Hort Innovation

Final Report

Industry-specific impact assessment program: Berries

2021 Aggregated Report

Impact analyst

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Delivery partner:

AgEconPlus and Agtrans Research

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MT20008

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Executive Summary

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) through the Berries Industry Fund made up of both the Rubus (RB) and Strawberry (BS) industries. The process has been used to identify and report the impacts from, and economic performance of, four individual project investments. The four project investments were drawn at random from a population of completed projects that was defined as projects that (1) had a final deliverable submitted during the period 1 July 2015 to 30 June 2020, (2) included Hort Innovation levy funds, (3) had at least 50% of the total investment sourced from the named industry (RB + BS), and (4) had a total project value greater than, or equal to, $80,000 over each project's lifetime.

Methodology

Hort Innovation specified that four individual RD&E projects were to be selected and evaluated for the Berries (RB + BS) industry impact assessments under Project MT20008. The sample was to include one project from the Rubus (RB) industry and three projects from the Strawberry (BS) industry. A stratified random sampling approach was used to select the four RD&E projects for evaluation from a total population of 17 RD&E projects (two RB RD&E projects and 15 BS RD&E projects). The random sample was stratified across the two component industries (RB + BS) and then across the industry investment priority areas represented in the population as defined by (1) the Raspberry and Blackberry Industry Strategic Investment Plan 2017-2021, and (2) the Strawberry Industry Strategic Investment Plan 2017-2021. The stratified random sample also was constructed to represent at least 10% (by value) of the total investment in the overall project population (17 projects, Hort Innovation managed investment only, in nominal dollar terms).

Each of the four projects selected 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 (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR) and Modified IRR. The investment criteria that were estimated and reported include the investment criteria for each project investment and the aggregate investment criteria for all four projects.

Results/key findings

The four RD&E projects subjected to impact assessment were found to have produced a range of economic, environmental and social impacts. Across all four projects assessed there were 21 individual impact types identified. Of these, approximately 38% were identified as economic (8), 19% environmental (4) and 43% social (9).

Aggregate investment criteria

Total funding from all sources for the four project investments totalled $6.19 million (present value terms) and produced estimated total expected benefits of $20.50 million (present value terms). This gave an aggregate weighted average BCR of approximately 3.31 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 2021 RB + BS sample was considered loosely representative of the investment in Hort Innovation's overall Berry Industry RD&E porfolio for the 2015/16 to 2019/20 period, given the small sample size. Therefore, the impacts and aggregate investment criteria estimated are broadly indicative of impacts and performance across the broader suite of RB + BS RD&E investments undertaken by Hort Innovation.

Thus, the results reported should be viewed positively but interpreted with some caution by Hort Innovation, the Australian Berries industry, and policy personnel responsible for allocation of public funds.

Keywords

MT20008, impact assessment, cost-benefit analysis, rubus industry, strawberry industry, berry industry, aggregate assessment, investment criteria, RD&E performance

Introduction

All research and development (R&D) and marketing levy investments undertaken by Horticulture Innovation Australia Limited (Hort Innovation) are guided by, 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 previous industry SIPs apply to the financial years 2016/17 – 2020/21. Recently published current SIPs[1] apply to the financial years 2021/22 – 2025/26.

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 berries (made up of rubus (RB) and strawberries (BS)), mango (MG), turf (TU), and nursery (NY) research, development, and extension (RD&E) investment funds.

In total, fourteen RD&E investments (projects) were selected through a stratified, random sampling process. The industry samples were as follows:

- Four RB + BS projects were chosen worth $1.44 million (nominal Hort Innovation investment) from an overall population of 17 projects worth an estimated $8.59 million,
- Three MG projects worth $1.77 million (nominal Hort Innovation investment) from an overall population of 16 projects worth approximately $7.9 million,
- Four TU projects worth $0.66 million (nominal Hort Innovation investment) from a total population of 15 projects worth $4.81 million[2], and
- Three new NY projects worth $0.96 million (nominal Hort Innovation investment) from an overall population of 19 projects worth $7.32 million.

The project population for each industry included projects where a final deliverable had been submitted in the five-year period from 1 July 2015 to 30 June 2020. The projects for each industry sample were chosen such that, where possible given the small sample size required, 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.

