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INTEGRATION OF RESEARCH EVALUATION ANALYSIS INTO RESEARCH INSTITUTION DECISION-MAKING: AN OVERVIEW OF PROGRESS AT ACIAR

Jeff Davis* and Godfrey Lubulwa**

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* Coordinator, Economic Evaluation Unit, Australian Centre for International Agricultural Research, Canberra.

** Senior Economist Economic Evaluation Unit, Australian Centre for International Agricultural Research, Canberra.

CONTENTS

ABBREVIATIONS

ISNAR:	International Service for National Agricultural Research
ACIAR:	Australian Centre for International Agricultural Research
PMIS:	Project Management Information System—now renamed PISA
PISA:	Project Information System, ACIAR
PAC:	Policy Advisory Council, ACIAR
BOM:	Board of Management, ACIAR
IARC:	International Agricultural Research Centres
CGIAR:	Consultative Group on International Agricultural Research
CPA:	Completed project assessments
PDA:	Project development assessments
NPV:	Net present values
CIMMYT:	Centro Internacional de Mejoramiento de Maiz y Trigo (International Maize and Wheat Improvement Center)
IRR:	Internal Rate of Return

1. INTRODUCTION

Since it was created in 1982, the Australian Centre for International Agricultural Research (ACIAR) has placed considerable importance on developing a systematic information base to support its research resource allocation decision-making. As with most research institutions the form and sources of this support information are quite varied. ACIAR has, however, placed considerable emphasis on quantitative replicable information to complement the judgement of scientific experts. The first step in this quantification process was development of a, so called, 'scoring model' approach to priority setting. While this effort had some constructive aspects it was soon found to be difficult to replicate. Priorities set using one group were often not the same as using other groups. It was often difficult to rationalise these differences.

In 1986, ACIAR initiated a more detailed effort to develop a quantitative, systematic set of information which could be used to support priority setting and, therefore, its research-resource-allocation decisions. Important requirements were that the information and suggested priorities be replicable and that, as improved data became available, it could be readily incorporated into the system. A clear theoretical basis for the analysis was also regarded as important.

At the same time, several other research institutions which ACIAR interacted with had been considering developing similar support information systems. Collaborative activities were developed between ACIAR and several of these groups in partner country and international research institutions. Initially these groups were in the Philippines, Thailand, Indonesia, Papua New Guinea, the International Service for National Agricultural Research (ISNAR) and Australia. Major summaries of the status of these efforts were reported at a Workshop in 1991 and are summarised in Davis and Ryan (forthcoming).

In an effort to formalise the ACIAR component of this work, an Economic Evaluation Unit (EEU) was created in by ACIAR in 1992. This Unit was given responsibility for maintaining and enhancing the **Information System** originally developed and ensuring that it continued to adapt to changes in the decision-making environment. This paper provides an overview of the current status of these efforts.

The paper does not attempt to provide details of the methodologies and data used, this has been documented in detail in, for example, al (1987) and Davis and Ryan (forthcoming). In addition Alston et al (1995) provide a very detailed review of the current status of research evaluation methodology and how this might be used to support priority setting. The large number of papers referenced in these primary summaries give details of specific aspects of the evolution of these types of systems. Instead of repeating much of this information this paper begins with a brief discussion of the background to ACIAR's activity. It then provides an overview of the specific **Information System** developed at ACIAR and how it is integrated into the decision-making structure. Important features of the major components of the **Information System**, aggregate-priority-setting and project-level evaluations are briefly described. Some of the ways this information is used to support decision-making are also discussed. Finally a brief summary of some future directions is provided.

2. BACKGROUND TO ACIAR'S INFORMATION SYSTEM DEVELOPMENT

The process of allocating research resources in the public sector has increased in complexity during the past few decades. At the same time, the demand for a more systematic, accountable basis for making these allocations has increased. An important source of this demand has been the decision-makers in the public sector research institutions. However, decision-makers in other areas of the public sector have also begun to insist on this greater accountability for public sector expenditure.

In this atmosphere of greater accountability decisions based largely on the intuitive judgement of senior management are becoming less acceptable. There has been an increased demand for this intuitive judgement to be complemented by information compiled more systematically. Sometimes, there is an inclination to infer that such information can substitute for the final judgement of senior management. Systematically-gathered information can often strengthen decision-making, especially by providing continuity for decision-making even when senior management changes. However, it is unrealistic to expect such information to be comprehensive enough to replace the need for the judgement of managers. Better informed judgements, however, are more likely to satisfy the increased accountability being required from public sector institutions. It is important to also recognise that it is often the process of exposing decision-making to the activity of generating the information, rather than the basic summary information itself, which has the main impact on decision-making and improved judgements. The more complex the decision-making environment becomes the more likely this will be the case.

Figure 1 illustrates a typical decision-making process in a research institution. In most institutions decisions are made by an executive group (or groups). This group is usually drawn from a variety of backgrounds. Indeed it is a diversity of experiences that is usually necessary to provide the interchanges that result in effective decisions being made. As indicated in Figure 1 a range of information sources will influence each of the decision-makers. These may include such things as: past experience; professional training; peer group interactions and pressures; and political considerations. The intuitive judgements of each decision-maker, based on these different sources of information, are generally combined to give institutional decisions for research priorities and resource allocations. With increased public demand for accountability by these institutions it is often important to complement these decision-maker specific inputs with institutionally-generated information. In this way there will be an established set of information which can be well documented and remains with the institution as inevitably the decision-makers change.

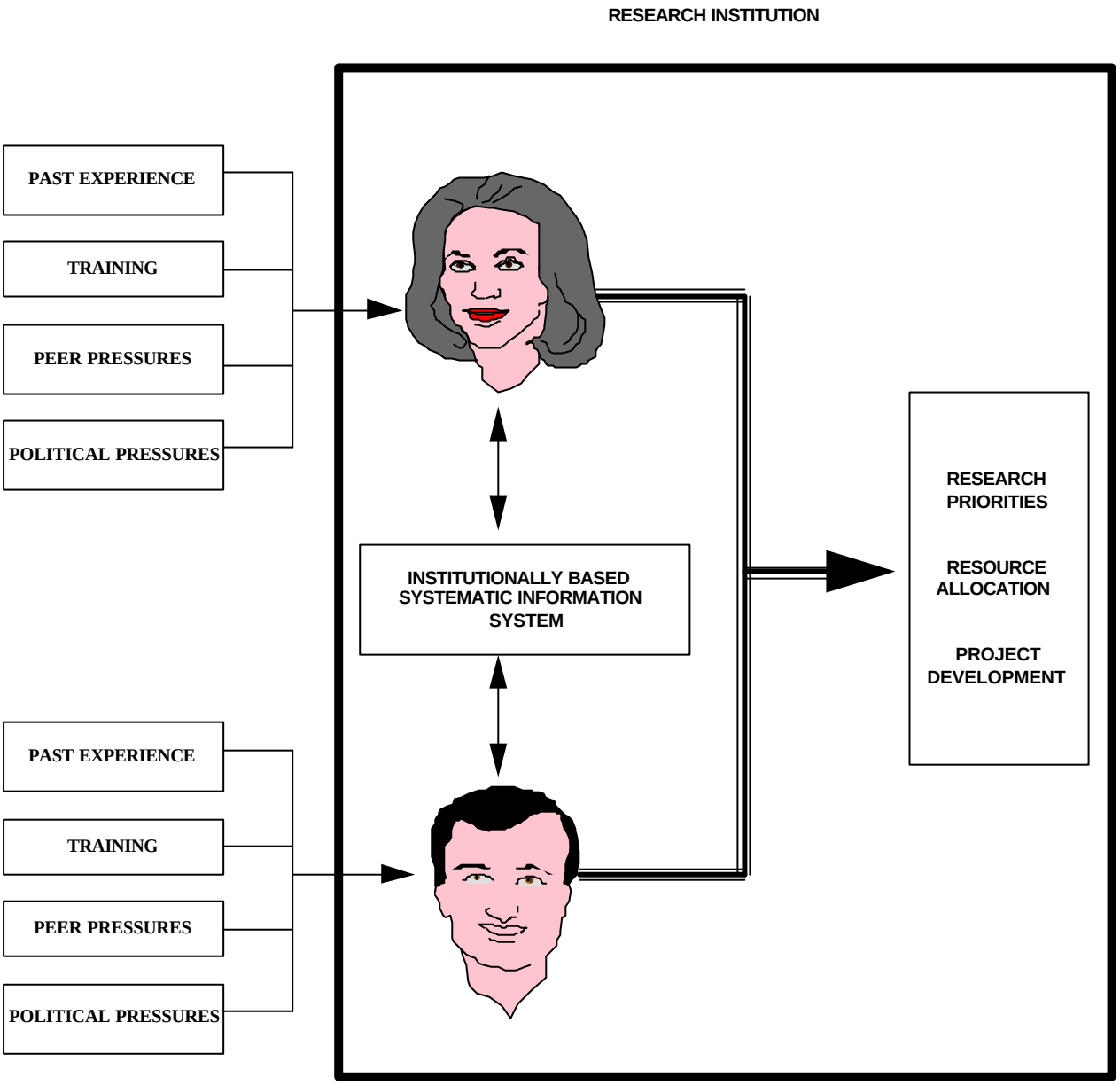

Figure 1. The complementarity between institutionally based information systems and other information sources which support decision-making.

As indicated in Figure 1 an important feature of any institutional information system should be that it evolves through interaction between the decision-makers, institution members and those collaborating with the institution. In this way the important experience and information contributed by these groups can be systematically incorporated in the institutional information. If the information system is effective it should contribute to a strengthening of decisions made by the institution.

At ACIAR initial efforts to develop an institutional information system included the use of a subjective scoring-model type of approach. As is usual with this approach, staff of ACIAR were asked to list criteria they thought were important in determining research priorities. These were then scored and weighted to rank different possibilities. The activity had several positive impacts, for example, it encouraged staff to discuss issues more

broadly. However, personal biases which were not always obvious often dominated. Also, replication of outcomes did not always occur and it was not always clear why this was so. It was decided that a more rigorous basis for the **Information System** was required.[1]

From ACIAR's perspective important requirements of the **Information System** included:

- a focus on specific research institution objectives and the need to clarify these;
- assessment of the potential and actual research impacts should be developed in a manner that is consistent and comparable at all levels in the decision-making chain. For example, information to support aggregate-priority-setting should be consistent with individual project-level evaluations. It should also be possible to use the latter to strengthen the former as more project-level assessments become available;
- being a research institution it was important to adopt a scientific approach and, therefore, make full use of the extensive stock of knowledge on research evaluation methods. Drawing from and enhancing the existing extensive set of literature was regarded as an important component; and
- any analysis must be systematically based and be readily replicated.

Achievement of these requirements was soon found to depend on: developing a clear perspective of the research process; how the objectives of a research institution are influenced by the potential impact of research funding decisions; and how these impacts are best measured to determine how well objectives are being met by different strategies. Figure 2 illustrates the simplified two-region version of the research-process model and related interactions which were used as the basis for ACIAR's **Information System**.

