Hort Innovation

First year report

Horticulture Impact Assessment Program:

2019 Aggregate Report (2017/18 Sample)

Impact analyst

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What the report is about

This report describes a process for evaluating a series of project investments in research, development and extension (RD&E) by Horticulture Innovation Australia Limited (Hort Innovation). The process has been used to identify and report the impacts from, and economic performance of, 15 individual project investments. These 15 project investments were drawn at random from a population of completed projects that was defined as projects that had a final deliverable submitted during the year ending June 2018 that included Hort Innovation levy funds and had a total project value greater than, or equal to, $80,000 over each project's lifetime.

Methodology

The sample of RD&E projects was drawn at random using a random number technique. The sample was stratified by six, pre-defined investment value ranges to represent the spectrum of Hort Innovation RD&E investments by size. Further, the stratified, random sample was constructed to make up at least 10% by value of the total project population investment (Hort Innovation investment only, in nominal terms).

Each of the 15 projects was evaluated using a logical framework approach that reported project objectives, activities and outputs, outcomes, and impacts. Impacts for each project were categorised and described in a triple bottom line framework. Some of the impacts identified were then valued in monetary terms. Project Principal Investigators, Hort Innovation personnel and industry personnel were consulted and assisted with information relevant to the project descriptions as well as to assumptions relevant to the impact valuations.

The investment criteria reported for the individual projects included the present value of costs, the present value of benefits, net present value, Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR) and Modified IRR. Individual investment criteria were estimated for all 15 of the projects selected in the 2017/18 sample.

The investment criteria that were estimated and reported include the investment criteria for each project investment and the aggregate investment criteria for all 15 projects.

Results/key findings

The 15 RD&E projects subjected to impact assessment were found to have produced a range of economic, environmental and social impacts. Eighty-six (86) individual impacts were subjectively identified. Of these, approximately 42% were classified as economic (36), 13% environmental (11) and 45% social (39).

Across the 15 projects assessed the leverage ratio (defined as the ratio of non-Hort Innovation investment to Hort Innovation investment) varied from 0 to 1.96 on an individual project basis (nominal terms). The weighted average leverage ratio for all 15 projects was approximately 0.82 (nominal terms).

Aggregate investment criteria

Total funding from all sources for the 15 project investments totalled $21.20 million (present value terms) and produced estimated total expected benefits of $62.95 million (present value terms). This gave an aggregate weighted average BCR of approximately 3.0 to 1 after 30 years at a 5% discount rate. The results are consistent with other, similar evaluations of agricultural RD&E investments conducted by the evaluation team where average BCRs have been estimated between 2 and 6 to 1.

Conclusions

The 2017/18 sample was considered largely representative of the investment in Hort Innovations overall RD&E porfolio for the same period. Therefore, the impacts and aggregate investment criteria estimated are indicative of impacts and performance across the broader suite of RD&E undertaken by Hort Innovation. Thus, the positive results reported should be viewed with confidence by Hort Innovation, the various Australian horticulture industries represented (including their levy payers and managers), and policy personnel responsible for allocation of public funds.

Keywords

Impact assessment, cost-benefit analysis, aggregate assessment, investment criteria, RD&E performance

Introduction

Horticulture Innovation Australia Limited (Hort Innovation) required a series of impact assessments to be carried out annually on a number of investments in the Hort Innovation research, development and extension (RD&E) portfolio. The assessments were required to meet the following Hort Innovation evaluation reporting requirements:

- Reporting against the Hort Innovation's current Strategic Plan and the Evaluation Framework associated with Hort Innovation's Statutory Funding Agreement with the Commonwealth Government.
- Reporting against strategic priorities set out in the Strategic Investment Plan for each Hort Innovation industry fund.
- Annual Reporting to Hort Innovation stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).

To meet these reporting requirements, the first series of impact assessments included 15 randomly selected Hort Innovation RD&E investments (projects) worth a total of approximately $9.31 million (nominal Hort Innovation investment). The investments were selected from an overall population of 85 Hort Innovation investments worth an estimated $50.38 million (nominal Hort Innovation investment) where a final deliverable had been submitted in the 2017/18 financial year.

The 15 investments were selected through a stratified, random sampling process such that investments chosen represented at least 10% of the total Hort Innovation RD&E investment in the overall population (in nominal terms) and was representative of the Hort Innovation investment across six, pre-defined project size classes.

This report presents a summary and the aggregate results for the first series of annual impact assessments of RD&E investments made by Hort Innovation (hereafter referred to as the 2017/18 sample).

Population & Sample Selection

Defining the Population

The population of Hort Innovation projects from which the first annual impact assessment sample was drawn was defined as all Hort Innovation projects that:

(a) Were completed in the 2017/18 financial year (a completed project was defined as an RD&E investment where a final deliverable had been submitted and subsequently accepted by Hort Innovation by 30 June 2018),
(b) Included Hort Innovation levy funds, and
(c) Had a total Hort Innovation managed investment value of $\geq$ $80,000.

Based on this population definition, Hort Innovation personnel provided the evaluation team (AgEconPlus and Agtrans Research) with a population dataset that contained 85 individual project investments with a total Hort Innovation investment value of approximately $50.4 million (whole population).

For each project in the population a suite of project data was captured to support selection of the stratified random sample. Data included the project code, project title, project fund code, start date, and completion date. The data for each project also included financial data (total investment over each project's life) for Hort Innovation and its funding partners.

