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Aggregate Summary Report (2019-2021)

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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 annual evaluations were undertaken to meet a variety of Hort Innovation reporting requirements. Each year, over a period of three years, a set of 15 randomly selected Hort Innovation RD&E investments (projects) were evaluated under the Hort Innovation annual impact assessment program.

This report presents a summary and aggregate results for the 2017/18, 2018/19 and 2019/20 evaluations of randomly selected samples of individual projects (45 projects in total) along with a selection of other summary results demonstrating the performance of Hort Innovation's RD&E investments.

Methodology

The real, undiscounted, aggregate benefit and cost cash flows from each annual series of impact assessments within each of the three evaluation samples (2017/18, 2018/19 and 2019/20) were extracted, integrated, and updated. All past and future cash flows were expressed in 2019/20 dollar terms. Cash flows then were discounted to the year 2019/20 using a 5% discount rate and the aggregate Present Value of Benefits and Present Value of Costs then were used to estimate aggregate investment criteria for:

- Each evaluation sample year (2017/18, 2018/19 and 2019/20), and
- All three evaluation samples in total.

Investment criteria were further estimated for the total investment and for the Hort Innovation investment alone for different time periods up to 30 years from the last year of aggregate Hort Innovation investment across all 45 Hort Innovation RD&E project investments included in the aggregate analysis.

Results/key findings

The table below shows the aggregate investment criteria for each of the evaluation sample years (2017/18, 2018/19 and 2019/20) and for the total investment across all three years. Results are shown for the total investment at 30 years after the last year of aggregate Hort Innovation investment (2019/20) using a 5% discount rate.

Investment Criteria	Evaluation Sample Year			Aggregate Results (all three years)
	2017/18	2018/19	2019/20	
PVB ($m)	66.07	40.50	162.92	269.49
PVC ($m)	23.54	12.04	40.04	75.62
NPV ($m)	42.53	28.46	122.88	193.87
BCR	2.81	3.36	4.07	3.56
IRR (%)	24.7	16.9	17.5	19.1
MIRR[(a)] (%)	6.5	6.9	7.7	8.1

(a) Note: the aggregate MIRR is calculated based on the aggregate real, undiscounted benefit and cost cash flows. As such the aggregate MIRR is not equal to the average of the MIRRs across the three sample years.

The 45 individual RD&E projects evaluated had a total investment of $75.62 million (present value terms) and generated estimated total benefits of $269.49 million (present value terms). This gave a NPV of $193.87 million, weighted average BCR of 3.56 to 1, an IRR of 19.1% and a MIRR of 8.1% over 30 years using a 5% discount rate.

Overall, the aggregate results reported show that Hort Innovation has demonstrated consistent, positive performance with BCRs between 2.81 and 4.07 to 1 for the total

investment over a period of 30 years using a 5% discount rate. Leverage ratios, expressed as the ratio of non-Hort Innovation investment to Hort Innovation investment, varied from 0 to 2.63 (nominal terms) across all 45 project investments. The weighted average leverage ratio for all 45 projects was 0.52 (nominal dollar terms).

The investment criteria reported for each sample year, and for all three years in the aggregate, are likely to represent a lower bound of Hort Innovation's RD&E performance because there were two projects of the 45 evaluated where no impacts were valued (project VG16005 in the 2018/19 sample, and project MC15008 in the 2019/20 sample), and, across the remaining 43 projects where impacts were valued, a number of other impacts were identified that were not valued in monetary terms. This also suggests that the investment criteria reported for each sample year are likely to be an underestimate of the true performance of the RD&E investments evaluated.

Also, as part of a continuous improvement process, the impact assessment project team assessed the evaluation process at the end of each year to identify areas for improvement. A number of recommendations were made, to be considered by Hort Innovation management personnel, that may improve any subsequent evaluations of Hort Innovation RD&E investment.

Conclusions

Based on the consistent random sample selection process across the three evaluation samples, the aggregate results are considered to be largely representative of the performance of the Hort Innovation RD&E investment portfolio for investments completed in the years ended June 2018 to 2020.

