

Industry-specific impact assessment program: Almond

Impact assessment report for project *Education of health professionals relating to the health benefits of almond consumption (AL12001)*

Impact analyst:

Michael Clarke

Delivery partner:

AgEconPlus and Agtrans Research

Project code:

MT19012

Date:

December 2020

Disclaimer:

Horticulture Innovation Australia Limited (Hort Innovation) makes no representations and expressly disclaims all warranties (to the extent permitted by law) about the accuracy, completeness, or currency of information in this Final Report.

Users of this Final Report should take independent action to confirm any information in this Final Report before relying on that information in any way.

Reliance on any information provided by Hort Innovation is entirely at your own risk. Hort Innovation is not responsible for, and will not be liable for, any loss, damage, claim, expense, cost (including legal costs) or other liability arising in any way (including from Hort Innovation or any other person's negligence or otherwise) from your use or non-use of the Final Report or from reliance on information contained in the Final Report or that Hort Innovation provides to you by any other means.

Funding statement:

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

Publishing details:

Published and distributed by: Hort Innovation

Level 7

141 Walker Street

North Sydney NSW 2060

Telephone: (02) 8295 2300

www.horticulture.com.au

© Copyright 2020 Horticulture Innovation Australia

Contents

Contents	3
Tables	3
Figures	3
Executive Summary	4
Keywords	4
Introduction	5
General Method	5
Background & Rationale	5
Project Details	7
Project Investment	8
Impacts	9
Valuation of Impacts	10
Results	12
Conclusion	14
Glossary of Economic Terms	15
Reference List	16
Acknowledgements	17
Abbreviations	17

Tables

Table 1: Almond Industry Performance 2015-2019	6
Table 2: Logical Framework for Project AL12001	7
Table 3: Annual Investment in Project AL12001 (nominal \$)	8
Table 4: Triple Bottom Line Categories of Principal Impacts from Project AL12001	9
Table 5: Australian Government Research Priorities	10
Table 6: Summary of Assumptions for Impact Valuation	11
Table 7: Investment Criteria for Total Investment in Project AL12001	12
Table 8: Sensitivity to Discount Rate	13
Table 9: Sensitivity to Contribution of AL12001 to Increase in Almond Farmgate Value	13
Table 10: Sensitivity to Assumed Proportion of Benefits Delivered Without AL12001	14
Table 11: Confidence in Analysis of Project	14

Figures

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs	13
--	----

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 *AL12001: Research and Education of Health Professionals Relating to the Health Benefits of Almond Consumption*. The project was funded by Hort Innovation over the period April 2013 to June 2016.

Methodology

The investment was first analysed qualitatively within a logical framework that included activities and outputs, outcomes, and impacts. Actual and/or potential impacts then were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation in monetary terms (quantitative assessment). Past and future cash flows were expressed in 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 AL12001 has collated new knowledge of the nutritional benefits of almonds as part of a healthy daily diet. This information has been communicated to three groups of health professionals – dietitians, General Practitioners, and fitness trainers. It has been assumed that transfer of information to health professionals has been responsible for a share of the increased demand for Australian almonds and has provided growers with additional profitable almond sales.

Investment Criteria

Total funding from all sources for the project was \$1.93 million (present value terms). The investment produced estimated total expected benefits of \$5.70 million (present value terms). This gave a net present value of \$3.76 million, an estimated benefit-cost ratio of 2.95 to 1, an internal rate of return of 122.1% and a modified internal rate of return of 10.6%.

Conclusions

The Hort Innovation investment in Project AL12001 has researched the nutritional benefits of almonds, communicated the findings to health professionals and grown the demand for Australian almonds. Two identified impacts were not valued as they 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, health, health professional, consumption, human nutrition, market development, consumer education.

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 volume of 85,909 tonnes (kernel weight equivalent), and a Farmgate Value of \$665.6 million. Almond supply and almond supply per capita have increased over the last five years – Table 1.

Table 1: Almond Industry Performance 2015-2019

Year Ended 30 June	Production (t)	Gross Value of Production (\$m)	Farmgate Value (\$m)	Domestic Supply (t)	Almond Supply Per Capita (kg)
2015	82,509	707.5	672.1	26,895	0.97
2016	82,333	854.1	811.4	29,055	1.02
2017	80,800	553.6	525.9	24,735	0.93
2018	79,901	553.1	525.4	28,819	1.09
2019	104,000	835.1	793.3	36,906	1.46
Average	85,909	700.7	665.6	29,282	1.09

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

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

Prior to the commencement of this project, growing the market for Australian almonds was a high priority for the industry. In 2011, the Australian almond crop was 40,000 tonnes and was forecast to increase to 67,000 tonnes in 2012 and double to 80,000 tonnes in 2015. Profitably sustaining and absorbing this rapid growth required major industry commitment and vision to researching, developing, and maintaining domestic and international almond markets.

