 round: Tran Thanh Trang (commenced studies at University of Tasmania in February 2013). Topic “The improvement of sawlog quality in acacia plantations by reducing stem defects caused by fungi”. Mr Huong, Mr Hung and Mr Trang were members of the project when they were awarded their scholarships. The immediate effect of their leaving the project (first to meet IELTs requirements and then to come to Australia) is a reduced capacity in the short-term to deliver on project goals as new Vietnamese staff need to be appointed, trained and then learn by experience. The advantage for these now “postgraduate students” is that they can commence their studies under an existing project umbrella and receive support from Australian project staff as they initiate their research programs. This enables them to more quickly build up a capacity to work at the level required in PhD programmes undertaken in Australia than would otherwise be the case for new students from developing countries who have not previously been exposed to training at this level. An issue for CSIRO staff providing associate supervisory support is that when the project finishes, these staff have no formal means within the organisation of continuing to support these students. In five years these students will have graduated and returned to Vietnam. Their training in a more rigorous research environment than is possible in Vietnam and their exposure to technologies and techniques which are often not accessible in Vietnam increase their competitiveness for more senior positions within their employment organisations from which they can seek to strengthen its scientific credentials, in part by further developing links between Vietnam and Australia. *English training* From the start of the project, a policy was adopted that training would be provided for all Vietnamese staff who were insecure in the use of English. Training was undertaken by Mr Quang, Mr Binh, Mr Dinh, Mr Bon and Mr Kien. This training was of great service to the project and enabled Mr Bon, Mr Quang and Mr Dinh to make presentation about their work in the project in English at the Final Review. This training has also facilitated good communication between Australian and Vietnamese staff within the project. Accepting the principle that when it comes to languages “use it or lose it”, if the former, this benefit will be continuing. *Analytical chemistry* The audit (Section 11.4) of the Analytical Laboratory at the Sub-Institute in HCMC triggered a rapid upgrade of the facility. Ms Tuyen who undertook the audit also provided up-to-date training for the analyst Mr Quang both in his laboratory, and her laboratory in Perth,

	Australia during a two-week training visit in September 2009. This was of immediate benefit to the project and this benefit will be ongoing, notwithstanding new technological advances in this area. *Use of computer software for data analysis* Final report: Page 60 Dr Chris Harwood provided advanced training in the use of EXCEL for all project staff in his visits to Vietnam during the project. Staff generally had high-level skills in the use of common software packages before this training. However, after this training, they were able to exploit EXCEL in a more disciplined way so that the recording and analysis of data was common to all parts of the project. This skill is ongoing. *Use of physiological equipment* The physiological campaigns were a focus for training local staff in the use of the LICOR LI-6400 (gas exchange); LICOR LI-2000 (Leaf Area Index, LAI) and PMS600 (Water Potential). A visual Guide and photographic images of the canopy were also used to measure LAI. Dr Alieta Eyles, Dr Daniel Mendham and Ms Maria Ottenschlaeger provided in-field training in Vietnam on the use of this equipment. In Australia Dr Eyles and Ms Ottenschlaeger provided training in the use of software for data analysis. An ongoing capacity in the use of this equipment in Vietnam has been developed through the John Allwright programs of Mr Dong, Mr Huong and Mr Hung. *Presentation skills and use of English* Dr Chris Beadle worked with Vietnamese staff to enhance their presentation skills and use of PowerPoint for their presentations at the Mid-term and Final reviews, and at the Field Extension Workshops. He also assisted Mr Huong with his English training as he was struggling to meet the required standard in his IELTS tests. He benefits from tis training should be ongoing. *Other* Australian ACIAR staff Dr Chris Beadle (Mr Dong, Mr Trang), Dr Daniel Mendham (Mr Huong), Dr Auro Almeida and Dr Caroline Mohammed (Mr Hung), and Dr Caroline Mohammed and Dr Chris Beadle (Mr Trang) are currently supervising the postgraduate programmes of the four John Allwright Fellows attached to the project. Mr Dong is in the final year of his studies and in currently writing papers for his thesis under the direction of Dr Chris Beadle and Richard Doyle (Academic supervisor). Increasing the capacity of Vietnamese staff to write in English has been an important activity in the project and this is now being extended to the writing of scientific papers.
Review Report May 2013	Page 15 **Train FSIV staff Three trained research staff (A, PC) Training undertaken in both Australia and Viet Nam in use of laboratory and field equipment.** **In addition four young scientists have been awarded Australian post-graduate fellowships for study in Australia.** **Page 16** (i) *Capacity-building impacts* This project has provided an excellent opportunity for upgrading skills and practices within Vietnamese forestry research. Anecdotally, research standards and methodologies, while understood philosophically, are not necessarily applied with rigour, within research facilities in Vietnam. The review of protocols and introduction of new analytical and safety methodologies (both in the field and in the laboratory) is invaluable in helping young scientists achieve international standards. In addition, training has also been provided in using physiological equipment, experimental design, plot layout, field measurement, data storage and maintenance, statistical analyses, English training, field methods for pruning, thinning and fertiliser application, stem analysis of decay and defect and the potential for economic modelling of project outcomes Importantly the project has seen the awarding of four postgraduate John Allwright Fellowships to young Vietnamese forest scientists associated with the project. This will be of long term benefits to Viet Nam in general and FSIV in particular. From my limited observation, technical transfer and extension of research and development results within the FSIV sphere is concentrated on publishing results in the

	Vietnam Journal of Forest Science. While FSIV has a Science and Planning Division, it did not appear to have an extension role. Late in the project, it became apparent that the Vietnamese Government had a National Extension Centre which promotes extension activities across the country. There may be potential in similar future projects to involve the Centre and to propose "Train the Trainer" components to promote project outputs.

FST/2008/007	Advanced breeding and deployment methods for tropical acacias
Annual Report May 2013	Page 9 *Capacity impacts* Australian and VAFS scientists have continued to collaborate in planning, implementing and writing up Project activities for publication. Our John Allwright scholar Ms (now Dr) Q.Nghiem Chi successfully graduated from UTasmania during the year and has now returned to Hanoi where she will continue her research activities but also assume senior management responsibilities and act as local organiser for the Acacia 2014 Conference. As one of the few women in senior positions in the organisations we can expect that Dr Chi will have a mentoring role with long term impacts on staff development. A final JA Scholarship applicant Mr Le Son has been supported in his wish to commence Ph.D. studies at UTas later in 2013. The involvement of the Director of IFTIB as a co-chair of the new IUFRO Working Party on Genetics and Silviculture of Acacia is an initiative with likely long term impact on ability of VAFS staff to take their place within the international scientific community. Vietnamese and Australian project staff are leading the organisation of a major international meeting "Acacia 2014: Sustaining the future of Acacia Plantation Forestry" (http://iufroacacia2014.com.vn/)in Hue which should greatly enhance networking opportunities for Vietnamese scientists.

