

Horticulture Impact Assessment Program: Appendix 2: Achieving more consistent yields of quality fruit in the Australian avocado industry (AV14000 Impact Assessment)

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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 *AV14000: Achieving more consistent yields of quality fruit in the Australian avocado industry*. The project was funded by Hort Innovation over the period July 2013 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 on-farm management project addressing irregular bearing resulted in management practice changes by some growers that will deliver higher and more consistent yield of good quality fruit, increased fruit size, reduced irregular bearing, and reduced likelihood of development and severity of alternate bearing.

Investment Criteria

Total funding from all sources for the project was \$1.58 million (present value terms). The investment produced estimated total expected benefits of \$5.78 million (present value terms). This gave a net present value of \$4.19 million, an estimated benefit-cost ratio of 3.65 to 1, an internal rate of return of 18.3% and a MIRR of return of 7.4%.

Conclusions

The investment in AV14000 will likely contribute to improved management of irregular bearing and associated issues, resulting in quality and yield increases for avocado growers and a smoothing of year to year fluctuations of product moving through the various regional supply chains. These two potential impacts were valued using conservative assumptions. However, some of the assumptions on which the valuations are based have not been well supported by evidence.

Keywords

Impact assessment, cost-benefit analysis, avocado industry, yields, irregular bearing, supply chain

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 Strategic Investment Priorities (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 AV14000: *Achieving more consistent yields of quality fruit in the Australian avocado industry* 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, 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%) (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, 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

Inconsistent supply of high quality avocados was identified as an important issue limiting profitability and development of the Australian avocado industry. One of the important issues leading to inconsistent supply was the occurrence of irregular bearing. While reducing the incidence of irregular bearing was central to improving the consistency of supply, such reductions in irregular bearing needed to be managed carefully, as combined with increasing yields, alternate bearing issues could then develop.

Inconsistent supply of avocados from year to year created year to year negative impacts along the avocado supply chain. These included additional costs and other management impacts due to disrupted planning including preparations for staffing and cash flows.

Various issues had been identified as contributing to irregular bearing including climatic conditions (particularly during flowering), various factors affecting fruit shedding such as the management of disease and nutrition, canopy management and irrigation, and issues associated with pollination. The project was developed to provide knowledge and management guidelines to assist growers take steps to improve yields and quality of avocados, as well as minimise the incidence of irregular and alternate bearing.

Project Details

Summary

Project Code: AV14000

Title: Achieving more consistent yields of quality fruit in the Australian avocado industry

Research Organisation: Department of Agriculture and Fisheries, Queensland

Project Leader: Simon Newett

Period of Funding: July 2014 to June 2018

Objectives

The overall aim of the project was to provide Australian avocado growers with the knowledge required to implement practices that will lead to more consistent high yields of good quality fruit. Specific strategies within this overall aim were:

1. Engage commercial avocado growers in a series of regional farm workshops where they will develop a better understanding of avocado phenology and how to implement practices that will result in more consistent yields of high quality fruit. There will be an emphasis on strategies to minimise the occurrence and development of irregular bearing.
2. Encourage growers to become more observant in their orchards particularly at flowering time so that they can make appropriate management decisions to improve and maintain fruit set. This may include instructing growers on how to carry out their own small scale trials to test changes in management practices.
3. Encourage growers to make use of the 'Growing' section of the industry's electronic 'Best Practice Resource' (BPR) to get the most up-to date information on growing avocados. This will be achieved by promoting the BPR whenever possible and keeping it current with engaging and 'grower friendly' information. The information will be presented in a way that helps develop a basic understanding of the topics as well as covering more advanced management practices.
4. Review the best practice guidelines for avocado nutrition, update where necessary and extend them to growers.