This report presents a summary and the aggregate results for the impact assessment of RD&E investments made by Hort Innovation from the berries industry fund (hereafter referred to as the 2021 RB + BS sample).

[1] The current Hort Innovation industry SIPs can be found at: https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/strategic-investment-plans/

[2] One project (TU13026) was subsequently excluded from the TU aggregate analysis when it was identified that it did not include Hort Innovation levy funding. As a result, the TU13026 results are not reported in the TU aggregate analysis but the individual impact assessment report for TU13026 is included as a stand-alone evaluation in the TU aggregate report appendix.

Population & Sample Selection

Defining the Population

The population of RB + BS Hort Innovation projects from which the 2021 RB + BS impact assessment sample was drawn was defined as all Hort Innovation projects that had the following characteristics:

(a) Were completed during the period 1 July 2015 to 30 June 2020 (5-year period). A completed project was defined as a project where the final deliverable was submitted and accepted by Hort Innovation between 1 July 2015 and 30 June 2020,
(b) Included Hort Innovation R&D levy funds (e.g. this excluded projects funded solely through grants and/or the Hort Innovation Frontiers fund),
(c) For multi-industry projects (MT project code), the projects must have included levy funds from the named industry (i.e. RB or BS) representing at least 50% of the total investment in each project,
(d) Had a total Hort Innovation managed investment value of > $80,000 (excludes 'trivial' projects), and
(e) Excludes 'enabler projects' not suitable for evaluation (e.g. minor use permit, mid-term review/evaluation, consultation, and SIP development type projects).

Based on this population definition, Hort Innovation personnel provided the evaluation team (AgEconPlus and Agtrans Research) with an RB + BS population dataset that contained 17 individual project investments (two RB RD&E projects and 15 BS RD&E projects) with a total Hort Innovation investment value of approximately $8.76 million (whole population, Hort Innovation managed funds only, nominal dollar terms) representing two of the potential four SIP outcome areas for RB and two of the potential four SIP outcome areas for BS.

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

Hort Innovation specified that four individual RD&E projects were to be selected and evaluated for the RB + BS industry impact assessments. A stratified random sampling approach was used to select the four RD&E projects for evaluation from the total population of 17 RB + BS RD&E projects. The random sample was stratified across the two component industries (RB + BS) and then across the industry investment priority areas represented in the population as defined by (1) the Raspberry and Blackberry Industry Strategic Investment Plan 2017-2021, and (2) the (1) Strawberry Industry Strategic Investment Plan 2017-2021. The stratified random sample also was constructed to represent at least 10% (by value) of the total investment in the overall project population (17 projects, Hort Innovation managed investment only, in nominal dollar terms). Table 1 (below) shows the total proportion of Hort Innovation managed investment by RB and BS SIP Outcome that were used to assess the stratification of the random sample

Thus, the sample of four projects was selected to be loosely representative of the spectrum of RD&E investments under the Hort Innovation RB + BS levy fund for investments completed in the five-year period ending June 2020, given the small sample size.

Table 1: Hort Innovation RD&E Investment by RB + BS SIP Outcome Area for the RB + BS Project Population

SIP Outcome Area Identifier	SIP Outcome Area	Total Project Value[(a)] in each SIP Outcome area in the Population ($)	SIP Outcome Area as a Proportion of Population (%)	No. of Projects to be Selected for Evaluation
Rubus Industry				
1	By 2021, domestic per capita consumption of fresh Australian raspberries will increase by at least 40 per cent, supported by positive consumer perceptions of product value	0	0.0	0
2	By 2021, exports of Australian raspberries exceed five per cent of national production by volume, in selected markets with a capacity and willingness to pay a premium for quality fruit	0	0.0	0
3	By 2021, the industry will increase farm productivity (marketable yield per hectare) by an average 10 per cent	134,607	43.6	1[(b)]
4	By 2021, at least 90 per cent of growers and other firms involved in raspberry and blackberry value chains will be directly engaged with and value national industry services	174,000	56.4	
Rubus Totals		308,607	100.0	1
Strawberry Industry				
1	By 2021, per capita domestic consumption of fresh Australian strawberries will increase by 10 per cent, underpinned by consistent supply of premium quality fruit that matches consumer desires	0	0.0	0
2	By 2021 increase exports of Australian strawberries from four per cent to at least eight per cent of national production by volume, in selected markets, with a capacity and willingness to pay a premium for quality fruit	0	0.0	0
3	Greater skills, capacity and knowledge in the industry	6,272,020	74.2	2
4	By 2021, at least 90 per cent of growers and other firms involved in the strawberry value chain will be directly engaged with and value national industry services	2,181,829	25.8	1
Total		8,453,849	100.00	3

