

Industry-specific impact assessment program: apple and pear

Impact assessment report for project *Apple and pear technical manager* (AP11014)

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Executive Summary

What the report is about

This report presents the results of an impact assessment of a Horticulture Innovation Australia Limited (Hort Innovation) investment in *Apple and pear technical manager (AP11014)*. The project was funded by Hort Innovation from August 2011 to March 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 2017/18 dollar terms and were discounted to the year 2018/19 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 this apple and pear project has delivered a more efficient deployment of R&D by identifying knowledge gaps and identifying opportunities for improving existing apple and pear program planning and subsequent management. Of perhaps more importance has been the role of the project in extending knowledge to apple and pear growers and its contribution to grower productivity and profitability.

Investment Criteria

Total funding for the project was \$1.45 million (present value terms). The investment produced estimated total expected benefits of \$10.56 million (present value terms). This gave a net present value of \$9.12 million, an estimated benefit-cost ratio of 7.30 to 1, an internal rate of return of 103% and a MIRR of 18.4%.

Conclusions

The Hort Innovation investment in Project AP11014 has added an important complementary dimension to effective and efficient apple and pear RD&E grower knowledge and management. Also, several economic and social impacts identified in the assessment were not valued in the economic analysis. This was because the impacts were considered difficult to value due to lack of data upon which credible assumptions could be based. Hence, the investment criteria provided by the valuation may be an underestimate of the actual performance of the investment.

Keywords

Impact assessment, cost-benefit analysis, apple and pear industry, Technical Manager, productivity, RD&E investment

Introduction

All research and development (R&D) 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 apple & pear (AP), avocado (AV), mushroom (MU) and table grape (TG) RD&E investment funds.

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

- Nine AP projects were chosen worth \$15.46 million (nominal Hort Innovation investment) from an overall population of 19 projects worth an estimated \$33.31 million,
- Seven AV projects worth \$1.91 million (nominal Hort Innovation investment) from an overall population of 27 projects worth approximately \$9.97 million,
- Five MU projects worth \$1.75 million (nominal Hort Innovation investment) from a total population of 20 projects worth \$7.94 million, and
- Six TG projects worth \$2.84 million (nominal Hort Innovation investment) from an overall population of 11 projects worth \$5.0 million.

The project population for each industry included projects where a final deliverable had been submitted in the five-year period from 1 July 2013 to 30 June 2018.

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.

Project AP11014: *Apple and pear technical manager* was randomly selected as one of the 22 unique MT18009 investments and was analysed in this report.

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

Apples and pears are two of the main horticulture crops produced in Australia. Combined, the apple and pear industries produce more fresh fruit than any other fruit industry in Australia (APAL, 2019). The main production of apples and pears occurs in Victoria (at 45% and 88% of national production respectively), with major apple producers also located in all other states. Most Australian apples and pears are for fresh supply, but both also have significant production sent for processing (for juices and other value-added products).

In 2017/18, Australian apples had a farm gate value (FGV) of \$418.3 million and production of 269,355 tonnes, while pears (including Nashi) had an FGV of \$80.2 million and production of 103,748 tonnes (ABS, 2019). Domestic apple consumption has remained relatively stable over time, but per capita consumption has been falling (Hort Innovation, 2016). Fresh pear (excluding Nashi) per capita consumption has remained stable since 2002/03 (Hort Innovation, 2016).

Exports, while relatively small compared to domestic consumption, represent an important growth area for apples and pears. A total of 2,134 tonnes (or 1% of fresh production) of apples was exported in 2014/15 (Hort Innovation, 2016) with major markets being Papua New Guinea, United Kingdom, Sri Lanka, and Hong Kong.

For pears, a total of 7,647 tonnes (7% of fresh production) was exported the same year (Hort Innovation, 2016), with major export markets being New Zealand, Indonesia, Canada, Singapore, and more recently India. Australia does allow imports of both apples and pears, but quantities are relatively small compared to domestic production.

There are both opportunities and challenges for the Australian apple and pear industry to improve in areas such as biosecurity, inconsistency of eating quality, export competition and market access, and an oversupply leading to lower prices (Hort Innovation, 2016).