FST/2008/039	Enhancement of production of acacia and eucalypt peeled and sliced veneer products in Vietnam and Australia
Mid-Term Review 2014	
Annual Report May 2014	Page 10 *Capacity impacts* Following the 'Veneering on Surfaces' training program in July 2013, Woodsland factory developed new veneered products for European markets and Bui Gia installed a new veneer line which has attained an output of 2,500 m^2 per month in less than one year. Key researchers from VFU (1 person) and VAFS (2 persons) received training from DAFF researchers in the fields of: • data analysis using Excel Stat and efficient data management practices using spreadsheets; • use of Australian Standards for veneer grading; • use of testing equipment to determine mechanical properties of veneers and veneer-based products; • general use of adhesives for wood-based products; • quality assurance methods for bond quality. Three VAFS researchers received on-site training in critical inspection and review of manufacturing facilities and operations. These staff will be able to confidently undertake future industry surveys. Four undergraduate students and a graduate student from VFU have been undertaking their thesis studies related to the project content. Two researchers from VFU and VAFS received John Allwright Fellowship PhD scholarships. *Training activities* *Australia* 9-12 to 20-12-13 - Mr Nguyen Tat Thang from Vietnamese Forestry University (VFU) participated in training in veneer processing and grading, data analysis and report writing units necessary for the completion of VFUs component of this project. 3-03 to 7-03-14 -Dr Nguyen Tu Kim and Mr Nguyen Thanh Tung from Vietnamese Academy of Forest Sciences (VAFS) participated in training in veneer processing and products manufacturing, gluing, report writing, mechanical testing of wood based veneer products necessary for the completion of VAFSs component of this project. Discussions have commenced with Dr Kien in regard to application for a John Dillon Fellowship award. This would allow Dr Kien the opportunity to travel to Australia and undertake intensive training with experts in Sydney, Canberra and Brisbane in the field of forestry economics and policy analysis. *Vietnam* Four training courses were held in Vietnam for company managers:

Date	Training course	Target group	Duration (days)	Participants
Jul 2013	Veneering of Surfaces	CEO & middle management	4	27
Feb 2014	Middle management	Middle management	2	17

	course – Module 1				
Mar 2014	Middle management course – Module 2	Middle management	2	13	
Apr 2014	Middle management course – Module 3	Middle management	2	14	

FST/2010/034	Agroforestry for livelihoods of smallholder farmers in north-western Vietnam
Annual Report 2014	Page 9 Six partners participated the World Congress on Agroforestry, New Delhi, Feb. 2014. *3.2 Capacity impacts* Assessment of capacity development activities has not been implemented at this stage, but anecdotal evidence suggests improvements in stakeholder understanding and appreciation of agroforestry. For this reporting period, the total number of participants to various capacity development activities was 428 male and female farmers and extension workers. *4. Training activities* Between April 2013 and March 2014, a total of **428 male and female farmers**, extension workers and researchers participated in research and management trainings, field tours and workshops. Six partners also participated in the World Congress on Agroforestry in New Dehli, India.

Objective	**Topic**	**Participants**	**Number of participants**	**Number of activity**	**Date conducted**
Obj. 1	Training on data collection and trial management	Research partners	21	1	8/2013
Obj. 4	Training on smallholder nursery establishment and grafting technique(TOT)	Commune and district extension workers	21	1	10/2013
	Training on basic knowledge and agroforestry trial management	Farmers	89	4	12/2013
	Study tour to share good agroforestry practices from Tuyen Quang and Bac Kan provinces	Farmer co-operators and extension workers	56	2	17-21/9/2013
Workshop	Policy analysis	Farmers and leaders from village, district, province to national level	236	10	9-11/2013
International Conference	World Congress on Agroforestry	Research partners	6	1	10-14/2/2014

Fisheries Program with RIA No1

FIS/2000/018	The economics of developing reservoir aquaculture in Vietnam
Undated feedback report	No information on capacity building

FIS/2001/013	Culture-based and capture fisheries development and management in reservoirs in Vietnam
Final report (incomplete)	*Training and capacity-building*

	Degrees: ▪ Nguyen Hai Son: Masters In Aquaculture (taught course; 16 Units), Deakin University, 2003 (ACIAR) ▪ Bui The Anh: PhD, Thesis title " Fish and fisheries of large reservoirs in Vietnam", Thesis submitted to Deakin University in June 2006, awaiting examination outcome (John Albright Scholarship) ▪ Phan Dinh Phuc: PhD, Thesis title, " Biology and fisheries management in three inland water bodies, Central Vietnam", Thesis submitted to Deakin University in June 2006, awaiting examination outcome (funding MRC two years and one year ACIAR) **Training**: ▪ Bui The Anh & Nguyen Hai Son: Intensive ten day training on the use of GIS software application to reservoir catchment characteristics, GIS Unit, University of Agriculture & Forestry, HCMC, September 2002 (ACIAR) ▪ Nguyen Hai Son: Training on data analysis, Deakin University, 05-07 to 05-08, 2003 (ACIAR) ▪ Nguyen Hai Son, Nguyen, Q.D.: Training on scientific writing; **Error! Not a valid link.**, two weeks, July 2004 (ACIAR) ▪ Nguyen Quang Dieu, Nguyen Hai Son; Nguyen Van Gioi, Nguyen Dinh Hung,Nguyen Ngoc Trang; Nguyen Thi Tuyet; Nguyen Van Lung;Tran Tinh: Ten day study tour to Thailand , March 2005 (ACIAR) **Observations on institutional strengthening:** Tat the commencement of the project there was very limited activity on reservoir fisheries as well as on culture-based fisheries at RIA 1. The project has been responsible for bringing about capacity building in a critical mass of researchers at RIA 1 (six) and RIA 3 (three), who are now capable of proceeding on their own. Project formulation, data gathering, monitoring, data analysis and scientific report and manuscript writing of these researchers have been significantly enhanced. Most of all, the confidence of the researchers in dealing at the grass root level and at scientific meetings has reached a stage comparable to those from anywhere else. The best evidence in this regard comes from: ▪ The establishment of a Reservoir Research and Development Group in RIA 1, with the provision of all physical facilities, computer access etc., ▪ the fact that The MoF, GoV provided the first ever research grant (approximating A$160K) on reservoir fisheries management in selected reservoirs in Vietnam to Bui The Anh, a lead researcher of the group, based on a national competitive bidding process, ▪ one of the two Research Assistants to the project, Thai Nguyen, was selected to proceed to read for his Masters Degree at RIA1, conducted in conjunction with the Fisheries University of NhaTrang, ▪ the confidence of the Australian and NACA counterparts to utilise the services of a lead researcher of the project, Nguyen Hai Son, to be utilised as a key note speaker in workshops on culture-based fisheries held in Cambodia, Indonesia and Lao PDR, and ▪ utilization of RIA 1 expertise to provide training and familiarization on culture-based fisheries by other projects such as that of the Asian Development Bank project in Sri Lanka. The project has also brought about much closer cooperation and dialogue between the farming community and the researchers at RIA 1, as well as between provincial fishery authorities and RIA 1. It is not uncommon for farmers to address their queries to RIA 1 directly, which was rare before hand.
Annual Report 2003	*Page 2* Capacity: • Increased capacity in RIA 1 and RIA 3 on reservoir fisheries management, with one of the RAs currently reading for the MSc and the other for the PhD • Preparation of two scientific papers to be communicated to an international journal • Utilisation of previous findings by other scientists as examples of development of culture-based-fisheries in small reservoirs elsewhere.

