Industry-specific impact assessment program: Almond

Impact assessment report for project *Protecting pollination for Australian horticultural industry - Stage 3* (MT13002)

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What the report is about

This report presents the results of an impact assessment of a Horticulture Innovation Australia Limited (Hort Innovation) investment in *MT13002: Protecting Pollination for Australian Horticultural Industries.* MT13002 was a 'parent' project that supported two 'daughter' projects – MT12049 (A model for industry planning and preparedness for an incursion of Varroa mite) and MT13027 (understanding practices in key pollination industries). All three projects were funded by Hort Innovation over the period July 2013 to June 2016.

Methodology

The investment was first analysed qualitatively within a logical framework that included activities and outputs, outcomes, and impacts. Actual and/or potential impacts then were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation in monetary terms (quantitative assessment). Past and future cash flows were expressed in 2019/20 dollar terms and were discounted to the year 2019/20 using a discount rate of 5% to estimate the investment criteria and a 5% reinvestment rate to estimate the modified internal rate of return (MIRR).

Results/key findings

The investment in MT13002 has delivered improved protection of honey bees and the pollination services they provide for the benefit of Australian horticulture. Horticultural industries are better prepared for an incursion of an exotic honey bee pest such as *Varroa destructor*.

Investment Criteria

Total funding from all sources for the project was $0.21 million (present value terms). The investment produced estimated total expected benefits of $0.60 million (present value terms). This gave a net present value of $0.39 million, an estimated benefit-cost ratio of 2.85 to 1, an internal rate of return of 41.7% and a modified internal rate of return of 9.3%.

Conclusions

The Hort Innovation investment in project MT13002 has reduced Australian horticulture's risk exposure to honey bee pests and pest bees. A number of the identified impacts were not valued as they were considered uncertain and difficult to value with credible assumptions. Hence, investment criteria provided by the valuation may be underestimates of the actual performance of the investment.

Keywords

Impact assessment, cost-benefit analysis, almond, pollination, practices, honey bee, Varroa mite, biosecurity.

Introduction

All research, development, and extension (RD&E) and marketing levy investments undertaken by Horticulture Innovation Australia Limited (Hort Innovation) are guided and aligned to specific investment outcomes, defined through a Strategic Investment Plan (SIP). The SIP guides investment of the levy to achieve each industry's vision. The current industry SIPs apply for the financial years 2016/17 – 2020/21.

In accordance with the Organisational Evaluation Framework, Hort innovation has the obligation to evaluate the performance of its investment undertaken on behalf of industry.

This impact assessment program addresses this requirement through conducting a series of industry-specific ex-post independent impact assessments of the almond (AL), banana (BA), citrus (CT) and onion (VN) RD&E investment funds.

Twenty-nine RD&E investments (projects) were selected through a stratified, random sampling process. The industry samples were as follows:

- Nine AL projects were chosen worth $5.84 million (nominal Hort Innovation investment) from an overall population of 21 projects worth an estimated $10.78 million,
- Eight BA projects worth $3.02 million (nominal Hort Innovation investment) from an overall population of 22 projects worth approximately $16.72 million,
- Eight CT projects worth $5.4 million (nominal Hort Innovation investment) from a total population of 35 projects worth $15.78 million, and
- Four VN projects worth $2.4 million (nominal Hort Innovation investment) from an overall population of 8 projects worth $3.89 million.

The project population for each industry included projects where a final deliverable had been submitted in the five-year period from 1 July 2014 to 30 June 2019.

The projects for each industry sample were chosen such that the investments represented (1) at least 10% of the total Hort Innovation RD&E investment expenditure for each industry, and (2) the SIP outcomes (proportionally) for each industry.

General Method

The impact assessment follows general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres, State Departments of Agriculture, and some universities. The approach includes both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2018).

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts. The principal economic, environmental, and social impacts were then summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were then valued in monetary terms. Where impact valuation was exercised, the impact assessment uses cost-benefit analysis as its principal tool. The decision not to value certain impacts was due either to a shortage of necessary evidence/data, a high degree of uncertainty surrounding the potential impact, or the likely low relative significance of the impact compared to those that were valued. The impacts valued are therefore deemed to represent the principal benefits delivered by the project. However, as not all impacts were valued, the investment criteria reported for individual investments potentially represent an underestimate of the performance of that investment.

