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Rural Industries Research and
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Pollination Australia

Education and Training

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By David Brous and Jude Nettleingham

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Foreword

This report informs the pollination industry on issues relevant to the specification and satisfaction of the education and training needs of the industry, comprising those horticultural and agricultural industries dependent on pollination services and the providers of pollination services.

The report highlights the key issues that need to be considered in identifying, prioritising and actioning initiatives to advance the knowledge and skills base of pollinators and growers dependent upon pollination for the production of crops. Investment in education and training will assist in securing ongoing access to reliable, consistent quality and cost-effective pollination services to support the sustainability without which many Australian rural industries would not be productive.

The project has its genesis in a Honeybee Industry Linkages workshop hosted by the Rural Industries Research and Development Corporation (RIRDC) in Canberra in April 2007, funded by the Department of Agriculture, Fisheries and Forestry (DAFF) under its Advancing Agricultural Industries Programme (Advancing Industries) and by RIRDC. The workshop was attended by stakeholders across a range of pollination dependent industries.

At the Honeybee Industry Linkages workshop, the pollination industry agreed to form an entity known as Pollination Australia, an industry alliance between the honeybee industry as providers of pollination services and those horticultural and agricultural industries that are dependent on honeybee pollination. A business plan for the alliance will be prepared, including three linked consultancies to inform the business plan. The consultancies were a risk management assessment, an education and training strategy for the pollination industry and a research and development plan. This report is the outcome of the second consultancy. Advancing Agricultural Industries and RIRDC are providing support for the formation of the industry alliance and for development and endorsement of the business plan.

All industries with a dependency on pollination services, should consider the possible strategies suggested and participate in planned industry decision-making.

This report, an addition to RIRDC's diverse range of over 1800 research publications, forms part of our Honeybee R&D program, which aims to improve the productivity and profitability of the Australian beekeeping industry.

Most of our publications are available for viewing, downloading or purchasing online through our website:

Most of our publications are available for viewing, downloading or purchasing online through our website:

- Downloads at www.rirc.gov.au/fullreports/index.html
- purchases at www.rirc.gov.au/eshop

Peter O'Brien

Managing Director

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Abbreviations

AFIA	Australian Fodder Industry Association
AHA	Animal Health Australia
AHBIC	Australian Honeybee Industry Council
AQTF	Australian Quality Training Framework
AUSVEG	Australian Vegetable and Potato Growers
AUSVETPLAN	Australian Veterinary Emergency Plan
EADRA	Emergency Animal Disease Response Agreement
CCD	Colony collapse disorder
CIE	Centre for International Economics
CIT	Canberra Institute of Technology
CRC	Cooperative Research Centre
COAG	Council of Australian Governments
DAFF	Australian Government Department of Agriculture Forestry and Fisheries
DPI	Department of Primary Industries
EAD	Emergency Animal Disease
EU	European Union
GM	Genetically Modified
FSANZ	Food Standards Australia New Zealand
HACCP	Hazard Analysis and Critical Control Point
HECS	Higher Education Contribution Scheme
MINTRAC	National Meat Industry Training Council Limited
PHA	Plant Health Australia
QA	Quality assurance
R&D	Research and development
RIRDC	Rural Industries Research and Development Corporation
RPL	Recognition of prior learning
SHB	Small hive beetle
TAFE	Technical and Further Education
UWS	University of Western Sydney
WAFIC	Western Australia Fishing Industry Council

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Executive Summary

What the report is about

This report examines the key issues in education and training for the pollination services industry and suggests strategies for addressing industry needs, both current and future.

The report is one of a suite of three studies that have been completed to contribute to the development of a comprehensive business plan for the industry alliance, Pollination Australia. The other two components are a review of the research and development requirements of the pollination industry and a risk management strategy for the pollination industry.

Who is the report targeted at?

The report is targeted at all who have an interest in the pollination industry in Australia including beekeepers, those who grow pollination-dependent crops and those who service, support and regulate these activities.

Background

In April 2007, a Honeybee Industry Linkages Workshop was held. At this workshop, it was proposed that the industry alliance, Pollination Australia, be formed. The workshop:

- gave rise to a project to produce a business plan for the Australian pollination industry
- identified the major risks to the pollination industry in Australia as
 - the incursion of the Varroa mite (*Varroa destructor*) or other exotic bee pests and diseases
 - restricted access to native floral resources
- specified the development of
 - a biosecurity risk management strategy for the pollination industry
 - a biosecurity research and development plan for the pollination industry
 - an education and training strategy for the pollination industry.

A briefing paper was prepared to support the preliminary analysis and assist in the determination of issues for discussion at a workshop on 10 December 2007 in Canberra. The paper addressed:

- current education and training initiatives in the pollination industry and pollination-dependent industries
- the skills and competencies required to develop paid pollination services
- education and training implications of alternative pollination approaches
- initial thoughts on the pollination industry and pollination-dependent industry education and training gaps and future needs.

The education and training strategies being studied in detail in this project and the identification of opportunities for implementation will provide input into consideration of the research and development (R&D) gaps and priorities. The outcomes of this research will be included in development of a business plan for Pollination Australia.

Aims/Objectives

The objectives of the study have been to determine the education and training needs of pollinators that allow them to develop a business model and appropriately price services including:

- investigation of the education and training needs for the development of a quality assurance program within the pollination industry
- investigation of the opportunities for formal recognition of training, such as national certificates/diplomas, and the use of units of competency already established and cross training in other pollination-dependent industries.

Outcomes from this study and from the parallel studies of risk management and research and development were discussed in a workshop of future Pollination Australia alliance members in March

2008. The outcomes will also be used to develop immediate directions that an alliance can work towards within the framework of a business plan that will be developed by June 2008.

Methods used

This study has used the processes generally applied to assess training needs in industry, including rural industries.

The education and training study has been completed in seven stages:

1. Project inception.
2. Literature review and preparation of the briefing paper.
3. Consultation with current training providers and beneficiaries of training and briefing paper update, incorporating research and development and risk management insights and consultation outcomes.
4. Workshop to review current education and training initiatives and to establish prospective pathways and priorities.
5. Draft education and training report prepared and submitted.
6. Final education and training report submitted.
7. Presentation to industry alliance members.

Results/key findings

The study has identified and prioritised honeybee and pollination-dependent industry education and training needs and issues. The results are detailed below:

Registered training organisations

While very few registered training organisations (RTOs) currently have the specialist delivery area of beekeeping as part of their scope of registration, many RTOs are certified to provide training in agricultural and horticultural qualifications. The rules that cover the issue of these qualifications allow most of these RTOs to offer formal programs in beekeeping and related areas, provided that the programs meet the requirements of the Australian Quality Training Framework (AQTF)¹.

Underpinning national standards for education and training

In the United Kingdom, Australia and New Zealand, competency standards have been developed that cover functions relevant to pollination. In principle, these standards form the basis of any accredited or publicly-funded vocational programs, particularly those used in traineeship programs. With the exception of the voluntary B-Qual industry quality assurance program, there are no standards or examinations administered by any beekeeping association in Australia.

Identification of required skills and knowledge relating to pollination services

The existence of nationally endorsed competency standards for beekeeping and the skills that they cover is not known beyond a small cohort of stakeholders very familiar with the Australian beekeeping vocational education and training system. As a consequence, the skills and knowledge needed for pollination service provision, or beekeeping in general, are rarely discussed or identified in specific terms in papers or reports addressing the Australian apiary industry. In addition, the functional analysis undertaken for the development of the beekeeping competency standards did not address the skills required of growers.

As the requirements for the provision and securing of pollination services is refined and documented through occupational and training needs analyses, further work remains to be done to review the original beekeeping competency standards.

Industry quality assurance or accreditation programs

B-Qual Australia Pty Limited (B-Qual) has been established by the Australian Honey Bee Industry Council (AHBIC) as an independently developed and audited food safety program to accredit and ensure adoption of a quality assurance program for greater than 90 per cent of the production of the Australian honeybee industry. The project has developed accreditation and trained industry participants in quality assurance standards, organic standards and biosecurity, and provided an ongoing third-party audit system.

All enterprises are required to participate in the B-Qual education program and develop a quality system prior to accreditation being granted. It is not known how many honey producers, if any, have been audited against the pollination standard.

There are a number of industry-owned and/or managed quality assurance programs for growers. A specific gap in industry quality management protocols is the consideration of the standards to ensure effective and efficient pollination, including the interface between growers and beekeepers with regard to honeybee health and pollination effectiveness. An assessment of strategic plans, policy papers and annual reports for a number of the grower industry bodies found little reference to issues of pollination and the application of quality assurance protocols to the utilisation of managed hives on growers' properties for pollination purposes. The almond industry is a clear exception, with its acknowledgment of the importance of pollination protocols and their relationship with the beekeeping industry.

Delivery of education and training relating to pollination

There are no pollination-specific courses in Australia. As far as can be determined, pollination is addressed mainly at a theoretical level in agricultural/horticultural programs currently being offered at either higher education or vocational levels. The focus in almost all cases is on biological processes. The development of beekeeping or business skills relating to pollination service delivery are not addressed.

Training in business modelling and the pricing of services

Beekeepers providing pollination services, either directly to growers or through a broker or other arrangement, will require an appropriate business structure and will need to undertake business planning, marketing and pricing of their services. Therefore, beekeepers are no different to all enterprises engaged in the provision of agricultural/horticultural services to clients.

No specific provision should be made for the development of targeted business modelling and pricing of education for beekeepers. Mainstream courses in small business management and agricultural enterprise should be sufficient for the acquisition of the necessary skills.

Training in the identification and measurement of risks and benefits involved in offering paid pollination services

The barriers to new entrants to the field of pollination services appear to be higher than for honey production. Amongst the considerations are:

- understanding the direct and indirect costs incurred in providing managed hives, including transport infrastructure, staffing and associated on-costs, hive maintenance and monitoring, utilisation of floral resources, insurance and regulatory requirements
- specifying the capability of managed hives for paid pollination and the requirements of crops for pollination
- contracting with one or more growers, including scheduling the delivery of hives, pricing, use of chemicals, liability
- negotiating the terms of the services to be provided and/or received
- certifying quality assurance, including documentation of outputs and outcomes associated with the operation of managed hives and the reporting and monitoring of pests and diseases, hive activity and well being
- maintaining and upgrading skills to conform with evolving standards and competencies.

Beekeepers are likely to have a long-term contractual arrangement with a specific broker who, in turn, will have a variety of contractual relationships with a range of pollination-dependent growers on both a continuing and casual basis. Pollination brokers will be the specialists in the business of managed pollination services. Beekeepers will be specialists in the application of managed pollination, and growers will be specialists in the appropriate utilisation of managed pollination for their crops.

Training in the pricing of services and the development and use of business models

As with business modelling, there is little evidence that the general needs of beekeepers for training in the pricing of services and use of business models within the identified risk environment are any different from those of other agricultural contracting sectors. There would be a benefit in offering a series of workshops or other training events specifically targeting beekeepers who are considering a change in primary business activity from honey production to pollination service provision or contemplating an extension of their activities into pollination broking.

Industry quality assurance

The pollination process and biosecurity management across the pollination supply chain are currently under-represented in biosecurity and quality assurance (QA) programs within both the apiary and horticultural industries.

Enhancing the status of pollination and its biosecurity management in such programs would contribute to an improvement in the standards of pollination management and assist in minimising the incidence and impact of pests and diseases on the pollination industry.

Arrangements whereby the QA programs of the apiary industry and the pollination user industries are closely articulated with one another would ensure that the biosecurity interests of all parties to the pollination industry are better addressed.

Training for the development of a quality assurance program in the pollination industry

Growers and beekeepers are required to conform to established industry quality assurance protocols and systems. It is the responsibility of AHBIC and each of the relevant grower organisations concerned with the effective production of pollination-dependent crops to ensure that all operatives in their industry sectors comply with established quality structures.

Training will be needed to support implementation of quality assurance systems and standards (such as the pollination standard established by B-Qual).

Development of education and training competency units

Existing units of competency for relevant areas of beekeeping, business skills, production, horticulture, and to a lesser extent agronomy, are satisfactory bases from which to develop curricula and learning programs that will address the needs of those involved with the provision of pollination services. The qualification structures for vocational education and training programs are also flexible enough to allow for the inclusion of units of competency relevant to pollination services.

Both the qualifications and units of competency must continue to be reviewed to ensure that they remain relevant to the emerging needs of the pollination industry.

Pollination Australia should identify the most important and unique skill sets for pollination service providers, growers and brokers. It should also ensure that these skill sets reflect the requirements of industry quality assurance programs and are included in the relevant nationally endorsed training packages.

Location of training courses

Currently, as there is a relatively low demand for training across all the jurisdictions in Australia, it would be practical for one institution to take a national role in the training of apprentices in

beekeeping. Through a combination of distance and on-campus education in the apiarists' winter or 'off season', an appropriate curriculum could be delivered in a cost-effective manner to support the training of future beekeepers from across Australia. The consolidation of a critical mass of teaching and industry expertise in one institution would also support training in managed pollination.

Incorporation of pollination education and training into mainstream programs

It is appropriate that all agricultural personnel are educated in the importance of the beekeeping industry and that all agricultural, horticultural and agronomy courses cover the key knowledge areas of insect/plant interactions, the role of honeybees in crop pollination, and the adverse effects of some farm chemicals used for crop protection on honeybees.

Costs of training requirements

All people participating in training will have to meet some costs, which can include such direct costs as materials, tools, equipment, travel, accommodation, use of computers and internet time. In addition, those individuals already employed in an enterprise may be required to forego earnings by spending time on learning new skills that would be used to increase their profitability or earning power into the future.

Procurement of funding by Pollination Australia or pollination industry stakeholders to develop industry supported packages and engage industry participants will be an important factor in the success of the education and training program.

Formal recognition of training

The future industry alliance, Pollination Australia, would actively promote and encourage recognition of prior learning (RPL) for the members of its industry constituents, focusing initially on skill sets or small groups of units of competency that directly link to B-Qual or other relevant quality assurance programs.

Implications for relevant stakeholders

The implementation of an education and training program and a competency framework for provision of bee pollination services will ensure the industry develops and maintains a high calibre, uniformly skilled workforce. The execution of such education and training will also attract younger individuals into the beekeeping industry. This is important, as the existing honeybee workforce is ageing and new labour is not currently forthcoming. The implications for relevant stakeholders are such that, without pollination, there is an increased cost of food production and a decrease in the quality of fresh produce.

Recommendations

It is recommended that results of this study be used to set directions for education and training for Pollination Australia. This will contribute to the framework of the Pollination Australia business plan which is expected to be completed by June 2008.

1. Study purpose

Introduction

In April 2007, the Honeybee Industry Linkages Workshop was held. At this workshop, it was proposed that the industry alliance, Pollination Australia², be formed. The workshop:

- gave rise to a project to produce a business plan for the Australian pollination industry
- identified the major risks to the pollination industry in Australia as
 - the incursion of the Varroa mite (*Varroa destructor*) or other exotic bee pests and diseases
 - restricted access to native floral resources
- specified the development of
 - a biosecurity risk management strategy for the pollination industry
 - a biosecurity research and development plan for the pollination industry
 - an education and training strategy for the pollination industry.

These three documents will form part of the pollination industry business plan that is being developed for Pollination Australia by the Centre for International Economics (CIE). CIE is also undertaking an additional assignment to investigate the economic aspects of the current pollination industry and assess likely future developments and potential.

This report documents a determination of education and training needs in the pollination industry that will enable it to move from a volunteer perspective to a more professional approach. The focus is on the needs of pollinators and pollination-dependent industries. It also includes the education and training needs of potential trainers, the needs identified in the parallel study on a risk management strategy and the broader needs of the pollination industry, regardless of any exotic pest incursions.

Impact Consulting Group completed this study for the Rural Industries Research and Development Corporation (RIRDC) and the Department of Agriculture, Fisheries and Forestry (DAFF) between October 2007 and February 2008. RIRDC managed the study on behalf of the industry and other bodies that intend to form Pollination Australia. The study was a component of a broader project, funded under the DAFF advancing industries program, for the formation of the Pollination Australia industry alliance and for development and endorsement of a business plan.

Objectives

The key objective of the study is to make a significant contribution to the development of the business plan for the pollination industry that:

- has full backing by the industry participants
- can be independently administered by an industry-based alliance/organisation
- can be maintained under continued industry funding.

Outcomes from this study and from the parallel studies of risk management and research and development will be discussed in a workshop of future Pollination Australia alliance members to be held in March 2008. It will also be used to develop immediate directions that an alliance can work towards within the framework of the business plan that is being prepared by the CIE. It is expected that the business plan will be completed by June 2008.

Formally, the objectives of the study have been to:

- determine the education and training needs of pollinators that allow them to develop a business model and appropriately price services, including
 - identification and measurement of the risks involved in offering paid pollination services
 - identification and measurement of the benefits provided by paid pollination services to the grower
 - pricing of services that provide a return commensurate with the expanded risks from supplying paid pollination services

- development and use of a business model that leads to a more profitable and sustainable paid pollination business
- investigate the education and training needs for the development of a quality assurance program within the pollination industry
- investigate the opportunities for formal recognition of training, such as national certificate diplomas, and the use of units of competency already established and cross training in other pollination-dependent industries, including
 - development of education and training competency units
 - development of materials required to undertake training courses
 - location of training courses
 - incorporation of education and training into existing programs (eg within the honeybee and horticultural industries)
 - the overcoming of impediments to education and training, such as the current State-by-State arrangements
 - estimated costs of training requirements
 - investigation of alternative avenues of funding
 - determination of the likelihood of receiving sufficient funding from potential avenues
 - development of an implementation plan.

The study has identified and prioritised honeybee and pollination dependent industry education and training needs and issues.

A briefing paper was prepared to support the preliminary analysis and assist in the determination of issues for discussion at a workshop on 10 December 2007 in Canberra. The paper addressed:

- current education and training initiatives in the pollination industry and pollination-dependent industries
- the skills and competencies required to develop paid pollination services, including
 - the supply of services
 - the economic impact
 - yield increase differentials
 - crop quality considerations
 - reliability
 - differences between crops
- education and training implications of alternative pollination approaches
- initial thoughts on the pollination industry and pollination-dependent industry education and training gaps and future needs.

The education and training strategies being studied in detail in this project and the identification of opportunities for implementation will provide input into consideration of the research and development (R&D) gaps and priorities. Further, the outcomes of this consultancy will be taken up by CIE in its development of a business plan for the proposed Pollination Australia.

Approach

The education and training study has been completed in seven stages:

1. Project inception.
2. Literature review and preparation of the briefing paper.
3. Consultation with current training providers and beneficiaries of training and briefing paper update, incorporating research and development and risk management insights and consultation outcomes.
4. Workshop to review current education and training initiatives and to establish prospective pathways and priorities.
5. Draft education and training report prepared and submitted.
6. Final education and training report submitted.
7. Presentation to industry alliance members.

2. Pollination of commercial plant species in Australia

Importance of honeybee pollination to Australian industries³

The broad context

It is said that approximately 65 per cent of horticultural and agricultural production in Australia relies to some extent on pollination to achieve its potential². There are three dimensions to this claim to consider:

- the degree to which particular crops and enterprises rely on pollination varies from the essential to the marginal
- the directness of the impact of pollination on production varies from direct to remote
- the involvement of honeybees, and managed honeybee colonies in particular, in performing the pollination service varies from central to incidental.

At one end of the scale sits the almond industry where there is a direct and immediate correlation between yield and pollination and where the relationship is so direct and important that to ensure adequate pollination an almond producer will almost always contract for managed hives to be located within the almond grove while the trees are flowering to provide pollination services.

At the other extreme might be a commercial dairying operation where pollination of the white clover component of the pasture currently performed primarily at no cost to the enterprise, by feral bees and other incidental pollinators might cease over time. The farmer would eventually observe a change in the composition of the pasture and experience a more frequent need to re-sow to maintain the clover component and/or be required to apply additional nitrogen fertiliser to replace the reduction in soil nitrogen attributable to the clover³.

At other points along the scale lie:

- **horticultural crops**, grown in glasshouses for which pollination is essential but for which honeybees are but one of a range of available or potential pollination agents
- **fruit crops**, such as apples and cherries
 - the importance of pollination varies between varieties
 - the impact, in the extreme, might be measured in yield but might also be expressed as fruit quality or storage properties
 - pollination is often by feral bees supplemented with some managed colonies
- **vegetable crops**, such as onions and broccoli
 - the production of the commercial crop (the bulb or head) has no direct requirement for pollination
 - however the production of seed for future crops is heavily and directly reliant on pollination usually provided using managed honeybee colonies
- **legume pasture** species like Lucerne and White Clover
 - vegetative growth and the production of fodder or hay is independent of pollination
 - however, seed production requires pollination
 - harvesting and sale of seed is part of the commercial enterprise, managed colonies are commonly used
- **citrus crops**
 - there is a reliance on pollination, but
 - wind pollination is more important than the activity of insects including honeybees⁴
- the **Canola oilseed** production industry
 - generation of hybrid seed relies on honeybee pollination, but

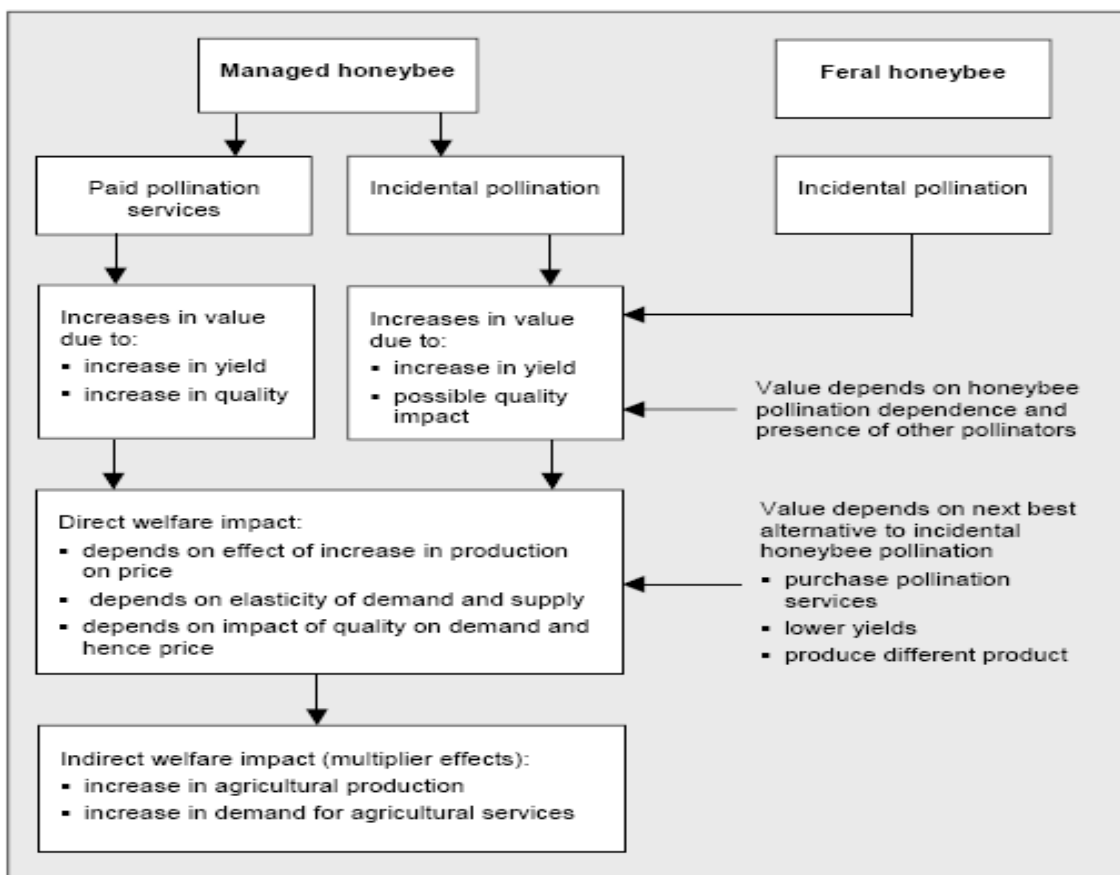
- paid pollination services are rarely used on broad-acre commercial crops despite research having demonstrated a yield response to pollination and which provide an important source of pollen and nectar to the honeybee industry⁵.