(a) Hort Innovation managed investment.
(b) Hort Innovation specified that only one project was to be selected from the Rubus project population as part of the Berries Industry Impact Assessment. Therefore, only one project was selected at random across the two SIP outcome areas represented.

Sample Selection Process

The sample selection for the four RD&E investments to be evaluated was initiated using a spreadsheet that utilised only the project code, SIP code, and total Hort Innovation managed investment for each of the projects in the population. A random number technique then was applied to the 17 unique Hort Innovation RD&E projects in the RB + BS population to generate the first random sample of four projects for the 2020/21 evaluations.

The first set of four 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.

Once the set of four randomly selected projects met the sample criteria, the sample was submitted to Hort Innovation for verification and approval. The final sample of four RB + BS RD&E projects for evaluation is shown in Table 2.

The final stratified, random sample of four Hort Innovation RB + BS RD&E projects had a total Hort Innovation managed investment value of approximately $2.36 million (nominal dollars) representing approximately 26.9% of the overall Hort Innovation managed investment in the population ($8.76 million). Further, to meet the SIP Outcome area criterion, one project was selected for SIP Outcome area 3 for the RB industry, two for Outcome area 3 for the BS industry, and one for Outcome area 4 for the BS industry.

Thus, the sample of four projects was selected to be loosely representative of the spectrum of RD&E investments under the Hort Innovation RB + BS levy fund for investments completed in the five-year period ending June 2020, given the small sample size.

Table 2: Stratified Random Sample of four RB + BS RD&E Projects Selected for Impact Assessment (by Project Code

No.	Project Code	Project Title	Total Hort Innovation Investment ($)	Start Date	End Date	SIP Outcome Area
1	RB14003	Building resilience to drupelet disorder in Rubus	145,211	May 2015	January 2019	O3
2	BS11013	National Strawberry Varietal Improvement Program – Southern Node	1,585,135	June 2012	June 2017	O3
3	BS12009	Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners	230,451	December 2012	July 2016	O3
4	BS12015	Assisting the ongoing development of the Queensland Strawberry Industry	396,427	October 2012	March 2016	O4
Total Hort Innovation Investment			**2,357,224**			

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 Council of Rural Research and Development Corporations (CRRDC) (CRRDC, 2018). The quantitative assessments used cost-benefit analysis as its principal tool.

For all four projects included in the 2021 RB + BS sample, the evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts for each RD&E investment selected. 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 four randomly selected RB + BS projects that were subjected to impact assessment as part of the 2021 Hort Innovation industry-specific impact assessment program. The impacts and potential impacts from each project investment were identified, described, and then classified into economic, environmental, and social impacts, on an individual project basis. The principal impacts and potential impacts for each project are shown in Table 3 (economic impacts), Table 4 (environmental impacts), and Table 5 (social impacts).

Table 3: Principal Economic Impacts by Project

Economic	RB14003	• A reduction in the incidence/severity of Red Drupelet Reversion (RDR) for some Australian rubus growers resulting in an increase in the gross margin per ha via one or more benefits of increased yield, increased price and/or reduced costs.
	BS11013	• A potentially increased demand for strawberries due to the past and future releases of new varieties with characteristics valued by consumers. • A potential contribution to improved profitability of strawberry growing for southern regions due to, for example: increased productivity, price, and/or growing-cost reductions compared with varieties replaced. • An increase in capital value of unreleased strawberry germplasm in the program between 2013 and the end of the investment in 2018.
	BS12009	• Reduced risk of pathogen incursions into the Victorian Strawberry Industry Certification Authority strawberry certification scheme. • Increased rate of gain in varietal performance over time (yield and quality) due to earlier introduction of improved varieties.
	BS12015	• Improved decision making by some Queensland strawberry growers (e.g. strawberry variety selection for planting, management activities) potentially resulting in impacts on revenues and costs. • Improved R&D resource allocation due to an increasing appreciation of the feedback from the Queensland industry on new varieties and other issues.

