Integration Of Research Evaluation Analysis Into Research Institution Decision-Making: An Overview of Progress at ACIAR

Jeff Davis and A. S. Godfrey Lubulwa
Economic Evaluation Unit,
Australian Centre for International Agricultural Research
GPO Box 1571, Canberra, ACT 2601, Australia.

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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 replicateable 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 aimed at developing a quantitative systematic set of information which could be used to support priority setting and, therefore, its research resource allocation decisions. An important requirement was that the information and suggested priorities be replicateable 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 an important requirement.

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 institutionalise the ACIAR component of this work an Economic Evaluation Unit (EEU) was created in by ACIAR 1992. This Unit was given responsibility for maintaining and enhancing the information system originally developed and to ensure that it continued to be adapted to suit 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, Davis et al (1987) and Davis and Ryan (forthcoming). In addition Alston et al (1994) provide a very detailed review of the current status of research evaluation methodology and how this might be used to support priority setting. There are a large number of papers referenced in these primary summaries which 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 direction are provided.

2. BACKGROUND TO ACIAR'S INFORMATION SYSTEM DEVELOPMENT

The process of research resource allocation in the public sector has increased in complexity during the last few decades. As this has occurred, 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. Accountability for public sector expenditure in general is increasingly being demanded.

In this atmosphere 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 more systematically-based information. Sometimes there is an inclination to infer that such information can substitute for the final judgement of senior management. While systematically-based information can often strengthen decision-making, especially by providing continuity in the basis for decisions even when senior management changes, 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

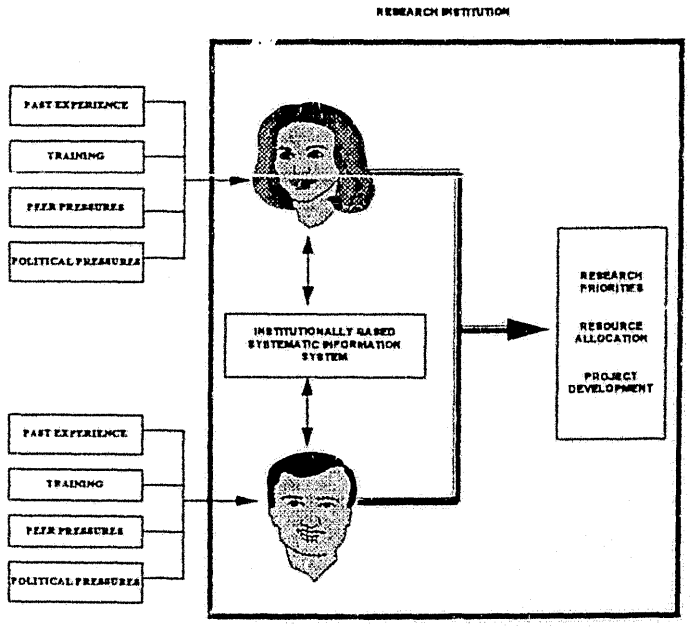
basic summary information itself, which has the main impact on decision-making and improved judgements. The more complex the decision-making environment becomes the more likely this will be the case.

Figure 1 illustrates a common research institution decision-making situation. 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 which is usually necessary to provide the interchanges which 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 regarding 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.

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 the decisions which are 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 determine research priorities. These were then scored and weighted to give rankings of different possibilities. While the activity had several positive impacts, for example, it encouraged staff to discuss issue more broadly, personal biases often dominated but were not always obvious. 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]

Figure 1: The Complementarity Between Institutionally Based Information Systems and Other Information Sources Which Support Decision-Making



1 Ryan and Davis (forthcoming, a) provide a more detailed account of the evolution of the information system.

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 which 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 regarding research evaluation methods. Drawing from and enhancing the existing extensive set of literature was regarded as an important component.
- Any analysis must be systematically based and be readily replicated.

Achievement of these requirements was soon found to depend on development of 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 was used as the basis for ACIAR's information system.

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 research projects which, if successful, generate knowledge which 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 could also be applicable (and spillover) to other commodities or outputs.

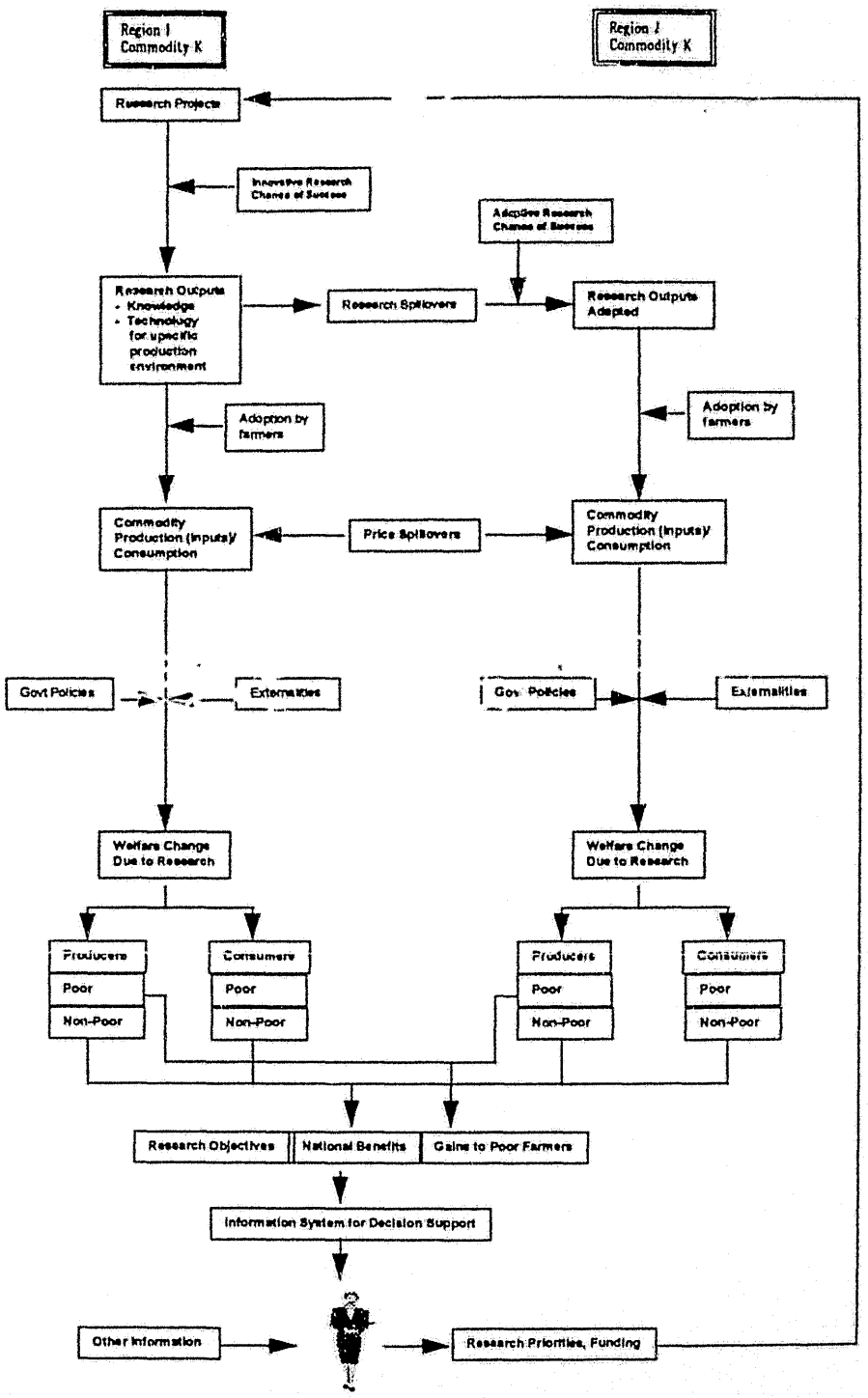
Once usable technologies are generated they can be adopted by farmers or other producers and the research then begins to have an impact on the production and consumption of the products. Sometimes this can first be through an impact on one or more of the many renewable or non-renewable resources or inputs 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 research objectives are being met and how well. Estimates of these welfare impacts are indicators of how well the research decisions will 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 is two databases. These are:

Figure 2: A Simple Multi-Regional (Country) Model of the Research Process and Decision Making



(i) A Project Management Database

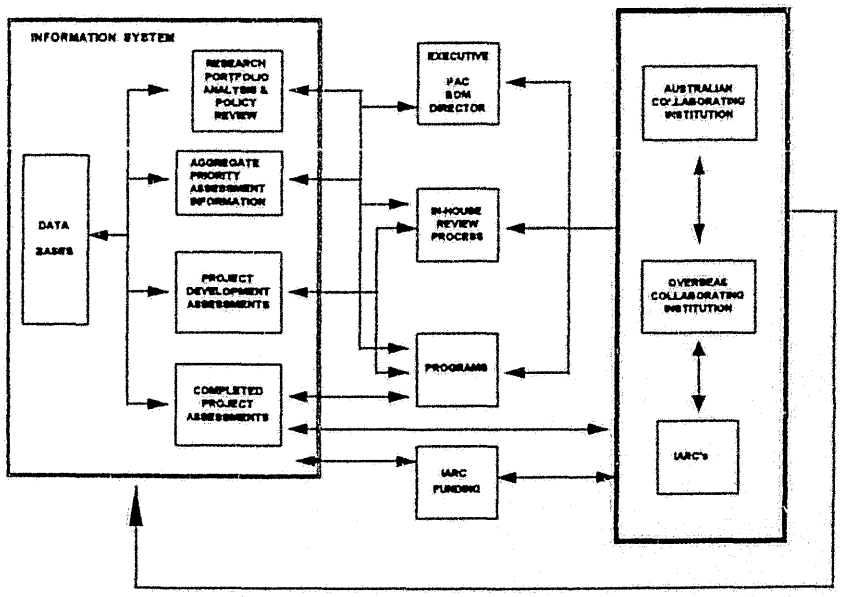
The initial project management database was called the **Project Management Information System** (PMIS). It is a complete record of the information set for each Project funded by ACIAR since its inception. The information ranges from the detailed budgets to the publications and the country/commodity 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 under going a major review. The system is to be renamed PISA (Project Information System 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 especially 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 and validation they do represent a comprehensive set of data.

Figure 3: An Illustration of the Information System Interface with Decision-Making Groups for ACIAR



2 Davis (1991) provides a detailed discussion of the model used to estimate the spillover effects from research.

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 percent reduction in the cost of producing a unit (usually a metric 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. Inclusion of all countries is necessary to facilitate incorporation of any world price effects which might flow from the technology spillovers to developed countries. 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 usually only contains a small subset of all possible production environments.

The information and analysis is currently available for 45 different commodities. These include 27 from the agricultural sector, 8 for 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 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 to provide 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 2 summarises, in simple terms, the components of the Information System. The two databases have been discussed above. These are used as a basis for producing summary information to provide support to 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 still ongoing, for example, the ACIAR Policy

Advisory Council (PAC) meeting in December 1994 discussed this issue again. Currently maximisation of the mandate regional welfare gains 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 percent unit cost reduction for each commodity. In this case the regions illustrated are the five mandated for ACIAR and Australia, information for all countries and regions of the world are available from the analysis and are in the database.

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 priority setting. Instead an alternative format has been developed. This format uses, what have been called, break-even relativities. See Table 2a & b. These relativities are calculated by ordering the commodities 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 percent cost reduction from prawns/shrimp research is expected to generate a welfare gain in present value terms of $US14m. (A research and adoption lag of 11 years and a 30 year planning period is assumed and a real discount rate of 12 percent used). On the other hand, the same 5 percent unit cost reduction from rice research is expected to provide regional welfare gains to South Asia of $US421m. 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).

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, China by each of the highest gains in 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. Six priority groups have proven useful and the following relativity ranges have been found to be 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 highest expected gain commodities. Rather it is used more as a screening device. That is, research focusing on commodities which are in the 4, 5, and 6 priority groups are flagged as requiring closer scrutiny regarding the likely level of welfare gains which may result. The trend is toward 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 South East Asia. Included are the cut-off points for each of the six priority groups.

