

Industry-specific impact assessment program: Onion

Impact assessment report for project *New onion protocols to assure viability of European exports* (VN10001)

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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 *VN10001: New onion protocols to assess viability of European exports*. The project was funded by Hort Innovation over the period January 2011 to December 2014.

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 VN10001 has produced an onion production protocol which will contribute to the supply of consistent exports to the European market. Australian onion exports are dominated by sales to Europe and exports are important to the Australian onion industry because they remove excess volume from domestic markets and drive upward price pressure.

Investment Criteria

Total funding from all sources for the project was \$2.14 million (present value terms). The investment produced estimated total expected benefits of \$4.18 million (present value terms). This gave a net present value of \$2.04 million, an estimated benefit-cost ratio of 1.95 to 1, an internal rate of return of 128.5% and a MIRR of 9.6%.

Conclusions

A positive return has been assessed for this project. Several impacts identified were not valued, the impacts were considered uncertain and indirect compared with the impact valued. Consequently, the investment criteria provided by the valuation may be underestimates of the actual performance of the investment.

Keywords

Impact assessment, cost-benefit analysis, onion industry, export, Europe, production protocols, new onion varieties, crop nutrition, curing practice.

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 onion industry is a mature industry with stable production. It is the fourth largest vegetable crop produced in Australia and the second largest vegetable category exported. Onions are grown across most Australian states, but Tasmania and South Australia together produce 71% of the Australian crop. Major growing areas include the north-west region of Tasmania, Upper South Australia, the Adelaide Plains, and the Lockyer Valley of Queensland. Most Australian onions are sold on the fresh market and apparent Australian consumption is 7.8 kg per capita, 7% of the Australian onion crop is sent for processing. Brown onions account for 79% of production, red onions 19%, white onions 1% and shallots/spring onions less than 1% (Hort Innovation 2020).

In the five years ending 30 June 2019, Australia produced an average of 247,423 tonnes of onions valued at \$164.8 million. Australia is a net exporter of onions sending an average of 37,224 tonnes per annum valued at \$26.8 million overseas during the period 2015 to 2019 (Table 1).

Table 1: Australian Onion Production, Value and Exports 2014/15 to 2018/19

Year Ended 30 June	Production (tonnes)	Gross Value of Production (\$m)	Exports (tonnes)	Gross Value of Exports (\$m)
2015	231,465	136.0	39,431	26.8
2016	260,674	157.7	43,888	28.1
2017	237,635	174.2	24,798	18.1
2018	249,145	164.8	30,514	21.7
2019	258,195	191.2	47,490	39.2
Average	247,423	164.8	37,224	26.8

Source: Horticulture Statistics Handbook 2017/18 and 2018/19

Exports are important to Australian onion industry profitability because they remove excess volume from the domestic markets for the season and thereby drive upward price pressure (Hort Innovation 2017).

Europe is by far the biggest market for Australian onions, accounting for around 50% of all exports. Although the statistics record Belgium as being the biggest market, in fact, most of the export is going to Germany through Belgian traders. Almost all of the trade occurs in the April to June quarter in the European counter-season. This market is built around the small seasonal window filling the supply gap at the end of Europe's onion storage and before the start of the local season. It can therefore be a fluctuating market, depending on the quality of the European harvest. This trade is extremely price sensitive and highly dependent on the seasonal conditions in Europe and the ability of European growers to successfully store local product. Australia faces strong export competition in the price and quality sensitive European market from counter- season suppliers New Zealand, South Africa, and Peru (Hort Innovation 2017).

The onion industry has a statutory levy in place for RD&E, marketing, biosecurity, and residue testing programs. The RD&E levy is used for onion research, development, and extension activities across a range of disciplines targeting both on-farm and supply chain sectors in accordance with industry priorities.

Onion RD&E levy investment is guided by the Onion industry's SIP. The current SIP has been driven by levy payers and addresses the Australian onion industry's needs from 2017 to 2021. Strategies and priorities in the SIP have been driven by a set of four desired outcomes (Hort Innovation 2017):

1. Increased domestic consumption
2. Growth in export markets
3. Improved farm productivity
4. An informed and engaged industry.

