Industry-specific impact assessment program: apple and pear

Impact assessment report for project *Australian apple and pear industry development initiative* (AP12037)

Impact analyst:

Joseph Abell

Delivery partner:

AgEconPlus and Agtrans Research

Project code:

MT18009

Date:

18 October 2019

Funding statement:

This project has been funded by Hort Innovation, using research and development levies and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Publishing details:

Published and distributed by: Hort Innovation

Level 7
141 Walker Street
North Sydney NSW 2060

Telephone: (02) 8295 2300

www.horticulture.com.au

Contents

Tables

Figures

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 *Project AP12037 Australian apple and pear industry development initiative.* The project was funded by Hort Innovation over the period June 2013 to July 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 project has delivered an improved alignment of Apple and Pear R&D investment by Hort Innovation with the Strategic Investment Plan for the industry, particularly with alignment with needs of business decision making and international competitiveness. This has resulted in a more efficient deployment of R&D resources from the identification of knowledge gaps and new opportunities for investment in line with the industry strategic plan.

As a result of the project, improved market development and market access will potentially expand demand and increase profitability or avoid decreased profitability in future. Of much importance has been improved relevance and transfer of relevant business management knowledge to apple and pear growers that has made a potential contribution to their increased productivity and profitability.

Investment Criteria

Total funding from all sources for the project was $0.59 million (present value terms). All project funding was provided by Hort Innovation. The investment produced estimated total expected benefits of $3.62 million (present value terms). This gave a net present value of $3.03 million, an estimated benefit-cost ratio of 6.17 to 1, an internal rate of return of 186% and a MIRR of 20.7%.

Conclusions

The investment in AP12037 is likely to contribute to improved resource allocation of R&D investment by Hort Innovation. More importantly is the likely delivery of productivity, profitability and international competitiveness of the Australian apple and pear industry through a range of mechanisms and pathways.

Keywords

Impact assessment, cost-benefit analysis, industry development, apple and pear industry, market access, capacity building, market development, apple and pear exports

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 *AP12037: Australian apple and pear industry development initiative* 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 industries representative body and non-profit membership organisation.

Rationale

The Australian apple and pear industries have faced significant challenges, due to a range of both domestic and international factors. There had been an increase in exports to Australian target export markets from other northern and southern hemisphere apple and pear suppliers. The domestic market also have had competitive challenges from other fruit and snack foods. These factors have had impacts on domestic consumption and farm gate price pressures.

A lower relative Australian dollar and removal of non-tariff barriers presented an opportunity for Australian apple and pear growers to offset a lower local price for apple and pears. To take advantage of these apple and pear opportunities, there was investment in industry development in understanding new ideas and concepts, improved understanding of the regulatory environment, improving the industry investment strategy, and improving leadership capacity in the industry.

Project Details

Summary

Project Code: AP12037

Title: *Australian apple and pear industry development initiative*

Research Organisation: Apple and Pear Australia Limited

Principal Investigator: Anne Farrow, Industry Services Manager

Period of Funding: June 2013 to July 2016

Objectives

The industry challenges and opportunities as described above were being addressed by the strategies driven by the objective embedded in the updated Apple and Pear industry Strategic Investment Plan (2017-2021). These broader industry objectives provided the framework for Project AP12037. These broader industry objectives were:

1. Improve sales volume of apples by 5% and maintain pear volume by stimulating domestic demand by 5% through product quality and innovation, as well as by expanding apple and pear exports to 10% of marketable product by 2015.
2. Produce high quality apples and pears at internationally competitive prices.
3. Provide a supportive operating environment.

To assist with industry meeting the above broader objectives, AP12037 was funded with the following specific objectives:

1. To Identify gaps and pre-scoping of new industry development initiatives to improve business decision making and the productivity and international competitiveness of the industry.
2. To provide general consultation with the industry supply chain.
3. To assist the research community and service providers to understand and meet the industry's strategic plan and investment plan, research needs and research priorities.
4. To liaise with government and non-government organisations on policy and regulatory matters of importance to the industries.
5. To build capacity and strategic industry coordination including people and leadership development and intra-industry and inter-industry relationship building.

Logical Framework

Table 1 provides a description of AP12037 in a logical framework structure.