Logical Framework

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

Table 2: Logical Framework for Project AV14000

Activities	<p>Major project activities undertaken throughout the project included:</p> <ul style="list-style-type: none"> • The project assembled the latest Information associated with flowering, fruit-set and fruit retention that related to irregular bearing. • A series of grower workshops was held throughout eight major avocado growing regions of Australia, ranging from North Queensland to Western Australia. The workshops were designed to provide growers with knowledge to encourage management practices that would deliver more consistent yields of high-quality avocados. • Growers were encouraged to monitor trees during flowering, fruit-set and fruit shedding periods and to react with appropriate management practices to optimise fruit-set and fruit retention. • The project team and growers were involved in monitoring of flowering and fruit-set across 28 orchards, in conjunction with the use of data loggers for monitoring temperature and humidity. • The existing Best Practice Resource (BPR) was updated and knowledge of its importance was extended to growers. • A focused study and update of good avocado nutritional practices was carried out; this included a workshop for nutrition experts. The previous guidelines were based on a previously popular avocado variety (Fuerte) and were inappropriate for the newer popular Hass variety. Therefore, good avocado nutritional practices required an updated version. • The project supported 12 attendees at the 9th World Avocado Congress in 2015 in Peru and project personnel co-organised the grower study tour in Chile for Australian participants.
Outputs	<ul style="list-style-type: none"> • Information on the latest management information relevant to irregular bearing and alternate bearing was assembled. • A total of 42 grower workshops were held in eight avocado growing regions across five states; some of these workshops were organised by the project and some by Avocados Australia. • Total attendance at the workshops was 2,613, with coverage estimated to be greater than 60% of the estimated 682 avocado growers in Australia. • The data from the monitoring activity (Activity 4 above) were analysed and results presented at workshops (Activity 2 above); outputs from these analyses were made available on the BPR. • The review and updating of the BPR was achieved and the material and its availability was further communicated to growers. • Three new YouTube videos on management practices were produced, shown at the grower workshops, and made available via the BPR. • Customised 'Avo Alert' lists were produced for each of the eight main production regions for each month of the year; these were designed to alert growers to the orchard practices due. • The applicable findings from the South American activities (Activity 7 above) were extended to the Australian avocado industry, presented at workshops and made available on the BPR.
Outcomes	<ul style="list-style-type: none"> • Management practice changes by some growers that will deliver higher and more consistent yield of good quality fruit, increase fruit size, reduce irregular bearing, and reduce the likelihood of development and severity of alternate bearing. • The management practice changes were expected to be delivered by the knowledge imparted by the workshops on irregular bearing, the increased use of the BPR, and the additional nutritional management guidelines available and their promotion. • Some reduction in year to year variability of the quantity and quality of avocados flowing along the supply chain to market.

	<ul style="list-style-type: none"> While grower practice change and smoothing along the supply chain is expected, evidence of these expected changes is not available and has not been sought (Simon Newett, pers. comm., July 2019).
Impacts	<ul style="list-style-type: none"> Increases in avocado yields and quality for a number of growers. Reduced costs along the supply chain due to more consistent year to year throughputs allowing improved planning for resources required.

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project AV14000 by Hort Innovation and the Queensland Department of Agriculture and Fisheries (DAF).

Table 3: Annual Investment in Project AV14000 (nominal \$)

Year ended 30 June	HORT INNOVATION (\$)	DAF (\$)	TOTAL (\$)
2015	35,500	63,982	99,482
2016	189,942	342,336	532,278
2017	142,517	256,861	399,378
2018	91,990	165,795	257,785
Totals	459,949	828,974	1,288,923

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.

For the DAF investment the management and administration costs for the project were assumed already built into the nominal \$ amounts appearing in Table 2. The salary multiplier that had been used by DAF (Wayne Hall, pers. comm., 2017) was a 2.85 multiplier for salaries contributed by DAF.

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 involved growers and was extension oriented; the project also maintained communication channels with avocado interests (e.g. State Departments and grower organisations) in all regions.

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 AV14000

Economic	<ul style="list-style-type: none"> Increased value of avocados for a number of growers, driven by both yield and quality improvements. A decrease in year to year variability of avocado flows along the supply chain, resulting in a reduction in grower to market costs.
Environmental	<ul style="list-style-type: none"> Nil
Social	<ul style="list-style-type: none"> Some regional social impacts may have been derived from increased spill-overs to families and businesses along the supply chain from both increased average value and less variability of avocado quantity flows from year to year.

Public versus Private Impacts

The impacts identified from the investment are predominantly private impacts accruing to avocado growers in most Australian avocado producing regions. However, some public benefits have been produced in the form of spill-overs to regional communities from enhanced grower incomes, increased supply chain activity from the increased avocado production, and greater management cost efficiencies along the supply chain leading to higher regional economic activity and employment.

Distribution of Private Impacts

The private impacts will have been distributed along the supply chain. The share of impact realised by each link in the supply chain will depend on both short- and long-term supply and demand elasticities in the avocado market.

Impacts on Other Australian Industries

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

Impacts Overseas

As currently exports of avocados are minimal (only a few percent by value) it is unlikely that there will be any significant spill-over impacts to overseas interests. However, as avocado exports could increase in future due to increased Australian supply, reduced supply variability would be helpful in Australian export development.