Background & Rationale

Background

The Australian almond industry is a significant horticultural sector with a five-year average production area of 36,206 ha, a production volume of 85,909 tonnes (kernel weight equivalent), and a Farmgate Value of $665.6 million – Table 1.

Table 1: Almond Industry Performance 2015-2019

Year Ended 30 June	Area of Production (ha)	Production (t)	Gross Value of Production ($m)	Farmgate Value ($m)
2015	29,437	82,509	707.5	672.1
2016	30,981	82,333	854.1	811.4
2017	35,866	80,800	553.6	525.9
2018	39,662	79,901	553.1	525.4
2019	45,089	104,000	835.1	793.3
Average	36,206	85,909	700.7	665.6

Source: Australian Horticulture Statistics Handbook and Almond Insights, various years. Tonnes is kernel weight equivalent.

The industry is comprised of a value chain that spans investors, almond growers through to end retail consumers and export markets. A number of the larger Australian growers have become vertically integrated and encompass processing, packing, domestic and export marketing (Hort Innovation, 2017).

Almond research and development (R&D) activity is guided by the Almond industry's Strategic Investment Plan (SIP). The activities are funded by levies payable on almonds produced in Australia; and the R&D levy funds are managed by Hort Innovation.

The current SIP has been developed with levy payers and addresses the Australian Almond industry's needs from 2017 to 2021. Strategies and priorities in the Plan have been driven by a set of five desired outcomes (Hort Innovation, 2017):

1. Pest and disease damage to almonds has been reduced through enhanced integrated pest management and integrated disease management.
2. A major productivity gain in almond pollination by 2022 through a 25% reduction in honey bee stocking rate with no loss in pollination efficiency (nut set).
3. Improvements in the crop production system have lifted average industry kernel yield from 3 to 4 t/ha, 4ML of irrigation water generates a tonne of almond kernel yield and proven 'shake and catch' harvesting / processing technology is in place.
4. Australian almonds are an informed industry that adopts R&D outcomes and has the capacity to support current and future industry needs.
5. Increased domestic almond consumption up from 16,000 t in 2016 to 27,500 t in 2022. Increased export sales up from 61,000 t in 2016 to 110,000 t in 2022.

Rationale

Almond production is reliant on successful pollination of the crop in August and September each year using managed honey bees which are transported to the orchard. Other crops have varying degrees of reliance on honey bees for crop pollination.

This Stage 3 RD&E project was a 'parent' project that supported the AgriFutures Australia Pollination R&D Committee development of 'daughter' projects to ensure ongoing pollination services for the Australian horticultural industry.

The Stage 3 RD&E program was intended to assist horticultural industries, government, and scientific agencies to keep exotic bee pests (e.g. *Varroa destructor*, *Tropilaelaps clareae*, *Acarapis woodi* (tracheal mite)) and pest bees (e.g. *Apis cerana* and *Apis dorsata*) out of Australia. Projects were also to be developed to prepare industry for the possible establishment of Varroa mite (*Varroa destructor*) which is already present in both New Zealand and Papua New Guinea. Establishment of Varroa mite in Australia, would result in a decline in the number of unmanaged (feral) honey bee crop pollinators. It is estimated that unmanaged bees account for 70% of present honey bee numbers and provide free pollination to horticultural crops, albeit at suboptimal levels.

The program was designed to protect pollination reliant horticultural industries, their market access, trade, sustainable production, and Australian food security. The program was jointly managed by Hort Innovation in conjunction with AgriFutures Australia and received funding support from the Almond, Apple & Pear, Avocado, Canning Fruit, Cherry, Dried Prune, Melon and Onion industries.

The two 'daughter' projects funded under the MT13002 'parent' project were:

- MT12049 A model for industry planning and preparedness for an incursion of Varroa mite.
- MT13027 Understanding practices in key pollination industries.

