Horticulture Impact Assessment Program:

Appendix 3: Supply chain quality improvement - cool chain best practice guidelines (AV15010 Impact Assessment)

Impact analyst:

Peter Chudleigh

Delivery partner:

AgEconPlus and Agtrans Research

Project code:

MT18011

Date:

19 September 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 *AV15010: Supply Chain Quality Improvement - Cool Chain best practice guidelines.* The project was funded by Hort Innovation over the period July 2016 to June 2018.

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 avocado supply chain project has resulted in the adoption of improved management practices that will increase the quality of avocados at point of retail sale. This outcome should result in an improved consumer image of avocados as a fruit of reliable quality and could result in an increase in price, or more likely, the protection of current prices, given the increased future supply of avocados from trees already in the ground.

Investment Criteria

Total funding from all sources for the project was $0.62 million (present value terms). The investment produced estimated total expected benefits of $2.23 million (present value terms). This gave a net present value of $1.61 million, an estimated benefit-cost ratio of 3.59 to 1, an internal rate of return of 17.7% and a MIRR of 9.7%.

Conclusions

The Hort Innovation investment in Project AV15010 is likely to have been successful in reducing damage from different causes along the supply chain and lifting avocado quality in the eyes of the consumer. This is an important achievement in securing current demand and prices and/or increasing demand in the future, given the expected increase in avocado supply in the forthcoming years.

Several economic and social impacts identified were not valued as the impacts 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.

The project investment was made in the context of a larger supply chain quality improvement program funded by Hort Innovation. As well as AV15010, the program included Projects AV15009, AV15011 and a more recent Hort Innovation Project AV18000 'Implementing best practice of avocado fruit management and handling practices from farm to ripening'. These past and current investments would have had some quality impact along the supply chain, irrespective of AV15010 funding, and have interacted with and/or built on AV15010.

Keywords

Impact assessment, cost-benefit analysis, avocado industry, supply chain, avocado quality

Introduction

Horticulture Innovation Australia Limited (Hort Innovation) required a series of impact assessments to be carried out annually on a number of investments in the Hort Innovation research, development and extension (RD&E) portfolio. The assessments were required to meet the following Hort Innovation evaluation reporting requirements:

- Reporting against the Hort Innovation's current Strategic Plan and the Evaluation Framework associated with Hort Innovation's Statutory Funding Agreement with the Commonwealth Government.
- Annual Reporting to Hort Innovation stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).

Under impact assessment program MT18011, the first series of impact assessments included 15 randomly selected Hort Innovation RD&E investments (projects) worth a total of approximately $9.31 million (nominal Hort Innovation investment). The investments were selected from an overall population of 85 Hort Innovation investments worth an estimated $50.38 million (nominal Hort Innovation investment) where a final deliverable had been submitted in the 2017/18 financial year.

The 15 investments were selected through a stratified, random sampling process such that investments chosen represented at least 10% of the total Hort Innovation RD&E investment in the overall population (in nominal terms) and was representative of the Hort Innovation investment across six, pre-defined project size classes.

Under a separate impact assessment program (MT18009), a second series of impact assessments addressed a requirement for 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.

Five projects included in the MT18009 industry specific samples were also randomly selected and evaluated as part of a separate, whole of Hort Innovation impact assessment program (MT18011). Such overlapping projects were evaluated such that the impact assessment reporting would meet Hort Innovation's requirements under both MT18011 and MT18009.

Project *AV15010: Supply Chain Quality Improvement - Cool Chain best practice guidelines* was randomly selected as one of the 15 investments under MT18011 , and also as one of the investments under MT18009, 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

The Australian avocado industry is one of Australia's 'growth' horticultural industries as illustrated in Table 1 below.

Table 1: Avocado Industry Performance 2014-2018

Year ended June	Production (tonnes)	Gross Value of Production ($m)	Farmgate value ($m)	Export value ($m)
2014	48,715	313	297	5.6
2015	57,595	356	331	6.4
2016	66,716	438	412	9.2
2017	65,992	398	374	12.5
2018	77,032	557	543	11.6
Average	63,210	412	391	9.1

Source: Facts at a Glance for the Australian avocado industry-2017/18 (Avocados Australia, 2018).

While avocados are grown in all Australian States and the Northern Territory, Queensland dominates production followed by Western Australia; together these two states produced 87% of avocados in 2017/18. Due to the broad range of climatic conditions and locations where avocados are grown, they are produced nearly all year round. Two varieties of avocados dominate the industry: Hass (78%) and Shepard (19%) (Facts at a Glance for the Australian avocado industry-2017/18).

