Benefits to Australia of selected CABI products

David Pearce and Michael Monck
Centre for International Economics

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Australian Government
Australian Centre for International Agricultural Research

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The Research Program Manager
Policy Linkages and Impact Assessment Program
ACIAR
GPO Box 1571
Canberra ACT 2601
Australia

tel +612 62170500
email <aciar@aciar.gov.au>

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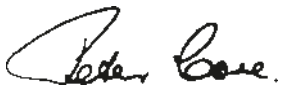
Foreword

CAB International, known generally as CABI, is one of the 15 International Agricultural Research Centres (IARCs) that the Australian Centre for International Agricultural Research (ACIAR) provides funding for in its multilateral program. CABI is interesting as an international research organisation in that many of its activities are in the form of publishing, abstracting and dissemination of scientific information. These services play an important role in all of the research activities funded by ACIAR and in other research around the world.

This impact assessment study is part of a series of studies commissioned by ACIAR over the past 10 years that look at the impact on Australia of research undertaken by some of the important IARCs. Until now these IARC impact assessment studies have been published in the research series of the institutions of the people undertaking the studies. ACIAR feels, however, that they are best published in its Impact Assessment Series so that a consistent record of them is kept and they are readily accessible.

While CABI undertakes a range of activities, this study focused on just two components: CAB Abstracts and the CABI Crop Protection Compendium. The impact study differs from many that have been undertaken in that it measures the benefits from CABI activities in terms of the resulting savings in transaction costs for *other* research groups. The authors undertook a detailed survey of Australian users of these services to estimate the savings in research time that were generated as a result. The study suggests that the benefit to Australia from using the two CABI products is between $1.2m and $2.2m per year. This is a conservative estimate of the benefits because the savings are likely to have been used to support additional research activities within the research organisations.

I thank the Centre for International Economics team and the cooperating members of CABI and Australian research organisations for the innovative effort used to undertake this study and for providing the information needed to complete it.



Peter Core
Director, ACIAR

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Acknowledgments

We thank Denis Blight and Ruth Ibbotson of CABI for providing information on Australian users of CABI products. Thanks also go to Yuan Chou for coordinating the survey of CAB Abstracts users, and special thanks to the users and librarians who responded to our survey.

Summary

About CABI

- CABI, and its associated business units in publishing, international development and bioservices, is an international research and publishing organisation that undertakes a range of activities, many of which overlap with the interests of ACIAR and other agricultural research and extension agencies in Australia.
- CABI is interesting as an international research organisation in that only 3% of its income comes from member-country contributions, the vast bulk coming from product sales and project income.

This report

- This report examines the benefits to Australia of two of CABI's publishing and information dissemination activities: CAB Abstracts and the CABI Compendia, specifically the CABI Crop Protection Compendium.
- Our approach to evaluating the benefits of these products centres around three surveys of the users of these products. Those surveyed included university and research institution librarians and individual researchers (in the case of CAB Abstracts), and researchers and officials involved in biosecurity in the case of the Compendia.

The economics of information dissemination

- The efficient and cost-effective dissemination of research findings is essential if additions to the stock of knowledge are to result in practical outcomes.
- Researchers typically use a variety of publications to find out about previous research in a particular area and to disseminate the findings of their own research.
- More-effective dissemination can lower the transactions costs involved in undertaking research activities. This cost saving is most likely to come about through reduced person-hours in initial stages of research.
- More-effective dissemination of research results means a productivity improvement in the conduct of research activities. Like other productivity improvements, this means that a higher level of output can be achieved for a given level of input costs.

Key findings

- Based on a survey of Australian users, we estimate that the use of CAB Abstracts results in:
  - median time savings per researcher of between 3 and 5 days per year
  - across all researchers, time savings valued at between $470,000 and $790,000 per year.
- Australian survey results indicated that the use of CABI Compendia results in:
  - median time savings per researcher of between 37 and 54 days per year
  - across all researchers, time savings valued at between $940,000 and $1,380,000 per year.
- Total benefits to Australia from these two products therefore amount to between $1.4 million and $2.2 million per year.
- These benefits are potentially available to increase the effective resources devoted to new research activities.

1 Introduction

Background

CAB International, once the Commonwealth Agricultural Bureaux, but now generally known as CABI, comprises three closely related and overlapping enterprises in publishing, international development and bioservices. Of most interest for this report is CABI Publishing—a not-for-profit publisher in the applied life sciences.

These organisations undertake a diverse range of activities, many of which overlap considerably with the interests of ACIAR and other agricultural research and extension agencies in Australia. CABI's work is concerned with the generation, dissemination and use of information in the applied life sciences. Much of this work is in agriculture, but CABI's reach is steadily extending beyond agriculture. CABI maintains a focus on developing countries and is actively engaged in the development process.

CABI is interesting as an international research organisation in that only a very small proportion of its income (3%) comes from member-country contributions. Most of CABI's revenue comes from product sales and project income.

This report

The purpose of this report is to characterise and, to the extent possible, quantify some of the benefits that CABI brings to Australian agricultural researchers and the wider Australian community. To do that, we have chosen to focus on two CABI products that have relatively large Australian customer bases: CAB Abstracts and CABI Compendia.

CAB Abstracts is a comprehensive bibliographic, abstracting and indexing database covering the applied life sciences, including agriculture, forestry, human nutrition, veterinary medicine and the environment.

CABI Compendia is an encyclopaedic-type reference that employs multimedia tools to present a range of information from various sources.

These electronic databases raise the productivity of Australian researchers by providing fast and convenient access to published research from around the world and by facilitating the global dissemination of results from Australian research. The wider Australian community, in turn, benefits when some of this research is commercialised through increased agricultural production and better biosecurity.

Outline

This report is structured as follows. Chapter 2 summarises the CABI products analysed here and chapter 3 some of the broad economics of information dissemination as it relates to CABI products.

Our main tool for analysing the effects of CABI products is a survey of three user groups, the details and results of which are presented in chapter 4. Chapter 5 uses these survey results to estimate the value to Australia of the two products examined. Chapter 6 concludes the report.

2 CABI and its products

CAB Abstracts

CABI publishing disseminates information through books, journals and bibliographic databases. The databases, CAB Abstracts and the CABI Compendia covering animal health and production, crop protection and forestry, are the products predominantly used by the Australian clients of CABI.

What is CAB Abstracts?

CAB Abstracts is a comprehensive bibliographic, abstracting and indexing database covering the applied life sciences, including agriculture, forestry, human nutrition, veterinary medicine and the environment. CAB Abstracts includes information on molecular biology, genetics, biotechnology, breeding, taxonomy, physiology and other aspects of pure science relating to organisms of agricultural, veterinary or environmental importance.

The CAB Abstracts database scans and abstracts over 6,000 journals and 3,500 books, grey literature, proceedings and other publications annually; more than 200,000 new records are added each year. Subject classification and indexing are done by specialist editors. International coverage spans 140 countries publishing in 50 languages. The database contains almost 5 million records from 1973 to the present.

As discussed further below, the results of recent analysis suggest that CAB Abstracts is the largest and most comprehensive database in its areas of expertise, including its coverage of agricultural journals.

Database coverage

Table 1 summarises some of the broad subject areas covered by CAB Abstracts. Subject coverage appears comprehensive and, as the survey results presented later indicate, this allows CAB Abstracts to be used by a variety of researchers in a broad range of fields.

Delivery options

CAB Abstracts is a fully searchable bibliographic database available on multiple platforms: through CAB Direct from CABI Publishing or online through around seven other service providers. The broad range of access options means that it is very convenient for institutions to provide access to CAB Abstracts. They can do so either specifically, or in conjunction with other services that they may already subscribe to.

Competitors and substitutes

CAB Abstracts is, of course, not the only source of abstracting information. Other key players in the field (which may complement or replace use of CAB Abstracts) include:

- AGRICOLA
- AGRIS
- Biological and Agricultural Index Plus
- BIOSIS
- CSA Life Sciences
- Web of Science.

Summary details of each of these follow.

AGRICOLA

AGRICOLA (AGRICultural OnLine Access) is a bibliographic database of citations to the agricultural literature created by the National Agricultural Library (NAL) of the US Department of Agriculture and its collaborators. Production of these records in electronic form began in 1970, but the database covers materials in all formats, including printed works from the 15th century.

The records describe publications and resources encompassing all aspects of agriculture and allied disciplines, including animal and veterinary sciences, entomology, plant sciences, forestry, aquaculture and fisheries, farming and farming systems, agricultural economics, extension and education, food and human nutrition, and earth and environmental sciences.

AGRIS

AGRIS is an information system created by the Food and Agriculture Organization of the United Nations (FAO) in 1974, to facilitate information exchange and to bring together literature dealing with all aspects of agriculture. AGRIS is a cooperative system in which participating countries contribute references to the literature produced within their boundaries and, in return, draw on the information provided by the other participants. To date, 240 national, international and intergovernmental centres participate.

Biological and Agricultural Index (BAI) Plus

This database contains bibliographic and citation information for journals from 1983 onwards but differentiates itself from its competitors by offering the full text of articles published from 1997 onwards. Full text citations also link to PDF page images that give the associated graphs, charts, diagrams, photos, and illustrations, which are indispensable to progress in scientific research.

Table 1. Summary of research areas covered by CAB Abstracts

Subject area	Subject area
Agricultural economics and rural sociology	Horticultural science
Agricultural engineering	Invasive species
Animal production	Leisure and tourism
Animal health	Medicinal plants and pharmacology
Animal science	Microbiology
Aquaculture	Molecular biology
Biofuels	Mycology
Biosafety and bioterrorism	Natural resources, land/water management
Biotechnology and animal and plant breeding	Nematology
Chemistry	Organic and sustainable agriculture
Crop science and grasslands	Parasitology
Entomology	Plant pathology
Environmental science	Postharvest
Food science and technology	Protozoology
Forestry	Soil science
Genetics	Veterinary medicine
Helminthology	Virology

Source: CABI

BIOSIS

BIOSIS, much the same as CABI Publishing, provides information in the area of life sciences. It does this by indexing and abstracting documents from numerous sources worldwide and making these abstracts searchable via database access.