Off the scale lie enterprises seeking to produce “seedless” mandarins, where pollination is a distinct negative and efforts are made to exclude honeybees and other pollination agents from the orchard during flowering.

The quantum of pollination service provided may range from a single small hive to service a variety breeding and selection program being conducted by a commercial seed supplier, in a one metre square ‘tent’ to 30,000 hives used to pollinate a 5,000 ha almond enterprise.

Figure 2.1 depicts a flow diagram of the role that honeybees play in the horticulture and broad-acre industries that require pollination.

Figure 2.1 Economic Benefits Attributable to Honeybee Pollination Services



Data source: Gordon and Davis 2003

Honeybee pollination provides significant value to Australian horticulture and agriculture with the derived benefit being estimated at \$1.7 billion per annum in 1999-2000 for the 35 most important honeybee dependent crops⁶. When other crops, including pastures such as lucerne and clover, are added this estimate becomes even larger. If honeybee pollination were to stop completely, large losses would be felt in a horticultural sector that produces around \$3.8 billion per annum.

Pollination can be effected by:

- the wind
- feral honeybees
- paid pollination services by managed honeybees

- incidental and unpaid pollination by honeybees managed to produce honey or provide pollination services to other nearby crops
- by a range of other pollination agents including:
 - insects other than honeybees
 - birds
 - some smaller mammals
 - by **some combination of these factors**.

Paid pollination involves the grower contracting with an apiarist to place bee colonies on the grower's land in order for the bees to pollinate the grower's crop.

With **incidental pollination** by managed honeybees, the apiarist's specific purpose is either to produce honey or provide pollination services to some third party and pollination of the crop in question is a positive externality received by growers.

Figure 3.1 does not address pollination performed by agents other than honeybees. As indicated above, such agents are numerous but their contribution to agriculture in Australia while important in some instances, is relatively minor in total and these agents are not considered in detail in this study.

Further, Figure 3.1 does not address the non-monetary impacts for the apiarist providing the bees to perform the pollination services. Depending on the nature and condition of the crop being pollinated and the quality of the management of the crop and the bees providing the services, these impacts may be positive, neutral or negative.

Optimal circumstances occur where:

- the crop being pollinated provides a good balance of nectar and pollen of appropriate quality,
- competition between bees is managed to match the resources available
- there is nothing deleterious to the bees about the management of the crop being pollinated
- the colonies provided by the apiarist may complete the pollination service in strong conditions
- the harvest of honey supplements the monetary consideration paid by the grower for the pollination services provided.

Where managed bees are involved in the provision of pollination services under optimal circumstances, there can be benefits to the apiarist in the form of an additional income stream and in some instances supplementary production of honey and possibly an improvement in hive health and colony strength.

Non optimal circumstances occur where:

- a hive is located in a crop of a species that does not provide a good balance of nectar and pollen or for which the pollen is of undesirable quality
- the number of bees competing for the available resources is not well managed
- the crop is treated with chemicals that are adverse to the health of bees
- unfavourable weather conditions prevail during the pollination period.

In these circumstances, the apiarist may find at the conclusion of the pollination contract that the colony is severely weakened and may require a significant investment of time and care to restore it to a condition in which it can be of further commercial value.

Both paid honeybee pollination services and incidental honeybee pollination increase the value of crops to growers through an increase in yield and/or an increase in quality. The outcome is that pollination has a direct impact on the economic welfare of those growers who benefit from pollination services.

In addition, there are general positive benefits:

- to the entire agricultural industry due to the flow-on effects that arise from an increase in the value of crops

- to consumers as it increases production (thereby putting downward pressure on prices) while providing better quality products.

Consequently any risk to the availability of honeybee pollination services can lead to a potential loss in the economic welfare of growers, apiarists and consumers. Losses from the absence of pollination services would be split between:

- producers who would forfeit horticulture and broad acre crop income
- apiarists who would lose an alternative source of income and other possible benefits
- consumers who would suffer the impacts of a reduction in the supply and/or an increase in the cost of many fresh fruits, nuts, vegetables and honey.

Although some of these crops could be replaced through imports, Australia's capacity to import many of the affected products would be limited by quarantine restrictions. Consequently, prices for the reduced supply of fresh fruits, vegetables, nuts and honey could be driven up by the reduction in supply, thereby reducing access to these products and potentially reducing consumer welfare.

Gordon and Davis⁷ have estimated that if honeybee pollination had stopped completely in 1999/2000, the agricultural industry would have experienced a loss of around \$1.7 billion in production and consumption, resulting in the loss of around 9,500 jobs. It was also estimated that there would have been short-term flow-on effects which would add an additional \$2 billion loss to agricultural industry output and a further 11,000 lost jobs. Partial loss in pollination services would also have resulted in major economic costs. For example, if dependence on pollination were half the level assessed by Gordon and Davis, the direct loss to Australia would have been \$0.6 billion per annum, reinforcing the importance of honeybee pollination to the agricultural industry. Inclusion of pasture species and the full range of agricultural crops only increase this impact.

For reasons outlined below, a more considered analysis indicates that the catastrophic premise upon which the above conclusions are based, is somewhat exaggerated.

The significance of pests and diseases

Varroa mite is cited as the major threat to the Australian honeybee industry and thereby to the pollination industry in this country. However, Varroa is not the only significant threat to the closely interdependent industries and the impact of any of the range of threats will depend upon the particular circumstances surrounding the realisation of the threat and the capability and quality of the response by the affected industries and relevant authorities.

The evidence from other parts of the world where one or more of these threats, including Varroa, has come to pass, is that **there is no biological process that would result in the immediate or total cessation in the availability of pollination services**. Even untreated, Varroa takes about a year to destroy a colony. Its geographic spread, whilst apparently inexorable, is relatively slow and, as is the case in the USA and New Zealand, at least there are means by which capable and committed apiarists can, in the presence of Varroa, manage hives to provide effective, albeit more costly, pollination services.

Whilst it is extremely unlikely that any biological threat could have a direct and severe 'overnight' impact on the pollination industry, regulatory restrictions on the movement of bees in the event of the presence of Varroa or one of the other serious biological threats being detected in Australia, could have an immediate and significant negative repercussion for the industry.

The prospect facing the pollination industry in Australia in the event of a threat such as Varroa being detected and eradication not attempted because it is determined that it could not be achieved, is that:

- over a period of two to five years, populations of feral bees would be decimated to the point that they could no longer be considered as significant or reliable providers of pollination

- more immediately, apiarists would incur significantly increased costs in monitoring, managing and maintaining colony strength in the presence of the disease.

Inevitably the higher costs would flow through to the users of paid pollination services, especially as, with the contribution from feral hives being severely discounted, the demand for paid services would be expected to increase.

The experience in other countries is that it is the apiary industry, more than those using pollination services, which are adversely affected by *Varroa* becoming established. The cost and effort required to maintain hives in the presence of *Varroa* has resulted in a consolidation of the commercial apiary industry into larger enterprises each managing a larger number of colonies⁸.

If the current cost of operating a commercial apiary is about \$150 per hive per year and the additional management cost in the presence of *Varroa* is \$40 - \$50 per hive per year⁹, the cost of *Varroa* in Australia might be of the order of \$32 million per year for the additional cost of managing the existing 650,000 hives and a further \$30 million to provide and manage an additional 150,000 hives to substitute for the loss of the contribution from feral bees.

For pollination service users the main effects would seem to be in terms of an increase in the costs of production due to the higher cost of pollination services rather than the loss of access to honeybee pollination services. Whether this would lead to a fundamental change in the economics of the enterprise would depend upon margins and returns within the industry and the particular enterprise. Only in a user industry on the edge of profitability would an incursion of *Varroa* be likely to result in a significant restructuring within that industry.

Crops dependent on honeybee pollination

The CIE has identified 35 Australian horticultural and agricultural crops to be included in the analysis of the market for pollination services in Australia¹⁰ and these are listed in Table 3.2. The 35 crops identified were 'largely honeybee pollination-dependent' and had readily available data. The list excludes other pasture crops, including lucerne and clover.

Table 3.2 Crops included in the Analysis of the Market for Pollination Services in Australia

Crop type	Dependence on honeybees^a	Crop type	Dependence on honeybees^a
	Per cent		Per cent
Almond	100	Lemon & Lime	20
Apple	90	Lettuce	10
Apricot	70	Lupin	10
Asparagus	90	Macadamia	90
Avocado	100	Mandarin	30
Bean	10	Mango	90
Blueberry	100	Nectarine	60
Broccoli	100	Onion	100
Brussels sprout	30	Orange	30
Cabbage	30	Papaya	20
Carrot	100	Peach	60
Cauliflower	100	Peanut	10
Celery	100	Pear	50
Cherries	90	Plum & prune	70
Cotton lint	20	Pumpkin	90
Cucumber	90	Strawberry	40
Grapefruit	80	Watermelon	70
Kiwi	90		

Our consultations with beekeepers, growers, and their representatives indicate:

- that the citrus crops listed rely more on pollination by the wind than bees or other biological agents, and that for the production of seedless mandarins growers make efforts to exclude potential insect pollinators¹¹
- for many of the vegetables listed (onions, carrots, broccoli etc), pollination is required to produce seed but not for the production of the principal commercial crop
- crops excluded include hybrid Canola varieties and key pasture species such as lucerne and white clover, known to require pollination to achieve their potential seed-set and for which seed producers commonly pay for pollination services
- other crops, such as faba beans and other clover species¹², are not currently considered to benefit from pollination but there is a belief that an economic return could be achieved with managed pollination.

With assistance from HAL, Table 3.3 has been prepared to better represent the pollination industry in Australia. Table 3.3 also indicates the principal periods of the year when pollination services are required for each of the plants listed. Those species for which the commercial value of pollination has yet to be demonstrated have been excluded.

Canola has also been included, because while pollination is essential for the generation of hybrid seed and non-hybrid Canola giving yield responses to pollination, a flowering Canola crop can provide a significant floral resource for many apiarists at a time of the year when alternatives capable of sustaining an improvement in colony strength may not be readily available¹³.

Table 3.3 Period Pollination Services Required (after Sumner and Boriss, 2006)

Crop	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	Key Production Areas	Comment
Almond			■										Riverland, Sunraysia, Riverina	Almonds highly pollination dependent
Apple						■								
Apricot		■	■	■									Vic and NSW; SA, WA, QLD and TAS	Peak pollination occurs around August Bee pollination not required
Asparagus														
Avocado	■	■	■	■	■	■	■	■	■	■	■	■	Qld, NSW, Vic, WA	Variety of insect pollinators Most bean seeds are imported
Bean														
Blueberry		■	■	■	■	■	■						Vic, Tas & Northern NSW	Oct-Nov for south; Jul-Sept for north
Broccoli		■	■	■	■	■	■						Tas, Vic	Pollination for seed production only
Brussels sprout				■	■	■	■						Tas, Vic	Pollination for seed production only
Cabbage, chinese							■	■	■	■			Tas, SE South Australia	Pollination for seed production only
Cabbage, other				■	■	■	■	■	■	■			Tas, Vic	Pollination for seed production only
Canola			■	■	■	■	■	■	■	■	■		All winter cereal growing areas	Pollination essential for hybrid seed
Carrot							■	■	■	■	■		Tas, (not verified in other states)	Pollination for seed production only
Cauliflower							■	■	■	■	■		Tas, Vic	Pollination for seed production only
Celery, parsley							■	■	■	■	■		Tas, SE South Australia	Pollination for seed production only
Cherries				■	■	■							NSW, Vic, SA	
Cotton lint														
Cucumber														Pollination for seed production only
Grapefruit														Bee pollination not critical
Kiwi fruit					■	■	■	■	■	■				High bee densities required
Lemon & Lime														Bee pollination not critical
Lettuce													SE Australia	Pollinated by wind; bees not critical
Lucerne							■	■	■	■			Southern Australia	Pollination only required for seed set.
Lupin			■	■	■								Southern winter cereal growing areas	
Lychee		■	■	■	■								Northern NSW & Qld	Various insects, services maybe used
Macadamia			■	■	■	■							Lismore, Gympie, Bundaberg regions Victoria, NSW and SA.	Bee pollination is critical
Mandarin														Non pollinated seedless fruit preferred
Mango	■	■	■	■	■								Northern WA and NSW; NT & Qld	Various insects, services not used.
Nectarine		■	■	■	■								Vic and NSW; SA, WA, QLD and TAS	
Onion							■	■	■	■				Pollination for seed production only
Orange													Vic and NSW; SA, WA, QLD and TAS	Bee pollination not critical
Papaya	■	■	■	■	■	■	■	■	■	■	■	■	Innisfail, Mareeba	Pollinated by Hawk Moths
Peach		■	■	■	■	■							Vic and NSW; SA, WA, QLD and TAS	
Pear				■	■	■								
Plum & prune		■	■	■	■	■							Vic and NSW; SA, WA, QLD and TAS	
Pumpkin							■	■	■	■			Qld, NSW, WA	Pollination for seed production only
Strawberry	■											■	Qld; Vic, WA, SA, Tas	Bees and hand pollination used.
Watermelon			■	■	■	■	■	■	■	■				
White Clover				■	■	■	■	■	■	■	■		Vic, Tas, SA and NSW	Pollination for seed production only

Commercial pollination service supply chain

The Commercial Pollination Service Supply Chain involves a beekeeper delivering an agreed number of hives to a location specified by the pollination service customer on a specified date and leaving them there for an agreed period, usually a few weeks, to allow the bees to effect the pollination of the customer's crop or pasture.

Such a simple description grossly understates a process that may require the beekeeper to commence preparing the hives to perform the service months in advance and may render the hives so depleted in condition by the performance of the service, that they require a significant period of time with access to suitable supplies of pollen and nectar to recover before they can be of further commercial value to the beekeeper.

Such a description may also not adequately reflect the requirement for

- the preparation of the hives to occur at a location some hundreds of kilometres from the site at which the service is performed
- the number of hives providing the service to vary as the flowering of the crop progresses
- the hives to be transported to a possibly distant, third location to allow their recovery
- a further move, over a significant distance, to a fourth location where they resume activities that produce a commercial return to the beekeeper in the form of either the production of honey or the provision of pollination services.

Figure 3.4 provides a diagrammatic representation of the processes involved in the management of beehive prior to, during and following the provision of pollination services.

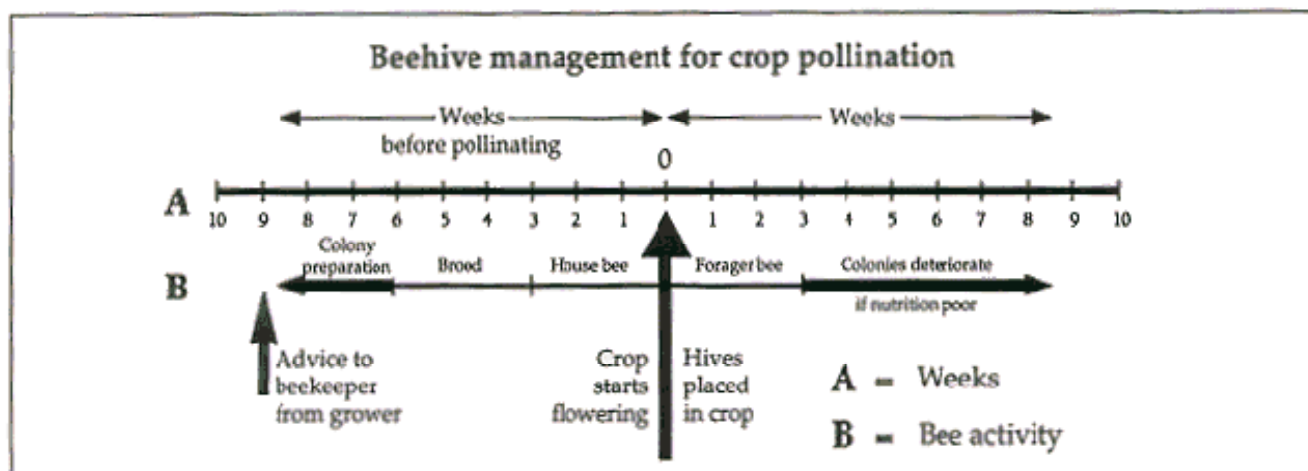


Figure 3.4 Beehive management for crop pollination – a beekeeper's view

Source: Parker 1989

The combination of activities that precede and follow the performance of a particular commercial pollination service will be determined by the interaction of a number of factors including:

- the time of the year at which the service is required
- the species and variety of the crop to be pollinated
- the location of the crop
- weather conditions at the time and at the site of the crop to be pollinated
- seasonal conditions and floral resources at the various sites where preparation or recovery of the hives may occur
- access to, and availability of, apiary sites at those locations

- the nature, location and timing of other demands for pollination services
- the incidence and severity of pest and disease burdens at each point along the supply chain.

For a beekeeper providing typical pollination services, about two thirds of the complement of colonies will be in a condition that meets the standard required to perform commercial pollination services at any given time. In any 12 month period a colony might be deployed to perform two, or at most three, month-long pollination contracts¹⁴. The actual availability of a colony to perform pollination services will be influenced by:

- weather conditions
- the nature and location of the crops to be serviced
- the total and timing of demand for pollination services
- the availability, location and quality of floral resources to rebuild colony strength
- prevailing weather conditions¹⁵.

As Table 3.3 indicates, there are periods of the year, particularly in spring, when the pollination requirements of a number of different crops coincide, intensifying the demand for available pollination services. In other periods, particularly late summer, autumn and winter there is effectively no demand for paid pollination services.

The apiarist servicing the pollination industry must maximise the number of hives available to be deployed in periods of peak demand and find other floral resources to maintain the hives when no pollination is required, preparing the hives for the next season at a time when conditions and resources are often not conducive to an improvement in colony strength and health.

In Australia the provision of pollination services has in the past largely been effected as a contract between the owner of the bees and the owner or manager of the crop to be pollinated.

In other parts of the world and most notably in the United States, there has developed over some decades a trend for pollination services to be arranged by **pollination brokers** who coordinate the provision of pollination services to one or more, usually large-scale, growers of pollination-dependent crops, with hives owned by a large number of beekeepers. In this arrangement the Pollination Broker provides certainty to the grower regarding the availability and quality of hives and certainty of payment for the service to the beekeeper¹⁶.

In recent years the role of the Pollination Broker has become established in Australia. The proportion of pollination services provided through brokers in Australia is currently small but likely to grow as the number of large plantations of pollination-requiring species, particularly almonds, increases. For these enterprises, the number of hives required may range from 3-10,000, and exceeds the amount that a single apiarist can supply.

Factors influencing the efficiency and effectiveness of a pollination service

Issues to be considered by the beekeeper and the grower of a pollination-dependent crop in the provision and use of managed pollination services are described in various reports and papers¹⁷.

The effectiveness and efficiency of the delivery of a pollination service may be influenced by factors that are within the control of either (or both) the beekeeper and the grower, or other factors that are outside the control of either party¹⁸. These factors are listed in Table 3.4.

Table 3.4 Factors influencing the effectiveness and efficiency of pollination service delivery

Within the beekeeper's control	Within the grower's control	Outside the control of either the beekeeper or the grower
precise location, aspect and configuration of hives stocking rate timing of insertion and withdrawal of bees availability of water traffic movements and other influences that disturb bees		
strength and condition of the colony on delivery pest and disease status of the colony on delivery	access to the site choice of fruiting and pollinating cultivars arrangement of fruiting and pollinating cultivars compatibility of fruiting and pollinating cultivars condition of plants presence and nature of non-target species (weeds, undergrowth and adjacent plants) use of pesticides crop hygiene	weather conditions during pollination presence of incidental pollinators including feral bees quantity and quality of nectar and pollen presence and nature of non-target species outside property boundary

Contracts for pollination services

Typically contracts for the provision of pollination services specify only the number of hives to be provided and include conditions that seek to ensure a minimum strength for the colonies, usually by specifying

- the number of frames present in a hive of a standard configuration
- a percentage cover of these frames at a specified temperature
- compliance with these conditions to be determined by inspection under the prescribed conditions usually by a third party.