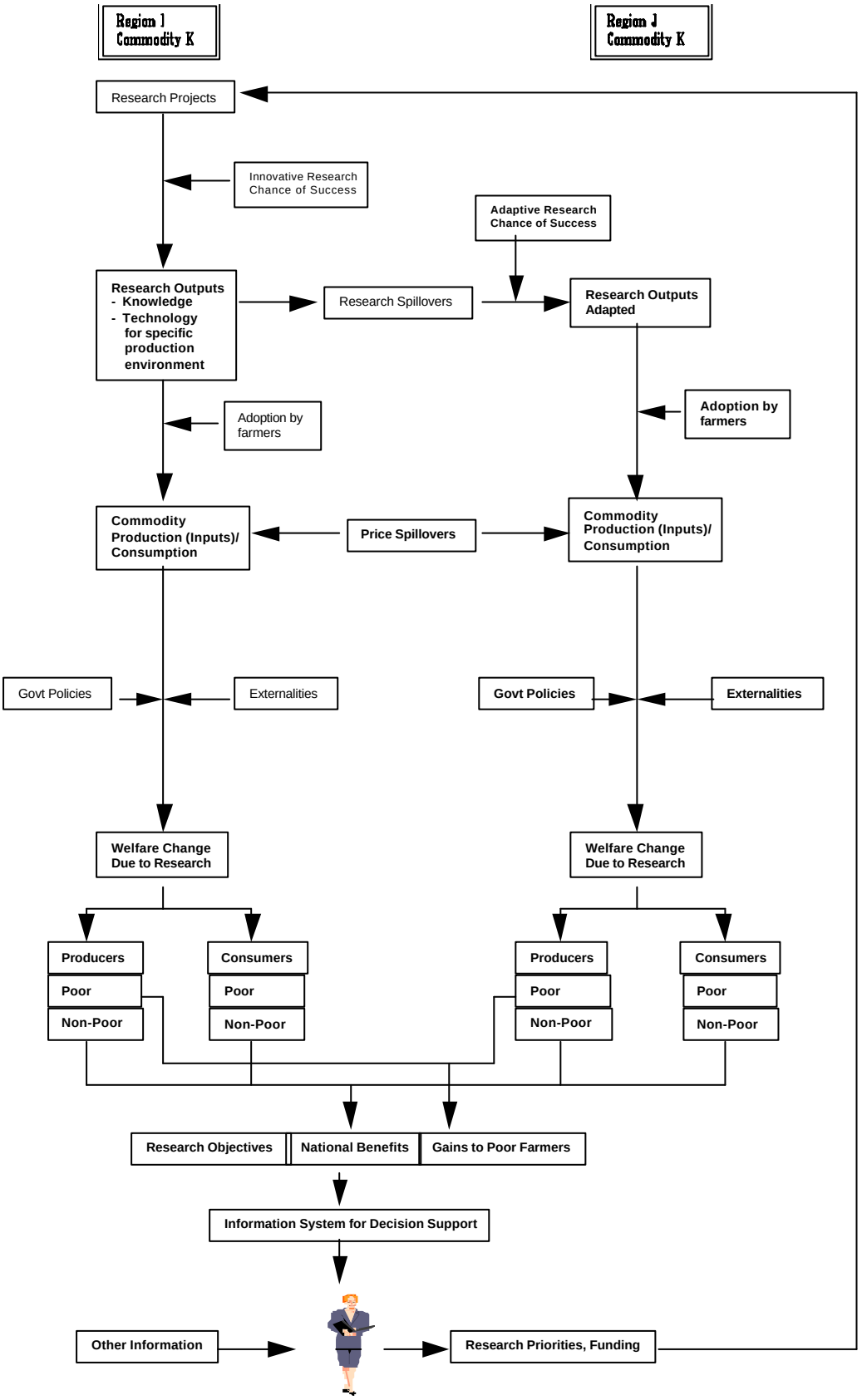
Region I
Commodity K
Region J
Commodity K
Research Projects
Innovative Research
Chance of Success
Adaptive Research
Chance of Success
Research Outputs
- Knowledge
- Technology
for specific
production
environment
Research Spillovers
Research Outputs
Adapted
Adoption by
farmers
Adoption by
farmers
Commodity
Production (Inputs)/
Consumption
Price Spillovers
Commodity
Production (Inputs)/
Consumption
Govt Policies
Externalities
Govt Policies
Externalities
Welfare Change
Due to Research
Welfare Change
Due to Research
Producers
Poor
Non-Poor
Consumers
Poor
Non-Poor
Producers
Poor
Non-Poor
Consumers
Poor
Non-Poor
Research Objectives
National Benefits
Gains to Poor Farmers
Information System for Decision Support
Other Information
Research Priorities, Funding

Figure 2. A simple multi-regional (country) model of the research process and decision-making.

A detailed discussion of each of the components of this model is given in Davis et al (forthcoming). It consists of several important sub-components. The research activities at the top of the flow chart start with clearly defined research projects which, if successful, generate knowledge that may then be converted into technologies applicable to particular production environments. In many cases there will be spillover impacts of the research on other regions, often with the same or similar production environments. In most cases adaptive research is required before the technologies are applicable to these other regions. The same output or commodity is used for illustration in Figure 2, however, the research (and spillover) could also be applicable (and spillover) to other commodities or outputs.

Once useable technologies are generated they can be adopted by farmers or other producers and the research then begins to have an impact on the production and consumption of the products. Sometimes this can first be through an impact on one or more of the many renewable or non-renewable resources or inputs to the production process. Effects on production and consumption will also result in changes in the prices of inputs and outputs, which in turn can create price spillover impacts. This may be to regions where the research outputs were not applicable. If the potential influences of government policies and possible externalities are included, the research will eventually (often after a considerable passage of time) have an impact on the welfare of many groups in the community. It is this impact on the welfare of different groups which usually determines whether, and how well, research objectives are being met. Estimates of these welfare impacts are indicators of how well the research decisions will meet, or have met, research objectives.

Quantification of the potential impacts illustrated in Figure 2 was the foundation of ACIAR's **Information System**. Particularly crucial was disaggregation of the model to include sub-models of each component of this process.

3. A BRIEF OVERVIEW OF ACIAR'S INFORMATION SYSTEM

As indicated earlier a detailed account of the evolution of ACIAR's Information System is provided in Davis and Ryan (forthcoming, chapters 8 to 11). Figure 3 provides a simple illustration of the structure of the institutional Information System developed by ACIAR and the interface between this System and groups within ACIAR and the institutions it collaborates with. The two-way flow of information is highlighted as a crucial aspect of the System. One important component comprises two databases. These are:

(i) A Project Management Database

The initial project management database was called the **Project Management Information System** (PMIS). It is a complete record of the information set for each Project funded by ACIAR since its inception. The information ranges from the detailed budgets to the publications and the country/commodity focus of the project. The database has been designed to produce a range of reports. Some are used to assist day-to-day project management while others provide summary information for all projects or various groups of projects. The structure of this database and software used to access it is currently undergoing a major review. The system is to be renamed PISA (Project Information System ACIAR).

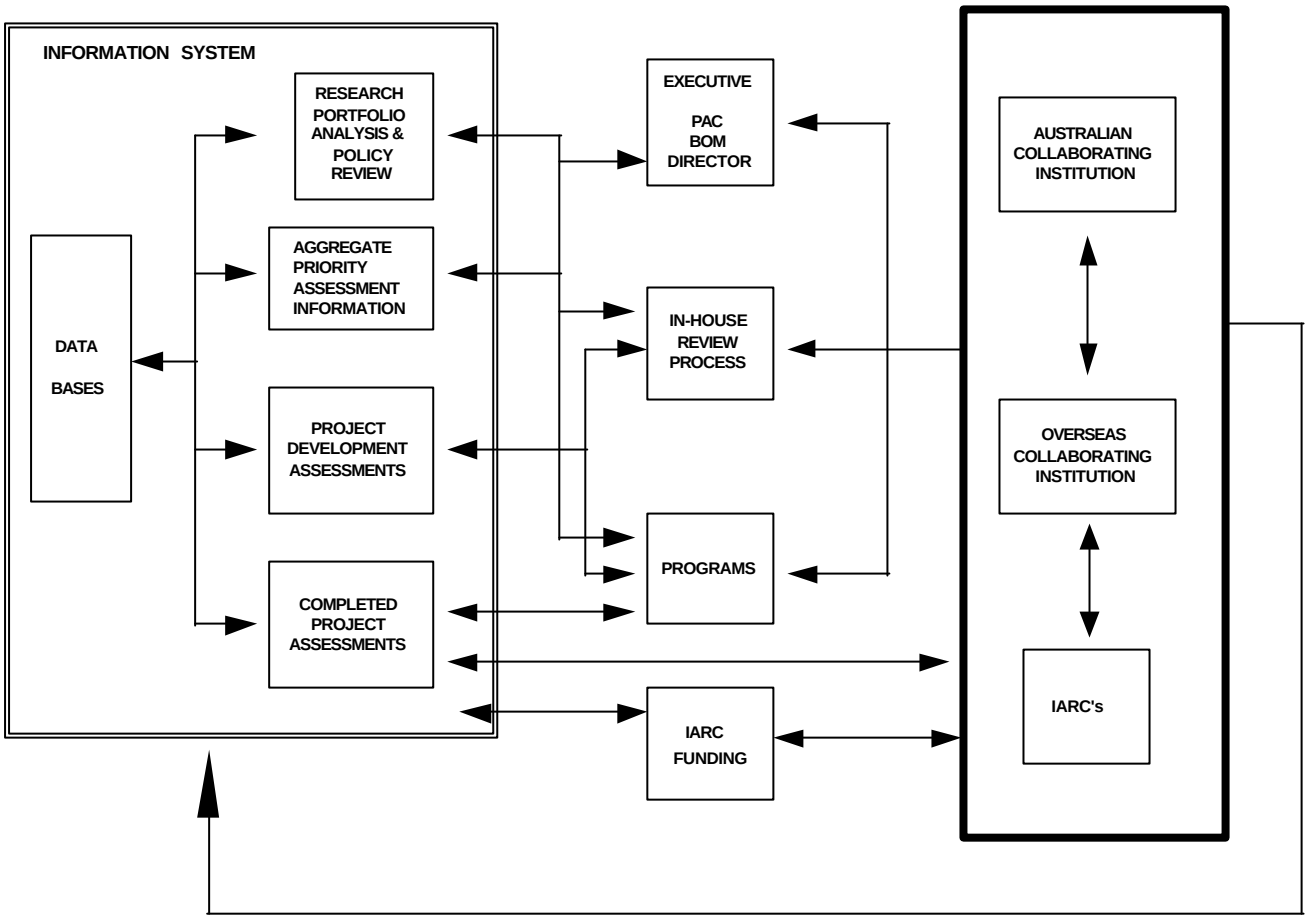

Figure 3. An illustration of the Information System interface with decision-making groups for ACIAR.