BIOSIS databases are interdisciplinary, integrating important subjects from many different fields across the full spectrum of biology. They are also international in scope, with more than 90 nations represented in the databases.

BIOSIS products include:

- Abstracts of Entomology—insect-related research from around the globe
- Abstracts of Mycology—a specialised resource indexing new mycology resources
- BIOSIS Previews—a comprehensive index to life sciences and biomedical research
- Biological Abstracts—an expansive index to the world's life sciences journals
- Biological Abstracts/RRM—life sciences information from reports, reviews and meetings.

CSA Life Sciences

CSA Life Sciences Abstracts contains abstracts and bibliographic citations from recent worldwide research literature in major areas of biology, medicine, biochemistry, biotechnology, genetics, immunology, ecology and microbiology, and in some aspects of agriculture and veterinary science. CSA Life Sciences Abstracts corresponds to the print versions of more than 20 abstracting journals.

This database, produced by Cambridge Scientific Abstracts, contains abstracts from 1982 to the present. It has a wider range of topics than CAB Abstracts, including areas of medicine and genetics, but nevertheless contains a large number of references in areas such as veterinary science and agriculture, making it a direct competitor to CAB Abstracts.

Web of Science (WoS)

In terms of scope, Web of Science is possibly the closest competitor to CAB Abstracts (see below). It includes coverage from 1900 onwards in its Science Citation Index and allows navigation to the full text content referenced in the database.

Other competitors

There are several other abstracting services available—including Zoological Record, and Food Science and Technology Abstracts—that compete in the same market space as CAB Abstracts. At present these are minor players and, as such, may not be considered as viable alternatives. New services such as Google Scholar™ that are based on similar concepts to traditional internet search engines are entering the market but, given the infancy of these, it is hard to evaluate what impact they might have.

Comparing the abstracts databases

Kawasaki (2004) undertook a detailed analysis of the coverage of various life sciences databases, deriving a list of core agriculture journals (of which there were 542 in 2003) and analysing the coverage of seven life sciences databases, along with a broad 'other' category.

Table 2 summarises Kawasaki's key results. None of the databases has full coverage of all the core journals, but CAB Abstracts has the highest coverage at 92.1%, with 7.6% of the core journals covered uniquely by CAB Abstracts. After CAB Abstracts the next greatest coverage is by the Web of Science (73.9%), followed by AGRIS (62.7%).

Table 3 summarises some two-way combinations of databases that could be used to increase coverage if, for example, CAB Abstracts were not available.

A combination of AGRIS and Web of Science is capable of covering 84.1% of the 542 core agricultural journals, still less than the 92.1% reached by CAB Abstracts alone. A combination of AGRIS and AGRICOLA, the two databases accessible free through the internet, covers 67.7% of the core agricultural journals. According to Kawasaki, very little is gained by combining three or more databases.

Table 2. Primary agriculture journals in each database (2003)

	Number of journals covered	Percentage the 542 'core' journals	Journals covered unique to the database	Percentage of the 'core' that is unique
AGRICOLA	259	47.6	0	0
AGRIS	340	62.7	0	0
BAI Plus	116	21.3	0	0
BIOSIS	311	57.2	2	0.04
CAB Abstracts	499	92.1	41	7.6
CSA	219	40.3	0	0
Web of Science	402	73.9	10	1.8
Other	24	4.4	24	4.4

Source: Kawasaki (2004)

Table 3. Primary agriculture journals in different database combinations (2003)

	Journals covered	Percentage of 'core'
Web of Science + AGRIS	456	84.1
Web of Science + BIOSIS	430	79.3
Web of Science + AGRICOLA	428	79.0
Web of Science and CSA	422	77.9
AGRIS + BIOSIS	404	74.5
AGRIS + CSA	376	69.4
AGRIS + AGRICOLA	367	67.7
BIOSIS + AGRICOLA	365	67.3

Source: Kawasaki (2004)

Kawasaki (2004, p. 5) writes:

> If one does not have CAB [databases] available for searching [the] agriculture literature, then one must be knowledgeable in searching a number of databases to pull together a comprehensive search. These databases would cover the plant and soil sciences, forestry, human nutrition and health, engineering, food sciences, sociology, economics, animal sciences, education, and many other topics applied to the broad discipline of agriculture. Other databases to search might include Food Science and Technology Abstracts, Zoological Record, PubMed, Economics Literature, Engineering Index, and Chemical Abstracts. If one does not search CAB, an extensive knowledge of search tools, vocabulary, search interfaces, access to databases, and a vast amount of time would need to be available to the researcher.

This statement assumes, of course, that the researcher wishes to find abstracts from the 16% of core journals that are not covered by the combination of, say, AGRIS and Web of Science.

Without knowing anything about the particular needs of individual researchers, it can be inferred from this analysis that, if CAB Abstracts were not available, to get close to the same coverage, researchers would need to access two databases (at presumably twice the time) but would get only around 90% of the information. This implication is tested in more detail in our survey analysis presented below.

CABI Compendia

CAB International also produces a range of encyclopaedic reference products known as CABI Compendia. Each compendium consists of various multimedia tools designed to enable research in a specific area. Currently, the areas covered are forestry, crop protection, animal health and production, and aquaculture.

Crop Protection Compendium

The Crop Protection Compendium is the one most widely used in Australia. The compendium is predominantly used by researchers in organisations involved with quarantine, biosecurity, agriculture and education.

The compendium, published on both CD-ROM and the internet, contains information on pests, diseases and weeds, and their natural enemies, and details the crops that are their hosts and the countries in which they occur. The coverage is broad (with around 2,380 pests, diseases, weeds and invasive species included) and detailed (each pest has a datasheet covering taxonomy, hosts, geographic distribution, morphology and so on) and contains a number of features to allow ease of use (images, taxonomic frameworks, decision-support tools, electronic note pads and so on).

The compendium is funded by a development consortium consisting of the bodies set out in Table 4.

The compendium was developed in a partnership between CABI and the following organisations:

- Centre for Biological Information Technology, University of Queensland, Australia
- European and Mediterranean Plant Protection Organization (EPPO)
- Food and Agriculture Organization of the United Nations (FAO)
- Iowa State University, USA
- Plant Resources of South-East Asia (PROSEA) / PUDOC Publishers
- Systematic Botany and Mycology Laboratory, curators of Germplasm Resources Information Network (GRIN) Taxonomy, United States Department of Agriculture – Agricultural Research Service (USDA–ARS)
- University of Bonn, Germany.

Information in the compendium was authored and validated by more than 1,100 specialists. The broad coverage and contribution to the compendium make it a unique product. We have been unable to find any comparisons between it and related products.

Table 4. Agencies funding the CABI Crop Protection Compendium

Funding agency	Funding agency	Funding agency
Agriculture and Agri-Food Canada (AAFC)	Grains Research and Development Corporation (GRDC), Australia	Pioneer Hi-Bred
American Cyanamid	Horticulture Australia (HA)	Rockefeller Foundation
Asian Development Bank (ADB)	Indian Council of Agricultural Research (ICAR)	Seminis Vegetable Seeds
Australian Centre for International Agricultural Research (ACIAR)	International Center for Tropical Agriculture (CIAT)	Sumitomo Chemical Company Limited
Australian Government Department of Agriculture, Fisheries and Forestry (DAFF)	International Development Research Centre (IDRC), Canada	Swiss Agency for Development and Cooperation (SDC)
Bayer CropScience	International Institute of Tropical Agriculture (IITA)	Syngenta (including Novartis Crop Protection and Zeneca Agrochemicals)
CAB International	International Maize and Wheat Improvement Center (CIMMYT)	Tanzania Commission for Science and Technology (COSTECH)
Canadian Food Inspection Agency (CFIA)	International Plant Genetic Resources Institute (IPGRI)	The Africa Rice Center (WARDA)
Canadian International Development Agency (CIDA)	International Potato Center (CIP)	United Nations Development Program (UNDP)
Central Science Laboratory (CSL), UK	International Rice Research Institute (IRRI)	United States Agency for International Development (USAID)
Danish Government Institute of Seed Pathology/Danish International Development Agency (DGISP/ DANIDA)	Kenya Agricultural Research Institute (KARI)	United States Department of Agriculture – Agricultural Research Service (USDA – ARS)
Deere & Company	Malaysian Agricultural Research and Development Institute (MARDI)	United States Department of Agriculture – Animal & Plant Health Inspection Service (USDA – APHIS)
Department for International Development (DFID), UK	Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan	United States Department of Agriculture – Cooperative State Research, Education and Extension Service (USDA – CSREES)
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Germany	Monsanto	United States Department of Agriculture – Foreign Agricultural Service (USDA – FAS)
Dow AgroSciences (including Rohm & Haas)	National Department of Agriculture (NDA) and Agriculture Research Council (ARC), South Africa	World Bank
DuPont	New Zealand Agency for International Development (NZAID)	

Source: CABI

3 The economics of literature review and information dissemination

Reviewing previous research, and understanding what has already been discovered, is a crucial, and ongoing, step in any research project. From the first research proposal to the presentation of final results, references to literature and to previous research are key activities in research. Previous work guides both new and fruitful directions for new research, as well as providing essential ideas about how to go about doing the research itself.

The role of literature review in research is illustrated in Figure 1, which shows a notional breakdown of research activity into two subactivities— literature search and review—and other research activities.

