Industry-specific impact assessment program: Almond

Impact assessment report for project *Australian almonds industry – liaison & extension project* (AL12000)

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What the report is about

This report presents the results of an impact assessment of a Horticulture Innovation Australia Limited (Hort Innovation) investment in *VG12000: Australian Almond Industry – Liaison and Extension Project.* The project was funded by Hort Innovation over the period August 2012 to October 2015.

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 2019/20 dollar terms and were discounted to the year 2019/20 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 AL12000 has resulted in growers, processors, and other industry stakeholders contributing to research direction setting and being supplied with information on research outputs in a wide variety of forms and forums. The result of this liaison and extension effort is the uptake of research findings that will lower the cost of almond production, deliver improved supply conditions and more profitable almond sales.

Investment Criteria

Total funding from all sources for the project was $2.09 million (present value terms). The investment produced estimated total expected benefits of $7.13 million (present value terms). This gave a net present value of $5.05 million, an estimated benefit-cost ratio of 3.42 to 1, an internal rate of return of 27.1% and a modified internal rate of return of 9.1%.

Conclusions

The Hort Innovation investment in Project AL12000 has engaged the Australian almond industry in setting research direction, taking up research findings and responding to project generated information that improved supply opportunities. Several of the 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.

Keywords

Impact assessment, cost-benefit analysis, almond, extension, liaison, industry development, best practice, strategic plan implementation.

Introduction

All research, development, and extension (RD&E) 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 almond (AL), banana (BA), citrus (CT) and onion (VN) RD&E investment funds.

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

- Nine AL projects were chosen worth $5.84 million (nominal Hort Innovation investment) from an overall population of 21 projects worth an estimated $10.78 million,
- Eight BA projects worth $3.02 million (nominal Hort Innovation investment) from an overall population of 22 projects worth approximately $16.72 million,
- Eight CT projects worth $5.4 million (nominal Hort Innovation investment) from a total population of 35 projects worth $15.78 million, and
- Four VN projects worth $2.4 million (nominal Hort Innovation investment) from an overall population of 8 projects worth $3.89 million.

The project population for each industry included projects where a final deliverable had been submitted in the five-year period from 1 July 2014 to 30 June 2019.

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.

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 almond industry is a significant horticultural sector with a five-year estimated production area of 36,206 ha, a production volume of 85,909 tonnes (kernel weight equivalent) and a Gross Value of Production of $701 million – Table 1.

Table 1: Almond Industry Performance 2015-2019

Year Ended 30 June	Area of Production (ha)	Production (t)	Gross Value of Production ($m)
2015	29,437	82,509	707.5
2016	30,981	82,333	854.1
2017	35,866	80,800	553.6
2018	39,662	79,901	553.1
2019	45,089	104,000	835.1
Average	36,206	85,909	701.0

Source: Australian Horticulture Statistics Handbook and Almond Insights, various years. Tonnes is kernel weight equivalent

Almonds are grown in the south of Australia, with the majority of production occurring along the Murray River. Key production areas include the North Adelaide Plains (South Australia), Riverland (South Australia), Sunraysia (Victoria), and the Riverina (NSW). There is also a small production area in the Swan Region (Western Australia).

Australia's almond growing season commences with the almond blossom in July and August each year. Harvest takes place in February and March, with produce ready for the market in April and May. Over 90% of almonds consumed in Australia are grown and produced by Australian farmers. There is also a strong export industry.

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

The current SIP has been developed with levy payers and addresses the Australian Almond industry's needs from 2017 to 2021. Strategies and priorities in the Plan have been driven by a set of five desired outcomes (Hort Innovation, 2017):

1. Pest and disease damage to almonds has been reduced through enhanced integrated pest management and integrated disease management.
2. A major productivity gain in almond pollination by 2022 through a 25% reduction in honey bee stocking rate with no loss in pollination efficiency (nut set).
3. Improvements in the crop production system have lifted average industry kernel yield from 3 to 4 t/ha, 4ML of irrigation water generates a tonne of almond kernel yield and proven 'shake and catch' harvesting / processing technology is in place.
4. Australian almonds are an informed industry that adopts R&D outcomes and has the capacity to support current and future industry needs.
5. Increased domestic almond consumption up from 16,000 t in 2016 to 27,500 t in 2022. Increased export sales up from 61,000 t in 2016 to 110,000 t in 2022.

