Industry-specific impact assessment program: Citrus

Impact assessment report for project *Data packages to support market access for additional citrus varieties to Japan* (CT15011)

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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 *CT15011: Data packages to support market access for additional citrus varieties to Japan.* The project was funded by Hort Innovation over the period 15 September 2015 to 28 February 2017.

Methodology

The investment was analysed qualitatively within a logical framework that included activities and outputs, outcomes and impacts. Impacts were categorised into a triple bottom line framework. The principal impact identified was then considered for valuation. 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.

Results/key findings

The investment in Project CT15011 is likely to contribute to a future increase in the quantity and value of exports of mandarins to Japan from Australia, thus increasing industry profitability. This will benefit the Australian citrus industry, including citrus growers, citrus supply chains and citrus exporters.

Investment Criteria

Total funding from all sources for the project was $0.14 million (present value terms). The investment produced total expected benefits of $0.43 million (present value terms). This gave a net present value of $0.29 million, an estimated benefit-cost ratio of 3.02 to 1, an internal rate of return of 12.9% and a modified internal rate of return of 9.1%. However, as a number of other impacts identified were not valued in monetary terms, the investment criteria as provided by the valued benefit are likely to be underestimated.

Conclusions

The trials funded via Project CT15011 were successful in producing a data package that is being considered by regulatory authorities in Japan and is likely to result in import acceptance of Australian mandarins and other citrus types via cold disinfestation treatment. Japan's acceptance of cold disinfestation for Afourer mandarins is also considered an important mitigation measure against the potential collapse of the Riverland Pest Free Area where several recent outbreaks of pests have led to exports from parts of the Riverland region in South Australia being suspended.

Keywords

Impact assessment, cost-benefit analysis, CT15001, mandarin, citrus industry, Japan, market access

Introduction

All research and development (R&D) and marketing levy investments undertaken by Horticulture Innovation Australia Limited (Hort Innovation) are guided and aligned to specific investment outcomes, defined through a Strategic Investment Plan (SIP). The SIP guides investment of the levy to achieve each industry's vision. The current industry SIPs apply for the financial years 2016/17 – 2020/21.

In accordance with the Organisational Evaluation Framework, Hort innovation has the obligation to evaluate the performance of its investment undertaken on behalf of industry.

This impact assessment program addresses this requirement through conducting a series of industry-specific ex-post independent impact assessments of the 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 24 projects worth approximately $16.72 million,
- Eight CT projects worth $5.40 million (nominal Hort Innovation investment) from a total population of 35 projects worth $15.78 million, and
- Four VN projects worth $2.40 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. Four projects had been randomly selected as part of a related Hort Innovation project (MT18011) and were included in the samples for the AL industry (AL14006 and AL16004) and the CT industry (CT15006 and CT15013). This left 25 unique projects randomly selected for evaluation under MT19012.

Project CT15011: *Data packages to support market access for additional citrus varieties to Japan* was randomly selected as one of the 25 unique MT19012 investments and was analysed in this report.

General Method

The impact assessment follows general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres, State Departments of Agriculture, and some universities. The approach includes both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2018).

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts. The principal economic, environmental and social impacts were then summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were then valued in monetary terms. Where impact valuation was exercised, the impact assessment uses cost-benefit analysis as its principal tool. The decision not to value certain impacts was due either to a shortage of necessary evidence/data, a high degree of uncertainty surrounding the potential impact, or the likely low relative significance of the impact compared to those that were valued. The impacts valued are therefore deemed to represent the principal benefits delivered by the project. However, as not all impacts were valued, the investment criteria reported for individual investments potentially represent an underestimate of the performance of that investment.

