

Industry-specific impact assessment program: avocado

Impact assessment report for project *Health professional education and research program (AV13010)*

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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 *AV13010 Health professional education and research program*. The project was funded by Hort Innovation over the period November 2013 to June 2014.

Methodology

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 contributed to increased knowledge and understanding of the health benefits of avocados among health professionals including dietitians, fitness professionals and food regulatory agencies/public health professionals. The project also achieved improved positioning of avocado as a health food with a 4 health star status. These impacts contributed to additional demand for avocados by consumers, and additional profitable sales of avocados by growers. Positive social impacts also resulted including the social impact of increased community spillover benefits associated with a more profitable avocado industry.

Investment Criteria

Total funding from all sources for the project was \$0.38 million (present value terms). All project funding was provided by Hort Innovation. The investment produced estimated total expected benefits of \$0.83 million (present value terms). This gave a net present value of \$0.45 million, an estimated benefit-cost ratio of 2.19 to 1, an internal rate of return of 61.4% and a MIRR of 2.79%.

Conclusions

The main economic impact of investment in AV13010 was valued, however one social impact was not valued. When inability to value all impacts is combined with conservative assumptions for the principal economic impacts valued, it is reasonable to conclude that the valuation may be an underestimate of the actual performance of the investment.

Keywords

Impact assessment, cost-benefit analysis, AV13010, avocado, health, nutrition, education, market, research, communication.

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 *AV13010: Health professional education and research program* 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

Avocado industry

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, production is dominated by Queensland 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%) (Avocados Australia, 2018).

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.

The Australian Avocado Nutrition Program was developed in recognition of the importance of health and nutrition as drivers of future growth for avocado consumption. The Australian Avocado Nutrition Program was funded over a six-year period from 2010/11 to 2015/16, with AV13010 comprising the 2013-14 financial year component of this broader program of related work. The Australian Avocado Nutrition Program and project AV13010 sought to contribute to the first desired outcome of the avocado industry SIP which was to increase domestic demand for Australian avocados by at least 20% by 2021.

Rationale

Project AV13010 was nested within the broader Australian Avocado Nutrition Program. This project and program built on the platform of many years of prior market research and R&D with the aim of increasing domestic avocado consumption. Prior research such as AV07025 delivered information to understand and positively influence the dietary advice provided by health professionals to patients and clients with the aim of further increasing domestic avocado consumption.

To maintain and increase avocado demand project AV13010 was funded for one year to develop and provide appropriate information to dietitians, fitness professionals, and food regulatory agencies/public health agencies.

Project Details

Summary

Project Code: AV13010
Title: <i>Health professional education and research program</i>
Research Organisation: Lisa Yates Consultant Dietitian
Principal Investigator: Lisa Yates
Period of Funding: November 2013 to June 2014

Objectives

The goal of this project was to educate and arm dietitians, fitness professionals and food regulatory agencies/public health agencies with information to enable these health professionals to recommend the inclusion of avocados in their clients' diets.

The project sought to provide clear, credible, authoritative leadership in nutrition for the Australian avocado industry.

Logical Framework

Table 2 provides a description of AV13010, a health professional education and research project, in a logical framework.