Rationale

AL12000 is the third Australian Almond Industry Liaison and Extension Project. It was proceeded by AL07008 and AL09021. Near the completion of AL07008, the industry undertook an Industry Development Needs Assessment (IDNA) to gauge the success of past industry development outcomes and to receive recommendations for the future direction of liaison and extension.

One of the key outcomes of the IDNA was the recommendation that peak industry body, the Australian Almond Board (ABA), become the delivery body for industry liaison and extension. AL12000 would employ an Industry Development Manager (IDM) and an Industry Development Officer (IDO) who together would be responsible for servicing the needs and requirements of each almond growing region.

The project was to be responsible for:

- Industry issue identification.
- Detailed strategy development.
- Identification of gaps in the outputs required to active industry strategy.
- Ensuring the delivery of outputs through scoping and commissioning of R&D projects.
- Assisting with the implementation of the strategies to achieve industry outcomes.

Project Details

Summary

Project Code: AL12000

Title: Australian Almond Industry – Liaison and Extension Project

Research Organisation: Almond Board of Australia (ABA)

Project Leader: Ben Brown

Period of Funding: August 2012 to October 2015

Objectives

Specific objectives of project AL12000 were:

1. Identify industry R&D issues.
2. Formulate industry strategy to address R&D issues.
3. Identify research gaps that need to be filled in order to deliver strategy.
4. Develop projects to deliver strategy.
5. Ensure implementation of the strategies to achieve industry outcomes.

Logical Framework

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

Table 2: Logical Framework for Project AL12000

Activities	The important activities included: • Employment of an IDM (Ben Brown) and IDO (Brett Rosenzweig) on a full time basis. The IDM and IDO served as a conduit between growers, research providers and other key industry stakeholders. The IDO reported to the IDM who in turn reported to the ABA Chief Executive Officer (CEO) (Ross Skinner). • The IDM was the project leader and was responsible for Annual Operating Plan implementation, issue and gap identification, strategy formulation, commissioning R&D projects and realising industry outcomes via extension and technology transfer. • The IDO assisted with the discharge of the IDM role and took the lead in delivering extension and technology transfer to the almond industry. • The ABA CEO was also employed through the project on a part-time basis (0.1 FTE) to supervise and support the IDM and IDO and take a lead in relation to the industry development aspects of the supply chain and almond marketing. • The project employed a part-time (0.1 FTE) Industry Communications Officer with responsibility for industry publications (e.g. factsheets, the industry magazine, website). • A finance manager was employed part-time (0.1 FTE) to manage budgets and reporting and a part time receptionist (0.1 FTE) was engaged to facilitate logistics associated with extension activities (e.g. travel, meetings, workshops, field days). • A steering committee was formed to guide the project. It included members of the industry's Production, Plant Improvement, Processing and Marketing Committees as well as representative from Hort Innovation and the ABA Executive. • R&D issues were identified via consultation with industry committees (Production, Plant Improvement, Processing and Marketing), Hort Innovation, DAWR, industry survey, consultation with key industry stakeholders (growers, processors, marketers, input manufacturers, merchandise suppliers, beekeepers, international and horticultural consultants), Plant Health Australia, and the RIRDC Pollination R&D Committee. • Detailed strategies for each objective were developed using the industry's 2010 R&D plan as a foundation. Strategies addressed almond health benefits, quality, food safety, product differentiation, productivity, biosecurity, sustainability, planting material, skills, extension, and the two-way flow of information through the value chain.