FIS/2002/068	Improving feeds and feeding for small scale aquaculture in Vietnam and Cambodia

Final report Aug 2009 (289 pp)	**Page 3** The Australian Volunteers International placement, Mr Daniel Wright was instrumental in getting the best out our Cambodian team with important liaison and initiation of the work being undertaken there. Those results achieved in Cambodia wouldn't have been so without Danny's initiative. **Page 5** During the course of the project a significant enhancement in the scientific capacity has occurred to support the growing Pangasius and tilapia industries in Vietnam and Cambodia and the barramundsi sector in Australia. This has positioned groups like the College of Aquaculture and Fisheries at CanTho University to be fully capable research service prodivers to the Pangasius industry in Vietnam and support the local development and refinement of feeds, ingredients andadditives. This is a notable outcome of this project. Page 282 Capacity impacts – now and in 5 years Substantial capacity impacts have been made in both Vietnam and Cambodia. In Vietnam the capacity of the group at CanTho University to undertake independent research to support the *Pangasius* catfish feeds industry in that region is now at an international level. This has been demonstrated through publication of their work in this area in the international peer-review literature, presentation at international conferences and also being commissioned to independently undertake contract research for the private sector in this industry. This capacity should be maintained so long as the group continues to effectively engage with industry and the broader research community. In northern Vietnam, substantial progress was made towards establishing a nutrition research capacity in Hanoi. With future engagement that group in northern Vietnam would consolidate this capacity and begin to become an effective research provider to underpin the needs of the feed and aquaculture production sectors in northern Vietnam. In Cambodia, the placement of an Australian Volunteers International (AVI) person provided substantial capacity development assistance and direction to that team. At the end of the project this group still needed further development to enable some effective capacity in aquaculture research. In Australia, the 18 month post-doctoral appointment was ended early by the candidate taking an opportunity 3 months from the end of their term. This problem was somewhat attributable to the inability to fully finance a postdoctoral position for a longer (e.g. 3 year) term to provide some stability to the proejct. As a consequence that capacity developed in Australia was lost from the research sector as the encumbent moved to the private (aquaculture hatchery) sector

FIS/2002/077	Improved hatchery and growout technology for marine finfish in the Asia-Pacific region
Final report Dec 2011	Page 9 Sub-objective 1.5. Strengthen and expand the research coordination and regional collaboration activities of the Asia-Pacific Marine Finfish Aquaculture Network. Page 36

	3.4 Training courses	Regional grouper hatchery training course – CRIA or DGA centres as appropriate	Yr 1, m7–12 Yr 2, m7–12 Yr 3, m7–12 (Jan – Jun 2004, 2005, 2006)	Completed Four training courses have been held at BBAP Situbondo: 18 April – 8 May 2005: 17 participants from 8 countries. 20 November – 9 December 2006: 20 participants from 13 countries. 9–29 July 2007: 16 participants from 8 countries. 5–25 May 2008: 19 participants from 10 countries. APMFAN also organised a marine finfish hatchery training course in Thailand in May 2007 for 6 trainees from Pacific Islands on behalf of SPC.
	Training of YPH staff in farm-made feeds (RICA)	Yr 2, m1–12 (Jul 2005 – Jun 2006)		Completed Five farmers and staff from Yayasan Palu Hijau (Central Sulawesi) attended a short course on grouper feed management at RICA Maros,19–23 September 2005.
	3.5 APMFAN strengthening and expansion	Assess regional interest in formal membership of APMFAN	Yr2, m1 – Yr 1, m6 (Jul – Dec 2005)	Completed Following expression of support by NACA member countries, a model based on the NACA Fish Health Program model was developed.
	Formalise institutions and individuals as RRCs and RREs	Yr2, m7 – Yr2, m12 (Jan – Jun 2006)		Completed A total of 11 institutions have been recognised as Regional Resource Centres (RRCs). Institute profiles have been completed for 6 Indonesian institutions. Thirty-one individuals have been recognised as Regional Resource Experts (RREs).
	Attract corporate sponsorship of newsletter and other network activities	Yr 1, m1 – Yr4, m12 (Jul 2004 – Jun 2008)		Completed Support from Skretting Asia, which sponsored the APFMAN web portal, news and communications, and provided scholarships for developing country participants in the APMFAN grouper hatchery training course, lapsed in March 2009. No other sponsors have been engaged. Page 80

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3.5 Strengthen and expand the research coordination and regional collaboration activities of APMFAN

The Regional Resource Centres / Regional Resource Experts approach is based on that used by NACA for its Fish Health Program. However, replication of this approach for APMFAN has been largely unsuccessful. Many countries (e.g. Australia) simply ignored the call for nominations of RRCs / RREs. Most RREs are not active in supporting the network.

Regional Resource Centres (RRCs)

At the 18th NACA Governing Council Meeting (GC 18) in Bali, 2007, four institutes were approved as Regional Resource Centres for the Asia-Pacific Marine Finfish Aquaculture

Network:

1. Research Centre for Mariculture, Gondol, Indonesia.
2. National Brackishwater Aquaculture Development Centre, Situbondo, Indonesia.
3. Mariculture Development Centre, Batam, Indonesia.
4. Rajiv Gandhi Centre for Aquaculture, India.

In response to the recommendations of GC 18, NACA wrote to member governments requesting them to nominate additional RRCs and Regional Resource Experts (RREs) for the network. An additional seven RRCs were endorsed by the GC 19 in 2008:

5. Main Centre for Mariculture Development, Lampung, Indonesia.
6. Main Centre for Brackishwater Aquaculture Development Centre, Jepara, Indonesia.