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		South East Asia Regional Benefits		China Regional Benefits		South Pacific Regional Benefits		Africa Regional Benefits		Australian Benefits	
Commodity Ranking	Regional Benefits	Commodity Ranking	Regional Benefits	Commodity Ranking	Regional Benefits	Commodity Ranking	Regional Benefits	Commodity Ranking	Regional Benefits	Commodity Ranking	Regional Benefits
Rice	421	Rice	200	Rice	1157	Tunas,bonitos et	6	Fuelwood (NC)	65	Wheat	63
Milk	269	Saw&Ven.Logs (	181	Pigmeat	594	Fuelwood (NC)	6	Saw&Ven.Logs	11	Wool	48
Fuelwood (NC)	204	Fuelwood (NC)	167	Sweet Potato	311	Saw&Ven.Logs (	4	Milk	8	Beef&Buffal	41
Wheat	131	Palm Oil/Kernel	98	Maize	277	Sugar	2	Cocoa	8	Milk	37
Pulses All	115	Rubber	64	Potatoes	237	Banana/Plantain	1	Beef&Buffalo	7	Sugar	36
Potatoes	63	Sugar	23	Wheat	233	Palm Oil/Kernel	1	Charcoal	7	Sheep & Go	30
Cotton	52	Coconut	22	Cotton	130	Coffee	1	Palm Oil/Kernel	7	Prawns/shri	22
Sugar	50	Banana/Plantain	20	Eggs (poultry)	102	Cocoa	1	Cassava	7	Lobsters	12
Saw&Ven.Logs (	38	Cassava	16	Soybean	60	Demersal/other	0	Sheep & Goat	6	Pigmeat	10
Sorghum	37	Pigmeat	14	Pulses All	59	Pigmeat	0	Oth.Ind.Rdwoo	4	Saw&Ven.L	10
Groundnut	35	Demersal/other	13	Fuelwood (NC)	59	Coconut	0	Banana/Plantai	3	Pulses All	7
Millet	24	Prawns/shrimps	13	Saw&Ven.Logs (	45	Pulpwood	0	Rice	3	Rice	7
Sheep & Goat M	24	Maize	12	Sugar	44	Saw&Ven.Logs (	0	Eggs (poultry)	3	Potatoes	6
Banana/Plantain	20	Eggs (poultry)	11	Fuelwood (Con.)	40	Sweet Potato	0	Tilapias	3	Saw&Ven.L	6
Maize	18	Coffee	11	Poultry Meat	37	Milk	0	Sugar	3	Cotton	6
Beef&Buffalo	16	Poultry Meat	10	Sheep & Goat M	30	Prawns/shrimps	0	Millet	3	Poultry Mea	6
Eggs (poultry)	15	Beef&Buffalo	8	Groundnut	29	Rice	0	Maize	2	Pulpwood	6
Prawns/shrimps	14	Tilapias	7	Saw&Ven.Logs (	28	Tilapias	0	Poultry Meat	2	Eggs (poultr	5
Coconut	13	Cocoa	7	Milk	25	Beef&Buffalo	0	Pulpwood	1	Sorghum	4
Demersal/other	8	Oth.Ind.Rdwood	6	Oth.Ind.Rdwood	19	Cassava	0	Fuelwood (Con.	1	Oranges & T	4
Oranges & Tang	8	Tunas,bonitos et	4	Prawns/shrimps	17	Charcoal	0	Groundnut	1	Fuelwood (N	3
Herrings & other	7	Mackerals & oth	3	Millet	14	Cotton	0	Herrings & othe	1	Tunas,bonit	1
Cassava	6	Charcoal	3	Sorghum	13	Eggs (poultry)	0	Cotton	1	Oth.Ind.Rdw	1
Fuelwood (Con.)	6	Sheep & Goat M	3	Wool	12	Fuelwood (Con.)	0	Saw&Ven.Logs	1	Banana/Plan	1
Saw&Ven.Logs (	6	Herrings & other	3	Oranges & Tang	9	Groundnut	0	Potatoes	1	Maize	1
Soybean	6	Soybean	2	Beef&Buffalo	8	Herrings & other	0	Pigmeat	1	Soybean	1
Charcoal	6	Milk	2	Pitprops	7	Lobsters	0	Demersal/other	1	Fuelwood (C	1
Oth.Ind.Rdwood	4	Pulpwood	2	Mackerals & oth	5	Mackerals & oth	0	Pulses All	1	Demersal/ot	1
Wool	3	Sweet Potato	2	Demersal/other	5	Maize	0	Sorghum	1	Groundnut	0
Poultry Meat	3	Pulses All	1	Cassava	4	Millet	0	Wheat	0	Millet	0
Coffee	3	Saw&Ven.Logs (	1	Rubber	4	Oranges & Tang	0	Coffee	0	Pitprops	0
Tilapias	3	Groundnut	1	Palm Oil/Kernel	4	Oth.Ind.Rdwood	0	Soybean	0	Mackerals &	0
Pigmeat	3	Cotton	1	Pulpwood	3	Pitprops	0	Wool	0	Cassava	0
Rubber	2	Oranges & Tang	1	Tunas,bonitos et	3	Potatoes	0	Coconut	0	Palm Oil/Ker	0
Pitprops	1	Lobsters	1	Banana/Plantain	1	Poultry Meat	0	Sweet Potato	0	Cocoa	0
Pulpwood	1	Potatoes	0	Coffee	0	Pulses All	0	Tunas,bonitos	0	Coconut	0
Sweet Potato	1	Sorghum	0	Herrings & other	0	Rubber	0	Lobsters	0	Coffee	0
Mackerals & oth	1	Wheat	0	Charcoal	0	Sheep & Goat M	0	Mackerals & ot	0	Sweet Potat	0
Tunas,bonitos et	1	Millet	0	Cocoa	0	Sorghum	0	Oranges & Tan	0	Rubber	0
Lobsters	0	Fuelwood (Con.)	0	Coconut	0	Soybean	0	Pitprops	0	Charcoal	0
Cocoa	0	Pitprops	0	Lobsters	0	Wheat	0	Prawns/shrimps	0	Tilapias	0
Palm Oil/Kernel	0	Wool	0	Tilapias	0	Wool	0	Rubber	0	Herrings & o	0

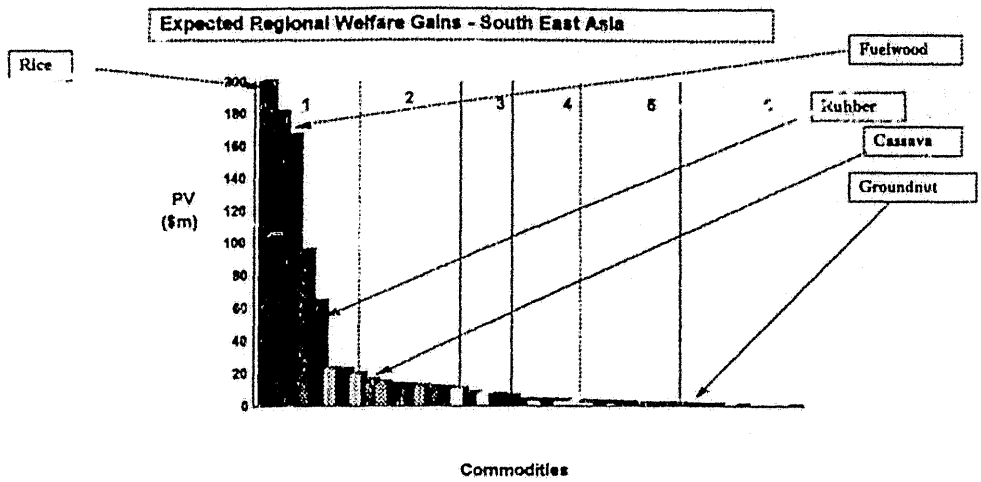
Table 2a: Regional commodity research priority groupings for a regional benefits objective.