	• Identification of gaps in planned R&D outputs was achieved via consultation and structured gap analysis completed by the IDM and IDO. • Ensuring delivery of outputs through scoping and commissioning R&D projects required identification of the most appropriate R&D providers (e.g. literature review, consultation with other industries), direct appointment of preferred supplies, an expression of interest (EOI) process when no preferred supplier was apparent and a general call for projects to fill any un-envisaged opportunities. • Implementation of strategies and R&D outputs was completed via classroom and field based technology transfer sessions, presentations by experts, development of industry tools (e.g. spreadsheets, manuals), technical articles (published in 'Australian Nutgrower', 'In a Nut Shell', and factsheets), conference presentations, international study tours, and the development, update, and promotion of the ABA's website. • Following a mid-term review of AL12000, greater use was made of the cloud-based orchard management and diagnosis system OrchardNet to identify production constraints and promote key messages to growers around yield and quality. The review also recommended greater use of the website and electronic communications with less emphasis on the current in-person extension model. • The in-person extension model was heavily drawn upon to service the needs to industry new entrants. A surge in interest in the industry resulted in the need for the project to provide information on best practice from irrigation systems to varieties, equipment, water market and suppliers such as nurseries, harvest contractors, etc. • The project worked with state governments to advance a proposal to establish experimental and training orchards that will develop and promote new production systems that address yield gains, crop risks from weather, improved input efficiency, enhanced quality, and better food safety management.
Outputs	The important outputs of the project included the generation and communication of information to growers and the supply chain on: • The food safety characteristics of almonds, production systems that improve quality, supply chain critical control points to maintain food safety, scientific data/publications that support product differentiation. The project managed market access issues associated with European Union (EU) concerns about aflatoxins in Australian almonds. • Reduced deficit irrigation techniques, best practice spray applications, pollination guidelines, storing and managing moist almonds, robotics, and agrichemical supply. • Biosecurity resources including a pest and disease guide, update of the orchard biosecurity manual, and contribution to relevant biosecurity committees. AL12000 assisted with extension of research findings on Carob moth and an R&D project to address Carpophilus beetle management. • Technical and financial analysis of sustainable uses for almond waste i.e. hulls and shells. • The merits of superior plant material including cultivars from the industry's breeding program, imported cultivars, and maintenance of disease free scion and rootstocks. • Skilling of students, delivery of industry awards and completion of study tours. A landmark study tour of the Sunraysia and Riverina regions by growers focussed on harvest maturity, canopy management, light interception, and the new Californian almond variety Independence. A factsheet was subsequently prepared and distributed to growers on the potential role of Independence in the Australian industry. • R&D project briefs, management of EOI processes, contracting and monitoring of suppliers to ensure projects deliver appropriate outputs. • Delivery of factsheets (e.g. lower limb dieback management), technical bulletins magazine articles, newsletters, field days, workshops, user guides, manuals, spreadsheets, a valuable website, conference materials and expert advice. • The project delivered milestone reports, a mid-term review, a review of the performance of the IDM and IDO and a project final report.
Outcomes	The outcomes driven by the project included: • Appropriate research and growers better informed about research findings that lower production costs (e.g. pests/diseases management, irrigation best practice, chemical access, pollination). • Growers with better supply conditions that deliver additional profitable sales (e.g. food safety through supply chain, Australian product differentiation, EU market access).

Impacts	• Economic – lower costs of production for almond growers as a result of appropriate research and its adoption. • Economic – more profitable sales for almond growers with improved market conditions including increased awareness of food safety requirements in export markets, and opportunities to differentiate Australian product. • Capacity – ABA staff, almond growers, and the supply chain with additional skills in liaison, extension, production, and marketing. • Social – direct employment of 2.3 FTE persons in regional Australia. • Social - contribution to improved regional community wellbeing from spill-over benefits as a result of a sustainable, profitable almond industry - North Adelaide Plains, Riverland, Sunraysia, Riverina and the Swan Region Western Australia.

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project AL12000 by Hort Innovation. There were no other investors in AL12000.

Table 3: Annual Investment in Project AL12000 (nominal $)

Year ended 30 June	HORT INNOVATION ($)	ABA ($)	TOTAL ($)
2013	316,946	0	316,946
2014	313,589	0	313,589
2015	313,589	0	313,589
2016	293,171	0	293,171
Total	**1,237,295**	**0**	**1,237,295**

Source: AL12000 Revised Schedule

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 3.

Real Investment and Extension Costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2019/20 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2020). No additional extension costs were incurred.

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 AL12000

Economic	• Lower costs of production for almond growers as a result of appropriate research and its adoption. • More profitable sales for almond growers with improved market conditions including increased awareness of food safety requirements in export markets, and opportunities to differentiate Australian product.
Environmental	• Nil

Social	• ABA staff, almond growers, and the supply chain with additional skills in liaison, extension, production, and marketing. • Direct employment of 2.3 FTE persons in regional Australia. • Contribution to improved regional community wellbeing from spill-over benefits as a result of a sustainable, profitable almond industry - North Adelaide Plains, Riverland, Sunraysia, Riverina and the Swan Region Western Australia.