7. Mariculture Development Centre, Lombok, Indonesia.

8. Central Marine Fisheries Research Institute, Kochi, India.

9. South Iran Aquaculture Research Centre, Iran.

10. National Integrated Fisheries Technology Development Centre, Philippines.

11. Krabi Coastal Fisheries Research and Development Centre, Thailand.

Regional Resource Experts (RREs)

Member countries of NACA were requested to nominate RREs who were internationally accepted as experts in grouper / marine finfish aquaculture, and who would actively contribute to the network. Nominations were formally accepted / rejected by the NACA Governing Council. Terms of reference for consideration / acceptance as an RRE are:

• Available to answer technical questions related to their field of expertise.
• Provide a contact point for national / provincial interest in the development of sustainable marine finfish aquaculture.
• Assist network in development of extension materials and related documents
• Support distribution of extension materials locally.
• Provide an annual summary of developments in their field of expertise.
• Assist the development of NACA's annual work program in regard to marine finfish aquaculture activities.

Currently, there are formally accepted RREs from India (7), Indonesia (6), Iran (6), Hong Kong SAR (1), Malaysia (10), Philippines (1).

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8.2 Capacity impacts – now and in 5 years

Research capacity

RIM Gondol staff were trained in high-sensitivity enzyme analysis techniques through training in Australia, as well as on-site training at RIM Gondol. This training substantially increased the capacity of RIM Gondol staff to undertake analyses of larval digestive enzymes. This enhanced capacity is being utilised for other projects at RIM Gondol. For example, Regina Melianawati and Retno Andamari undertook another study to evaluate digestive enzymes in larval coral trout (*P. leopardus*). Ms Melianawati received training in enzyme analysis techniques at Gadjah Mada University, but acknowledged Ketut Suwirya's assistance in the enzyme analyses done at RIM Gondol.

DPI&F technical staff were also trained in enzyme analysis techniques at NFC Cairns during 2005–06.

Hatchery technology

DPI&F technical staff were trained in marine finfish larval rearing techniques during a visit to RIM Gondol in April 2006. These training outcomes were successfully transferred to NFC Cairns with resultant improvements in hatchery production. These techniques have also been extended to commercial hatcheries in Australia.

Nutrition and feed development

This project and its predecessor project have substantially increased capacity of staff at

	RICA Maros and to a lesser extent at RIM Gondol, to undertake research into fish nutrition and feed development. During this project, RICA Maros staff published five scientific papers in the Indonesian Journal of Aquaculture (see Section 10 References, p.93). Usman (RICA Maros) attended the Aquaculture Nutrition Master Class, 7–19 August 2006 in Bangkok, Thailand. Participation in this Master Class improved Usman's knowledge of fish nutrition and increased his capacity to undertake nutrition research. ***Project training courses*** As noted above, the Regional Grouper Hatchery Production Training Course operated by the Asia-Pacific Marine Finfish Aquaculture Network, through NACA, has now trained in excess of 100 hatchery practitioners from 22 countries. Final report: Improved hatchery and grow-out technology for marine finfish aquaculture in the Asia–Pacific region Page 83 This training course has been effective in 'training of trainers'. For example, Mr Samart Detsathit of Krabi CFRDC was trained in the 2002 training course at RIM Gondol under the APEC Staff Exchange Program. Mr Detsathit succeeded in producing tiger grouper after his return to Krabi CFRDC and he is now one of the main trainers for the marine finfish hatchery training course in Krabi CFRDC. APMFAN also organised a marine finfish hatchery training course for the Secretariat for the Pacific Community (SPC) for a group of six trainees from Pacific Islands Countries (Fiji, French Polynesia, New Caledonia, Papua New Guinea) in May 2007 at Krabi Coastal Fisheries Research and Development Centre (Krabi CFRDC) of DOF Thailand. Participation in the annual Regional Grouper Hatchery Production Training Course by Brackishwater Aquaculture Development Centre (BADC) Situbondo

FIS/2005/114	Building bivalve hatchery production capacity in Vietnam and Australia
Final report Nov 2012	Page 4 The scientific and management capacity to develop mollusc industries in Vietnam has expanded greatly. Seven RIA1 staff were trained in Australian hatcheries, 25 undergraduate students and 3 MSc students were involved directly on the program. Two RIA staff were successful in acquiring John Allwright fellowships to undertake PhD studies in molluscan biology in Australia. Page 39 *Capacity impacts – now and in 5 years* Mollusc production capacity in northern Vietnam has been significantly enhanced. • A commercial hatchery facility capable of producing a range of bivalves species has been established. • Nursery and growout systems have developed that have paved the way for the establishment of a commercial oyster industry and form a platform for further work to assist industry to advance. • The NMBC has a significantly enhanced capacity to deal with molluscan research programs. • MARD capacity to manage molluscan industry development has increased and they have actively (independent of this program), begun to formulate the legislative framework for industry control and expansion. • Local farmers have rapidly adapted simple culture technologies for large scale, low cost oyster production. • The supply chain required to transport, process and sell up to 7.000 tonnes of oysters (molluscs) has developed.
Ex-Post Analyisis Dec 2012	Page 7 Central to the project was a program of hands-on training to improve the skills of local technicians, initially in Australia, but also on-site in Vietnam. Page 11 Provide training for staff from Cat Ba Island in hatchery techniques. Three training modules conducted for Vietnamese staff in 2007 & 2008 at the PSFI (Port Stephens

	Fisheries Institute) and two staff from NSW DPI spent a total of 4 weeks at Cat Ba. A third training module in 2009 devoted to triploid induction was undertaken at the PSFI for staff from RIA. Page 12 Provide training to Cat Ba/commercial hatchery staff in nursery techniques for clams, oysters and byssal attachers (pearl oysters, scallops and mussels). Two RIA No1 staff trained annually in bivalve larval and nursery technology.*