(ii) A Research Evaluation Database

The **Research Evaluation** Database has been developed with the view of making use of an extensive set of research evaluation literature which has been produced during the last three decades. The methodology which has evolved has been adapted to suit the decision-making environment in and structure of ACIAR. This has entailed incorporating more detailed technical parameters in the underlying models and involving technical scientists in the collection of the data used in the subsequent analysis. The models currently used are based on a detailed interpretation of the research process which interfaces the technical and socio-economic aspects of a multi-country world, as illustrated in Figure 2.

The technical dimensions of the research process model focus on estimates of the relative strengths of the research systems in different countries, the potential for research output to spillover to other countries and the potential adoption levels of the final technologies.[2] Estimates of the information used to represent these components have been obtained through consultations with research managers and technical experts. While the current estimates still require further verification they do represent a comprehensive set of data.

The socio-economic components have been modelled using a multi-region traded good model with the concept of producer and consumer surplus used to estimate the potential welfare effects of the research. To accommodate this part of the model a range of data sets have been added to the database. These include production, consumption (both commercial and subsistence), prices and elasticities. As well as the basic data the database includes a full set of the estimates of the potential welfare changes due to research.

To support aggregate level decision-making an important assumption used for the base-case set of welfare changes is that the research results in a 5% reduction in the cost of producing a unit (usually a tonne) of the commodity.

In its current form the database includes data and estimates of the parameters for all countries. However, these are then aggregated into 75 countries or aggregations of countries. By including all countries, any world price effects, which might flow from the technology spillovers to developed countries, can be incorporated. In addition to the 75 political/geographic regions the technical research spillovers are estimated using between 5 to 75 different production environment classifications, depending upon the commodity. This spillover information is, therefore, available for each of these production environments for each country, although each country will usually only contain a small subset of possible production environments.
The information and analysis is currently available for 45 different commodities. These include 27 from the agricultural sector, 8 from forestry and 10 from the fisheries sector.

In addition to the aggregate level information the database is used to develop project-level evaluations. Since the same economic-surplus based, research-evaluation methodology has been adopted for all levels, data can be readily shared. The important additional information required for project level evaluations is that on details of the costs associated with production of commodities in different production conditions (production environments) — and the assessments of the potential impact different types of research are likely to have on these costs and production conditions. This information is combined with project-specific revisions to the aggregate parameter set; thus providing assessments of the potential welfare impact of specific research projects.

Both of the databases described above have been computerised. The **PMIS** follows a more conventional database format while the **Research Evaluation** database uses primarily spreadsheets.

The databases developed as part of the Information System are extensive. To be useful for supporting decision-making it is necessary to develop summary reports which condense this information into useful ready-reckoner forms. Considerable effort has been focused on this aspect of the Information System. More effort is still required to refine the summary reports to ensure that they achieve maximum effectiveness. Ryan et al. (forthcoming) provide a detailed outline of the original efforts and indicate how this has been and continues to be an evolutionary process.

Figure 3 summarises, in simple terms, the components of the Information System. The two databases have been discussed above. These are used to produce summary information to support several decision-making groups. As indicated, this summary information currently takes four main forms.

(i) Project related information.
(ii) Aggregate priority assessment information.
(iii) Project development assessments.

(iv) Completed project assessments.

In the rest of this paper we will summarise some of the important dimensions of this Information System and illustrate how the information has been used to support decision-making in ACIAR.

4. AGGREGATE PRIORITY ASSESSMENT INFORMATION

4.1 Brief overview of the current status of aggregate-priority-assessment information

A crucial aspect of developing summary information to support priority assessment decisions was clear determination of ACIAR's objectives. This clarification is ongoing, for example, the ACIAR **Policy Advisory Council** (PAC) meeting in December 1994 discussed this issue again. Currently, maximising the regional welfare gains for each mandate region is given most prominence. However, Australian benefits are beginning to receive more attention. The large set of welfare gain information estimated in the **Research Evaluation** database has been employed to support priority assessments. These estimates provide an indication of the likely ordering of the commodities by the regional welfare gains which might result from successful research. Table 1 illustrates the monetary measures of the potential regional welfare gains from research if it is undertaken on problems relevant to the particular region and generates a 5% unit cost reduction for each commodity. In this case the regions illustrated are the five mandated for ACIAR plus Australia. Information for all countries and regions of the world are available from the analysis and are in the database.

Table 1. Gross present value of regional welfare benefits for a regional research focus (welfare measured in $US M. over 30 years with 12% discount rate).

South Asia Regional Benefits		Southeast Asia Regional Benefits		China Regional Benefits		South Pacific Regional Benefits		R
Commodity	Regional	Commodity	Regional	Commodity	Regional	Commodity	Regional	Commo
Ranking	Benefits	Ranking	Benefits	Ranking	Benefits	Ranking	Benefits	Rankin
Rice	421	Rice	200	Rice	1157	Tunas,bonitos etc	6	Fuelwo
Milk	269	Saw&Ven.Logs (NC)	181	Pigmeat	594	Fuelwood (NC)	6	Saw&V
Fuelwood (NC)	204	Fuelwood (NC)	167	Sweet Potato	311	Saw&Ven.Logs (NC)	4	Milk
Wheat	131	Palm Oil/Kernel	96	Maize	277	Sugar	2	Cocoa
Pulses All	115	Rubber	64	Potatoes	237	Banana/Plantain	1	Beef&B
Potatoes	63	Sugar	23	Wheat	233	Palm Oil/Kernel	1	Charcoa
Cotton	52	Coconut	22	Cotton	130	Coffee	1	Palm O
Sugar	50	Banana/Plantain	20	Eggs (poultry)	102	Cocoa	1	Cassava
Saw&Ven.Logs (NC)	38	Cassava	16	Soybean	60	Demersal/other pelagic	0	Sheep &
Sorghum	37	Pigmeat	14	Pulses All	59	Pigmeat	0	Oth.Ind
Groundnut	35	Demersal/other pelagic	13	Fuelwood (NC)	59	Coconut	0	Banana
Millet	24	Prawns/shrimps	13	Saw&Ven.Logs (C)	45	Pulpwood	0	Rice
Sheep & Goat Meat	24	Maize	12	Sugar	44	Saw&Ven.Logs (C)	0	Eggs (p
Banana/Plantain	20	Eggs (poultry)	11	Fuelwood (Con.)	40	Sweet Potato	0	Tilapias
Maize	18	Coffee	11	Poultry Meat	37	Milk	0	Sugar
Beef&Buffalo	16	Poultry Meat	10	Sheep & Goat Meat	30	Prawns/shrimps	0	Millet
Eggs (poultry)	15	Beef&Buffalo	8	Groundnut	29	Rice	0	Maize
Prawns/shrimps	14	Tilapias	7	Saw&Ven.Logs (NC)	28	Tilapias	0	Poultry
Coconut	13	Cocoa	7	Milk	25	Beef&Buffalo	0	Pulpwo
Demersal/other pelagic	8	Oth.Ind.Rdwood	6	Oth.Ind.Rdwood	19	Cassava	0	Fuelwo
Oranges & Tangarines	8	Tunas,bonitos etc	4	Prawns/shrimps	17	Charcoal	0	Ground
Herrings & others	7	Mackerals & others	3	Millet	14	Cotton	0	Herring
Cassava	6	Charcoal	3	Sorghum	13	Eggs (poultry)	0	Cotton
Fuelwood (Con.)	6	Sheep & Goat Meat	3	Wool	12	Fuelwood (Con.)	0	Saw&V
Saw&Ven.Logs (C)	6	Herrings & others	3	Oranges & Tangarines	9	Groundnut	0	Potatoe
Soybean	6	Soybean	2	Beef&Buffalo	8	Herrings & others	0	Pigmea
Charcoal	6	Milk	2	Pitprops	7	Lobsters	0	Demers

Oth.Ind.Rdwood	4	Pulpwood	2	Mackerals & others	5	Mackerals & others	0	Pulses
Wool	3	Sweet Potato	2	Demersal/other pelagic	5	Maize	0	Sorghu
Poultry Meat	3	Pulses All	1	Cassava	4	Millet	0	Wheat
Coffee	3	Saw&Ven.Logs (C)	1	Rubber	4	Oranges & Tangarines	0	Coffee
Tilapias	3	Groundnut	1	Palm Oil/Kernel	4	Oth.Ind.Rdwood	0	Soybea
Pigmeat	3	Cotton	1	Pulpwood	3	Pitprops	0	Wool
Rubber	2	Oranges & Tangarines	1	Tunas,bonitos etc	3	Potatoes	0	Coconu
Pitprops	1	Lobsters	1	Banana/Plantain	1	Poultry Meat	0	Sweet P
Pulpwood	1	Potatoes	0	Coffee	0	Pulses All	0	Tunas,b
Sweet Potato	1	Sorghum	0	Herrings & others	0	Rubber	0	Lobster
Mackerals & others	1	Wheat	0	Charcoal	0	Sheep & Goat Meat	0	Macker
Tunas,bonitos etc	1	Millet	0	Cocoa	0	Sorghum	0	Orange
Lobsters	0	Fuelwood (Con.)	0	Coconut	0	Soybean	0	Pitprop
Cocoa	0	Pitprops	0	Lobsters	0	Wheat	0	Prawns
Palm Oil/Kernel	0	Wool	0	Tilapias	0	Wool	0	Rubber

It has been found that this type of presentational format is not always the most convenient for quick use by decision-makers to assist in setting priorities. Instead, an alternative format has been developed. This format uses, what have been called, break-even relativities. (Table 2a, b). These relativities are calculated by placing the commodities in order from highest regional benefits to lowest; and then dividing the highest by each of the other commodity's expected gains. For example, in South Asia a 5% cost reduction from prawns/shrimp research is expected to generate a welfare gain in present value terms of US$14m. (A research and adoption lag of 11 years and a 30 year planning period is assumed and a real discount rate of 12% used). On the other hand, the same 5% unit cost reduction from rice research is expected to provide regional welfare gains to South Asia of US$421m. The break-even relativity for prawns/shrimp is 421/14 = 30. In other words, prawns/shrimp research would need to generate approximately 30 times the percentage cost reduction to provide the same regional welfare gains as rice research (remember that differences in potential spillovers, adoption levels and chances of adaptive research success between different countries and commodities are incorporated in these estimates).

Table 2a. Regional commodity research priority groupings for a regional benefits objective.