Public versus Private Impacts

The impacts identified from the investment are predominantly private impacts accruing to almond growers and the almond supply chain. However, some public benefits have also been produced including capacity building, direct employment in regional areas and spill-over benefits to regional communities.

Distribution of Private Impacts

The private impacts will have been distributed between growers, processor/packers, wholesalers, exporters, retailers, and consumers in Australia and overseas. 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 almond market.

Impacts on Other Australian Industries

Investment has been tightly focussed on almond industry needs and subsequent adoption. It is unlikely that there will be impacts on other Australian industries.

Impacts Overseas

Some of the research commissioned as a result of this project will be published in the international scientific literature and may be relevant to almond industries in other countries e.g. pest/disease management.

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 to Rural RD&E Priority 4, and to Science and Research Priority 1, 2, 7 and 8.

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 Almond Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the almond industry are outlined in the Almond Industry's Strategic Investment Plan 2017-2021[1] (Hort Innovation, 2017). Project AL12000 addressed Outcome 4, 'An informed industry that adopts R&D outcomes and has the capacity to support current and future industry needs', Strategy 1 ('Support adoption of R&D outcomes by effective extension') and Strategy 3 ('Ensure industry stakeholders remain engaged through an effective communications program').

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

Valuation of Impacts

Impacts Valued

Analyses were undertaken for total benefits that included future expected benefits. A degree of conservatism was used when finalising assumptions, particularly when some uncertainty was involved. Sensitivity analyses were undertaken for those variables where there was greatest uncertainty or for those that were identified as key drivers of the investment criteria.

Two impacts were valued they were:

- Lower costs of production for almond growers as a result of more appropriate research and its adoption
- More profitable sales with improved market conditions.

Impacts Not Valued

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

- ABA staff, almond growers, and the supply chain with additional skills in liaison, extension, production, and marketing.
- Direct employment of 2.3 FTE persons in regional Australia.
- Contribution to improved regional community wellbeing from spill-over benefits as a result of a sustainable, profitable almond industry.

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

Valuation of Impact 1: Lower costs of production as a result of more appropriate research and its adoption

AL12000, continuation of the almond industry liaison and extension project, provided direction for research investment and extension to ensure adoption of research outputs. Appropriate research and its adoption are expected to contribute to lower costs of production for almond growers e.g. reduction in the cost of pests/disease management, efficiencies associated with irrigation best practice, access to cost effective chemicals and pollination efficiencies.

Valuation of Impact 2: More profitable sales with improved market conditions

AL12000 has provided almond growers with better supply conditions that deliver more profitable sales e.g. food safety through the supply chain, Australian product differentiation, measures to secure ongoing access to the EU market.

Attribution

Some of the cost savings and additional profitable sales described will be attributable to past liaison and extension projects i.e. AL07008 and AL09021. Consequently, an attribution factor of 60% has been used in this analysis.

Counterfactual

In the absence of this project some liaison and extension would have been undertaken by other parties e.g. ABA, state DPIs, and other researchers as part of their engagement with the almond industry. The proportion of benefits estimated that would have been delivered without Project AL12000 is 70%.

Summary of Assumptions

A summary of the key assumptions is provided in Table 6.

Table 6: Summary of Assumptions for Impact Valuation

Variable	Assumption	Source/Comment
Impact 1: Lower costs of production as a result of more appropriate research and its adoption		
Average cost of production without AL12000.	$13,640/ha	Adapted from Waycott, 2011.
Saving in cost of production due to AL12000.	0.5%	A total saving of 2% is assumed by the analyst. However, 1.5% of this gain is attributable to the research rather than its design and adoption.