Australian consumption of avocados has increased in line with the production increase. Based on new plantings, production of Australian avocados is expected to increase significantly in the next few years. Avocado exports are minimal at 2.3% of production in 2017/18, but growth in exports is expected in the future if the third desired outcome in the SIP is achieved (10% of production exported - see below).

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

The previous avocado Industry Strategic Plan expired in 2015 and placed emphasis on development of the domestic market, increased production for year-round supply, and the maintenance of demand and price via marketing programs and supply of consistent quality avocados.

The current SIP has been driven by levy payers and addresses the Australian avocado industry's needs from 2017 to 2021. Strategies and priorities in the Plan have been driven by a set of four desired outcomes (Avocados Australia, 2017).

1. By 2021, increase domestic demand for Australian avocados has increased by at least 20%.
2. By 2021, over 90 per cent of avocados received by consumers will meet or exceed their expectations of quality.
3. By 2021, over 10 per cent of production will be exported to markets where customers have a willingness and capacity to pay a premium for Australian avocados.
4. By 2021, productivity (marketable yield per hectare) has improved by 15 per cent on average, without increased production costs per kilogram

Rationale

Before this project, retail surveys had reported consistently that fruit on sale at retail were characterised by significant internal quality impacts such as bruising or rotting. This project was funded therefore to address post-harvest management of fruit from the orchard to the retail to reduce these impacts by increasing the adoption of best management practices in the orchard and along the supply chain.

Because project AV15010 addressed quality of avocados presented at retail, it was relevant to all four strategies contained in the 2017-2021 SIP as listed earlier.

Project Details

Summary

Project Code: AV15010

Title: Supply Chain Quality Improvement - Cool Chain best practice guidelines

Research Organisation: Applied Horticultural Research

Project Leader: Gordon Rogers

Period of Funding: July 2016 to June 2018

Objectives

Specific objectives of project AV15010 were:

1. To increase the adoption of best practice in cool chain management and postharvest handling across all sectors of Australian avocado supply chains from orchard to retail
2. To reduce the incidence of body rots and other quality defects in avocado fruit
3. To increase the awareness across the supply chain of factors that predispose fruit to quality defects

Logical Framework

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

Table 2: Logical Framework for Project AV15010

Activities	Major project activities included: • A review of postharvest research on avocado, both in Australia and world-wide. • A review of current information on post-harvest related management issues from both Australian and overseas sources made available to the Australian avocado industry. • The identification of factors that generate internal rot, including orchard management as well as management along the supply chain to retail. • A review of current and likely future developments in managing avocado post-harvest diseases, including the two main diseases (anthracnose and stem end rots). • An audit of current management practices along the supply chain to identify constraints to best practice management. • The development and implementation of a program of adoption of best practice for each supply chain sector. • The adoption strategy was to demonstrate the financial benefits from a reduction in damaged fruit at retail in order to motivate change; the adoption program involved

	working closely with industry supply chain partners and had strong links to another project AV15004 (quality improvement extension program). • The measurement of the effectiveness of the project was undertaken via a Monitoring, Evaluation, Reporting and Improvement (MERI) plan.
Outputs	The important outputs of the project included: • The development and use of the MERI Plan. • Reviews of international and Australian research and of Australian existing resources to identify areas for improvement. • From the above two reviews, a set of new best practice management (BMP) guidelines was produced. • These guidelines in management and handling along the supply chain from orchard to retail recognised the preferred format of stakeholders for such information. • Industry consultations guided activities that focused on participatory research via key packhouses in different regions, resulting in studies in 12 packhouses across five different growing regions. • Findings from these studies referred to issues and suggestions for improvement with regard to harvesting, packing lines, cooling management, transport temperatures, and ripening temperatures. • Most packhouses did not meet all BMP guidelines with five of the 12 packhouses having issues expected to impact fruit quality. • The outputs outlined above were used to develop four best management practice resources for the avocado industry: o The Australian Avocado Supply Chain Best Practice Guide o Problem Solver o Checklists o Ripening Poster • The best management practice materials were distributed and extended via a series of seven workshops supported by Avocados Australia. • The new set of resources are available also via Avocados Australia Best Practice Resource (BPR) and have been extended via emails and newsletters • The packhouse audit and the BMP guides are being used by industry to identify potential improvement opportunities in their operations. • Several packhouses have already implemented change in their procedures and others have shown interest in the guidelines • As positive feedback has been received from industry concerning the revised BPR, and implementation by packhouses in 2018, it is likely that adoption of improved practices will continue to increase.
Outcomes	The outcomes driven by the project included: • An increased awareness by industry participants of the quality damage being incurred along the avocado supply chain, particularly concerning the magnitude of the quality damage being incurred and its impact, as well as the management changes in different processes and stages that can lead to reduced quality damage. • As fruit quality is important for the industry to manage the increasing avocado supply in the future due to the number of young trees in the ground, the improvement of quality by management changes is recognised by growers as important for both domestic and export markets. • Increased adoption is anticipated of best practice in management of avocados across all sectors of the Australian avocado supply chains from orchard to retail. • The reduction in incidence of quality defects fruit is expected to result in higher quality avocado fruit in retail presentation to consumers.
Impacts	• The most important impact is that the improvement in quality perceived by purchasers of avocados is likely to increase demand for avocados in future. • Most management changes being implemented are likely to have only a minor change on production costs along the supply chain. • The improved quality will either increase demand and associated prices, and/or will allow the anticipated increased supply of avocados to be sold without any reduction in price.