Each of these activities is further made up of essential inputs—labour, capital and perhaps other kinds of inputs. In undertaking the research activity there is a choice about how much review versus other activities takes place. In economic terms, there is scope for substitution between different activities.

This means that there is a trade-off between the resources (mostly labour) devoted to literature review and search, and resources devoted to other research activities (original research, talking with experts in the field, attending conferences and so on).

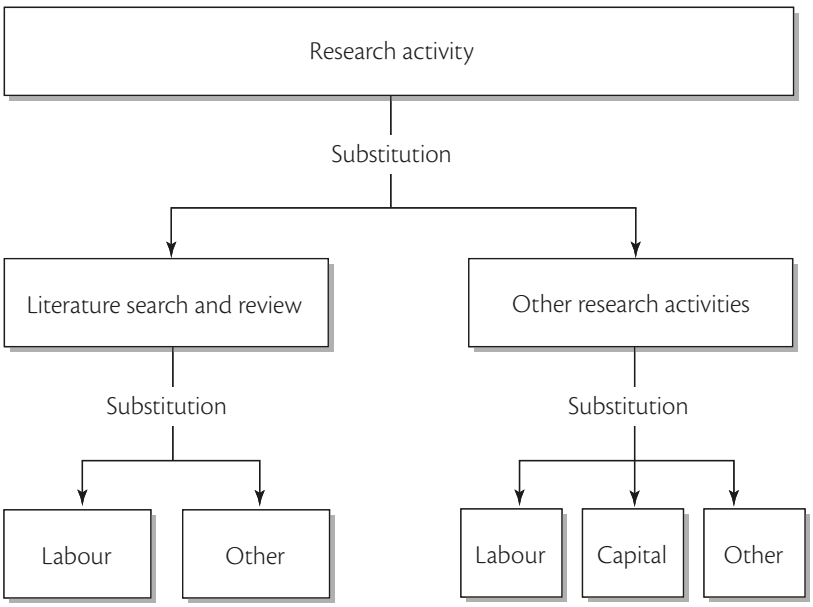

Figure 1. Notional components of research activity

This trade-off is illustrated in Figure 2. The first panel (I) illustrates the substitution possibilities between the two broad groups of activities: literature search and review, and other research activities. Each point along the curve shows a possible combination of the two activities, with the whole curve representing a given level of research activity. As the amount of literature review increases, the need for other research activities declines. How much it declines determines the shape of the substitution curve, which will itself depend on many factors, including the field of study, the expertise of the researchers involved, the institution within which the research takes place and so on.

The second panel (II) of Figure 2 illustrates that there are a number of possible relationships between the two types of activities. The top curve illustrates a case where devoting more resources to literature review has relatively little effect on the need for other research activities. This may be the case, for example, in a relatively new research field where there is little previous work to build on.

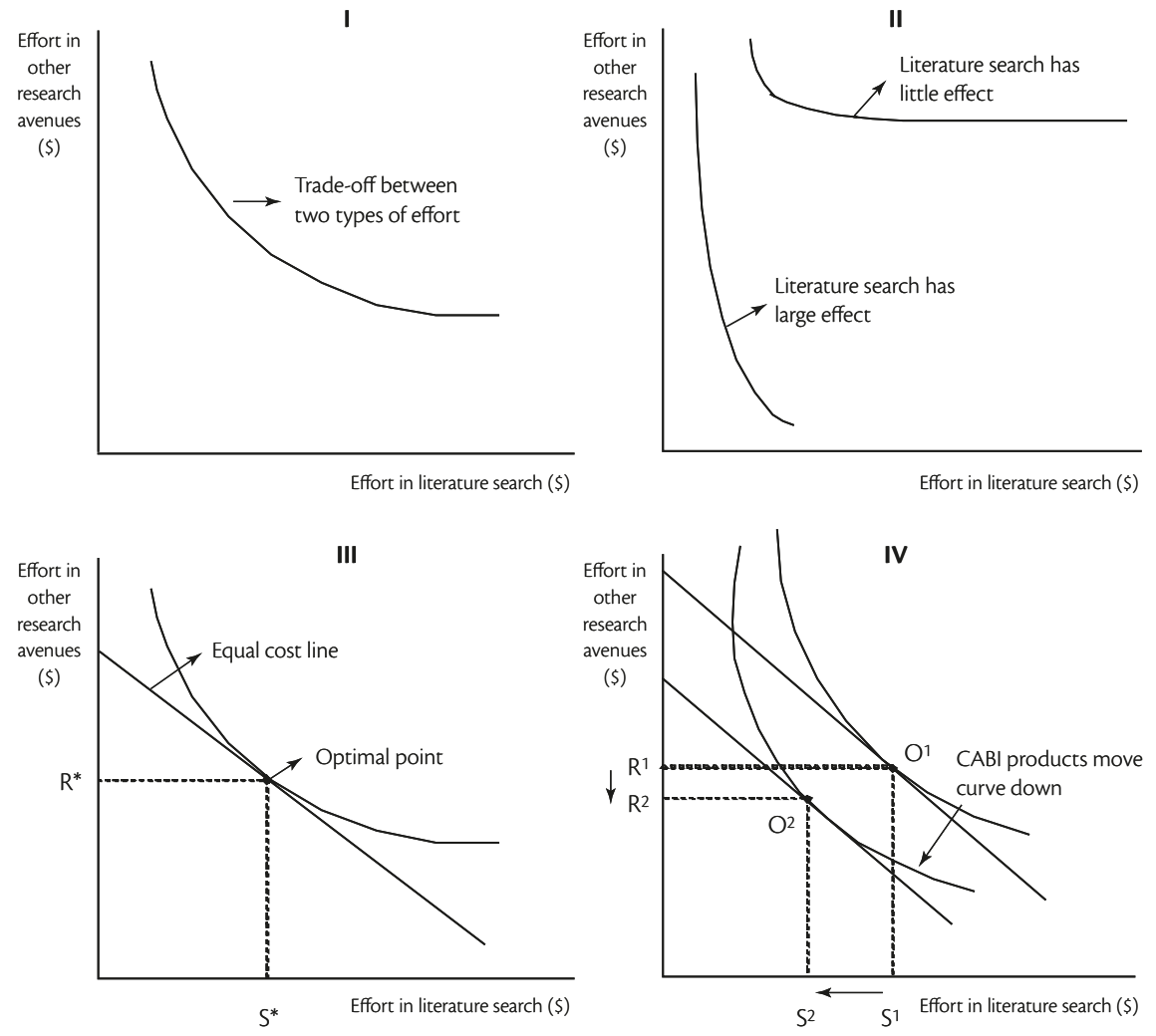

Figure 2. Trade-offs: literature search versus other research activities

The lower curve shows a case where relatively small increases in resources devoted to literature review leads to a rapid decline in the need to devote resources to other kinds of research activities. This may be the case, for example, in well-researched areas or areas where research has been taking place for a long time and thus a large amount of information needs to be assessed before new work can fruitfully be undertaken.

Panel III in Figure 2 illustrates the process that leads to the choice of particular levels of resources devoted to the different research activities. The straight line represents equal cost combinations of resources devoted to either literature search or other research activities. Given these relative costs, the optimal point that minimises the cost of a given level of research is where the cost line is tangential to the substitution frontier.

While it is unlikely that researchers or research managers explicitly seek out such an 'optimal' point, given the fact that funds for research are always limited, we would expect that experienced managers have an excellent feel for the need to do review in combination with the need for original research. Too much time spent on review, of course, limits the resources that are available for original research and lowers the chance of getting a career-building, unique publication. At the same time, too little time devoted to understanding the literature risks unnecessary repetition of research or an appearance of ignorance.

Panel IV of Figure 2 shows the effect of a service such as CAB Abstracts or CABI Compendia. Essentially, these products make the activity of literature search less costly and more effective than would otherwise be the case. This has the effect of shifting the substitution frontier downwards and to the left —fewer resources are needed for a given level of research activity. Note that the shift in the curve is not uniform, but has a relatively greater decline along the literature search axis. This represents a technical change 'biased' towards literature search and review.

The new substitution frontier intersects a new cost line (which is lower, but has the same slope as before), and the optimal point is now at O^2, rather than O^1. The way these particular curves are drawn there is an initial reduction in the effort devoted to literature search, and roughly the same amount of effort devoted to other research activities. The optimal combination involves lower cost than previously, as seen by the shift to a lower relative cost line. The difference between the old and new lines is a measure of the benefit of the technical change; that is, it is a measure of the cost reduction achieved through having a product such as CAB Abstracts or CABI Compendia.

Implementing these ideas

Our approach to estimating the value of CABI products is to try to simulate the effect of their loss; that is, to calculate how their removal would affect research costs. Our core tool is a survey to estimate the effective increase in researcher labour that would be required to compensate for the loss of CABI products. This is, in effect, directly asking about the magnitude of the horizontal difference between the two curves in panel IV of Figure 2.

4 User surveys

Survey set-up and design

CAB Abstracts

Figure 3 summarises the basic sample frame and responses for a survey of library administrators and individual users of CAB Abstracts.

CABI provided information on the top 20 Australian subscribers to CAB Abstracts. Subscribers were individually contacted (the contact point usually being a library administrator) and asked if they would be willing to participate in a user survey. From this, 18 organisations were sent survey forms (covering 6 government agencies and 12 universities). Each administrator was asked to fill out an administrator survey and forward a separate user survey to key users within their organisation.

Each administrator was then followed up three times in order to ensure maximum responses. Administrator surveys were completed by 10 organisations (5 government and 5 university) and individual user survey responses were provided from 6 organisations (3 government and 3 university). In all, 27 individual responses came from these organisations, as set out in Figure 3.