Impact 2: More profitable almond sales with improved market conditions		
Profit on almond production.	$11,360/ha	Gross receipts of $25,000/ha (Australian Nut Industry Council, undated) less production costs of $13,640 (adapted from Waycott, 2011).
Increase in profit due to AL12000 facilitated improvements in market conditions.	1%	Analyst assumption.
Assumptions common to valuation of both impacts		
Annual production of almonds.	36,206 ha.	See Table 1 above.
Proportion of production benefiting from AL12000.	80%	Industry is dominated by corporate growers, processors and marketers who work closely with ABA and on AL12000 initiatives.
Year of first impact.	2016/17.	Benefits of liaison and extension are manifest on farm and in the market place one year after product completion.
Number of years to maximum impact is reached.	3 years.	Analyst assumption.
Number of years of maximum impact.	10 years.	Analyst assumption.
Number of years over which impact declines to zero.	3 years.	Analyst assumption.
Probability of the project generating useful outputs that reduce almond cost of production and deliver more profitable sales.	100%	Analyst assumption – outputs have been communicated to growers.
Probability of impact (assuming successful outcome)	75%	Analyst assumption – there is some probability that growers will not successfully implement recommendations.

Results

All costs and benefits were discounted to 2019/20 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 (2015/16) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

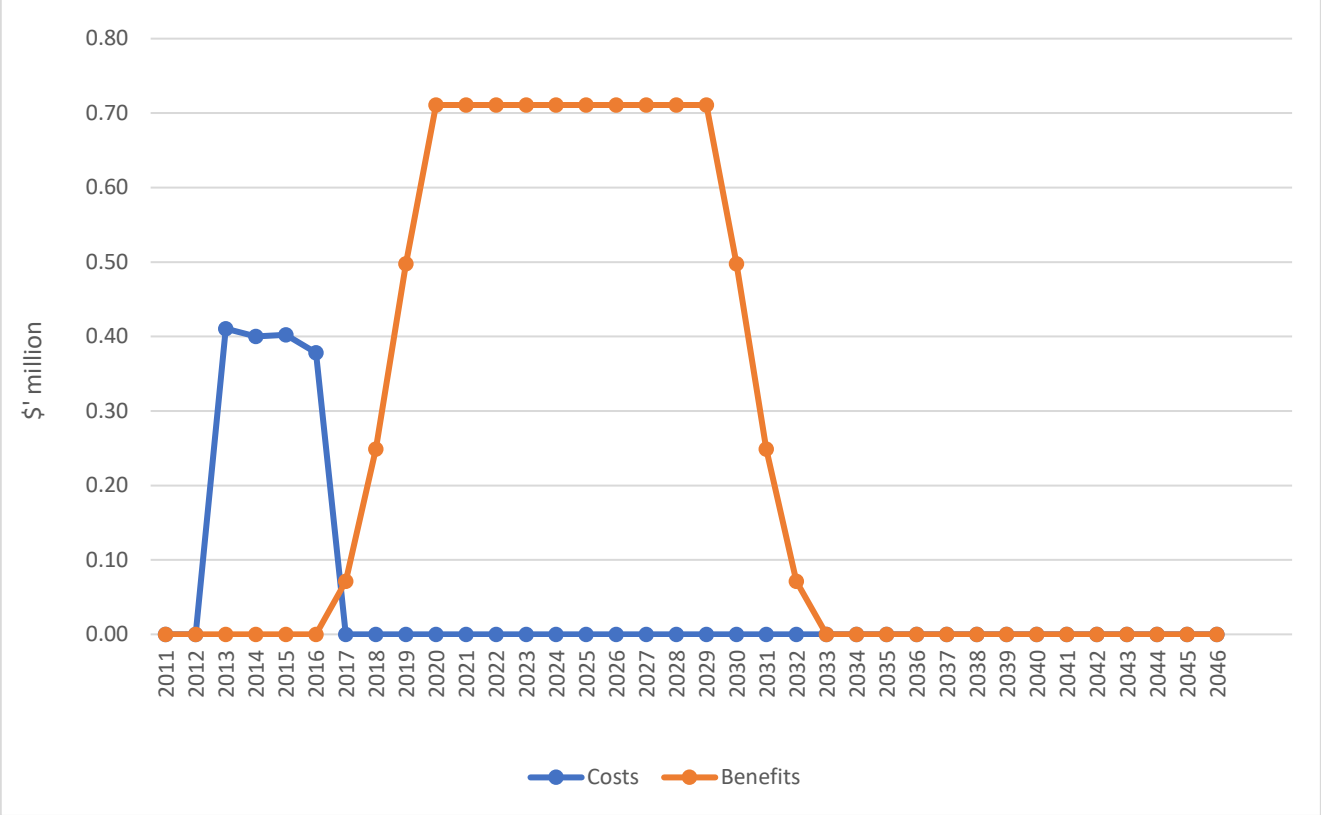
Table 7 shows the investment criteria estimated for different periods of benefit for the total investment. Hort Innovation was the only investor in the project.