The collective goal of the two industries is to increase the growth in domestic consumption of apples and pears, and to see growth in exports. The apple and pear industries have funded a number of projects, through Hort Innovation and industry RD&E investments, around improving access to the Asian export market, improved marketing of apples and pears, and improving industry productivity and quality (APAL, 2013). Statutory levies are in place for both industries for Emergency Plant Pest Response, National Residue Testing, Plant Health Australia, Marketing and R&D. Marketing and R&D levies are managed by Hort Innovation. APAL is the apple and pear industry's representative body and non-profit membership organisation.

Rationale

The project continues on from Project AP08039, originally established to improve technical improvements and competitiveness of the Australian industry that was facing the threat of imported apples. The continuation of the technical development initiative was considered by the APAL Board as an essential industry R&D strategy to remain competitive by assisting with identifying R&D needs and priorities and assisting the adoption of R&D outputs by growers.

Project Details

Summary

Project Code: AP11014

Title: *Apple and pear technical manager*

Research Organisation: Apple and Pear Australia Limited (APAL)

Project Leader: Jesse Reader (2012-2014), Angus Crawford (2014-2016)

Period of Funding: August 2011 to June 2016

Objectives

Specific objectives of project AP11014 and the Technical Manager were:

- To identify R&D needs including filling gaps and capturing opportunities.
- To establish and manage programs including delivering R&D outcomes
- To extend results to growers
- To report R&D projects
- To participate in other issues including investment planning, providing technical input, and facilitate responses to various industry issues, represent the technical interests of the industry at meetings and workshops, and respond to general technical enquiries from growers and other industry stakeholders.

Table 1 following provides a detailed description of the project in a logical framework.

Table 1: Logical Framework for Project AP11014

Activities and Outputs	<p>Major project activities and outputs included:</p> <ul style="list-style-type: none"> • The project ran from August 2011 to March 2016. • Gaps in research and development that needed attention were identified. • Programs were managed to assist with delivery of R&D outcomes. • A specific activity of the Technical Manager was to coordinate and deliver the Future Orchards project (AP11017). • The Technical Manager was also responsible for other projects such as Speed Updating (AP14003), the US study Tour (AP12704), and Post-Harvest seminars. • The Technical Manager participated in a number of workshops, events, committees, and industry meetings. This activity included liaison with the Apple and Pear Industry Advisory Council R&D sub-committee. • The Technical Manager acted as the Technical Editor of the Australian Fruitgrower magazine and other verbal and written communication channels with apple and pear growers.
Outcomes	<ul style="list-style-type: none"> • Most of the activities of the Technical Manager have assisted stakeholders align with the strategic plan of the apple and pear industry. • Through the Speed Updating and Post-Harvest seminars, closer relationships were forged between researchers, growers, and the others involved with the apple and pear industry. • The Future Orchards Program has contributed to a number of productivity outcomes such as an increase in average fruit yields from 34 tonnes per hectare in 2008 to 40 tonnes per hectare in 2014; further the Future Orchards program precipitated 80% of growers making changes to their orchard management. • The project assisted Class A quality of apples and pears being maintained at 69% of production. • A mid-term review of the Project AP11014 was conducted in 2013 and concluded that the project was critical for the systematic and effective transfer of technical information to the industry. • Without the co-ordination of the Technical Manager, many AP projects would not have been as effective in delivering their impacts. • The Technical Manager has been recognised as a valuable source of technical knowledge for the Australian apple and pear industry.
Impacts	<p>The most important impacts provided by the project investment were:</p>

	<ul style="list-style-type: none"> • More efficient and relevant investment of industry resources in existing and new R&D projects. • An improvement in the effectiveness of knowledge of R&D outputs being transferred to apple and pear growers. • Improved international competitiveness, productivity and profitability exhibited by growers due to more effective R&D investment, informative communication and extension of information to industry, and its higher relevance to, and uptake by, industry than otherwise would have been the case.
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Project Investment

Nominal Investment

Table 2 shows the annual investment made in Project AP11014 by Hort Innovation. There were no other funding organisations involved.