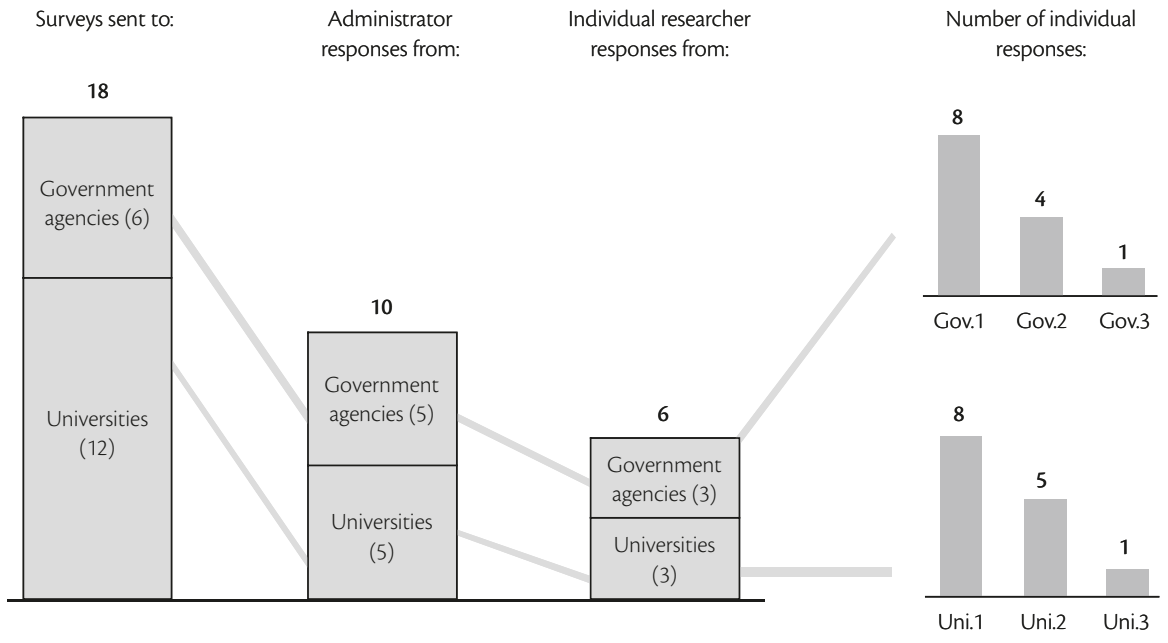

Figure 3. CAB Abstracts sample frame and responses

CABI Compendia

The set of users of CABI Compendia is considerably smaller than that of CAB Abstracts and these subscribers were individually identified through a combination of information from CABI and follow-ups within the Australian Government.

Detailed survey responses were obtained from nine organisations, comprising five state government agencies and four Australian Government agencies, all dealing with biosecurity issues.

CAB Abstracts: survey of library administrators

Librarians and library administrators were asked about their subscriptions to CAB Abstracts, their sensitivity to price changes (as a measure of consumer surplus), their reasons for choosing CAB Abstracts over its competitors and usage statistics.

Access platform and licence type

CAB Abstracts is accessed through diverse platforms. Of the 10 libraries that responded, 4 accessed CAB Abstracts directly from CABI, and 6 through other services.

Most site licences are for four concurrent users. Two government departments had site licences for 8 concurrent users while one (large) university had a licence for 12 concurrent users.

Subscription and renewal

The majority of libraries surveyed renewed their subscriptions to CAB Abstracts annually. Many had been subscribing to CAB Abstracts and its predecessors for 10–20 years.

Criteria for renewal

Libraries indicated a number of criteria for deciding whether to renew a particular information service. The criteria most frequently cited were:

- usage statistics
- relevance of the product to core areas of teaching and research
- depth of product coverage
- reliability
- cost.

Other criteria listed by some libraries include the access model, comparison with other databases, user-friendliness, and the quality and scope of content.

Tolerance for a price increase

The library administrators were asked how much extra they would be prepared to pay for access to CAB Abstracts before deciding to discontinue the subscription. The mean maximum price increase that would be tolerated was 32%.

Other abstracts databases

Many of the libraries surveyed also subscribed to related or competing products. They were, in order of frequency, Web of Science (6 libraries), AGRICOLA (5), BIOSIS (3), CSA Life Sciences (3), and AGRIS (2).

Reasons for choosing CAB Abstracts

The reasons for choosing CAB Abstracts cited by libraries were:

- comprehensive coverage (breadth, depth and time span)
- value for money
- complementarity with other databases (such as BIOSIS and World of Science)
- reputation of provider
- search accuracy.

Relative search accuracy and search time

While a number of the librarians considered that CAB Abstracts' search accuracy was similar to that of other abstracts databases, one large university library that had undertaken a detailed evaluation of CAB Abstracts and its competitors had ranked the different database products by their comparative search accuracy and search time. Results were as follows.

Comparative accuracy: 1. CAB Abstracts, BIOSIS and Web of Science; 2. AGRICOLA; 3. AGRIS; 4. Biological Sciences via CSA Illumina

Comparative search time: 1. CAB Abstracts, BIOSIS, AGRICOLA, Web of Science; 2. Biological Sciences via CSA Illumina; 3. AGRIS.

User profile and usage frequency

The library administrators indicated that CAB Abstracts is used by researchers from many departments in their organisations. The users were engaged in widely diverse research areas, including forestry, environmental science, horticulture, plant science and plant breeding, biomedicine, agriculture, veterinary sciences (including dairy science), public health and tropical medicine, tourism, resource management and environmental studies.

Usage statistics

One of the university libraries surveyed reported that there were 1,824 sessions where users accessed CAB Abstracts in 2004. Some 5,991 searches were conducted. Three other libraries also collected usage statistics but did not release them to us.

Other CABI products

The 10 libraries that responded also purchased or subscribed to other CABI products:

- Forestry Compendium (1 library)
- Crop Protection Compendium (1)
- CAB Archives (2)
- CAB Thesaurus (1)
- online journals (5)
- books (3).

CAB Abstracts: survey of end users

Twenty-seven end users (from three universities and three government agencies) responded to a survey on the frequency, duration and fruitfulness of their CAB Abstracts sessions. Respondents were also asked about the performance of CAB Abstracts relative to other abstracts databases they knew about, and how much extra time would be involved in trying to do the same literature research in the absence of CAB Abstracts.

Profile of end users

Of the 27 survey responses received from end users: 13 in government agencies and 14 in universities. The university users were primarily university teaching staff, but also included five postgraduate students and one librarian.

Research areas

The research areas of the end users were very diverse, ranging from agricultural science and applied statistics to veterinary science (Table 5).

Reasons for using CAB Abstracts

Many reasons were given by the responding end users for using CAB Abstracts, including:

- ease of compiling a body of scientific data to demonstrate an argument or validate a risk rating
- ability to access research literature while working from a rural location
- ease of finding relevant literature when writing reviews and books
- ability to find out if a pathogen or micro-organism has been reported in Australia and the severity of any disease that had resulted
- access to published articles on pest distribution and host relationships
- ability to source papers to provide a literature review when preparing lectures
- ease of finding research articles for theses
- ability to find up-to-date research on sampling techniques for weeds in agriculture
- ability to assist method development for research projects
- rapid location of important literature for a new research topic area.

Table 5. Research areas of respondents to the survey of end users

Universities	
Agricultural science	Agriculture
Biometry	Pastures
Economic modelling of farms	Environmental horticulture
Horticultural science	Plant biology and ecology
Milk marketing margins	Soil science
Plant sciences	Marine biology
Government agencies	
Animal health and production	Aquatic and terrestrial animal disease
Invertebrate pest risk analysis	Entomology
Lupin R&D	Plant biosecurity
Farming systems	Veterinary quarantine
Swine health	Veterinary science – animal welfare

Source: CIE survey of end users

Access and yield statistics

The end users were asked:

- how many times they accessed CAB Abstracts in a typical month
- how long the average session was
- how many searches they made during a typical session
- how many useful articles they found in a typical session
- how many of these articles influenced their subsequent research.

Access frequency

On average, the responding end users accessed CAB Abstracts 5.7 times a month (with a standard deviation of 7.64). As Figure 4 illustrates, the distribution of accesses is skewed, with a large range (from 35 times a month to one every 2 months) and with a median around half the mean.

Session duration

The mean session duration for the end users was 42.5 minutes (Figure 5), with a median duration of 30 minutes (standard deviation 35 minutes). Session durations ranged from 10 to 120 minutes

Access frequency versus duration

Figure 6 indicates that there is no systematic relationship between access frequency and session duration. This may indicate that, rather than researchers doing reviews all at once—perhaps in a very long session every few months, usage is more frequent. Most likely, literature review is undertaken in response to the needs of research as they arise.

Yield per session

On average, 12.5 useful articles were found per session. Again the distribution amongst respondents was skewed, with seven being the median number of useful articles found (Figure 7).

As Figure 8 illustrates, there is no systematic relationship between session duration and the number of useful articles found per session. One implication of this is that users may continue with a session until they consider a suitable number of articles has been found or until they consider that sufficient ground has been covered.

Comparison with other abstracts databases

Other abstracts databases that some of the surveyed end users were familiar with included AGRICOLA, PubMed, Scirus, BIOSIS and Web of Science.

Relative accuracy

Of the end users, five believed that CAB Abstracts searched with similar accuracy to its competitors, three believed that CAB Abstracts had better search accuracy than AGRICOLA, and one user claimed that the search accuracy of CAB Abstracts was inferior to that of the Web of Science. The others had no opinion on relative search accuracies.

Other advantages of CAB Abstracts

The end users believed that the advantages of CAB Abstracts over its competitors included:

- ease of use
- comprehensive coverage and the ability to find obscure publications
- massive archive of older publications
- provision of important keywords.