Table 2: Logical Framework for Project AV13010

Activities and Outputs	<p>Activities completed within project AV13010 are listed below.</p> <ul style="list-style-type: none">• The "Australian Avocado Nutrition" brand/logo was created and used to communicate health and nutrition recommendations.• A 'hero image' was created to communicate the nutritional value of avocado (heart shaped) and high appetite appeal.• Research was conducted to produce a Nutrition and Health Claims substantiation report that included the recommended serving size for avocado.• A monthly search of health and medical journal literature was conducted to source content for sharing via traditional and social media (blogs/twitter).• Health education activities for key health professional audiences were developed. Key audiences for these activities included dietitians, fitness professionals, and food regulatory agencies/public health agencies. Key activities included:<ul style="list-style-type: none">- A one year major partnership with the Dietitians Association of Australia (DAA).- Update of old fact sheets and development of new fact sheets highlighting avocado's key nutritional benefits such as healthy fats and folate.- Research and development to inform the development of the Australian Avocado Health summary report.
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	<ul style="list-style-type: none"> - Promotional work at three trade exhibitions (one aimed at dietitians and two aimed at fitness professionals) including the production of posters and other promotional materials. - Assessment of the nutrition content of the avocado and development of a health professional section of the Avocados Australia website. • Social media activities were developed: twitter account commenced and #eatkit twitter chat sponsorship. • A public relations agency was appointed to complete health blogger education activities. • Four Food Regulations and Public Health advocacy activities were completed. • Communication of program activities to the Australian avocado industry occurred via industry conference attendance (Lisa Yates presented at the World Avocado Congress in NZ on behalf of the Australian Avocado Industry), an article in an avocado industry newsletter (Talking Avocados, Feb 2014), and regular articles in Guacamole e-newsletter for Australian Avocado members. • Lisa Yates also provided assistance to other avocado agencies by responding to ad hoc social media inquiries and developing responses to avocado grower inquiries. <p>Key outputs of project AV13010 are listed below:</p> <ul style="list-style-type: none"> • “Australian Avocado Nutrition” brand/logo device: A new overarching communication device for the Australian Avocado Nutrition program was developed giving identity and credibility to all communications. The brand was used to develop business cards, digital letterhead, entry forms etc. • The 15 page internal strategic plan for avocado nutrition research and education (August 2014) was amended following the Australian Avocado Strategic Investment Panel decision to remove General Practitioners as a health professional audience. • A Nutrition and Health report was developed including an assessment and recommendations for avocado serving size. • Outputs associated with the “Horticulture Consortium” of the DAA Major Partnership with Australian almond mushroom and avocado industries were produced. Activities included: <ul style="list-style-type: none"> - Updating avocado information on the DAA website (https://daa.asn.au/smart-eating-for-you/smart-eating-fast-facts/food-and-food-products/fast-facts-all-about-avocados/). - Improved positioning for the trade stand at the DAA conference and promotion of the stand on conference electronic direct mail. - Avocado recipes were added to DAA website. - Promotion of avocado via DAA social media channels. - DAA endorsement of the Avocado Nutrition Report published in March 2015. - Information on avocado shared with DAA media spokespeople. • Health and Nutrition report and fact sheets were developed and updated: <ul style="list-style-type: none"> - The Nutrient Rich Fitness avocado fact sheet from 2011/12 was updated. - A healthy fats fact sheet and folate fact sheet was developed and updated to include new serving size. The factsheets were distributed via conferences and housed on the avocado website health professional section. - Research and development of an Avocado Health Report commenced. This report was endorsed by DAA in 2014/15 and distributed to around 200 health bloggers and media dietitians through a Public Relations agency as well as via conference trade exhibitions in 2014/15. • The Avocados Australia website content was reviewed, a smaller health professional section developed, and blogs published.
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	<ul style="list-style-type: none"> • The Daily Spread Nutrition Blogs were published. Seventeen blogs were written and the majority published on the avocado website. Six were held over and published in 2014/15 due to changes to the digital agency. Blogs were also developed into health professional centric research pieces. Blog topics included: primary messages regarding the benefits of folate and healthy fats, summaries of newly published research papers and other topics. • Trade exhibitions were organised at three conferences. New pull up banners were designed, developed and used at all three conference events: <ul style="list-style-type: none"> - DAA conference May 2014. 750 delegates, Key activities included 1,400 smashed avocado on crackers shared. A competition with questions on healthy fats and folate incorporated into the program with 125 entries (17% of delegates) and 90% correctly answering the healthy fats question and 94% correctly answering the folate question. Forty six per cent of respondents answered both questions correctly and went into the draw to win the avocado tray. Email addresses were collected and added to a database of dietitians and fitness professionals for further promotional activity. - FILEX fitness industry conference – 1,000 delegates and similar activities to above were conducted; 1,900 serves of smashed avocado on crackers distributed and 65 email addresses added to database. - Exercise and Sports Science Australia Conference that included many sports dietitians and 900 delegates; 1400 avocado cracker samples shared, and a further 129 email addresses added to the database. • Social media outputs included: <ul style="list-style-type: none"> - Avonutrition twitter account commenced March 2014 with 155 followers by June 2014. Klout Score benchmarked at 28 by June 2014. - One hour Eatkit twitter chat sponsorship involving 23 active tweeters in March 2014. Radian 6 software was used. There were 421 tweets and retweets with a possible reach of 1.2 million opportunities to see. Storify used to house twitterchat content; calculated reach based on tweets and their followers was 1.26 million. - Infographics developed and used to promote key avocado nutrition messages via social media. • Food regulation and Public Health Advocacy activities/outputs included: <ul style="list-style-type: none"> - Victorian Government funded Healthy Eating Advisory Service managed by Nutrition Australia Victoria Branch. Avocado was given an amber ranking in December 2013. Project staff liaised with the Victoria Health chief nutritionist to enable avocado to be given a green ranking. - A short submission was provided to the Australian Bureau of Statistics in February 2014 detailing Australian avocados position regarding future analysis of the Australian Health Survey 2011-2013. - A submission was provided regarding the <i>Health Star rating system</i> highlighting that avocado received a lower star score than avocado oil. The system was given approval for use on 27th June 2014 with avocado scoring 4 stars and avocado oil scoring 3.5 stars out of five. • Follow on work was conducted in 2015/16 involving updating the nutrition and health claims reports (for adults, infants and toddlers) and new fact sheets. • Since this project concluded in June 2014, a new website for health professionals was launched by Avocados Australia in May 2019 http://australianavocados.com.au/health-professionals/
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Outcomes	<ul style="list-style-type: none"> As a result of this project, health professionals including dietitians, fitness professionals and food regulators increased their knowledge and understanding of the health benefits of avocado, specifically benefits of healthy fats and folate. A market research survey of health professionals in 2015/16 concluded AV13010 achieved the following outcomes: <ul style="list-style-type: none"> improved understanding of the role of avocado in a healthy diet for all Australians among food regulators and public health advocates; and improved reputation and greater awareness of Australian Avocado Nutrition as a credible source of data and information on the nutrition and health benefits of avocado among health professionals and others. Avocado industry better informed and able to deliver efficient and effective marketing and promotion investments. Individual growers used improved knowledge of the health benefits of avocados to inform production and marketing decisions.
Impacts	<ul style="list-style-type: none"> Additional profitable sales of avocados due to improved knowledge and understanding of the health benefits of avocados among health professionals such as dietitians, fitness professionals and food regulatory agencies/public health professionals. Improved positioning of avocado as a health food in food regulatory and public health spaces as a result of avocado achieving 4 health star status. Greater knowledge of the health benefits of avocado for a range of audiences including consumers, industry members, regulators, etc. Spillover impacts in avocado growing regions associated with a more profitable industry with additional sales.