Table 2: Annual Investment in Project AP11014 (nominal \$)

Year ended 30 June	HORT INNOVATION (\$)	TOTAL (\$)
2012	154,000	154,000
2013	154,000	154,000
2014	156,106	156,106
2015	157,661	157,661
2016	318,648	318,648
Total	940,415	940,415

Program Management Costs

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). This information was 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 2.

Real Investment and Extension Costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2017/18 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2019). No additional costs of extension were included as the project itself was extension oriented and involved and maintained communication channels with a number of other apple and pear projects as well as apple and pear growers.

Impacts

Table 3 provides a summary of the principal types of impacts delivered by the project, based on the logical framework described earlier. Impacts have been categorised into economic, environmental and social impacts.

Table 3: Triple Bottom Line Categories of Principal Impacts from Project AP11014

Economic	<ul style="list-style-type: none"> • More efficient deployment of R&D resources from the identification of knowledge gaps and new opportunities for investment, including avoidance of research duplication as well as new program planning, development, and management. • Improved knowledge transfer to apple and pear growers that has improved apple and pear quality, as well as industry productivity and profitability.
Environmental	<ul style="list-style-type: none"> • No direct environmental impacts were delivered; however, some indirect impacts may have occurred in so far as some redirection of project funding may have captured increased environmental benefits from improved information and management practices (e.g. pest control).
Social	<ul style="list-style-type: none"> • Improved productivity and profitability of growers of apples and pears has increased or protected current spillovers to regional communities where apples and pears are produced and distributed.

Public versus Private Impacts

The impacts identified from the investment are predominantly private impacts accruing to apple and pear growers and their supply chains. However, some minor public benefits also have been produced in the form of spillovers to regional communities from enhanced incomes of growers and others along the supply chain (e.g. enhanced or maintained employment).

Distribution of Private Impacts

The private impacts will have been distributed between apple and pear growers and the various businesses along their product supply chains,

Impacts on Other Australian Industries

It is likely that most impacts will be confined to the Australian apple and pear industry.

Impacts Overseas

It is unlikely that there will be any significant spillover impacts to overseas interests

Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E priorities are reproduced in Table 4. The project outcomes and related impacts will contribute primarily to Rural RD&E Priorities 4 and 1, and to Science and Research Priority 1.

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

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

Alignment with the Apple and Pear Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the apple and pear industry are outlined the Apple and Pear Strategic Investment Plan 2017-2021¹ (Hort Innovation, 2017). Project AP11014 addressed Outcome 3 (Strategy 3.1 through to 3.8).

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.

Two impacts were valued:

Impact 1: Increased efficiency of R&D investment

Impact 2: Increased productivity and profitability of apple and pear growers

Impacts Not Valued

Not all of the impacts identified in Table 3 could be valued in the assessment. Those not valued included:

- Environmental impacts
- Increased regional community spillovers.

These two potential impacts were not valued largely due to lack of readily available information to support credible assumptions.

Summary of Assumptions

A summary of the key assumptions made for valuation of the two impacts of Project AP11014 is provided in Table 5.

Table 5: Summary of Assumptions for Impact Valuation

Variable	Assumption	Source/Comment
Impact 1: Increased efficiency of R&D investment		
Annual R&D investment in apples and pears 2014-2018	\$4.14 million per annum	Based on \$4.14 m in 2017/18 (Hort Innovation 2018)
Efficiency dividend assumed to include contribution from Technical Manager	2.5%	Agtrans Research
Annual investment to deliver the same outcomes without the Technical Manager	\$4.24 million per annum	\$4.14 m * (1+2.5%)
Potential saving	\$103,500 per annum	\$4.24-\$4.14 m
Year in which efficiency dividend commences	2014	Agtrans Research
Year in which efficiency dividend ends	2018	
Probability of impact	75%	
Impact 2: Increased profitability of apple and pear production		
Farm gate value of Australian apples	\$418.3 million in 2017/18	ABS (2019)
Farm gate value of Australian pears	\$80.2 million in 2017/18	
Farm gate value of Australian apple and pears	\$498.5 million in 2017/18	418.3 m + 80.2 m
Estimate of farm profit of apple and pear growers (includes impact of Technical Manager)	15% of gross value produced	Conservative analyst assumption. Based on average net orchard profits (before tax) of \$0.20 per gross kg of production. $0.20/1.05 = \sim 19.0\%$ reduced