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project AV15010 by Hort Innovation.

Table 3: Annual Investment in Project AV15010 (nominal $)

Year ended 30 June	HORT INNOVATION ($)	AVOCADOS AUSTRALIA[(a)] ($)	TOTAL ($)
2017	386,897	0	386,897
2018	89,860	7,000	96,860
Total	**476,757**	**7,000**	**483,757**

(a) Workshop expenses of about $14,000 were shared equally between the project and Avocados Australia; the AFR share was included in the Hort Innovation budget.

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 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, 2018). No additional costs of extension were included as the project itself was extension oriented and involved and maintained communication channels with avocado supply chains.

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 AV15010

Economic	• The reduction in damage along the supply chain will result in an increased gross value of all avocados sold at retail, shared by operators along the supply chain. • The improvement in avocado quality may result in any potentially reduced decline in price given the expected increased avocado production levels in future due to trees already in the ground. • Some minor increases in variable and capital costs due to changes in management will be experienced by supply chain operators (including growers) who improve practices and improve quality
Environmental	• Nil
Social	• The improved profitability of the avocado industry supply chains will increase or protect current positive benefit spill-overs to regional areas where avocados are produced and distributed.

Public versus Private Impacts

The impacts identified from the investment are predominantly private impacts accruing to operators along the supply chain. However, some public benefits also have been produced in the form of spill-overs to regional communities from enhanced grower incomes, and a more efficient supply chain.

Distribution of Private Impacts

The private impacts will have been distributed between avocado producers and the businesses along their product supply chains. 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 avocado market.

Impacts on Other Australian Industries

It is likely that most impacts will be confined to the avocado industry.

Impacts Overseas

It is unlikely that there will be any significant spill-over impacts to overseas interests except the removal of a constraint to overseas demand for Australian exports of avocados.

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 primarily to Rural RD&E Priority 4, and to 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 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 Avocado Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the avocado industry are outlined the Avocado Strategic Investment Plan 2017-2021[1] (Hort Innovation, 2017). Project AV15010 primarily addressed Outcome 2 (Strategies 1, 2 and 4) with some contribution to Outcome 3 (via Strategy 1) and Outcome 4 (via Strategy 4).

[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.

The impact that was valued was the quality improvement represented by the decrease in marketable fruit due to damage along the supply chain.

Impacts Not Valued

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

- Increased regional community spill-overs.
- Quality improvements leading potentially to the prevention of price reductions due to excess supply over demand in the future.

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

Summary of Assumptions

A summary of the key assumptions made for valuation of the reduced damage due to project AV15010 is provided in Table 6.

Table 6: Summary of Assumptions for Impact Valuation

Variable	Assumption	Source/Comment
Gross value of Australian avocado production before project AV15010	$412.4 m per annum	Average 2014-2018 (Avocados Australia)
Assumed drop in gross value due to current damage and rotting	2.5% approximately 2.4% of farm gate price)	Agtrans Research
Gross value of Australian avocados if all damage and rotting removed	$422.71 m per annum	412.4*(1+2.5%)
Increase in gross value if all damage and rot removed	$10.31 m per annum	$422.71-$412.4
Annual cost of achieving reduced damage/improved quality	10% of gross value gain	Agtrans Research
Potential increase in net value if all damage and rot removed	$8.248 m	$10.31m x (1-20%)
Proportion of damage assumed eliminated by Project AV15010	5% industry wide along the supply chain	Agtrans Research, based on information in the Monitoring and Evaluation section of the Project Final Report
Maximum gross value of damage eliminated by Project AV15010	$412,400 per annum	$8.248m x 5%
Year in which improvement commences	2019	Agtrans Research
Year in which maximum improvement reached	2023	Agtrans Research
Risk factors		
Probability of outcome (management improvements occurring along the supply chain)	75%	Already some evidence of such occurring
Probability of impact (assuming successful outcome)	75%	Agtrans Research
Counterfactual		
If Project AV15010 had not been funded it is assumed that, while some improvement in quality by some growers and supply chains would have been made, such improvements would have been less in		