The data were integrated and rationalised by the evaluation team so that all relevant information (e.g. project code, completion date, and total Hort Innovation managed investment) could be observed and used in the sampling process.

Sample Selection Criteria

The sample of projects to be subjected to impact assessment (evaluation) was selected against the following criteria:

1. A total of 15 projects in the sample.
2. The total sample to represent at least 10% of the total Hort Innovation managed investment in the overall population ($50.4 million in nominal terms).
3. Sample projects must be randomly selected from the population (defined above).
4. The sample to be stratified across a set of pre-determined, Hort Innovation investment value ranges according to the proportion of projects (by Hort Innovation investment value) in each value range in the population (see Table 1 below).

Table 1: Hort Innovation RD&E Investment Value Ranges

Range Identifier	Value Range	Total Project Value[(a)] in each Value Range ($)	Value Range as a Proportion of Population (%)
1	$50,000 and under[(b)]	0	0.0
2	$50,000 - $100,000	694,671	1.4
3	$100,000 - $200,000	4,024,742	8.0
4	$200,000 - $500,000	8,344,089	16.6
5	$500,000 - $1M	9,624,703	19.1
6	$1M and above	27,691,784	55.0
Total		50,379,989	100.0

(a) Hort Innovation managed investment.
(b) Excluded based on population definition.

Hort Innovation also requested that, where possible, within each value range strata, each project should represent a unique Hort Innovation program area (also known as investment themes[1]).

Sample Selection Process

The sample selection was initiated using a spreadsheet that utilised only the project code, value range identifier, total Hort Innovation managed investment, and program data for each of the projects in the population. A random number technique then was applied to the 85 unique Hort Innovation RD&E projects in the population to generate the first random sample of 15 projects for 2017/18 evaluations.

The first set of 15 randomly selected projects was checked against the sample selection criteria (described previously). Where a criterion was not met (for example, the total Hort Innovation investment in the sample did not meet the 10% minimum value hurdle), individual projects were progressively removed based on the sample criteria required and then replaced with alternative, randomly drawn projects until all stratification criteria were met. The final sample is shown in Table 2.

The final stratified, random sample of 15 Hort Innovation RD&E projects had a total Hort Innovation managed investment value of approximately $9.3 million (nominal dollars) representing 18.5% of the overall Hort Innovation managed investment in the population ($50.4 million). Further, for the value range criterion, each value range target for the sample (described by column four of Table 1) was met within 1% of the target proportions. Table 3 describes how the sample met the value range criterion. Each of the 15 projects drawn were attributable to a unique Hort Innovation program area.

[1] Hort Innovation's Program Framework identifies 11 cross-sectoral investment themes: (1) pest and disease management, (2) crop production, (3) sustainability, (4) novel technologies, (5) data insights, (6) industry development, (7) domestic market development, (8) international market development, market access and trade, (9) product integrity, (10) corporate services, and (11) strategic drive. For more information see Hort Innovation's 2017/18 annual report, available at: https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/company-annual-report/

Table 2: Stratified Random Sample of 15 RD&E Projects Selected for Impact Assessment (by Project Code)

No.	Project Code	Project Title	Total Hort. Innovation Investment ($)	Start Date	End Date	Portfolio Name	Value Range (Identifier)
1	AP12002	Profitable Pears: Maximising productivity and quality of new pear varieties	1,409,195	16/07/2012	31/05/2018	Crop Production	6
2	AV14000	Achieving more consistent yields of quality fruit in the Australian avocado industry	459,037	30/01/2015	31/12/2017	Technology Transfer and Adoption	4
3	AV15010	Supply chain quality improvement - cool chain best practice guidelines	476,757	20/06/2016	31/05/2018	Supply Chain	4
4	BS12021	National Strawberry Varietal Improvement Program	2,664,465	1/12/2012	31/03/2018	Breeding	6
5	MT17001	Berry export strategy	153,436	30/10/2017	16/02/2018	Export Trade	3
6	MU14000	Communication and education of mushroom nutrition research to health professionals (Phase 2)	760,870	30/10/2014	29/08/2017	Human Nutrition	5
7	MU16005	Food safety for the Australian mushroom industry	148,821	15/06/2017	1/06/2018	Product Integrity	3
8	NY16004	Nursery industry statistics and research	173,953	13/09/2016	15/11/2017	Industry Analysis	3
9	NY16005	Where should all the trees go? An investigation of the impact of tree canopy coverage on socio-economic status	185,868	15/09/2016	15/09/2017	Emerging Technologies	3
10	VG13004	Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	1,123,681	28/02/2014	30/04/2018	Plant Health: Pathology / Virology / Nematodes	6
11	VG13044	New end-point treatment solutions to control Fruit Fly (2)	268,680	26/06/2014	31/05/2018	Biosecurity & Market Access R&D	4
12	VG15703	Women's and Vegetable Young Grower Industry Leadership and Development Mission 2016-2018	502,597	16/12/2015	30/06/2018	Study Tours	5
13	VG16025	Increasing consumption by developing community awareness and benefits of vegetables	87,309	27/02/2017	27/07/2017	Vegetable Industry Development	2
14	VG16026	Addressing vegetable consumption through food service organisations (chefs, TAFEs and other training institutions)	323,850	13/12/2017	31/03/2018	Industry Market Research	4
15	VM12003	Development of the Australian melon industry through communication and market focussed activity	566,794	24/06/2013	30/09/2017	Industry Communications	5
Total Hort. Innovation Investment			**9,305,312**				