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

Sources: DAWR (2015) and OCS (2015)

Alignment with the 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 AV14000 addressed primarily Outcome 4 (Strategy 5) as well as some contribution to Outcome 2 (via several strategies).

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.

Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. The impact not valued was Increased regional community spill-overs. This impact was not valued largely due to lack of data to support credible assumptions.

Summary of Assumptions

The two impacts that were valued included:

Impact 1: An increased value of avocados for some growers

The assumptions that have driven avocado value increases due to the improved management of avocado production by a number of growers are provided in Table 6. The assumption table shows a small proportion of growers are estimated to have improved their management resulting in a small increase in average yield and quality from year to year.

Impact 2: Reduced costs along the supply chain

The assumptions that have driven reduced costs along the supply chain are the expected reduced supply variability from year to year by some growers. The assumption table shows a proportion of costs along the supply chain may exhibit small cost reductions as a result of reduced irregular bearing. A summary of the key assumptions made for valuation of Impact 2 is provided in Table 6.

Table 6: Summary of Assumptions for Impacts Valued

Variable	Assumption	Source/Comment
Impact 1: Yield and quality increase by some growers		
Average farm gate value of avocado production in Australia	\$391 m per annum	Avocados Australia (2018)
Proportion of current avocado production with a yield/quality increase driven by Project AV14000	5%	Agtrans Research, after consultation with Simon Newett; also, there has not been any further assessment of change since the final report was prepared (Simon Newett, pers. comm., July 2019).
Yield/quality increase assumed due to management changes adopted due to project AV14000	3%	
Value of yield increase	\$586,500 per annum	$\$391\text{m} \times 5\% \times 3\%$
Additional costs	20% of value gain	Agtrans Research
Net value increase	\$469,200 p.a.	$\$586,500 \times (1-20\%)$
First year of some impact (year ended June)	2018	Agtrans Research, after consultation with Simon Newett
Year of maximum impact	2022	
Probability of outcome (adoption)	75%	
Probability of impact (value increase)	75%	
Impact 2: Cost reduction along the supply chain		
Value added along the supply chain from grower to retail	\$23 m per annum	Avocados Australia (2018)

Proportion of added value contributed by supply chain costs	90%	Agtrans Research
Supply chain costs	\$20.7 m per annum	\$23m x 90%
Proportion of added value costs influenced by reduced supply chain variability	20%	Agtrans Research, after consultation with Simon Newett; also, there has been no collection of evidence of supply chain smoothing to date (Simon Newett, pers. comm., July 2019)
Reduction in supply chain costs due to reduced variability in production	5%	
Reduction in supply chain costs	\$207,000 per annum to change	\$20.7m x 20% x 5%
First year of impact (year ended June)	2018	Agtrans Research
Year of maximum impact	2022	
Probability of outcome (adoption)	75%	
Probability of impact (value increase)	75%	

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 AV14000

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.08	1.37	2.72	3.78	4.61	5.27	5.78
Present Value of Costs (\$m)	1.58	1.58	1.58	1.58	1.58	1.58	1.58
Net Present Value (\$m)	-1.50	-0.22	1.14	2.20	3.03	3.68	4.19
Benefit-Cost Ratio	0.05	0.86	1.72	2.39	2.91	3.33	3.65
Internal Rate of Return (%)	negative	1.7	13.9	16.8	17.8	18.1	18.3
MIRR (%)	negative	2.5	10.3	10.9	10.2	8.5	7.4

Table 8: Investment Criteria for Hort Innovation Investment in Project AV14000

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.03	0.54	1.07	1.48	1.81	2.06	2.26
Present Value of Costs (\$m)	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Net Present Value (\$m)	-0.59	-0.08	0.45	0.86	1.19	1.44	1.64
Benefit-Cost Ratio	0.05	0.86	1.72	2.39	2.91	3.33	3.65
Internal Rate of Return (%)	negative	1.7	13.9	16.8	17.8	18.1	18.3
MIRR (%)	negative	1.0	11.8	12.0	11.3	10.6	9.9

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the AV14000 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