Pollination contracts also usually include general obligations on the grower to avoid actions that would adversely affect the bees.

To date, provisions relating to the biosecurity of either the bees or the crop being pollinated have not generally been included in pollination service contracts.

Since the discovery of SHB in Australia, there is a requirement that hives crossing the NSW – Victoria border are certified by the relevant authority to be free of SHB. This requirement should provide a prima facie element of biosecurity assurance for certified hives, but whether this is in fact the case is not clear, as it seems the results of any inspection are not recorded or reported¹⁹.

Asymmetries in the Australian pollination industry

Any consideration of the Australian pollination industry including management of the biosecurity risks confronting the industry must acknowledge and address a number of significant asymmetries between

- the demand and supply sides of the industry such as those with:
 - a commercial interest in the supply of, and demand for, pollination services
 - regulatory responsibility and authority for the conduct of beekeeping in Australia
 - statutory powers in the event of a plant or animal disease outbreak.

Many of these asymmetries may apply in other countries but some are either unique to the Australian industry or displayed in the extreme in this country. These asymmetries include:

- **Commercial asymmetries**
 - revenues earned from paid pollination services are minute compared to the value attributable to those services
 - revenues derived by the beekeeping industry from the provision of paid pollination services are small compared to those derived from other beekeeping activities, particularly the production of honey.
- **Operational asymmetries**
 - most enterprises that require pollination services need them for only about four weeks each year
 - a beekeeper may require three months or more to prepare hives to provide these services
 - a major concern for growers of pollination-dependent crops is the quality of the managed hives that they contract to perform pollination services, yet in many cases the same growers rely for a significant portion on the pollination services of feral bee colonies, the quality of which they can neither measure nor, by definition, control
 - many of the major pollination dependent industries are consolidating into ever larger operations
 - the apiary industry in Australia remains highly dispersed and comprised largely of small operations.
- **Biological asymmetries**
 - some of the crops most heavily dependent upon pollination require pollination at a time when hives, both managed and feral, are cyclically not normally in the best condition to meet the requirement
 - some pollination-dependant crops provide amounts of nectar that will not sustain the colonies pollinating them and therefore, even less honey to the apiarists providing the hives
 - in Australia the eucalypts which are key floral resources for apiarists providing highly important honey flows, have little or no requirement for pollination by honeybees
 - the requirement for commercial pollination services is generally quite time-specific and highly predictable, whilst in Australia, the events that produce the most honey and which are often used to condition hives to provide pollination services are generally imprecise and comparatively unpredictable.
- **Biosecurity asymmetry**
 - feral hives which currently perform a major component of pollination services for Australia's pollination-dependent industries represent the greatest biosecurity risk to themselves, other feral hives, managed hives and possibly, pollination-dependent industries.
- **Regulatory asymmetries**
 - in all Australian jurisdictions regulatory authority for the management of diseases of bees rests with animal health authorities whilst, potentially, the greatest economic impact of bee diseases will be borne by plant-based industries dependent on pollination services provided by bees
 - regulation of beekeeping activities is state-based whilst, along the eastern seaboard of Australia in particular, beekeeping in general and the provision of pollination services routinely involves the transport of colonies across state borders. While many of these asymmetries have little or no direct impact on the biosecurity risks faced by the pollination industry, they have the potential to impact the effective management of these risks.

3. Current activities in education and training for the pollination industry

The purpose of the literature review has been to investigate Australian and international activity in education and training in the pollination industry. It has also sought to

- review the skills and competencies that support pollinators to develop business models and appropriately price services relating to:
 - the type and location of crops
 - the risk of contamination from pesticides and insecticides being used in the local area
 - costs associated with offering paid pollination services
 - the level of competition within the market
- review current pollination industry and honeybee industry education and training projects and initiatives
- review current and prospective quality assurance and accreditation frameworks in the pollination industry and pollination-dependent industries (eg horticulture, grains, pasture production), including the application of existing quality processes to incorporate education and training parameters
- review international education and training efforts (especially in relation to exotic pests and diseases, such as Varroa mite and colony collapse disease (CCD)).

General relevant research

Within the general literature, there are references made to the importance of education and training as a means to resolving difficulties within the industry in dealing with the changing nature of the pollination industry and its operations.

Cutler and Reeves (2005) noted that apiarists who provide pollination services have limited ability to capture the value generated for horticulture due to their part-time operation as beekeepers and their lack of knowledge. There is difficulty in controlling the quality of paid honeybee pollination services because a number of apiarists supply below-strength hives, are unsure of stocking rates, lack awareness of colony management techniques, and/or have clients who do not understand the advantages of correct pollination. This segment operates to the detriment of skilled pollinators, as well-publicised industry standards are needed, together with an education program for growers receiving pollination services.

In Australia, honeybee pollinators face a high risk of chemical spray drift from growers of neighbouring properties and labels on chemicals used by growers do not identify whether the chemical is dangerous to bees.²² In addition, there are currently not enough hives available for the expected demand in pollination services, due to the limited supply of honeybees, the drought and poor access to public forests.

Actions suggested by the May 2005 pollinator workshop in Orange, NSW, included:

- development of industry education programs for apiarists on correctly priced pollination services as well as education on industry standards and regional coordination to ensure that pollination services are effective
- marketing by paid pollinators of the benefits of honeybee pollination to horticultural and agricultural producers through advertisements and articles in agricultural journals, supported by information provided to government to assist with ongoing access to public forests
- increased coordination between apiarists, seed companies and agricultural and horticultural producers, with commissioning of joint research between these industries aimed at improving the effectiveness of honeybee pollination to maximise the benefits of paid honeybee pollination services.

In addition to these suggestions, growers should be educated on the importance of better managing pollination of their crops so they can see the value of paying more for a better pollination service.

CIE's current **analysis of the market for pollination services in Australia** will identify those factors that determine the supply and demand for pollination services in Australia and assess the size and scope of such a market. Furthermore it will examine the likely impacts of a *Varroa destructor* incursion and the difference in returns that would arise from a proactive development of the industry versus a reactive ex post response by industry. This project is an input into the Pollination Australia business plan.

It is acknowledged that in New Zealand, pollination is one of the most important factors affecting crop yields and hence profitability²³. Growers need to ensure sufficient flowers are available and that bees are protected from pesticides. Beekeepers need to be responsible for providing sufficient colonies to pollinate a crop, introducing them at the appropriate time and placing them in an appropriate location. In New Zealand, grower and beekeeper industry groups fund research of mutual interest and organise educational opportunities. The education program is so effective that all growers understand the need for pollination and more than NZ\$15 million is paid for pollination services each year.

To support effective pollination, the actual specification of the input from honeybees required for each crop, including the number of hives and the intensity of the pollination process, needs to be established either from the literature or research. Growers and beekeepers need to be educated on their responsibilities.

De Barro (2007) reports that the seeds industry in Australia invests more than \$250,000 annually in hives for pollination, but there is no correlation between the cost of hives and the quality of service provided. He notes that a hive-brokering scheme operates in North America that is based upon standards set on natural European honeybee dynamics. The scheme is underpinned by the provision of hives for pollination rather than honey collection. Since the incursion of Varroa mites in the United States the cost of hives for pollination has increased from \$15/hive in 1990 to \$110/hive in 2007.

In the **Honeybee R&D Plan**²⁴, the Pollination Research Goal objectives are to:

- better understand the cost and value of pollination services provided by beekeepers
- generate industry value through shared learning with crop producers, especially the Australian almond industry.

The R&D plan outlines several strategies, including:

- assessment of the value to crop producers of pollination services on an individual crop basis to assist beekeepers with the pricing of their services (eg almonds, pome fruit, canola, etc)
- research on, and communication of, the cost of pollination service provision to beekeepers to assist with the pricing of pollination services, including the costs of beekeeper investment in hive preparation)
- extension of the Tasmanian Crop Pollination Association Code of Practice to all Australian States
- investigation of the feasibility of investment in joint R&D projects with the Australian almond industry (especially with Horticulture Australia Limited).

The R&D Plan performance indicators and related measures include:

- availability of information guides on the cost of pollination service provision and the value generated for each of the most important horticultural/agricultural crops by 2012
- publication of information guides at the rate of two per annum
- publication of the six State-based codes of practice for pollination by 2012, at the rate of one per annum
- a joint R&D project with the Australian almond industry to be completed by 2010.

Education and training specific research

Identification of required skills and knowledge relating to pollination services

Gibbs and Muirhead (1998) noted that ‘the many skills required for beekeeping are learned by experience and often passed from generation to generation’. The same can almost be said of our knowledge of what constitutes beekeeping skills, particularly those relating to pollination of agricultural and horticultural crops.

Industry members and associations with a specific interest in pollination have begun to consider the impediments to delivering pollination services and have identified the need for training. Bourke (2007) notes that:

In order to command a premium on pollination services and to maximise the opportunities paid pollination presents ... a recognised and standardised education program on pollination with certification needs to be developed that can be used by the pollinator to indicate they have undertaken the necessary skills training. This will reduce the risk to growers of receiving a substandard service. It will also standardise the quality of services, thereby generating greater confidence within the paid pollination market and enabling the pollinator to capture some of the enormous value that pollination services currently provide to growers. To date, the only formal consideration of skills required for the provision of pollination services in Australia has been that undertaken as part of the development of the suite of beekeeping competency standards included in the RTE03 Rural Production Training Package.²⁵ This project involved considerable consultation with beekeeping industry members and resulted in the national endorsement of beekeeping-specific units of competency and vocational qualifications from Certificate 2 to Diploma. These qualifications include both bee husbandry and business competency standards. The unit of competency RTE4128A Provide Bee Pollination Services, focuses on the provision of pollination services²⁶.

As this work has only now begun to be implemented through the development of learning materials for training courses and the supporting documentation was not published, the existence of nationally endorsed competency standards and the skills that they cover is not known beyond a small cohort of stakeholders very familiar with the Australian beekeeping vocational education and training system. As a consequence, the skills and knowledge needed for pollination service provision, or beekeeping in general, are rarely discussed or identified in specific terms in papers or reports addressing the Australian apiary industry. In addition, standards do not address the skills required of growers.

Nevertheless, the relatively extensive literature available on the beekeeping industry, and in particular its organisation and economics, in the absence of any more targeted research can be used to confirm skills and knowledge or competencies, required by beekeepers. It is thereby possible to identify the competencies needed by growers to achieve satisfactory crop pollination.

Cutler and Reeves (2005) identify a number of desirable outcomes for both beekeepers and growers relating to pollination services that could be achieved in part through education and training programs:

- determining and communicating realistic pricing of paid pollination services
- demonstration of benefits to growers of managed pollination (rather than opportunistic, ‘free’ pollination)
- identifying and communicating to growers, the differences between good and bad pollination service provision
- understanding and adopting a quality system, including the purpose of (third-party) audits
- setting and achieving financial goals through income diversification for beekeeping enterprises
- developing and implementing industry standards for the provision of pollination services
- assessing and communicating the competence of individual beekeepers who provide pollination services
- planning and coordinating pollination services within a district

- adopting R&D outcomes relating to
 - optimum hive strength and management for specific crops
 - optimum number of hives and bee types to deliver value to the grower
 - application of chemicals
 - benefits of managed pollination for individual crops, including those where honeybee pollination is not essential
- retaining access to a diversity of floral resources, such as in national/State parks/forests.

Various training needs for beekeepers and growers have been identified in individual submissions to the House of Representatives Inquiry on The Future Development of the Australian Honey Bee Industry or the Inquiry into Rural Skills Training:

Farmers need to be educated about contracts. Despite the obvious need for more skilled seed growers, for the past decade, seed growers have been leaving the industry at an estimated rate of 10 per cent per annum. Many are citing the reason as difficulties with contracts²⁷.

Extension persons to promote honeybee pollination preferably should be trained in agriculture and horticulture and include pollination as part of their day to day extension programs. This requires an education program that educates persons in all these areas²⁸.

The effect of agricultural chemicals on bees requires research as well as education of farmers on using bees for pollination²⁹.

Pollination research has been identified as a key objective in the RIRDC **Honeybee R&D Plan 2007--2012**. It is intended that projects will aim to better understand the cost and value of pollination services provided by beekeepers, and to generate industry value through shared learning with crop producers including the almond industry³⁰.

Growers of orchard and horticultural crops are reluctant to acknowledge research information which shows bees can improve yields. Education of farmers, horticulturists and agricultural students on the benefits of honeybees is lacking. Irrigation, genotype, fertiliser and soil are all components that growers understand, but the important part of how crops are fertilised by insects to form fruit is often overlooked³¹.

A Strategic Plan for the future needs to focus on such issues as financial viability, recruitment and skills training, and being able to meet the needs of associated horticultural groups (i.e. pollination)³².

The training and skills maintenance for beekeepers should give appropriate emphasis to pollination services, and the level of financial support for training and skills maintenance should reflect the much higher value that efficient and effective pollination provides to horticultural and pastoral industries. It should also be recognised that primary producers who will increasingly depend on pollination services will benefit from a solid understanding of the role of pollination in sustainable production³³.

As our appreciation of what is required to provide and obtain pollination services is refined and documented through occupational and training needs analyses, further work remains to be done to review the original beekeeping competency standards, including the pollination unit (RTE4128) and selected units of competency relevant to crop production to ensure that both standards and units adequately address the skills and knowledge required of both beekeepers and growers. As noted by AHBIC (2006): ‘they represent the *first move* towards the development of an Australia wide recognised training program for the beekeeping industry’.

Underpinning national standards for education and training

In the United Kingdom, Australia and New Zealand, competency standards have been developed that cover functions relevant to pollination. In principle, these standards form the basis of any accredited or publicly-funded vocational programs that are offered, particularly those used in traineeship programs. These standards include:

- crop production
 - Australia RTE5016A Develop production plans for crops
 - Australia RTF5001A Develop a horticulture production plan
 - Australia RTF4003A Plan a plant establishment program
 - Australia RTC4702A Minimise risks in the use of chemicals
 - Australia RTC4703A Plan and implement a chemical use program
 - New Zealand 776 Fruit production—Manage pollination of a fruit crop
 - United Kingdom AgC15 Novel Cropping
- providing honeybee pollination services
 - Australia RTE4128A Provide bee pollination services³⁴
 - New Zealand 20253 Apiculture—Plan, manage beehives for, and evaluate, pollination programmes
 - New Zealand 20255 Apiculture—Describe the role of bees in pollination.

In addition, the Australian vocational education and training system has developed a very large number of units of competency in the following ‘enabling’ areas, relevant to managing pollination services. The following are examples:

- business management
 - PRMCMN402A Facilitate effective relationships
 - PSPMNGT607A Develop a business case
- implementing and monitoring quality assurance programs
 - RTE5903A Plan, implement and review a quality assurance program
- setting/managing prices/costs
 - SIRXFIN006A Manage prices
 - RTE6905A Manage price risk through trading strategy
 - RTC5908A Prepare estimates, quotes and tender
 - RTC4905A Cost a project
- risk management
 - BSBCMN416A Identify risk and apply risk management processes
 - BSBMGT611A Develop risk management strategy
- managing contracts
 - BSBPUR402A Negotiate contracts
 - RTE5920A Negotiate and monitor contracts/commercial agreements.

Standards and examinations administered by industry associations

Australia

Beekeeping

With the exception of the voluntary B-Qual industry quality assurance program (see below), there are no standards or examinations administered by any beekeeping association in Australia.

United Kingdom

The British Bee Keepers Association (BBKA) operates its own Examination Board that is responsible for the examinations framework and for setting written and practical examinations. The Board is also responsible for the management of the correspondence courses to help beekeepers to train for BBKA examinations and qualifications. The examination, which has both theoretical and practical components, requires students to explain the processes of pollination and fertilisation in the apple, the genetic and evolutionary importance of cross-pollination and an outline of the methods used by plants to favour cross-pollination and the management of colonies used for migratory beekeeping for both honey production and pollination services.

Similar examinations are offered by the Welsh Beekeepers Association.

In addition, the Examination Board for the National Diploma in Beekeeping offers examinations for the award of a National Diploma in Beekeeping, including in the syllabus:

- the management of colonies used for migratory beekeeping for both honey production and pollination services
- the economics, and organisation of a pollination enterprise
- ways of assessing the value of a colony for honey production or as a pollinating unit.

Assessment requires candidates to give a brief description of methods used by overseas enterprises for the provision of honeybee colonies for pollination services.

United States

The Eastern Apicultural Society (EAS) offers the Master Beekeepers Certification program. Tests for certification are conducted in conjunction with the annual EAS Conference and consist of:

- a written examination on knowledge of all aspects of beekeeping
- a laboratory practical examination on recognition of diseases, equipment and proper practices; an apiary performance test on the proper explanation of beekeeping practices and on handling of bee colonies
- an oral examination on knowledge and ability to communicate effectively to both beekeepers and the public.

The certification program does not appear to cover managed pollination services.

Industry quality assurance or accreditation programs

Beekeeping

Australia

B-Qual Australia Pty Limited has been established by the Australian Honey Bee Industry Council as an independently developed and audited food safety program. Its purpose is to accredit and adopt a quality assurance program for more than 90 per cent of the production of the Australian honeybee industry. The project has developed accreditation and trained industry participants in quality assurance standards, organic standards and biosecurity as well as providing an ongoing third-party audit system.

It is well recognised in the honey industry that quality standards in relation to food safety are demanded by customers, wholesalers and governments. It is also necessary to comply with the Food Standards Australia New Zealand (FSANZ) Food Safety Standard, which requires food businesses to develop a hazard analysis and critical control point (HACCP) based food safety program.

The project includes the production and delivery of:

- an industry food safety plan
- a *Honey Quality Standard* booklet
- [QA templates to assist beekeepers with the writing of a quality manual](#)
- training materials for industry facilitators
- an auditor training manual
- national Auditor Training Workshops
- templates that include criteria for the production of organic honey
- development of an [industry biosecurity plan](#).

The project involves a three-year program with the ultimate aim of ensuring that in excess of 90 per cent of all honey produced in Australia is quality assured for both domestic and export customers. The specific requirements of the European Union (EU) for the export of honey and honey products (including organics) are to be met, together with the requirements of the FSANZ Food Safety

Standard. Adoption of these standards will enable continued market access both in Australia and overseas.

The project will also produce an auditable biosecurity plan for industry to adopt. The adoption of a national quality standard will form the basis of an ongoing program to ensure industry best practice and ongoing industry training.

Product standards include all facets of production and services of the industry including honey, queen bees, pollination and honey packing. The resulting system provides a self-policing means of ensuring standards are kept at industry best practice and meet the domestic and international market demands.

All enterprises are required to participate in the B-Qual education program prior to accreditation being granted. The B-Qual education program materials contain a copy of all the required documentation for accreditation:

- a B-Qual Self Learning Program
- an Approved Supplier Manual
- a Site Folder (Records/References)
- a Risk Management and Plant Folder (Food Safety Plan).

Each enterprise is required to develop a quality system that addresses the relevant sections of the education program materials prior to B-Qual accreditation being granted.

To be accredited an enterprise must:

- participate in the B-Qual education program
- develop a quality system that includes operating procedures that demonstrate how the enterprise meets the requirements of the industry standards
- maintain records for all honey that is collected by the enterprise according to these procedures
- undergo a third-party audit of these procedures, records and facilities at the enterprise.



B-QUAL ACCREDITATION FLOW

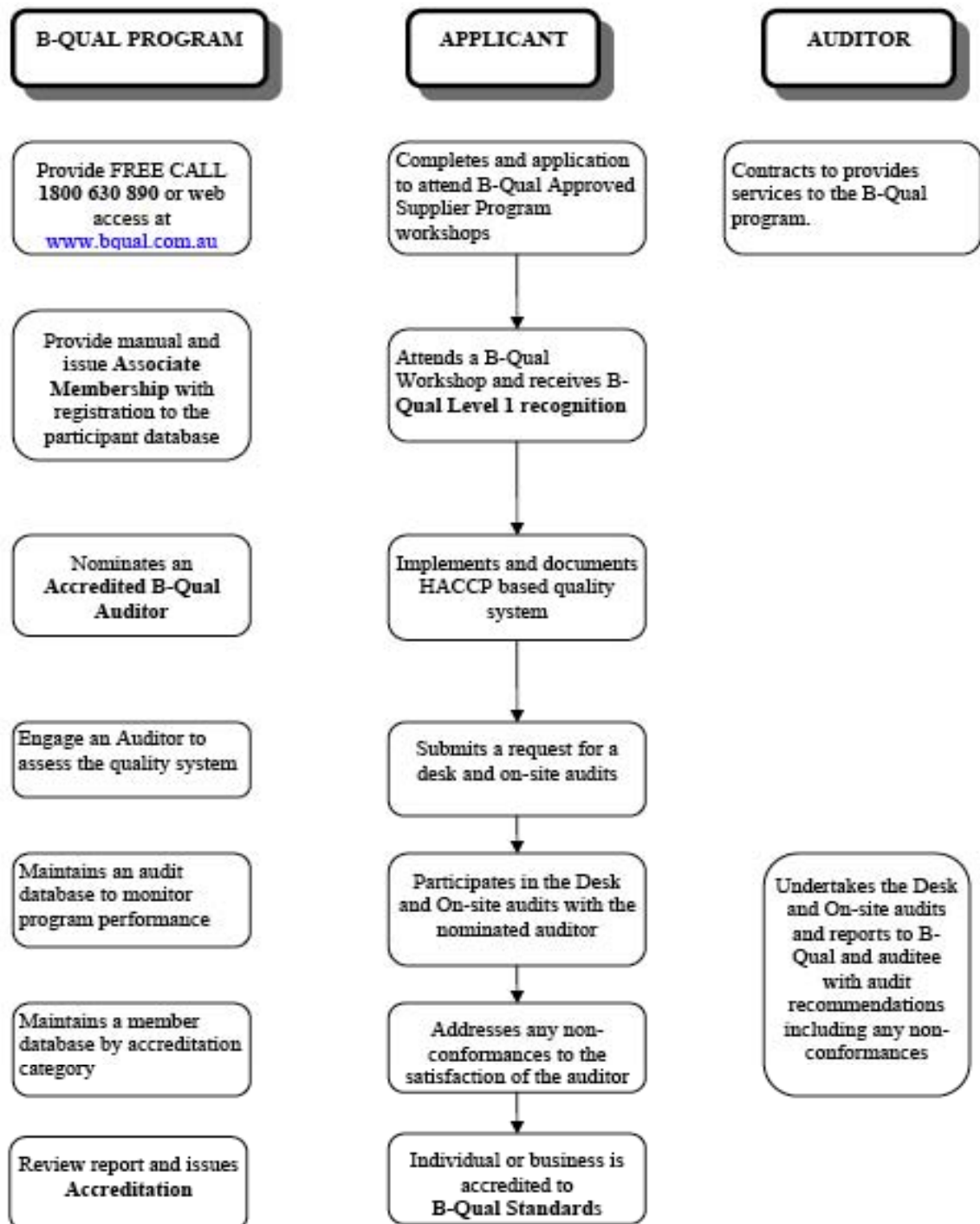


Figure 2.1 above outlines the accreditation flow chart.