The results demonstrate that Hort Innovation has consistently delivered benefits to Australia's horticultural industries and the broader Australian community. Further, the results are consistent with the performance of the Australian Rural Research and Development Corporations and should be viewed positively by Government, Australia's horticultural industries, other stakeholders, and Hort Innovation management.

Keywords

MT18011, impact assessment program, impact assessment, evaluation, 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 the 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).

AgEconPlus, in association with Agtrans Research, was contracted to undertake the annual impact assessments over a period of three years and, as of September 2021, three series of annual impact assessments had been completed and submitted to Hort Innovation in calendar years 2019, 2020, and 2021. Each of the three sets of annual assessments included 15 randomly selected Hort Innovation RD&E investments (projects) from a population of projects completed in the previous financial year (for example, the 2021 sample included 15 randomly selected projects that were completed, with a final deliverable submitted and accepted by Hort Innovation in the 2019/20 financial year). Forty-five individual, project level evaluations have been completed to date. The published reports for the Hort Innovation annual impact assessment program can be found at: https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/mt18011/.

The 15 investments for each series of annual assessments were selected through a random sampling process such that the RD&E investments selected represented at least 10% of the total Hort Innovation managed RD&E investment in the overall population (in nominal terms) and spanned a set of pre-defined life of project (LOP) value ranges. Thus, the aggregate results for each series of annual impact assessments were considered largely representative of the performance of the wider Hort Innovation RD&E investment portfolio.

This report presents a summary and aggregate results for the 2017/18, 2018/19 and 2019/20 evaluations of randomly selected samples of individual projects (45 projects in total) along with a selection of other summary results demonstrating the performance of Hort Innovation's RD&E investments.

Method

Individual Impact Assessments

The individual, project level evaluations completed for each annual series of 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 a principal tool.

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts for each RD&E investment randomly selected evaluation. 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 based on the scope and resources of the Hort Innovation annual impact assessment program, availability of necessary evidence/data, the level of uncertainty surrounding the potential impact, and/ or the likely low relative significance of the impact compared to those that were selected for valuation. The impacts valued were therefore deemed to represent the principal benefits delivered by each project. However, as not all impacts were valued, the investment criteria reported within the individual impact assessments potentially represent an underestimate of the performance of the investment evaluated.

Aggregate Analysis

The undiscounted benefit and cost cash flows from each individual project evaluation for each annual series of impact assessments within each of the three evaluation samples (2017/18, 2018/19 and 2019/20) were extracted, integrated, and updated such that all past and future cash flows were expressed in 2019/20 dollar terms using the Implicit Price Deflator for Gross Domestic Product (Australian Bureau of Statistics, 2020). The benefit and cost cash flows then were aggregated and discounted to the year 2019/20 using a 5% discount rate as required by the CRRDC Impact Assessment Guidelines.

The aggregate Present Value of Benefits (PVB) and Present Value of Costs (PVC) then were used to estimate updated aggregate investment criteria for each evaluation sample (2017/18, 2018/19 and 2019/20) and across all three evaluation samples in total. Further investment criteria were estimated for the total investment and for the Hort Innovation managed investment alone for different time periods up to 30 years from the last year of Hort Innovation investment across all 45 RD&E investments included in the aggregate analysis.

Investment criteria reported included the Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR) and the Modified IRR (MIRR). Definitions of these economic terms can be found in the Glossary at the end of this report. The PVB for the Hort Innovation investment was estimated by multiplying the total PVB for each project by the Hort Innovation proportion of real, undiscounted investment for that project and then aggregating by sample year. The Hort Innovation proportion of real investment varied from 30.6% in project MC15005 in the 2018/19 sample to 100% (seven projects in the 2017/18 sample, seven projects in the 2018/19 sample, and six projects in the 2019/20 sample).

Results

Aggregate Investment Criteria by Sample Year

The aggregate investment criteria for different time periods from the last year of aggregate Hort Innovation investment[1] for the total investment in each of the three annual evaluation samples are presented in Table 1 (2017/18 sample), Table 2 (2018/19 sample), and Table 3 (2019/20 sample).