(Sources: AV13010 proposal and final report; discussions with Lisa Yates, pers. comm.)

Project Investment

Nominal Investment

Table 3 shows the annual investment (cash and in-kind) in project AV13010 by Hort Innovation. There were no 'other' investors in this project.

Table 3: Annual Investment in the Project AV13013 (nominal \$)

Year ended 30 June	Hort Innovation (\$)	Other (\$)	Total (\$)
2014	224,441	0	224,441
Totals	224,441	0	224,441

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). 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 3.

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 Gross Domestic Product deflator index. There were no additional costs associated with project extension. Results were communicated to Avocados Australia and other key audiences as part of the AV13010 communication activities as detailed in Table 2 above. Communication costs of health professionals to consumers were assumed to only replace existing costs that would have been incurred without the project.

Impacts

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

Table 4: Triple Bottom Line Categories of Principal Impacts from Project AV13010

Economic	<ul style="list-style-type: none"> • Additional profitable sales of avocados due to improved knowledge and understanding of the health benefits of avocados among health professionals such as dietitians, fitness professionals and food regulatory agencies/public health professionals and their influence on consumer purchasing decisions. • Improved positioning of avocado as a health food in food regulatory and public health spaces as a result of avocado achieving 4 health star status.
Environmental	<ul style="list-style-type: none"> • Nil.
Social	<ul style="list-style-type: none"> • Increased knowledge and realisation of the health benefits of avocado for a range of audiences including consumers, industry members, etc. • Increased community spillover incomes and employment in avocado growing areas associated with a more profitable industry with additional sales.