Table 1: Logical Framework for Project AP12037

Activities and Outputs	Activities: • A high-level Steering Committee for the project was established consisting of the APAL Board and the Hort Innovation Portfolio Manager-Industry Development. • A work program was formalised annually and approved by the Steering Committee. • APAL's Industry Service Manager was the principal staff member assigned to the project and was supported by the Managing Director of APAL, knowledgeable external contractors, and from time to time, APAL's Technical Manager, Market Development Manager and Communications Manager. • The project involved gathering and sharing knowledge through a variety of methods including: ○ literature searches and reviews ○ interactions with supply chain participants ○ consultations with the development officers and management from other industries;

	○ discussions with participants in other horticultural agricultural industries; ○ workshops and interactions with government commercial operators; Outputs: • Identification and evaluation of various industry development ideas for the apple and pear industry. • Assistance to RD&E service providers to better understand the Industry Strategic Investment Plan and associated objectives. • Guidance to RD&E service providers to develop new project funding proposals, as well as assistance to Hort Innovation for developing Terms of Reference for new commissioned projects. • Inputs to reviews of other RD&E projects. • Participation in cross-industry activities associated with fruit fly and other biosecurity issues. • Involvement in and assistance with Apple and Pear key Stakeholder Roundtable meetings. • A review of skill needs for capacity building across business management and leadership areas for growers, and recommendations for pursuing adult learning opportunities. • Strengthening of the wider extension network across temperate fruit industries, as well as across wider horticulture and agricultural interests. • Facilitation of grower adoption of relevant new knowledge aligned with R&D outputs and business management, improving the accuracy of industry data, and identifying opportunities for production cost savings. • The project played a supporting role to AP11014 (Apple and Pear Technical Manager) and AP11017 (Future Orchards™) • Through liaising with growers and supply chain participants, the project was able to prioritise grower and supply chain needs. This was achieved, for example, by farm visits, workshop meetings, and industry meetings. • Government liaison involved consultation with government and government agencies including the Department of Agriculture and Water Resources, Department of Industry, Innovation, Climate Change, and Science, Department of Infrastructure and Transport, Department of Regional Australia, Department of Immigration, Plant Health Australia, Australian Pesticides and Veterinary Medicines Authority, Australian Competition and Consumer Commission, and various State Departments of Agriculture. • The government consultations involved a number of communication channels, liaising with growers and growers groups, as well as with respective government representatives. • A number of meetings were held with different stakeholders (including government, retailers, suppliers, and industry groups) to discuss ongoing issues with the apple and pear industry. The results of these meetings were communicated to growers through the industry newsletter *Industry Juice*. • The industry development initiative was complementary to the delivery of other Hort Innovation projects, such as: ○ AP14701 (Nuffield Scholarship) ○ AP14701 (Asian Market Access) ○ AP11023 (Asian Market Development) ○ AP13036 (Key Stakeholder Roundtable) ○ AP12013 (Apple and Pear Communications) • Market development and access was a key theme included in the Project, with a number of activities taking place to support further market access into Asia. These included, for example, submissions to the South Korea-Australia Free Trade Agreement, meetings with Asian importers and retailers, and designing a collaborative strategy with Chinese importers. • During a Trade Fair in September/October 2014, Anne Farrow met with Pagoda (a large fresh retailer in China), with contacts for Tasmanian product supplied.

Outcomes	• More relevant R&D investment with regard to greater alignment with the industry strategic plan. • Facilitation of adoption of R&D and Innovation (Project assisted AP11014 and AP11017). • The research has assisted growers to uptake research outputs to produce high quality fruit for export. • There has been improved biosecurity preparedness, with an increase in capacity to fight exotic diseases such as the European Canker and the Torres Strait Fruit Fly, with funding being shared between Commonwealth and State governments, and the apple and pear industry. • Improved understanding of trade access implementations and required plans and strategies for biosecurity in terms of exporting to international markets. • Through the industry and capacity component of the project, there has been an improvement in understanding apple and pear skill gaps within different growing regions. • There has been improved leadership capacity. For example, there is now a Nuffield Scholar that is engaged with the industry. • There are better training programs available to growers in terms of financial literacy. and hence an enhanced capacity • These outputs have allowed industry to seize opportunities and face challenges by building capacity in leadership • Improved business and operating environment • Further knowledge of trade agreements and regulation have assisted growers in their regulatory obligations both for exports and operations. • Through improved industry data, there is a greater chance of precision in managing orchard block and variety replacements. • Pre-screening is now taking place to encourage growers to improve quality control for exports. • Through relationships built during the project, apple and pear growers have better access to export markets in China and other Asian markets. • Despite the project reported as being successful, there was no industry confidence evaluation survey completed at the end of the project to evaluate its effectiveness the project.
Impacts	• Improved efficiency of apple and pear R&D investment. • Increased relevance of apple and pear knowledge available to growers and relevant to improved productivity and profitability. • Improved market development and market access will potentially expand demand and increase profitability or avoid decreased profitability in future.