Table 3: Hort Innovation 2017/18 Impact Assessment Sample – Value Range Criterion

Range Identifier	Proportion of Population[(a)] (Sample Target) (%)	Total Project Value (for Sample) in each Value Range[(b)] ($)	Value by Range as a Proportion of Total Investment in the Sample (%)	Difference from Population Value Range Target (%)	No. of Projects Selected
1	0.0	0	0.0	0.0	0
2	1.4	87,309	0.9	-0.4	1
3	8.0	662,078	7.1	-0.9	4
4	16.5	1,528,324	16.4	-0.1	4
5	19.1	1,830,261	19.7	0.6	3
6	55.0	5,197,341	55.9	0.9	3
Total	100.0	9,305,312	100.0	0.0	15

(a) See Table 1.

(b) Hort Innovation managed investment.

General Evaluation Method

The individual impact assessments followed general evaluation guidelines that are 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 included both qualitative and quantitative assessments that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2018). The quantitative assessments used cost-benefit analysis as its principal tool.

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts for each RD&E investment selected for the 2017/18 sample. 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. 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.

Impacts

Summary of Project Impacts

The following section summarises the key qualitative results for the 15 randomly selected projects that were subjected to impact assessment as part of the Hort Innovation annual impact assessment program. The impacts and potential impacts from each project investments were identified, described and then classified into economic, environmental and social impacts, all on an individual project basis. The principal impacts and potential impacts for each project are shown in Table 4 (economic impacts), Table 5 (environmental impacts), and Table 6 (social impacts).

Table 4: Principal Economic Impacts by Project

Economic	AP12002	• Increased productivity and profitability for Australian pear producers through adoption of optimal orchard management systems and practices that increase average yield and fruit quality. • Increased area of pear trees planted because of potentially improved market access (through increased average quality) and crop profitability. • Potentially, increased capital and operating costs for Australian pear producers adopting new management systems (e.g. drip irrigation, high-density planting, unmanned aerial vehicle monitoring, etc.), likely offset by improved productivity and profitability of pear orchards. • Increased efficiency of pear RD&E resource allocation because of improved identification and prioritisation of future research areas. • Increased industry capacity to maximise orchard potential through implementation of new management systems and practices, and new cultivar x rootstock combinations.
	AV14000	• Increased value of avocados for a number of growers, driven by both yield and quality improvements. • A decrease in year to year variability of avocado flows along the supply chain, resulting in a reduction in grower to market costs.
	AV15010	• The reduction in damage along the supply chain will result in an increased gross value of all avocados sold at retail, shared by operators along the supply chain. • The improvement in avocado quality may result in any potentially reduced decline in price given the expected increased avocado production levels in future due to trees already in the ground. • Some minor increases in variable and capital costs due to changes in management will be experienced by supply chain operators (including growers) who improve practices and improve quality.
	BS12021	• Increased demand for strawberries across Australia due to improved characteristics of new varieties valued by consumers. • Increased supply of strawberries with consumer-desirable characteristics particularly from strawberries growing in subtropical environments and Western Australia, but also to some extent in temperate and other Mediterranean environments. • Contribution to improved profitability for subtropical strawberry growers due to increased productivity and cost reduction compared with previous varieties. • Increase in capital value of strawberry germplasm in the program between 2013 and the end of the investment in 2018.
	MT17001	• Increase in profitable sales for strawberry growers. • Increase in profitable sales for raspberry and blackberry growers.
	MU14000	• Increase in profitable sales for mushroom growers.

	MU16005	• Reduced risk of a food safety incident for mushrooms, supporting consumer confidence, consumption and prices received by growers.
	NY16004	• Cost reduction for a portion of nursery businesses utilising project generated data to make more informed decisions. • Increased demand for nursery products and services which are better targeted to prevailing market conditions. • Improved resource allocation – industry research, marketing and biosecurity budgets that better reflect the 'real world' situation (and realise an efficiency dividend). • Improved policy development for the nursery industry based on sound statistical data. • More efficient formation of government economic policies from improved statistical data on the industry (spill-over).
	NY16005	• Nil
	VG13004	• Avoided yield loss with maintenance of virus control through the Pathogen Tested Scheme and longer term through the safe importation of superior genetic material. • Production cost savings as a result of lower cost planting material (i.e. material is more reliably and cost effectively produced in improved planting beds) and reduced input requirements (i.e. fewer chemicals required for the control of virus vectors such as aphids and whitefly).
	VG13044	• Contribution to maintained and/or improved market access for Australian capsicum producers/exporters, specifically in the New Zealand market. • Some contribution to maintained or improved capsicum fruit quality along the supply chain, allowing Australian capsicums to compete in the market and leading to increased volume of Australian capsicums available for export. • Contribution to the maintenance of methyl bromide as a post-harvest treatment.
	VG15703	• Production cost savings as a result of adoption of new technologies and best management practices observed and discussed during tour visits. • Better industry decisions – more integrated, efficient and profitable supply chains, better allocation of public RD&E and marketing resources, along with capacity to shape favourable public policy outcomes.
	VG16025	• Increase in profitable sales for vegetable growers - a longer term and marginal impact that may be realised following further investment in longitudinal research and industry support for 'best bet' community interventions.
	VG16026	• Increase in profitable vegetable sales for vegetable growers – a longer term impact that may be realised following investment in program implementation. • Improved financial outcomes for the food service sector – including better quality meals/menus and cost savings through the use of seasonal vegetables.
	VM12003	• Increased adoption of beneficial management practices from training and other extension and awareness activities resulting in reduced costs of production. • Reduced impact of biosecurity and food safety incidents from improved coordination of industry mitigation practices and eradication or management responses. • Increased sales of melons through support of domestic marketing and export development.