One strand in the almond industry’s strategy to grow its markets was to demonstrate the nutritional benefits of almonds and communicate the findings to health professionals. Almonds, the industry believed, had a role in addressing current lifestyle derived illnesses such as diabetes, heart disease and overweight/obesity. The project would also address misconceptions about almond consumption including the important role that healthy unsaturated fat, of the type contained in almonds, played in the daily diet.

The almond industry’s nutritional research and health professional education program targeted three key audiences: dietitians, doctors in general practice (GPs) and fitness trainers. All three professions have a high level of influence over the people they advise. The project targeted preventative health (understanding and communicating the relationship between the nutrient profile of almonds and the prevention of major lifestyle diseases) and proactive/aspirational health (presenting almonds as a food people aspire to eating because of its positive nutritional attributes).

Health professional research and education was to focus on the Australian domestic market as well as the neighbouring export markets of New Zealand, Indonesia, Malaysia, Thailand, Vietnam, South Korea, Japan, China, and India.

For context, Joseph Ebbage, Market Development Manager, Almond Board of Australia points out “in 2007, the domestic sales of Australian almonds were 11,334 tonnes. Health and nutrition have been key consumption drivers

during this period of rapid growth. Ensuring the Australian almond industry has the support of key health professionals was critical to the spread of the nutritional benefits of almonds in both mainstream and social media as well as through word-of-mouth recommendations”.

Project Details

Summary

Project Code: AL12001
Title: Research and Education of Health Professionals Relating to the Health Benefits of Almond Consumption
Research Organisation: Almond Board of Australia (ABA)
Project Leader: Joseph Ebbage
Period of Funding: April 2013 to June 2016

Objectives

The objective of this study was to grow the almond market by researching the nutritional benefits of almonds as part of a healthy daily diet and communicating the findings to health professionals.

Logical Framework

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

Table 2: Logical Framework for Project AL12001

Activities	<p>The important activities included:</p> <ul style="list-style-type: none"> • Scientific research - review of current nutritional studies relevant to almonds with a focus on the role of almonds in achieving a healthy weight, and the prevention of diabetes, heart disease and osteoporosis. • The project included formation of the Australian Almond Nutrition Council which provided advice on both the science and the health issues being investigated. • Research included work with two Australian universities to understand linkages between almonds, heart health and the Mediterranean diet. • Data collection – comprehensive collation of Australian almond media, analysis of global product development, identification of trends via Datamonitor and news articles via Media Monitor (print media) and Meltwater (online media). • Food trend and new product development data was collated by Innova Research. Trend information was used to communicate the role of almonds in capturing the zeitgeist e.g. growth in gluten free foods and the role of almonds in providing gluten free options. • Papers reviewed and synthesised for communication included, but were not limited to, A literature review on heart health and diabetes, Long-term associations of nut consumption with body weight, A review of the effects of nuts on appetite, food intake, metabolism, and body weight, Nut consumption for vascular health and cognitive function, Mediterranean diet to reduce 24-hour ambulatory blood pressure, Prebiotic effects of almonds and almond skins on intestinal microbiota, and the Protective effect of nuts on the development of breast cancer. Preparation of information for health professionals on ‘Almonds and Calorie Consumption’ and ‘Healthy After- school snacking’. Information packs highlighted USDA research showing almonds supply 20% fewer effective calories than previously estimated. • Education packs highlighted the health attributes of almonds and their relevance to a healthy weight, and the prevention of diabetes, heart disease and osteoporosis. • Presenting and rollout of new information and media kits at conferences and events. • Health focussed events targeted by the project included the Royal College of GPs annual conference, GP Registrars Australia training events, GP Conference and Exhibition in both Sydney and Melbourne, Dietitians Association of Australia conference, the New Zealand Dietitians conference, Diabetes Congress and the Heart Foundation conference.
------------	--