South Asia Regional Benefits			Southeast Asia Regional Benefits			China Regional Benefits		
Priority Group	Commodity Ranking	Break-even Relativities	Priority Group	Commodity Ranking	Break-even Relativities	Priority Group	Commodity Ranking	Break-even Relativities
	Rice	1		Rice	1		Rice	1
	Milk	2		Saw&Ven.Logs (NC)	1		Pigmeat	2
	Fuelwood (NC)	2		Fuelwood (NC)	1		Sweet Potato	4
1	Wheat	3	1	Palm Oil/Kernel	2	1	Maize	4
	Pulses All	4		Rubber	3		Potatoes	5
	Potatoes	7		Sugar	9		Wheat	5
	Cotton	8		Coconut	9		Cotton	9
	Sugar	8		Banana/Plantain	10			
							Eggs (poultry)	11
	Saw&Ven.Logs (NC)	11		Cassava	12	2	Soybean	19
	Sorghum	11		Pigmeat	14		Pulses All	20
2	Groundnut	12		Demersal/other pelagic	15		Fuelwood (NC)	20
	Millet	17	2	Prawns/shrimps	16			
	Sheep & Goat Meat	18		Maize	16		Saw&Ven.Logs (C)	26
				Eggs (poultry)	18		Sugar	26
	Banana/Plantain	21		Coffee	18	3	Fuelwood (Con.)	29
	Maize	23		Poultry Meat	19		Poultry Meat	31
3	Beef&Buffalo	27					Sheep & Goat Meat	39
	Eggs (poultry)	27		Beef&Buffalo	25		Groundnut	40
	Prawns/shrimps	30	3	Tilapias	27			
	Coconut	33		Cocoa	28		Saw&Ven.Logs (NC)	41
				Oth.Ind.Rdwood	33	4	Milk	46
	Demersal/other pelagic	53					Oth.Ind.Rdwood	62
	Oranges & Tangerines	55		Tunas,bonitos etc	57		Prawns/shrimps	67
	Herrings & others	64		Mackerels & others	61			

4	Cassava	67	4	Charcoal	63		Millet	81
	Fuelwood (Con.)	67		Sheep & Goat Meat	65		Sorghum	89
	Saw&Ven.Logs (C)	67		Herrings & others	67	5	Wool	97
	Soybean	75					Oranges & Tangerines	129
	Charcoal	77		Soybean	83		Beef&Buffalo	139
				Milk	95			
	Oth.Ind.Rdwood	98	5	Pulpwood	111		Pitprops	163
	Wool	136		Sweet Potato	133		Mackerels & others	214
5	Poultry Meat	140		Pulses All	143		Demersal/other	
pelagic	227		Maize	0				
	Coffee	145		Saw&Ven.Logs (C)	143		Cassava	276
	Tilapias	156					Rubber	276
				Groundnut	167		Palm Oil/Kernel	289
	Pigmeat	162		Cotton	200		Pulpwood	413
	Rubber	183		Oranges & Tangerines	222	6	Tunas,bonitos etc	463
	Pitprops	301		Lobsters	286		Banana/Plantain	1286
	Pulpwood	324		Potatoes	500		Coffee	5786
6	Sweet Potato	351	6	Sorghum	500		Herrings & others	5786
	Mackerels & others	421		Wheat	667		Charcoal	0
	Tunas,bonitos etc	842		Millet	2000		Cocoa	0
	Lobsters	2105		Fuelwood (Con.)	0		Coconut	0
	Cocoa	4210		Pitprops	0		Lobsters	0
	Palm Oil/Kernel	0		Wool	0		Tilapias	0
Regional Relativities	2.7			5.8			1	

Table 2b. Regional commodity research priority groupings for a regional benefits objective (continued).

Africa Australian Regional Benefits Benefits			W Asia/ N Africa Regional Benefits			Latin America Regional Benefits		
Priority Group	Commodity Ranking	Break-even Relativities	Priority Group	Commodity Ranking	Break-even Relativities	Priority Group	Commodity Ranking	Break-even Relativities
	Fuelwood (NC)	1		Wheat	1		Soybean	1
	Saw&Ven.Logs (NC)	6		Milk	2		Fuelwood (NC)	1
	Milk	8		Beef&Buffalo	3		Coffee	1
1	Cocoa	9		Sheep & Goat Meat	3		Milk	2
	Beef&Buffalo	9		Oranges & Tangerines	3		Beef&Buffalo	2
	Charcoal	9		Cotton	4		Sugar	2
	Palm Oil/Kernel	9		Rice	5		Pigmeat	2
	Cassava	10	1	Saw&Ven.Logs (C)	5		Saw&Ven.Logs (C)	2
				Pulses All	5		Herrings & others	2
2	Sheep & Goat Meat	11		Sugar	6		Oranges & Tangerines	3
	Oth.Ind.Rdwood	17		Fuelwood (Con.)	7		Saw&Ven.Logs (NC)	3
				Herrings & others	7	1	Demersal/other	
pelagic	3		Rice	9				
	Banana/Plantain	22		Fuelwood (NC)	7		Rice	4
	Rice	22		Eggs (poultry)	9		Maize	4
	Eggs (poultry)	22		Poultry Meat	9		Poultry Meat	5
3	Tilapias	22		Potatoes	10		Eggs (poultry)	5
	Sugar	25					Cocoa	6
	Millet	26	2	Maize	11		Prawns/shrimps	6
	Maize	27		Wool	14		Pulpwood	6
	Poultry Meat	28					Wheat	7
			3	Saw&Ven.Logs (NC)	22		Cassava	9
	Pulpwood	50		Oth.Ind.Rdwood	34		Fuelwood (Con.)	9
	Fuelwood (Con.)	54					Banana/Plantain	9
4	Groundnut	54		Mackerels & others	46			
	Herrings & others	59		Demersal/other pelagic	58		Sheep & Goat Meat	11
	Cotton	65	4	Pitprops	71		Charcoal	11
	Saw&Ven.Logs (C)	65		Charcoal	80	2	Cotton	14
				Pulpwood	80		Pulses All	16
	Potatoes	81		Soybean	80		Wool	17
	Pigmeat	92						
5	Demersal/other pelagic	129	5	Millet	92		Potatoes	22
	Pulses All	129		Banana/Plantain	107	3	Sorghum	25

	Sorghum	129					Oth.Ind.Rdwood	26
				Prawns/shrimps	214		Rubber	36
	Wheat	161		Tunas,bonitos etc	214			
	Coffee	215		Groundnut	641		Palm Oil/Kernel	44
	Soybean	215		Pigmeat	641		Tilapias	53
	Wool	215		Cassava	0	4	Lobsters	56
	Coconut	323		Cocoa	0		Mackerels & others	56
	Sweet Potato	323	6	Coconut	0		Tunas,bonitos etc	72
6	Tunas,bonitos etc	323		Coffee	0			
	Lobsters	645		Lobsters	0			
	Mackerels & others	645		Palm Oil/Kernel	0		Coconut	253
	Oranges & Tangerines	645		Rubber	0		Pitprops	507
	Pitprops	645		Sorghum	0	6	Sweet Potato	507
	Prawns/shrimps	645		Sweet Potato	0		Groundnut	1013
	Rubber	-645		Tilapias	0		Millet	0
Regional Relativities		17.9			18.1			11.4

Notice that as well as the break-even relativities for all commodities within a region, Table 2 also includes the relativities between the geographical regions. This is calculated by dividing the highest regional welfare gains, that is, those for China by each of the highest gains for the other regions. Therefore, it is seen that for tuna, bonitos etc. research in the South Pacific to generate the same welfare gains as rice research in China, about 200 times the percentage unit cost reduction would be required.

In addition to calculating these relativities, it has proven useful to use priority groups instead of an ordered list. We have found six useful and the following relativity ranges appropriate:

Priority Grouping	**Range of Break-Even Relativity**
1	0–10
2	11–20
3	21–40
4	41–80
5	81–160
6	> 160

Care is obviously required in using this type of summary information to support decision-making. In ACIAR it is not used to dictate that research should only be supported for the commodities expected to provide the highest gains. Rather it is used more as a screening device. That is, research focusing on commodities that are in the 4, 5, and 6 priority groups are flagged as requiring closer scrutiny for the likely level of welfare gains that may result. The trend is towards having more detailed economic assessments included with these types of projects to demonstrate more clearly that, as well as scientifically attractive attributes, there are high potential regional welfare gains.

Figure 4 illustrates graphically the information from Table 1 for Southeast Asia. Included are the cut-off points for each of the six priority groups.

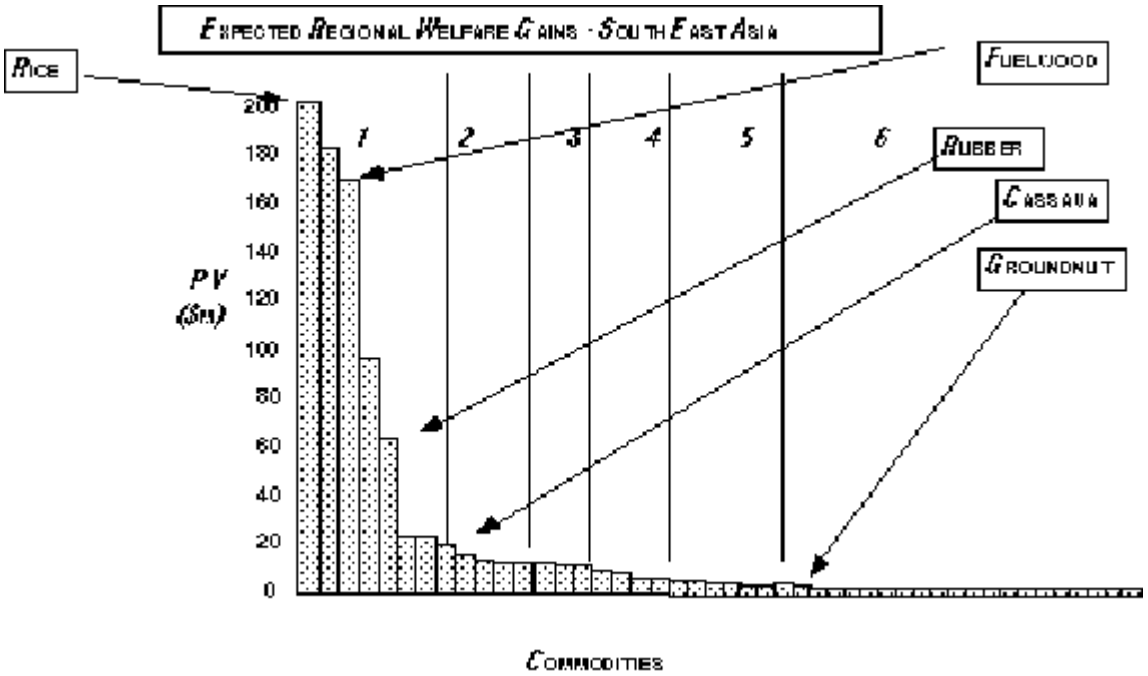

Figure 4. Graphical representation of potential research benefits and priority groupings.

4.2 How is the information used

This aggregate potential impact information has been used to support decision-making by most of the decision-making groups illustrated in Figure 2. Some of the important examples include:

(i) **Project screening**. The major share of ACIAR's research funding is focused on bilateral collaborative projects involving Australian scientists and scientists in partner countries in the five mandate geographical regions. ACIAR's Board of Management (BOM) approves all major funding but relies on the advice of an extensive project-development process within the Centre to support these decisions. This project-development process includes detailed screening and project identification by the nine research program coordinators. Projects that complete this stage are then subjected to several detailed reviews. These are made by the, so called, In-House-Review committee which comprises senior management and all of the senior scientific staff in the Centre, including the staff of the EEU. The priority listings in Table 2 are used by coordinators as one of several factors to screen early ideas. However, the list is used more formally as one of the screening factors during the In-House-Review discussions. Ryan et al (forthcoming) provide a detailed outline of this process.