MT13002 follows on from the previous project MT09026 Protecting Pollination for Australian Horticultural Industries, Stage 2.

Project Details

Summary

Project Code: MT13002 ('parent' project for MT12049 and MT13027)

Title: Protecting Pollination for Australian Horticultural Industries, Stage 3

Research Organisation: Hort Innovation and AgriFutures Australia

Project Leader for MT12049: Sam Malfroy, Plant Health Australia (PHA)

Project Leader for MT13027: Mark Leech, TQA Australia

Period of Funding: July 2013 to June 2016

Objectives

The objective of this project was to support RD&E that will secure the pollination of Australia's horticultural crops into the future on a sustainable and profitable basis.

Logical Framework

Table 2 provides a detailed description of the project in a logical framework.

Table 2: Logical Framework for Project MT13002

Activities	Important activities associated with MT12049 included: • Almond industry wide review of pollination status and post Varroa establishment contingency planning – honey bee hive numbers and location, managing regional restrictions, projection of almond industry growth to identify future pollination needs, identification of key pollination personnel, understanding the impact of state government border policies, reviewing Varroa mitigation measures, and projection of supply/demand balances for pollination services. • Clarification and further documentation of cost sharing arrangements between the almond industry and government should Varroa establishment occur. • Completion of a two day Varroa incursion simulation workshop, June 2014. Simulation workshop provided in-depth training on biosecurity issues using real world examples to test response readiness – does everybody understand their role, are enough resources available for an effective response, what communication channels are required, etc. • Preparation of draft and final reports. Dissemination of results to the almond industry. Important activities associated with MT13027 included: • Steering committee establishment to guide the project including survey design. • Survey of almost 100 apple, pear, blueberry, and cherry growers to determine the importance growers place on pollination, how significant unmanaged honey bees are to their operation, to what extent paid pollination services are employed, the cost of paid pollination, the nature of the relationship with the pollination supplier, and to gauge grower interest in increasing their pollination skills and knowledge. • Ground truthing of the survey results via face-to-face meetings with 25 key growers. • Preparation of draft and final reports. • Results and recommendations communicated to research planners in Hort Innovation and AgriFutures Australia as well as the Australian Honey Bee Industry Council and the apple, pear, blueberry, and cherry industries through relevant publications.
Outputs	Important outputs associated with MT12049 included:

	• An almond industry pollination planning and preparedness report. • A paper answering almond industry questions regarding cost sharing arrangement post a Varroa incursion. • Documented results from the simulation workshop posted on the PHA website. • A recommendation to further strengthen the National Bee Pest Surveillance Program to ensure the likelihood of detecting Varroa mite early is increased. Important outputs associated with MT12049 included: • A project report detailing survey results, survey analysis, pollination recommendations and the survey instrument. • Recommendations addressing native bee research, orchard design to improve pollination, methods to detect the level of unmanaged honey bee activity, grower pollination training, a pollination diagnostic tool, a generic pollination agreement to serve growers and beekeepers, and pollination training for small beekeepers. • Presentation of findings to a half day meeting of the AgriFutures Pollination R&D Committee. • Preparation of a one page summary suitable for growers and industry peak bodies. • Production and distribution of a press release.
Outcomes	• Improved protection of honey bee pollination services for the benefit of Australian horticulture. • Almond, apple, pear, blueberry, and cherry industries better prepared for Varroa with a tested and refined biosecurity framework in place, and increased grower awareness. • Avoided production cost increases associated with Varroa incursion and establishment.
Impacts	• Economic – increase in grower profit associated with avoided pollination cost increases. • Environment – miticides for Varroa and other honey bee pests not required, leading to fewer chemicals in honey, beeswax, and the farm environment. • Capacity – growers with an increase in pollination awareness and knowledge. • Capacity - researchers and the staff of government agencies with increased pollination knowledge and incursion management expertise. • Social - contribution to improved regional community wellbeing in horticultural growing areas from spill-over benefits as a result of a sustainable, profitable production.

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project MT13002 by Hort Innovation. Hort Innovation was the only investor in the project.