	<ul style="list-style-type: none"> • Education and fitness events included Fitness Expos in Sydney and Melbourne, Australian Council for Health, Sports Dietitians & Exercise Physiologists conference, Physical Education and Recreation national and state conferences, and coaching seminars for major sports such as cricket and netball. • Use of Health 'E' and print Mediums to increase the industry's exposure in health publications including magazines, newsletters, and websites. Websites targeted included the Dietitians Association of Australia and Sports Dietitians Australia. • Innovation in the educating of health professionals through the development of a digital Nutrition Learning Centre. The Centre housed nutritional studies as well as coursework that can be used for accredited professional development points. • Production and distribution of the almond industry's Healthy Handful Newsletter which informed and connected with over 1,000 health professionals on a quarterly basis. • Project evaluation based on surveys of health professionals and feedback gathered from industry stakeholders on the value of the research and information disseminated. • Regular reporting of milestones to Hort Innovation and a final report summarising the initiatives delivered.
Outputs	<p>The important outputs of the project included:</p> <ul style="list-style-type: none"> • Reviews of the scientific literature tailored to three health professional sectors. • Responses to the latest news and product developments in relation to weight loss. • Communication of the benefits of almonds to 2,000 members of the Australian GP community, 2,000 dietitians and 1,700 fitness, sport coaches and trainers. • Presentations at 22 major health and fitness events.
Outcomes	<p>The outcomes driven by the project included:</p> <ul style="list-style-type: none"> • An increase in health professional understanding of the role almonds play in combating lifestyle diseases such as obesity, diabetes, heart disease and osteoporosis. • An increase in the profile of almonds as an aspirational sports recovery snack. • An increase in the number of health professionals who advocate regular consumption of almonds to their patients and clients. • Consumers being more aware of almond nutritional characteristics. • An increase in the consumption of Australian almonds on the back of favourable advice from health professionals.
Impacts	<ul style="list-style-type: none"> • Economic – additional profitable sales of almonds as consumers respond to favourable advice from health care professionals. • Capacity – health care professionals and ABA staff with additional knowledge of the health attributes of almonds. • Social - contribution to improved regional community wellbeing in almond growing areas from spill-over benefits as a result of a sustainable, profitable almond industry.

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project AL12001 using a combination of Hort Innovation managed Voluntary Contributions and levy receipts from the almond industry. There were no other investors in AL12001.

Table 3: Annual Investment in Project AL12001 (nominal \$)

Year ended 30 June	HORT INNOVATION (\$)	ABA (\$)	TOTAL (\$)
2013	228,000	0	228,000
2014	334,200	0	334,200
2015	222,200	0	222,200
2016	371,100	0	371,100
Total	1,155,500	0	1,155,500

Source: AL12001 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 AL12001

Economic	<ul style="list-style-type: none"> Additional profitable sales of almonds as consumers respond to favourable advice from health care professionals.
Environmental	<ul style="list-style-type: none"> Nil.
Social	<ul style="list-style-type: none"> Health care professionals and ABA staff with additional knowledge of the health attributes of almonds. Contribution to improved regional community wellbeing in almond growing areas from spill-over benefits as a result of a sustainable, profitable almond industry.

Public versus Private Impacts

The impacts identified from the investment are predominantly private impacts accruing to almond growers and the almond supply chain i.e. additional profitable almond sales. However, some public benefits have also been produced including capacity building and spill-over benefits to regional communities.

Distribution of Private Impacts

The private impacts (additional profitable sales) will be distributed between growers and 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 almond market.

Impacts on Other Australian Industries

Some of the research reviewed and communicated addressed the health benefits of all nuts (e.g. the role of nuts in a healthy Mediterranean diet). To this extend the whole nut category, including the Australian macadamia, chestnut, walnut, pecan, and pistachio industries, may benefit from the project.

Impacts Overseas

Materials prepared and communicated through the project will also be relevant to Australian almond exports and the almond growing industries of other countries. Project outputs targeted Australian export markets in New Zealand, Indonesia, Malaysia, Thailand, Vietnam, South Korea, Japan, China, and India. There are large almond growing industries in California, Spain, Turkey, and Italy.

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 Science and Research Priority 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 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 2017-2021¹ (Hort Innovation, 2017). Project AL12001 addressed Outcome 4, ‘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’, Strategy 2 (‘Market research and insights to help industry increase domestic almond consumption’) and Strategy 3 (‘Facilitate Australian almond exports through market research and improved market access’).

Valuation of Impacts

Impacts Valued

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

The impact valued was additional demand and ensuing profitable sales for almond growers.