FIS/2006/141	Improving feed sustainability for marine aquaculture in Vietnam and Australia
Annual Report 2013	Page 6 Objective 6: Improve the capacity in Vietnam to undertake industrially applicable research.… Page 8 3.2 Capacity Building Project partners have been integrally involved in the development of all research protocols. Through this they have gained experience in the design constraints placed on a range of studies from socio-economic survey development and implementation to the design and preparation required for ingredient digestibility studies. The partners were also engaged in the analysis of the socio-economic data and manuscripts for publication and several have already been published with the Vietnamese scientists as coauthors. The four Regional Aquafeed Forums have allowed the partners in the project to present aspects of their scientific background and also refine their scientific presentation standards and capabilities. An Aquafeed Extrusion Masterclass was held in June 2010 and a second held for June 2011. Through this not only has there been critical capacity development in the project scientific partners, but also the feed production sector in Vietnam as well. This training improves the understanding of both sectors (research and industry) of critical limitations in the feed production process, and helped the two sectors better engage with each other. T he project partners have also been integrally involved in the development of the first of the animal experimental protocols. Through this they have gained experience in the design constraints placed on nutritional trial development and implementation. These experiments are yet to be completed, but through this they will be engaged in the process of sample analysis and data interpretation. Page 11 4. Training activities Two Aquafeed Extrusion Masterclasses have been held (Hanoi; June 2010 and CaiBe; June 2011). The course was be delivered by Mr Dennis Forte and supported by Dr Brett Glencross and Dr Craig Foster, with translation provided by the staff from RIA-1 and RIA-2. The audience was primarily the local feed manufacturing sector, in the relevant parts of Vietnam where each course was held, though many researchers also participated. Informal mentoring of Vietnamese participants at the Regional Aquafeed Forums in preparation of presentations and assisting them in rehearsals was also undertaken. This is a key skill for young scientists to develop in the communication of their work. A John Allwright Fellowship application was submitted in 2010 for Ngo Thi Diu from RIA-1. The application was successful, and the applicant has now taken up the fellowship and is into her second year of her postgraduate studies. We are also still striving to get Vietnamese scientists to visit Australia as part of this project. Despite this issue being raised each year at the Project Planning Meetings, progress from the Vietnamese end has not occurred in terms of defining when to visit. So far only a single scientist has made the trip to visit Australia as part of this project. Two

	others are due to arrive in mid-June 2013.
Review may 2014 [14]	Page 3 This project aimed to improve the capacity for nutritional research in Vietnam and to consolidate nutritional research capacity in Australia to optimise nutritional models to better account for growth prediction and nutrient and raw material utilisation. The project included a significant training and extension program, including hosting Vietnamese researchers in Australia, facilitating training workshops (in nutrition and feed extrusion) and running annual nutritional forums sponsored by the feed manufacturing industry to allow technology exchange amongst the project participants and other aquaculture nutrition researchers in the broader Southeast Asian region. The close involvement of the feed manufacturing sector was judged critical to the effective adoption of manufactured feeds and replacement of direct feeding of low value fish for marine aquaculture. Pages 8/9 Only one Nutrition Masterclass Shortcourse has been held. This was at Nha Trang University in March 2014. There were 50 registrants for the course. They came from a variety of backgrounds, though principally from the research sector and feed milling, but also included people from the feed ingredient sector. The course was co-sponsored by USSEC. Course content for the Masterclass Shortcourse is attached. Several Vietnamese scientists have travelled to Australia on Scientific Exchange visits. Dr Vu Anh Tuan (March 2012); Ms. Dam Thi My Chinh from RIA 1 Ms. Tran Mai Huong from RIA 1Mr Nhuyen Khac Dat from RIA 3 Mr Tran Quoc Binh from RIA2 Travel planned to Int Symp Feeding & Nutrition of Fishers (ISFNF), Cairns: Dr Nguyen Van Tien RIA1 Dr Truong Ha Phuong RIA3 Dr Vu Anh Tuan RIA2 Dr Le Anh Tuan NTU Initially visits of 40 d were planned. This proved extremely difficult for scientists from Vietnam with many other commitments. Shorter visits were arranged. Mr Giang RIA 3 proposed MSc scholarship (John Allwright) but didn't meet English skills. Page 17 **A. Capacity Impacts** i. The nutrition research capacity at collaborating institutions has been greatly increased. The focus on improved research practice has been demonstratively successful. Major success is evident in greatly improved ability and confidence of Vietnamese scientists. ii. There has been an increase in scientific exchange among collaborators. All collaborators rated the success of collaboration in this project and the benefits

[14] *The review format for this project is substantially different and includes a scoring system for project evaluation. This type of format could be useful for future evaluations.*

	that delivered to all as very high. The regional aquafeed forums were a very successful method of helping to facilitate collaboration. The success is evident in Vietnamese intention to continue to build collaboration, including regional aquafeed forums regardless of future ACIAR involvement. **iii.** There has been improved exchange between researchers and industry, particularly for RIA1 and Kinh Bac and RIA2 with Vinh Hoan.

FIS/2012/101	Developing technologies for giant grouper (Epinephelus lanceolatus) aquaculture in Vietnam, the Philippines and Australia
	No data yet available

Appendix 2 Reporting of Capacity Building Utilisation in Adoption Studies.

One component of the Impact Assessment program of ACIAR is to look back on all large projects, three to four years after their completion. This has resulted in a series of ten publications – adoption studies AS001 to AS010 - the first on projects completed in FY 1999-2000 and the most recent on projects completed in FY2008-2009. In all but one publication (AS002) an overview of the levels of adoption of project outputs and capacity is written by the series editors: McWaters and Templeton (AS001, AS002 and AS003), Gordon and Davis (AS004), Pearce and Davis (AS005), Pearce and Templeton (AS006, AS007, AS009) and Jilani, Pearce and Templeton (AS009) and, Pearce Jilani and Templeton (AS010). Although authorship of the overviews has varied over the years the format of the overview has remained stable since AS004

Each study compiles and summarises what has happened in partner countries after the end of a group of projects and is usually conducted by the project leader who, while not being an independent observer, has intimate knowledge of the context in which the project was implemented and what kinds of outcomes were expected. The author of each study is usually the Australian project leader and it assumed that they have drawn on the insights and comments of their Australian and Partner Country counterparts.

Each of these publications and the studies described each year was reviewed to better understand how capacity building was reported and assessed (Table 1). The most salient section has been extracted and a sample of Table 2 is also tabulated for easy reference.

Each overview paper is by necessity very general in its characterisation of capacity impacts Our general comment on the Adoption Series as a whole is that almost all of the richness of information contained in the adoption study of each project is lost when it is summarised in the overview. By summarising the capacity impacts all of the detail and the *sum* of the parts is lost. This leads to the important question of how best to aggregate the capacity built without the result being bland statements and generalities.

In the earliest study (AS001) Capacity Building and Scientific Impact are gathered under the same heading so, by implication at least, it is the capacity of scientists involved in the project that is being assessed not other participants in the research: farmers, traders, extension workers, communities.

A major shift in emphasis have been the tabulation of capacity in AS004 to included ‘Capacity Used’, including both positive and negative (up to that date at least) outcomes. The career trajectories of students are commented upon, for example that they have continued their work but with different agencies. It may not have seemed relevant to comment on how that capacity is being used in their new positions or the information may not have been available.

AS003 provides an interesting list of the consequence of capacity building for project scientists with both hard and soft benefits identified.