Public versus Private Impacts

Impacts identified in this evaluation are mostly private in nature. Private benefits will be realised by avocado growers via additional profitable sales of avocados domestically. Public benefits will include increased knowledge and realisation of the health benefits of avocados as well as increased income and employment in avocado growing areas associated with increased consumer demand and production.

Distribution of Private Impacts

The impacts on the avocado industry from investment in this project will be shared along the supply chain with input suppliers, growers, ripeners, transporters, wholesalers, retailers and consumers all sharing impacts produced by the increased demand driven by the project.

Impacts on Other Australian Industries

No potential benefits to other Australian industries were identified from AV13010.

Impacts Overseas

It is unlikely AV13010 will directly benefit overseas avocado industries as project impacts of increased demand will be predominantly relevant to the Australian domestic market.

Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E priorities are reproduced in Table 5. The project findings and related impacts will contribute to Rural RD&E priority 4 and to Science and Research Priority 1 and 8.

Table 5: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	Science and Research Priorities (est. 2015)
<ol style="list-style-type: none"> 1. Advanced technology 2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D 	<ol style="list-style-type: none"> 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 2017-2021¹ (Hort Innovation, 2017). Project AV13010 addressed Outcome 1 (Strategy 1.1).

Valuation of Impacts

Impacts Valued

The primary impact of AV13010 was additional profitable sales for avocado growers due to an education and research program in 2013/14 targeting health professionals, in particular dietitians and fitness professionals. The primary impact of additional avocado sales could also be attributed somewhat to the improved positioning of avocado as a health food in food regulatory and public health spaces as a result of avocado achieving 4 health star status within AV13010. Furthermore, the social impact of greater knowledge of the health benefits of avocado for a range of audiences including consumers, industry members, regulators etc would also be considered a factor influencing increased consumption and additional profitable sales for avocado growers.

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.

Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. Social impacts were difficult to value due to lack of evidence/data, difficulty in quantifying the causal relationship and pathway between AV13010 and the impact and the complexity of assigning monetary values to the impact. However, to some extent this impact could be considered included in the consumption based impact that has been valued.

The social impact identified but not valued was:

- Increased spillover impacts to regional communities associated with avocado supply chains via additional throughput and employment.

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

Valuation of Impact: Additional Demand and Ensuing Profitable Sales for Avocado Growers

The AV13010 investment contributed to improved understanding of health benefits of avocados among dietitians and fitness professionals and increased domestic consumer demand for avocados in Australia. As a result of this additional understanding among dietitians and health professionals, it is likely that avocado consumers (both existing and new) would have been influenced to increase consumption and increased sales of avocados would have been achieved. No additional marginal costs associated with increasing avocado supply were valued as it was assumed avocado growers would not incur any additional costs due to increasing demand and supply of avocados.

Attribution

Increased domestic demand for avocados is likely influenced by a wide range of activities. The activities completed within project AV13010 that focussed on the education of dietitians and fitness professionals, has been considered as one of the many likely factors that have increased domestic demand for avocados since 2014.

Counterfactual

It is assumed that in the absence of Hort Innovation investment in AV13010 over the period 2013-14 the quality, quantity, relevance and rigour of information regarding the health and nutritional benefits of avocados reaching dietitians and fitness professionals would have been lower. Thus, without AV13010 domestic demand for avocados from both existing consumers and potential new consumers of avocados would have been lower than anticipated.

Summary of Assumptions

A summary of the key assumptions made for valuation of the impacts is shown in Table 6.