Disadvantages of CAB Abstracts

Some of the disadvantages of CAB Abstracts noted by a few survey respondents were:

- a bias towards 'British coverage' (the respondent did not elaborate on what he/she meant by this)
- fewer recent articles than PubMed and ASFA
- the Web of Science gave a wider set of references
- in horticulture, there was a focus on production matters, with little on social or environmental issues.

The world without electronic abstracts databases

When asked what alternative research strategies they would pursue in the complete absence of electronic abstracts databases, the end user respondents listed the following:

- use Google™ and Google Scholar™
- talk to relevant colleagues
- search journals individually and use library catalogues and services
- use hard-copy indexes of abstracts in libraries
- use reference lists of prominent authors in areas of interest
- use open-access online journals.

Three of the end users surveyed claimed they simply could not imagine having no access to CAB Abstracts or its competitors, and would be at a loss to know how to proceed if such a situation arose.

Extra time taken and information yield without CAB Abstracts

Respondents were directly asked how much longer it would take them to research the literature in the absence of CAB Abstracts, and what proportion of information that would have been obtained from CAB Abstracts could in fact be obtained from alternative sources.

On average, respondents claimed that it would take 2.7 times longer to find and search the relevant literature if they were denied access to CAB Abstracts or its competitors (Figure 9). The distribution of these answers is slightly skewed, with the median being 2.5 times longer. This is similar to the extra time that can be inferred from the analysis of Kawasaki (2004) discussed earlier.

In addition, users believed that in using the alternatives, they would find, on average, only 64% of the information they would have obtained using CAB Abstracts (Figure 10). In this case, the median result was 70%. This proportion is lower than might be inferred from the analysis of Kawasaki (2004) discussed earlier.

Assisting dissemination of research results

Six of the responding end users felt that CAB Abstracts helped to disseminate research results. The inclusion of their published research in CAB Abstracts resulted in enquiries about the research and requests for reprints of their publications. It was, however, difficult to quantify this effect.

End user survey: CABI Compendia

End users and decision-makers from government and private-sector organisations were asked to participate in a survey to determine which CABI Compendia products were purchased and how and why they were used.

Respondents

Most replies came from a senior person within an organisation, who responded on behalf of multiple users. The participants came from four Australian Government departments, four state-government departments and one private-sector organisation. The role of the responding person was generally in research or management.

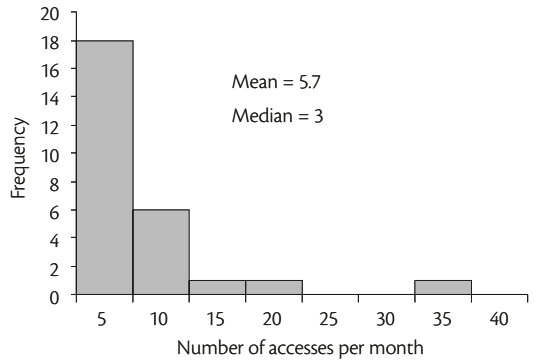

Figure 4. Frequency distribution of use of CAB Abstracts by survey respondents. Data source: CIE end user survey.

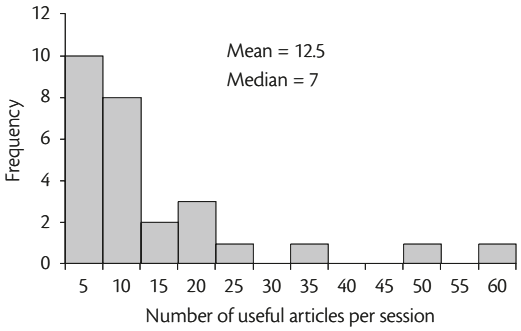

Figure 7. Frequency distribution of the numbers of useful articles found by survey respondents per session on CAB Abstracts. Data source: CIE end user survey

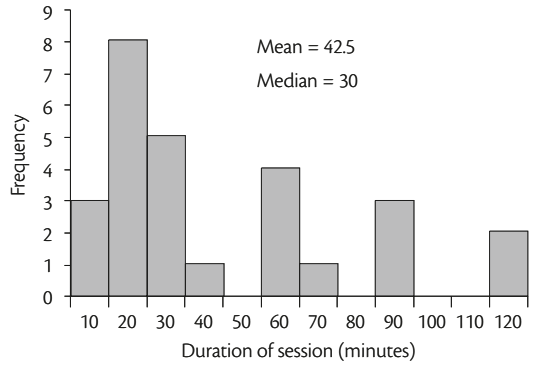

Figure 5. Frequency distribution of average CAB Abstracts session duration of survey respondents. Data source: CIE end user survey

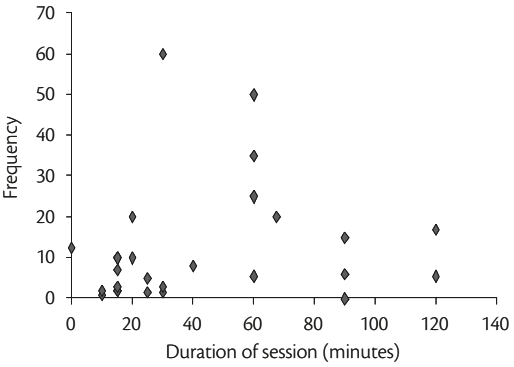

Figure 8. Plot of CAB Abstracts session duration versus number of useful articles found by survey respondents. Data source: CIE end user survey

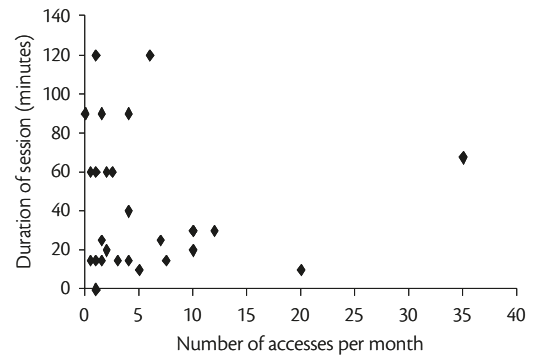

Figure 6. Frequency of access of CAB Abstracts versus session duration for survey respondents. Data source: CIE end user survey

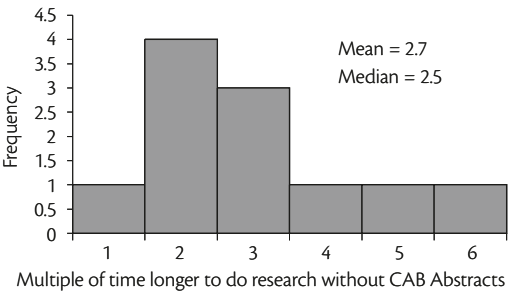

Figure 9. Frequency distribution of survey respondents' estimates of the relative increase in time that would be needed to undertake literature searches without CAB Abstracts. Data source: CIE end user survey

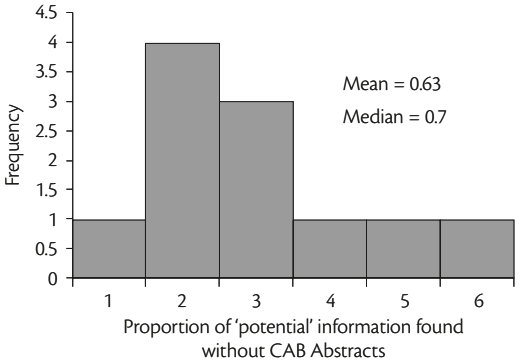

Figure 10. Survey respondents' estimates of the reduced proportion of information that would be obtained if CAB Abstracts were not available. Data source: CIE end user survey

Product use

All of the respondents used only the Crop Protection Compendium and indicated that they were highly unlikely to use the forthcoming coffee and aquaculture products.

The Crop Protection Compendium was first released in 1997 and most of the respondents indicated that they had used it since around that time. One participant indicated that their organisation had used it only since 2000, but was uncertain about this, while three others could give no indication of when their organisation began using the product.

Purchasing decisions

Decision-makers were asked a range of questions on their purchasing choices, in order to ascertain why they chose CABI Compendia.

When assessing products for purchase, the following criteria were used:

- suitability
- thoroughness
- price and convenience
- effectiveness.

The characteristics which led to the purchase of CABI Compendia, specifically the Crop Protection Compendium, over competing products included:

- better scientific validation of data
- speed of access
- ease of finding relevant information
- comprehensiveness.

Alternatives

None of the respondents cited specific alternatives to the Compendia but the most commonly considered in general terms were the internet or library searches along with journal searches and industry publications.

Tolerance for price increase

The mean percentage price increase that would be tolerated by the responding organisations was 25%, but was 50% for one Australian Government department. The same department had the highest stated monthly use of the product.

Product usage

The frequency of use of CABI Compendia by respondents was quite high, with some individuals indicating daily use. The per person number of references found and subsequently used in research was quite high and most users indicated that the product saved them time.

Access frequency

The mean number of sessions per month was 12.7 (Figure 11), with a median of 10.

Session duration

Average session duration was 42 minutes, with a median duration of 45 minutes (Figure 12).

Numbers of useful references

On average, survey respondents found 4.4 useful references per session (Figure 13) with most of them being used in subsequent work.