(ii) **Highlighting trade-offs between different research objectives.** ACIAR aims to achieve maximum collaboration and mutual benefits from its funding of projects. To achieve this, it balances the Australian national benefits objective of most Australian research institutions with the potential regional welfare gains which are more consistent with the foreign policy aid oriented primary objective of ACIAR. The aggregate-priority information and, what have been called, box diagrams have been used to highlight the types of commodities for which research is likely to satisfy both objectives well for a region and those

which satisfy one better than the other. Ryan et al (forthcoming) provide some more detailed illustrations of these.

(iii) **Research Program Planning**. Subsets of the information can be extracted which focus on the individual research programs within ACIAR. These types of information have been presented at regular meetings of project leaders in each of the nine research programs. The information has been used in a range of ways. In many cases it has been used to indicate to project leaders and potential project leaders the types of information used to support research funding decisions in ACIAR. In other cases the information has been formally included in program-strategic-planning exercises. Examples of papers with this focus are Davis (1994), Davis and Lubulwa (1994, 1995) and Davis and Fearn (1992 a,b).

(iv) **Funding Patterns and Trends**. Combining information from the PMIS database and the Research Evaluation database can provide summary information about the funding structure for all projects, by individual programs, by research area and for different time periods. Examples of this information can be found in the papers listed above for research program meetings. Recent information for all ACIAR funding and different time periods is briefly discussed below as an illustration.

(v) **International Agricultural Research Centres (IARC) Funding**. During the last few years ACIAR has been given responsibility for Australia's funding of IARC's. The major share of this funding is to the Consultative Group for International Agricultural Research (CGIAR) Centres. A preliminary adaptation of the aggregate research evaluation database and model has been used to support funding allocation decisions in this area. See Davis et al (1993) and Ryan and Davis (1990, 1991).

Table 3 provides a brief illustration of the type of summary-funding information which is generated from the **Information System** A combination of the PMIS and Research Evaluation databases provide this summary of expenditure patterns by region and aggregate priority group. This table is an aggregation of the more detailed funding information which includes a breakdown by each commodity and country if required. Care is required in drawing strong conclusions from aggregated data, however, Table 3 and Figure 5 suggest a few points and trends.

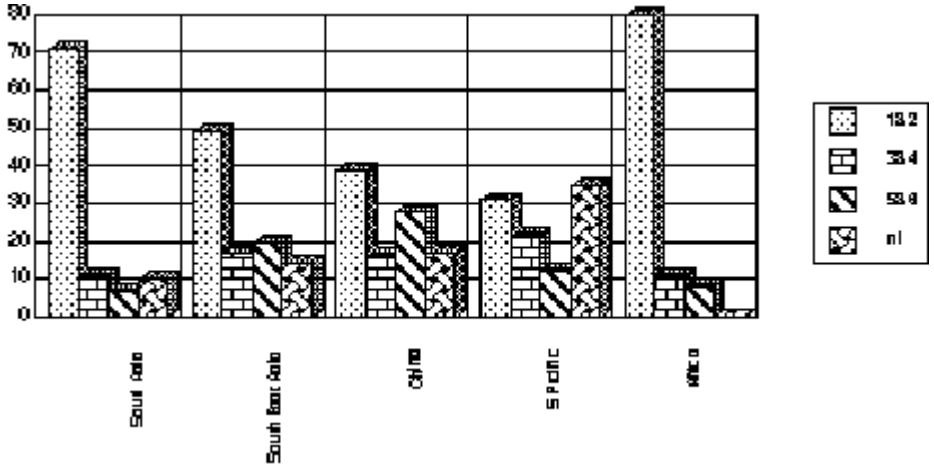

Figure 5. Share of funding by major priority groups—all ACIAR programs 1982–95 (%).

Table 3. Total ACIAR research funding by research priority groupings and regions—1982 to 1995 (%).

Priority Group	Southeast Asia			South Asia			China			Soutl
	1982–1995	1982–1988	1989–1995	1982–1995	1982–1988	1989–1995	1982–1995	1982–1988	1989–1995	1982–1
1	36	42	30	50	61	43	27	32	24	25
2	13	12	14	21	16	17	12	11	13	6
3	12	10	14	8	12	1	9	6	13	21
4	5	4	5	3	3	3	7	3	7	1
5	13	15	11	4	3	5	20	27	14	0
6	7	8	6	3	3	4	8	8	8	12
Not Included	14	8	20	10	0	27	17	12	21	35

In regions such as Africa and South Asia a major share of funding has been on projects likely to have a final impact on high-priority commodities. In Africa this is over 80% of funding and in South Asia over 70%. It is important to remember that in many projects the research results in an impact on more than one commodity. Sometimes these are both high- and lower-priority commodities. In addition, if the research is applicable to several commodities, then the relative priority of the projects is closer to a summation of the set of commodities rather than an average of them. In several regions research has focused on commodities that are not in the set of 45 so far included in the research-evaluation analysis. Many of these commodities are in the fruit and vegetable groups. In more recent years, emphasis has been especially placed on tropical fruits. Preliminary inspection of the data required to include these in the analysis suggests that several will probably be in the high-priority groups. The South Pacific and PNG have projects on root crops etc. which have not yet been included since they are specific to this region.

China is noticeable with a reasonably large share of funding having been in the lowest priority groups. This is at least partly explained by the obvious importance for Australia of wool, sheep and cattle research and therefore a strong interest by Australian groups for research in these areas. It is also important to remember that the sheer size of China means that the absolute benefits from research even on the lower-priority commodities are still likely to be high. These are likely to be higher than the benefits from research on high-priority commodities in some of the smaller regions.

In Table 3 the funding information has also been separated into two, seven-year periods each representing half the period of ACIAR's existence. Two trends are noticeable. First, there has been a trend to research related to several commodities not yet included in the research evaluation analysis. Most notable of these are tropical fruit and vegetables. Second, if the 'not included' commodity projects are ignored then there appears to have been a

trend from the lower- to higher-priority areas. This is clearer for some regions than for others. For example, in Africa, the South Pacific and South Asia there have been significant shifts. It is not possible to assign clear causal relationships, however, it is likely that the development of the **Information System** has made an important contribution to this trend.

4.3 Overview

This section has briefly described the nature of the aggregate-priority-setting component of ACIAR's **Information System** and indicated how this information has been institutionalised as part of the decision-making structure. There is still considerable scope to expand the range of information and also verify and validate much of the existing data used to generate it.

At this stage the estimates of welfare impacts have been developed allowing for many components illustrated in Figure 2 to vary for each commodity, country and region. These include, for example, spillovers, adoption levels, chances of innovative and adaptive research success and all economic parameters. However, several sets of parameters are still assumed to be standard, especially the research impact on costs (assumed to be a standard 5%) and the research and adoption lags. It is important to consider whether research in some regions and on some commodities is likely to consistently generate higher cost reductions (or equivalents) and/or lags than others. These types of issues can only be addressed by considering specific projects and the technologies generated by these. The information generated, if extensive enough, can cast important light on the broader notion of a research-production function. This area has received very little quantitative attention in the literature. As was indicated in Figure 2, the project-development and completed-project assessments have been included in the Information System to add this detail. The rest of the paper briefly discusses these assessments.

5. THE CURRENT STATUS OF ACIAR'S PROJECT ASSESSMENT ACTIVITIES

The initial emphasis of ACIAR's **Information System** was to provide information to support the determination of aggregate-priority-assessment directions. After the initial impact of this information it became clear that its effectiveness could be enhanced if it was complemented by project-level assessments of potential and actual research impacts. This is likely to be especially important for indicating the type of research-production function which exists for the types of collaborative research ACIAR funds. If all, or at least most, of ACIAR-funded projects are evaluated then a rich set of information will be available to enhance, the mostly subjectively estimated, parameters used in the aggregate-priority setting analysis.

This section briefly summarises these assessments which have been separated into completed-project assessments (CPA) and project-development assessments (PDA).

5.1 Completed-project assessments

In preparation for ACIAR's Sunset Review, it was decided to have commissioned a set of completed-project economic assessments. Initially, a set of 20 projects or 12 research areas was selected. The primary basis for choosing these projects was that the benefits from the projects had started to flow and that they were identifiable. Since this time several further projects have been evaluated. These included a Tuna Bait Fish Biology project which had also been the subject of an earlier project development assessment. However, the main addition to these completed-project evaluations has been the evaluation of four postharvest tropical fruit projects. The longer-term aim of evaluation work in ACIAR is to develop more of the integrated-assessment efforts, that is, from the initial project idea through to well after the research has been completed and had an impact on the production process. Table 4 summarises the results of the seventeen assessments completed to-date. A description of these studies is give in Menz (1991), Fearn (1991) and Lubulwa and Davis (1994) and will not be repeated here.

Table 4. Summary of economic assessments for selected completed ACIAR research project areas.

Economic Assessment Number	Project Number	Short Project Title	Program Area	NPV Estimate[1] Most Likely ($ million)	Internal Rate of Return (%)	Region	Co
1	8340	Salvinia Control	Crop Sciences	25.0	469	S Asia	Sr
3	8203/8601	Straw Utilisation by Livestock	Animal Sciences	117.0	100	S Asia	In
8	8307	Stored Grain Under Plastic	Post Harvest	9.2	38	S E Asia	Ph M
9	8309/8609/8311	Integrated Pesticide Use in Grain Storage	Post Harvest	24.3	43	S E Asia	Ph
5	8321	Tick-Borne Disease Control	Animal Sciences	30.7	68	S Asia	Sr
7	8334/8717	Newcastle Disease of Poultry	Animal Sciences	144.0	50	S E Asia	M In
12	8457/8848	Australian Trees for China	Forestry	115.0	37	China	Ch
10	8207	Grain Sorghum Book	Land and Water	9.2	38	S Asia	In
2	8343	Fruit Fly Control	Crop Sciences	176.2	260	S E Asia	M
6	8469/8839	Rapeseed Breeding	Crop Sciences	66.3	58	China	Ch
11	8332/8733	Giant Clam Mariculture	Fisheries	1.9	-	S Pacific	
South Pacific	Giant Clams 6						
4	8451/8929	Nematodes To Control Pests	Crop Sciences	97.0	80	China	Ch
		Sub-Total (Assessment 1-12)		*815.8*			
-	8543/9003	Tuna Bait Fish Biology	Fisheries	3.8	21	S Pacific	
South Pacific	Tuna 1						
	8355	Postharvest Technology for Banana	Postharvest	50.6	48	S E Asia	M
	8356	Chemical Control of Fruit Disease	Postharvest	36.6	41	S E Asia	M Th
	8844	Cool Storage, CA and Chemical Controls of Fruit	Postharvest	18.7	27	S E Asia	Th
	8319	Vacuum Infiltration of Fruit with Calcium	Postharvest	2.7	21	S E Asia	In

1. Values represented in 1990 dollars, with NPV estimated for 1990. All research costs, including expenditures by the collaborating and commissioned organisations are included.

ni not presently included in priority assessment commodity group.