South Asia Regional Benefits			South East Asia Regional Benefits			China Regional Benefits			South Pacific Regional Benefits		
Priority Group	Commodity Ranking	Break-even Relativities	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		Tunas,bonitos etc	1
	Milk	2		Saw&Ven Logs (NC)	1		Pigmeat	2		Fuelwood (NC)	1
	Fuelwood (NC)	2		Fuelwood (NC)	1		Sweet Potato	4		Saw&Ven Logs (NC)	1
1	Wheat	3	1	Palm Oil/Kernel	2		Maize	4	1	Sugar	3
	Pulses All	4		Rubber	3		Potatoes	5		Banana/Plantain	4
	Potatoes	7		Sugar	9		Wheat	5		Palm Oil/Kernel	6
	Cotton	8		Coconut	9		Cotton	9		Coffee	7
	Sugar	8		Banana/Plantain	10						
							Eggs (poultry)	11		Cocoa	12
	Saw&Ven Logs (NC)	11		Cassava	12	2	Soybean	19	2	Demersal/other pelagic	20
	Sorghum	11		Pigmeat	14		Pulses All	20		Pigmeat	20
2	Groundnut	12		Demersal/other pelagic	15		Fuelwood (NC)	20			
	Millet	17	2	Prawns/shrimps	16					Coconut	30
	Sheep & Goat Meat	18		Maize	16		Saw&Ven Logs (C)	26	3	Pulpwood	30
				Eggs (poultry)	18		Sugar	26		Saw&Ven Logs (C)	30
	Banana/Plantain	21		Coffee	18	3	Fuelwood (Con.)	29		Sweet Potato	30
	Maize	23		Poultry Meat	19		Poultry Meat	31			
3	Beef&Buffalo	27					Sheep & Goat Meat	39		Milk	59
	Eggs (poultry)	27		Beef&Buffalo	25		Groundnut	40	4	Prawns/shrimps	59
	Prawns/shrimps	30	3	Tilapias	27					Rice	59
	Coconut	33		Cocoa	28		Saw&Ven Logs (NC)	41		Tilapias	59
				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		Beef & Buffalo	0
	Herrings & others	64		Mackerels & others	61					Cassava	0
4	Cassava	67	4	Charcoal	63		Millet	81		Charcoal	0
	Fuelwood (Con.)	67		Sheep & Goat Meat	65		Sorghum	89		Cotton	0
	Saw&Ven Logs (C)	67		Herrings & others	67	5	Wool	97		Eggs (poultry)	0
	Soybean	75					Oranges & Tangerines	129		Fuelwood (Con.)	0
	Charcoal	77		Soybean	83		Beef&Buffalo	139		Groundnut	0
				Milk	95					Herrings & others	0
	Oth Ind Rdwood	98	5	Pulpwood	111		Pitprops	163		Lobsters	0
	Wool	136		Sweet Potato	133		Mackerels & others	214		Mackerels & others	0
5	Poultry Meat	140		Pulses All	143		Demersal/other pelagic	227		Maize	0
	Coffee	145		Saw&Ven Logs (C)	143		Cassava	276	6	Millet	0
	Tilapias	156					Rubber	276		Oranges & Tangerines	0
				Groundnut	167		Palm Oil/Kernel	289		Oth Ind Rdwood	0
	Pigmeat	162		Cotton	200		Pulpwood	413		Pitprops	0
	Rubber	183		Oranges & Tangerines	222	6	Tunas,bonitos etc	463		Potatoes	0
	Pitprops	301		Lobsters	286		Banana/Plantain	1286		Poultry Meat	0
	Pulpwood	324		Potatoes	500		Coffee	5786		Pulses All	0
6	Sweet Potato	351	6	Sorghum	500		Herrings & others	5786		Rubber	0
	Mackerels & others	421		Wheat	667		Charcoal	0		Sheep & Goat Meat	0
	Tunas,bonitos etc	842		Millet	2000		Cocoa	0		Sorghum	0
	Lobsters	2105		Fuelwood (Con.)	0		Coconut	0		Soybean	0
	Cocoa	4210		Pitprops	0		Lobsters	0		Wheat	0
	Palm Oil/Kernel	0		Wool	0		Tilapias	0		Wool	0
Regional Relativities		2.7			5.8			1			196.1