Pollination is classified as a specialist activity that requires the beekeeper to comply with the generic sections covering all apiary operations. The pollination standard has an objective of providing a high standard of bee pollination services and reads:³⁵

2.9.1 Pollination Services

Beekeepers aim to use best industry practices to provide a high standard of bee pollination services. It is essential for all agreements for the pollination service to include hive stocking rates, dates of hive introduction and removal, placement of hives, payment of fees and strength of hives to be agreed to prior to the hive placement. Agreements also include payment for the removal of hives in the event of pesticide applications. It is also imperative that the B-Qual Biosecurity Plan is adhered to.

In accordance with **Enterprise Auditing**, each B-Qual-accredited enterprise is visited biennially or annually to monitor compliance to their approved QA system. Audits are conducted by B-Qual auditors who are contracted to AUS-Qual Pty Ltd as the national service provider (NSP). Biennial auditing is available under certain conditions, although B-Qual reserves the right to audit all participants through an annual surveillance program as determined from time to time. Enterprises that are found not to be following their QA system are to be visited more frequently to assist them with any changes to maintain their accreditation. These additional audits are charged at a full commercial rate.

It is not known how many honey producers, if any, have been audited against the pollination standard. Both the templates and the work instructions available on the B-Qual website to support recording of operational activities are oriented towards the production of honey. The documentation is supported by workbooks and comprehensively addresses:

- standards
 - apiary
 - extraction (of honey)
 - packer (of honey)
 - biosecurity
- work instructions
 - apiary operations
 - apiary health
 - agricultural and veterinary chemicals
 - hive identification and movement
 - extraction process
 - personal hygiene and food handling
 - maintenance, cleaning and sanitation
 - pest control
 - honey storage, bulk sale and recall
 - biosecurity procedure
 - corrective action
 - packer operation
 - record keeping
 - purchase and receipt
 - equipment calibration
 - stocktake procedure
 - internal and external audit
 - staff training
 - occupational health and safety
 - honey grading.

A Pollination Services Record has been developed and a copy is at Appendix III of this report (it does not appear to be available for download from: <http://www.bqual.com.au/>).

The material available on the B-Qual website is passive, in that there is no facility for online interaction with an expert in QA as it is applied to beekeeping. Assessment of beekeeper capability in implementing the QA process is not formally undertaken and it is the audit process that potentially identifies any issues of concern with the application of the templates.

The need for a certification program has been recognised by AHBIC³⁶:

In particular, a recognised and standardised education program on pollination with certification needs to be developed that can be used by the pollinator to indicate they have undertaken the necessary skills training. This will reduce the risk to growers of receiving a sub-standard service. It will also standardise the quality of services, thereby generating greater confidence within the paid pollination market and enabling the pollinator to capture some of the enormous value that pollination services currently provide to growers.

Growers

Australia

Plant Health Australia has developed a range of diagnostic standards for identified high priority pest threats and examined options for the formation of a national diagnostic network and accreditation scheme.

There are a number of industry-owned and/or managed quality assurance programs for growers.

Freshcare is the national, on-farm food safety program for the fresh produce industry. Freshcare links food safety on the farm to the quality and food safety programs of the other members of the fresh produce supply chain. Key industry associations are the owners of Freshcare Ltd and AUS-Qual provides auditing and audit management services to the Freshcare program.

Freshcare certification is achieved through a third-party on-farm assessment, designed to ensure that the delivery of the training has been effective, checking that the trainee has a good understanding of the Freshcare Code of Practice and of food safety requirements, and that they have then been able to effectively implement the Freshcare system on their property.

Freshcare does not address cultivation aspects that do not have a direct link to food safety. The Freshcare training programs have been mapped to endorse competency standards.

Enviroveg is a voluntary program owned by the vegetable industry through the Australian Vegetable and Potato Growers Federation (AUSVEG). It assists growers to identify farming practices that affect the environment and adopt practices that may be more beneficial to production, profitability and the surrounding environment. Growers can choose to have a third-party audit conducted.

Enviroveg covers some areas that may be relevant to pollination including:

- chemical use and storage
- hydroponic production
- greenhouse production
- organic production
- biodiversity
- biosecurity.

Enviroveg has been extensively mapped to endorsed competency standards.

With regard to other specific grower industry bodies:

- The Almond Board of Australia promotes and encourages industry involvement in industry QA and testing programs to:
 - achieve quality management protocols across the supply chain
 - address HACCP and food safety compliance requirements.

- Avocados Australia’s Strategic Plan has strategies and objectives to:
 - create general industry awareness and rapid uptake of the successful outcomes from fruit quality improvement R&D
 - accelerate the rate of adoption of currently available information regarding orchard management and post-harvest systems and practices for assuring that product quality meets consumer requirements (e.g. canopy management, crop nutrition management, irrigation management, disease prevention and treatment, crop protection)
 - create general industry awareness and rapid uptake of the successful outcomes from fruit quality improvement R&D.
- The Australian Citrus Council supported research that was completed in 1995 on the development of quality management systems and markets for Riverina citrus growers.
- The Australian Macadamia Society revised the Macadamia Industry Quality Assurance Handbook in 2001 and all major processors have obtained International Organization of Standardization (ISO) ISO 9002 accreditation.
- The Australian Melon Association Strategic Plan has a strategy to provide industry with tools and information, including production and handling support packages, that will assist melon supply chains to implement quality management arrangements that meet or exceed agreed industry minimum variety and grade standards.
- The Australian Fodder Industry Association:
 - acknowledges the importance of R&D to manage quality assurance and certification in the industry
 - has developed a code of practice to assist fodder producers to enhance their product and on-farm management, involving the preparation of an annual declaration certifying that conditions of product safety and quality have been met
- The Australian Grains Council has undertaken extensive assessment of quality processes and has noted that:
 - in relation to the production of genetically modified (GM) canola³⁷ the quality management procedures in place vary from formal systems, such as those based on hazard analysis critical control point (HACCP) and International Organization of Standardization (ISO), through to proprietary systems, industry codes of practice and best agricultural or manufacturing practice
 - across the broader grains industry, application of quality assurance systems is promoted as a generic risk mitigation technique
 - the focus on quality management through the supply chain ensures that the requirements of suppliers and receivers are understood and met, and form part of the verification process.

A specific gap in industry quality management protocols is the consideration of the standards for effective and efficient pollination, including the interface between growers and beekeepers with regard to honeybee health and pollination effectiveness. An assessment of strategic plans, policy papers and annual reports for a number of the grower industry bodies found little reference to issues of pollination or quality assurance protocols for managed hives on growers’ properties for pollination purposes. **The almond industry was a clear exception**, with its acknowledgment of the importance of pollination protocols and the relationship with the beekeeping industry.

Delivery of education and training relating to pollination

Education and training programs that addressed any aspect of pollination or provision of pollination services were investigated for the following countries: United Kingdom, United States, Canada, New Zealand and Israel. These programs can be categorised as:

- vocational programs intended for apiarists
 - short courses
 - components of technical courses, such as a diploma in beekeeping
- vocational programs intended for plant industry members, such as fruit or vegetable growers
 - short courses
 - components of a technical course, such as a diploma of horticulture
- ‘programs’ designed for the general public

- providing information about honeybees and their value as honey producers
- providing information and raising awareness about the importance of all pollinators in terms of biological diversity (eg native bees, birds)
- subjects or units that form part of a university program in agriculture, ecology, agronomy, or rural science streams.

Australia

Pollination-specific programs

There are no pollination-specific courses in Australia. As far as can be determined, pollination is addressed mainly at a theoretical level in agriculture/horticulture programs currently being offered at either the higher education or vocational levels. The focus in almost all cases is on biological processes; the development of beekeeping or business skills relating to pollination service delivery is not addressed. For example:

- Curtin University's Department of Agribusiness offers two units Fruit Production 201 and Fruit Production 502 which specifically include pollination in the syllabus, whilst Vegetable Production 401 and 501 do not include pollination
- University of New England offers zoology units on insect/plant interaction which are not options within the plant production stream of a Bachelor of Agriculture but can be taken as electives in a Bachelor of Rural Science
- University of Queensland offers elective subjects that cover apiculture and pollination
- Hawkesbury Agricultural College (one of the main centres where professional apiculturists and beekeepers were educated and trained), is now part of the University of Western Sydney (UWS); apiculture ceased to be offered at UWS in 2005 following major course rationalisations (although UWS continues to provide postgraduate training in apiculture and is keen to position itself as a pollination research centre)³⁸.

Certificates and Diplomas in Production Horticulture are widely offered through TAFE colleges and private RTOs. The selection of units to be undertaken may vary widely as, in theory, the program of study is tailored to the work requirements and interests of individuals. Pollination is included as underpinning knowledge in some components of these courses.

Beekeeping courses

In Australia, it is notable that many of the courses or workshops available for either beekeeping or horticulture are aimed at hobbyists/amateurs etc (e.g. as provided by TAFE NSW/OTEN, Canberra Institute of Technology (CIT) and Bendigo Regional Institute of TAFE).

In brief, the following programs are offered in Australia:

- Beekeeping-Apiculture Practices (678) TAFE PLUS course (known as the OTEN course), a correspondence course provided by TAFE NSW that includes a practical weekend and focuses on bee husbandry with a section on crop pollination. This non-accredited course is popular with hobbyists and people who do not keep bees, but is not based on competency standards³⁹
- Introduction to Beekeeping (B320PI08) is a short course offered by Bendigo Regional Institute of TAFE, aimed at beginner amateur beekeepers and covers the basic practical and theoretical knowledge required for the establishment, operation and maintenance of a beehive. It also covers how to responsibly manage honeybees for honey production, with its development informed by the beekeeping competency standards, but not externally accredited
- traineeships for new apiary industry entrants based on the Certificates in Rural Operations, offered by Bendigo Regional Institute of TAFE
- an annual weekend beekeeping course offered the University of Queensland
- short courses offered by the NSW Department of Primary Industries
- extension courses offered by Departments of Primary Industries or their equivalents in other jurisdictions
- short training programs on specific topics, such as food safety, offered by a variety of training organisations

- a field surveillance program designed as part of the emergency animal disease response preparedness (EADRP) by Animal Health Australia
- a 16-hour backyard beekeeping course, offered by the CIT, focuses on basic bee husbandry and is aimed at hobbyists.

United States

Universities and technical colleges in the United States, which have either an entomology or agriculture/horticulture program with an extension component, regularly offer summer schools or short courses on aspects of beekeeping. In some cases, these programs address pollination. Some programs may give students credit for university or college courses.

Canada

Pollination specific programs

Simon Fraser University, Burnaby Campus, British Columbia, offers a week long 'Bee Masters' program which includes two one-hour lectures on 'Alternate Pollinators' and 'Management of Honey Bees for Pollination'.

New Zealand

Beekeeping courses

Most formal beekeeping training is offered through the Telford Rural Polytechnic, South Island. The Telford Certificate in Apiculture (Level 3) is a 37-week, full-time course combining theory and practice. Course content includes:

- disease identification
- honey extraction
- beehive products
- pollination
- bee behaviour
- botany
- hive management
- marketing
- business administration
- mechanics
- food safety
- first aid
- agricultural chemicals.

Students also undertake work experience with commercial beekeepers.

Other resources

Advice and other resources for growers and beekeepers is also available detailing good practices, some specific to pollination. This information may be used in a variety of education and training-related ways, for example as private home study, as part of a workshop or as an adjunct to formal extension activities. Some examples follow.

AgNotes/PrimeNotes

These are produced by a number of jurisdictional Departments of Primary Industries. The NSW Department of Primary Industries has published fact sheets addressing pollination.

Research reports

Rural Industries Research and Development Corporation publishes research reports relating to the honeybee industry and some horticultural industries with an interest in pollination issues (eg the olive industry). The full reports are available for download from <http://www.rirdc.gov.au/programs/hb.html>

Horticulture Australia Limited publishes abstracts of research reports on its website:
www.horticulture.com.au.

Good Practice Guide Vegetables WA 2007

These guidelines are representative of the better approaches taken by grower groups in Australia. They focus on nutrient, soil and water management but do not address pollination of crops.

Honeybee pollination: technical data for potential honeybee-pollinated crops and orchards in Western Australia

Adapted from Bulletin 4298, with additional material prepared by Rob Manning, a Research Officer with the Department of Agriculture and Food, Western Australia. This publication includes information about technical pollination, contracts and worked examples of calculations of honey production costs.

Honey Money: Cost of Honey Production Calculator, NSW Department of Primary Industries, 2006

This CD or internet-based resource assists beekeepers to determine the profitability of their honey production enterprise using an Excel spreadsheet.

Good Agricultural Practices (GAPs) for Almonds

Web-based modules produced by the Almond Board of California. See
http://www.almondboard.com/content/eLearning/ABC_GAP_Goldv3.6_20060801/index.htm

Honey Bees, Rental Fees and Pollination Contracts, College of Agriculture and Life Sciences

New York State Agricultural Experiment Station (Entomology Department) Scaffolds Fruit Journal (online publication at http://www.nysaes.cornell.edu/ent/scaffolds/1999/4.26_insects.html)
Advice to fruit growers about identifying and contracting for quality pollination services.

Africanised Honey Bee Education Project: sample lesson plans

Part of the Africanized Honeybee Education Project, The University of Arizona, and includes lessons on pollination: <http://ag.arizona.edu/pubs/insects/ahb/ahbhome.html>

Insect Pollination of Cultivated Crop Plants S.E. McGregor, United States Department of Agriculture, Agricultural Research Service; Carl Hayden Bee Research Center, Tucson Arizona, 1976. Available online at: <http://gears.tucson.ars.ag.gov/book/>

Pollinators.com

This is the primary web-based resource for pollination in the United States.

University of Georgia, College of Agricultural and Environmental Sciences
<http://www.ent.uga.edu/bees/Pollination/Pollination.htm>

University of Georgia Insect Lab provides information about pollination for growers: Pollination: A Growers Last Chance to Increase Yields: <http://www.uga.edu/caes/insectlab/Beehome.html>

International Pollination Systems—a private enterprise that provides bees for pollination, lesson plans for school students and conducts research. They have a particular interest in leaf cutter bees and pollination of alfalfa (lucerne) <http://www.pollination.com/>

Western Apicultural Society (WAS) and Eastern Apicultural Society (EAS) each hold an annual conference. The WAS conference includes hands-on workshops and discussion of pollination research findings <http://groups.ucanr.org/WAS/> The EAS conference includes short courses. <http://www.easternapiculture.org/>

[Pesticides and Bees <http://www.gov.mb.ca/agriculture/crops/fruit/fbc02s00.html>](http://www.gov.mb.ca/agriculture/crops/fruit/fbc02s00.html) (Manitoba, Government)

Guidelines for the application of Canadian prairie pesticides without harming honeybees.

[Pollination and Bee Poisoning Prevention <http://www.omafra.gov.on.ca/english/food/inspection/bees/pollination.htm>](http://www.omafra.gov.on.ca/english/food/inspection/bees/pollination.htm) (Ontario, Government)

Guidelines for pollination of crops and Ontario strategies to prevent pesticide poisoning.

[Insect Pollination Of Cultivated Crop Plants <http://gears.tucson.ars.ag.gov/book/>](http://gears.tucson.ars.ag.gov/book/) (USA Government)

A comprehensive online guide to the pollination requirements of the agricultural crops of North America.

[Pollination of Wild Blueberries <http://www.gnb.ca/0171/10/0171100009-e.asp>](http://www.gnb.ca/0171/10/0171100009-e.asp) (New Brunswick, Government)

Information on the pollination of wild blueberries, an important crop in Canada's Maritimes.

[Pollination Contract \[http://www.agf.gov.bc.ca/apiculture/forms/pollination_contract.pdf\]\(http://www.agf.gov.bc.ca/apiculture/forms/pollination_contract.pdf\)](http://www.agf.gov.bc.ca/apiculture/forms/pollination_contract.pdf) (BC, Government)

A sample pollination contract.

Pollination Canada, a joint venture of [Seeds of Diversity Canada <http://www.seeds.ca/>](http://www.seeds.ca/) and [Environment Canada's Ecological Monitoring and Assessment Network Coordinating Office <http://www.eman-rese.ca/>](http://www.eman-rese.ca/) provides a wealth of education material and activities with a focus on ecological monitoring of native pollinators.

Education and training delivery strategies

The education and training strategies of a number of primary industries have been reviewed.

Common features of industry education and training strategies are:

- undertaking formal surveys of industry members to determine training needs and demand (eg AUSVEG surveys)
- identifying opportunities for working within the formal education and training system, for example
 - developing competency standards and qualifications that can be used for traineeships for new industry entrants or for recognition of prior learning for existing members (eg certificate/diploma programs offered by Tocal Agricultural College)
 - developing supporting ‘industry-endorsed’ learning and assessment materials,
 - developing school curriculum materials (eg Weeds Co-operative Research Centre and other activities such as the Promotion of Agriculture to Schools network)
 - sponsoring or assisting with research activities conducted by universities, such as the work being done by Dr Shona Blair at the University of Sydney
- developing informal or formal (where there is allocation of points for participation) programs of professional development activities for industry members, such as
 - short courses
 - workshops
 - conferences
 - provision of guidelines and publications
- identifying opportunities to link accreditation or the issue of licences or permits into other education and training activities, so that industry members can obtain additional benefits for their efforts in attending compulsory training or assessment events and avoid duplication of testing by regulators, for example
 - Fertcare
 - EADRP/AUSVETPLAN roles
 - farm chemical purchases

- establishing an education and training group with responsibility for initiating and/or overseeing activities, such as
 - a committee of an industry association/council (eg AHBIC education and training committee)
 - a separate entity such as the Agri-Food Industry Skills Council
- appointing an education and training coordinator
- developing an arrangement with a training organisation for the delivery of training and/or assessment services, such as the
 - arrangement between Tocal Agricultural College and Animal Health Australia
 - National Centre for Dairy Education Australia and its links with a number of training organisations, such as TAFE Tasmania
- identifying and promoting overt linkages between education and training activities and key business or other performance areas for the industry and individual enterprises, such as environmental areas.

Australia

Poultry industry

The Australian poultry industry's education and training program is designed to achieve an increased level of skills for all sectors of the industry and draws on strategic linkages with poultry industry enterprises and other related industries, such as the feed industry. The Poultry Co-operative Research Centre's education program operates across the full range of qualifications and sectors:

- secondary schools sector
- vocational education and training (VET) sector (TAFE and registered private providers)
- higher education sector (mainly universities).

The operational plan includes the following strategies:

- to conduct an audit of existing education and training courses and materials of relevance to persons working in the poultry industry, or who wish to pursue a career in the poultry industry and to compile a regularly updated central repository of information about those courses and materials
- to survey and consult with all levels of the industry to determine education and training needs and to identify shortcomings in what is currently available
- to assist education providers to develop new courses and materials of relevance to the needs of the Australian poultry industries
- to enhance the value to Australia of postgraduate researchers, for example, training the new generation of poultry research scientists.

The poultry CRC did consider establishing an industry-owned registered training organisation but decided to use its website to provide linkages to training providers that can offer appropriate education and training in accredited programs that comply with the Australian Qualifications Framework. The CRC's focus will be on providing resources to training deliverers and to increase the take up of training by industry members.

Vegetable industry

The Australian vegetable industry strategic plan, VegVision 2020, clearly identified the importance of developing skills and knowledge in the industry and the need for a long-term commitment to developing the industry's people resources.

As part of its implementation of VegVision 2020, the vegetable industry has researched the education and training needs of its workforce and appointed a full-time 'people development coordinator'. The industry is seeking expressions of interest from training providers for the delivery of business skills training and Horticulture Australia Limited call for proposals also highlights the need for 'people development'. These training initiatives form part of the overall change management program for the vegetable industry.

Fertiliser industry

Ferticare is a national training and accreditation initiative for all fertilizer and soil ameliorant industry businesses and staff. It is managed by the Fertiliser Industry Federation of Australia and has three components:

- **Level A - Logistics** for transport, storage and spreader operators
- **Level B - Sales** for agricultural sales staff and staff in related agricultural and environmental roles, including government and research institutions
- **Level C - Advisers** for crop and pasture nutrition advisers and consultants who are providing detailed plant nutrition advice based on soil and plant testing.

Each level is linked directly to endorsed units of competency.

Viticulture Co-operative Research Centre

The former CRC for Viticulture had a very strong education/technology transfer program and developed a series of Research to Practice® Viticulture workshops. These were initially designed to facilitate practical training for grape growers and associated industry personnel in integrated pest management, with a view to improving levels of adoption and assisting with informed decision making. It grew to cover a broad series of topics focused primarily on sustainable economic growth along with sound natural resource management. It involved researchers and experts from many agencies and organisations across Australia.

A variety of organisations are licensed to deliver Viticulture Research to Practice® training including universities, TAFE colleges, wineries, viticulture consultants, wine industry organisations and jurisdictional departments of primary industries. With the cessation of the CRC for Viticulture, the program is now managed by the Grape Wine Research and Development Corporation. It is reported to be very worthwhile, but somewhat costly for an organisation to deliver, dependent on the availability of specific, specialist expertise to deliver the training and industry development officers to provide follow up with growers.