At this stage, 30 (15%) of the 180 completed projects funded by ACIAR since 1982 have been evaluated in detail. While the initial 20 evaluations chose projects which were expected to have resulted in clear impacts, more recent evaluations have used unselected sets of projects. For example, all completed postharvest tropical

fruit projects were selected. Current activities include evaluation of all projects in Africa, the Philippines and the Forestry program. The aim is to eventually evaluate all projects and to consider a wider range of possible impacts of the research effort. As a preliminary step, a completed project assessment survey form has been developed. This facilitates collection of preliminary information which is used as the basis for a later detailed assessment. The types of information include:

- Scientific output
- Technologies developed
- The use or adoption of the technologies
- Capacity building in Australia and partner countries
- Human capital through formal and informal training
- Research facilities
- Intellectual property

At this stage there have not been enough assessments to provide a comprehensive set of information which can be used to look at research production function issues in a detailed way. However, it is possible to start to look at some preliminary trends using various groupings of the information in Table 4. The following are some examples:

(i) Impacts and Research Priority Groupings

Figure 6 illustrates the net present values (NPV) of the research project impacts arranged by the priority groupings in Table 2. Remembering that most of these projects were selected because it was felt that they had had an important impact, some interesting trends are found. The large majority of projects have had an impact on commodities in the two highest priority groups. One, a low benefit project was from group 6 and three focused on commodities that have not been analysed. There are, however, substantial ranges in the levels of benefits, with several yet well over NPV's of $100m. There are some lower pay-off research activities in the high priority groups, and this suggests variability in the research impacts.

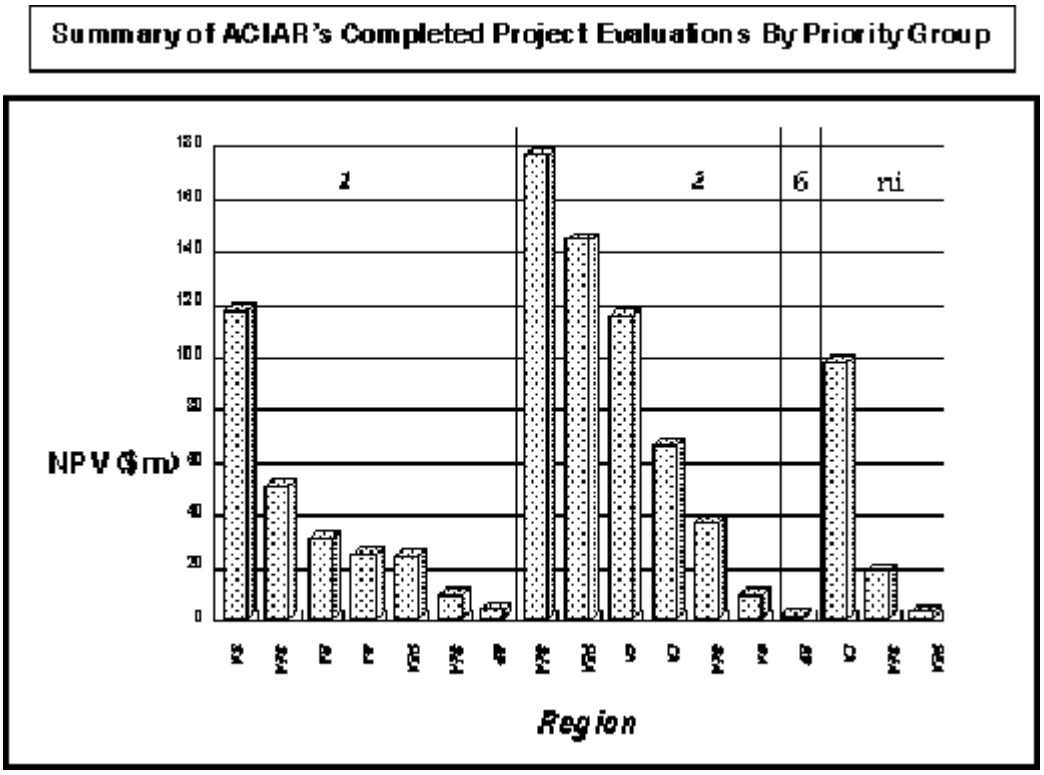

Figure 6. Summary of ACIAR's completed-project evaluations by priority group.

(ii) Impacts and Research Areas

It is sometimes suggested that some areas of research, for example, genetic enhancement have received considerable past research attention and therefore the stage of diminishing returns has perhaps been reached. Table 5 illustrates the evolving attempts to develop a classification system for research areas. Figure 7 illustrates the patterns which emerge when this classification of research areas is combined with the set of assessments. The sample of assessment is probably too small yet to draw any strong conclusions. However, the postharvest wastage type projects seem to have generated lower benefit projects. The others have some high and some low benefit estimates.

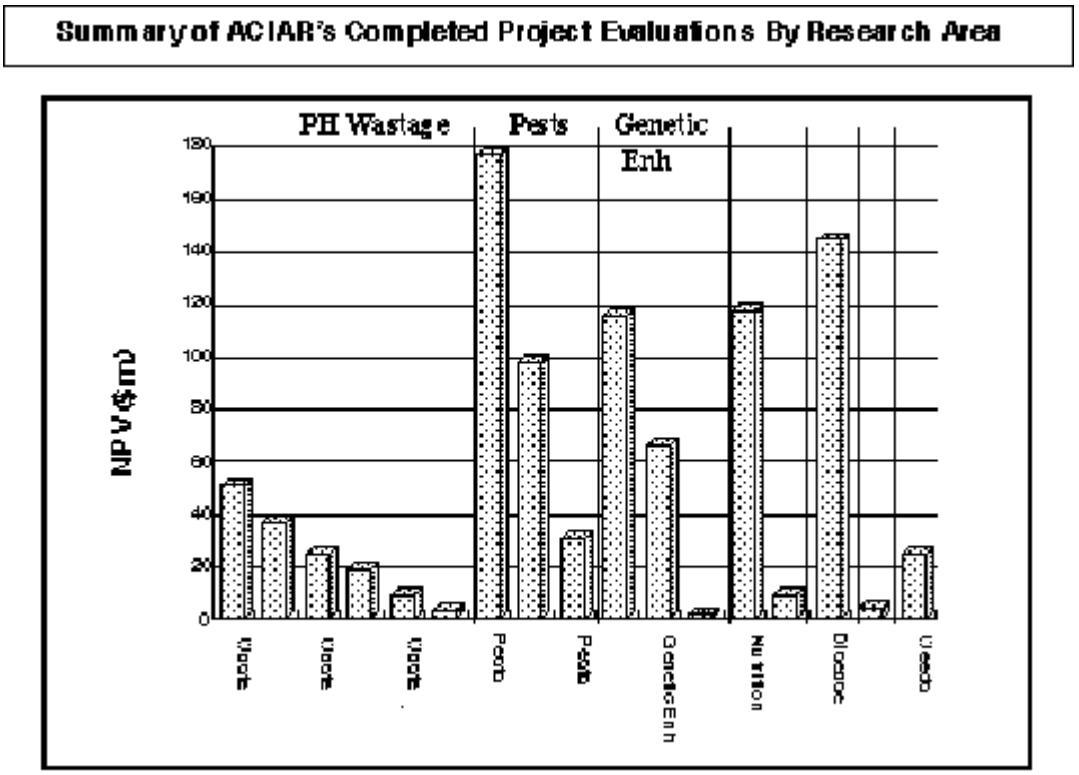

Figure 7. Summary of ACIAR's completed-project evaluations by research area.

Table 5. Possible classification of research areas and associated research evaluation methods.

Research Area	Type of Evaluation Model	Comments
Pre-Farm gate		
Genetic Enhancement	Single or multi-regional, multi-commodity supply shift model with a productivity increase.	Need to consider the importance of a shift in the minimum TAC associated
Disease	Single or multi-regional, multi-commodity supply shift model	Private/Public sector relevance can be important.
Pests/Weeds	Single or multi-regional, multi-commodity supply shift model	
Nutrition	Single or multi-regional, multi-commodity supply shift model	
Purchased Input Use	Single or multi-regional, multi-commodity supply shift model	
Natural Resource Use	Single or multi-regional, multi-commodity supply shift model	Inclusion of externalities important.
Farming, Forestry & Fisheries Systems Practices	Single or multi-regional, multi-commodity supply shift model	Multi-commodity models are likely to be especially important.
Post-Farmgate		

Wastage Reduction	Multi-regional vertical market model	Wastage reduction version can be useful simplification.
Processing Methods	Multi-regional vertical market, probably factor-biased, model	Private sector relevance since most research gains are appropriable.
Transport	Multi-regional vertical market model	Private sector relevance since most research gains are appropriable.
Farm & Off-Farm		
Product Quality	Multi-commodity, related in consumption, vertical market model	Care is required if a simple increase in price model is used.
New Product	Single or multi-regional, multi-commodity supply shift model subject to more error.	Quantity associated with minimum TAC required. Care is required as estimates are
Policy	Value of information with saving in dead weight loss model.	Model not well developed and few applications.
Price and Marketing	Value of information with saving in dead weight loss model.	Model not well developed and few Analysis applications.
Environmental/Natural Resource Management	Single or multi-regional, multi-commodity supply shift model	Other areas also involve environmental issues.
Human Health	Labour supply shift, demand for health services	Models not well developed or applied.
Institutional Analysis	Value of information with saving in dead weight loss model.	Model not well developed and few applications
Sustainability other research areas	Model required not clear. Usually a research context.	Concept still requires clearer definition in part of

(iii) Impacts and Mandate Regions

The aggregate-priority-assessment information suggested that there are large potential regional differences in welfare effects of research in ACIAR's five mandate regions. These were summarised by the regional relativities at the bottom of Table 2. Figure 8 illustrates the assessment information arranged by region. As predicted, China has had consistently high-benefit projects and the South Pacific low returns. The average welfare gains for the other two regions are around the expected relative order, however, the dispersion around this mean is quite large.