Rationale

Field Fresh Tasmania (now part of the Sumich Group) produces 44,000 tonnes of onions per year; 27,000 tonnes, valued at \$23 million, are exported to Europe. Field Fresh Tasmania reported that there was a market opportunity to increase exports to Europe by 5% to 10% per annum for five years from 2010. However, to realise this opportunity, Field Fresh Tasmania required onions of consistent quality. Prior to this project, onion exports to Europe were under threat due to inconsistency in field production and turnout in Europe. Research completed for Field Fresh Tasmania showed that poor turnout in Europe has been caused by a run of unusual seasonal conditions, possibly linked to climate change (Glen Graham report to Webster Ltd Board of Directors 2009).

Onions exported to Europe must be robust enough to be graded and packed in Australia, survive up to eight weeks shipping in ambient conditions, be able to be regraded and repacked in Europe and survive long storage in the importing country. Furthermore, in-country storage is in a warming environment (spring, summer), whereas storage and variety testing has previously been based on cooling temperatures (autumn, winter) in Tasmania. All product losses up to and including in-country storage are paid for by the Australian exporter. Unlike the supply of onions to the domestic market, quality issues that were not apparent in Australia may manifest themselves in onions subject to this extended and testing supply chain.

Consequently, the purpose of this project was to develop a new production protocol for Australian onions exported to Europe. The protocol would address firmness, tendency to produce undesirable outer layer skins, and shelf life – attributes that are particularly important in the European market. The protocol would be used to assess

new onion varieties, crop nutrition programs and curing practices for the European market.

The project would build on a body of previous research that established links between the timing of nitrogen application and the use of calcium, phosphorus and potassium to improve onion firmness and shelf life; the use of starter fertiliser, copper and sulphur to improve onion skins; and the testing of stored onions in rising ambient temperatures. The project would also review research that showed that onions that are not firm and are field cured (standard practice in Tasmania) are vulnerable to sun burn and translucent scale.

This task was an ambitious research challenge, and this was reflected in the multistrand methodology and the five-year duration of the project. Field Fresh Tasmania initiated this project through Hort Innovation’s Voluntary Contribution program and company funds were ‘matched’ using Australian Government R&D contributions.

Project Details

Summary

Project Code: VN10001
Title: New onion protocols to assure viability of European exports
Research Organisation: Field Fresh Tasmania
Project Leader: Jason Dennis
Period of Funding: January 2011 to December 2014

Objectives

The objective of this project was to develop an integrated method (protocol) to determine firmness, skins and shelf-life and correlate these measures with superior commercial outcomes in Europe.

Logical Framework

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

Table 2: Logical Framework for Project VN10001

Activities	Major project activities included:
	<ul style="list-style-type: none"> • Formation of a project steering committee made up of University of Tasmania (UTAS) and Field Fresh Tasmania scientists and representatives from the onion industry advisory committee. The steering committee provided advice on trial design, season plans and review of project progress. • Develop a commercially applicable method (protocol) suitable for the assessment of onion exports to Europe. In addition to standard yield, pack-out, and quality measures, the protocol was to address firmness, skins, and shelf life requirements. Protocol development included onion testing using sequences of tumbling to mimic mechanical handling in Australia, diurnal storage to induce hydration/dehydration, further tumbling to mimic European supply chain conditions and a second sequence of storage under conditions designed to test onion dormancy (warm dry days and cool humid nights). • Review new onion varieties against the protocol to determine their suitability for export to Europe. All seed companies that sell varieties in Australia were invited to submit new varieties for assessment. A mix of open pollinated and hybrid brown and red varieties were tested including the cream gold genetic type that has dominated export to Europe. • Evaluate onion crop nutrition programs to deliver export onions suitable for Europe, with emphasis on the timing of nitrogen applications and the evaluation of new products (including those containing copper, sulphur, and other elements) to deliver improved firmness, skins, and shelf life. Priority was given to new products that increase the number of onion leaves or assist with early crop establishment. • Evaluate onion curing strategies to improve onion suitability for European exports. The project investigated the timing of bulb lifting for field curing considering top fall, root