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

	Africa Regional Benefits			W Asia/ N Africa Regional Benefits			Latin America Regional Benefits			Australian Benefits	
Priority Group	Commodity Ranking	Break-even Relativities	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		Wheat	1
	Saw&Ven Logs (NC)	6		Milk	2		Fuelwood (NC)	1		Wool	1
	Milk	8		Beef&Buffalo	3		Coffee	1		Beef&Buffalo	2
1	Cocoa	9		Sheep & Goat Meat	3		Milk	2		Milk	2
	Beef&Buffalo	9		Oranges & Tangerines	3		Beef&Buffalo	2		Sugar	2
	Charcoal	9		Cotton	4		Sugar	2		Sheep & Goat Meat	2
	Palm Oil/Kernel	9		Rice	5		Pigmeat	2	1	Prawns/shrimps	3
	Cassava	10	1	Saw&Ven Logs (C)	5		Saw&Ven Logs (C)	2		Lobsters	5
				Pulses All	5		Herrings & others	2		Pigmeat	6
2	Sheep & Goat Meat	11		Sugar	6		Oranges & Tangerines	3		Saw&Ven Logs (NC)	7
	Oth Ind.Rdwood	17		Fuelwood (Con.)	7		Saw&Ven Logs (NC)	3		Pulses All	9
				Herrings & others	7	1	Demersal/other pelagic	3		Rice	9
	Banana/Plantain	22		Fuelwood (NC)	7		Rice	4		Potatoes	10
	Rice	22		Eggs (poultry)	9		Maize	4		Saw&Ven Logs (C)	10
	Eggs (poultry)	22		Poultry Meat	9		Poultry Meat	5			
3	Tilapias	22		Potatoes	10		Eggs (poultry)	5		Cotton	11
	Sugar	25					Cocoa	6		Poultry Meat	11
	Millet	26	2	Maize	11		Prawns/shrimps	6	2	Pulpwood	11
	Maize	27		Wool	14		Pulpwood	6		Eggs (poultry)	13
	Poultry Meat	28					Wheat	7		Sorghum	16
			3	Saw&Ven Logs (NC)	22		Cassava	9		Oranges & Tangerines	17
	Pulpwood	50		Oth.Ind.Rdwood	34		Fuelwood (Con.)	9			
	Fuelwood (Con.)	54					Banana/Plantain	9	3	Fuelwood (NC)	23
4	Groundnut	54		Mackerels & others	46						
	Herrings & others	59		Demersal/other pelagic	58		Sheep & Goat Meat	11		Tunas,bonitos etc	45
	Cotton	65	4	Pitprops	71		Charcoal	11		Oth.Ind.Rdwood	53
	Saw&Ven Logs (C)	65		Charcoal	80	4	Cotton	14	4	Banana/Plantain	63
				Pulpwood	80		Pulses All	16		Maize	79
	Potatoes	81		Soybean	80		Wool	17		Soybean	79
	Pigmeat	92									
5	Demersal/other pelagic	129	5	Millet	92		Potatoes	22	5	Fuelwood (Con.)	90
	Pulses All	129		Banana/Plantain	107	3	Sorghum	25		Demersal/other pelagic	126
	Sorghum	129					Oth.Ind.Rdwood	26			
				Prawns/shrimps	214		Rubber	36		Groundnut	210
	Wheat	161		Tunas,bonitos etc	214					Mackerels & others	631
	Coffee	215		Groundnut	641		Palm Oil/Kernel	44		Millet	631
	Soybean	215		Pigmeat	641		Tilapias	53		Pitprops	631
	Wool	215		Cassava	0	4	Lobsters	56		Cassava	0
	Coconut	323		Cocoa	0		Mackerels & others	56		Charcoal	0
	Sweet Potato	323	6	Coconut	0		Tunas,bonitos etc	72	6	Cocoa	0
6	Tunas,bonitos etc	323		Coffee	0					Coconut	0
	Lobsters	645		Lobsters	0					Coffee	0
	Mackerels & others	645		Palm Oil/Kernel	0		Coconut	253		Herrings & others	0
	Oranges & Tangerines	645		Rubber	0		Pitprops	507		Palm Oil/Kernel	0
	Pitprops	645		Sorghum	0	6	Sweet Potato	507		Rubber	0
	Prawns/shrimps	645		Sweet Potato	0		Groundnut	1013		Sweet Potato	0
	Rubber	645		Tilapias	0		Millet	0		Tilapias	0
Regional Relativities		179			181			114			183

Figure 4: Graphical Representation of Potential Research Benefits and Priority Groupings.



4.2 How is the Information Used

This aggregate potential impact of 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 co-ordinators. Projects which are progressed through this stage are then subjected to several detailed reviews by the, so called, In-House-Review committee which is comprised of 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 co-ordinators 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.** The collaborative, mutual benefit feature of ACIAR funded projects involves matching the Australian national benefits objective of most Australian research institutions with the potential mandate region 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 which are 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 (1992a,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 for 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.

In regions such as Africa and South Asia a major share of funding has been on projects which are 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 focuses on more that one commodity. Some times 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 which 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 more specific to these regions.

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 shear 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

Figure 5 : Share of Funding by Major Priority Groups - All ACIAR Programs 1982 -95(%)

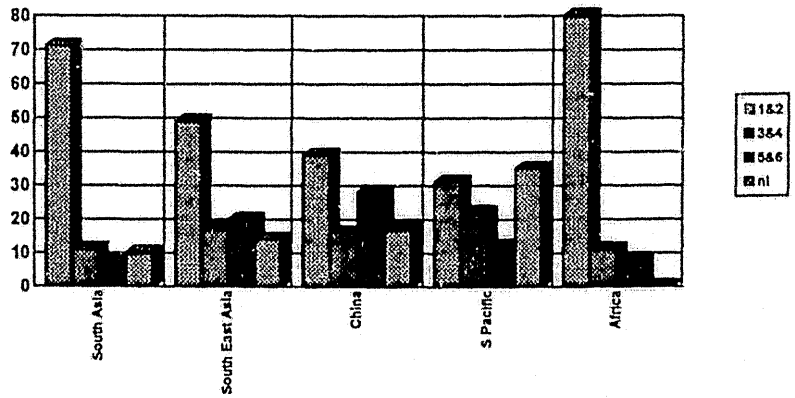


Table 3: Total ACIAR Research Funding by Research Priority Groupings and Regions - 1982 to 1995 (%)

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

Priority Group	South Pacific & PNG			Priority Group	Africa		
	1982-1995	1982-1988	1989-1995		1982-1995	1982-1988	1989-1995
1	25	14	36	1	75	59	92
2	6	7	4	2	5	3	8
3	21	32	10	3	11	22	0
4	1	0	2	4	0	0	0
5	0	0	0	5	4	8	0
6	12	19	6	6	4	8	0
Not Included	35	29	42	Not Included	0	0	0