Only rarely do the overviews venture to describe how the capacity of players other than project scientists has changed in the course of a project or in the few years since its completion. In AS006 there is the observation that:

> *A very interesting form of capacity building is seen in the Chinese wool-textile mills project. Here, much of the capacity development includes increased communication and linkages between different parts of the processing chain and between the wool chain and government. This form of ‘soft’ infrastructure will clearly be productive in years to come and so represents an investment in capacity.*

In summary, the great strength of the Adoption Studies lies in the individual reports of the completed projects and this data set is important and accumulating resource for reference. The major challenge is how to add value to the data they contain to better understand and improve capacity building.

AS01	**Adoption of ACIAR project outputs: Studies of projects completed in 1999-2000**
	Capacity-building and scientific impacts (page 7) Capacity-building and scientific impacts are often described in terms of products (scientific papers, publications, seminars etc.) rather than improvements in the scientific capability of a country outside the sphere of the project. While a link between the number and types of papers published and capacity building and/or scientific impact is often made, this link may give a false impression. Skills and knowledge gained within a project (as evidenced by research papers and reports) may or may not be used or drawn upon once the project is finished. Nonetheless, there is considerable evidence contained within the adoption studies which indicates that the projects in general had capacity-building and/or scientific impact. As an example, teachers, researchers and policy-makers familiar with the results of the ACIAR-funded project on accelerating growth through globalisation of Indian agriculture are of the view that the project has already, and will continue to, strengthen capacity to use the frontier production function methodology and software to analyse productivity levels and allocative inefficiencies in agriculture and other industries in India. There has also been significant recognition of the work the project scientists undertook, both within and outside the scientific community. For example, scientists involved in the development of mud crab aquaculture in Vietnam have received numerous awards and recognition. Similarly, even though there has been limited uptake of mud crab aquaculture in the Philippines, scientists there have attracted funds for ongoing research and regularly network with other scientists. The study on ectomycorrhizal fungi for eucalypt plantations in China is an excellent example of how a project can leave a legacy in the form of a group of trained scientists able to carry on further research and with enough credibility to gain more funding. Indeed, the ability of in-country scientists to obtain further funding is a common successful feature in many of the ACIAR projects. Another significant impact is the use of knowledge and techniques in tertiary education, where students are being attracted to courses in 'newer' sciences such as biotechnology. On the other hand, factors that inhibit capacity-building and scientific impacts include the transfer of trained scientists to other roles, institutions or projects and, in some cases, the choice by some scientists to move to other countries to further their careers. It is, of course, not known whether these scientists will return to their own countries in the future.

AS002	**Adoption of ACIAR project outputs: studies of projects completed in 2000-2001**
	No overview paper included.
AS003	**Adoption of ACIAR project outputs: studies of projects completed in 2001-2002**
	Training (page 11) Targeted training of scientists, extension officers and users has been a consistent theme in the success of adoption. Where training has been provided to in-country scientists, they are more able to continue the project when it is formally over. In addition, farmers who receive practical, hands-on training are more likely to use the new technologies**.** **Capacity building and scientific impacts (pages 17/18)** Products and activities, such as scientific papers, publications, seminars, training courses, workshops and conference presentations continue to be described as indicators of capacity building and scientific impacts. As suggested previously, it may be unreliable to attribute scientific impact to the number of these only, as publication alone is not a good indicator of scientific impact. However, there is no doubt that the increased scientific knowledge gained by being involved in the project and publishing the results contributes to partner-country scientists having a better understanding of their field and therefore able to make more informed scientific decisions. As evidenced in other adoption studies, ACIAR projects contribute significantly to increasing the scientific capacity of the partner-country scientists involved directly with the project. In some cases, where adoption is limited due to factors outside of the control of the project, the capacity building and scientific impacts can be the most significant legacies. Trained, expert local staff continue to apply their new knowledge and skills in their ongoing work. This has multiple benefits for partner-country scientists, such as: • more likely to be promoted to lead further research • being awarded PhD candidatures and places for other post-graduate study • ability to secure more funding, and be involved in ongoing research • improved laboratory equipment and processes that are used in subsequent projects • improved and enhanced, formal and informal, scientific networks and contacts • new knowledge and skills transferred more broadly as scientists and others move to new • positions/organisations/regions • a better understanding of the need to consult and work with local communities • generating local interest and knowledge when a new approach is taken to research • prizes, rewards and recognition. • Without exception, all the adoption studies identified the capacity-building and scientific impacts as significant.

AS004	Adoption of ACIAR project outputs: studies of projects completed in 2002-2003

Capacity Development (Page 8)

The projects also delivered considerable outputs in terms of capacity built. In general the projects incorporated researchers already involved in the field, and in some cases there was considerable exchange of existing knowledge (notably in brassica vegetable IPM in China and the eucalypt rust in Brazil). In a few cases the projects made investments to build the institution's research infrastructure as well as in staffskills and knowledge (notably for insect pathology on white grubs in India and eucalypt rust in Brazil).

Table 2 summarises the main capacity built. It also notes the extent to which the capacity has continued to be used.

Table 2. Research capacity built by the projects

Project	Partner-country/ies researchers	Research infrastructure	Capacity used
Policy analysis of linkages between Indonesia's agricultural production, trade and the environment	Development of modelling skills of students and researchers involved; former students now teaching in major universities	WAYANG CGE[a] model publicly available via the web	Use of the model has been requested by the Ministers of Agriculture and Trade; research leaders involved have progressed to high-level government positions
Management of white grubs in peanut cropping systems in Asia (India) and Australia	Skills built in insect pathology and intersection with crop production; capacity also built in farmers involved in the project	Laboratory equipment and facilities developed to support insect pathology research	Laboratories have been closed; researchers have retired or their work has been terminated
Improvement of IPM[b] in brassica vegetable crops in China and Australia	Major improvements in the networking of research and extension staff in China		Research is continuing and skills are being applied to tackle new pest problems
Assessment of eucalypt rust as a pathogen of *Eucalyptus* spp. and other Myrtaceae, and development of sensitive methods for its detection in germplasm in Australia	Scientific skills built in both Brazilian and Australian researchers involved	Improvement in research infrastructure in Brazil	Continued progress in research in the area using the facility and staff in Brazil and ongoing research in Australia
Conjunctive water management for sustainable irrigated agriculture in South Asia (Pakistan)	Facilitated a PhD dissertation and a Masters thesis		While the scientists have progressed in their careers, none continued with the agencies
Shelf-life extension of leafy vegetables (China)	Budgeting and project management skills developed and closer contact with industry gained		Major increase in R&D on postharvest handling due to greater ability to attract investment
Nutrition of tropical hardwood species in plantations in the south-western Pacific (Solomon Islands)	Major improvement in know-ledge, skills and confidence of plantation staff involved		Most researchers have moved to other organisations; indirect use of skills gained

[a] CGE = computable general equilibrium

[b] IPM = integrated pest management

AS005	Adoption of ACIAR project outputs: studies of projects completed in 2003-2004

Capacity Building (Page 10)

As well as the specific output intended for the research, by bringing together diverse groups of researchers and by connecting Australian and partner-country practitioners, ACIAR-funded projects can lead to the development of increased capacity (to do research, to apply research techniques or to understand policy issues) amongst partner-country researchers and decision-makers. ACIAR funding may also create research infrastructure that may generate returns from future use.