New Zealand

The Strategic Pollination Group developed a pollination strategy (August 2006) which includes the following proposed actions that reflect the typical components of an industry education and training strategy:

- research is undertaken to determine the current level of business acumen of New Zealand beekeepers in order to identify the common skill gaps that exist
- training packages are identified or developed to deliver to New Zealand beekeepers in order to address the identified skill gaps and hence increase the business skill level within the industry
- a program is set up to encourage new entrants to either invest or work in the New Zealand beekeeping industry
- a series of workshops is held with those growers who are reliant upon hives for pollination, to inform them of measures they can take to optimise the use of honeybees in pollination and alternatives to honeybees
- opportunities are taken to inform the New Zealand public about the impact of honeybees on the New Zealand economy and landscape aesthetics and the threats that exist to the honeybee population
- numerous recommendations have been developed relating to informing stakeholders about threats to pollination and production posed by Varroa mite.

It is not known yet what progress has been made in implementing the strategy through the delivery of workshops and courses.

Conclusion

Increasing attention is being paid to the availability of resources (both print based and online) and training programs addressing pollination. Programs are aimed at beekeepers and growers. Apart from the *AgNotes*, there are few pollination resources written for the Australian context. However, considerable awareness of the need to address the lack of resources is shown in submissions to the House of Representatives, Standing Committee on Agriculture, Fisheries and Forestry, Inquiry on The Future Development of the Australian Honey Bee Industry and in the recommendations from the April 2007 Linkages Workshop.

In the United Kingdom, New Zealand and Australia, some competency standards have been developed to address the pollination service provision. The Australian standards are yet to be implemented. As discussed earlier, some work remains to be done in this area, including the development of the occupational profile of a 'pollinator' and the associated mapping to existing competency standards. This may result in the need to modify existing units of competency or develop new ones. Competency standards are useful benchmarks for the development of education and training activities, including those funded by various government programs and, as a consequence, should receive an appropriate level of attention in a pollination industry education and training strategy.

In Australia, primary industry associations have begun to develop strategic education and training plans for their sector. More research needs to be conducted to determine any resultant training initiatives implemented by individual enterprises. This project is the first step in the development of such a plan to address the needs of a significant sector of the honeybee industry, as well as raising the importance of including pollination in plans developed by organisations representing the interests of growers.

Any plan developed for the pollination industry should take account of the lessons learned by other primary industries, particularly in relation to improvements in enterprise performance that can be directly attributable to education and training activities.

4. Education and training needs of pollinators

The terms of reference addressed in this report include:

- determining the education and training needs of pollinators that allow them to develop a business model and appropriately price services, including:
 - identification and measurement of the risks involved in offering paid pollination services
 - identification and measurement of the benefits provided by paid pollination services to the grower
 - pricing of services that provide a return commensurate with the expanded risks from supplying paid pollination services
 - development and use of a business model that leads to a more profitable and sustainable paid pollination business.

Satisfaction of the education and training needs of pollinators cannot occur in a knowledge vacuum. The development of competencies and curricula requires acknowledgment of an evidence-based body of knowledge that can be codified and transmitted to those personnel required to apply the knowledge to produce tangible outcomes, in this case, the effective and efficient pollination of crops.

Impact of risk management

Development of a comprehensive risk management strategy for the pollination industry has identified a range of issues and initiatives that need to be taken up by appropriate levels of government and industry. The strategy identifies clear implications for the specification of the knowledge required by all levels in the pollination supply chain to deliver quality outputs and outcomes.

The risk management strategy supports the enhancement of the capability and performance of the pollination industry through pollination awareness training and an education plan. It cites an important action on the management of incursions of pests and diseases as being disease response and management training and simulations.

To sustain the growth and development of the pollination industry, including the need to raise the levels of knowledge and the standards of management on both the supply and demand sides, there is a need for a training and education program. This program needs to devolve the outputs from the research program that provides the basis for optimising and continuously improving the management of pollination services throughout the industry.

A prime focus of the risk management strategy has been the risks posed by an incursion of an exotic pest or disease of significance to the pollination industry and the mite, *Varroa destructor* in particular. Research and consultation undertaken as part of that study suggested that the pollination industry should have a broader view of pests and diseases than might have been anticipated and identified five broad groups that require attention, being:

- a pest or disease of bees that impacts cost and availability of the supply of pollination services including Varroa
- a pest or disease of a major pollination crop that affects demand for pollination services
- a pest or disease of a key floral resource that impacts upon the non-pollination elements of beekeeping
- a pest or disease of plants that is vectored by bees and results in restrictions upon the transfer of beehives (and, by definition, bees)
- a pest or disease of other plants or animals, the management of which restricts the movement of beehives and their occupants.

The potential impact of Varroa would be such as to demand that every reasonable effort be made to ensure its exclusion or, if it is detected, to eradicate it early. Such efforts should include enhanced surveillance and response preparedness and a review of the national expertise required to assist these efforts.

The combination of an expansion of pollination dependent industries and an incursion of a pest or disease, such as Varroa, would result in a significant increase in the required number of:

- managed honeybee colonies to provide the pollination services required
- people skilled in the management of bees and pollination to service the additional colonies.

In addition to the biosecurity risks facing the Australian pollination industry, the Risk Management Strategy identified a number of additional risks that have the potential to either impact the supply or demand side of the pollination industry, thereby altering the context in which biosecurity threats are viewed or leading to an interaction with a biosecurity risk to exacerbate or ameliorate its effect on the pollination industry. Those with an implication for education and training are listed in the following table.

Table 4.1 Education and training opportunities identified by the risk management strategy—organisation and risk management

Specific risk	Action required
Lack of awareness of, and capacity for, management of pollination	<ul style="list-style-type: none"> • All stakeholders involved in the process—beekeepers and their employees, growers and their employees and contractors, pollination service brokers and government and private advisers—are aware and/or are trained and educated in the best practice standards, consistent with the responsibilities of their role in the pollination process.
Deficiencies in human resources, awareness and expertise	<ul style="list-style-type: none"> • Enhancing future research capacity and the availability of experienced researchers, with a sustained approach to the recruitment and training of younger researchers. • Provision of awareness training and formal instruction to beekeepers on monitoring and surveillance of beehives • Provision of awareness training to growers on the biosecurity risks of pollination and grower actions that minimise risk.
Barriers to effective implementation and management of a response to an incursion	<ul style="list-style-type: none"> • Provision of awareness training and formal instruction to growers on emergency response processes and protocols • Development and conduct of simulation and training exercises, particularly those involving implementation of arrangements formalised to address interface issues across bees and plants
Lack of awareness, education and training arrangements for the pollination industry	<ul style="list-style-type: none"> • Awareness education and training at all levels within the pollination industries and related government and private regulatory and advisory agencies, with the awareness and competencies required in each instance being consistent with the role and responsibility discharged.
The prospect of industry restructuring	<ul style="list-style-type: none"> • Recruitment to the industry must be increased and broadened beyond families with established apiary interests or hobbyists who move to full-time beekeeping. • Training courses need to progress beyond introductory beekeeping for aspiring hobbyists • Professional management will be required for larger corporate entities providing managed pollination services.

Impact of research and development

Identification of knowledge deficiencies more closely defines those areas in which effective education and training needs can be satisfied in the immediate and medium term. By necessity, education and training in those areas that are yet to be defined and the effectiveness of practice documented must be

delayed pending the delivery of the research and development outcomes. The parallel report on R&D Priorities²⁰ has identified the following areas as those requiring research that relate more specifically to pollination services:

- the constitution of optimum strength hives (readily agreed standards, development of a certification/branding system to support hive strength, QA implementation, etc), with the standards likely to vary across crops and at different times of the year and geographic location
- establishment and maintenance of optimum strength hives, including research and extension advice to apiarists
- the economics of preparing optimum strength hives and the costs/returns needed to profitably provide pollination services, including gross margins and benchmarking provider costs against industry levels
- establishment of pollination requirements needed for each crop for Australian conditions either from the literature or from research
- development of pollination standards for all the major Australian crops (stocking rates/hives per hectare, bees per hive, the timing of bee introduction, placement in appropriate locations, in-field effective management, chemical management needs, costing models, QA implementation)
- development of best practice guidelines for crop growers outlining their responsibilities to beekeepers, including ensuring sufficient flowers are available and that bees are protected from pesticides and other harmful chemicals (with the Tasmanian Code of Practice providing a useful template)
- economic benefits to growers of correct pollination including the dollar yield per hectare of additional profit as information for growers
- labelling of chemicals to notify crop growers of possible dangers to bees
- research to understand the impact of agricultural chemicals in subsequent generations of plants on bees and the impact of chemicals in combination
- education and training materials for agronomists so that they understand both the economic benefits of paid pollination and chemical management responsibilities
- development and testing of pollination service marketing materials, including brochures, agricultural journal articles, outlining the economic benefits to crop/horticultural producers of correct pollination
- establishing the feasibility of a United States and New Zealand-style hive-brokering service
- spatial information to highlight the regions that would be affected by pollinator loss
- strategies to provide drought reserves and over wintering areas, etc to build bee strength prior to employment in pollination, including the provision of information to government
- strategies to achieve regional coordination in the provision of pollination services
- production of a New Zealand-style pollination manual
- convening a New Zealand-style seminar series aimed at educating both beekeepers and growers.

Education and training delivery strategies

Publicly available training

RTO business activities often consist of full-time programs that run over a term, semester or calendar year. Typically the courses cover areas that are well known, so that there is relatively little difficulty in attracting interest and filling courses. For example, TAFEs (and some private training providers) will have a suite of courses that they regularly offer and which almost always run, such as business administration, hospitality and retailing programs. Fees are usually charged on the basis of the ‘nominal hours’ that a course is deemed to take (i.e. the study load). Some of these programs can be undertaken on a part-time basis or flexibly, with changing hours of participation depending upon an individual’s availability.

As well as ‘standard’ courses primarily designed for full-time students or apprentices, many RTOs offer short course training, often through an allied entity, such as CIT Solutions, which is the ‘commercial arm’ of the Canberra Institute of Technology, or TAFE PLUS, the commercial arm of TAFE NSW. These programs are often designed for particular professional groups or to fill an obvious niche or

demand for training that is not met through the standard full-time programs. Examples are courses in work-related areas such as project management, training and assessment or other programs in areas considered to be primarily recreational (eg art, designing a fish pond, running a hobby farm, or a range of personal development programs).

Beekeeping is sometimes included in these course offerings and such courses are only available where there is sufficient demonstrated demand. They are not likely to run unless a minimum enrolment number is reached. Fees vary according to the type of course, anticipated class sizes and materials or facilities required.

Benefits and disadvantages

Generally, this approach works best in cases where there is a big enough pool of potential participants (trainees/apprentices/members of the public) with similar interests and needs, enabling the RTO to schedule courses on a regular basis. This will suit employers or students who wish to study in a 'popular' course. Some units of competency relevant to pollination service provision may be available as a standard public offering.

On the other hand, RTOs find it difficult to cater for all interests and needs, with areas of study or occupations that attract fewer people tending not to be addressed, or at least not on a regular or frequent basis. RTOs are less likely to invest in developing learning resources or finding and contracting teachers for areas with less proven demand.

Individual subject choices may be limited to those areas that are most popular with the target client groups and can be most easily delivered by the RTO, taking into account staff, equipment, space, time and other resources.

Design and delivery of programs for a specific employer or organisation

In many cases, an organisation will approach an RTO that has a track record in delivering training in a particular area and commission that RTO to develop and deliver training that is 'customised' to the needs of their workforce/membership. This can be either by designing and delivering a specially written program or by adapting existing material to meet that client's needs in a better mode. In some circumstances, it might be the same content as a 'standard' program offered to full-time students but delivered at a different pace, time, place or using other, flexible delivery arrangements. Fees will vary between RTOs and may involve a lump sum for development work and a per head or per course fee for the delivery of training and assessment.

Similar arrangements are made where an organisation such as a professional association or industry body (not an employer) has a contract with an RTO to design and deliver training/assessment for its members. For example, the following case study provided by Response Training and the National Meat Industry Training Advisory Council (MINTRAC) illustrates a 'full service' arrangement⁴⁰:

MINTRAC approached Response Learning, a number of years ago, requesting that as a registered training organisation (RTO), we manage their diploma units in NSW and Victoria and their National Leadership Advanced Diploma program. Both of these programs are delivered and assessed under the Australian Meat Industry Training package.

This has developed into a close partnership between the industry body and the RTO. Working closely together the parties have been able to identify industry training needs, create marketing strategies, design delivery and assessment methodologies and deliver and evaluate programs. This has resulted in MINTRAC providing consistent, high quality and relevant technical and leadership programs to the industry and has served to build both organisations' reputation with industry. In addition, having Response Learning provide competency advice and manage this training has taken considerable administration work and pressure off this industry body.

Additionally, Response supports MINTRAC through being a key sponsor of their 2007 Meat Training Conference, providing advice to other RTOs delivering in other States and attending State training managers' meetings.

The MINTRAC model includes performance management coaching by the RTO for all MINTRAC selected facilitators during the creation and delivery of programs to provide ongoing support and advice on facilitation styles. This has resulted in excellent competency outcomes for the participants and a desire for industry to engage in MINTRAC programs.

Benefits

The organisation has a greater degree of control over the content and timing of training/assessment programs that are undertaken by their workforce. It can contract out as much administration, including marketing and promotion, as it wishes to the RTO.

Provision of assessment services

An RTO may provide assessment-only services where students can gather evidence of their competency from any number of sources, including through the completion of training programs conducted by other organisations, and present other forms of evidence (as suggested earlier under Assessment formats). The student then presents his/her evidence to the assessing RTO that determines whether it is satisfactory.

Benefits and disadvantages

This approach works very well with a professional development program that offers a range of options to members, including access to programs that sit outside the formal Vocational Education and Training (VET) system but which are very well regarded.

For example, a member could participate in the Australian Rural Leadership Program, undertake the Australian Company Directors course and attend a number of industry conferences, as well as documenting projects and activities that have been undertaken as part of beekeeping / pollination / production horticulture work. As none of these training or development activities are 'competency-based' or conducted by an RTO, they would not automatically attract formal recognition or 'credit'. However, all of these activities provide valuable evidence of competency as well as being important development activities in their own right. Individuals benefit by using evidence from a wide range of sources, drawing on formal or informal learning as well as evidence relating to work or other areas in their personal life.

The benefits to the RTO are that it does not need to develop training materials or delivery strategies. The RTO needs to work with the association or employer to determine what will constitute appropriate evidence and to develop an assessment strategy and tools/forms.

The employer/association has the freedom to provide or suggest a range of development options for members, without being limited to those that are written specifically to meet competency standards. Some activities may be 'mapped' to competency standards so that the links are more explicit and the level of training can be demonstrated to be equivalent to a particular level within the Australian Qualification Framework, a past requirement of FarmBis.

A disadvantage is that the approach requires individuals to show additional initiative and organisation to in undertaking professional development and assessment. The organisation must also invest resources in managing the professional development program.

Partnership between RTOs

Creation of a partnership between two or more RTOs is similar to the arrangements already described above. An RTO can contract with a number of other RTOs each with their own systems, staff and resources that support the delivery of training and/or provision of assessment to students.

Partnership works well where one RTO would not be able to cover very specialist areas of training by itself. For example, where one RTO has expertise in delivering training and assessment in managing contracts and another is able to provide hands-on training in beekeeping and farm chemical use, together the two providers could deliver many of the units of competency required for personnel in various roles in the pollination industry.

Auspicing and quality assurance

An RTO may provide quality assurance services without providing actual training or assessment to students.

An example of this role has been provided by Animal Health Australia (AHA)⁴¹, which has an arrangement with Tocal Agricultural College in New South Wales for the provision of 'RTO services' for the training components of the Emergency Animal Disease (EAD) Response Preparedness Program. AHA develops the delivery and assessment strategies and the training and assessment materials. The materials are quality assured by the college and made available electronically to State/Territory departments responsible for animal health. These departments are then able to use the materials to deliver training and assessment to personnel who will be required to undertake a formal role in an emergency animal disease response). Trainers/assessors meet standards of delivery and assessment and hold qualifications as determined by the college; students receive qualifications or statements of attainment. Animal Health Australia maintains the learning and assessment materials as electronic files that the trainer/assessor downloads, prints and distributes, undertaking all course organisation. Each State/Territory has an EAD Training Coordinator who promotes the program and sources the participants and the trainers/assessors.

Tocal Agricultural College:

- undertakes annual quality assurance visits to each jurisdiction
- attends meetings of the National Animal Health Training Steering Committee, coordinated by Animal Health Australia
- participates in occupational and functional analyses and course design workshops
- provides Animal Health Australia with advice on compliance with the national AQTF standards and education best practice
- has membership of Animal Health Australia's Community of Practice for EAD trainers.

Benefits and disadvantages

RTOs have systems in place to ensure that the usual training and assessment activities comply with the requirements of the AQTF. An RTO does not need to recruit, train or manage trainers/assessors, ensures that the trainers/assessors delivering the service meet its requirements and keep records of their credentials and the assessments that have been made. Providing that the costs of adding the client's record keeping requirements to the RTO system are met and that an appropriate fee for the services is agreed upon, additional costs to the RTO are small. The RTO does not face up front expenditure or commitment of resources for marketing, promotion, design and printing of materials which otherwise might not be recouped if the course was not well subscribed.

The Training Coordinators are able to use those trainers/assessors that they prefer and plan the delivery of training programs at times and places that are suitable for trainers and participants. The trainers do not have to:

- become an RTO to ensure that participants receive statements of attainment or qualifications, resulting in a significant reduction in record keeping and administrative time
- keep all the records or have all the systems required to demonstrate AQTF compliance.

By retaining responsibility for the content of the materials, Animal Health Australia can ensure an acceptable standard of uniformity of course content and assessment methodology across all jurisdictions. This is important, as personnel trained in one jurisdiction may be called on to work in a response in another jurisdiction. Contracting an RTO for its quality assurance services allows Animal Health Australia to avoid the need to become an RTO itself.

The client (employer) must invest resources in developing a brief for the RTO and the contract, and in monitoring contract performance. Costs to the employer may be greater than the quantum it would incur if its employees were enrolled in a standard course offering. The employer may need to play a greater role in the training and assessment activities than that required if all the activities were delivered by the RTO as part of their standard course arrangements.

Many of these options could provide additional benefits to the pollination industry and organisations if Pollination Australia or its members were to negotiate a 'branding' arrangement with an RTO issuing a 'pollination industry specific' qualification. In this way, whatever the nominal qualification, it would be clear that the individual student had completed all or part of a recognised pollination education and training program.

Informal delivery modes

A common means of communicating knowledge and information about horticultural practice is the field day. Field days are a traditional means of informing growers and agricultural operatives of new developments in practice that can improve effectiveness and efficiency of activities on the land. Field days are a means of reaching participants in the pollination process who would otherwise not be involved in more formal means of acquiring new skills or understandings.

Industry conferences are an additional means by which growers and beekeepers can not only interact in an informal environment, but also exchange views and experiences, improving their knowledge of the broader pollination environment, supported by effective networking for future business activity.

Training in business modelling and the pricing of services

Beekeepers providing pollination services, either directly to growers or through a broker or other arrangement, will require an appropriate business structure and will need to undertake business planning, marketing and pricing of their services. Beekeepers are no different to all enterprises engaged in the provision of agricultural/horticultural services to clients.

However, perhaps unlike some other agricultural contracting sectors, the skills and knowledge of beekeepers have tended to be passed down through the family line, or acquired by many years of amateur or hobby beekeeping. Many beekeeping businesses are small, family-run affairs and it is likely that these enterprises have continued to be run in the same way over a long period of time.

Beekeeping enterprises that have grown from an amateur and hobbyist interest are also likely to be small-scale operations. Rodriguez (2003) reported that approximately 51 per cent of Australian honeybee producers are sole traders; while 46 per cent are partnerships. These small businesses (in reality, micro businesses) were run almost entirely by family and non-hired labour and worked almost three times the number of hours per operated hive compared with the few large businesses engaged in beekeeping.

Products, especially honey, are sold under long-standing contracts to a small number of customers, such as the major honey packers or co-operatives. Access to bee sites may also be based on custom and unwritten 'understandings' and contracts establishing conditions for use of a private site may be very informal and based on barter rather than a monetary fee-for-site use.

It is not known how many beekeepers have undertaken formal training in business management, participated in workshops (such as those funded through FarmBis), or used the services of financial or business planners. Beekeepers considering providing pollination services should be encouraged to undertake formal education and training and seek professional advice on appropriate business structures and practices, pricing and contract management rather than rely on their previous experience and established customs as they move into a new way of working.

There is no evidence that the business planning and management requirements for the provision of pollination services are distinctively different from, for example, a business involved in weed control, aerial spraying or ground fertiliser spreading. Beekeepers engaged in pollination service provision are unlikely to require some unique or specialist business management education and training program.

With the development of pollination brokerage and the aggregation of small beekeeping operations into larger entities, individual beekeepers are likely to be 'price-takers', rather than 'price-makers'. Only those operations that control large numbers of hives are likely to influence the economics of their supply relationship with pollinators. As it is unlikely that such large enterprises could be run in a hobby-like, non-business manner, the provision of specialist business modelling and service pricing training is unlikely to be an issue.

There are many TAFE colleges and universities offering business programs, although no course is undertaken that is specific to the application of pricing models for the pollination industry. It would be expected that training providers would be able to develop a customised program based on the relevant units of competency. However, they would need to know the demand for such training if they were to undertake development using their resources, or alternatively, be adequately remunerated by the industry or some other funding source. Programs based on the well-established business services training package units of competency should meet these needs, particularly if delivered in a readily understood industry context (for example with case studies and worked examples illustrating typical scenarios).

Access to preparatory programs in areas such as business communication, computer skills and financial literacy would be helpful for beekeepers who have not had the prior opportunity to undertake formal studies in these areas. As beekeepers move from being hobbyists to pollination practitioners and adopt mainstream business structures that include incorporation, the normal business management practices required by all businesses operating under the Commonwealth Government taxation system will become mandatory and utilisation of acquired or purchased business management skills will determine the viability and tenure of a beekeeper's business.

Consequently, no specific provision should be made for the development of targeted business modelling and pricing education for beekeepers. Mainstream courses in small business management and agricultural enterprise should be a sufficient avenue for the acquisition of skills.