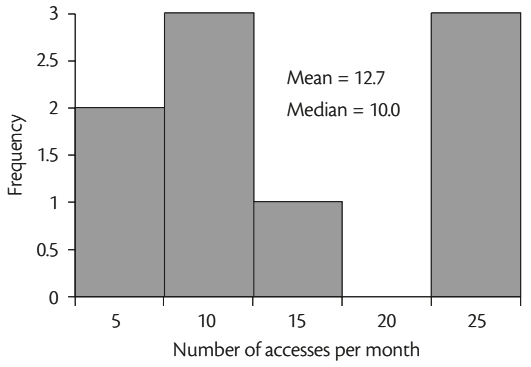

Figure 11. Survey respondents' frequency of access of CABI Compendia. Data source: CIE end user survey

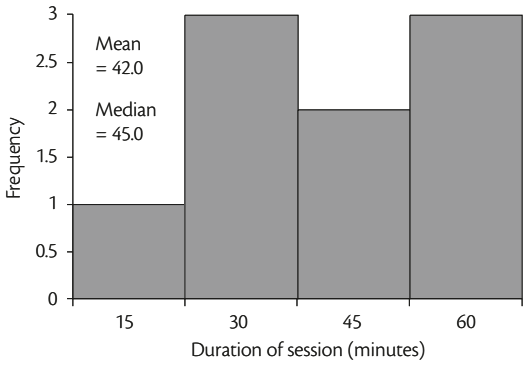

Figure 12. Frequency distribution of duration of access to CABI Compendia by survey respondents. Data source: CIE end user survey

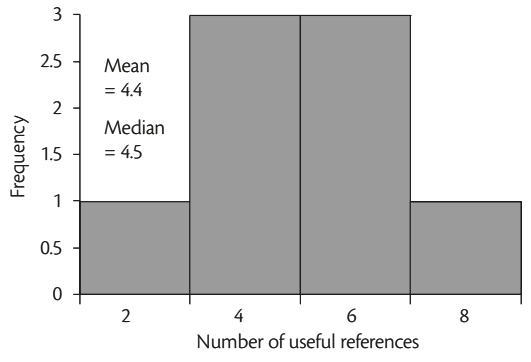

Figure 13. Numbers of useful references found by survey respondents per session access to CABI Compendia. Data source: CIE end user survey

The world without CABI Compendia

Although library and internet searches, combined with industry publications and journal searches, were frequently cited as alternatives to CABI Compendia, most researchers said they would take longer to perform and would not yield as much information. Several said that doing the same work without CABI Compendia would be almost impossible.

How much longer do the same work?

Users generally considered that it would take longer to do the same literature research in the absence of CABI Compendia. On average, survey respondents said it would take 6.2 times longer (Figure 14). The median was 5 times longer.

What proportion of information would be found?

Users also considered that trying to do the same work without CABI Compendia would yield fewer results in total (Figure 15). On average, the alternatives were expected to yield 75% of what could be obtained with the Compendia. The distribution of this is skewed, with a median of 85%.

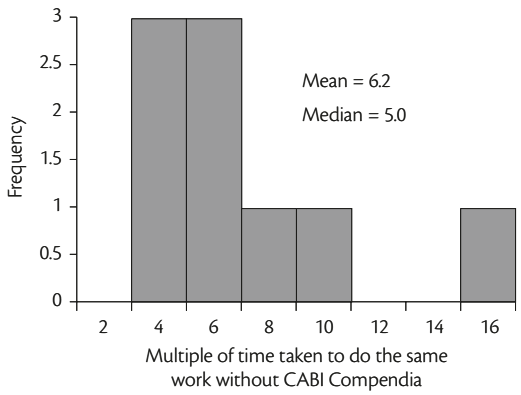

Figure 14. Survey respondents' estimates of the increase in relative time that would be needed to search the literature using methods other that CABI Compendia. Data source: CIE end user survey

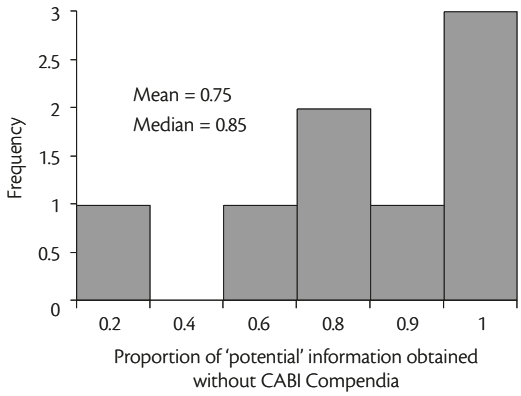

Figure 15. Survey respondents' estimates of the proportion of potential information that would be obtained using methods other than CABI Compendia. Data source: CIE end user survey

5 Valuing the benefits

Background

The survey results and discussion indicate that researchers spend a significant amount of time using CABI products, that they generally prefer CABI products to any alternatives and that using these products both saves time and increases the likelihood of finding useful material.

Given that the primary benefit of CABI products is the time saved in undertaking research, we focus our quantitative valuation on the amount of time saved using CABI products over the alternatives. In particular, we construct a counterfactual in which we imagine that CABI products are removed from the market. We then use the survey results to quantify the increase in the time spent on literature search in the absence of CABI products. There are three aspects to this quantification:

- estimating the number of days increase in time per researcher
- choice of an appropriate valuation of that time
- application of the per-researcher estimates to an appropriate population base to yield total benefits.

Key assumptions

The construction of the counterfactual is very much partial equilibrium in that we cannot fully account for the responses of other supplies should CABI products disappear from the market. Given that CABI appears to fill a particular niche and is able to do so because of its structure, it is unlikely that other products will fill the niche in the short term. Over the longer term, however, other publishers may well do so.

Our estimates of time saved from the use of CABI products come from subjective evaluations of users themselves. That is, users were directly asked to estimate the extra time required in the notional absence of CABI products. Such a notional situation is, of course, difficult to fully think through and we cannot be sure that the stated expectations of users necessarily reflect actual outcomes were CABI products to be removed. Users themselves may adjust their behaviour in various ways to change the impact. Indeed, some users noted that, because it would take longer to do the literature review, less would actually be done—implying a substitution for other research activities. This 're-optimisation' aspect of the problem is considered further below when we discuss valuation of the increased time per researcher.

As is evident from the survey results, and as will be seen further below, there is a very broad, and often skewed, distribution of outcomes from the survey. This raises the question as to whether the survey results can be considered as representative of the underlying population, or whether there is bias or lack of precision in the results.

We were able contact 18 organisations that subscribe to CAB Abstracts. All of them were part of the survey, and we ultimately received user responses from 6 of the 18 (a 33% response rate) covering 27 users (an average of 4.5 users per organisation). We estimate that there is a population base of around 900 researchers (see below), so our end user respondents represent 3% of the population. From a sampling perspective this is small, but given the resources we had to devote to getting this response, we consider that it would be unreasonable to expect anything higher.

For the CABI Compendia, there is a much smaller population base because of the nature of the product. Here we consider that we have covered most of the users, but that the diversity of uses creates a problem in generating a representative result.

Increase in time per researcher

Two sets of questions in the survey of end users were designed to derive information about the notional effect of the removal of CAB Abstracts or CABI Compendia, in particular how long it would take to do the same work without the CABI products and what proportion of information would be obtained using the alternatives.

Using the information on initial time spent and expected increase in time in the absence of CABI products, we can estimate the net effective increase in researcher days to do the same amount of work in the absence of the CABI products; that is, we can use the survey data to simulate the effect of the removal of CABI products. In doing this we focus on the increase in labour time required to do the same amount of research if CABI products were absent.

We calculate:

- (Net increase in time) = (Original time spent) × (Estimated increase in time) – (Original time spent)
- (Net increase in effective time) = (Net increase in time)/(Proportion of information)

The original time spent, increase in time and proportion of information are all taken from the survey results (either for the CAB Abstracts end users or the Compendia users). The full dataset is used to simulate the results of the above two calculations; that is, using the original data, we repeatedly sample from the survey distributions recalculating the two variables of interest (increase in time and increase in effective time) each time. Doing this a large number of times provides a probability distribution for days and effective days.[1]

The results are summarised in Figure 16.

The top panel of the chart shows that we interpret the information from the survey as providing an indication of the horizontal shift in the substitution curve as a result of removing CABI products. That is, to produce the same output, more labour input in terms of literature review is needed.

The bottom panels of the chart show the simulated increase in the number of researcher-days, and effective researcher-days obtained from the survey.

The results show that:

- the removal of CAB Abstracts would result in an average productivity loss of 7 days per researcher per year, with a median loss of 3 days per researcher per year
- the removal of CAB Abstracts would result in an average effective-days loss of 16 per researcher per year, with a median of 5 days per researcher per year
- the removal of CABI Compendia would result in an average productivity loss of 60 days per researcher per year, with a median loss of 37 days per researcher per year
- the removal of CABI Compendia would result in an average effective-days loss of 200 per researcher per year, with a median loss of 54 days per researcher per year.

Several points are evident from these results.

- The distribution of results is highly skewed. This is a consequence of the skewed distribution of all the input variables (initial time spent, expected increase in time and so on). The 'direction' of the skew in all these cases is the same, so the effects are compounding.

[1] That is, we have used a bootstrap procedure to calculate the distribution of the results of a calculation (additional time and effective time) based on the original data. This can also be interpreted as a form of sensitivity analysis—rather than calculating the variable of interest from the average survey results, we have used the full set and generated a probability distribution for the results.

- That the expected time increase is higher for CABI Compendia than for CABI Abstracts reflects the initial amount of time spent using those products, which was higher for the Compendia.
- The results for the Compendia are very high, especially the mean effective days lost. Indeed, the upper end of the distribution seems a little unrealistic. Taken at face value, this implies that a small number of researchers would need to spend most of their year in activities to replace the loss of CABI Compendia.

Because of the skewed nature of the distribution, in the analysis that follows we focus on the median benefits rather than the mean, as we consider this provides a better indication of central tendency.

Valuation of the time

As noted above, the actual increase in labour time spent on literature review will not necessarily be the same as the initial expectation. The initial shift in the substitution curve is not necessarily the final result—that depends on the shape of the curve and the exact nature of the shift. This is illustrated in Figure 17. If the curve shifts as illustrated, from O^1 to O^2, and if the slope of the budget line at O^2 is the same as at O^1, then the new optimal point will indeed involve exactly ($L^2 - L^1$) of additional labour, and the increase in research costs is equal to this value multiplied by an appropriate labour cost.