Table 4: Principal Environmental Impacts by Project

Environmental	RB14003	• Potential for reduced nitrogen fertiliser and chemical use and hence a reduction in nutrient and chemical export to the off-farm environment.
	BS11013	• Increased disease resistance of some new varieties may have resulted in reduced chemical use and hence a reduction in chemical export to the off-farm environment.
	BS12009	• Potential for reduced chemical use and hence a reduction in chemical export to the off-farm environment.
	BS12015	• Potential for reduced export of soil, nutrients and chemicals from strawberry farms to waterways.

Table 5: Principal Social Impacts by Project

Social	RB14003	• Improved R&D resource allocation in future research and extension investment addressing RDR. • Increased future capacity to change across the Australian rubus growing industry. • Regional community spillovers from the benefits of a more productive rubus industry.
	BS11013	• Increased regional community spillovers from a more productive southern strawberry industry. • Enhanced capability and capacity of strawberry breeders.
	BS12009	• Increased regional community spillovers from a more productive national strawberry industry. • Enhanced capability and capacity of scientists associated with strawberry pathogens.
	BS12015	• Increased regional community spillovers captured by local families and businesses along the supply chains from a more productive Queensland strawberry industry • Increased capacity to change in future across the Queensland strawberry industry.

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. The identification and classification of impact types is provided in Tables 6, 7 and 8 (below).

Each individual project impact is represented by one tick mark (✓) in three (broad economic impact types), two (broad environmental impact types) and four (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 four projects assessed there were 21 individual impact types identified. Of these, approximately 38% were identified as economic (8), 19% environmental (4) and 43% social (9).

Table 6: Impacts by Broad Economic Impact Type for each Project in the Hort Innovation 2021 RB + BS Impact Assessment Sample

Project Code	**Economic Impact Type**			
	Increased profitability for the RB + BS Industry (e.g. through reduced costs, increased farm income, and/or increased consumer demand)	Increased rate of gain in varietal performance and/or an increase in capital value of unreleased germplasm	Improved industry decision making and/or improved R&D resource allocation	Other/ Miscellaneous
RB14003	✓			
BS11013	✓✓	✓		
BS12009		✓		✓
BS12015			✓✓	
Impact Count	**3**	**2**	**2**	**1**

Table 7: Impacts by Broad Environmental Impact Type for each Project in the 2021 RB + BS Impact Assessment Sample

Project Code	**Environmental Impact Type**
	Reduced potential for agricultural chemical, soil and/or other nutrient export to the off-farm environment through reduced on-farm chemical/ fertiliser use
RB14003	✓
BS11013	✓
BS12009	✓
BS12015	✓
Impact Count	**4**

Table 8: Impacts by Broad Social Impact Type for each Project in the 2021 RB + BS Impact Assessment Sample

Project Code	**Social Impact Type**		
	Increased regional community wellbeing from spillover benefits of a more productive and profitable RB + BS industry	Increased industry and/or researcher capability and capacity	Other/ miscellaneous
RB14003	✓	✓	✓
BS11013	✓	✓	
BS12009	✓	✓	
BS12015	✓	✓	
Impact Count	**4**	**4**	**1**

Results

Overview

The following sections present the estimated investment criteria for each of the four Hort Innovation RB + BS RD&E project investments evaluated and for all four projects in aggregate. The total investment for each project was typically a combination of resources from Hort Innovation and other funding partners, for example from State Government 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 2020/21 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2021). All benefits after 2020/21 also were expressed in 2020/21 dollar terms. All costs and benefits were discounted to 2020/21 (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) as per the CRRDC Impact Assessment Guidelines[3]. 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. Impacts from all four projects were valued in monetary terms.

Investment Criteria by Project

The individual project investment criteria for the total investment and the Hort Innovation investment for the 2021 RB + BS sample are reported in Table 9 and Table 10 respectively. Hort Innovation contributed 100% of the funding for two of the four RB + BS projects evaluated (BS12009 and BS12015), therefore, only the investment criteria for RB14003 and BS11013 are different in Tables 9 and 10.