Training in the identification and measurement of risks and benefits involved in offering paid pollination services

Education and training of the providers and purchasers of paid pollination services is, in part, an 'inoculant' to the risks that are likely to be faced by the parties involved in the pollination transaction process. In determining an appropriate strategy to support new and developing providers and purchasers, it is important to recognise the evolution of industry structure that is likely to occur in the short to medium term and to configure the education strategies to support future industry scenarios.

A review of the literature on the economics of pollination reveals that in many instances individual plant industries receive an economic return by using paid, managed pollination services, whilst beekeepers do not²¹.

If beekeepers consider that they are underpaid for providing pollination services, they are unlikely to invest in the time and effort required to bring hive strength up to a required standard for effective pollination of key crops. Honey production alone is likely to be a more financially rewarding alternative enterprise, especially as unpaid incidental pollination is probably more important for most crops. In the event of a serious biosecurity breach and loss of access by growers to unpaid pollination services, that is, incidental pollination from managed and feral honeybees, these plant industries could face cost increases in the provision of managed pollination services or significant loss of production²².

To the individual beekeeper and grower, the risk of involvement in the provision or purchase of managed pollination lies in the effort and time required to transact a commercial relationship to provide and purchase the pollination services available from managed hives. Each single negotiation between a grower and a beekeeper will be multiplied by:

- the availability of the critical mass of hives to give effect to the individual grower's pollination needs of a crop
- the number of purchasers that an individual beekeeper requires to ensure an economic return from involvement in the provision of paid pollination services.

Current processes of honey production appear to favour the retention of existing operational structures in the beekeeping industry, with the ability to harvest and sell honey to wholesalers or direct to retail buyers. The barriers to entry into beekeeping appear to be relatively low, evidenced by the high numbers of sole traders and partnerships operating in the industry, as outlined above.

The barriers to entry into the provision of managed pollination services appear to be higher than those applying to entry into honey production. Amongst the considerations are:

- an understanding of the direct and indirect costs incurred in providing managed hives, including transport infrastructure, staffing (and associated on-costs, such as superannuation and out-of-pocket expenses), hive maintenance and monitoring, utilisation of floral resources, insurance and regulatory requirements
- specifying the capability of managed hives for paid pollination and the requirements of crops for pollination
- Arranging contracts with one or more growers, including scheduling the delivery of hives, pricing, use of chemicals, liability
- negotiating the terms of the services to be provided and/or received
- certification of quality assurance, including documentation of outputs and outcomes associated with the operation of managed hives and the reporting and monitoring of pests and diseases, hive activity and well being
- maintenance and upgrading of skills to conform with evolving standards and competencies.

As the demands on primary producers have increased in complexity and the economics of operation have become onerous, there has been a move towards the aggregation of smaller operations into larger agribusinesses. The operation of agricultural co-operatives transferred the scale economies available to larger operations to individual farmers and for many years these were successful entities. However, in recent years, many have responded to changed economic and business conditions and adopted a corporatised operational environment.

Similar processes will apply to the providers and purchasers of managed pollination services and the emergence of the pollination broker is evidence of the gradual movement towards an agribusiness approach to the industry. Beekeepers wishing to enter or remain in the managed pollination sector will seek to transfer their operational risks and will be prepared to sacrifice potentially higher, but uneven revenue, in order to secure greater guarantees of revenue streams. Beekeepers are likely have a long-term contractual arrangement with a specific broker, who in turn will have a variety of contractual relationships with a range of pollination dependent growers, on both a continuing and casual basis. The continued availability of unpaid feral pollination or opportunistic pollination from managed hives on adjacent properties will govern the extent of contracts between brokers and growers.

Pollination brokers will be the specialists in the business of managed pollination services, beekeepers will be specialists in the application of managed pollination and growers will be specialists in the appropriate utilisation of managed pollination for their crops.

The degree of market power able to be exerted by either beekeepers or growers will be influenced by the orientation of the broker. Where the broker is oriented to the needs of the grower, it is likely that beekeepers will tend towards price-taking behaviour. On the other hand if the beekeepers were able to establish an effective brokerage function, they would tend towards price-making behaviour. Where the brokers were independent of both beekeepers and growers, they could tend towards retaining control of price making functions and seek to ensure that both beekeepers and growers were price takers.

With these potential changes in industry structure in mind, the education and training implications are clearer, reinforcing the respective roles of each of the three stakeholder interests.

Training in the pricing of services and the development and use of business models

As with business modelling, there is little evidence that the general needs of beekeepers for training in the pricing of services and use of business models within the identified risk environment are any different from those of other agricultural contracting sectors.

However, there would be a benefit in offering a series of workshops or other training events specifically targeting beekeepers, who are:

- considering a change in primary business activity from honey production to pollination service provision
- contemplating an extension of their activities into pollination broking.

For these two groups, detailed knowledge of the risks, opportunities and requirements of the pollination industry and of individual enterprises within it will be crucial and this level of specific detail and context will most likely be obtained through a customised program, rather than a general small business skills course. As outlined later, pollination brokerage requires a broader and generally a higher level of knowledge than does the provision of managed pollination services, which has a specialist focus.

Such a customised program could be funded by a range of options, such as:

- FarmBis (or a similar program) subsidy arrangements paid to either the trainer or the participants
- Government funds provided as part of an apiary industry restructuring program
- an existing pollination broker who may choose to provide training to pollination service providers either as fee-for-service or as part of a broader contractual arrangement for brokerage
- pollination service providers and intending brokers who choose to self-fund their participation in such training and pay fees as set by the training provider.

Once growers are aware of the need to purchase a managed pollination service, they will be able to account for and appraise the price of pollination services in the same way that they currently make decisions about the prices to be paid for other agricultural services (such as crop spraying, harvesting or fertiliser treatments). Should this not be the case, growers would benefit from undertaking training in the procurement of services, including the management of contracts.

5. An industry quality assurance program

This report includes investigation into the education and training needs for the development of a quality assurance program within the pollination industry.

The effectiveness and efficiency of the delivery of a pollination service will be influenced by factors that are listed in Table 3.4 above. The consultations conducted for this study highlight the possibility that information on the technical attributes of an effective paid pollination service is not widely known and that research on these attributes has not been extensive. Over time, with the appropriate research and development projects in place, the attributes will be more clearly articulated and documented, with the expectation that the pollination industry stakeholders will adopt and adhere to processes that maximise pollination outputs and outcomes.

An effective paid pollination service can be widely disseminated to, and applied by, all stakeholders through the application of appropriate industry quality assurance programs. The programs that are currently operative within the pollination industry are outlined above.

Context

The recent advent and rapid growth of large-scale almond production, which has a high dependence upon and demand for managed pollination services, is one of the key emerging factors likely to shape the apiary and pollination industries in Australia. The effect is likely to be two-fold:

- restructuring of arrangements within the apiary industry to meet the scale and intensity of required pollination services
- defining a new standard for the quality of management of both sides of the pollination relationship.

The pollination process and biosecurity management across the pollination supply chain are currently under-represented in **biosecurity** and **quality assurance** programs within both the apiary and horticultural industries. Enhancing the status of pollination and its biosecurity management in such programs would contribute to an improvement in the standards of pollination management and would assist in minimising the incidence and impact of pests and diseases on the pollination industry.

The risk management strategy supports the co-ordination and articulation of pollination industry biosecurity and quality assurance plans. Having reviewed biosecurity and quality assurance plans, it concluded that none specifically addressed pollination or the biosecurity issues associated with the movement of hives into and off crops, despite the fact that pollination is an important input for many of the vegetable and nut species covered by the plans.

The strategy concluded that, if industry associations intended to promote biosecurity plans and QA programs as the bases for sustainable production, it would be appropriate for:

- QA programs be extended to include biosecurity elements
- these extended programs to address the biosecurity and food quality aspects of pollination, where pollination is a factor in the production of the particular crop.

Arrangements whereby the QA programs of the apiary industry and the pollination user industries are closely articulated with each other would ensure that the biosecurity interests of all parties to the pollination industry are covered.

To overlook pollination in these 'best practice' arrangements would be to discount the importance of pollination in the production process and overlook the risks to both the users and providers of pollination services associated with the practice.

Development of a quality assurance program

The key role of quality assurance programs is to mitigate risks to the participants and stakeholders in the activities governed by the programs. For the participants in the pollination industry, the programs need to cover each of the roles outlined above, for example:

- pollination brokers as specialists in the business of managed pollination services
- beekeepers as specialists in the application of managed pollination
- growers as specialists in the appropriate utilisation of managed pollination for their crops.

An important issue is whether quality assurance is an effective way to mitigate pollination industry risks, utilising record keeping and audits to help with incursion identification and management.

Growers and beekeepers must conform to established industry quality assurance protocols and systems. It is the responsibility of AHBIC, and relevant grower organisations concerned with the effective production of pollination-dependent crops, to ensure that all operatives in their industry sectors comply with established quality structures.

Training will be needed to support implementation of quality assurance systems and standards (such as the pollination standard in B-Qual). Supporting actions should include:

- developing and offering training modules for beekeepers planning to implement B-Qual's standard for the provision of pollination services
- ensuring that training programs developed to support grower industry QA systems include information about pollination standards and QA programs in operation within the apiary industry
- establishing a clear and transparent articulation of the B-Qual standard for the provision of pollination services into each quality assurance framework applying to each grower industry where there are pollination-dependent crops in production.

6. Opportunities

The term of reference to be addressed required the consultants to investigate the opportunities for formal recognition of training, such as national certificate diplomas and the use of units of competency already established and cross training in other pollination-dependent industries, including:

- developing an education and training competency units
- developing materials required to undertake training courses
- locations of training courses
- incorporating of education and training into existing programs (eg within the honeybee industry and the horticultural industries)
- overcoming impediments to education and training, such as the current State-by-State arrangements
- estimating costs of training requirements
- investigating of alternative avenues of funding
- determining the likelihood of receiving sufficient funding from potential avenues
- developing of an implementation plan.

Delivery of education and training relating to pollination

The development of additional content of formal vocational or higher education courses for beekeepers, growers and agronomists has been identified by a range of stakeholders, including participants in the Education and Training Workshop. A range of content areas were identified and appropriate strategies have been derived from the material.

Chemicals

Beekeepers assert that growers have been known to apply pesticides and other chemicals to crops at times and in ways that affect honeybees pollinating or feeding from those crops or within the spray canopy that results from the application of the chemicals in the vicinity of honeybees accessing floral resources. Beekeepers believe that growers are not receiving accurate information about the impact of pesticides (and other chemicals) upon honeybee well being.

Nicotinoids do not kill bees but can disorientate them which decreases their effectiveness.

Agronomists and chemical companies are said to be unaware of the impact of combined chemicals on second generation plants and of nicotinoids at low doses on bee health. A national effort is therefore necessary to inform agronomists and chemical companies of these facts.

Information on the use and risks of farm chemicals is usually found on the manufacturers' product labels. The details are provided by chemical resellers or consultant agronomists, or via farm chemical user training programs. The latter include **ChemCert** and **Smartrain**, both of which are well known and offered across Australia and are, in most cases, linked directly to nationally endorsed units of competency. In some States, completion of the training program is linked to the issue of a permit to purchase certain farm chemicals. In New Zealand, chemical labels must include information about risks to honeybees.

Appropriate activities to address these concerns include:

- development and circulation of supplementary training material about the impacts of chemical sprays on honeybees for use in established farm chemical user training programs (eg ChemCert, Smartrain)
- adaptation of this material to improve agricultural, horticultural and agronomy programs offered by universities and vocational training providers.

Vocational training programs for growers should be expanded to cover alternative pest/disease control strategies that are more bee-friendly, or at least recognise the threat to honeybee safety and well being.

These initiatives would require the review of course curricula and materials, as well as the national training framework as it relates to these areas, to ensure that course content, qualification structure and units of competency adequately capture these additional education and training requirements.

Value and benefits of managed pollination

There are strong views expressed by non-grower stakeholders that generally growers do not recognise the potential for increased productivity that can result from managed pollination. Stakeholders indicated that the benefits of managed pollination were not addressed adequately in courses of training available to growers of pollination dependent crops. There is recognition, however, that some grower industry bodies, particularly the Almond Board of Australia, have enhanced the awareness and knowledge base of growers in their industry sector regarding the operation of managed pollination on their crops.

Suggested activities include:

- developing case studies and illustrating crop-by-crop guides to show the benefits of managed pollination
- reviewing competency standards and course curricula to ensure pollination is adequately covered.

Business skills for beekeepers providing pollination services

Responses from stakeholders affirm the importance to beekeepers of an ability to develop a business case for the provision of pollination services and to develop skills to negotiate with growers on the provision of pollination services and the development and documentation of contracts.

As outlined above, the risk management assessment for the pollination industry has highlighted the growing importance of pollination brokers in developing supplier relationships with beekeepers and growers and brokering both the supply of hives to growers and the supply of pollination sites to beekeepers. As the increased utilisation of managed pollination services is facilitated by brokers, the opportunities for individual beekeepers to negotiate directly with growers will diminish.

Table 6.1 summarises the business skills required of each of the three parties to the pollination process and provides a rating of the skill level required of each party.

Pollination brokers require high to very high level skills and training in all aspects of the business relationship. The emphasis is on top level skills in all areas, except in the provision and receipt of managed hives, where there is a need to understand, but slightly less skill required.

Table 6.1 Business skills required by stakeholders in managed pollination

Skill area	Pollination brokers	Pollination providers (beekeepers)	Pollination purchasers (growers)
Costing and business management			
• the provision of managed hives	High	Very high	Low
• the receipt of managed hives	High	Low	Very high
• the co-ordination of managed pollination services	Very high	Low	Low
Specification of pollination requirements			
• capability of managed hives	Very high	High	Low
• requirements of pollinated crops	Very high	Low	High
• matching capability and requirements			

Skill area	Pollination brokers	Pollination providers (beekeepers)	Pollination purchasers (growers)
	Very high	Medium	Medium
Contracting and negotiating			
• the provision of managed hives	Very high	Very high	Low
• the receipt of managed hives	Very high	Low	Very high
• the co-ordination of managed pollination services	Very high	Medium	Medium
Quality assurance and compliance with certification			
• B-Qual	Very high	Very high	Low
• Freshcare, Enviroveg or equivalent	Very high	Low	Very high

Beekeepers specialise in the application of managed pollination and must have a very high level of skill and training in running their operation, or alternatively, purchase equivalent levels of skilled services. Whilst they need not be strongly skilled in aspects of grower operations, they must have a medium knowledge base with which to deal with the interface issues that are overseen by the broker.

Similarly, **growers** specialise in the appropriate utilisation of managed pollination and must have a very high level of skill in running their operation, or alternatively, purchase equivalent levels of skilled services. Whilst they need not be strongly skilled in aspects of beekeeper operations, they must have a medium knowledge base with which to deal with the interface issues that are overseen by the broker.

The three parties in the pollination process can access training in business skills relevant to their responsibilities from one of the many formal business training courses available at TAFEs or registered training providers throughout the country that offer certificate level courses. Action should focus on reviewing the marketing activities of providers of such training to ensure that beekeepers, growers and their industry organisations are aware of the availability and opportunities that arise from completion of relevant, broad-based business negotiation and business planning training. Individuals and entities wishing to take on brokerage responsibilities will be encouraged to take up appropriate levels of business training from these same sources as a pathway to business success and will benefit from the broader-based awareness initiatives directed to beekeepers and growers.

Ongoing review by AHBIC and grower organisations of the appropriate vocational qualifications for beekeepers and growers would ensure that relevant units of competency in business management are included in curricula and training that is more broadly focused on pollination skills.

Biosecurity/disease response preparedness

Both growers and beekeepers require ongoing training on the developing issues of biosecurity and pest and disease responses. The role of hobby beekeepers as ‘front-line’ surveillance is reinforced by the experience in New Zealand where the Varroa mite was first identified by an amateur beekeeper. As the number of hobby beekeepers is large, the provision of education programs specifically focused on surveillance techniques and the indicators to determine the occurrence of a pest or disease incursion would serve the industry’s interests.

In the event that the Varroa mite is discovered in Australia, it will be necessary for all beekeepers to be informed and skilled in the identification of the indicators of Varroa mite infestation and, most importantly, their obligations for reporting and instigating containment measures.

Alternatively, the presence of fire blight in Australia would require apple growers to be skilled in its identification and the role that honeybees have as a prime vector in its transmission.

Preparedness for a biosecurity or pest or disease response must be continuing and ongoing. The audit processes instigated by both Animal Health Australia (AHA) and Plant Health Australia (PHA) respectively, are designed to identify issues in the ability of jurisdictions and industry associations to deal with a breach in biosecurity protocols that lead to a pest or disease incursion. If the periodic audits identify areas for action, it is the responsibility of the jurisdictions and/or the industry bodies to take immediate action to rectify any deficiencies, including the provision of ongoing education to growers and beekeepers.

As the procedures followed by providers and purchasers of pollination services are covered under the respective AHA and PHA deeds, there should be no special requirement placed on the pollination industry to mount specific courses of training.

There is an additional issue regarding the development of continuing entomological and associated expertise to deal with the ongoing monitoring and research of honeybees and the pests and diseases that affect them. As noted elsewhere in this report, there is a need for a strategy to be developed within the CSIRO and universities with entomological teaching and research capability, whereby these organisations take responsibility for training young scientists capable of undertaking the future opportunities for research. .

Skills mapping is required to ensure that ‘generational handover’ occurs and that the personnel are available to ensure the successful implementation of R&D initiatives. Core skills that could be lost when current researchers retire in 2010 include: pathology, genomics, ecology and biology.

Appropriate actions include:

- ensuring that beekeeping vocational qualifications mandate the acquisition of training in programs on field surveillance managed by AHA
- ensuring that equivalent vocational qualifications of growers cultivating pollination dependent crops mandate the acquisition of training in programs on field surveillance managed by PHA
- ensuring that relevant, higher education courses for agronomists, veterinary scientists and agricultural scientists adequately cover this area
- requesting the Australian Research Council to establish the future prospects for the maintenance of teaching and research capability in entomological and other research fields related to the needs of the pollination industry.

Formal recognition of training

One of the main features of the Australian vocational education and training system is that it allows for the recognition of training and existing skills and knowledge through a process known as recognition of prior learning (RPL) or recognition of current competence. The benefit is that stakeholders in the pollination industry, be they pollination service providers, growers or brokers are able to obtain national qualifications regardless of how they acquired their expertise, and more importantly, that all industry members performing the same or similar tasks are assessed against and to the same standards of competence. This accords well with industry quality assurance programs that require personnel to have received appropriate training or to be able to demonstrate that they have the skills and knowledge required to perform their work to the standards required.

RTOs provide RPL services with the appropriate qualifications or units of competency within their scope of registration. This is described in more detail in Chapter 4 under the heading “Education and training delivery strategies”.

A future Pollination Australia would actively promote and encourage RPL for the members of its industry constituents, focusing initially on skill sets or small groups of units of competency that directly link to B-Qual or other relevant quality assurance programs. To be most attractive to members, a small pilot program could be undertaken to identify likely outcomes of a wider RPL

program. In this way, likely gaps in competency can be anticipated and a range of suitable learning activities/materials/projects can be developed ready to use as part of a larger program. If in the initial stages (Year One), the costs to individuals of RPL could be subsidised, an inability or unwillingness to pay would not become an impediment to implementation.

Training could also be recognised as contributing to ongoing professional development. Some industry associations require members to demonstrate that a minimum quantum of continuing professional development has been undertaken each year in order for them to retain their industry certification.²³ A future Pollination Australia should develop a professional development/continuing education program that is linked to B-Qual and/or other certification programs and provide opportunities for the gathering of evidence of competency that can be used as part of a formal RPL program.

Development of education and training competency units

In the broad range of pollination-dependent industries, there are a very large number of units of competency available for operatives. Government policy⁴⁵ has been to ensure that the essential skills and knowledge are captured for each area of work, while at the same time establishing the greatest degree of transferability across work areas. In practice, units of competency are written in a comparatively broad manner, which can create an impression that the units are not relevant to any particular area or field of work (which in turn leads to the demand for more detailed job specific units of competency). The Agri-food Industry Skills Council plans to redress this situation by producing industry-endorsed implementation guides⁴⁶.

Elsewhere in this report, existing units of competency for relevant areas for beekeeping, business skills, production, horticulture and, to a lesser extent agronomy, have been reviewed. In most cases, the units are satisfactory bases from which to develop curricula and learning programs that will address the needs of those involved in the provision of pollination services. The qualification structures for vocational education and training programs were also reviewed and the programs are also flexible enough to allow for the inclusion of units of competency relevant to pollination services.

As noted above, both the qualifications and units of competency must be reviewed to ensure that they continue to be relevant to the emerging needs of the pollination industry.

Areas that appear to be lacking adequate units of competency with a tendency towards deficient qualifications are agronomy and rural merchandising. The two areas are covered to a minor extent by units of competency and qualifications, with a focus on the provision of advice relating to chemicals and fertiliser/soil ameliorants, but lacking underpinning knowledge relating to honeybees, other pollinators, plant/insect interactions and pollination processes. These units of competency and qualifications should be reviewed.

The discussion above has focused on units of competency and qualifications. However, feedback from consultations highlighted the need to identify and use skill sets as the basis for formal education and training rather than continuing to promote full qualifications, as if they were the only option for vocational education and training.

A skill set is defined⁴⁷ as either a group of units of competency which meet an identified:

- requirement set by a licensing or regulatory authority
- need or industry outcome.

Skill sets are clearly more attractive to employers and workers alike who do not relish the prospect, costs and time of undertaking a full qualification. RTOs do not have to develop as many learning and assessment materials and training courses, as they do not need to prepare 'candidates' to meet the requirements of a full qualification. Combined with RPL, training becomes a much more manageable and cost-effective proposition for all parties.

For the pollination industry there are a number of obvious skill sets, for example:

- agricultural contracting, including units of competency addressing contract management, customer service, risk management, quality management
- small business financial management
- facilitation and coordination
- bee husbandry
- farm chemical use.

A future Pollination Australia should identify the most important and unique skill sets for pollination service providers, growers and brokers and ensure that these reflect the requirements of industry quality assurance programs and are included in the relevant nationally endorsed training packages.