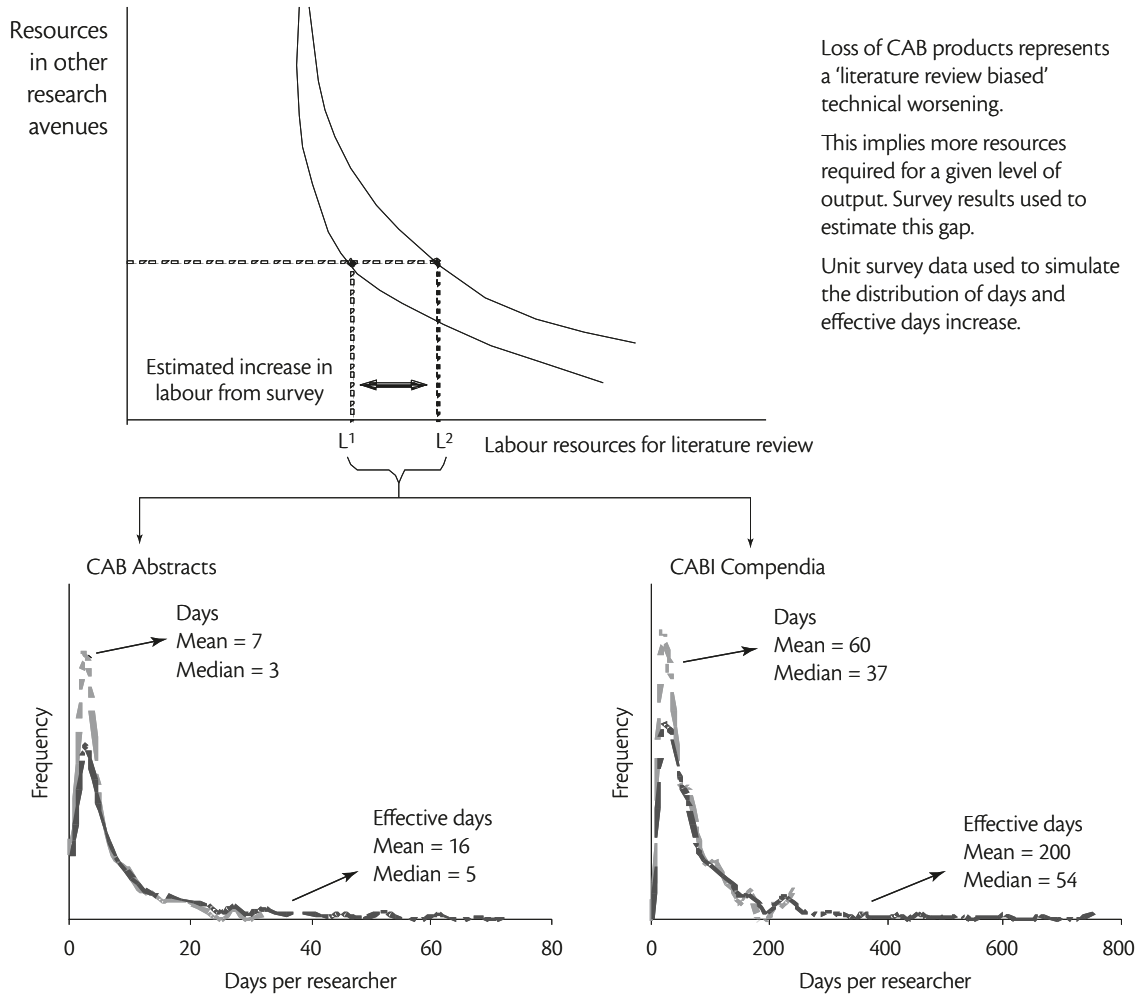

Figure 16. Simulation of the effect of removing CABI information products, in terms of the number of extra days per researcher per year thereby needed. Data source: CIE estimates

This is a special case, however. It is possible that the new optimal point will involve a combination of changes in literature review and other research activities. The dotted lines on Figure 17 show alternative curve shapes that would each give a different outcome to the final point O^2.

Estimating the total change in costs requires knowledge of the full shape of the substitution curve. Given that this is not available, we value of the increase in labour time using the labour cost rate. This is only an approximation, however, and probably forms an upper bound to the cost.

Calculation of average researcher costs

To estimate average person-year researcher costs, we combine information from the Australian Bureau of Statistics (ABS 2004) on research costs, with appropriate weights taken from our estimate of the underlying population. The calculations are set out in Table 6. Because different sectors (university, Australian Government and state government) have different weights for the two CABI products, the average cost is different for CAB Abstracts and CABI Compendia.

Overall, the average cost per researcher involved in CAB Abstracts is $175 per day, while the average cost per researcher involved in CABI Compendia is $283 per day.

Valuing person days using estimated costs

Using the researcher costs set out in Table 6 and applying these to the extra days required should the CABI products we removed, we find that the median cost per researcher (per year) of removing CABI products is:

- $525 in person-days for CAB Abstracts
- $875 in effective person-days for CAB Abstracts
- $10,470 in person-days for CABI Compendia
- $15,282 in effective person-days for CABI Compendia.

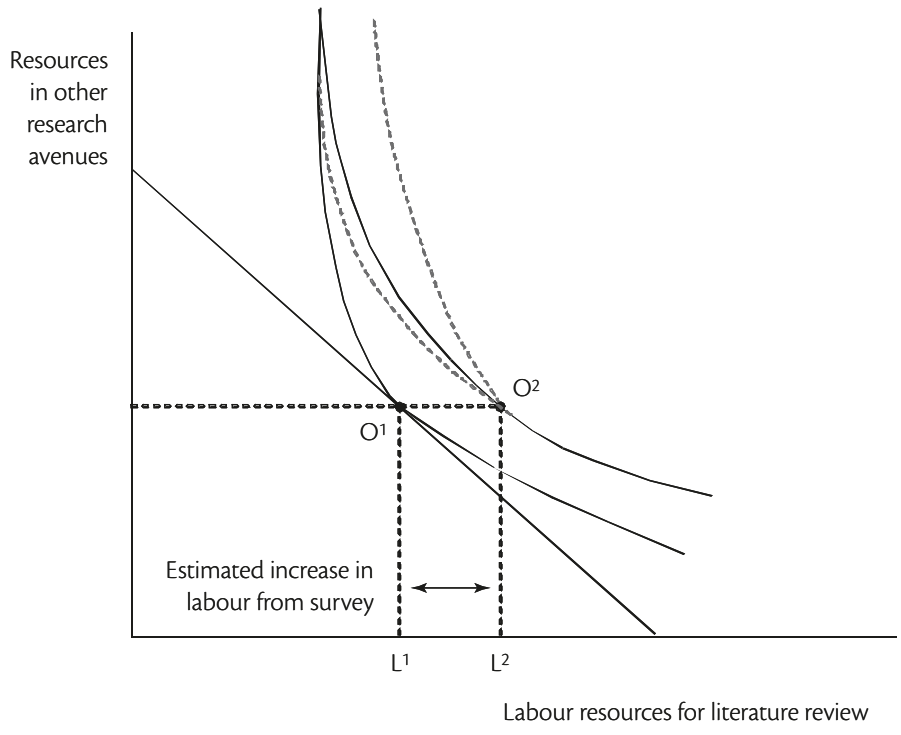

Figure 17. Re-optimisation as a result of the productivity loss

Application to an appropriate population base

The per-researcher costs can be converted to a total cost by applying them to an appropriate population base. Because the survey respondents did not supply any aggregate usage information, we need to indirectly calculate the appropriate population base.

Table 7 sets out the basis of the calculation for CAB Abstracts. From ABS (2004) we derive an estimate of the number of researcher-years per organisation. This ranges from 54 in the case of universities to 200 in the case of Australian Government and state agencies.

In order to be conservative, we assume that half this number is applicable to the population base using CAB Abstracts. Applying this to the number of organisations that we surveyed, we generate an estimate of the number of researcher-years as 900. To put this in context, we note that, according to ABS (2004) estimates, there are around 6,000 researcher-years in relevant research fields. Thus, the CAB Abstracts population is around 15% of total researchers in the field.

For CABI Compendia, the underlying population is likely to be considerably smaller, as the application of the product is more restricted to specialists. We assume in this case that there are 10 researchers per organisation which, when applied to our survey responses, yields a population of 90.

Table 6. Calculation of average costs for researchers using CAB Abstracts or CABI Compendia

	University	Australian Government	State government
Labour costs per person year	$29,000	$77,000	$60,000
Weights for CAB Abstracts [a]	0.66	0.12	0.22
Average wage for CAB Abstracts:			
Per person year	$42,000		
Per person day	$175		
Weights for CABI Compendia [b]	0	0.55	0.45
Average wage for CABI Compendia			
Per person year	$68,000		
Per person day	$283		

[a] Taken from our population estimates: 12 universities, 2 Australian Government agencies and 4 state agencies.

[b] Taken from our survey, four Australian Government agencies and four state agencies.

Source: CIE estimates based on ABS (2004), CABI, Survey information

Table 7. Calculation of population base for CAB Abstracts

	University	Australian Government	State government	Total
(1) Researcher-years per organisation	54	200	200	
(2) Assumption for analysis [0.5×(1)]	25	100	100	
(3) Organisations in population	12	2	4	
(4) Estimated number of researchers [(2)×(3)]	300	200	400	900

Source: CIE estimates based on ABS(2004) and CABI

Applying these population figures to the per-researcher costs yields a total annual cost of removing CABI products (or an annual benefit from having CABI products) of:

- $472,500 in person-days for CAB Abstracts
- $787,500 in effective person-days for CAB Abstracts
- $942,300 in person-days for CABI Compendia
- $1,375,380 in effective person-days for CABI Compendia.