Table 1: Aggregate Investment Criteria by Evaluation Sample Year – 2017/18 Sample (Total Investment, 5% Discount Rate)

Investment Criteria	Years after last year of Hort Innovation investment (2019/20)						
	0	5	10	15	20	25	30
PVB ($m)	24.22	42.40	51.32	57.44	61.51	64.60	66.07
PVC ($m)	23.54	23.54	23.54	23.54	23.54	23.54	23.54
NPV ($m)	0.68	18.86	27.78	33.91	37.97	41.06	42.53
BCR	1.03	1.80	2.18	2.44	2.61	2.74	2.81
IRR (%)	6.3	22.2	24.1	24.5	24.7	24.7	24.7
MIRR (%)	negative	22.0	14.1	10.8	8.8	7.5	6.5

Table 2: Aggregate Investment Criteria by Evaluation Sample Year – 2018/19 Sample (Total Investment, 5% Discount Rate)

Investment Criteria	Years after last year of Hort Innovation investment (2019/20)						
	0	5	10	15	20	25	30
PVB ($m)	2.14	10.75	20.12	27.52	33.24	37.71	40.50
PVC ($m)	12.04	12.04	12.04	12.04	12.04	12.04	12.04
NPV ($m)	-9.90	-1.29	8.08	15.48	21.19	25.67	28.46
BCR	0.18	0.89	1.67	2.29	2.76	3.13	3.36
IRR (%)	negative	2.6	12.9	15.5	16.4	16.8	16.9
MIRR (%)	negative	1.3	9.1	9.2	8.4	7.7	6.9

Table 3: Aggregate Investment Criteria by Evaluation Sample Year – 2019/20 Sample (Total Investment, 5% Discount Rate)

Investment Criteria	Years after last year of Hort Innovation investment (2019/20)						
	0	5	10	15	20	25	30
PVB ($m)	2.61	27.98	67.98	105.50	129.13	147.60	162.92
PVC[(a)] ($m)	39.99	40.04	40.04	40.04	40.04	40.04	40.04
NPV ($m)	-37.39	-12.06	27.94	65.46	89.09	107.56	122.88
BCR	0.07	0.70	1.70	2.63	3.23	3.69	4.07
IRR (%)	negative	negative	12.4	16.1	17.0	17.4	17.5
MIRR (%)	negative	negative	9.6	10.5	9.4	8.5	7.7

(a) See footnote one for explanation as to why the PVC at year zero is different to the PVC for years 5 to 30.

[1] Across the three sample years, the final year of aggregate Hort Innovation investment was 2019/20 and this corresponds to the criteria used to define the evaluation populations and random sample selection. However, in the 2019/20 sample there was one project (CT17003) that reported funding from co-contributors in the 2020/21 financial year. The amount was trivial compared to the total funding in the 2019/20 sample. Thus, the aggregate cash flows and associated investment criteria were reported using 2019/20 as the last year of aggregate investment.

The next set of tables shows the same aggregate investment criteria but for the Hort Innovation investment only - Table 4 (2017/18 sample), Table 5 (2018/19 sample), and Table 6 (2019/20 sample).

Table 4: Aggregate Investment Criteria by Evaluation Sample Year – 2017/18 Sample (Hort Innovation Investment, 5% Discount Rate)

Investment Criteria	Years after last year of Hort Innovation investment (2019/20)						
	0	5	10	15	20	25	30
PVB ($m)	12.44	21.73	26.30	29.83	32.37	34.35	35.26
PVC ($m)	12.80	12.80	12.80	12.80	12.80	12.80	12.80
NPV ($m)	-0.37	8.92	13.50	17.02	19.57	21.54	22.46
BCR	0.97	1.70	2.05	2.33	2.53	2.68	2.75
IRR (%)	3.7	20.7	22.7	23.3	23.4	23.5	23.5
MIRR (%)	negative	18.6	12.4	9.9	8.3	7.2	6.2

Table 5: Aggregate Investment Criteria by Evaluation Sample Year – 2018/19 Sample (Hort Innovation Investment, 5% Discount Rate)