Table 9: Investment Criteria for Total Investment by Individual RB + BS Project (30 years, 5% discount rate)

Project Code	Project Title	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
RB14003	Building resilience to drupelet disorder in Rubus	1.58	0.28	1.30	5.71	20.80	10.80
BS11013	National Strawberry Varietal Improvement Program – Southern Node	12.59	4.78	7.81	2.63	11.47	8.44
BS12009	Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners	2.57	0.41	2.16	6.23	22.91	11.06
BS12015	Assisting the ongoing development of the Queensland Strawberry Industry	3.76	0.72	3.04	5.25	52.67	13.01

[3] The current CRRDC Impact Assessment Guidelines can be found at: http://www.ruralrdc.com.au/wp-content/uploads/2018/08/201804_RDC-IA-Guidelines-V.2.pdf

Table 10: Investment Criteria for the Hort Innovation Investment by Individual RB + BS Project (30 years, 5% discount rate)

Project Code	Project Title	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
RB14003	Building resilience to drupelet disorder in Rubus	1.31	0.23	1.08	5.71	20.80	12.60
BS11013	National Strawberry Varietal Improvement Program – Southern Node	8.09	3.17	4.92	2.55	10.99	10.39
BS12009	Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners	2.57	0.41	2.16	6.23	22.91	11.06
BS12015	Assisting the ongoing development of the Queensland Strawberry Industry	3.76	0.72	3.04	5.25	52.67	13.01

The total investment per project (PVC) across all four RB + BS RD&E investments (Table 9) ranged from $0.28 million to $4.78 million (present value terms). Estimated benefits (PVB) ranged from $1.58 million to $12.59 million (present value terms). The highest NPV ($7.81 million) was reported for project BS11013 (*National Strawberry Varietal Improvement Program – Southern Node*). The highest BCR, on the other hand, was 6.23 to 1 and was reported for Project BS12009 (*Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners*).

Aggregate Investment Criteria (4 Projects)

Table 11 and Table 12 provide the aggregate investment criteria for all four projects for both total investment and the Hort Innovation investment only.

Table 11: Aggregate Investment Criteria for Total Investment in all Four Projects (5% discount rate)

Investment Criteria	Years after last year of investment						
	0	5	10	15	20	25	30
PVB ($m)	2.64	7.52	11.69	14.95	17.52	19.52	20.50
PVC ($m)	6.19	6.19	6.19	6.19	6.19	6.19	6.19
NPV ($m)	-3.55	1.33	5.50	8.76	11.33	13.33	14.31
BCR	0.43	1.21	1.89	2.42	2.83	3.15	3.31
IRR (%)	negative	8.32	13.54	15.17	15.79	16.05	16.13
MIRR (%)	179.09	5.17	11.89	10.65	9.35	8.30	7.34

Table 12: Aggregate Investment Criteria for Hort Innovation Investment in all Four Projects (5% discount rate)

Investment Criteria	Years after last year of investment						
	0	5	10	15	20	25	30
PVB ($m)	2.64	6.59	9.53	11.83	13.64	15.05	15.73
PVC ($m)	4.53	4.53	4.53	4.53	4.53	4.53	4.53
NPV ($m)	-1.89	2.07	5.00	7.31	9.11	10.52	11.20
BCR	0.58	1.46	2.11	2.61	3.01	3.32	3.47
IRR (%)	negative	11.44	15.31	16.56	17.03	17.22	17.28
MIRR (%)	94.05	13.83	13.40	11.17	9.58	8.42	7.40

The results in Table 11 show that the weighted average BCR for all four projects was approximately 3.31 to 1 for the total investment after 30 years. The simple average BCR was approximately 4.96 to 1 (derived from Table 9). The aggregate investment criteria were positive after five years (BCR of 1.21).

The PVB for the Hort Innovation investment (Table 12) 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 four projects. Hort Innovation contributed 100% of the funding for two of the four projects (BS12009 and BS12015). Hort Innovation contributed 83.1% and 64.2% of the total, undiscounted investment costs for projects RB14003 and BS11013 respectively.