Project Investment

Nominal Investment

Table 2 shows the annual investment (cash and in-kind) in project AP12037 by Hort Innovation. There were no 'other' investors in this project.

Table 2: Annual Investment in the Project AP12037 (nominal $)

Year ended 30 June	Hort Innovation ($)	Total ($)
2013	59,345	59,345
2014	59,345	59,345
2015	118,691	118,691
2016	118,691	118,691
2017	39,563	39,563
Totals	395,365	395,365

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 2.

Real Investment and Extension Costs

For the purposes of the investment analysis, investment costs of all parties were expressed in 2017/18 dollar terms using the GDP deflator index (ABS, 2018). There were no additional costs associated with project extension.

Impacts

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

Table 3: Triple Bottom Line Categories of Principal Impacts from Project AP12037

Economic	• Improved alignment of Apple and Pear R&D investment by Hort Innovation with the Strategic Investment Plan for the industry, particularly with alignment with needs of business decision making and international competitiveness. • More efficient deployment of R&D resources from the identification of knowledge gaps and new opportunities for investment in line with the industry strategic plan. • Improved market development and market access will potentially expand demand and increase profitability or avoid decreased profitability in future. • Improved relevance and transfer of relevant business management knowledge to apple and pear growers that has made a contribution to their increased productivity and profitability.
Environmental	• No environmental impacts were specifically delivered; however, some indirect impacts may have occurred in so far as some redirection of future project funding may have captured increased environmental benefits from management practices (e.g. pest control).
Social	• Any improved productivity and profitability of growers of apples and pears may have 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 public benefits also may have been produced in the form of spillovers to regional communities from enhanced incomes (or avoidance of reduced incomes of growers and others along the supply chain.

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 Priority 4, 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 2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D	1. Food 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 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 2017-2021[1] (Hort Innovation, 2017). Project AP12037 addressed Outcome 1 (through Strategy 1.5) and Outcome 3 (Strategy 3.1).

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

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: A contribution to Increased efficiency of R&D investment
Impact 2: A contribution to 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:

- Any 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 AP12037 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 included in $4.14	1%	Agtrans Research
Annual investment to deliver the same outcomes without the Industry Development Project	$4.18 million per annum	4.25 -1% =4.18
Potential saving	$40,000 per annum	$4.18-$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 (or reduced loss of profits) 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+ 80.2
Estimate of 2017/18 profits of apple and pear growers (includes impact of project)	15% of gross farm gate value	Based on average net orchard profits (before tax) of $0.20 per gross kg of production. 0.20/1.05 = ~19.0% reduced for tax (AgFirst, 2017)
Return to growers with Industry Development Project in 2017/18	$74.78 million	$498.5 million x 15%
Increased productivity and profitability due	1%	Agtrans Research; as there was

to Industry Development		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 Industry Development	$86.46 million	$43.7 million-($43.7 m*1%) = $43.26 million
Potential increase due to Industry Development Project	$870,000 in 2017/18	$87.33-86.46 million
Year in which improvement commences	2014 (20% of increase rising to 100% in 2017/2018	Agtrans Research
Year in which maximum improvement reached	2018, reducing to zero by 2023	
Probability of impact	75%	
Counterfactual		
If Project AP12037 had not been funded it is assumed that the impacts described above would not have eventuated; this assumption is based on the unique nature of the investment in the Industry Development Initiative.		

Results

All costs and benefits were discounted to 2018/19 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 potentially 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). However, due to the assumptions made regarding the longevity of benefits (Table 5), benefits reduced to zero by 2023, well before the thirty-year period.