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. These have especially been fruit (tropical) 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. In some regions this is clearer than 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 most 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 welfare impact estimates have been developed allowing for many components illustrated in Figure 2 to vary for each commodity, country and region, 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, these include 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 are 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 caste important light on the broader area of the 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 developing an indication of 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 were 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 stage 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	Research Area	NPV Estimate (most likely) ($ million) [1]	Internal Rate of Return (%)	Region	Country	Commodity	Commodity /Region Priority Grouping	
1	8340	Salvinia Control	Crop Sciences	Weeds	45 0	469	S Asia	Sri Lanka	Rice	1	
3	8203/8601	Straw Utilisation by Livestock	Animal Sciences	Nutrition	117 0	100	S Asia	India	Milk	1	
8	8307	Stored Grain Under Plastic	Post Harvest	Wastage	9 2	38	S E Asia	Philippines, Thailand, Malaysia, Indonesia	Rice	1	
9	8309/8609/8311	Integrated Pesticide Use in Grain Storage	Post Harvest	Wastage, Pests	24 4	43	S E Asia	Philippines	Rice	1	
5	8321	Tick-Borne Disease Control	Animal Sciences	Pests	30 7	68	S Asia	Sri Lanka	Milk	1	
7	8334/8717	Newcastle Disease of Poultry	Animal Sciences	Disease	144 4	50	S E Asia	Malaysia, Philippines, Indonesia, Thailand	Chicken	2	
12	8457/8848	Australian Trees for China	Forestry	Genetic Enhancement	115 3	37	China	China	Fuelwood NC	2	
10	8207	Grain Sorghum Book	Land and Water	Nutrition	9 3	38	S Asia	India	Sorghum	2	
2	8343	Fruit Fly Control	Crop Sciences	Pests	176 2	260	S E Asia	Malaysia	Mango Etc	2	/ni
6	8469/8839	Rapeseed Breeding	Crop Sciences	Genetic Enhancement	66 3	58	China	China	Rapeseed	2	/ni
11	8332/8733	Giant Clam Mariculture	Fisheries	Genetic Enhancement	1 9	-	S Pacific	South Pacific	Giant Clams	6	
4	8451/8929	Nematodes To Control Pests	Crop Sciences	Pests	57 0	80	China	China	Apples	ni	
		Sub-Total (Assessment 1-12)			815 8						
-	8543/9003	Tuna Bait Fish Biology	Fisheries	Natural Resource Use	3 8	21	S Pacific	South Pacific	Tuna	1	
	8355	Postharvest Technology for Banana	Postharvest	Wastage	50 6	48	S E Asia	Malaysia, Philippines	Banana	1	
	8356	Chemical Control of Fruit Disease	Postharvest	Wastage, Disease	36 6	41	S E Asia	Malaysia, Philippines, Thailand	Mango, Mangost	2	
	8844	Cool Storage, CA and Chemical Controls of Fruit	Postharvest	Wastage	18 7	27	S E Asia	Thailand	Longan, Mango,	ni/2	
	8319	Vacuum Infiltration of Fruit with Calcium	Postharvest	Wastage	2 7	21	S E Asia	Indonesia	Avocado	ni	

1. Values represented in 1990 dollars, with NPV estimated for 1990
2. 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:

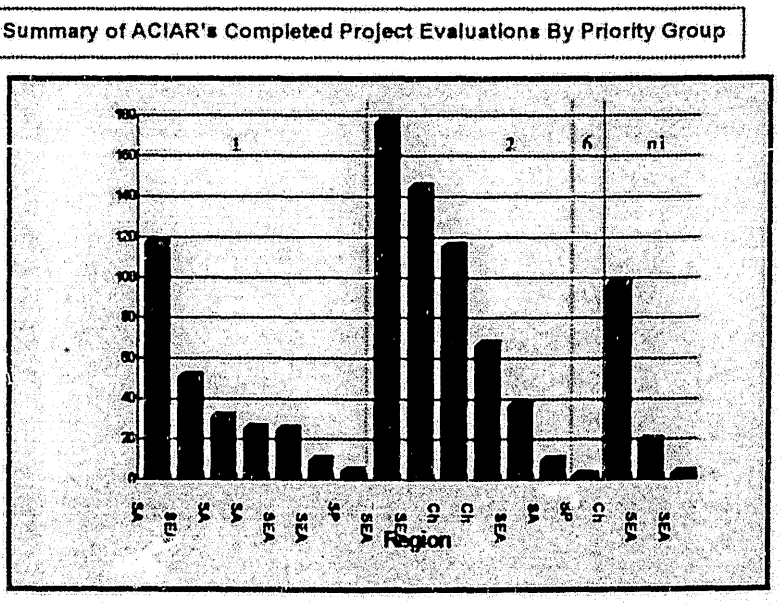
- Scientific output
- Technologies developed
- The use or adoption of the technologies
- Capacity building in Australia and partner countries
    - Human capital through formal and informal training
    - Research facilities
- Intellectual property

At this stage there have not been enough assessments to provide a comprehensive set of information which can be used to look at detailed research production function issues. 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 which have not been analysed. There are, however, substantial ranges in the levels of benefits, with several are well over NPV's of $100m. There are some lower pay-off research activities in the high priority groups suggesting variability in the research impacts.

Figure 6:



(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.

(iii) Impacts and Mandate Regions

The aggregate priority assessment information suggested that there are large potential regional difference 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.

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 stronger insights into the potential spillover effects of research.

5.2 Project Development Assessments

Project development assessments have been a more recent addition to ACIAR's Information System. They have developed for a number of reasons. Important among these has been the need to develop a means of comparison between projects from the diverse program areas within ACIAR. They are also used to provide a mechanism for checking under what types of conditions high welfare gains will result from technically attractive projects which focus on what appear, on average, to be potentially lower research benefit commodities (or outputs). They have largely been used as a complement to the aggregate priority screening process and the rigorous scientific project development mechanisms. 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 of this efforts.

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%. There has been a range in the sources of these assessments. Some have been incorporated in the proposals by the researchers preparing the documents. Others have been developed with extensive interaction between the project researchers and the 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 a formal quantitative research evaluation assessments. It does encourage project leaders to include rigorous assessment and has taken the view that it has a role to play in supporting the scientists (including economists) in developing them. This is probably different to many research funding bodies, however, is consistent with the significant interactive process ACIAR has implemented as part of its project development mechanisms. One eventual 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 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 which is important to the focus of the project. If it is not incorporated in the assessment then the important benefit of improvement to project design for this evaluation work is likely to be lost. As a larger number of assessment are completed the hope is that these standardised procedures will evolve.

Table 5: Possible Classification of Research Areas and Associated Research Evaluation Methods.

Research Area	Type of Evaluation Model	Comments
Pre-Farmgate		
Genetic Enhancement	Single or multi-regional, multi-commodity supply shift model	Need to consider the importance of a shift in the minimum TAC associated with a productivity increase.
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	Quantity associated with minimum TAC required. Care is required as estimates are subject to more error.
Policy	Value of information with saving in dead weight loss model.	Model not well developed and few applications.
Price and Marketing Analysis	Value of information with saving in dead weight loss model.	Model not well developed and few 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	Model required not clear. Usually part of other research areas	Concept still requires clearer definition in a research context.