Table 3: Annual Investment in Project MT13002 (nominal $)

Year ended 30 June	Hort Innovation ($)	AgriFutures ($)	TOTAL ($)
2014	0	0	0
2015	67,666	0	67,666
2016	63,542	0	63,542
Total	**131,208**	**0**	**131,208**

Source: MT13002 Board Report

Program Management Costs

For the Hort Innovation investment, the cost of managing the Hort Innovation funding was added to the Hort Innovation contribution for the project via a management cost multiplier (1.162). This multiplier was estimated based on the share of 'payments to suppliers and employees' in total Hort Innovation expenditure (3-year average) reported in the Hort Innovation's Statement of Cash Flows (Hort Innovation Annual Report, various years). This multiplier was then applied to the nominal investment by Hort Innovation shown in Table 3.

Real Investment and Extension Costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2019/20 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2020). No additional extension costs are envisaged.

Impacts

Table 4 provides a summary of the principal types of impacts delivered by the project, based on the logical framework. Impacts have been categorised into economic, environmental, and social impacts.

Table 4: Triple Bottom Line Categories of Principal Impacts from Project MT13002

Economic	• Increase in grower profit associated with avoided pollination cost increases.
Environmental	• Miticides for Varroa and other honey bee pests not required, leading to fewer chemicals in honey, beeswax, and the farm environment.
Social	• Growers with an increase in capacity in relation to pollination awareness and knowledge. • Researchers and the staff of government agencies with additional skills and capacity in relation to pollination and incursion management expertise. • Contribution to improved regional community wellbeing in horticultural growing areas from spill-over benefits as a result of a sustainable, profitable production.

Public versus Private Impacts

The impacts identified from the investment are mostly private i.e. increase in grower profit associated with avoided pollination cost increases. Public benefits include the avoided environmental cost of introducing miticide chemicals to control exotic honey bee pests, an increase in pollination capacity (growers and researchers), an increase in capacity in relation to exotic pest incursion management and spill-over benefits to regional communities from more profitable horticultural production.

Distribution of Private Impacts

The private impacts (additional profit) will be distributed between growers, processors, and the balance of the supply chain. The share of impact realised by each link in the supply chain will depend on both short- and long-term supply and demand elasticities in the almond market.

Impacts on Other Australian Industries

In addition to impacts realised by horticultural industries participating in the project (almond, apple, pear, blueberry, and cherry), lower pollination cost benefits will be available to other horticultural (e.g. citrus, macadamia, mango, cucumber, carrot seed) and broadacre (e.g. canola, sunflower, cotton, soy) industries.

Impacts Overseas

The biosecurity measures developed and put in place as part of this project (i.e. almond industry planning for Varroa incursion, understanding practices in key pollination industries) are specific to Australian conditions. No overseas impacts are anticipated.

Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E priorities are reproduced in Table 5. The project outcomes and related impacts will contribute to Rural RD&E Priority 2 and Science and Research Priority 1.

Table 5: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	**Science and Research Priorities (est. 2015)**
1. Advanced technology	1. Food

2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D	2. Soil and Water 3. Transport 4. Cybersecurity 5. Energy and Resources 6. Manufacturing 7. Environmental Change 8. Health

Sources: (DAWR, 2015) and (OCS, 2015)

Alignment with the Almond Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the almond industry are outlined in the Almond Industry's Strategic Investment Plan 2017-2021[1] (Hort Innovation, 2017). Project MT13002 addressed Outcome 2, (a major productivity gain in almond pollination), Strategy 1 (Develop and maintain a robust honey bee pest and disease incursion response including efforts to keep Australia free of *Varroa destructor* and similar exotic honey bee pests).

Valuation of Impacts

Impacts Valued

Analyses were undertaken for total benefits that included future expected benefits. A degree of conservatism was used when finalising assumptions, particularly when some uncertainty was involved. Sensitivity analyses were undertaken for those variables where there was greatest uncertainty or for those that were identified as key drivers of the investment criteria.

The impact valued was increase in grower profit associated with avoided pollination cost increases.

Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. Those not valued included:

- Miticides for Varroa and other honey bee pests not required, leading to fewer chemicals in honey, beeswax, and the farm environment.
- Growers with an increase in capacity in relation to pollination awareness and knowledge.
- Researchers and the staff of government agencies with additional skills and capacity in relation to pollination and incursion management expertise.
- Contribution to improved regional community wellbeing in almond growing areas from spill-over benefits as a result of a sustainable, profitable almond industry.

These impacts were not valued due to lack of data to support credible assumptions.

Valuation of Impact 1: Increase in grower profit associated with avoided pollination cost increases

The MT13002 investment contributed to a reduction in the probability of Varroa mite incursion and establishment in Australia. Varroa incursion and establishment would increase the cost of beekeeping including purchase of miticides and additional apiary labour (checking hives, inserting/replacing miticide strips). These costs would be passed on to horticultural producers in the form of higher pollination fees. It would not be unreasonable to assume average fee increases from $80/hive to $120/hive for pollination services.

Attribution

Effective protection of managed honey bees to provide ongoing pollination is the result of a long standing investment program that includes pre- and post-border initiatives, RD&E, and training. The Stage 3 investments described in this impact assessment are a small part of a much larger picture. For this reason, an attribution estimate of 10% has been assumed for MT13002.

Counterfactual

If project MT13002 had not been funded, it is assumed that the AgriFutures Australia Honey Bee RD&E Program would have supported a smaller more modest project. Consequently, a 50% counterfactual has been applied.

[1] For further information, see: https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/strategic-investment-plans/

Summary of Assumptions

A summary of the key assumptions is provided in Table 6.

Table 6: Summary of Assumptions for Impact Valuation

Variable	Assumption	Source/Comment
Impact 1: Increase in grower profit associated with avoided pollination cost increases		
Number of managed honey bee hives used to pollinate horticultural crops.	354,889 honey bee hives used per annum.	Estimate dominated by almond pollination and was sourced from AgEconPlus 2020.
Reduction in probability of Varroa establishment following completion of MT13002.	10%	Analyst assumption made after considering that previous investments have kept Australia Varroa free and that MT13002 mostly identified priorities for further investment. Assumption tested using sensitivity analysis.
Increase in pollination cost with Varroa incursion and establishment.	$40/hive	Analyst discussion with beekeepers providing hives for pollination. Current cost of $80/hive increases to $120/hive with Varroa establishment.
Year of first impact.	2016/17	One year after MT13002 completion.
Year of final impact.	2025/26	Ten years after initial adoption – insights from MT13002 replaced with new knowledge generated from subsequent research.
Probability of outputs.	100%	Valuable outputs have already been generated.
Probability of outcomes.	100%	Outputs have been translated into outcomes for Varroa preparedness.
Probability of impact.	60%	There is some risk that preparedness measures will not translate into honey bee protection and avoided cost increases for growers.
Attribution	10%	See above.
Counterfactual.	50%	See above.

Results

All costs and benefits were discounted to 2019/20 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the Modified Internal Rate of Return (MIRR). The base analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the project investment period plus 30 years from the last year of investment (2015/16) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