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

		for tax (AgFirst, 2017)
Return to growers with Technical Manager in 2017/18	\$74.78 million	\$498.5 m x 15%
Increased productivity and profitability due to Technical Manager	2.5%	Agtrans Research; as there was no evidence found on which to base this important assumption, this variable was subjected to a sensitivity analysis (see Table 10)
Return to growers without Technical Manager	\$72.96 million	\$74.78 m /1.025
Potential annual increase in grower returns due to Technical Manager	\$1.82m in 2017/18	\$74.78- \$72.96
Year in which improvement commences	2014	Agtrans Research
Year in which maximum improvement reached	2018, reducing to zero by 2023	
Probability of impact	90%	Based on findings of the mid-term review which states that the investment has been 'critical' to the underlying success for the transfer of knowledge
Counterfactual		
If Project AP11014 had not been funded it is assumed that the impacts described above would not have eventuated; this assumption is based on the unique and specialised nature of the investment in the Technical Manager position.		

Results

All costs and benefits were discounted to 2017/18 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 (2017/18) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

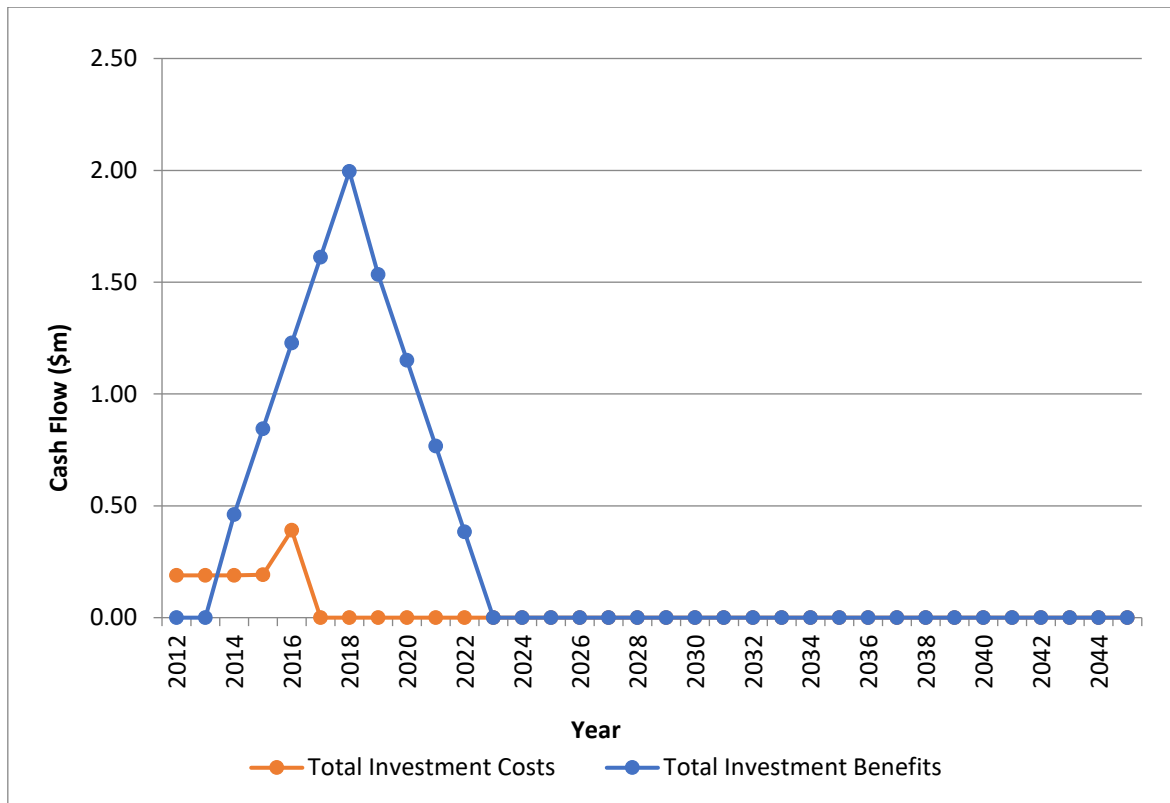
Table 6 shows the investment criteria estimated for different periods of benefits for the total investment. The investment criteria for Hort Innovation investment are the same as for total investment, as Hort Innovation was the only investor.