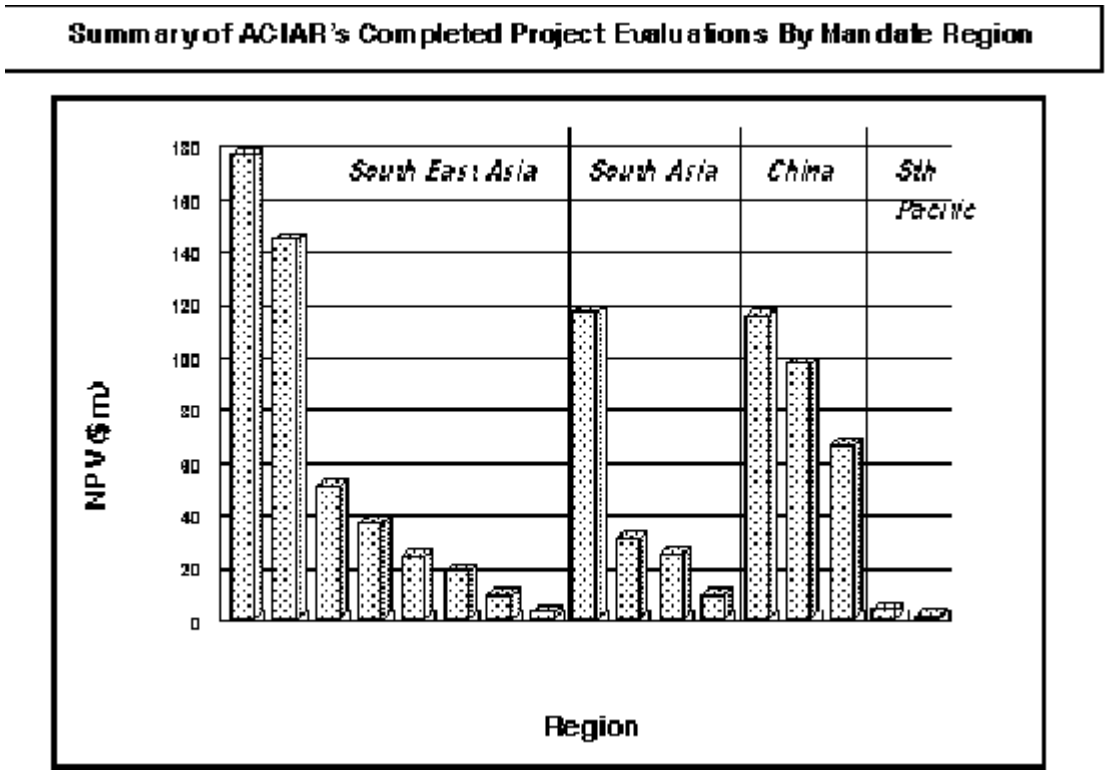

Figure 8. Summary of ACIAR's completed-project evaluations by mandate region.

In addition to evaluation of the bilateral research program ACIAR is supporting evaluations of the impact of the IARC's especially on the agricultural sector in Australia. The first of these is an update of the work by Brennan (1986) which assessed the impact of research by CIMMYT, the international wheat and maize breeding centre, on Australia's wheat production. This work provides important insights into the potential spillover effects of research.

5.2 Project-development assessments (PDAs)

Project-development assessments have been a more recent addition to ACIAR's **Information System**. They have been developed for a number of reasons. Important among these has been the need to compare projects from the diverse program areas within ACIAR. They are also used to demonstrate the types of conditions likely to result in high welfare gains from technically attractive projects that focus on — what appear on average — to be potentially lower research–benefit commodities (or outputs). In addition, these activities have been found to provide a useful interdisciplinary interaction which often results in clearer project specification and objectives. The latter has often been the most important contribution to this effort.

Table 6 summarises the 34 project-development assessments which have been included in recent ACIAR project proposals. If taken together with the completed-project assessments there are now 63 out of about 250 total projects which have been evaluated in some fashion, this is approximately 25%. These assessments have been developed in a variety of ways. Some have been incorporated in proposals by researchers preparing the documents. Others have been developed with extensive interaction between project researchers and economists at ACIAR. At this stage ACIAR requires project proposals to include a section on the expected impact of the

research but does not demand formal quantitative research-evaluation assessments. It does encourage project leaders to include rigorous assessments and believes it should support the scientists (including economists) to develop them. This approach probably differs from that of many research-funding bodies However, it is consistent with the significant interactive process implemented by ACIAR as part of its project-development mechanisms.

Table 6. Recent project development assessments of projects considered for funding by ACIAR.

Project Number	Description	Program Change	Region Level of Area	Country	Commodities		Priority Grouping
Internal Rate of Return	Unit Cost	in	Analysis		Primary	Other	Most I
9323	Dairy Policy in Indonesia	Economics	SEA	Indonesia	Milk		5
94%	ne	na	na	Internal (FI)			
9318	Improved Ruminant Production through	Animal Science	SEA	Indonesia	Beef/Buffalo	Sheep/Goat	3/4
71%	ne	na	10%	Internal (PI)			
	Efficient Use of Shrubs						
9109	Coconut Marketing and Policies in Philippines	Economics	SEA	Philippines	Coconut		1
70%	ne	na	na	Internal (PI)			
9404	Water Management in Vietnam	Land & Water	SEA	Vietnam	Rice	Maize, Vegetables	1/2
53%	28–64%	na	na	External			
9411	Prawn Health Management and Disease Control	Fisheries	SEA	Thailand	Prawns		2
52%	38–72%	na	na	External			
9132	Self-Medicated Blocks for Ruminants	Animal Science	SA/SEA/SP	Fiji, India, Malaysia	Milk	Sheep/Goat	1/3
50%	41–48%	na	na	Internal (PI)			
9105	Edible Coatings for Fruit and Vegetables	Post Harvest	SEA/China	Thailand, China	Durian	Lychee	ni
50%	45–89%	na	na	Internal (FI)			
9123/9049	Liver Fluke Vaccine and Control in Indonesia	Animal Science	SEA	Indonesia	Beef/Buffalo		3
41%	35–50%	15%	20%	Internal (FI)			
9045	Water Use in Fruit Production	Land & Water	China	China	Peaches		ni
40%	50–150%	37%	40%	Internal (PI)			
8923	Economic Pressures on Thailand Agricriculture	Economics	SEA	Thailand	Rice	Maize, Cassava	1
40%	34–77%	5%	na	External			
8940	Efficiency of Urea as Fertilizer	Plant Nutrition	China	China	Rice		1
40%	40–73%	1.7%	8%	Internal (MI)			
9040	Soybean Improvement in Thailand	Crop Science	SEA	Thailand	Soybeans		5
39%	26–54%	11.3%	20%	Internal (PI)			
9048	Improvement of Rainfed Rice	Crop Science	SEA	Thailand	Rice		1
39%	21–49%	9.5%	15%	Internal (PI)			
9120	Boron Fertiliser in Oilseeds	Land & Water	China	China	Rapeseed		ni
39%	28–82%	11%	25%	Internal (FI)			
9313	Non–Chemical Control of Fruit Disease	Postharvest	SEA	Thailand	Mango,	Avocardo, Longan, etc	2
38%	30-45%	na	na	Internal (FI)			
9406	Replacements for Methyl Bromide in Timber	Postharvest	SEA	Malaysia	Saw & Veneer Logs NC		1
34%	23–36%	na	na	Internal (FI)			
8911	Mineral Limiting Sheep Production	Animal Science	China	China	Wool	Sheepmeat	5
32%	14–40%	4.9%	10%	Internal (MI)			
9017	Control of Peanut Stripe Virus	Crop Science	SEA	Indonesia	Groundnuts		6
32%	ne	ne	ne	External			
8938	Clay Soils	Land & Water	SEA	Philippines	Pulses	Rice	5
31%	13–31%	20%	105%	Internal (FI)			
9003	Baitfish For Tuna in South Pacific	Fisheries	SP	Solomon Is, Kiribati, Fiji	Tuna		1
30%	14–56%	2.25%	0	Internal (FI)			
9009	Use of Mix of Grain Protectants	Post Harvest	SEA	Philippines, Malaysia	Rice	Maize, Groudnuts	1
30%	3–48%	ne	ne	External			
9039	Philippines Livestock Sector	Economics	SEA	Philippines	Beef/buffalo		3
30%	20–40%	na	na	Internal (PI)			
9316	Trees for Salt Affected Land	Forestry	SA/SEA	Pakistan, Thailand	Fuelwood NC		1
26%	18–37%	na	na	Internal (PI)			
8845	Grain Storage in Plastic Enclosures	Post Harvest	SEA	Philippines	Rice	Maize	1
25%	–6–30%	ne	ne	External			
9303	Forages for Red Soils in China	Land & Water	China	China	Milk		4
25%	20–50%	na	na	Internal (FI)			
9317	Plant Tissue Culture in Tea	Crop Science	SEA	Indonesia	Tea		ni
23%	19–23%	30%	300%	Internal (FI)			
9407	Pineapple Quality Improvement	Postharvest	SEA	Malaysia	Pineapple		ni
22%	18–25%	na	na	Internal (FI)			
9020	Economics of Native Forests Vanuatu	Economics	SP	Vanuatu	Saw&Veneer Logs NC	Tourism	1/?
20%	19–28%	1%	na	External			
9107	Papaya Improvement in the Philippines	Crop Science	SEA	Philippines	Papaya	Fruit/veges	ni
20%	15–40%	5.5%	360%	Internal (FI)			
9131	Pearl Oyster Resource Development	Fisheries	SP	Cook Is, Kiribati	Pearls		ni
18%	0–26%	34–37%	133%	Internal (FI)			
9008	Multipurpose Grain Drying Systems	Post Harvest	SEA	Philippines	Maize	Rice	2/1
17%	14–20%	8%	0	External			
9206	Genetic ID & Stock Improvement of Tilapia	Fisheries	SEA/SP	Malaysia, Fiji	Tilapia		3
11%	4–25%	13%/22%	20%	Internal (FI)			

8913	Small Ruminants in South Pacific	Animal Science	SP	Fiji	Sheep/Goat Meat		5
11%	11%	12/25%	110%	Internal (PI)			
9302	Forage Production from Saline and Sodic Soils	Land & Water	SA	Pakistan	Sheep/Goat Meat	Beef/Buffalo	2/3
$12m NPV	$2–20m NPV	na	na	External			

Notes:

ni not presently included in priority assessment commodity group
ne not directly estimated
na not applicable
Internal (MI)—Internal ACIAR assessment, minimal interaction
Internal (PI)—Internal ACIAR assessment, partial interaction
Internal (FI)—Internal ACIAR assessment, full interaction
External—External assessment by project proponents
Shaded Projects are in the Postharvest Program area

One aim is to develop a set of spreadsheets with guidelines for project evaluations. However, the experience to this stage has indicated that this is not going to be a simple and quick task. There is significant variability in the types of impacts associated with research efforts. In most situations experienced so far, many impacts have characteristics which required some variation in the research-evaluation methodology used in the assessment. If these adaptations are not included in the assessment, the benefit estimates are certain to be biased. More importantly, it is usually the subtlety of this variation that is important to the focus of the project. If it is not incorporated in the assessment, then the important benefit — improving the project design for the evaluation work — is likely to be lost. As a larger number of assessments are completed, the hope is that these standardised procedures will evolve.

Given the *ex ante* nature of these assessments caution is required in using the impact results to draw strong conclusions about research efforts. At ACIAR the PDAs are seen as a good support tool for focusing projects and also an integrated part of the evaluation process. The paper by Davis and Lubulwa (1995) and earlier, similar papers discuss in detail the framework being adopted for integration of the *ex ante* and *ex post* efforts. Once fully implemented this integration will provide a balance to the moral hazards associated with having scientists predict the likely impact of their research. More importantly, this integrated process should mean that scientists collect the information in a form that facilitates quick and effective evaluation. Detailed and early interaction between scientists and economists is essential for this to occur. Despite these words of caution, the information generated can provide some useful support to decision-making discussions and project development.