Impacts Not Valued

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

- Health care professionals and ABA staff with additional knowledge or the health attributes of almonds.
- Contribution to improved regional community wellbeing in almond growing areas 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.

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

Valuation of Impact 1: Additional demand and ensuing profitable sales for almond growers

The breakdown of the health professionals engaged, and education packs requested during AL12001 is shown in Table 6.

Table 6: Summary of Assumptions for Impact Valuation

Health Professional Sector	No. Engaged	No. Requesting Education Packs
GP doctors and nurses	7,800	1,251
Dietitians	4,650	1,450
Fitness professionals	5,450	785
Diabetes educators	4,300	734
Total	22,200	4,220

Source: Joseph Ebbage, Market Development Manager, ABA (pers. comm., August 2020).

NB: each health professional works with approximately 2,000 patients/clients. Estimate derived from GP numbers presented at <https://theconversation.com/how-can-australia-have-too-many-doctors-but-still-not-meet-patient-needs-78535>.

The AL12001 investment contributed to improved understanding of the health benefits of almonds amongst GPs, dietitians, fitness professionals and diabetes educators and increased consumer demand for almonds. As a result of this additional understanding amongst health professionals, it is likely that almond consumers (both existing and new) would have been influenced to increase consumption and increased sales of almonds would have been achieved.

Attribution

Increased demand for almonds is influenced by a wide range of activities. The activities completed as part of AL12001 that focussed on the education of health professionals between 2013 and 2016 are just one set of investments. Investment in influencing health professionals has a 15 year history inside ABA (Joseph Ebbage, ABA, pers. comm., July 2020). The increase in consumption needs to be considered against other factors contributing to sales growth including promotion by individual firms, promotion by industry, health awareness and promotion originating overseas especially from the dominant Californian industry, and the very large increase in almond products available to Australian consumers (e.g. flour, milks, value added confectionary). It is difficult to precisely estimate the role of health professionals in increased production between 2013 and 2016. Against this background, 10% has been attributed to AL12001 and this is tested using sensitivity analysis.

Counterfactual

If project AL12001 had not been funded, it is assumed that some messages on the health benefits of almonds would have reached health professionals via say, the Almond Board of California and the international health literature. A 50% counterfactual has been applied.

Summary of Assumptions

A summary of the key assumptions is provided in Table 7.

Table 7: Summary of Assumptions for Impact Valuation

Variable	Assumption	Source/Comment
Impact 1: Additional demand and ensuing profitable sales for almond growers		
Average annual increase in farmgate gross value of almonds post AL12001 (2016/17 to 2018/19).	\$89.1 M.	Calculated from data published in the Horticulture Statistics Handbook (Hort Innovation 2019, 2020) (\$793.3 M (farmgate value in 2018/19) - \$525.9 M (farmgate value in 2016/17))/3 (number of years).
Attribution of project AL12001 to average annual increase in farmgate gross value of almonds post AL12001 (2016/17 to 2018/19).	10%	See above explanation. Analyst assumptions tested using sensitivity analysis.
Almond grower gross profit as a	45%	Estimated assuming production costs of

proportion of farmgate value.		\$13,640 (adapted from Waycott, 2011) and gross receipts of \$25,000/ha (Australian Nut Industry Council, undated).
Year of first impact.	2016/17.	Year following completion of AL12001.
Year of final impact.	2020/21.	Five years following completion of AL12001.
Probability of outputs.	100%	Analyst assumption – outputs have been communicated to health professionals.
Probability of outcomes.	90%	Analyst assumption – health professionals advocate for almond consumption.
Probability of impact.	60%	Analyst assumption – clients and patients adopt health professional recommendations.
Counterfactual.	50%	See above.