Table 5: Principal Environmental Impacts by Project

Environmental	AP12002	• Potentially, improved environmental outcomes as a result of increased water use efficiency and reduced export of chemicals off-farm.
	AV14000	• Nil.
	AV15010	• Nil.
	BS12021	• Increased disease resistance of new varieties may have resulted in reduced chemical use and hence reduced the risk for any potential chemical export to the off-farm environment.
	MT17001	• Avoided berry waste associated with additional production , with berries likely to have been wasted in the absence of export market development. • Environmental costs associated with servicing export markets (e.g. carbon emissions associated with export airfreight).
	MU14000	• Nil.
	MU16005	• Nil.
	NY16004	• Nil.
	NY16005	• Potential increase in the value of biodiversity in some Local Government Areas.
	VG13004	• With improved Sweetpotato virus control, fewer chemicals will be needed for the control of insect virus vectors. This reduced usage means fewer chemicals on farm and a reduced potential for chemicals in the district environment, with potential positive impacts on biodiversity and water quality.
	VG13044	• Potentially, some contribution to positive environmental outcomes through reduced chemical use for fruit fly disinfestation prior to export (post-harvest).
	VG15703	• Adoption of environmentally sustainable practices and technologies.
	VG16025	• Nil.
	VG16026	• Nil.
	VM12003	• Increased use by growers of best management practices in relation to chemical use for pest management and food safety.

Table 6: Principal Social Impacts by Project

Social	AP12002	• Increased knowledge and scientific capacity. • Potentially, improved regional community well-being from spill-over benefits from more productive and profitable Australian pear producers.
	AV14000	• Some regional social impacts may have been derived from increased spill-overs to families and businesses along the supply chain from both increased average value and less variability of avocado quantity flows from year to year.
	AV15010	• The improved profitability of the avocado industry supply chains will increase or protect current positive benefit spill-overs to regional areas where avocados are produced and distributed.
	BS12021	• Higher utility gained by consumers of new strawberry varieties. • Apart from the increase in consumer satisfaction as evidenced by increased consumption, other social impacts may have been derived from increased community spill-overs via the increased production of strawberries captured by local families and businesses along the supply chain as well as some growers.

		• Increased employment from an increased area of strawberries grown.
	MT17001	• Increased grower and supply chain partner capacity in export development and export culture. • Increased income in regional Australia associated with more profitable and sustainable strawberry, raspberry and blackberry industries (spill-over benefits).
	MU14000	• Improved health outcomes for the Australian population – 83% of the population already consume some mushrooms and there is scope to increase mushroom consumption to levels achieved in similar markets such as Canada. Australia presently consumes 2.9kg per person per year; Canada consumes 3.5kg per person per year. • Health professionals, communication stakeholders, industry and government have additional health care knowledge and capacity. • Increased income in mushroom growing areas associated with a more profitable and sustainable industry (spill-over impact).
	MU16005	• Improved food safety systems with the possibility of improved health outcomes for Australian mushroom consumers. • Additional industry food safety capacity and researcher food safety capacity. • Increased income in mushroom growing areas associated with a more profitable and sustainable industry (spill-over impact).
	NY16004	• Higher utility gained by consumers of nursery products and services. • Capacity built in industry and capacity built in researchers in the collection and interpretation of data.
	NY16005	• Health and wellbeing improvement in some urban Local Government Areas due to the identification of priority areas and associated actions, compared to what otherwise would have been delivered by the 202020 vision without the project investment.
	VG13004	• Increased industry, extension and research capacity in Australia, especially in relation to planting bed management and virus diagnostics. • Increased regional income in Australia as a result of stronger, more profitable sweetpotato growing communities (spill-over impact).
	VG13044	• Improved regional community wellbeing through spill-over benefits from market access for Australian capsicum producers/exporters and associated more stable Australian capsicum industry incomes.
	VG15703	• Increased networks domestically and internationally amongst vegetable industry participants. • More women in leadership roles in vegetable and horticulture industry organisations. • Increased satisfaction of young growers from their involvement in the vegetable industry. • More women and young leaders able and willing to contribute to regional and rural Australia through industry committees and representative organisations.
	VG16025	• Improved health outcomes for the Australian community including high risk population groups such as low socio-economic status. • Increased research capacity in relation to understanding community interventions.

		• Increased income in regional Australia associated with more profitable and sustainable vegetable industries (marginal long-term spill-over impact).
	VG16026	• Improved health outcomes for the Australian community associated with any increase in vegetable consumption following program implementation. • Increased research capacity in relation to understanding and working with the food service sector. • Increased income in regional Australia associated with more profitable and sustainable vegetable industries (marginal long-term spill-over impact).
	VM12003	• Recognition of contribution of growers to the melon industry and positive engagement of growers with researchers and government agencies • Increased individual capacity and wellbeing of melon farm managers and staff. • Improved food safety for consumers. • Spill-over benefits to other susceptible crop species from improved plant and disease management in melons. • Spill-over benefits to local communities from sustainable and profitable melon growers.