their aggregate impact and consistency of impact over time, compared to the impact of AV15010. It should be noted that Project AV15010 was part of a larger supply chain quality improvement program that included AV15009, AV15011 and a current Hort Innovation Project AV18000 'Implementing best practice of avocado fruit management and handling practices from farm to ripening'. These past and current investments would have had some quality impact along the supply chain, irrespective of AV15010 funding .		
Proportion of benefits estimated that would have been delivered without Project AV15010	40%	Agtrans Research

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

Tables 7 and 8 show the investment criteria estimated for different periods of benefits for the total investment and the Hort Innovation investment alone.

Table 7: Investment Criteria for Total Investment in Project AV15010

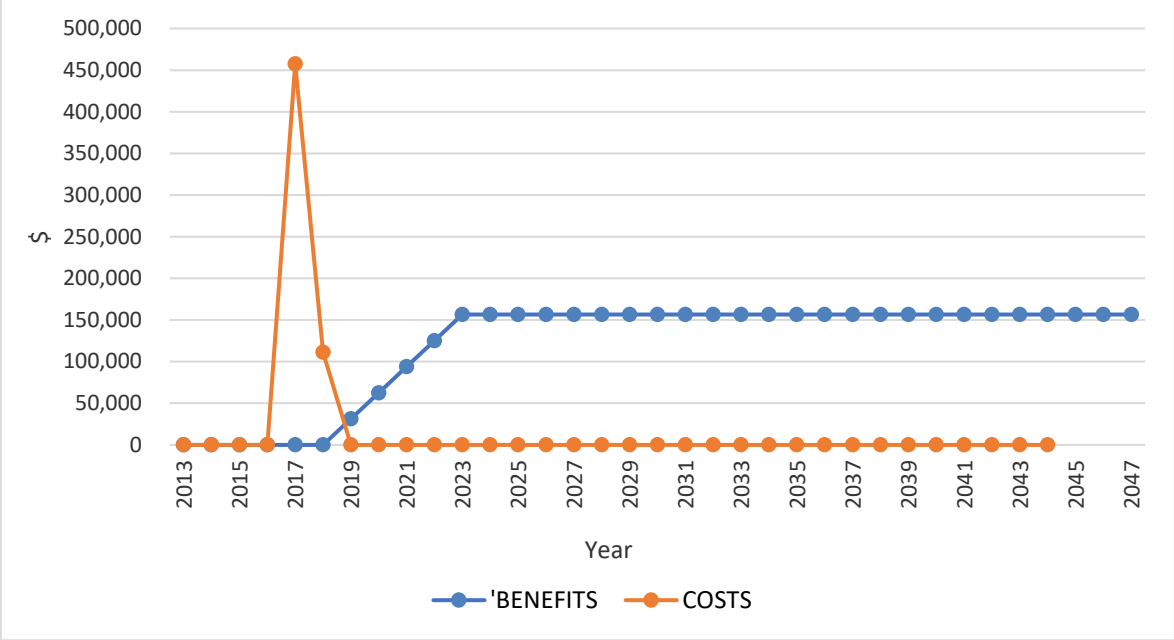
Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($m)	0.00	0.41	0.97	1.41	1.75	2.02	2.23
Present Value of Costs ($m)	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Net Present Value ($m)	-0.62	-0.21	0.35	0.79	1.13	1.40	1.61
Benefit-Cost Ratio	0.00	0.66	1.56	2.27	2.82	3.25	3.59
Internal Rate of Return (%)	negative	negative	12.3	15.9	17.1	17.5	17.7
MIRR (%)	negative	negative	10.3	11.3	10.9	10.3	9.7

Table 8: Investment Criteria for Hort Innovation Investment in Project AV15010

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($m)	0.00	0.41	0.96	1.39	1.73	1.99	2.20
Present Value of Costs ($m)	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Net Present Value ($m)	-0.61	-0.21	0.34	0.78	1.11	1.38	1.59
Benefit-Cost Ratio	0.00	0.66	1.56	2.26	2.81	3.25	3.58
Internal Rate of Return (%)	negative	negative	12.3	15.9	17.1	17.5	17.7
MIRR (%)	negative	negative	10.3	11.3	10.9	10.3	9.7

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the AV15010 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 9 present the results. The results show a moderate sensitivity to the discount rate.