Background & Rationale

Citrus Industry

The Australian citrus industry is one of Australia's 'traditional' horticultural industries. A range of citrus types are produced in Australia. Oranges are the predominant citrus type grown by tonnage followed by mandarin, lemon/lime and grapefruit, in that order. South Australia is a significant producer and exporter of citrus including both oranges and mandarins

Tables 1 and 2 provide information on citrus production and exports by State. These tables show South Australia is the second largest exporter of mandarins after Queensland. South Australia also is the second largest exporter of oranges after Victoria. Table 3 shows the export destinations for Australian mandarins and that exports to Japan are included in the Other category.

Table 1: Australian Fresh Mandarin Exports by State for Years ending June 2017 to 2019 (tonnes)

State	Year ended June		
	2017	2018	2019
Queensland	30,525	44,374	36,820
South Australia	10,695	15,210	16,956
Victoria	7,324	3,472	4,377
New South Wales	418	839	1,185
Western Australia	30	42	132
Other	2,048	23	1
Total	51,041	63,960	59,471

Source: Australian Horticultural Statistics Handbook 2018/19

Table 2: Australian Fresh Orange Exports by State Years ending June 2017 to 2019 (tonnes)

State	Year ended June		
	2017	2018	2019
Victoria	76,536	89,127	89,138
South Australia	58,928	68,121	60,347
New South Wales	23,683	27,918	34,787
Queensland	2,633	1,579	2,054
Western Australia	1,917	2,550	1,730
Other	346	748	Negligible
Total	164,044	190,043	188,056

Source: Australian Horticultural Statistics Handbook 2018/19

Table 3: Fresh Australian Mandarin Exports by Country (tonnes)

Year ended June	China	Thailand	Hong Kong	UAE	US	Other	Total
2017	9,461	7,884	3,692	4,703	3,586	21,714	51,041
2018	19,337	9,237	4,926	3,385	4,279	22,795	61,960
2019	16,059	7,482	4,755	4,537	4,105	22,534	59,471
Average	14,952	8,201	4,458	4,208	3,990	22,348	57,491

The research and development activities of the citrus industry are guided by the industry's Strategic Investment Plan (SIP). The activities are funded by levies payable on citrus produced in Australia.

The process of preparing the latest SIP was managed by Hort Innovation in consultation with the Industry Representative Body (Citrus Australia) and the Strategic Investment Advisory Panel. The current citrus SIP has been driven by levy payers and addresses the Australian citrus industry's research and development (R&D) needs (and marketing specifically for the orange industry) from 2017 to 2021.

Project Rationale

Australian export markets for citrus were increasingly being targeted at Asian markets. Markets in China and Japan were already increasing and profitable to the industry. The growth in citrus exports, including those to Asian countries including Japan, has been attributed to the reputation of Australian citrus fruit being high quality and having excellent food safety standards.

In terms of total citrus exports, South Australia is the second largest exporter of mandarins after Queensland (Table 4) and the second largest exporter of oranges after Victoria (Table 5). Before Project CT15011 commenced the export of Australian mandarins to Japan was valued at about $3m per annum.

The Riverland region of South Australia is recognised by the Japanese authorities as being free from all species of fruit flies. Accordingly, citrus is exported to Japan from the Riverland under Pest Free Area certification. Citrus exports from other states (where fruit flies are known to occur) takes place under in-transit cold disinfestation. The cold disinfestation protocols were developed several decades ago and the Japanese regulatory authorities (Ministry of Forestry Agriculture and Fisheries (MAFF)) accepted cold disinfestation as an export pathway only for certain citrus varieties — namely navel and Valencia oranges, Mineola tangelos, Murcotts, Imperial mandarins and Ellendale mandarins (David Daniels, pers. comm., 2020).

Since 2007, there have been plantings in Australia of new mandarin varieties that are not covered under the existing market access protocol. For example, varieties of Afourer and Dekopons mandarins, as well as blood oranges, are expected to have significant market opportunities in Japan, but cannot be exported from states other than South Australia under the existing market access protocols. Moreover, if the Pest Free Area status of the Riverland was ever revoked (due to pest incursions) the existing trade in mandarin varieties (e.g. Afourer) would end (David Daniels, pers. comm., 2020).