Overview of Impact Types

The specific, project level impacts then were generalised into broad impact categories/types to describe the overall economic, environmental and social impacts of the total Hort Innovation RD&E portfolio, as represented by the stratified, random sample of projects assessed. Each individual project impact is represented by one tick mark (✓) in Table 7 (broad economic impact types), Table 8 (broad environmental impact types) and Table 9 (broad social impact types). Some projects have multiple ticks in the one category; this is because these impacts were different to one another but fell into the same category.

Across all 15 projects assessed there were 86 individual impacts identified. Of these, approximately 42% were identified as economic (36), 13% environmental (11) and 45% social (39).

Table 7: Impacts by Broad Economic Impact Type for each Project in the Hort Innovation 2017/18 Impact Assessment Sample

Project Code	**Economic Impact Type**						
	Increased productivity and/or profitability for Australian horticulture crops (including through increased average yields, increased area grown, increased average value, increased average quality)	Increased supply of and/or demand for Australian horticulture products	Reduced production and/or demand variability risks	Maintained and/or improved market access (domestic or international)	Decreased (or, potentially, increased) production or supply chain costs	Increased efficiency of resource allocation, particularly for horticulture RD&E expenditure	Other/ miscellaneous
AP12002	✓✓				✓	✓	✓
AV14000	✓				✓		
AV15010	✓✓					✓	
BS12021	✓	✓✓					✓
MT17001	✓✓						
MU14000	✓						
MU16005			✓				
NY16004		✓			✓	✓	✓✓
NY16005							
VG13004	✓				✓		
VG13044	✓			✓			✓
VG15703					✓	✓	
VG16025	✓						
VG16026	✓✓						
VM12003		✓	✓		✓		
Impact Count	**14**	**4**	**2**	**1**	**6**	**4**	**5**

Table 8: Impacts by Broad Environmental Impact Type for each Project in the Hort Innovation 2017/18 Impact Assessment Sample

Project Code	**Environmental Impact Type**					
	Reduced risk of chemical export to the off-farm environment	Increased water use efficiency	Avoided waste	Enhanced biodiversity	Increased adoption of environmentally friendly, best management practices	Other/ miscellaneous
AP12002	✓	✓				
AV14000						
AV15010						
BS12021	✓					
MT17001			✓			✓
MU14000						
MU16005						
NY16004						
NY16005				✓		
VG13004	✓			✓		
VG13044	✓					
VG15703					✓	
VG16025						
VG16026						
VM12003					✓	
Impact Count	**4**	**1**	**1**	**2**	**2**	**1**

Table 9: Impacts by Broad Social Impact Type for each Project in the Hort Innovation 2017/18 Impact Assessment Sample

Project Code	**Social Impact Type**				
	Increased knowledge and scientific/ research capacity	Productivity/ profitability benefits having a flow-on effect to support improved regional community wellbeing	Improved producer and/or consumer health, wellbeing or utility	Increased industry or other stakeholder capacity (e.g. export capacity)	Other/ miscellaneous
AP12002	✓	✓			
AV14000		✓			
AV15010		✓			
BS12021		✓	✓		✓
MT17001		✓		✓	
MU14000		✓	✓	✓	
MU16005	✓	✓	✓	✓	
NY16004	✓		✓	✓	
NY16005			✓		
VG13004	✓	✓		✓	
VG13044		✓			
VG15703			✓		✓✓✓
VG16025	✓	✓	✓		
VG16026	✓	✓	✓		
VM12003		✓	✓	✓	✓✓
Impact Count	**6**	**12**	**9**	**6**	**6**

Results

Overview

The following sections present the estimated investment criteria for each of the 15 Hort Innovation RD&E project investments evaluated and for all 15 projects in aggregate. The total investment for each project was usually a combination of resources from Hort Innovation and other funding partners, for example from State departments or other research/industry organisations. The investment criteria for each project investment are reported for both the total investment (including that of Hort Innovation) and for the Hort Innovation investment alone.

The investment costs for all resources (cash and in-kind) were expressed in 2017/18 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2018). All benefits after 2017/18 also were expressed in 2017/18 dollar terms. All costs and benefits were discounted to 2018/19 (year of evaluation) using a discount rate of 5% and using a reinvestment rate of 5% for calculating the Modified Internal Rate of Return (MIRR). The base analyses used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All individual analyses ran for the length of the individual project investment period plus 30 years from the last year of investment.

Results presented include the Present Value of Costs (PVC), estimated Present Value of Benefits (PVB), Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR) and MIRR. Definitions for these terms may be found in the Glossary of Economic Terms at the end of this report.

For the first series of Hort Innovation's annual impact assessments, all 15 projects were valued in monetary terms. However, this may not always be the case. In future assessments, where project impacts identified are not able to be quantified, detailed reasoning behind the decision not to value such impacts can be found in the individual project evaluation reports available from Hort Innovation. For projects where no impacts are valued, only the PVC will be reported, with all other investment criteria appearing as NR (not reported) where applicable. However, the cost cash flows for projects with no impacts valued are still to be included in the calculation of the aggregate investment criteria for all 15 projects.