Figure 7:

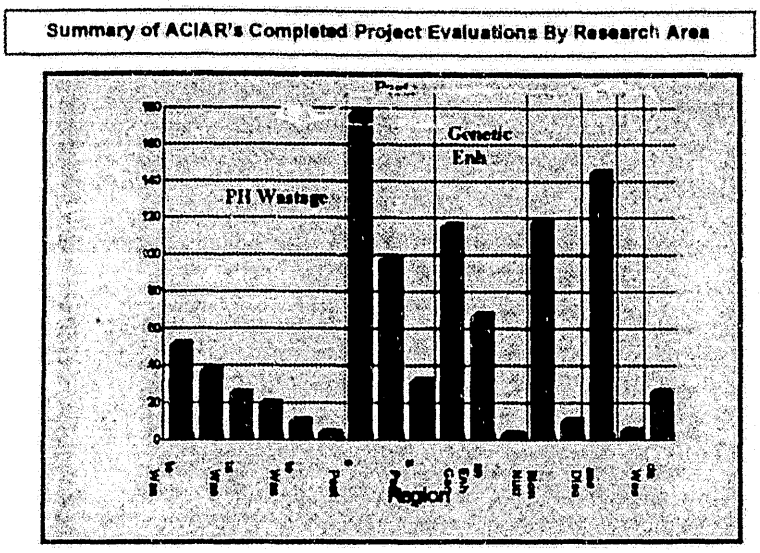


Figure 8:

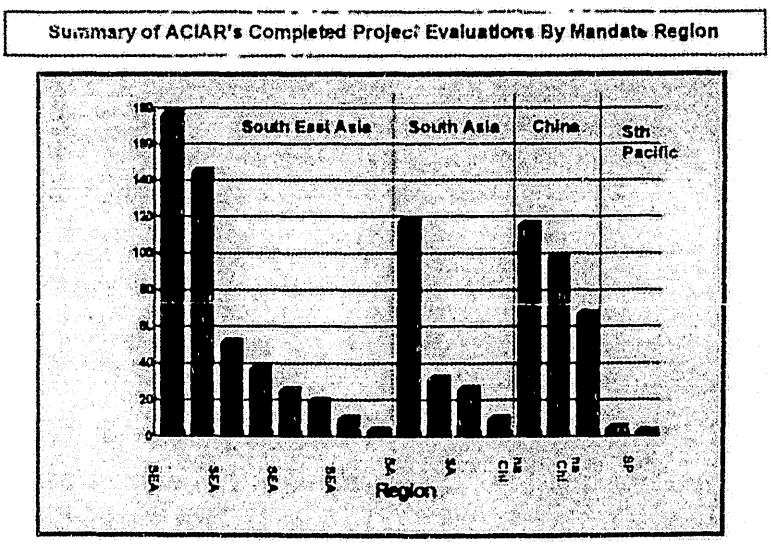


Table 6: Recent project development assessments of projects considered for funding by ACIAR.

Project Number	Description	Program Area	Region	Country	Commodities		Priority Grouping	Internal Rate of Return		Unit Cost Reduction	Change in Output	Level of Analysis
					Primary	Other		Most Likely	Range			
9323	Dairy Policy in Indonesia	Economics	SEA	Indonesia	Milk		5	94%	na	na	na	Internal (FI)
9318	Improved Ruminant Production through Efficient	Animal Science	SEA	Indonesia	Beef/Buffalo	Sheep/Goat	3 /4	71%	na	na	10%	Internal (PI)
9109	Coconut Marketing and Policies in Philippines	Economics	SEA	Philippines	Coconut		1	70%	na	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 Agriculture	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%	11.1%	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,	Avocado, Longa , 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 (FI)
9017	Control of Peanut Stripe Virus	Crop Science	SEA	Indonesia	Groundnuts		6	32%	na	na	na	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, Kiribas, 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, Groundnuts	1	30%	3-48%	na	na	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%	na	na	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 /7	20%	19-28%	1%	na	External
9107	Papaya Improvement in the Philippines	Crop Science	SEA	Philippines	Papaya	Fruit/Vegetables	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

Given the *exante* nature of these assessments caution is required in using the impact results to draw strong conclusions about research efforts. At ACIAR the PDA's are seen as a good support tool for focusing projects and also an integrated part of the evaluation process. Davis and Lubulwa (1995) plus earlier similar papers discuss in detail the framework being adopted for integration of the *exante* and *expost* efforts. Once fully implemented the latter will provide a balance to the moral hazard problem 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 which facilitates quick and effective evaluation. Detailed interaction between scientists and economists early 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 (group 5 and 6) priority commodities do seem to require substantial impacts on the commodity output to generate rates of return which are in the range of those found in past evaluations of agricultural research and those which focus 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, resulted in fruitful interactions. Both the 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 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.

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 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 and for project development assessments it is the interaction process between the technical and economic scientists which is as important, if not more important than, the assessment numbers which are generated. This interaction has been found to result in clearer project specification and a better understanding of the potential research impact by both sides. In the case of ACIAR this improved project 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. In the meant time direct support from ACIAR staff for project scientists is seen as the important option.

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3 The reason for using different return measures for the CPA's and PDA's was purely for illustration in this paper. As most are aware care is required in using either measure since a different picture can be presented. Although space does not permit it here both should be used to ensure a complete picture is given.

4 Note though the highest benefit project which is in priority group 5 is in fact an economic policy project which is looking at dairy policy. The benefits are not measured as a standard unit cost reduction rather as dead weight loss saving from not continuing distortionary policies if the research results are adopted.

Figure 9:

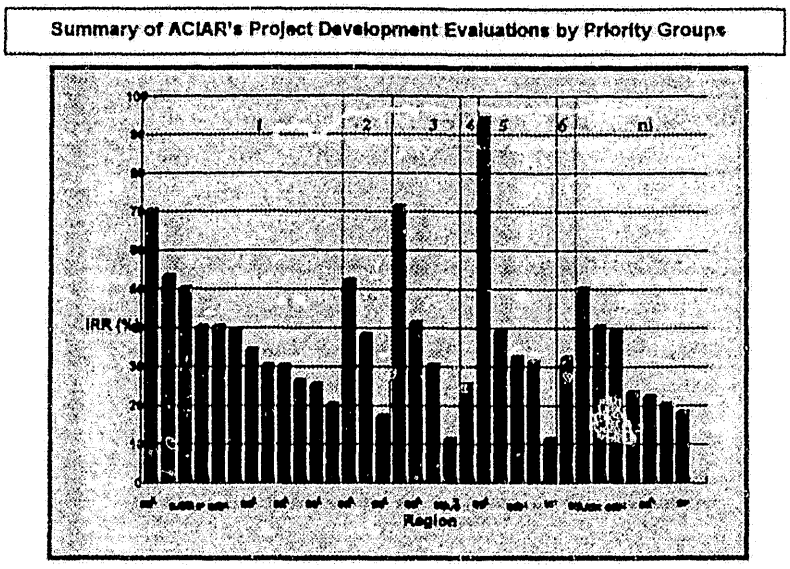
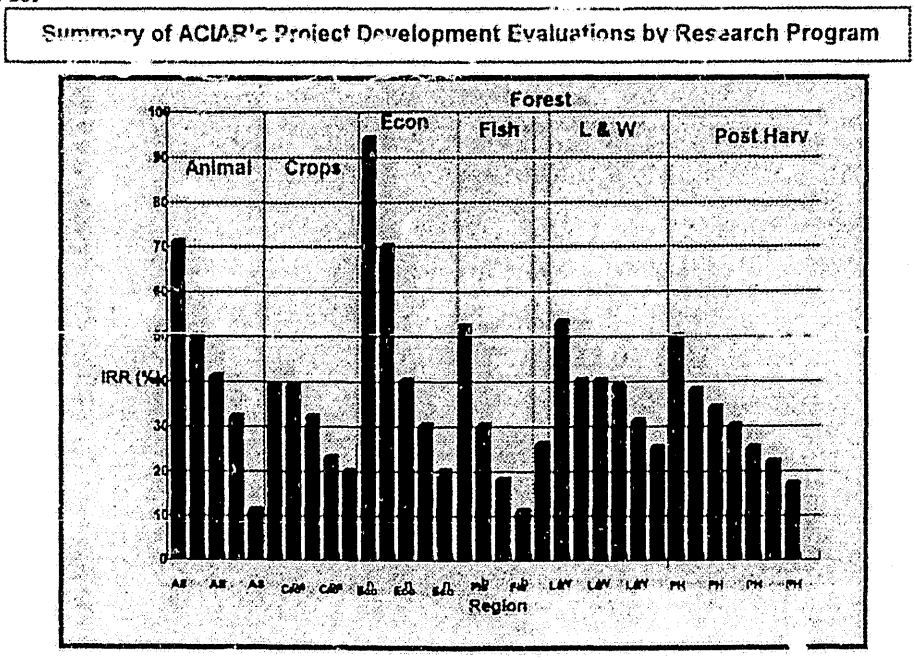


Figure 10:



6 SUMMARY AND FUTURE DIRECTIONS

ACIAR has been evolving an extensive systematic information system to support research resource allocation decision-making for about 8 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 of 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 integration benefits between the aggregate and project level. Existence of an extensive theoretical welfare economics based methodology 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 those who view it as standard "back of the envelope" benefit cost analysis usually appreciate. The strong theoretical base becomes an essential component once this is appreciated.

It is always difficult to determine exactly how effective information provision is. 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 be 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 is 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 tha impact of social science research.

REFERENCES

Alston J.M., G.W. Norton and P.G. Pardey, (1994), "Science Under Scarcity: Principles and Practice for Agricultural Research Evaluation and Priority Setting", Cornell University Press, Ithica.

Brennan, J.P., (1986) "Impact of Wheat Varieties from CIMMYT on Australian Wheat Production", Agricultural Economics Bulletin No. 5, Department of Agriculture New South Wales, September.

Davis J.S. and J.G. Ryan, eds (Forthcoming), 'Designing Information Systems to Support Priority Assessments in Agricultural Research : Concepts and Practices for International and National Institutions', ACIAR Monograph No 17, Canberra.

Davis J.S., M.C. Bantilan and J.G. Ryan, (Forthcoming), "Development of Information Systems to Support Decision-Making: An Overall Perspective", Chapter 2 in Davis and Ryan (Forthcoming).

Davis, J.S., (1991), "Spillover Effects of Agricultural Research: Importance for Research Policy and Incorporation in Research Evaluation Models", ACIAR/ISNAR Project Paper No. 32, February.

Davis, J. and Fearn, M. (1992a), 'Information to support resource allocation for forestry research: aggregate priorities and project level assessments', Paper presented at the ACIAR Forestry Program Project Leaders Meeting, Brisbane, Australia, 4-5 February.

Davis J.S. and M.J. Fearn, (1992b), "Information to Support Resource Allocation for Fisheries Research: Aggregate Priorities and Project Level Assessments", Paper Prepared for ACIAR Fisheries Program Project Leaders' Meeting, June 3-5.

Davis J.S. and G. Lubulwa (1995), "An Overview of ACIAR's Economic Evaluation Activities with an Animal Science Program Focus", Paper prepared for the ACIAR Animal Sciences Project Officer's Meeting, Victorian Institute of Animal Science, January 31 to February 1.

Davis J. S and G. Lubulwa (1994) "An Overview of ACIAR's Economic Assessments of the Postharvest Program Projects", Paper prepared for ACIAR Postharvest Research Program, Internal Workshop Number 15, November 8-9.

Davis Jeff, Godfrey Lubulwa and Christine Tweddell, (1993), "Expansion of ACIAR's Research Evaluation Information System to Support Resource Allocation to the International Agricultural Research Centres: Some Preliminary Information", Mimeographed Paper, Economic Evaluation Unit, ACIAR.

Davis, J S. (1994) "Some Economic Aspects for Considering Future Directions for Tropical Forage Research", Economic Evaluation Unit Working Paper No. 7, ACIAR, Canberra.

Davis, J.S., Oram, P.A. and J.G. Ryan, (1987), 'Assessment of Agricultural Research Priorities: An International Perspective', Australian Centre for International Agricultural Research, Monograph No. 4, Canberra, Australia.

Fearn, M., (1991), 'An Evaluation of the Impacts of Research on Bait Fish for the Tuna Fisheries of Selected Developing Countries', M Ec Thesis, University of New England, Armidale.

Lubulwa, A S G and Davis, J S, (1994), "An Economic Evaluation of Postharvest Tropical Fruit Research : Some Preliminary Results", Economic Evaluation Unit Working Paper No. 9, ACIAR, Canberra.

Menz, K., (1991), 'Overview of Economic Assessments 1-12', Economic Assessment Series, ACIAR, Canberra.

Ryan J.G., and J.S. Davis, (Forthcoming), "The Development of a Decision-Making Process and Support System in ACIAR", Chapter 8 in Davis and Ryan (Forthcoming).

Ryan J.G., J.S. Davis, K Menz and M. Fearn, (Forthcoming), "Development and Use of a Priority Assessment System in ACIAR", Chapter 11 in Davis and Ryan (Forthcoming).

Ryan, J.G. and J.S. Davis, (1991), "Assessing Agroecological and Commodity Priorities in International Agricultural Research, ACIAR/ISNAR Project Paper No. 34, February.

Ryan, J.G, and J. S. Davis, (1990), "A Decision Support System to Assist Agricultural Research Priority Setting : Experience at ACIAR and Possible Adaptations for the TAC/CGIAR", ACIAR/ISNAR Project Paper No. 17, March.