Table 6: Summary of Assumptions

Variable	Assumption	Source/Comment
Average annual increase in farmgate gross value of avocados post-AV13010 (2014/15 to 2017/18)	\$ 70.7 m	Calculated from data published by Avocados Australia (2018) (\$543m (farmgate value in 2017/18) – \$331m (farmgate value in 2014-15)) /3 (number of years)
Attribution of project AV13010 to average annual increase in farmgate gross value of avocados post-AV13010 (2014/15 to 2017/18)	5%	Agtrans Research
Avocado grower profit as a proportion of farmgate value	15%	Agtrans Research assumption based on data reported on page 64, AV13003 Final Report (Hall, 2016)
Year of first impact	2014/15	Year following completion of AV13010
Year of final impact	2017/18	Three years following completion of AV13010. (The Australian Avocado Nutrition Program was funded over a six-year period from 2010/11 to 2015/16, with AV13010 comprising the 2013-14 financial year component of this broader program of related work)
Risk Factors		
Probability of outcome (AV13010 contributing to increased domestic demand for avocados)	90%	Agtrans Research
Counterfactual		
If Project AV13010 had not been funded it is assumed that prior activities educating and informing dietitians and health professionals of the nutritional value and health benefits of avocados would have		

delivered a proportion of the assumed expected demand increase anyway. Furthermore, activities conducted after the completion of AV13010 over the period 2014/15 to 2017/18 are expected to have contributed to the delivery of a proportion of increased demand observed.

Proportion of benefits estimated that would have been delivered without Project AV13010	50%	Agtrans Research
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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 (2013/14) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

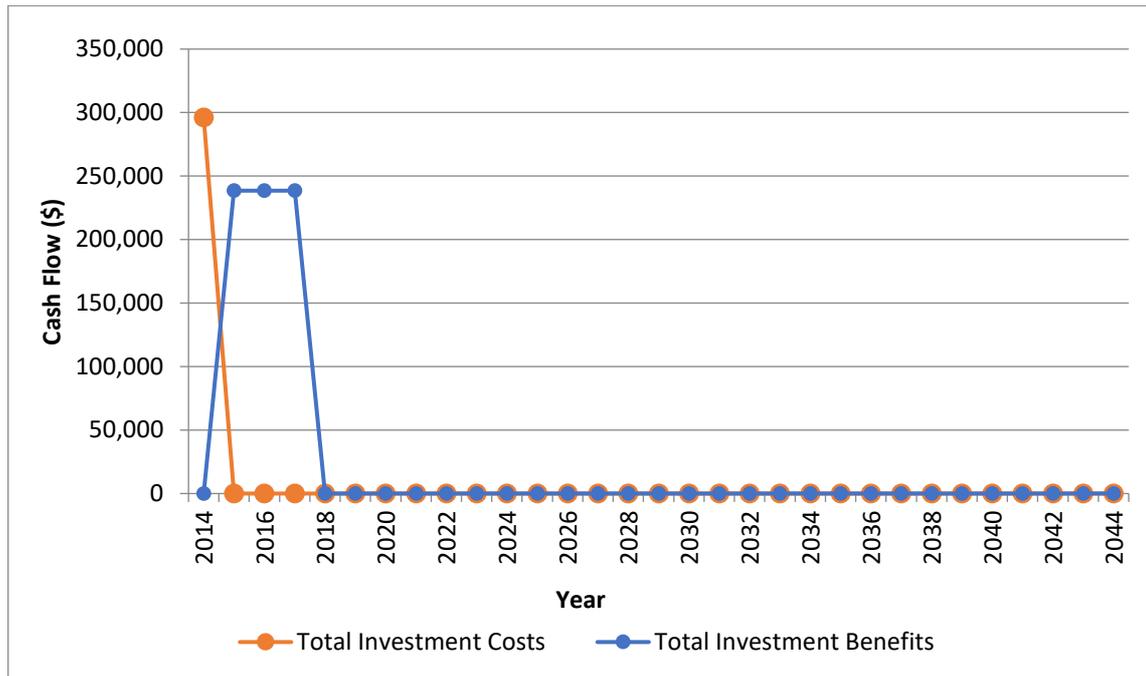
Table 7 shows the investment criteria estimated for different periods of benefit for the total investment. Hort Innovation was the only contributor to this project so there is no second set of analyses showing results for Hort Innovation.