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

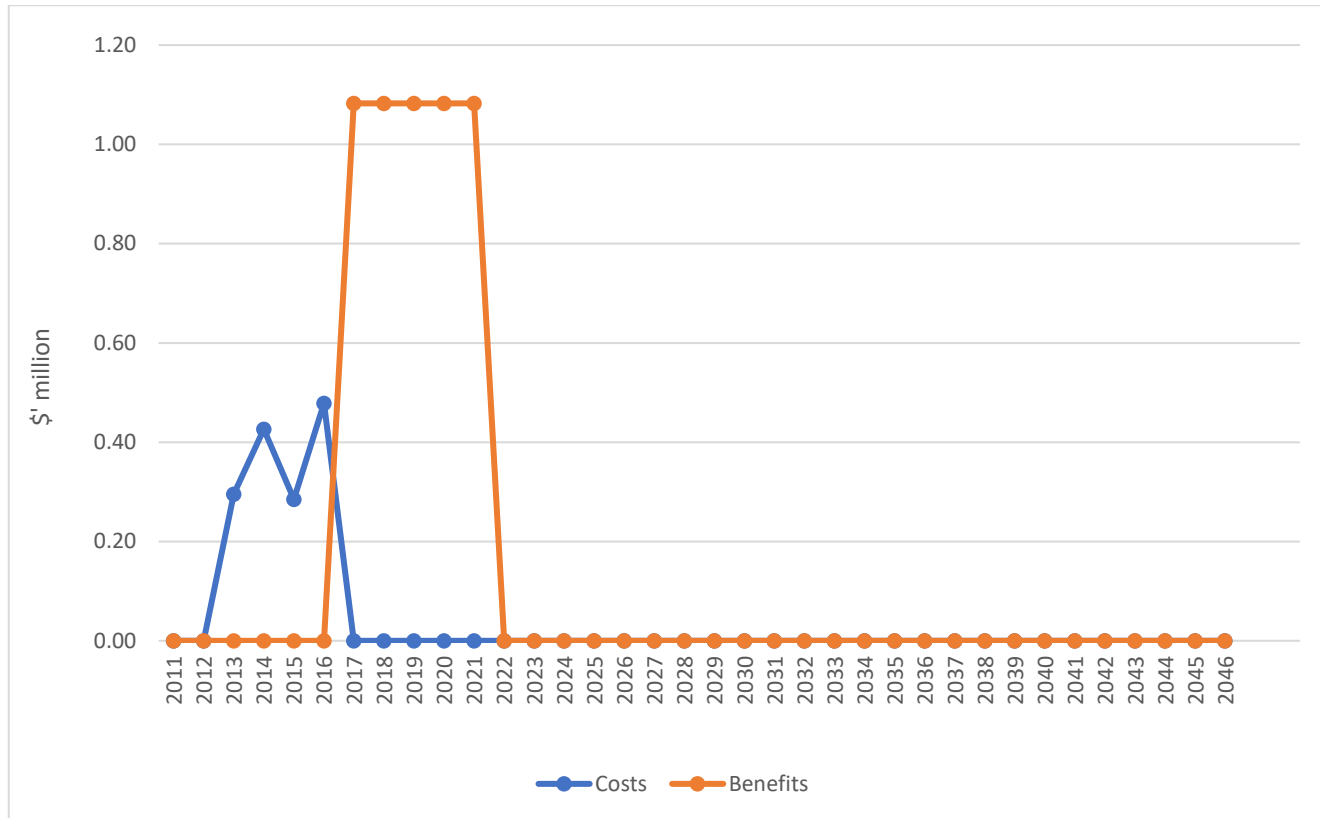
Table 8 shows the investment criteria estimated for different periods of benefit for the total investment. Hort Innovation managed funds were the only investment in the project.

Table 8: Investment Criteria for Total Investment in Project AL12001

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.00	5.70	5.70	5.70	5.70	5.70	5.70
Present Value of Costs (\$m)	1.93	1.93	1.93	1.93	1.93	1.93	1.93
Net Present Value (\$m)	-1.93	3.76	3.76	3.76	3.76	3.76	3.76
Benefit-Cost Ratio	0.00	2.95	2.95	2.95	2.95	2.95	2.95
Internal Rate of Return (%)	negative	122.1	122.1	122.1	122.1	122.1	122.1
MIRR (%)	negative	53.1	24.1	16.9	13.7	11.8	10.6

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the AL12001 investment plus 30 years from the last year of investment are shown in Figure 1.

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



Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 9 presents the results. The results show low 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)	5.41	5.70	6.01
Present Value of Costs (\$m)	1.49	1.93	2.49
Net Present Value (\$m)	3.93	3.76	3.52
Benefit-cost ratio	3.64	2.95	2.41

A sensitivity analysis was then undertaken on the assumed contribution of project AL12001 to average annual increase in farmgate gross value of almonds. Results are provided in Table 10. Even when the attribution factor is reduced from 10% to 5%, the project continues to 'breakeven'.