The existing project was conceived to demonstrate the efficacy of cold disinfestation against Mediterranean fruit fly for the above two mandarin varieties as well as for blood oranges. The methods to be used were based on advice provide by MAFF in Japan.

Project Details

Summary

Project Code: CT15011

Title: *Data packages to support market access for additional citrus varieties to Japan*

Research Organisation: South Australian Research and Development Institute

Project Leaders: Peter Taverner and Nancy Cunningham

Period of Funding: 15 September 2015 to 28 February 2017

Objective

The objective of the investment was to demonstrate the efficacy of cold disinestation at 3° C against Mediterranean fruit fly in Afourer mandarins, Dekopon mandarins, and blood oranges, using Valencia oranges and Ellendale mandarins as accepted trade standards.

Logical Framework

Table 4 provides a description of Project CT15001 in a logical framework format, organised by project activities, outputs, outcomes and impacts.

Table 4: Logical Framework for Project CT15011

Activities	• The methods used in the trials assumed an infestation rate of at least fifteen larvae per fruit. • A control sample of 80 fruit of each cultivar were randomly selected and infected with fruit fly larvae. • The number of pupae per fruit from the control sample was used to estimate the number of larvae in the treatment fruit. • Fruit from each cultivar were placed in the incubation chamber and other fruit were placed in the cold treatment chamber. • The cold stored fruit were held at 3.1 degrees C. for a period of 17 days and sampled each day from the 8th to the 17th day. • This allowed the efficacy of the cold treatment process to be assessed.
Outputs	• Data packages from the trials that demonstrate the efficacy of cold disinfestation at 3°C against Mediterranean fruit fly in Afourer mandarins, Dekopon mandarins and blood oranges using Valencia oranges and Ellendale mandarins as accepted trade standards. • Results show that the trial supports the claim that Afourer and Dekapon are at least equivalent to Ellendale in regard to achieving full mortality of Medfly using a cold treatment of 3.1 ±0.5°C for 18 days. • The trial also supports the claim that Moro blood orange are at least equivalent to Valencia orange in regard to achieving full mortality of Medfly using a cold treatment of 3.1 ±0.5°C for 18 days. (David Daniels, pers. comm., 2020).
Outcomes	• The targeted outcome from this project was to present data to the Japanese authorities that would support a change in Japanese import regulations to allow the entry of additional citrus varieties. However, as with many other market access issues, the situation has evolved since the project was funded. • Shortly after the CT15011 trials were completed, Annexes 16 & 17 to the International Standard on Phytosanitary Measures 28 (Cold treatment for *Bactrocera tryoni* on Citrus reticulata x C. sinensis) (Cold treatment for *Bactrocera tryoni* on Citrus sinensis) were adopted by all WTO member states, including Japan. • The associated implication is that the Japanese authorities accept that there is no technical reason why cold disinfestation should not apply to all varieties of mandarins and oranges. While this is a technical victory, Japan MAFF would still be required to amend its import regulation before new trade could take place. This market access request is currently being progressed. • Nevertheless, the data generated by the project can still be used as part of the body of evidence to be presented to Japan MAFF (David Daniels, pers. comm, 2020). • Circa 2010, there was a surge in mandarin plantings in Australia. This was a trend also seen worldwide in other citrus producing countries. Many of those plantings are entering into full production and Citrus Australia predicts an increase in the production volume of Afourer (and Afourer type) mandarins of 30,000 tonnes by 2027. Hence, it is important that there are as many markets as possible in which to place these mandarins, including export markets (David Daniels, pers. comm., 2020).
Impacts	• Potentially, the project has made a contribution to an increase in exports of mandarins to Japan for varieties currently exported to less profitable markets. • Japan's acceptance of cold disinfestation for Afourer mandarins is also considered an important mitigation measure against the potential collapse of the Riverland Pest Free Area. This is not a hypothetical risk as there have been several recent outbreaks leading to large parts of the Riverland being suspended in recent years.