Table 2 summarises the kinds ofcapacity developed in the projects covered in this report. Many of the projects involved formal training of partner-country researchers; others involved obtaining higher academic qualifications. In some cases, research infrastructure was provided, or new techniques were transferred to researchers in partner countries.

Capacity building was sometimes an explicit and essential part of the technology transfer from the project. In other cases it was the side effect of undertaking research for the project. In most cases, this increased capacity has continued to be used within similar areas of research in the partner country, sometimes with trained researchers being promoted to positions of greater responsibility in partner-country organisations and continuing to work in areas similar to those of the original project.

Two of the adoption reports noted that the encouragement of collaboration between Australian and partner-country researchers and the establishment of productive networks of exchange was in fact a major output of the projects. This was identified as a unique feature of ACIAR-funded projects.

Table 2. (continued)

Project	Partner-country/ies researchers	Research infrastructure	Capacity utilised
Leucaena management in West Timor and Cape York	Training of university staff		Those trained remained researchers within the field
An evaluation of the sustainability of farming systems in the brackish water region of the Mekong Delta	University collaborators exposed to new techniques Project produced PhD and Masters degrees		Scholars in senior university positions or continuing to study
Conservation, evaluation and utilisation of plant genetic resources from the Central Asian republics and Caucasus	Improved linkages between countries and international agencies	Increased availability of germplasm in Australia	Ongoing use

AS006	Adoption of ACIAR project outputs: studies of projects completed in 2004-2005

Capacity development (page 10)

As well as the specific output intended for the research, by bringing together diverse groups of researchers, and by connecting Australian and partner-country practitioners, ACIAR-funded projects can lead to the development of increased capacity (to do research, to apply research techniques or to understand policy issues) among partner-country researchers and decision-makers. ACIAR funding may also create research infrastructure that can generate returns from future use. Table 2 summarises the kinds of capacity developed in the projects covered in this report.

Capacity development included training in basic techniques and technologies (for example, laboratory techniques in the legume project or geographic information system technologies in the fire management project) that are applicable in areas outside the initial project research.

A component of most of the projects was formal training of partner-country researchers involved, including obtaining higher academic qualifications. In some cases, research infrastructure was provided, or new techniques were transferred to researchers in partner countries. In the case of the leafminer project, capacity building including the establishment of a new software platform.

A very interesting form of capacity building is seen in the Chinese wool-textile mills project. Here, much of the capacity development includes increased communication and linkages between different parts of the processing chain and between the wool chain and government. This form of 'soft' infrastructure will clearly be productive in years to come and so represents an investment in capacity.

Table 2. Research capacity built by eight ACIAR projects completed in 2004–05

Project	Partner-country/countries research capacity built	Research infrastructure	Capacity utilised
Traits for yield improvement of chickpea for drought-prone environments of India and Australia	Increased skills in: ▪ optimising genotype / environment (G × E) interaction in breeding programs ▪ agrophysiological techniques for drought-resistance traits ▪ PC-based data handling and multivariate analysis Eight scientists also visited Australia to see the G × E experiments	Increased collaboration between physiologists and breeders in India	Knowledge from the training courses and the advantages of collaboration continue to provide benefits to both physiologists and particularly breeders working in Indian research institutes

AS007	Adoption of ACIAR project outputs: studies of projects completed in 2005-2006

Capacity development (page 10)

Most of the projects presented here had explicit objectives to improve the capacity for research and development (R&D) in partner countries. This capacity development included training in basic experimental and research skills as well as the use of modelling techniques to enhance experimental research.

Most of the projects involved formal training of partner-country researchers, including some that led to higher academic qualifications. For example, eight students at the Henan University of Technology (China) were awarded MSc degrees based on research on various aspects of insect pest management and phosphine toxicology undertaken as part of phosphine fumigation practices into grain storage systems.

A number of the projects included the enhancement of research infrastructure. For example, in Vietnam, the soybean adaptation and improvement project provided a vehicle to enable researchers to access remote regions, and specialised fumigation equipment was installed at the Plant Protection Quarantine Laboratory in Hanoi through the phosphine fumigation practices in grain storage project. In China, various modelling and simulation techniques were developed and disseminated as part of the 'growing more rice with less water' project, while in the Philippines the integrated watershed management project introduced automated weather station and water sampler technologies.

Finally, a modern soil and plant analytical facility was developed in India under the eucalypt plantations project. In all cases, the research capacity and research infrastructure continue to be used. In a couple of cases, researchers who held junior positions during the course of the project now hold senior positions within the relevant organisations. Table 2 summarises the kinds of capacity developed in the projects covered in this report.

Table 2. Research capacity built by the eight ACIAR projects completed in 2005–06

Project	Partner-country research capacity built	Research infrastructure	Capacity used
Soybean variety adaptation and improvement in Vietnam and Australia	Specific training in agronomy and breeding (for soybean) Development of international research networks	Acquisition of a research vehicle, allowing broader field research access than previously available	Project trainees continuing to higher education Many project staff now in leadership roles Research vehicle still in use
Improving and maintaining the productivity of eucalypt plantations in India and Australia	Skills developed in the Kerala Forest Research Institute, including experimental and field skills Development of research networks	Development of a modern soil and plant analytical facility	Increased skill in the Kerala Forest Research Institute continues to be used Ongoing use of soil and plant analytical facility
Coconut tissue for clonal propagation and safe germplasm exchange	Increased skills for germplasm management in partner organisations through meetings and workshops	Supply of equipment to develop and maintain germplasm banks	Capacity continues to be used in all partner countries
Salinity management in south-eastern Australia, north-eastern Thailand and Lao PDR	Increased skills in geographic information systems, spatial analysis and numerical modelling		Some elements of new capacity continue to be used but others, such as some of the modelling, have not

AS008	Adoption of ACIAR project outputs: studies of projects completed in 2006-2007

Capacity development Pages 11 and 12)

Most of the projects presented here had explicit objectives to improve the capacity for research and development (R&D) in partner countries, and all of the projects had substantial capacity-building outcomes. Table 2 summarises the capacity developed and used in the projects covered in this report.