Investment Criteria by Project

The individual project investment criteria for the total investment and the Hort Innovation investment for the 2017/18 random sample are reported in Table 10 and Table 11 respectively.

Table 10: Investment Criteria for Total Investment by Individual Project
(30 years after last year of investment, 5% discount rate)

Project Code	Project Title	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
AP12002	Profitable Pears: Maximising productivity and quality of new pear varieties	6.22	3.56	2.66	1.75	8.0	5.3
AV14000	Achieving more consistent yields of quality fruit in the Australian avocado industry	5.78	1.58	4.19	3.65	18.3	7.4
AV15010	Supply chain quality improvement - cool chain best practice guidelines	2.23	0.62	1.61	3.59	17.7	9.7
BS12021	National Strawberry Varietal Improvement Program	24.87	7.02	17.85	3.54	43.1	13.1
MT17001	Berry export strategy	0.21	0.15	0.06	1.39	7.2	6.1
MU14000	Communication and education of mushroom nutrition research to health professionals (Phase 2)	2.80	1.08	1.72	2.59	13.7	8.1
MU16005	Food safety for the Australian mushroom industry	0.51	0.18	0.34	2.89	90.9	8.7
NY16004	Nursery industry statistics and research	0.89	0.23	0.66	3.82	33.4	9.6
NY16005	Where should all the trees go? An investigation of the impact of tree canopy coverage on socio-economic status	0.67	0.21	0.46	3.17	10.8	9.6
VG13004	Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	9.70	2.77	6.60	3.50	57.7	9.1
VG13044	New end-point treatment solutions to control Fruit Fly (2)	1.65	1.02	0.63	1.62	8.2	4.5
VG15703	Women's and Vegetable Young Grower Industry Leadership and Development Mission 2016-2018	3.13	1.46	1.67	2.15	24.1	7.9
VG16025	Increasing consumption by developing community awareness and benefits of vegetables	0.12	0.11	0.01	1.08	5.5	5.3
VG16026	Addressing vegetable consumption through food service organisations (chefs, TAFEs and other training institutions)	0.67	0.35	0.32	1.90	9.5	7.2
VM12003	Development of the Australian melon industry through communication and market focussed activity	3.47	0.85	2.62	4.09	57.3	10.6

Table 11: Investment Criteria for the Hort Innovation Investment by Individual Project
(30 years after last year of investment, 5% discount rate)

Project Code	Project Title	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
AP12002	Profitable Pears: Maximising productivity and quality of new pear varieties	3.49	1.97	1.51	1.77	8.1	5.3
AV14000	Achieving more consistent yields of quality fruit in the Australian avocado industry	2.26	0.62	1.64	3.65	18.3	9.9
AV15010	Supply chain quality improvement - cool chain best practice guidelines	2.20	0.61	1.59	3.58	17.7	9.7
BS12021	National Strawberry Varietal Improvement Program	8.41	2.38	6.04	3.54	43.1	13.1
MT17001[(a)]	Berry export strategy	0.21	0.15	0.06	1.39	7.2	6.1
MU14000[(a)]	Communication and education of mushroom nutrition research to health professionals (Phase 2)	2.80	1.08	1.72	2.59	13.7	8.1
MU16005[(a)]	Food safety for the Australian mushroom industry	0.51	0.18	0.34	2.89	90.9	8.7
NY16004[(a)]	Nursery industry statistics and research	0.89	0.23	0.66	3.82	33.4	9.6
NY16005[(a)]	Where should all the trees go? An investigation of the impact of tree canopy coverage on socio-economic status	0.67	0.21	0.46	3.17	10.8	9.6
VG13004	Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	5.38	1.53	3.85	3.52	59.3	9.2
VG13044	New end-point treatment solutions to control Fruit Fly (2)	0.61	0.38	0.23	1.61	8.1	4.4
VG15703	Women's and Vegetable Young Grower Industry Leadership and Development Mission 2016-2018	1.90	0.95	0.96	2.01	19.6	7.3
VG16025	Increasing consumption by developing community awareness and benefits of vegetables	0.11	0.10	0.01	1.08	5.5	5.3
VG16026[(a)]	Addressing vegetable consumption through food service organisations (chefs, TAFEs and other training institutions)	0.67	0.35	0.32	1.90	9.5	7.2
VM12003[(a)]	Development of the Australian melon industry through communication and market focussed activity	3.47	0.85	2.62	4.09	57.3	10.6

(a) 100% Hort Innovation managed investment. Thus, investment criteria for the total investment (Table 10) and the Hort Innovation investment are the same.

All 15 of the projects randomly selected for the 2017/18 sample for the Hort Innovation annual impact assessment program included impacts that were valued in monetary terms. The total investment per project (PVC) across all 15 RD&E investments (Table 10) ranged from $0.11 million to $7.02 million (present value terms). Estimated benefits (PVB) ranged from $0.12 million to $24.87 million (present value terms).

Table 12 and Table 13 identify the three projects with the highest NPVs and BCRs. The projects are listed in descending order of each key investment criterion.