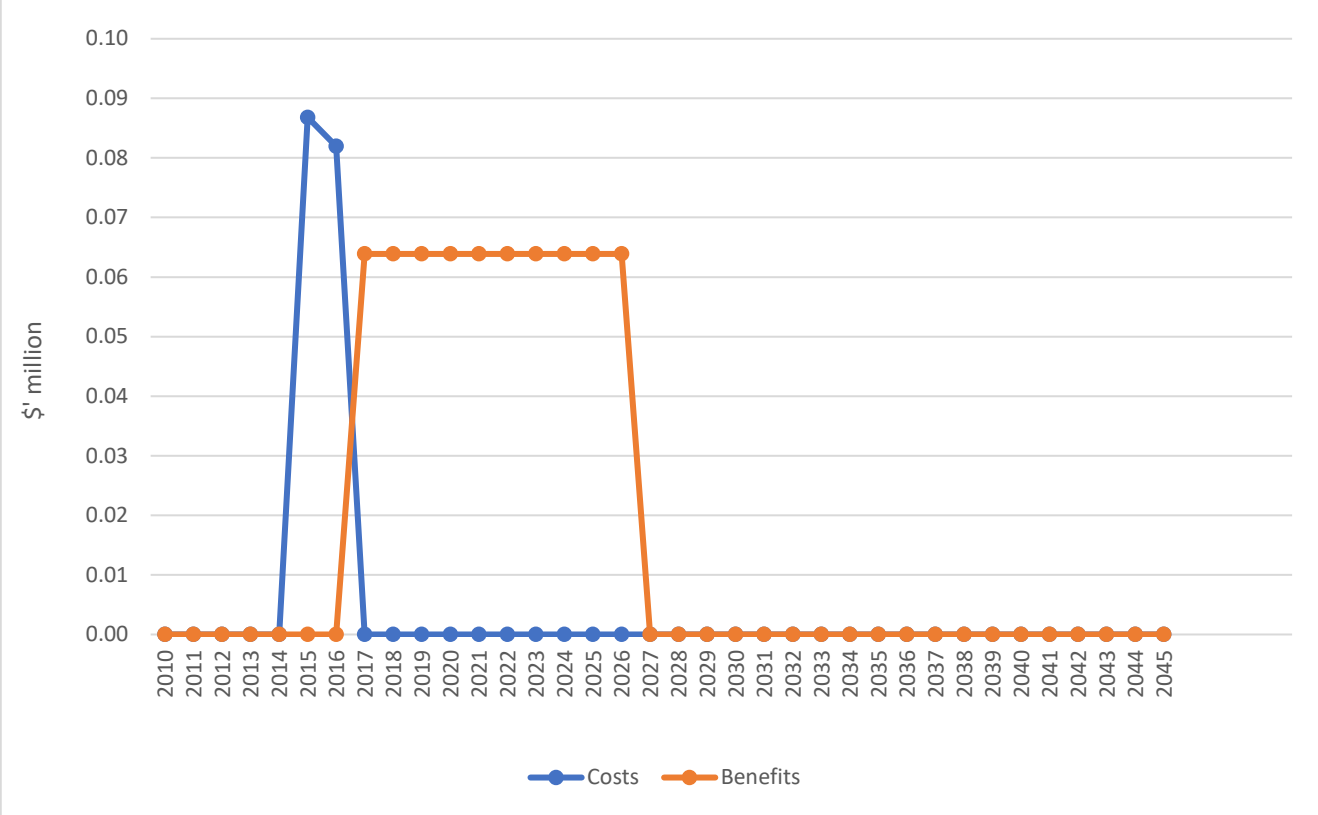
Table 7 shows the investment criteria estimated for different periods of benefit for the total investment. Hort Innovation was the only investor in the project.

Table 7: Investment Criteria for Total Investment in Project MT13002

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	0.28	0.55	0.60	0.60	0.60	0.60
Present Value of Costs ($m)	0.11	0.21	0.21	0.21	0.21	0.21	0.21
Net Present Value ($m)	-0.11	0.06	0.34	0.39	0.39	0.39	0.39
Benefit-Cost Ratio	0.00	1.31	2.62	2.85	2.85	2.85	2.85
Internal Rate of Return (%)	negative	14.7%	40.8%	41.7%	41.7%	41.7%	41.7%
MIRR (%)	negative	11.2%	19.5%	9.3%	11.8%	10.3%	9.3%

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the MT13002 investment plus 30 years from the last year of investment are shown in Figure 1.

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs



Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 8 presents the results. The results show a low level of sensitivity to the discount rate.

Table 8: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	**Discount rate**		
	0%	**5% (base)**	**10%**
Present Value of Benefits ($m)	0.64	0.60	0.57
Present Value of Costs ($m)	0.17	0.21	0.26
Net Present Value ($m)	0.47	0.39	0.31
Benefit-cost ratio	3.79	2.85	2.21

A sensitivity analysis was then undertaken on the assumed reduction in the probability of Varroa establishment as a result of the project. Results are provided in Table 9. If the decrease in probability is reduced from 10% to 5%, the project continues to deliver a favourable return on investment.