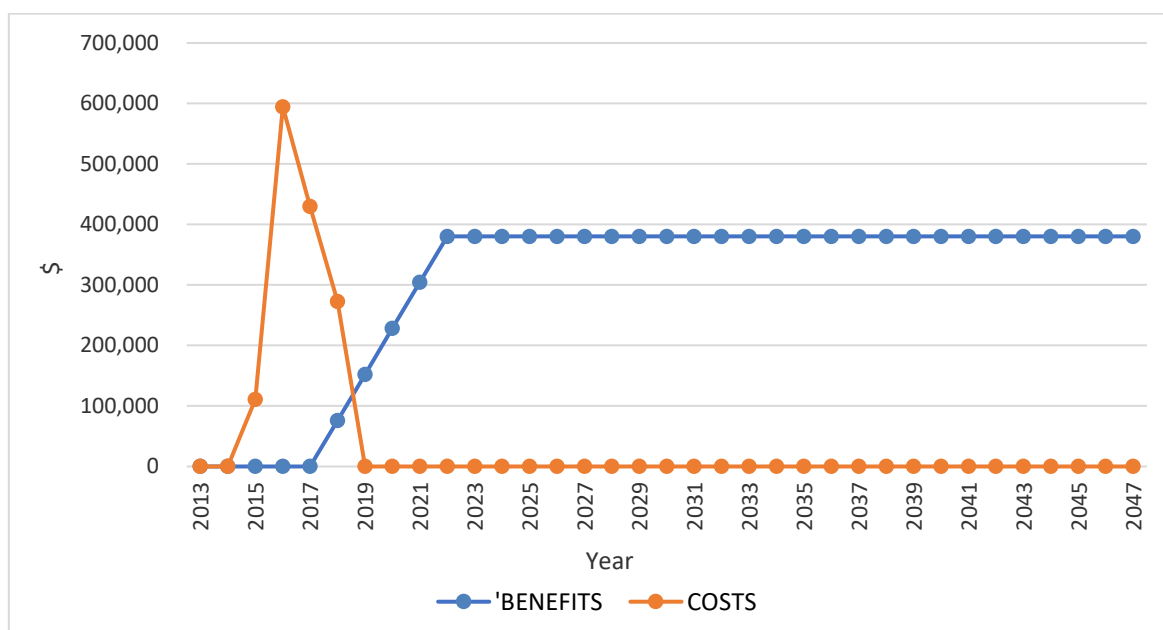


Table 9 shows the contribution of each impact to the total Present Value of Benefits (PVB). Table 9 shows that, if only one of the two impacts were delivered, the value of that impact alone would have covered the Present Value of Investment Costs (PVC) of \$0.58m.

Table 9: Contribution of Benefits by Source

Impact	PVB (\$M)	% of Total PBV
Impact 1: Grower value increase	4.01	69%
Impact 2: Supply chain cost reduction	1.77	31%
Total	5.78	100%

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 10 presents the results that show a moderately high sensitivity to the discount rate.

Table 10: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	Discount rate		
	0%	5%	10%
Present Value of Benefits (\$m)	11.03	5.78	3.60
Present Value of Costs (\$m)	1.41	1.58	1.77
Net Present Value (\$m)	9.62	4.19	1.82
Benefit-cost ratio	7.83	3.65	2.03

A sensitivity analysis was then undertaken for the average value increase assumed for those growers that that improve their management due to the project. Results are provided in Table 11.

Table 11: Sensitivity to Grower Value Increase Assumption
(Total investment, 30 years)

Investment Criteria	Value Increase		
	1%	3.0% (Base)	5%
Present Value of Benefits (\$m)	3.10	5.78	8.45
Present Value of Costs (\$m)	1.58	1.58	1.58
Net Present Value (\$m)	1.52	4.19	6.87
Benefit-cost ratio	1.96	3.65	5.34

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-High	Low

Coverage of benefits was assessed as Medium-High. The two most important impacts (grower value increase and reduction in supply chain costs) were valued. The impact relating to increased regional community spill-overs was not valued. Consequently, the investment criteria as provided by the valued benefits are likely to be slightly underestimated.

Confidence in assumptions for valuation was rated as Low as many of the assumptions made were not supported by surveys or other forms of evidence and had to be made according to the limited evidence produced by the project and the analyst's experience (e.g. risk parameters).

Conclusion

The investment in AV14000 is likely to contribute to improved management of irregular bearing and associated issues, resulting in quality and yield increases and a smoothing of year to year fluctuations of product moving through the various regional supply chains.

Total funding from all sources for the project was \$1.58 million (present value terms). The investment produced estimated total expected benefits of \$5.78 million (present value terms). This gave a net present value of \$4.19 million, an estimated benefit-cost ratio of 3.65 to 1, an internal rate of return of 18.3% and a modified internal rate of return of 7.4%.

As the social impact identified was not valued, the investment criteria estimated by the evaluation may have somewhat underestimated 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

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