Capacity development included training in basic experimental and research skills, both through formal training and less formal on-the-job training. Many of the projects involved training to obtain higher academic qualifications.

A number of the projects included the enhancement of research infrastructure, varying from basic laboratory equipment provided as part of the project, to the establishment of research systems such as geographical information system (GIS) tools and models, as well as enzyme-linked immunosorbent assay (ELISA) diagnostic systems and software for analysing plant genetics.

In most cases, the research capacity and research infrastructure continue to be used. In two cases, researchers who were originally junior during the course of the project now hold senior positions within the relevant organisations. In other cases, trained staff have moved to take positions in commercial organisations. In some cases, due to a lack of funds or changed priorities within the country concerned, the capacity developed is no longer used.

Table 2. Research capacity built by the projects

Project	Partner-country/ies research capacity built	Research infrastructure	Capacity utilised
1. Integrated management of botrytis grey mould of chickpea in Bangladesh and Australia	Capacity development of both researchers and farmers through a series of workshops and training sessions		Limited use due to reduced priority in Bangladesh
2. Biological control of *Chromolaena odorata* in Papua New Guinea	Considerable capacity development within both regional agencies and farm communities	Physical infrastructure developed in the course of the project	Human and physical capacity continues to be used
3. Reducing aflatoxin in peanuts in Indonesia and Australia	Training for Indonesian scientists in agronomic management, crop modelling and aflatoxin analysis with enzyme-linked immunosorbent assay (ELISA) systems	ELISA systems	Ongoing use of expertise developed in the course of the project
4. Management strategies for enhanced fisheries production in Sri Lanka and Australia	Extensive training of researchers to higher degree and PhD level Training of extension officers and fisheries inspectors Training of farmers (many formerly rice farmers)	Models and geographical information systems developed	Capacity continues to be used in relevant government agencies, fishing communities and the scientific community in general Teaching on culture-based fisheries has become a component of a number of university courses
5. Biology and status of the prawn stocks and trawl fishery in the Gulf of Papua	Formal and informal on-the-job training for National Fisheries Authority staff and Gulf province staff	Improved capacity of licensing and data control	Trained staff remain employed and active in their respective organisations

AS009	Adoption of ACIAR project outputs: studies of projects completed in 2007-2008

Capacity development (page 11)

Most of the projects presented here had explicit objectives to improve the capacity for research and development in partner countries, and all of the projects had substantial capacity-building outcomes. Table 2 summarises the capacity developed and used in the projects covered in this report.

Capacity development included training in basic experimental and research skills, through both formal training and less-formal on-the-job training. Many of the projects involved training to obtain higher academic qualifications, including doctorates.

A number of the projects included the enhancement of research infrastructure, varying from basic laboratory equipment and reagents provided as part of the project, to the development of a quarantine glasshouse and associated protocols as a result of project support.

In most cases, the research capacity and research infrastructure continue to be used. In a few cases, researchers who were originally junior during the course of the project now hold senior positions within relevant organisations. In other cases, trained staff have moved to take positions in other organisations or departments, often leaving no technical expertise behind. In some cases, capacity has not continued to be used after project completion due to limited opportunities to apply specific technical skills outside of the project.

Table 2. Research capacity built by the projects

Project	Partner-country/ies research capacity built	Research infrastructure	Capacity used
1. Development of a vaccine for the control of Gumboro in village and small poultry holdings in Indonesia	Laboratory manual for production and quality control of master seeds Enhanced capacity of partner-country research institute and its scientists in IBDV diagnosis, vaccine development and evaluation	Reagents for the differentiation of vvIBDV	Expertise and knowledge of those involved in developing IBDV vaccine in Indonesia have been used to provide training and advice in the further development of vaccines Reagents have been used in a diagnostic test
2. The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific	Postgraduate training of researchers to higher degree, including PhD, level Project training and skills and knowledge development of laboratory staff at the National Veterinary Laboratory (NVL)	Infrastructure, equipment and reagents provided during the course of the project	Infrastructure provided to the National Agriculture and Quarantine Inspection Authority has become essential for the continuing functions of the NVL Equipment continues to be used, improving efficiency Ongoing employment of skills and knowledge by laboratory staff and researchers
3. Control of Newcastle disease and identification of major constraints in village chicken production systems in Myanmar	Considerable training of Livestock Breeding and Veterinary Department (LBVD) staff through both formal courses and through working alongside Australian researchers, including: capacity building in epidemiology and disease surveillance; molecular methods for diagnosis; vaccine production and quality control; and extension methodologies	Diagnostic equipment (PCR machine, centrifuges etc.)	Capacity in molecular diagnostics now well embedded in LBVD Equipment continues to be used and has been upgraded Epidemiology section of LBVD has been expanded

AS010	Adoption of ACIAR project outputs 2013 (projects completed in 2009-2010)

Capacity development (pages 11 and 12)

Most of the projects reported here had explicit objectives to improve the capacity for research and development in partner countries, and all had substantial capacity-building outcomes. Table 2 summarises the capacity built and used in the projects.

Capacity development included training in basic experimental and research skills and farming practices through both formal training and less formal on-the-job training. Some projects involved training to obtain higher academic qualifications, including PhD and masters studies.

A number of projects included the provision or development of research infrastructure, varying from basic global positioning system (GPS) equipment and computers provided as part of the project to the development of poultry research and demonstration facilities that continue to be used for training in Solomon Islands.

In most cases, the research capacity and research infrastructure continue to be used. The collaboration developed between organisations remains in place, and staff skills and expertise developed through training continue to be used. However, there are some exceptions. For example, equipment such as computers and cameras provided in the smallholder cocoa production project in PNG no longer works, and Indonesian staff from the Water Planning and Infrastructure Department trained in the use of decision-support tools during the climate-forecasting project have moved on, resulting in limited capacity to use the technical models developed.

Table 2. Research capacity and infrastructure built by the projects and continued use

Project	Partner-country research capacity built	Research infrastructure	Capacity used
Poverty alleviation and food security through improving sweetpotato–pig systems in Papua, Indonesia	Linkages and networks were established between various partner organisations, including the South Australian Research and Development Institute (SARDI) and Papua Assessment Institute for Agricultural Technology. Eight scientists received training while employed in the project. Farmers and local technical staff completed training in modified sweetpotato–pig production systems, including 54 village farmers, 7 farmers to train other farmers and 5 technical staff from local non-government organisations (NGOs) associated with other farmer networks.		Collaboration between agencies has continued and has expanded to include Australian and Indonesian universities, as well as national, provincial and regional Indonesian Government agencies and NGOs. Farmers and scientists trained in this project are also involved in a new project that commenced in 2009; their expertise is being used to develop new crops and livestock production systems.