Source of Benefits

Table 13 shows the contribution of each project to the total PVB (Total Investment)

Table 13: Contribution of Benefits by Source

Project Code	Project Title	PVB ($m)	Proportion of Total PVB (%)
RB14003	Building resilience to drupelet disorder in Rubus	1.58	7.7
BS11013	National Strawberry Varietal Improvement Program – Southern Node	12.59	61.4
BS12009	Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners	2.57	12.5
BS12015	Assisting the ongoing development of the Queensland Strawberry Industry	3.76	18.3
Total[(a)]		20.50	100.0

(a) Aggregate total may not be exactly equal to the sum total of the individual project PVBs due to minor rounding errors.

Leverage

Leverage is expressed here as the ratio of non-Hort Innovation investment to Hort Innovation investment. Only two projects, RB14003 and BS11013, included any non-Hort Innovation managed investment. Project RB14003 had a leverage ratio of 0.20 to 1 and project BS11013 had a leverage ratio of 0.56 to 1. That is, for every $1 of Hort Innovation managed funds, co-contributors/ partners contributed $0.20 and $0.56 for projects RB14003 and BS11013 respectively. A summary of the leverage ratio findings for the 2021 RB + BS sample are provided in Table 14 below.

Table 14: Leverage Ratio by Project

Project Code	Project Title	Leverage Ratio[(a)]
RB14003	Building resilience to drupelet disorder in Rubus	0.20
BS11013	National Strawberry Varietal Improvement Program – Southern Node	0.56
BS12009	Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners	0.00
BS12015	Assisting the ongoing development of the Queensland Strawberry Industry	0.00
Aggregate leverage ratio		0.40

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

Conclusions

Impact assessments were carried out on four randomly selected Hort Innovation RB + BS industry RD&E investments that were completed with a final deliverable submitted in the five year period ended June 2020. These investments produced a range of economic, environmental and social impacts. Across all four projects assessed there were 21 individual impact types identified. Of these, approximately 38% were identified as economic (8), 19% environmental (4) and 43% social (9).

Total funding from all sources for the four project investments totalled $6.19 million (present value terms) and produced estimated total expected benefits of $20.50 million (present value terms). This gave an aggregate weighted average BCR of approximately 3.31 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. For example, an aggregate assessment of some 111 evaluations of RD&E investments across all 15 Australian Research and Development Corporations (RDCs) funded by the CRRDC generated a weighted average BCR of approximately 5.5 to 1 (Agtrans Research, 2019).

The sample of RB and BS projects evaluated:

- represented more than 10% of the total Hort Innovation lifetime funding of projects with a final deliverable submitted in the five year period ended 30 June 2020,
- was loosely representative across the specific industry SIP outcomes given the small sample size, 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 Berries industry RD&E investment evaluated.

The 2021 RB + BS sample was considered loosely representative of the investment in Hort Innovation's overall RB + BS industry RD&E portfolio for projects completed in the 2015/16 to 2019/20 period, given the small sample size. Therefore, the impacts and aggregate investment criteria estimated can be considered broadly indicative of impacts and performance across the broader suite of RB + BS RD&E undertaken by Hort Innovation.

Thus, the results reported should be viewed positively by Hort Innovation, the Australian Berries industry, 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 RB + BS 2021 aggregate report.

Table 15: Individual Impact Assessment Report Titles: RB + BS 2021 Sample

Project Code	Project Title
RB14003	Appendix 1: Building resilience to drupelet disorder in Rubus
BS11013	Appendix 2: National Strawberry Varietal Improvement Program – Southern Node
BS12009	Appendix 3: Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners
BS12015	Appendix 4: Assisting the ongoing development of the Queensland Strawberry Industry

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Abbreviations

BCR	Benefit-Cost Ratio
BS	Strawberry
CRRDC	Council of Rural Research and Development Corporations
Hort Innovation	Horticulture Innovation Australia Ltd
IRR	Internal Rate of Return
MG	Mango
MIRR	Modified Internal Rate of Return
NPV	Net Present Value
NY	Nursery
PVB	Present Value of Benefits
PVC	Present Value of Costs
RB	Rubus
R&D	Research and Development
RB + BS	Berries
RD&E	Research, Development and Extension
RDC	Research and Development Corporation
SIP	Strategic Investment Plan
TU	Turf