Table 10: Sensitivity to Contribution of AL12001 to Increase in Almond Farmgate Value
(Total investment, 30 years)

Investment Criteria	AL12001 Attribution Factor		
	5%	10% (base)	20%
Present Value of Benefits (\$m)	2.85	5.70	11.39
Present Value of Costs (\$m)	1.93	1.93	1.93
Net Present Value (\$m)	0.92	3.76	9.46
Benefit-cost ratio	1.47	2.95	5.90

A final sensitivity test examined the counterfactual proportion of benefits estimated that would have been delivered without AL12001 (Table 11). The break-even assumed proportion of benefits delivered without AL12001 was 83%, thus the investment criteria results were sensitive to changes in the assumed proportion of benefits delivered in the counterfactual scenario, i.e. without AL12001.

Table 11: Sensitivity to Assumed Proportion of Benefits Delivered Without AL12001
(Total investment, 30 years)

Investment Criteria	Counterfactual – Assumed Proportion of Benefits Delivered Without AL12001		
	25%	50% (base)	75%
Present Value of Benefits (\$m)	8.55	5.70	2.85
Present Value of Costs (\$m)	1.93	1.93	1.93
Net Present Value (\$m)	6.61	3.76	0.92
Benefit-cost ratio	4.42	2.95	1.47

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
High	Medium-Low

Coverage of benefits valued was assessed as High – the major benefit was valued. Confidence in assumptions was rated as Medium-Low, a number of key assumptions were made by the analyst.

Conclusion

The investment in AL12001 has collated new knowledge of the nutritional benefits of almonds as part of a healthy daily diet. This information has been communicated to three groups of health professionals. It has been assumed that transfer of information to health professionals has been responsible for a share of the increased demand for Australian almonds and has provided growers with additional profitable almond sales.

Total funding from all sources for the project was \$1.93 million (present value terms). The investment produced estimated total expected benefits of \$5.70 million (present value terms). This gave a net present value of \$3.76 million, an estimated benefit-cost ratio of 2.95 to 1, an internal rate of return of 122.1% and a modified internal rate of return of 10.6%.

As two 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.

Reference List

- Almond Board of Australia (ABA) (2019) Almond Insights various editions
<https://industry.australianalmonds.com.au/almond-board/almond-insights/>
- Australian Bureau of Statistics. (2020, March 4). 5206.0 – Australian National Accounts: National Income, Expenditure and Product, Dec 2019. Table 5. Expenditure on Gross Domestic Product (GDP), Implicit price deflators. Retrieved from Australian Bureau of Statistics:
<https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Dec%202019?OpenDocument>
- Australian Nut Industry Council (undated) Growing Tree Nuts in Australia. Retrieved at
<https://nutindustry.org.au/growing-tree-nuts-in-australia/>
- Council of Rural Research and Development Corporations. (2018). Cross-RDC Impact Assessment Program: Guidelines. Canberra: Council of Rural Research and Development Corporations. Retrieved from
http://www.ruralrdc.com.au/wp-content/uploads/2018/08/201804_RDC-IA-Guidelines-V.2.pdf
- Department of Agriculture and Water Resources (DAWR). (2015). Agricultural Competitiveness White Paper. Canberra: Commonwealth of Australia. Retrieved from
<http://agwhitepaper.agriculture.gov.au/SiteCollectionDocuments/ag-competitiveness-white-paper.pdf>
- Hort Innovation (2017) Almond Strategic Investment Plan - 2017-2021. Retrieved from
<https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/strategic-investment-plans/>
- Hort Innovation (2019) Horticulture Statistics Handbook 2017/18.
- Hort Innovation (2020) Horticulture Statistics Handbook 2018/19. Retrieved from
<https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/australian-horticulture-statistics-handbook/>
- Office of the Chief Scientist (OCS). (2015). Strategic Science and Research Priorities. Canberra: Commonwealth of Australia. Retrieved from http://www.chiefscientist.gov.au/wp-content/uploads/STRATEGIC-SCIENCE-AND-RESEARCH-PRIORITIES_181214web.pdf
- Waycott, R (2011) The Economics of Growing Almonds. Retrieved at
https://www.almonds.com/sites/default/files/content/attachments/economics_of_growing_almonds_revised.pdf

Acknowledgements

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

Specific acknowledgements:

Joseph Ebbage, Consumer Insights, Almond Board of Australia

Brendan O’Keeffe, Analyst, Hort Innovation

Ross Skinner, Chief Executive Officer, Almond Board of Australia

Abbreviations

ABA	Almond Board of Australia
AL	Almond
BA	Banana
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
GP	General Practitioner
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)
USDA	United States Department of Agriculture
VN	Onion