	<p>activity and soil moisture. A new technique to induce senescence when soil moisture was higher than desired was also investigated.</p> <ul style="list-style-type: none"> • The project successfully developed an integrated method to assess new varieties, fertiliser programs and field drying practices, which more accurately measure a crop’s suitability for export to Europe. • The project produced a final report that detailed the new protocol for export of onions to Europe and recommended varieties, crop nutrition programs and curing strategies for this trade. Circulation of the final report was limited for three years after its completion to provide Field Fresh Tasmania with a competitive advantage commensurate with its investment in the project.
Outputs	<p>The important outputs of the project were:</p> <ul style="list-style-type: none"> • New protocols that contribute to the constant production of onions of suitable quality for European export, regardless of any unseasonal climatic conditions. • A new assessment method to better determine the suitability of onions for European exports, before packing.
Outcomes	<ul style="list-style-type: none"> • The continuation of European onion exports at current or greater levels given no change in other conditions (e.g. adverse movements of \$A against the Euro).
Impacts	<ul style="list-style-type: none"> • Economic – contribution to avoided loss of industry profit resulting from cessation of onion exports to Europe (including resultant domestic oversupply and price collapse). • Environmental – avoided waste associated with spoiled onions in both Australia and in the export supply chain (unsold onions, onions that deteriorate in the supply chain). • Capacity – researchers and growers with additional skills in the production of onions suitable for long distance export. The project supported two higher degree by research candidates at UTAS. • Social – future contribution to improved regional community wellbeing with more profitable and sustainable onion growers.

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project VN10001. The project was funded by Field Fresh Tasmania through a Voluntary Contribution of \$745,125 which was then ‘matched’ by Hort Innovation.

Table 3: Annual Investment in Project VN10001 (nominal \$)

Year ended 30 June	HORT INNOVATION (\$ matching funding)	FIELD FRESH TAS. (\$ voluntary contribution)	TOTAL (\$)
2011	106,772	149,025	255,797
2012	106,772	149,025	255,797
2013	106,772	149,025	255,797
2014	106,772	149,025	255,797
2015	106,772	149,025	255,797
Total	533,860	745,125	1,278,985

Source: VN10001 Executed Research Agreement

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 the 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 costs of extension were included; Field Fresh Tasmania delivered the project and was the major beneficiary of the research.

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 VN10001

Economic	<ul style="list-style-type: none"> Contribution to avoided loss of industry profit resulting from cessation of onion exports to Europe (including resultant domestic oversupply and price collapse).
Environmental	<ul style="list-style-type: none"> Avoided waste associated with spoiled onions in both Australia and in the export supply chain (unsold onions, onions that deteriorate in the supply chain).
Social	<ul style="list-style-type: none"> Researchers and growers with additional capacity in the production of onions suitable for long distance export. The project supported two higher degree by research candidates at UTAS. Future contribution to improved regional community wellbeing with more profitable and sustainable onion growers.

Public versus Private Impacts

Impacts from investment in VN10001 will be mainly private and realised by all onion growers and exporters through avoided profit loss. Tasmanian based onion growers and exporters will use the project generated protocol to deliver superior commercial outturns in Europe. Longer term it is possible that growers in other states will make use of the protocol to service additional markets.

Distribution of Private Impacts

Economic benefits from avoided profit loss will be shared along the supply chain with input suppliers (e.g. seed, chemical, fertiliser), transporters, and exporters all benefiting. The share of benefit realised by each link in the supply chain will depend on both short- and long-term supply and demand elasticities in domestic and export onion markets.

Impacts on Other Australian Industries

Lessons learnt from this project may also be relevant to the production of other allium species including garlic, leek, and chive.