To put these into context, from the ABS (2004) data we estimate that total labour research costs in relevant fields are $330 million per year. Thus the combined savings from CAB Abstracts and CABI Compendia (using the labour days rather than the effective days, which comes to $1.4 million) are 0.5% of these costs. Using the effective days, the savings are 0.7% of total costs.

These annual savings are equivalent to an additional and substantial extra research project each year. If the funds are indeed spent on extra research, then we would also expect additional flow-on benefits. Total Australian research expenditure on agricultural and related fields is around $1.2 billion per year (ABS 2004). The cost savings from the use of CABI products is therefore equivalent to between a 0.1 and 0.2% increase in annual research funding.

6 Conclusions

When evaluating the impact of research activities, it is usual to value the effect of a particular new piece of knowledge, usually in the form of a technology or a product. Here we have considered the impact of two specific products designed to assist in the research process itself.

The two CABI products examined here—CAB Abstracts and CABI Compendia—are designed to help researchers to do their jobs more effectively and, in the process, save real resources that then become available for use elsewhere.

We have structured our analysis around the idea that the CABI products allow researchers to do more with less—to produce more research output for the same resources. In particular, we have viewed the products as a labour-saving technology and have estimated the magnitude of this saving using a direct survey of users.

We adopted a survey-based approach, as we considered that there were few alternatives to finding out how the CABI products were actually used and the sorts of impact they have. As is often the case, there were a number of trade-offs in taking this approach. As is frequently the case with surveys of this kind (where those surveyed have no particular incentive to respond), we found it very difficult to obtain a significant number of responses. Responses were obtained with considerable individual 'case management' and, of course, after a point, research ethics demanded that we simply stop asking.

Further, it turned out that the users of CABI products were extremely diverse, covering a broad range of fields and a broad range of research purposes. As a consequence, we cannot be sure that our estimates are representative of the full population.

Nevertheless, we consider that our results are very revealing. They show that labour-saving technologies in knowledge management, by providing small but significant savings to a number of users can, in aggregate, provide significant benefits.

One of the implications of this is that, in some cases, there may be good justification for agencies such as ACIAR to fund (or to continue funding) activities which enhance the productivity of researchers. As we have illustrated, such funding is, in essence, equivalent to finding extra research funds and so is likely to increase the efficiency with which taxpayer funds are used.

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IMPACT ASSESSMENT SERIES

No.	Author(s) and year of publication	Title	ACIAR project numbers
1	Centre for International Economics (1998)	Control of Newcastle disease in village chickens	8334, 8717 and 93/222
2	George, P.S. (1998)	Increased efficiency of straw utilisation by cattle and buffalo	8203, 8601 and 8817
3	Centre for International Economics (1998)	Establishment of a protected area in Vanuatu	9020
4	Watson, A.S. (1998)	Raw wool production and marketing in China	8811
5	Collins, D.J. and Collins, B.A. (1998)	Fruit fly in Malaysia and Thailand 1985–1993	8343 and 8919
6	Ryan, J.G. (1998)	Pigeon pea improvement	8201 and 8567
7	Centre for International Economics (1998)	Reducing fish losses due to epizootic ulcerative syndrome—an ex ante evaluation	9130
8	McKenney, D.W. (1998)	Australian tree species selection in China	8457 and 8848
9	ACIL Consulting (1998)	Sulfur test KCL–40 and growth of the Australian canola industry	8328 and 8804
10	AACM International (1998)	Conservation tillage and controlled traffic	9209
11	Chudleigh, P. (1998)	Post-harvest R&D concerning tropical fruits	8356 and 8844
12	Waterhouse, D., Dillon, B. and Vincent, D. (1999)	Biological control of the banana skipper in Papua New Guinea	8802-C
13	Chudleigh, P. (1999)	Breeding and quality analysis of rapeseed	CS1/1984/069 and CS1/1988/039
14	McLeod, R., Isvilanonda, S. and Wattanutchariya, S. (1999)	Improved drying of high moisture grains	PHT/1983/008, PHT/1986/008 and PHT/1990/008
15	Chudleigh, P. (1999)	Use and management of grain protectants in China and Australia	PHT/1990/035
16	McLeod, R. (2001)	Control of footrot in small ruminants of Nepal	AS2/1991/017 and AS2/1996/021
17	Tisdell, C. and Wilson, C. (2001)	Breeding and feeding pigs in Australia and Vietnam AS2/1994/023	
18	Vincent, D. and Quirke, D. (2002)	Controlling *Phalaris minor* in the Indian rice–wheat belt	CS1/1996/013
19	Pearce, D. (2002)	Measuring the poverty impact of ACIAR projects—a broad framework	
20	Warner, R. and Bauer, M. (2002)	*Mama Lus Frut* scheme: an assessment of poverty reduction	ASEM/1999/084
21	McLeod, R. (2003)	Improved methods in diagnosis, epidemiology, and information management of foot-and-mouth disease in Southeast Asia	AS1/1983/067, AS1/1988/035, AS1/1992/004 and AS1/1994/038
22	Bauer, M., Pearce, D. and Vincent, D. (2003)	Saving a staple crop: impact of biological control of the banana skipper on poverty reduction in Papua New Guinea	CS2/1988/002-C
23	McLeod, R. (2003)	Improved methods for the diagnosis and control of bluetongue in small ruminants in Asia and the epidemiology and control of bovine ephemeral fever in China	AS1/1984/055, AS2/1990/011 and AS2/1993/001
24	Palis, F.G., Sumalde, Z.M. and Hossain, M. (2004)	Assessment of the rodent control projects in Vietnam funded by ACIAR and AUSAID: adoption and impact	AS1/1998/036
25	Brennan, J.P. and Quade, K.J. (2004)	Genetics of and breeding for rust resistance in wheat in India and Pakistan	CS1/1983/037 and CS1/1988/014
26	Mullen, J.D. (2004)	Impact assessment of ACIAR-funded projects on grain-market reform in China	ANRE1/1992/028 and ADP/1997/021
27	van Bueren, M. (2004)	Acacia hybrids in Vietnam	FST/1986/030
28	Harris, D. (2004)	Water and nitrogen management in wheat–maize production on the North China Plain	LWR1/1996/164
29	Lindner, R. (2004)	Impact assessment of research on the biology and management of coconut crabs on Vanuatu	FIS/1983/081

IMPACT ASSESSMENT SERIES <CONTINUED>

No.	Author(s) and year of publication	Title	ACIAR project numbers
30	van Bueren, M. (2004)	Eucalypt tree improvement in China	FST/1990/044, FST/1994/025, FST/1984/057, FST/1988/048, FST/1987/036, FST/1996/125 and FST/1997/077
31	Pearce, D. (2005)	Review of ACIAR's research on agricultural policy	
32	Tingsong Jiang and Pearce, D. (2005)	Shelf-life extension of leafy vegetables—evaluating the impacts	PHT/1994/016
33	Vere, D. (2005)	Research into conservation tillage for dryland cropping in Australia and China	LWR2/1992/009, LWR2/1996/143
34	Pearce, D. (2005)	Identifying the sex pheromone of the sugarcane borer moth	CS2/1991/680
35	Raitzer, D.A. and Lindner, R. (2005)	Review of the returns to ACIAR's bilateral R&D investments	
36	Lindner, R. (2005)	Impacts of mud crab hatchery technology in Vietnam	FIS/1992/017 and FIS/1999/076
37	McLeod, R. (2005)	Management of fruit flies in the Pacific	CS2/1989/020, CS2/1994/003, CS2/1994/115 and CS2/1996/225
38	ACIAR (2006)	Future directions for ACIAR's animal health research	
39	Pearce, D., Monck, M., Chadwick, K. and Corbishley, J. (2006)	Benefits to Australia from ACIAR-funded research	
40	Corbishley, J. and Pearce, D. (2006)	Zero tillage for weed control in India: the contribution to poverty alleviation	CS1/1996/013
41	ACIAR (2006)	ACIAR and public funding of R&D, Submission to Productivity Commission study on public support for science and innovation	
42	Pearce, D. and Monck, M. (2006)	Benefits to Australia of selected CABI products	

ECONOMIC ASSESSMENT SERIES (DISCONTINUED)

No.	Author(s) and year of publication	Title	ACIAR project numbers
1	Doeleman, J.A. (1990)	Biological control of salvinia	8340
2	Tobin, J. (1990)	Fruit fly control	8343
3	Fleming, E. (1991)	Improving the feed value of straw fed to cattle and buffalo	8203 and 8601
4	Doeleman, J.A. (1990)	Benefits and costs of entomopathogenic nematodes: two biological control applications in China	8451 and 8929
5	Chudleigh, P.D. (1991)	Tick-borne disease control in cattle	8321
6	Chudleigh, P.D. (1991)	Breeding and quality analysis of canola (rapeseed)	8469 and 8839
7	Johnston, J. and Cummings, R. (1991)	Control of Newcastle disease in village chickens with oral V4 vaccine	8334 and 8717
8	Ryland, G.J. (1991)	Long term storage of grain under plastic covers	8307
9	Chudleigh, P.D. (1991)	Integrated use of insecticides in grain storage in the humid tropics	8309, 8609 and 8311
10	Chamala, S., Karan, V., Raman, K.V. and Gadewar, A.U. (1991)	An evaluation of the use and impact of the ACIAR book Nutritional disorders of grain sorghum	8207
11	Tisdell, C. (1991)	Culture of giant clams for food and for restocking tropical reefs	8332 and 8733
12	McKenney, D.W., Davis, J.S., Turnbull, J.W. and Searle, S.D. (1991)	The impact of Australian tree species research in China	8457 and 8848
	Menz, K.M. (1991)	Overview of Economic Assessments 1–12	