Table 12: Top Three Projects by Net Present Value
(Total Investment, 30 years, 5% discount rate)

Project Code	Project Title	NPV ($ million)
BS12021	National Strawberry Varietal Improvement Program	17.85
VG13004	Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	6.60
AV14000	Achieving more consistent yields of quality fruit in the Australian avocado industry	4.19

Table 13: Top Three Projects by Benefit-Cost Ratio
(Total Investment, 30 years, 5% discount rate)

Project Code	Project Title	BCR ($ million)
VM12003	Development of the Australian melon industry through communication and market focussed activity	4.09
NY16004	Nursery industry statistics and research	3.82
AV14000	Achieving more consistent yields of quality fruit in the Australian avocado industry	3.65

Aggregate Investment Criteria (15 Projects)

Table 14 and Table 15 provide the aggregate investment criteria for all 15 projects for both total investment and the Hort Innovation investment only.

Table 14: Aggregate Investment Criteria for Total Investment in all 15 Projects
(5% discount rate)

Investment Criteria	Years after last year of investment						
	0	5	10	15	20	25	30
PVB ($m)	9.71	35.51	45.94	52.71	57.25	60.50	62.95
PVC ($m)	21.20	21.20	21.20	21.20	21.20	21.20	21.20
NPV ($m)	-11.49	14.31	24.74	31.51	36.05	39.30	41.75
BCR	0.46	1.68	2.17	2.49	2.70	2.85	2.97
IRR (%)	negative	22.1	25.5	26.2	26.4	26.4	26.5
MIRR (%)	negative	26.4	16.3	12.2	9.8	8.3	7.3

Table 15: Aggregate Investment Criteria for Hort Innovation Investment in all 15 Projects
(5% discount rate)

Investment Criteria	Years after last year of investment						
	0	5	10	15	20	25	30
PVB ($m)	4.54	18.30	23.49	27.25	30.01	32.08	33.62
PVC ($m)	11.53	11.53	11.53	11.53	11.53	11.53	11.53
NPV ($m)	-6.99	6.77	11.96	15.72	18.48	20.55	22.08
BCR	0.39	1.59	2.04	2.36	2.60	2.78	2.91
IRR (%)	negative	20.5	24.0	24.9	25.1	25.2	25.2
MIRR (%)	negative	22.2	14.3	11.0	9.2	7.9	7.0

The results in Table 14 show that the weighted average BCR for all 15 projects was approximately 3.0 to 1 for the total investment after 30 years. The simple average BCR was approximately 2.7 to 1 (derived from Table 10). The aggregate investment criteria were positive after five years (BCR of 1.7).

The PVB for the Hort Innovation investment (Table 15) was estimated by multiplying the total PVB for each individual project by the Hort Innovation proportion of real investment in each project and then aggregating the Hort Innovation benefit cash flows for all 15 projects. The proportion of Hort Innovation investment at the project level varied from approximately 33.8% (Project BS12021) to 100% (seven projects).

Source of Benefits

Table 16 shows the contribution of each project to the total PVB (Total Investment)

Table 16: Contribution of Benefits by Source

Project Code	Project Title	PVB ($m)	Proportion of Total PVB (%)
AP12002	Profitable Pears: Maximising productivity and quality of new pear varieties	6.22	9.9
AV14000	Achieving more consistent yields of quality fruit in the Australian avocado industry	5.78	9.2
AV15010	Supply chain quality improvement - cool chain best practice guidelines	2.23	3.5
BS12021	National Strawberry Varietal Improvement Program	24.87	39.5
MT17001	Berry export strategy	0.21	0.3
MU14000	Communication and education of mushroom nutrition research to health professionals (Phase 2)	2.80	4.4
MU16005	Food safety for the Australian mushroom industry	0.51	0.8
NY16004	Nursery industry statistics and research	0.89	1.4
NY16005	Where should all the trees go? An investigation of the impact of tree canopy coverage on socio-economic status	0.70	1.1
VG13004	Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	9.70	15.4
VG13044	New end-point treatment solutions to control Fruit Fly (2)	1.65	2.6
VG15703	Women's and Vegetable Young Grower Industry Leadership and Development Mission 2016-2018	3.13	5.0
VG16025	Increasing consumption by developing community awareness and benefits of vegetables	0.12	0.2
VG16026	Addressing vegetable consumption through food service organisations (chefs, TAFEs and other training institutions)	0.67	1.1
VM12003	Development of the Australian melon industry through communication and market focussed activity	3.47	5.5
Total		62.95	100.0

Leverage

Leverage is expressed here as the ratio of non-Hort Innovation investment to Hort Innovation investment. Across the 15 projects, leverage ratios varied from 0 to 1.96 (nominal terms). Seven projects had a leverage ratio of 0 (no external funding). The highest leveraged project was the project BS12021 (*National Strawberry Varietal Improvement Program*) with a leverage ratio of 1.96.

The leverage ratios by project are provided in Table 17. The weighted average leverage ratio for all 15 projects was 0.82.