Impacts Overseas

Protocol content will have direct relevance for other Southern Hemisphere onion growing and exporting countries especially those supplying Europe (New Zealand, South Africa, and Peru). For this reason, protocol content was kept confidential.

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 1, 3 and 7.

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 Onion Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the onion industry are outlined in the Onion Industry’s Strategic Investment Plan 2017-2021¹ (Hort Innovation, 2017). Project VN10001 commenced prior to the industry’s current SIP. Nevertheless, the project aligns with Outcome 2 ‘export growth achieved through market diversification and product customisation, to support and maintain domestic pricing’.

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.

A single key impact was valued – contribution to avoided loss of industry profit resulting from cessation of onion exports to Europe.

Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. The three impacts identified but not valued were:

- Avoided waste associated with spoiled onions in both Australia and in the export supply chain.
- Researchers and growers with additional skills in the production of onions suitable for long distance transport.
- Future contribution to improved regional community wellbeing with more profitable and sustainable onion growers.

These potential impacts were not valued due to an absence of data that would allow the development of credible assumptions.

Valuation of Impact: Contribution to avoided loss of industry profit resulting from cessation of onion exports to Europe

The VN10001 investment provided a new production protocol to contribute to the ongoing viability of Australian onion exports to Europe. In the absence of this protocol it is likely that Australian onion exports would continue to experience inconsistent turnout in Europe, there would be a loss of confidence in the product, substitution of Australian onions for supply from other Southern Hemisphere competitors and a diversion of export onions onto the domestic market. Diversion of export onions onto the domestic market would result in a reduction in price received by onion growers for a number of years until less onions were produced, or new export markets could be established.

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

Attribution

VN10001 did not provide a complete solution to inconsistent Australian onion turnout in Europe. The final VN1001 report notes:

Restoring consistency to European export quality remains an ongoing challenge, but substantial headway has been made in this project by the development of a new assessment method which has been successfully applied to variety, fertiliser and curing trials. Finally, further work is recommended to better understand the influence of the transit conditions during shipping on onion quality. This area of research by its very nature is complex and will likely require a multi-disciplinary approach.

The onion export protocol for Europe developed as part of this project draws on knowledge generated by previous research including knowledge relating to varieties, crop nutrition, and curing. Consequently, an impact attribution factor that considers both past and future investment of 50% has been used for the VN10001 impact assessment.

Counterfactual

The scenario assumed if the investment had not been made is that it is 50% likely that some other project would have addressed production protocols to improve onion export quality. DPIPWE and UTAS are two institutions with an interest and capacity in this area.

Summary of Assumptions

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

Table 6: Summary of Assumptions

Variable	Assumption	Source/Comment
Impact 1: Contribution to avoided loss of industry profit resulting from cessation of onion exports to Europe		
Australian onion production.	247,423 tonnes.	5 year average 2015 to 2019, Horticulture Statistics Handbook 2017/18 and 2018/19.
Loss in onion grower profit with closure of the European export market.	\$35/tonne.	Consultant estimate assuming a 7.5% reduction in average onion price of \$459/tonne and costs of production of \$304/tonne. Price and production data sourced from ABARES via AUSVEG website (https://ausveg.com.au/resources/economics-statistics/australian-vegetable-production-statistics/#pricecost).
Year of first impact.	2015/16	Consultant estimate – European exporters lose faith in Australian exports five years after experiencing inconsistent turnouts in 2011 and in the absence of VN10001 linked improvements.
Year of last impact.	2019/20	Consultant estimate – profit recovers after 5 years when either less onions are produced, or new export markets are established.
Probability of European market loss to Australian onion exporters with inconsistent turnout.	50%	Consultant estimate – market loss 50% likely in the absence of VN10001 investment.
Probability of VN10001 generating a valuable output.	100%	Project has already generated valuable information to improve exports to Europe.
Probability of VN10001 outcome adoption.	100%	Project research completed by Field Fresh Tasmania who dominate Australian onion exports to Europe.