Investment Criteria

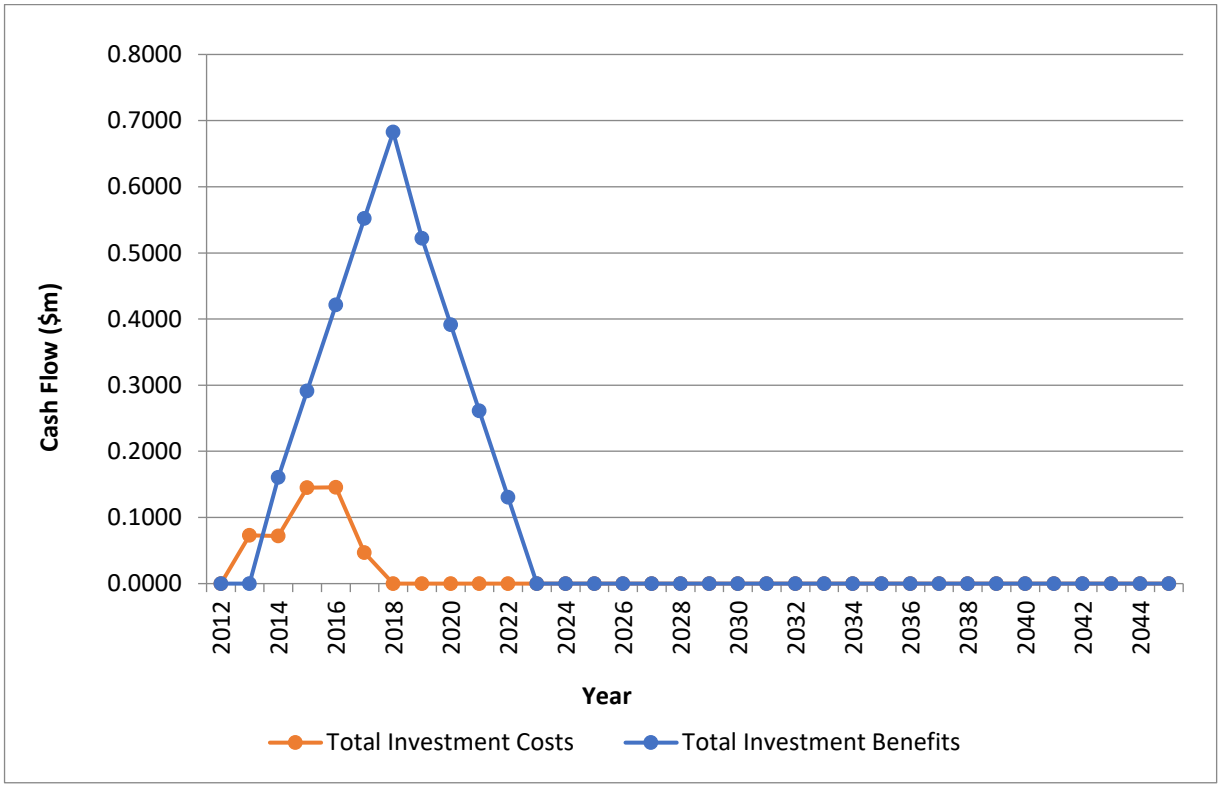
Table 6 shows the investment criteria estimated for different periods of benefits for the total investment. The investment criteria for Hort Innovation investment are the same as for total investment.

Table 6: Investment Criteria for Total Investment in Project AP12037

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($m)	1.66	3.62	3.62	3.62	3.62	3.62	3.62
Present Value of Costs ($m)	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Net Present Value ($m)	1.07	3.03	3.03	3.03	3.03	3.03	3.03
Benefit-Cost Ratio	2.83	6.17	6.17	6.17	6.17	6.17	6.17
Internal Rate of Return (%)	176.3	186.2	186.2	186.2	186.2	186.2	186.2
Modified Internal Rate of Return (%)	negative	267.5	68.0	40.2	31.0	24.6	20.7

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the AP12037 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 8 shows that, if only the grower productivity impact was delivered, the value of that impact alone would have covered the Present Value of Investment Costs (PVC) of $0.59m.

Table 7: Contribution of Benefits by Source

Impact	PVB ($M)	% of Total PBV
Impact 1	0.1741	4.8%
Impact 2	3.4420	95.2%
Total	3.6160	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 their reasonably close time-proximity to 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 ($m)	3.41	3.62	3.86
Present Value of Costs ($m)	0.48	0.59	0.71
Net Present Value ($m)	2.93	3.03	3.15
Benefit-cost ratio	7.08	6.17	5.45

A sensitivity analysis was undertaken for the assumed increased profits to growers driven by the investment in the Industry Development project over the five years, with all other assumptions remaining unchanged. Results are provided in Table 9.