Project Investment

Nominal Investment

Table 5 shows the annual investment in project CT15001 by Hort Innovation. There were no 'other' investors in this project.

Table 5: Annual Investment in Project CT15001 (nominal $)

Year ended 30 June	Hort Innovation ($)	Total ($)
2016	56,000	56,000
2017	39,043	39,043
Totals	95,043	95,043

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 5.

Real Investment and Extension Costs

For the purposes of the investment analysis, investment costs of all parties were expressed in 2019/20 dollar terms using the GDP deflator index (ABS, 2020). There were no additional costs assumed associated with project extension. Results were communicated to the industry, the Australian Government, and others as part of the project.

Impacts

Table 6 provides a summary of the principal types of impacts delivered by the project. Impacts have been categorised into economic, environmental and social impacts.

Table 6: Triple Bottom Line Categories of Principal Impacts from Project CT15011

Economic	• Potential contribution to an increase in exports of Australian citrus types to Japan, with implications for increased profitability of Australian citrus production. • Reduced impact of future potential collapse of part of the Riverland Pest Free Area in terms of market access to Japan.
Environmental	• Nil
Social	• Regional community spill-over impacts driven by increased profits by citrus growers and their supply chains.

Public versus Private Impacts

Predominantly private industry impacts to Australian citrus supply chains were identified as emanating from the investment. Some public impacts have been delivered as a spin-off to regional communities in citrus growing areas.

Distribution of Private Impacts

The positive impacts on the citrus industry from investment in this project are likely to be shared along the supply chain among growers, packers, wholesalers, and exporters and associated agents.

Impacts on Other Australian Industries

Impacts on industries other than the citrus industry are not anticipated from the CT15011 investment.

Impacts Overseas

No direct overseas impacts of CT15011 were identified. However, some overseas citrus exporters may indirectly lose some market profitability as Australian mandarin exports to Japan may increase due to the investment.

Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E priorities are reproduced in Table 7. The project findings and related impacts will contribute potentially to Rural RD&E priority 2 and 4 and to Science and Research Priority 1.

Table 7: 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 Citrus Strategic Investment Plan 2017-2021

The current strategic outcomes and strategies of the citrus industry are outlined the Citrus Strategic Investment Plan 2017-2021[1] (2017). Project CT15011 is directly relevant to a number of the desired outcomes in the SIP. First the project directly addresses the Outcome 1: "Market opportunities in both domestic and especially export markets have been developed and maintained, leading to increased demand and support for citrus prices". This outcome is directly addressed by CT15011 through the embedded strategy 1.1. In addition, the project addresses Outcome 2 via strategy 2.1 (Safeguard the Australian citrus industry from future biosecurity and phytosanitary risks throughout the value chain).

Valuation of Impacts

Impacts Valued

The impact valued in the economic assessment of CT15011 was:

- Potential contribution to an increase in exports of Australian mandarins to Japan

Impacts Not Valued

The impacts identified but not valued were:

- Apart from mandarins, other potential citrus types (e.g. blood oranges) were included in the project trials; however, only the future market access benefit for mandarins was included in the monetary valuation due to a lack of information on the current production and markets for the other citrus types included in the trials.
- Reduced impact of future potential collapse of part of the Riverland Pest Free Area (the second economic impact in Table 6) was not valued due to the uncertainty of the likelihood of such a collapse, and the duration and extent of any collapse.

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

- The third impact in Table 6 (the regional community spill-overs) was not valued due to the difficulty of making sound linkage assumptions between the project and the impact, the diversity of geographic locations involved, and the lack of time and resources.

Summary of Assumptions

The impact that was valued was the potential contribution of Project CT15011 to an increase in mandarin exports to Japan replacing exports to lower priced export markets. The assumptions that have been developed to value the increased export value are provided in Table 8.