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 (2014/15) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

Tables 7 and 8 show the investment criteria estimated for different periods of benefit for the total investment and Hort Innovation investment, respectively. The present value of benefits (PVB) attributable to Hort Innovation investment only, shown in Table 8, has been estimated by multiplying the total PVB by the Hort Innovation proportion of real investment (45.4%).

Table 7: Investment Criteria for Total Investment in Project VN10001

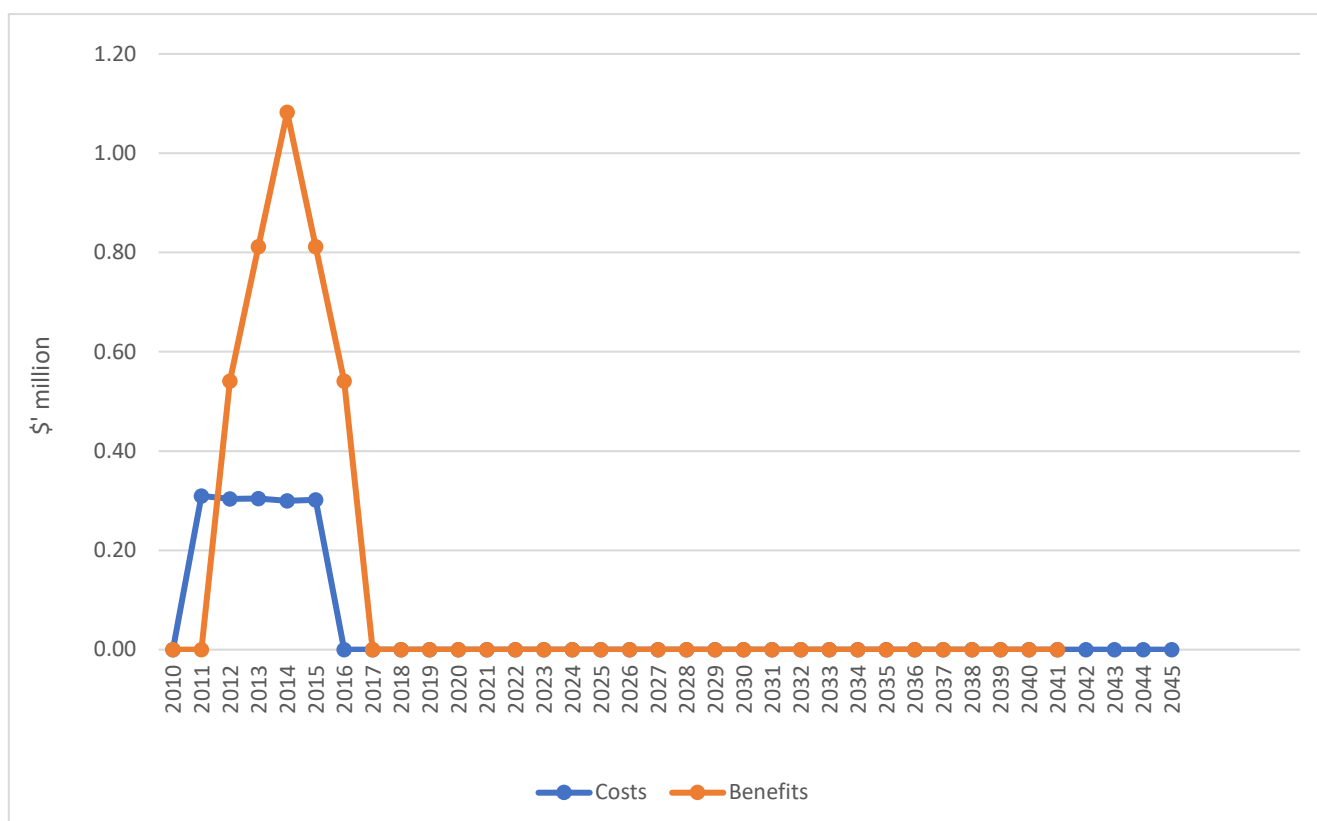
Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.00	4.18	4.18	4.18	4.18	4.18	4.18
Present Value of Costs (\$m)	2.14	2.14	2.14	2.14	2.14	2.14	2.14
Net Present Value (\$m)	-2.14	2.04	2.04	2.04	2.04	2.04	2.04
Benefit-Cost Ratio	0.00	1.95	1.95	1.95	1.95	1.95	1.95
Internal Rate of Return (%)	negative	128.5	128.5	128.5	128.5	128.5	128.5
MIRR (%)	negative	56.5	22.0	15.1	12.2	10.6	9.6