There have not been sufficient of these assessments undertaken to draw any firm trends from the information included in Table 6. Figure 9 highlights this information and the fact that there are both high and low return projects in each priority group (note in these figures the internal rate of return (IRR) is used rather than the NPV in previous figures).[3,4] However, as seen in Table 6, the potentially low-priority commodities (groups 5 and 6) do seem to require substantial impacts on the commodity output to generate rates of return — that is rates of return in the range of those found in past evaluations of agricultural research and those from research on the higher priority groups. Care is required at this stage because assessment procedures have not necessarily been comparable between assessments. The full-interaction-internal assessments (there have now been twelve of these) have, in most cases, been fruitful. Both scientists and economists have usually agreed that a better understanding of the issues have resulted. In addition the project proposals have usually become much clearer as a result of the interaction.

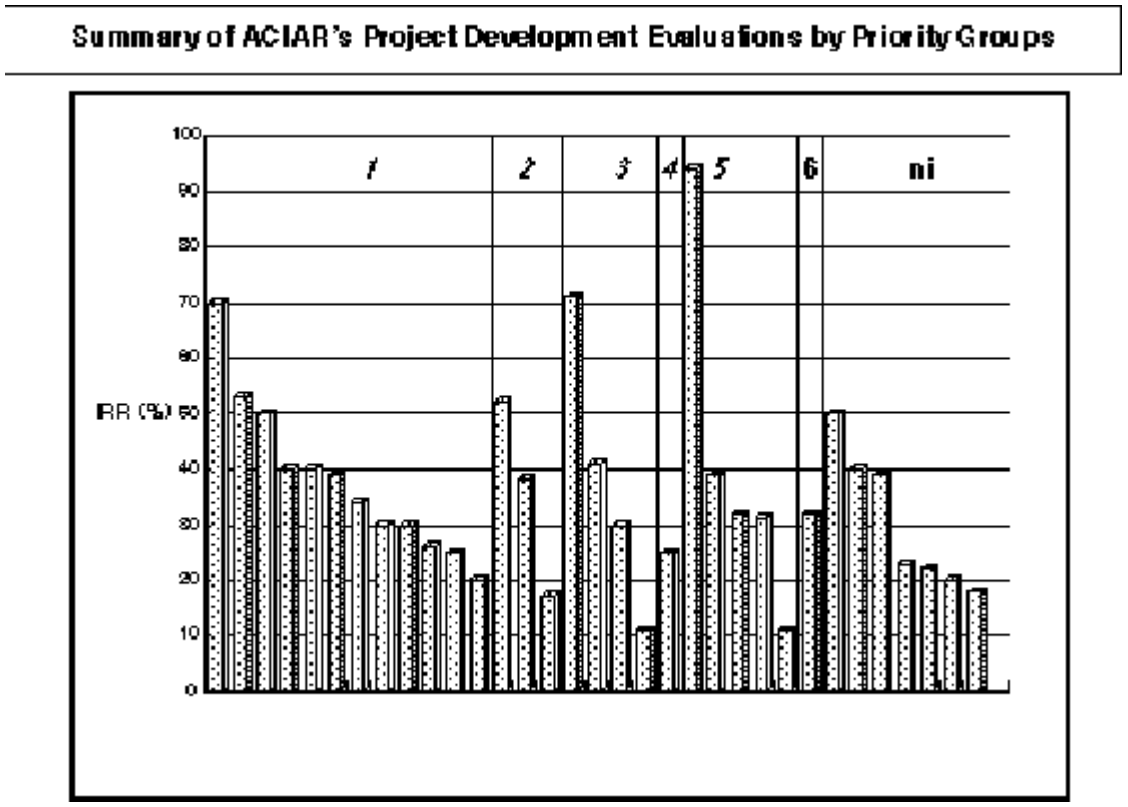

Figure 9. Summary of ACIAR's project-development evaluations by priority groups.

Figure 10 illustrates the same information grouped by the different research programs in ACIAR. Based on the current set of evaluations, it is not possible to detect any clear trends in returns by program area. There appear to be high and low return projects in all programs.

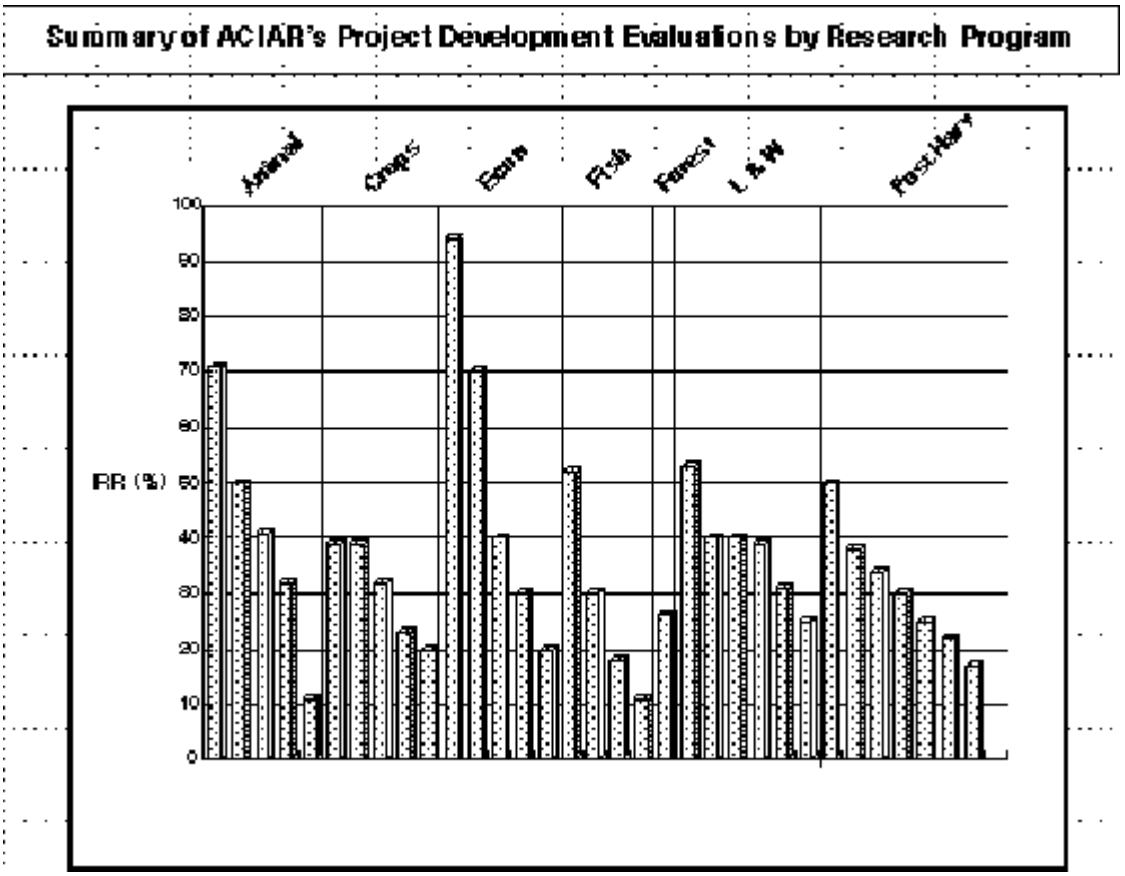

Figure 10. Summary of ACIAR's project-development evaluations by research program.

5.3 Overview

This section has provided a brief summary of how project level research evaluation has been integrated into ACIAR's **Information System** It has also illustrated some of the range of ways the information generated can be presented to decision-makers to potentially support decision-making activities.

Several points can be highlighted from this experience:

(i) It is important to recognise that the information from this type of system, and especially the economic assessments component, can only be used to support decision-making and not to make decisions for, or replace, the judgements of decision-makers. This is a crucial point to highlight and recognise. Often both technical scientists and economists fail to appreciate the importance of this point.

(ii) At the project/program level, it is the interaction process between the technical and economic scientists which is as important, if not more important than, the assessment numbers generated. This interaction results in a clearer project specification and a better understanding of the potential research impact by both sides. For ACIAR, this improved clarity has usually resulted in a better understanding by others involved in the project review process, especially, the In-House-Review process.

(iii) At this stage an effective, single, standardised, project-evaluation method has not evolved. The range of different types of research and potential forms of impacts has meant that development of this will be a complex and long-term task. Meanwhile, direct support from ACIAR staff for project scientists is seen as the important option.

6. SUMMARY AND FUTURE DIRECTIONS

ACIAR has been evolving an extensive systematic **Information System** to support research resource allocation decision-making for about eight years. The original emphasis of the system was on aggregate priority setting. This was especially driven by the wide ranging scope of ACIAR's mandate. It was to fund research in five diverse geographical regions of the world and potentially in three of the important primary industry sectors, agriculture, forestry and fisheries. Developing a consistent perspective for all of these combinations is a complex task.

More recently, project-level evaluations have been found to be an important complement to the original efforts. This project level evaluation activity has three important dimensions. First, it facilitates effective interaction between scientists and evaluation economists which has been found to be important in enhancing project focus and development. Second, it has scope to provide additional systematic overviews of different aspects of the research effort, for example, whether certain research areas, regions or programs are reaching diminishing returns. Third, the information generated can in the longer term strengthen the aggregate-priority-setting information base by providing validation of many of the subjective inputs to the analysis.

The importance of adopting a consistent research-evaluation-based methodology for all levels of the **Information System** cannot be overemphasised. Without this it would not be possible to capture the longer-term benefits of integrating aggregate and project-level evaluations. The existence of an extensive methodology based on welfare economics theory has been important. A consistent theoretical basis for expansion of the scope of evaluations is crucial. Many of the issues involved in research evaluation are far more complex than is appreciated by those who view it as standard "back of the envelope" benefit–cost analysis. Once this complexity is recognised, the need for a strong theoretical base is more readily appreciated.

It is always difficult to determine precisely the response to information. This paper has highlighted various areas where the **Information System** has supported decision-making at various levels in ACIAR. Indications are that the information has had a constructive impact. It is important to remember the important points raised in the discussion of Figure 1. Information systems cannot replace decision-makers only enhance the quality of the decisions which they make. If this important point is not recognised then the chance of effective adoption of these types of systems is reduced. ACIAR's experience has confirmed this.
At a project level an effective standardised evaluation spreadsheet format has not yet evolved. This has been one important objective. It has been illusive because of the diversity of research issues addressed and variability in potential types of impacts. It is still hoped that an effective set of guidelines and spreadsheets will eventually evolve. This will take longer than first expected and will require effective interaction between many groups.

Future directions for the efforts of the EEU at ACIAR include:

- Consolidation of interaction with others undertaking research evaluation work. Especially important for ACIAR are links with economists in partner countries and other international research groups. Formal

links have been developed with groups in the Philippines and at international research groups, such as ICRISAT, others are being developed. Links with Australian groups have existed but will be strengthened.

- Methodology development has been an important focus of this work at ACIAR. This will continue and is currently focusing on areas such as measuring environmental and health effects of research and the impact of social science research.

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