Table 17: Leverage Ratio by Project

Project Code	**Project Title**	**Leverage Ratio[(a)]**
AP12002	Profitable Pears: Maximising productivity and quality of new pear varieties	0.78
AV14000	Achieving more consistent yields of quality fruit in the Australian avocado industry	1.55
AV15010	Supply chain quality improvement - cool chain best practice guidelines	0.01
BS12021	National Strawberry Varietal Improvement Program	1.96
MT17001	Berry export strategy	0.00
MU14000	Communication and education of mushroom nutrition research to health professionals (Phase 2)	0.00
MU16005	Food safety for the Australian mushroom industry	0.00
NY16004	Nursery industry statistics and research	0.00
NY16005	Where should all the trees go? An investigation of the impact of tree canopy coverage on socio-economic status	0.00
VG13004	Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	0.80
VG13044	New end-point treatment solutions to control Fruit Fly (2)	1.72
VG15703	Women's and Vegetable Young Grower Industry Leadership and Development Mission 2016-2018	0.64
VG16025	Increasing consumption by developing community awareness and benefits of vegetables	0.04
VG16026	Addressing vegetable consumption through food service organisations (chefs, TAFEs and other training institutions)	0.00
VM12003	Development of the Australian melon industry through communication and market focussed activity	0.00
Weighted Average Leverage Ratio (all 15 projects)		0.82

(a) Ratio of non-Hort Innovation managed investment to Hort Innovation investment

Conclusions

Impact assessments were carried out on 15 randomly selected Hort Innovation RD&E investments that were completed with a final deliverable submitted in the year ended June 2018. These investments produced a range of economic, environmental and social impacts. Across all 15 projects assessed, 86 individual impacts were subjectively identified. Of these, approximately 42% were classified as economic (36), 13% environmental (11) and 45% social (39).

Total funding from all sources for the 15 project investments totalled $21.20 million (present value terms) and produced estimated total expected benefits of $62.95 million (present value terms). This gave an aggregate weighted average BCR of approximately 3.0 to 1 after 30 years at a 5% discount rate. The results are consistent with other, similar evaluations of agricultural RD&E investments conducted by the evaluation team where average BCRs have been estimated between 2 and 6 to 1.

Impacts from all 15 projects from the 2017/18 sample were valued as part of the Hort Innovation annual impact assessment process.

The sample of projects evaluated:

- represented more than 10% of the total Hort Innovation lifetime funding of projects with a final deliverable submitted in the year ended 30 June 2018,
- was representative of funding across the pre-defined Hort Innovation project value ranges, and
- was drawn at random.

Some, but not all, of the impacts identified for each project investment were valued as part of the evaluation process. The decision not to value certain impacts was, in general, 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 RD&E project investments. As not all impacts were valued, it is likely that the estimated investment criteria reported are an underestimate of the performance of the Hort Innovation RD&E investment evaluated.

The 2017/18 sample was considered largely representative of the investment in Hort Innovations overall RD&E porfolio for the same period. Therefore, the impacts and aggregate investment criteria estimated are indicative of impacts and performance across the broader suite of RD&E undertaken by Hort Innovation. Further, as part of Hort Innovation's ongoing, annual impact assessment program, the representative results from the 2017/18 evaluations will contribute to Hort Innovation's performance story over time.

Thus, the positive results reported should be viewed with confidence by Hort Innovation, the various Australian horticulture industries represented (including their levy payers and managers), and policy personnel responsible for allocation of public funds.

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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Appendices

The following table lists the titles of the individual impact assessment reports that form the appendices to the 2019 Aggregate Report (2017/18 Sample). These appendices are available for download from www.horticulture.com.au/mt18011.

Table 18: Individual Impact Assessment Report Titles: Hort Innovation Impact Assessment Program 2017/18 Sample

Project Code	Report Title
AP12002	Appendix 1: Profitable Pears: Maximising productivity and quality of new pear varieties (AP12002 Impact Assessment)
AV14000	Appendix 2: Achieving more consistent yields of quality fruit in the Australian avocado industry (AV14000 Impact Assessment)
AV15010	Appendix 3: Supply chain quality improvement - cool chain best practice guidelines (AV15010 Impact Assessment)
BS12021	Appendix 4: The National Strawberry Varietal Improvement Program (BS12021 Impact Assessment)
MT17001	Appendix 5: Berry export strategy (MT17001 Impact Assessment)
MU14000	Appendix 6: Communication and education of mushroom nutrition research to health professionals (Phase 2)
MU16005	Food safety for the Australian mushroom industry[(a)]
NY16004	Appendix 7: Nursery industry statistics and research
NY16005	Appendix 8: Where should all the trees go? An investigation of the impact of tree canopy coverage on socio-economic status
VG13004	Appendix 9: Innovating new virus diagnostics and planting bed management in the Australian Sweetpotato Industry
VG13044	New end-point treatment solutions to control Fruit Fly (2)[(a)]
VG15703	Appendix 10: Women's and Vegetable Young Grower Industry Leadership and Development Mission 2016-2018
VG16025	Appendix 11: Increasing consumption by developing community awareness and benefits of vegetables
VG16026	Appendix 12: Addressing vegetable consumption through food service organisations (chefs, TAFEs and other training institutions)
VM12003	Appendix 13: Development of the Australian melon industry through communication and market focussed activity

(a) Confidential. Individual impact assessment reports not to be published. Contact Hort Innovation for further information.

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Abbreviations

ABS	Australian Bureau of Statistics
BCR	Benefit Cost Ratio
CRRDC	Council of Rural Research and Development Corporations
Hort Innovation	Horticulture Innovation Australia Limited
IRR	Internal Rate of Return
MIRR	Modified Internal Rate of Return
NPV	Net Present Value
PVB	Present Value of Benefits
PVC	Present Value of Costs
RD&E	Research, Development and Extension