Table 8: Summary of Assumptions for Impact Valued

Variable	Assumption	Source/Comment
Impact 1: Industry gain due to increase in mandarin exports to Japan		
Value of Australian mandarin exports to Japan pre-investment	$3m per annum	Project proposal
Quantity of new mandarin exports to Japan due to project investment	10% of existing total exports	Analyst assumptions; it is too early in 2020 for existing export data to show any difference. Note that first year of any impact is likely to be 2022. While the project has secured a technical victory, Japan MAFF would still be required to amend its import regulation before new trade could take place. This market access request is currently being progressed in 2020 according to David Daniels.
Increase in price of new mandarin exports to Japan compared to existing export market destinations	20%	
First year of some impact from investment	2022	
Years to maximum adoption	4	
Year of maximum adoption	2025	
Risk and attribution factors		
Probability of outcome (Japan market access achieved for additional mandarin types)	75%	Analyst assumptions
Probability of impact (value increase from mandarin exports to Japan replacing other exports)	75%	
Attribution to CT15011	100%	Analyst assumption; despite Japan's acceptance of the International Standard on Phytosanitary Measures 28, MAFF Japan still has to amend its import regulation before new trade can take place.

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 (2016/17) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

Tables 9 and 10 show the investment criteria estimated for different periods of benefits for the total investment and the Hort Innovation investment alone. As Hort Innovation was the only investor in the project, the investment criteria are the same for both tables.

Table 9: Investment Criteria for Total Investment in Project CT15011

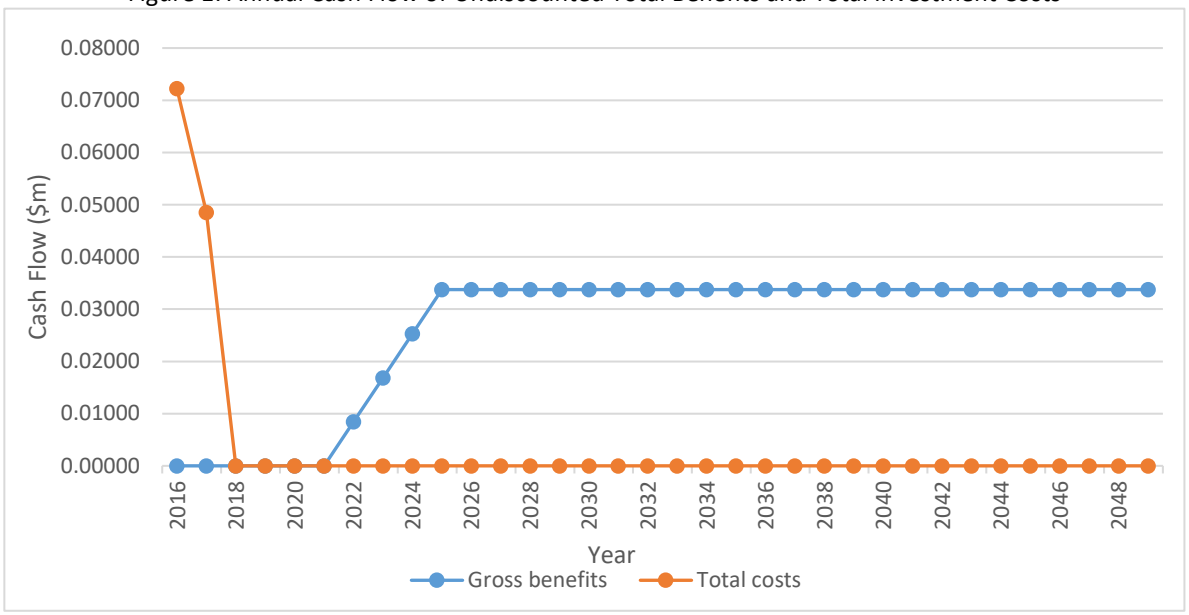
Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	0.04	0.16	0.26	0.33	0.39	0.43
Present Value of Costs ($m)	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Net Present Value ($m)	-0.14	-0.10	0.02	0.11	0.19	0.25	0.29
Benefit-Cost Ratio	0.00	0.30	1.13	1.79	2.30	2.70	3.02
Internal Rate of Return (%)	negative	negative	6.37	10.45	11.95	12.59	12.88
MIRR (%)	negative	negative	6.45	9.45	9.68	9.44	9.07