Table 8: Investment Criteria for Hort Innovation Investment in Project VN10001

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.00	1.90	1.90	1.90	1.90	1.90	1.90
Present Value of Costs (\$m)	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Net Present Value (\$m)	-0.97	0.93	0.93	0.93	0.93	0.93	0.93
Benefit-Cost Ratio	0.00	1.95	1.95	1.95	1.95	1.95	1.95
Internal Rate of Return (%)	negative	128.5	128.5	128.5	128.5	128.5	128.5
MIRR (%)	negative	56.5	22.0	15.1	12.2	10.6	9.6

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the VN10001 investment plus 30 years from the last year of investment are shown in Figure 2.

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 a low level of 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)	3.79	4.18	4.62
Present Value of Costs (\$m)	1.52	2.14	2.99
Net Present Value (\$m)	2.27	2.04	1.63
Benefit-cost ratio	2.49	1.95	1.54

A sensitivity analysis was then undertaken for the loss of onion grower profit associated with closure of the European market. Results are provided in Table 10. The project 'breaks even' when profit loss is half that assumed i.e. \$18/tonne.

Table 10: Sensitivity to Loss of Profit with Closure of the European Market
(Total investment, 30 years)

Investment Criteria	Loss of Profit		
	\$ (breakeven)	\$20/tonne	\$35/tonne (base)
Present Value of Benefits (\$m)	2.15	2.39	4.18
Present Value of Costs (\$m)	2.14	2.14	2.14
Net Present Value (\$m)	0.01	0.25	2.04
Benefit-cost ratio	1.00	1.12	1.95

A final sensitivity analysis tested the sensitivity of the investment criteria to the probability of European market closure to Australian onions. The results (Table 11) show that the investment 'breaks even' with a halving of assumed probability.

Table 11: Sensitivity to European Market Closure
(Total investment, 30 years)

Investment Criteria	Probability of Market Closure		
	25%	50% (base)	75%
Present Value of Benefits (\$m)	2.09	4.18	6.28
Present Value of Costs (\$m)	2.14	2.14	2.14
Net Present Value (\$m)	-0.05	2.04	4.13
Benefit-cost ratio	0.98	1.95	2.93

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	Medium

Coverage of benefits valued was assessed as Medium-High. While the key impact – contribution to avoided loss of industry profit resulting from cessation of onion exports to Europe – was valued, three other impacts were not quantified. Confidence in assumptions was rated as Medium, most of the data used came from credible sources, some key assumptions were made by the analyst.

Conclusion

The investment in VN10001 has produced an onion production protocol which will contribute to the supply of consistent exports to the European market. Australian onion exports are dominated by sales to Europe and exports are important to the Australian onion industry because they remove excess volume from domestic markets and drive upward price pressure.

Total funding from all sources for the project was \$2.14 million (present value terms). The investment produced estimated total expected benefits of \$4.18 million (present value terms). This gave a net present value of \$2.04 million, an estimated benefit-cost ratio of 1.95 to 1, an internal rate of return of 128.5% and a modified internal rate of return of 9.6%.

As several impacts identified 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

AL	Almond
BA	Banana
CRRDC	Council of Research and Development Corporations
CT	Citrus
DAWR	Department of Agriculture and Water Resources (Australian Government)
DPIPWE	(Tasmanian) Department of Primary Industries, Parks, Water and Environment
FFT	Field Fresh Tasmania
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
UTAS	University of Tasmania
VN	Onion