Development of materials required to undertake training courses

In order for any training to be provided, a curriculum and materials must be prepared. Where training is to result in a formally assessed and credentialed outcome, the requirements for materials are greater.

Materials are usually developed either by:

- RTOs for their own use
- commercial educational materials developers for general sale, or
- through government funding for use by any training organisation.

Best practice is to seek comment and assistance from reputable industry sources and informants to ensure that the content is technically correct and educationally sound. The format of materials is generally influenced by the intended delivery mode and the audience, although the availability of funds is often the most decisive factor in the choice of materials developed.

Computer-based e-learning materials, which can comprise case studies, spreadsheets, student work books or assessment amongst others, are relatively costly to produce and some potential trainees/participants are likely to experience difficulties in using the materials without access to a tutor. Print-based materials are usually cheaper to produce but the delivery costs of face-to-face learning can be much higher. Most materials, either e-learning or print-based, are produced only in English, although in some sectors of the pollination industry such as vegetable growers there are significant numbers of growers that use a language other than English⁴⁸ and training materials should reflect this.

AHBIC has received funding from DAFF for the development of two sets of learning and assessment materials:

- print-based materials for use in apprenticeship programs
- a small set of workshop materials for environmentally responsible beekeeping.

Neither of these projects specifically address pollination-related skills but do address the broad range of skills needed to be a competent beekeeper and honey producer.

Business-related skills are addressed by the development of generic learning materials by organisations such as the Innovation and Business Skills Council. Agricultural and horticultural learning materials are also available for many subject areas and learning guides have been produced for farm chemical use, including in some languages other than English.

Animal Health Australia has developed workshop training materials for field surveillance team members to take up AUSVETPLAN roles. These print materials are supplemented by an e-learning module that provides basic grounding in the emergency animal disease response system. To date, experience has shown that not all potential participants in this program are able to access and use the e-learning module, either due to lack of computer equipment, adequate (or any) internet connection or computer skills.

Material has also been developed by jurisdictions and reputable organisations referred to earlier in this report that can provide useful content for training programs; all trainees and industry members should be made aware of the availability of this material and be encouraged to use it.

At a minimum, all materials should be available in an electronic format, to ensure broad availability and to facilitate greater ease in revision of content. However, given the perception that access and utilisation of computers by beekeepers in particular may not be extensive, the capability of producing printed curriculum materials based on the electronic versions, appears to be a requirement for the foreseeable future.

Locations of training courses

As there is a relatively low demand for training across all jurisdictions in Australia, it would be practical that one institution was accorded a national role in the training of apprentices in beekeeping. Through a combination of distance and on-campus education in the apiarist (winter) 'off season', an appropriate curriculum could be delivered in a cost-effective manner to support the training of future beekeepers across the nation.

The consolidation of a critical mass of teaching and industry expertise in one institution would also support students to reach a common set of competencies and standards and reinforce the value of a nationally consistent approach to managed pollination. It would instill an ethos of professionalism and facilitate a sense of 'ownership' of the achievements of the training regime by the beekeeping industry, and by implication, the pollination industry. The costs of delivering the training course would offer greater value to all stakeholders.

Funding arrangements would need to be modified so that apprentices from various States would be funded and allowed to attend an institution out of their home State. The Tocal Agricultural College in Paterson in New South Wales should be considered a possible training centre for beekeeping apprentices, and a higher education institution should be identified as the lead provider of research and development and associated teaching of specialist scientific and pollination industry expertise.

In addition to training programs for beekeeping apprentices, there is a need for a regular program of regionalised training activities for beekeepers and others with an interest in pollination. These programs could cover business skills, beekeeping skills relevant to pollination (e.g. colony preparation) and could be offered as an adjunct to established industry conferences, field days or as weekend residential workshops in regional areas. Depending on interest, these short programs could also be offered as self-paced, independent learning programs, either online or by more traditional print-based distance learning.

Incorporation of pollination education and training into mainstream programs

Due to the geographical spread of the pollination industry and the degree to which paid pollination services are likely to penetrate many areas of agricultural activity, there is a need for all courses of training in rural industry and agriculture to acquaint agricultural workers with the role of bees and bee behaviour, including native bees, in the production of crops.

Short training programs, media interviews, talks, articles in farmers' magazines, books, newspapers, television, school education, honey label information, give-aways and internet resources are all ways to get the message out there that we all need to be aware of this precious resource and protect it⁴⁹.

Farmers particularly need to know the basics of beekeeping, so that the farming schedule can be adjusted to allow for the presence of pollinating insects.

Growers need to:

- plan where bees are going to be placed during pollination
- provide suitable access to sites
- have all spraying and related farm work finished
- know which chemicals are safe to use around bees and which chemicals they should avoid.

Farm and land managers—covering both growers of bee-dependent crops, such as almonds, cherries, apples, stone fruits and vegetables, and rotation crops that are grown to enrich the soil, such as faba beans or safflowers—need a greater understanding of honeybees.

Public land managers and most workers in agriculture have interaction with bee swarms and incidents that involve honeybees. Consequently, they need to understand the habits and basic needs of honeybees, including the availability of water and the means of handling bees.

Action required will include reviewing competency standards and course curricula across agriculture, horticulture, natural resource management and agronomy to ensure honeybees, their behaviour and role in pollination are adequately covered. In units of competency, it would be expected that this should be included as underpinning knowledge.

It is appropriate that all agricultural personnel are educated on the value and importance of the beekeeping industry and that all agricultural, horticultural and agronomy courses cover the key knowledge areas of insect/plant interactions, role of honeybees in crop pollination and the adverse effects on honeybees of some farm chemicals used for crop protection.

Overcoming impediments to education and training

The main challenges to delivery of education and training programs are likely to include:

- the capacity of a yet-to-be formed Pollination Australia or its constituent organisations to manage their part of any program arrangements, due to the very small sized secretariats that the constituents generally support
- the small numbers of potential participants in training initiatives who tend to be geographically dispersed, resulting in a ‘thin’ training market that is not attractive to **RTOs, providers and assessors of nationally recognised training**
- alternatives to face-to-face workshops, such as computer-based training or e-learning, require additional investment and lead time to implement and assume that there is a target audience that is ready for, and receptive to, independent or self-directed study
 - it is not readily apparent that beekeepers or growers are primed to take on additional training to prepare for the advent of managed pollination services
 - it is likely that in preparation for initial training, potential participants will need to gain the maximum benefit from formal training that they undertake by upgrading computer and general literacy and numeracy skills that may need attention
- the need for the Pollination Alliance to gain agreement from all stakeholders in the pollination industry and beyond into the agricultural training community, to a national professional development program that forms part of the national strategic plan for the pollination industry
- developing a program format that will encourage participation from all target groups
- prevailing uncertainty about the perceived benefits for individuals and the return to their enterprises in committing time and funds to formal training
- sourcing funding to cover the immediate costs of conducting group training, including travel, accommodation and/or communication costs, for participants scattered across regional areas
- finding the acceptable balance between developing generic, transferable skills that can be applied in the pollination and other industries at a low cost and specialist skills focused on the pollination industry at a higher cost
- structuring a program that will not require large amounts of time away from a participant’s place of employment.

These impediments have been faced by other industries over recent years. The key actions taken have been to incorporate education and training into strategic and business plans, both as actions in their own right and also as enabling actions to support achievement of other objectives⁵⁰.

Any business plan for Pollination Australia must include an education and training plan and also identify and provide resources for education and training activities that will support achievement of other components of the plan.

Cost of training requirements

Generally speaking, the costs of training requirements relate to the time required to devote to training and the funds required to support its delivery.

Within the apiary industry, there is a long established practice of relying upon industry members or jurisdictional extension officers to provide ‘gratis’ or pro bono direction and other input into training programs and initiatives. In some cases, industry bodies are able to include an ‘industry contribution’ in their budgets for government-funded projects, but generally the costs in both time and money are simply met by those individuals or agencies with services provided through goodwill. With ageing industry membership and declining jurisdictional investment in extension or apiary officers, this ‘free’ resource is likely to become much less available.

Agricultural and horticultural industries with a broader membership base and more secure funding arrangements have been in a better position to offer training to members, to prepare strong proposals for government funding and to rely less upon volunteers. Generally, these organisations have at least a part-time employed resource to assist with implementing an education and training program⁵¹.

Currently, in the national education and training system the costs of education and training are met through a variety of mechanisms. The following apply to all industries, including beekeeping and agriculture generally:

- ‘user choice’ arrangements can be applied to new entrants and existing workers. Depending on the specific arrangements that apply to each training contract, the costs of apprenticeship training are met through
 - State and Commonwealth Government subsidies to employers and trainees
 - government payments to TAFE colleges or other registered training organisations
- others who wish to undertake this type of formal training but who are not eligible under the ‘user choice’ apprenticeship programs, can enrol in programs on a ‘user pays’ basis
- students wishing to enrol in higher education programs can apply for places in universities either as
 - full fee paying students⁵²
 - subsidised students through Higher Education Contribution Scheme (HECS), or
 - through other arrangements including scholarships and cadetships
- in some circumstances, primary producers are able to access subsidies through the FarmBis⁵³ program, which applies to eligible business-related training that is linked to nationally endorsed competency standards (at the AQTF 4 level or above).

All people participating in training will have to meet some costs, which can include such direct costs as materials, tools, equipment, travel, accommodation, use of computers and internet time. In addition, those individuals already employed in an enterprise may be required to forego some earnings by spending time on learning new skills that would be used to increase their profitability or earning power into the future.

Alternative avenues of funding and the likelihood of success

There are a number of other organisations and programs that can provide assistance to industries. These organisations are likely to focus upon a particular type of training-related issue or response.

They include:

- ***Reframing the Future***⁵⁴, a major workforce development initiative of the Australian Commonwealth and State/Territory governments that assists in building the capacity of the Australian vocational education and training (VET) sector to support the implementation of the national training system. It addresses the aims of the Council of Australian Governments (COAG) and its national reform agenda, with projects including developing industry training networks (which provided AHBIC with a grant in 2005 to establish a national training network and, subject to continued funding, could provide a future Pollination Australia with funding to develop an education and training network).
- the **International Specialised Skills Institute (ISSI)**⁵⁵, a national organisation that has identified skill deficiencies through its market research, filling the gaps through its Overseas Skill Acquisition Plan (Fellowship Program) and consultancy services. It provides providing opportunities for Australian industry and commerce, learning institutions and public authorities to gain best-in-the-world skills and experience in traditional and leading-edge technology, design, innovation and management. There may be an opportunity for a future Pollination Australia to identify suitable applicants for an overseas fellowship to investigate best practices in pollination service provision and management.

The likelihood of the future Pollination Australia or a pollination industry stakeholder receiving funding from potential avenues is influenced by:

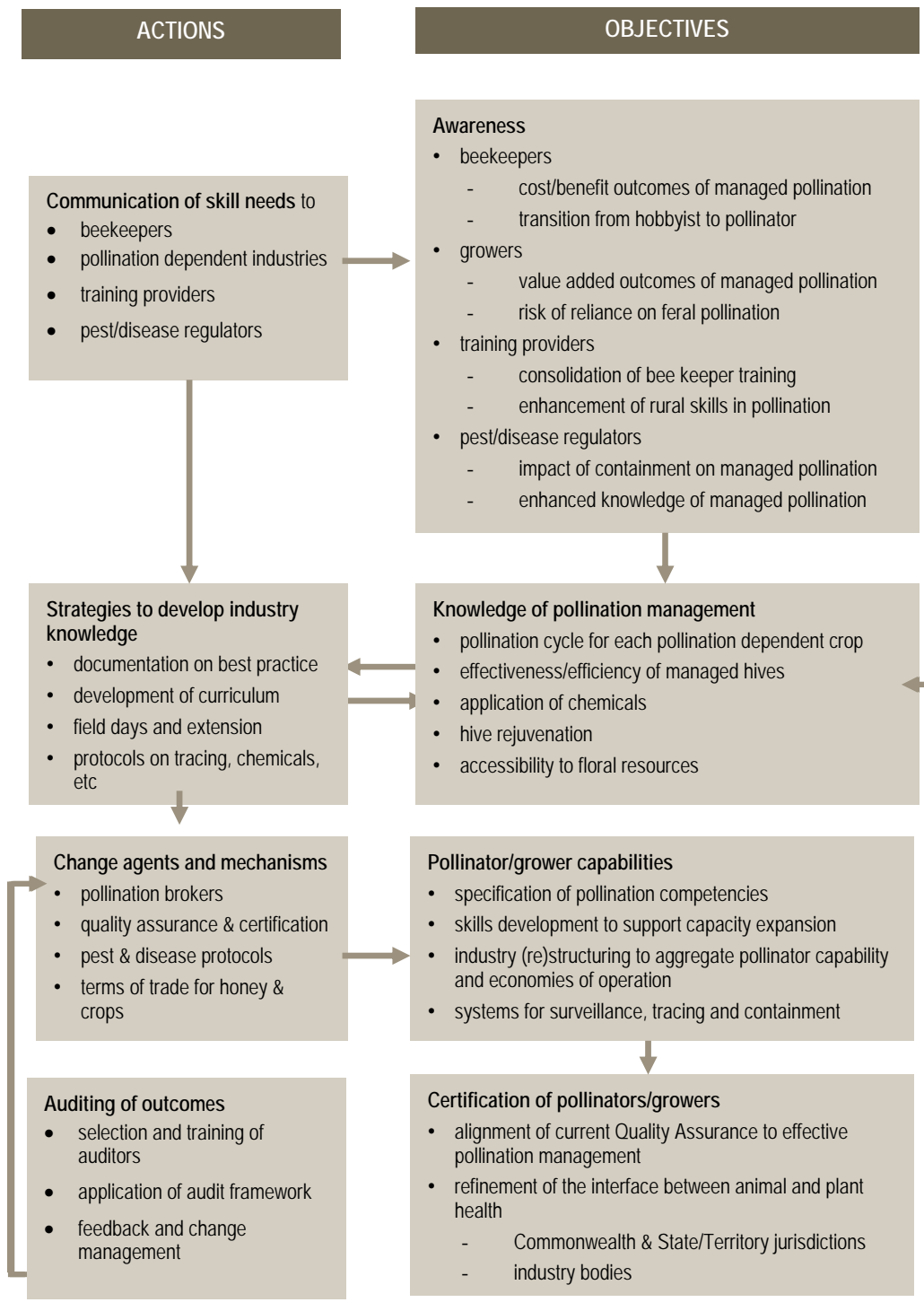
- the quality of the case presented to funding agencies and other bodies, including the evidence base that supports the suppositions and objectives of the proposed training activities
- the funding policies of the current Commonwealth Government and the likely policy changes subsequent to November 2007
- the willingness of industry stakeholders to invest resources in the preparation of funding submissions and match funded resources with financial and/or in-kind resources
- the resolve of pollination industry stakeholders to agree to a distinctive set of training priorities and initiatives that can be presented as a cohesive package and show support from a broad coalition of industry players, training providers and regulatory and policy setting agencies.

Development of an implementation plan

The general principles for the development of an implementation plan are to:

- build on existing activities and structures
- build the Pollination Australia alliance to secure a benefit for all constituent organisations by ensuring that their members can engage in common activities that are broadly available.

EDUCATION AND TRAINING FOR THE POLLINATION INDUSTRY



Successful implementation of all of the proposed projects and initiatives identified in the R&D and risk project reports and in the Pollination Australia Business Plan will hinge upon appropriate education and training and leadership. These factors will apply to all projects, not only those with an obvious education and training ‘tag’.

An education and training plan includes a mix of longer-term objectives and activities as well as the flexibility to respond in the initial stages to emerging or urgent needs, or to new opportunities or initiatives. These activities are to be managed strategically and industry activities must be coordinated over the relatively longer term.

The above chart, based on a concept developed by the CIE, outlines the flow of actions and objectives required to achieve an education and training strategy for the pollination industry.

The **Objectives** relate to the outputs and outcomes that are expected to be achieved by the industry, and encompass the best practice in human, infrastructure and financial resource utilisation. **Awareness** is required to drive involvement and commitment of all the parties in the development of the pollination industry. Although it must be supported by communication actions, in itself, it is an insufficient base upon which to build the industry,.

Knowledge as the basis for best practice is needed to reinforce awareness. The evidence base for pollination practice constantly interacts with the strategies to develop industry knowledge and create dynamism. The identification of change agents that will drive the strategies to develop industry knowledge, will develop the **capabilities** of both pollinators and growers.

The capability is credentialed through a process of **certification** that applies to both growers and pollinators and that has alignment across all the requirements of the pollination industry and the interface between the plant and animal health regimes. Auditing of outcomes is the action that ensures maintenance of certification and reassures the broader market that the outputs of the pollination process are effective.

7. Development of education and training strategies for the pollination industry

Context

The education and training strategy needs to incorporate the findings of the risk management strategy and the outcomes of the Honeybee Linkages Workshop in April 2007. Training initiatives need to contribute to:

- a reduction in the likelihood of incursions of exotic pests and diseases
- cost-effective responses to any pest or disease incursions in order to minimise damage to the industry
- mitigation of the impact of pests or diseases if they become established.

The studies have identified the importance of improving awareness and understanding of pollination processes in Australia to optimise the efficiency of the management of pollination services and establish best practice standards for the biosecurity of the pollination industry.

For each of the risks identified in the risk management strategy, we have identified a range of strategies and actions that relate to the provision of education and training to the pollination industry.

This report has identified a range of initiatives that will enable the future pollination industry to move from the current volunteer perspective of its constituents to a more professional approach. This professional approach encompasses not only the delivery of pollination through paid managed services (rather than through opportunistic pollination by feral honeybees), but also the way that the industry's constituent member organisations and enterprises manage their own activities and responsibilities.

The research focused on the education and training needs of personnel in beekeeping and pollination-dependent industries, including pollination brokers. It has found that in some areas their education and training needs are no different from those in other industry sectors engaged in or using agricultural contracting services. However there are some significant differences for this industry at this point in time, which include the need for:

- training to support industry-based quality assurance certification
- an urgent and comprehensive emergency disease/pest incursion response field surveillance training program for personnel across all pollination-related industries
- beekeeping enterprises to have the required business management skills in order to provide profitable pollination services
- building and sustaining an alliance of pollination service providers, pollination-dependent industries and pollination brokers.

Consultation with industry members and other stakeholders revealed considerable enthusiasm for the tasks ahead, tempered by an appreciation of the challenges and need for quick action in the face of risks to the future of pollination dependent cropping and beekeeping activities in Australia. The report has identified a number of key actions that should be included in a business plan for a future Pollination Australia. These actions will support the implementation of initiatives identified in the Risk Management Strategy and the Research and Development reports.

Success of these initiatives will depend on a motivated and skilled workforce working within appropriately structured industries and enterprises, supported by professional industry associations and enterprises. Participation in common education and training activities will promote some of the cooperation and goodwill as well as the common understandings that will be essential to the success of a future Pollination Australia.

Costing of proposed strategies

Strategy 1: Minimise the risk of incursion of exotic pests and diseases

Strategic Objective

Cost effective minimisation of the risk of incursion of exotic pests and diseases that threaten the viability of the pollination industry.

Strategic actions

Surveillance

- Introduce a hive monitoring and sampling and reporting element to B-Qual and consider differential registration fees as an incentive for participation in B-Qual and the proposed sampling element.
 - **\$100,000-\$200,000 per year**

Quarantine

- Undertake a national honeybee biosecurity skills audit to identify current capabilities in relevant areas of
 - higher level expertise, particularly in entomology
 - pest and disease identification management and research
 - bee breeding and selection skills
- Determine future requirements and develop and implement a national skills development and maintenance plan.
 - **\$10,000-\$50,000**

Biosecurity planning

- Identify the most important and unique skill sets for pollination service providers, growers and brokers and ensure that these reflect the requirements of industry quality assurance programs and are included in the relevant nationally endorsed training packages.
 - **\$10,000-\$50,000**

Research and development

- Negotiate with the CSIRO, the Australian Academy of Science and the Australian Research Council to identify the pathways for the future training and recruitment of scientific expertise to ensure that relevant research capability is maintained in Australia to support the pollination industry.
 - **initially \$25,000-\$50,000 (with additional funds to be specified)**

Strategy 2: Management of incursions of pests and diseases

Strategic objective

Cost-effective emergency response to exotic pest and disease incursions and nationally coordinated management of established pests and diseases that recognises the particular requirements of the pollination industry.

Strategic actions

Emergency response planning

- Develop and circulate supplementary training material about the impacts of chemical sprays on honeybees for use in established farm chemical user training programs, including ChemCert, Smartrain, and adapt this material to inform the delivery of agriculture, horticulture and agronomy programs by universities and vocational training providers.
 - **-part of ongoing farm training**

National disease containment and management protocol

- Develop and implement a national awareness plan that ensures that all parties with an interest and involvement in the conduct of a disease management plan understand the interests and requirements of the other parties.
 - **\$40,000-\$60,000**

Disease response and management training and simulations

- Establish the role of a future Pollination Australia within the disease response and management training system.
- Revise role descriptions and training courses to reflect any changes made to AUSVETPLAN and PLANTPLAN as a result of the review of those plans as recommended in the Risk Management Strategy.
 - **\$10,000-\$50,000 per course**
- Develop the role descriptions, competency requirements and training courses arising from the negotiation and establishment of the National Disease Containment and Management Protocol proposed above.
 - **-\$50,000-\$100,000**
- Ensure that the review and development of competency standards and qualifications across the broad areas of agriculture, horticulture, agronomy, rural merchandising and rural business management, adequately cover pollination.
 - **-cost to be borne by respective industry bodies**
- Undertake a pest and disease response and management skills audit of parties to the pollination industry, including relevant government authorities, to identify current capacities to fill the emergency response and disease management roles required to sustain the emergency response and pest and disease management plans referred to above.
 - **-\$10,000-\$50,000**
- Develop and implement within the honeybee and pollination-dependent industries, recruitment and training plans to address any deficiencies in pest and disease response and management capabilities identified by the skills audit.
 - **-cost to be determined as part of audit in item above**
- Develop disease incursion and management scenarios and undertake a simulation exercise to test the effectiveness of response and management plans and arrangements for the coordination and representation of the range of interested parties and to develop the skills of key industry and government personnel.
 - A preliminary two-day, desk-top exercise is recommended with:
 - the location of the scenarios including the cross-border regions abutting the Murray River in New South Wales, Victoria and South Australia, with a focus on the almond industry

- **day one** addressing the early stages of the emergency response following initial detection of an incursion
- **day two** addressing the transition from emergency response to disease management following a determination that the incursion is beyond eradication.
- **development of scenario: \$10,000--\$50,000;**
- **conduct of exercise \$50,000--\$100,000**

Strategy 3: Enhance the capability and performance of the pollination industry

Strategic objective

To improve the understanding of and expertise in the management of pollination processes in Australia and to establish best practice pollination management standards for both service providers and users with an emphasis on the biosecurity implications of best practice pollination management.