Table 10: Investment Criteria for Hort Innovation Investment in Project CT15011

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	0.04	0.16	0.26	0.33	0.39	0.43
Present Value of Costs ($m)	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Net Present Value ($m)	-0.14	-0.10	0.02	0.11	0.19	0.25	0.29
Benefit-Cost Ratio	0.00	0.30	1.13	1.79	2.30	2.70	3.02
Internal Rate of Return (%)	negative	negative	6.37	10.45	11.95	12.59	12.88
MIRR (%)	negative	negative	6.45	9.45	9.68	9.44	9.07

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the CT15011 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 11 presents the results that show a moderately high sensitivity to the discount rate.

Table 11: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	Discount rate		
	0%	5%	10%
Present Value of Benefits ($m)	0.89	0.43	0.25
Present Value of Costs ($m)	0.12	0.14	0.17
Net Present Value ($m)	0.77	0.29	0.08
Benefit-cost ratio	7.40	3.02	1.44

A sensitivity analysis was then undertaken for the price increase achieved for the additional mandarin exports to Japan. Results are provided in Table 12.

Table 12: Sensitivity to Assumption of Price Increase for the New Mandarin Exports to Japan
(Total investment, 30 years)

Investment Criteria	Increase in Price for New Mandarin Exports to Japan		
	15%	20% (Base)	25%
Present Value of Benefits ($m)	0.33	0.43	0.54
Present Value of Costs ($m)	0.14	0.14	0.14
Net Present Value ($m)	0.18	0.29	0.40
Benefit-cost ratio	2.26	3.02	3.77

A sensitivity analysis was then undertaken for the increase in Australian mandarin exports due to market access to Japan for additional Australian citrus types. Results are provided in Table 13.

Table 13: Sensitivity to Assumption of the Increase in Mandarin Exports due to Japan Market Access
(Total investment, 30 years)

Investment Criteria	Mandarin Export Increase over Existing Exports		
	5%	10% (Base)	15%
Present Value of Benefits ($m)	0.22	0.43	0.65
Present Value of Costs ($m)	0.14	0.14	0.14
Net Present Value ($m)	0.07	0.29	0.51
Benefit-cost ratio	1.51	3.02	4.52

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 14). 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 14: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
Medium-Low	Low

Coverage of benefits was assessed as Medium-Low. The most important impact from the investment was valued. The impacts relating to potential market access for other citrus types (e.g. blood oranges), the risk of a future lowered impact of a fruit fly incident in the Riverland, and the increased regional community spill-overs were not valued. Consequently, the investment criteria as provided by the valued benefits are likely to be underestimated.

Confidence in assumptions for valuation was rated as Low as many of the assumptions made refer to the success and timing related to the Japan MAFF protocol development as well as the increased Australian mandarin exports to Japan and their associated prices.

Conclusions

The investment in Project CT15011 is likely to have contributed to an increased value of exports of mandarins from Australia, thus increasing industry profitability.

Total funding from all sources for the project was $0.14 million (present value terms). The investment produced estimated total expected benefits of $0.43 million (present value terms). This gave a net present value of $0.29 million, an estimated benefit-cost ratio of 3.02 to 1, an internal rate of return of 12.9% and a modified internal rate of return of 9.1%.

However, as number of other impacts identified in the analysis were not valued in monetary terms, the investment criteria as provided by the valued benefits are likely to be underestimated.

Glossary of Economic Terms

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

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Abbreviations

CRRDC	Council of Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Australian Government)
GDP	Gross Domestic Product
OCS	Office of Chief Scientist Queensland
R&D	Research and Development
RD&E	Research, Development and Extension
SIP	Strategic Investment Plan