Table 9: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	**Discount rate**		
	0%	**5% (base)**	**10%**
Present Value of Benefits ($m)	4.38	2.23	1.34
Present Value of Costs ($m)	0.57	0.62	0.68
Net Present Value ($m)	3.82	1.61	0.66
Benefit-cost ratio	7.70	3.59	1.98

A sensitivity analysis was then undertaken for the proportion of total damage reduction assumed that was driven by Project AV15010. Results are provided in Table 10. The breakeven proportion of total damage reduction assumed to be driven by the project, given all other assumptions remaining unchanged, was 1.4%.

Table 10: Sensitivity to Assumed Proportion of Damage Reduction due to Project AV05010
(Total investment, 30 years)

Investment Criteria	**Proportion of Avoided Damage**		
	2.5%	**5% (base)**	**7.5%**
Present Value of Benefits ($m)	1.11	2.23	3.34
Present Value of Costs ($m)	0.62	0.62	0.62
Net Present Value ($m)	0.49	1.61	2.72
Benefit-cost ratio	1.79	3.59	5.38

A final sensitivity analysis tested the sensitivity of the investment criteria to the risk factors of probability of outcome and impact. The results (Table 11) show that the investment criteria are quite sensitive to the degree of uncertainty related to these two assumptions.

Table 11: Sensitivity to Probabilities of Outcome and Impact
(Total investment, 30 years)

Investment Criteria	Probability of Outcome and Impact		
	Both 50%	Both 75% (base)	Both 100%
Present Value of Benefits ($m)	0.99	2.23	3.91
Present Value of Costs ($m)	0.62	0.62	0.61
Net Present Value ($m)	0.37	1.61	3.30
Benefit-cost ratio	1.59	3.59	6.37

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 12). 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 12: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
Medium	Medium-Low

Coverage of benefits valued was assessed as only Medium due to several potentially important impacts not being valued (the quality improvements leading potentially to increased avocado prices for producers, and /or the prevention of price reductions due to excess supply over demand in the future. Confidence in assumptions was rated as medium-low, as the key driving assumption of the maximum increase in the value of production due to reduced damage/improved quality can only be validated over time.

Conclusion

The investment in AV15010 is likely to contribute to the reduction in damage to avocados along the supply chain and lift avocado quality in the eyes of the consumer. This is particularly important in securing current demand or increasing demand, given the expected increase in avocado supply in the forthcoming years.

Total funding from all sources for the project was $0.62 million (present value terms). The investment produced estimated total expected benefits of $2.23 million (present value terms). This gave a net present value of $1.61 million, an estimated benefit-cost ratio of 3.59 to 1, an internal rate of return of 17.7% and a modified internal rate of return of 9.7%.

As several economic and social impacts identified were not valued, the investment criteria estimated by the evaluation may be underestimates of the actual performance of the investment.

The project investment was made in the context of a larger supply chain quality improvement program funded by Hort Innovation. As well as AV15010, the program included Projects AV15009, AV15011 and a current Hort Innovation Project AV18000 'Implementing best practice of avocado fruit management and handling practices from farm to ripening'. These past and more recent investments would have had some quality impact along the supply chain, irrespective of AV15010 funding, and have interacted with and/or built on AV15010.

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

Avocados Australia (2017) Avocado Strategic Investment Plan 2017-2021, Accessed June 2019 at http://www.avocado.org.au/wp-content/uploads/2017/04/Avocado-Strategic-Investment-Plan-2017-2021.pdf

Avocados Australia (2018) Facts at a Glance for the Australian Avocado Industry -2017/18, Accessed at https://www.avocado.org.au/wp-content/uploads/2018/10/2017-18_AAL-Facts-at-a-glance_FINAL.pdf

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

Hort Innovation (2017) Avocado Strategic Investment Plan - 2017-2021. Retrieved from https://www.horticulture.com.au/globalassets/hort-innovation/levy-fund-financial-and-management-documents/sip-pdfs-new/hortinnovation-sip-avocado-2017-2021.pdf

Office of the Chief Scientist (OCS). (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 acknowledgements:
Adam Briggs, Head of Data & Insights, Hort Innovation
Gordon Rogers, Applied Horticultural Research
Adam Goldwater, Applied Horticultural Research
Jennifer Ekman, Applied Horticultural Research

Abbreviations

CRRDC	Council of Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Australian Government)
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
PVB	Present Value of Benefits
RD&E	Research, Development and Extension