Table 7: Investment Criteria for Total Investment in Project AL12000

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($m)	0.00	2.27	5.20	7.09	7.13	7.13	7.13
Present Value of Costs ($m)	2.09	2.09	2.09	2.09	2.09	2.09	2.09
Net Present Value ($m)	-2.09	0.18	3.11	5.01	5.05	5.05	5.05
Benefit-Cost Ratio	0.00	1.09	2.49	3.40	3.42	3.42	3.42
Internal Rate of Return (%)	negative	2.6	24.1	27.0	27.1	27.1	27.1
MIRR (%)	negative	3.3	14.6	13.6	11.3	10.0	9.1

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the AL12000 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



Source of Benefits

Estimates of the relative contribution of each benefit valued, given the assumptions made, are shown in Table 8.

Table 8: Contribution to Total Benefits from Each Source

	Contribution to PVB ($m)	Share of Benefits (%)
Reduction in handling costs associated with EU rejections	2.68	37.5
Recovery in almond value lost due to EU rejections	4.46	62.5
Total	7.13	100.0

Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 9 presents the results. The results show 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 ($m)	8.74	7.13	6.05
Present Value of Costs ($m)	1.59	2.09	2.71
Net Present Value ($m)	7.15	5.05	3.34
Benefit-cost ratio	5.50	3.42	2.23

A sensitivity analysis was then undertaken on the reduction in the cost of almond production attributable to

AL12000. Results are provided in Table 10. Even when cost reduction is 0.25%, and given all other assumptions remaining unchanged, the project continues to show benefits greater than cost.

Table 10: Sensitivity to Reduction in Cost of Almond Production Attributable to AL12000 (Total investment, 30 years)

Investment Criteria	Reduction in Cost of Almond Production		
	0.25%	0.5% (base)	1%
Present Value of Benefits ($m)	5.80	7.13	9.81
Present Value of Costs ($m)	2.09	2.09	2.09
Net Present Value ($m)	3.71	5.05	7.72
Benefit-cost ratio	2.78	3.42	4.70

A final sensitivity analysis tested the sensitivity of the investment criteria to the increase in almond growing profit attributable to AL12000. The results (Table 11) show that even if the assumed increase in profit is halved to 0.5%, project benefits continue to exceed project costs.

Table 11: Sensitivity to Increase in Almond Growing Profit Attributable to AL12000 (Total investment, 30 years)

Investment Criteria	Increase in Almond Growing Profit		
	0.5%	1% (base)	2%
Present Value of Benefits ($m)	4.90	7.13	11.59
Present Value of Costs ($m)	2.09	2.09	2.09
Net Present Value ($m)	2.82	5.05	9.50
Benefit-cost ratio	2.35	3.42	5.55

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 valued was assessed as Medium-High – while two key economic impacts were valued, three social impacts were not valued. Confidence in assumptions was rated as Low, a number of key assumptions were made by the analyst.

Conclusion

The investment in AL12000 has resulted in growers, processors, and other industry stakeholders contributing to research direction setting and being supplied with information on research outputs in a wide variety of forms and forums. The result of this liaison and extension effort is the uptake of research findings that will lower the cost of almond production, deliver improved supply conditions and more profitable almond sales.

Total funding from all sources for the project was $2.09 million (present value terms). The investment produced estimated total expected benefits of $7.13 million (present value terms). This gave a net present value of $5.05 million, an estimated benefit-cost ratio of 3.42 to 1, an internal rate of return of 27.1% and a modified internal rate of return of 9.1%.

As three of the identified impacts were not valued, the investment criteria estimated by the evaluation may be underestimates 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

ABA	Almond Board of Australia
AL	Almond
BA	Banana
CEO	Chief Executive Officer
CRRDC	Council of Research and Development Corporations
CT	Citrus
DAWR	Department of Agriculture and Water Resources (Australian Government)
EOI	Expression of Interest
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GVP	Gross Value of Production
IDM	Industry Development Manager
IDNA	Industry Development Needs Assessment
IDO	Industry Development Manager
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
RIRDC	Rural Industries Research and Development Corporation (now AgriFutures Australia)
VN	Onion