Strategic actions

Optimise efficiency of pollination management in Australia

- Establish and support an education and training network for the pollination industry and RTOs that have an interest in pollination and its related areas.
 - **-\$25,000—50,000 per year**
- Develop the occupational profiles of a pollination service provider and pollination broker and the associated mapping to existing competency standards and identification of gaps.
 - **\$60,000--\$80,000**
- Develop, maintain and publicise a listing of training courses that address the business skills required for profitable pollination service provision.
 - **\$10,000--\$15,000 to develop,**
 - **\$5,000--\$7,000 per year to maintain**
- Identify the preparatory training requirements of pollination industry participants, including computer skills and general literacy and numeracy skills, and the appropriate means of addressing the requirements.
 - **\$25,000--\$35,000**
- Develop a professional development/continuing education program that is linked to B-Qual and/or other certification programs and provides opportunities for the gathering of evidence of competency that can be used as part of a formal recognition of prior learning program.
 - **\$40,000--\$80,000 to develop,**
 - **\$30,000--\$50,000 per year to update and implement**

Pollination awareness training and education plan

- Develop awareness, training and education courses and resources relevant to the requirements and responsibilities of the various users and providers of pollination services.
 - **-\$30,000--\$60,000 per course, as determined by tender**
- Identify and implement the most suitable arrangements for training delivery, both for apprenticeship programs and short courses for existing industry members, including the possibility of ‘branding ‘ programs as Pollination Australia programs.
 - **\$25,000--\$40,000**
- Review curricula and course materials from all levels of education and provide advice on where the content on pollination can be enhanced.
 - **as part of development costs of courses**
- Identify industry organisations that have a responsibility for education and training and confirm their level of expertise and capacity to participate.
 - **\$10,000--\$15,000 to develop,**
 - **\$5,000--\$7,000 per year to maintain**

- Ensure that all training and education courses include an appropriate pollination biosecurity element.
 - **-as part of development costs of courses**
- Identify appropriate sources of funding for identified training activities and prepare submissions for funding.
 - **\$10,000--\$15,000**

Coordination and articulation of pollination industry biosecurity and quality assurance plans

- Review the biosecurity and quality assurance plans of pollination user and provider industries to ensure that biosecurity plans provide adequate coverage of the issues associated with the pollination process.
 - **\$10,000--\$50,000**
- Ensure that QA plans include provisions that address biosecurity issues and, in particular, those relating to the pollination process.
 - **part of ongoing development of plans**
- Ensure consistency and adequate articulation between the QA plans for pollination service providers and user industries, especially with regard to biosecurity management
 - compliance with B-Qual should require that hives are only placed on properties that are certified under that industry's QA scheme and that compliance with the pollination service user's QA scheme should require that only colonies from a B-Qual certified beekeeper are used for the provision of pollination services
 - **-part of review proposed above**
- Develop and offer training modules for beekeepers planning to implement B-Qual's standard for the provision of pollination services.
 - **\$25,000–50,000 per year**

Appendices

Appendix I: Consultations

Workshop

A workshop was held in Canberra on December 10, 2007 to discuss the contents of the briefing paper and deal with a range of relevant issues.

The program for the workshop was as follows:

Introduction – David Brous, Facilitator
Welcome – Stephen Ware, Executive Director – Australian Honeybee Industry Council
Purpose and context of workshop – Margie Thomson RIRDC
Pollination Australia Business Plan – Dr Jenny Gordon CIE
Introduction to participants – David Brous, Facilitator
Review of current and prospective pollination and honeybee industry education and training activities and initiatives – Jude Nettleingham, Consultant
Review of current and prospective quality assurance and accreditation frameworks in the pollination and pollination dependent industries – David Brous, Consultant
Review of international education and training efforts – Jude Nettleingham, Consultant
Morning tea
Workshop session – Brainstorming on identification of education and training gaps and needs (small group work)
Plenary session – Reporting on gaps and needs – David Brous, Facilitator
Lunch
Workshop session – Brainstorming on appropriate quality assurance and accreditation frameworks, including consideration of a single pollination industry framework compared to individual frameworks for each industry participant (small group work)
Plenary session – Discussion on quality assurance and accreditation frameworks – Jude Nettleingham, Consultant
Afternoon tea
Plenary session – Ranking gaps and needs to establish immediate, medium and long-term priorities for attention – David Brous, Facilitator
Synthesis of the workshop’s key outcomes – David Brous, Facilitator
Where to from here? – Stephen Ware, Executive Director, Australian Honeybee Industry Council
Thank you and close

Participants included:

- Denis Anderson, CSIRO Entomology
- Nicholas Annand, DPI NSW
- Jenny Arkle, Animal Health Australia
- Darren Bayley, Tocal Agricultural College
- Damien Bond, DAFF
- Ben Brown, Almond Board of Australia
- Paula Dewar, AHBIC Education and Training Committee
- Brendan Fewster, WAFIC
- Stephen Fewster, AHBIC
- Damien Martin, Bendigo TAFE
- Jo McCloskey, Horticulture Australia Limited
- Trevor Monson, Pollination Services broker
- Ross Ord, AUSVEG
- Graeme Smith, Chair, Australian Hydroponic & Greenhouse Association
- Stephen Ware, AHBIC
- Bruce White, AHBIC Project Team
- Ryan Wilson, Plant Health Australia
- David Brous, Impact Consulting Group
- Jenny Gordon, CIE
- Rob Keogh, Impact Consulting Group
- Greg Martin, IDA Economics
- Jude Nettleingham, Motomoda
- Margie Thomson, RIRDC
- Lea Edwards, RIRDC

Appendix II Competency framework for RTE4128A: provide bee pollination services

Unit descriptor

This unit of competency specifies the outcomes required to provide bee pollination services. Work will require the application of a broad range of knowledge about bee husbandry and bee behaviour, as well as the ability to negotiate commercial agreements with customers.

Employability skills

The required outcomes described in this unit of competency contain applicable facets of employability skills.

Application of the unit

This unit of competency applies to beekeepers providing pollination services to a crop grower under a commercial arrangement. Work is likely to be performed under minimal or no supervision.

ELEMENT	PERFORMANCE CRITERIA
Elements describe the essential outcomes of a unit of competency	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where <i>bold italicised</i> text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1 Assess pollination service requirement	1.1 Pollination services to be provided are confirmed with the customer 1.2 Number and types of colonies required for the crop are determined 1.3 <i>Strength and condition</i> of bee colonies are assessed for their suitability for use as crop pollinators 1.4 Risk of pollination problems is assessed with the customer and the process to <i>monitor risk</i> is agreed and established 1.5 <i>Technical information</i> is provided to the customer
2 Price and formalise agreement for pollination services	2.1 Costs in providing pollination services are identified and calculated 2.2 The price for pollination services is agreed with the customer 2.3 Formal <i>agreement</i> is made with the customer and documented
3 Monitor pollination performance of bee colonies	3.1 The crop is monitored within the appropriate timeframe for <i>evidence</i> of bee foraging and pollination efficiency 3.2 <i>Remedial action</i> is taken where required 3.3 Hive strength and condition are demonstrated to the customer where required 3.4 Swarm control is maintained 3.5 Bee husbandry practices are carried out as required
4 Comply with industry and legislative requirements	4.1 Appropriate health certificates and permits are obtained where bees are to be moved across State borders 4.2 An appropriate pollination code of practice is followed 4.3 All State or territory Apiary Acts and <i>other relevant Acts and regulations</i> , and local government regulations affecting beekeeping are addressed

Required Skills and Knowledge

This section describes the essential skills and knowledge and their level, required for this unit.

Required skills include:

- calculating strength and numbers of bee colonies required to pollinate crop
- communicating with customers and others
- managing pollination of honeybee colonies
- monitoring chemical use near hives
- monitoring climate and weather
- monitoring hive activity on target crop
- pricing and negotiating provision of services.

Required knowledge includes:

- chemicals used on each crop to be pollinated and available alternatives
- environmental and climatic factors affecting bee foraging behaviour and pollination
- essential elements of a valid contract
- location of colonies to maximise pollination
- management of health and performance of bee colonies
- nutrition and water requirements of bees
- pollination requirements of major crops in locality of operation, including nearby crops/plants that may be more attractive to foraging bees
- public liability insurance requirements.

Range statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. ***Bold italicised*** wording in the performance criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Factors to be considered when assessing <i>strength and condition</i> of bee colonies for pollination include:	<ul style="list-style-type: none">• healthy active queen and brood area• healthy hive, including absence of American foulbrood, European foulbrood and Chalk brood• stores of pollen and honey• type of crop to be pollinated• worker activity• young brood.
<i>Risks</i> associated with pollination that may be <i>monitored</i> include:	<ul style="list-style-type: none">• regular observation by beekeeper and/or customer and employees at appropriate times of the day for:<ul style="list-style-type: none">– hive activity– number of bees on target crop– use of pesticides• advice given by the customer to nearby farms that bees are present before placing hives.
<i>Technical information</i> provided to the customer should include:	<ul style="list-style-type: none">• duration of pollination• the need for any weed spraying and/or pruning to be completed before placing hives• the need to feed bees if pollination is occurring in a glasshouse or, if conditions require it, to stimulate bees to forage in crops outside• the number and strength of hives to successfully pollinate• the requirement for the customer to comply with Pesticide Acts.
<i>Agreement</i> should include:	<ul style="list-style-type: none">• access to the customer's services and facilities

Evidence of bee foraging and pollination efficiency may include:

- dates of hive introduction and removal
- payment for feed and strength of hives
- placement of hives
- restrictions on the use of pesticides before and during the pollination period
- stocking rates
- vehicle access
- agreements may also include details relating to:
 - the independent audit of hive strength and condition
 - liability for random stinging by bees
 - payment for removal of hives in event of pesticide applications
 - provision of water for bees
 - theft of hives
- agreements may be either through formal written agreements or contracts, or documents, detailing a verbal contract.
- bee activity which will vary according to the time of day and temperature but is likely to include
 - flight direction
 - fruit or seed set
 - pollen returning to hive
 - the number of bees on the target crop
 - wilted flowers and petal fall.

Remedial action taken to achieve appropriate colony strength and condition may include:

- introducing new colonies
- relocating hives on property
- removing old colonies
- supplementary feeding.
- animal health and welfare
- beekeeping activities
- fair trading as enacted in jurisdictions where services are provided
- insurance
- occupational health and safety
- the use of pesticides.

Other relevant Acts and regulations that apply to pollination activities include those covering:

Evidence Guide

Overview of assessment

This unit of competency could be assessed on its own or in combination with other units of competency relevant to the job function.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The critical requirements for this unit of competency as a whole are listed below.

Assessment must confirm one's ability to:

- assess the need for pollination
- negotiate the price and the pollination agreement
- comply with all industry and legislative requirements
- identify suitable locations within the crop or site for hive placement
- objectively assess hive condition and the suitability for pollination
- monitor performance of the contract and of bee colonies.

Context and specific resources for assessment

Assessment for this unit of competency is to be largely practical in nature and will most appropriately be assessed in a beekeeping workplace or in a situation that reproduces normal work conditions.

For valid assessment, one must have opportunities to participate in exercises, case studies and other real and simulated practical and knowledge assessments that demonstrate the skills and knowledge required to provide bee pollination services.

The candidate must also have access to the following resources:

- colonies of bees for pollinating crops in fields or glasshouses
- customer's crop pollination requirements.

Guidance information for assessment

To ensure consistency in one's performance, competency should be demonstrated on more than one occasion over a period of time in order to cover a variety of circumstances, cases and responsibilities, and where possible, over a number of assessment activities.

The skills and knowledge required to provide bee pollination services must be transferable to a range of work environments and contexts, including the ability to deal with unplanned events. For example, this could include the pollination of a variety of field and glasshouse crops.

Appendix III Pollination quality standards

Section 4: Standards	2.9.1 POLLINATION QUALITY STANDARDS	Version: 1.0 Page: 1 of 1
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Introduction

Beekeepers aim to use best industry practices to provide a high standard of bee pollination services. It is essential for all agreements for the pollination service to include stocking rates, dates of hive introduction and removal, placement of hives, payment of fees and strength of hives to be agreed to prior to hive placement. Agreements also include payment for the removal of hives in the event of pesticide applications. It is also imperative that the B-Qual Biosecurity Plan is adhered to.

Code	Standards	Check (√)
Pollination Services		
PS1	The Australian Food Standards, the B-Qual Standards, the Code of Practice for Pollination Services and relevant authorities requirements are complied with.	
PS2	A written agreement for pollination services is recommended.	
PS3	The health, strength and conditions of bee colonies are adequate to effectively forage crops and effect pollination.	
PS4	Crops are monitored for adequate bee foraging and pollination activity.	
PS5	Honey supplies are monitored for adequacy and supplementary feeding is provided if required.	
PS6	Bee colonies are not aggressive.	
PS7	Bee hives are located to maximise the potential for effective pollination.	
PS8	Toxic insecticides in the vicinity of hives and foraging areas are avoided.	
PS9	The B-Qual Biosecurity Plan is closely adhered to.	

Work Instruction 20	BEE POLLINATION PROCEDURE	Version: 1.0 Page: 1 of 1	Approved: Date:
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Action

Manager

- Comply with the Pollination Code of Practice.
- Provide a written agreement for pollination services or document details of a verbal contract (Record 13).
- Demonstrate the strength and condition of the bee colonies as required.
- Find agreement with all parties before delivery on the dates of introduction and removal of hives.
- Discuss any actual or perceived pollination problems with grower.
- Observe State Apiary Acts and Local Government laws which affect beekeeping.
- Ensure appropriate Health Certificate is obtained if bees are to be moved across State borders.
- Adhere to the B-Qual biosecurity plan.

All workers

- Ensure no damage to grower's property.
- Regularly liaise with grower regarding use of pesticide sprays.
- Move colonies if toxic sprays are to be used in the area.
- Ensure zero levels of AFB and minimal levels of other diseases.
- Follow the B-Qual biosecurity plan.
- Effectively manage bees prior to pollination to ensure healthy adult bees are ready to forage on the crop and effect pollination.
- Ensure sufficient room for egg-laying and honey storage. If necessary, remove excess honey.
- Adopt swarm prevention measures.
- Monitor hives for honey supplies and if necessary supply supplementary feeding of sugar and protein supplements to prevent decline of colony vitality and/or starvation.
- Choose colonies that are quiet and docile.
- Provide technical information to growers as required.
- Provide growers with protective clothing if required.
- Remove and replace colonies which do not meet agreed standards.
- Monitor crop for bee foraging and pollination efficiency.

RECORD 20	POLLINATION SERVICES RECORD	Version: 1.0 Page: 1 of 1	Approved: Date:
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Beekeeper: Address: Phone:	Alternative Contact: Address: Phone:	Grower: Address: Phone:
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Hive Delivery Date:	Hive Removal Date:
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ITEM	COMMENTS
Number of hives	
Hive distribution in crop	
Fees (Including \$/hive for emergency removal or additional moves)	
Crop spp. for pollination	
Pesticide usage in crop: <ul style="list-style-type: none"> past, present & future usage possible increased hive management 48 hr notice prior to spraying in vicinity 	

Hive Placement Checklist	Check (√)	Comments (Include details of any checks during pollination period)
Vehicle access		
Possible nuisance issues		
Water supply		
Colony strength: <ul style="list-style-type: none"> No. full depth frames. <ul style="list-style-type: none"> - containing brood. - covered with bees. Adequate Honey Stores? 		

BEEKEEPER SIGNATURE: Date:	GROWER SIGNATURE:
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Appendix IV: AFIA vendor declaration



Australian Fodder Industry Association Inc Fodder Vendor Declaration Form

VDF No.: _____
Contact No. _____

1. Vendor's Details		2. Buyer's Details	
Vendor's name:		Buyer's name:	
Address:		Address:	
Tel:	Fax:	Tel:	Fax:
3. Production Details <small>(If vendor not an AFIA member, vendor not supplying product to AFIA)</small>			
Paddock identification:		Delivery date:	
Commodity:		Cutting date:	
Is it free of genetic material genes? Yes <input type="checkbox"/> No <input type="checkbox"/> Other: _____			
4. Fodder Quality		Analysis: Lab Reference no.:	
Product description:		Dry matter: %	
Species: (if mixed include estimate of percentage)		Crude protein: % of DM	
Quantity:	Bale size:	Metabolisable energy: MJ/kg of DM	
Weeds:		Other: _____	
5. Testing and Chemical Status			
This form only applies to a single lot of hay (see Sampling Protocol or contact AFIA)			
Has the fodder sample been taken according to AFIA sampling protocol (one test per 200 square metres or paddock)?			
Yes <input type="checkbox"/>		No <input type="checkbox"/>	
Has the fodder been analysed for Aflatoxin or Fusarium? <input type="checkbox"/>			
Yes <input type="checkbox"/>		No <input type="checkbox"/>	
If yes name the laboratory: _____			
Name of Sample No: _____		and Result: _____	
Has the fodder been analysed for pesticide residues? <input type="checkbox"/>			
Yes <input type="checkbox"/>		No <input type="checkbox"/>	
If yes, attach a copy of testing results on the document provided.			
Has the crop been grown on a crop or soil with an organic chlorine (OC) class 1 classification, or under quarantine because of OC Australia, within the past 12 months? If yes give details: _____			
Yes <input type="checkbox"/>		No <input type="checkbox"/>	
Don't know <input type="checkbox"/>			
Does the property from where the fodder is grown carry a red alert status (a red alert property is a listed OC program)? <input type="checkbox"/>			
Yes <input type="checkbox"/>		No <input type="checkbox"/>	
If yes give name of program: _____			
Has the fodder crop been treated to spray drift during production? <input type="checkbox"/>			
Yes <input type="checkbox"/>		No <input type="checkbox"/>	
Don't know <input type="checkbox"/>			
If yes attach a list of chemical applications neighbouring crops, the date sprayed and application rates.			
If selling fodder to a client, complying with a redbook OC program, who req. a full list of chemical names, rates and dates (if applied to the fodder crop), as well as those applied to neighbouring crops with a >20% rate, please attach the details to this form.			

6 Declaration

I, the undersigned, declare that the above information is true and correct to the best of my knowledge and belief.

I declare that the fodder is free from any chemical residues, pesticides, herbicides, fungicides, insecticides, or any other substances that are prohibited by the AFIA Fodder Code of Practice.

I declare that the fodder is free from any genetic material genes.

I declare that the fodder is free from any Aflatoxin or Fusarium.

I declare that the fodder is free from any pesticide residues.

I declare that the fodder is free from any organic chlorine (OC) class 1 classification, or under quarantine because of OC Australia, within the past 12 months.

I declare that the property from where the fodder is grown does not carry a red alert status (a red alert property is a listed OC program).

I declare that the fodder crop has not been treated to spray drift during production.

I declare that the above information is true and correct to the best of my knowledge and belief.

I declare that the above information is true and correct to the best of my knowledge and belief.

By signing this form, you agree to the following conditions:

VENDOR'S SIGNATURE _____ **DATE** _____

The AFIA does not accept responsibility for any liability for the information provided in this declaration. December 2005

Phone 1300 663 144

TEL: 02 9893 0855 FAX: 02 4396 2228

Phone 02 4322 8198

AFIA, P O Box 4122, Bayswater, VIC 3102

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Endnotes

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- ¹¹ Canard, M; personal communication November 2007.
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- ¹⁶ Agnew, 2007.
- ¹⁷ For examples, see Somerville 1999a&b, 2002a&b, 2005; Rhodes, 2006.
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- ²³ Goodwin (2007).
- ²⁴ RIRDC 2007a.
- ²⁵ Available from the National Training Information service: www.ntis.gov.au. This work was completed in May 2005, but not nationally endorsed until March 2007.
- ²⁶ This work was completed in May 2005, but not nationally endorsed until March 2007.
- ²⁷ Australian Seed Authority 2006.
- ²⁸ Rhodes 2007.
- ²⁹ State of Queensland 2007.
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- ³⁹ Accredited courses are defined as those that are included in the National Training Information Service (www.ntis.gov.au). They are either accredited by a state/territory accreditation authority or are part of a nationally endorsed training package.
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- ⁴⁷ Department of Education, Employment and Workplace Relations 2008.
- ⁴⁸ Horticulture Australia Limited 2005.

⁴⁹ Monson 2007.

⁵⁰ For example, the Fisheries Research and Development Corporation *People Development Plan* forms a part of the overall research investment program for the industry.

⁵¹ For example, the People Development and Leadership Coordinator employed by AUSVEG.

⁵² The availability of full fee paying places for Australian students is under review.

⁵³ FarmBis programs operate somewhat differently in each State and Territory and are currently under review.

⁵⁴ For more information, see: <http://www.reframingthefuture.net> This program has been reviewed and a new program will be launched in early 2008.

⁵⁵ For more information, see: <http://www.issinstitute.org.au/about/about.html>.

Pollination Australia

Education and Training

RIRDC Pub. No. 08/059

What the report is about

This report examines the key issues in education and training for the pollination services industry and suggests strategies for addressing industry needs—both current and future.

It is one of three studies that have been completed to contribute to the development of a comprehensive business plan for the industry alliance, *Pollination Australia*. The other two studies are: - a review of the research and development requirements of the pollination industry; and a risk management strategy for the pollination industry.

Who is the report targeted at?

This report is targeted at those who have an interest in the pollination industry in Australia including beekeepers, those who grow pollination-dependent crops and those who service, support and regulate these activities.

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