Table 9: Sensitivity to Assumed Increase in Grower Profitability due to Project AP12037
(Total investment, 30 years)

Investment Criteria	Increase in Profitability		
	0.5%	1% (base)	2.0%
Present Value of Benefits ($m)	2.01	3.62	6.94
Present Value of Costs ($m)	0.59	0.59	0.59
Net Present Value ($m)	1.43	3.03	6.35
Benefit-cost ratio	3.44	6.17	11.85

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 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-Low

Coverage of benefits valued was assessed as Medium-High due to the prominence of the two impacts valued. Confidence in assumptions was rated as Medium-Low, as the key driving assumption of the benefits valued were not well-supported by specific evidence of change.

Conclusion

The investment in AP12037 is likely to contribute to improved resource allocation of R&D investment by Hort Innovation. More importantly is the likely delivery of productivity, profitability and international competitiveness of the Australian apple and pear industry through a range of mechanisms and pathways.

Total funding for the project was $0.59 million (present value terms). The investment produced estimated total expected benefits of $3.62 million (present value terms). This gave a net present value of $3.03 million, an estimated benefit-cost ratio of 6.17 to 1, an internal rate of return of 186 % and a modified internal rate of return of 20.7%.

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.

Reference List

Australian Bureau of Statistics (ABS) (2018) 5206.0 – Australian National Accounts: National Income, Expenditure and Product, Jun 2018. Canberra: Australian Bureau of Statistics. Retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Jun%202018?OpenDocument

Australian Bureau of Statistics (2019b) 7530.0 – Value of Agricultural Commodities Produced, Australia, 2017-18. Retrieved from: 7503.0 - Value of Agricultural Commodities Produced, Australia, 2017-18 Retrieved from: https://www.abs.gov.au/ausstats/subscriber.nsf/log?openagent&75030do001_201718.xls&7503.0&Data%20Cubes&14619FDD05B78A0DCA2583EB0021F2A7&0&2017-18&30.04.2019&Latest

Council of Rural Research and Development Corporations. (2018). Cross-RDC Impact Assessment Program: Guidelines. Canberra: Council of Rural Research and Development Corporations. Retrieved from http://www.ruralrdc.com.au/wp-content/uploads/2018/08/201804_RDC-IA-Guidelines-V.2.pdf

Department of Agriculture and Water Resources. (2015). Agricultural Competitiveness White Paper. Canberra: Commonwealth of Australia. Retrieved from http://agwhitepaper.agriculture.gov.au/SiteCollectionDocuments/ag-competitiveness-white-paper.pdf

Horticulture Innovation Australia Limited (2016) Apple and Pear Strategic Investment Plan 2017-2021, Accessed June 2019 at https://www.horticulture.com.au/globalassets/hort-innovation/levy-fund-financial-and-management-documents/sip-pdfs-new/hortinnovation-sip-apple-pear-2017-2021.pdf

Office of the Chief Scientist. (2015). Strategic Science and Research Priorities. Canberra: Commonwealth of Australia. Retrieved from http://www.chiefscientist.gov.au/wp-content/uploads/STRATEGIC-SCIENCE-AND-RESEARCH-PRIORITIES_181214web.pdf

Acknowledgements

AgEconPlus and Agtrans Research would like to thank all the project and program personnel associated with Horticulture Innovation Australia Limited that were involved in the evaluation process. Their cooperation and feedback throughout the evaluation process contributed significantly to this report.

Specific acknowledgments:
Adam Briggs, Head, Data and Insights, Hort Innovation

Abbreviations

AP	Apple and Pear
APAL	Apple and Pear Australia Limited
AV	Avocado
CRRDC	Council of Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Australian Government)
FGV	Farm Gate Value
GDP	Gross Domestic Product
MIRR	Modified Internal Rate of Return
MU	Mushroom
OCS	Office of Chief Scientist
PVB	Present Value of Benefits
PVC	Present Value of Costs
R&D	Research and Development
RDC	Research and Development Corporation
RD&E	Research, Development and Extension
SIP	Strategic Investment Plan
TG	Table Grape