Table 7: Investment Criteria for Total Investment in Project AV13010

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.00	0.83	0.83	0.83	0.83	0.83	0.83
Present Value of Costs (\$m)	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Net Present Value (\$m)	-0.38	0.45	0.45	0.45	0.45	0.45	0.45
Benefit-Cost Ratio	-	2.19	2.19	2.19	2.19	2.19	2.19
Internal Rate of Return (%)	negative	61.38	61.38	61.38	61.38	61.38	61.38
MIRR (%)	negative	negative	5.79	2.86	1.90	1.41	1.14

The annual undiscounted benefit and cost cash flows for the total investment for the duration of AV13010 investment plus 30 years from the last year of investment are shown in Figure 1.

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



Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 8 present the results. The results are not very sensitive to the discount rate.

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

Investment Criteria	Discount rate		
	0%	5% (base)	10%
Present Value of Benefits (\$m)	0.72	0.83	0.96
Present Value of Costs (\$m)	0.30	0.38	0.48
Net Present Value (\$m)	0.42	0.45	0.48
Benefit-cost ratio	2.42	2.19	2.00

A sensitivity analysis was then undertaken for the assumed attribution of increased avocado demand to AV13010 (Table 9). A halving of the assumed increase in avocado sales results in positive investment criteria, thus the results are moderately sensitivity to the attribution factor assumed.

Table 9: Sensitivity to Attribution of Increased Avocado Demand to AV13010
(Total investment, 30 years)

Investment Criteria	Increase in Avocado Demand Attributable to AV13010		
	2.5%	5.0% (base)	7.5%
Present Value of Benefits (\$m)	0.41	0.83	1.24
Present Value of Costs (\$m)	0.38	0.38	0.38
Net Present Value (\$m)	0.04	0.45	0.87
Benefit-cost ratio	1.10	2.19	3.29

A final sensitivity test examined the counterfactual proportion of benefits estimated that would have been delivered without AV13010 (Table 10). The break-even assumed proportion of benefits delivered without AV13010 was 77%, thus the investment criteria results were sensitive to changes in the assumed proportion of benefits delivered in the counterfactual scenario, i.e. without AV13010.

Table 10: Sensitivity to Assumed Proportion of Benefits Delivered Without AV13010
(Total investment, 30 years)

Investment Criteria	Counterfactual – Assumed Proportion of Benefits Delivered Without AV13010		
	25%	50% (base)	75%
Present Value of Benefits (\$m)	1.24	0.83	0.41
Present Value of Costs (\$m)	0.38	0.38	0.38
Net Present Value (\$m)	0.87	0.45	0.04
Benefit-cost ratio	3.29	2.19	1.10

Confidence Rating

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

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

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

Table 11: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
High	Low-Medium

Coverage of benefits was assessed as High – the major benefit was quantified.

Confidence in assumptions was rated as Low-Medium. While some base data were drawn from Avocados Australia (2018), no evidence was available on which to strengthen the assumption of the increase in demand for avocados due to the project.

Conclusion

The investment in AV13010 has contributed to additional profitable sales of avocados due to improved knowledge and understanding of the health benefits of avocados among health professionals such as dietitians, fitness professionals and food regulatory agencies/public health professionals and their influence on consumer purchasing decisions. Furthermore, AV13010 achieved improved positioning of avocado as a health food as a result of avocado achieving 4 health star status also contributing to additional profitable sales of avocados by growers. Positive social impacts are also anticipated. The primary impact of AV13010 of additional profitable sales for avocado growers was valued. The social impact of increased community spillover benefits associated with a more profitable avocado industry with additional sales was not valued. When inability to value all impacts is combined with conservative assumptions for the principal economic impacts valued, it is reasonable to conclude that the valuation may be an underestimate of the actual performance of the investment.

Glossary of Economic Terms

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

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Abbreviations

AP	Apple and Pear
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
R&D	Research and Development
RD&E	Research, Development and Extension
SIP	Strategic Investment Plan
TG	Table Grape