Table 6: Investment Criteria for Total Investment in Project AP11014

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	3.04	10.23	10.56	10.56	10.56	10.56	10.56
Present Value of Costs (\$m)	1.45	1.45	1.45	1.45	1.45	1.45	1.45
Net Present Value (\$m)	1.59	8.78	9.12	9.12	9.12	9.12	9.12
Benefit-Cost Ratio	2.10	7.07	7.30	7.30	7.30	7.30	7.30
Internal Rate of Return (%)	negative	103.52	103.52	103.52	103.52	103.52	103.52
MIRR (%)	negative	420.66	66.74	37.51	27.03	21.65	18.38

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the AP11014 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



Contribution to Total Benefits

Table 7 shows the contribution of each impact to the total Present Value of Benefits (PVB). Table 7 shows that, if only the grower productivity impact was delivered, the value of that impact alone would have comfortably covered the Present Value of Investment Costs (PVC) of \$1.45m.

Table 7: Contribution of Benefits by Source

Impact	PVB (\$M)	% of Total PVB
Impact 1	0.45	4.3%
Impact 2	10.11	95.7%
Total	10.56	100.0%

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 present the results. The results show a low sensitivity to the discount rate, largely due to the relatively short period of benefits assumed, and the relative timing of benefits and the investment costs.

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

Investment Criteria	Discount rate		
	0%	5% (base)	10%
Present Value of Benefits (\$m)	9.97	10.56	11.26
Present Value of Costs (\$m)	1.15	1.45	1.81
Net Present Value (\$m)	8.82	9.12	9.45
Benefit-cost ratio	8.67	7.30	6.22

A sensitivity analysis was undertaken for the increased profits to growers from the investment in the Technical Manager project over the five years. Results are provided in Table 9. The results show that even a 1% gain in grower

productivity and profitability would have easily given a positive return to the investment.

Table 9: Sensitivity to Assumed Increase in Grower Profitability due to Project AP11014
(Total investment, 30 years)

Investment Criteria	Increase in Profitability		
	1%	2.5% (base)	5%
Present Value of Benefits (\$m)	4.56	10.56	22.06
Present Value of Costs (\$m)	1.45	1.45	1.45
Net Present Value (\$m)	3.11	9.12	20.62
Benefit-cost ratio	3.15	7.30	15.24

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 10). 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 10: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
Medium-High	Medium

Coverage of benefits valued was assessed as Medium-High due to the prominence of the impacts valued. Confidence in assumptions was rated as Medium, as the key driving assumption of the benefits valued (the increase in profitability) was not well-supported by specific evidence. However, the findings of the mid-term review of the Technical Manager investment stated that the investment has been 'critical' to the underlying success for the transfer of knowledge.

Conclusion

The investment in AP11014 is likely to contribute significantly to resource allocation of R&D investment by Hort Innovation as well as, even more importantly, to the delivery of productivity, profitability and international competitiveness of the Australian apple and pear industry.

Total funding for the project was \$1.45 million (present value terms). The investment produced estimated total expected benefits of \$10.56 million (present value terms). This gave a net present value of \$9.12 million, an estimated benefit-cost ratio of 7.30 to 1, an internal rate of return of 103% and a modified internal rate of return of 18.4%.

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

ABS	Australian Bureau of Statistics
AP	Apple and Pear
APAL	Apple and Pears Australia Limited
AV	Avocado
CRRDC	Council of Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Australian Government)
MIRR	Modified Internal Rate of Return
MU	Mushroom
OCS	Office of Chief Scientist Queensland
PVB	Present Value of Benefits
PVC	Present Value of Costs
R&D	Research and Development
RD&E	Research, Development and Extension
SIP	Strategic Investment Plan
TG	Table Grape