Table 9: Sensitivity to Reduction in Probability of Varroa Establishment Following MT13002 (Total investment, 30 years)

Investment Criteria	Decrease in Varroa Establishment Probability		
	5%	10% (base)	20%
Present Value of Benefits ($m)	0.30	0.60	1.20
Present Value of Costs ($m)	0.21	0.21	0.21
Net Present Value ($m)	0.09	0.39	0.99
Benefit-cost ratio	1.42	2.85	5.70

A final sensitivity test examined the increase in fees for pollination with the establishment of Varroa (Table 10). Fee increases of as little as $14/hive produce a positive return on investment.

Table 10: Sensitivity to Fee Increases Following the Establishment of Varroa (Total investment, 30 years)

Investment Criteria	Pollination Fee Increase Following Varroa Establishment		
	$14/hive	$20/hive	$40/hive (base)
Present Value of Benefits ($m)	0.22	0.30	0.60
Present Value of Costs ($m)	0.21	0.21	0.21
Net Present Value ($m)	0.01	0.09	0.39
Benefit-cost ratio	1.07	1.42	2.85

Confidence Rating

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes.

A confidence rating based on these two factors has been given to the results of the investment analysis (Table 11). The rating categories used are High, Medium, and Low, where:

- High: denotes a good coverage of benefits or reasonable confidence in the assumptions made
- Medium: denotes only a reasonable coverage of benefits or some uncertainties in assumptions made
- Low: denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 11: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
High	Medium

Coverage of benefits valued was assessed as High –the major benefit was valued. Confidence in assumptions was rated as Medium, some key assumptions were made by the analyst.

Conclusion

The investment in MT13002 and its two 'daughter' projects MT12049 (A model for industry planning and preparedness for an incursion of Varroa mite) and MT13027 (understanding practices in key pollination industries) has delivered improved protection of honey bees and the pollination services they provide for the benefit of Australian horticulture. Horticultural industries are better prepared for an incursion of an exotic honey bee pest such as *Varroa destructor*.

Total funding from all sources for the project was $0.21 million (present value terms). The investment produced estimated total expected benefits of $0.60 million (present value terms). This gave a net present value of $0.39 million, an estimated benefit-cost ratio of 2.85 to 1, an internal rate of return of 41.7% and a modified internal rate of return of 9.3%.

However, as a number of the identified impacts were not valued, the investment criteria estimated by the evaluation may be underestimates of the actual performance of the investment.

Glossary of Economic Terms

Cost-benefit analysis:	A conceptual framework for the economic evaluation of projects and programs in the public sector. It differs from a financial appraisal or evaluation in that it considers all gains (benefits) and losses (costs), regardless of to whom they accrue.
Benefit-cost ratio:	The ratio of the present value of investment benefits to the present value of investment costs.
Discounting:	The process of relating the costs and benefits of an investment to a base year using a stated discount rate.
Internal rate of return:	The discount rate at which an investment has a net present value of zero, i.e. where present value of benefits = present value of costs.
Investment criteria:	Measures of the economic worth of an investment such as Net Present Value, Benefit-Cost Ratio, and Internal Rate of Return.
Modified internal rate of return:	The internal rate of return of an investment that is modified so that the cash inflows from an investment are re-invested at the rate of the cost of capital (the re-investment rate).
Net present value:	The discounted value of the benefits of an investment less the discounted value of the costs, i.e. present value of benefits - present value of costs.
Present value of benefits:	The discounted value of benefits.
Present value of costs:	The discounted value of investment costs.

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Abbreviations

ABA	Almond Board of Australia
AL	Almond
BA	Banana
CRRDC	Council of Research and Development Corporations
CT	Citrus
DAWR	Department of Agriculture and Water Resources (Australian Government)
DPI	Department of Primary Industries (Victoria)
GDP	Gross Domestic Product
GVP	Gross Value of Production
IRR	Internal Rate of Return
MIRR	Modified Internal Rate of Return
OCS	Office of Chief Scientist Queensland
PHA	Plant Health Australia
PVB	Present Value of Benefits
RD&E	Research, Development and Extension
RIRDC	Rural Industries Research and Development Corporation (now AgriFutures Australia)
VN	Onion