Investment Criteria	Years after last year of Hort Innovation investment (2019/20)						
	0	5	10	15	20	25	30
PVB ($m)	1.49	7.49	13.47	18.09	21.61	24.38	26.07
PVC ($m)	8.84	8.84	8.84	8.84	8.84	8.84	8.84
NPV ($m)	-7.35	-1.35	4.63	9.25	12.77	15.54	17.23
BCR	0.17	0.85	1.52	2.05	2.45	2.76	2.95
IRR (%)	negative	1.5	11.6	14.2	15.2	15.6	15.7
MIRR (%)	negative	0.1	7.9	8.2	7.6	7.0	6.3

Table 6: Aggregate Investment Criteria by Evaluation Sample Year – 2019/20 Sample (Hort Innovation Investment, 5% Discount Rate)

Investment Criteria	Years after last year of Hort Innovation investment (2019/20)						
	0	5	10	15	20	25	30
PVB ($m)	1.95	22.23	51.99	78.49	95.58	109.09	120.24
PVC ($m)	29.88	29.88	29.88	29.88	29.88	29.88	29.88
NPV ($m)	-27.93	-7.65	22.11	48.61	65.70	79.21	90.36
BCR	0.07	0.74	1.74	2.63	3.20	3.65	4.02
IRR (%)	negative	negative	12.9	16.3	17.2	17.6	17.7
MIRR (%)	negative	negative	9.9	10.4	9.3	8.4	7.7

A summary of the key investment criteria for each sample year for the total investment and for the Hort Innovation investment alone are shown in Table 7 and Table 8 respectively.

Table 7: Summary of Aggregate Investment Criteria by Evaluation Sample Year (Total Investment, 30 years, 5% Discount Rate)

Investment Criteria	Evaluation Sample Year		
	2017/18	2018/19	2019/20
PVB ($m)	66.07	40.50	162.92
PVC ($m)	23.54	12.04	40.04
NPV ($m)	42.53	28.46	122.88
BCR	2.81	3.36	4.07
IRR (%)	24.7	16.9	17.5
MIRR (%)	6.5	6.9	7.7

Table 8: Summary of Aggregate Investment Criteria by Evaluation Sample Year (Hort Innovation Investment, 30 years, 5% Discount Rate)

Investment Criteria	Evaluation Sample Year		
	2017/18	2018/19	2019/20
PVB ($m)	35.26	26.07	120.24
PVC ($m)	12.80	8.84	29.88
NPV ($m)	22.46	17.23	90.36
BCR	2.75	2.95	4.02
IRR (%)	23.5	15.7	17.7
MIRR (%)	6.2	6.3	7.7

Overall, the aggregate results presented indicated that, based on the representative random samples evaluated each year, Hort Innovation has demonstrated consistent, positive performance with BCRs between 2.81 and 4.07 to 1 for the total investment over a period of 30 years using a 5% discount rate.

The investment criteria reported for each sample year are likely to represent a lower bound of Hort Innovation's RD&E performance because there were two projects of the 45 evaluated where no impacts were valued (project VG16005 in the 2018/19 sample, and project MC15008 in the 2019/20 sample), and, across the remaining 43 projects where impacts were valued, a number of other impacts were identified that were not valued in monetary terms. This also suggests that the investment criteria reported for each sample year are likely to be an underestimate of the true performance of the RD&E investments evaluated.

Overall Aggregate Investment Criteria

Table 9 and Table 10 show the overall aggregate investment criteria across all three evaluation samples (2017/18, 2018/19 and 2019/20) for the total investment and for the Hort Innovation investment respectively.

Table 9: Overall Aggregate Investment Criteria (All Three Sample Years) (Total Investment, 5% Discount Rate)

Investment Criteria	Years after last year of Hort Innovation investment (2019/20)						
	0	5	10	15	20	25	30
PVB ($m)	28.97	81.13	139.42	190.46	223.87	249.91	269.49
PVC[(a)] ($m)	75.57	75.62	75.62	75.62	75.62	75.62	75.62
NPV ($m)	-46.61	5.51	63.80	114.85	148.25	174.30	193.87
BCR	0.38	1.07	1.84	2.52	2.96	3.30	3.56
IRR (%)	negative	6.8	15.8	18.2	18.8	19.1	19.1
MIRR (%)	negative	6.2	12.3	11.6	10.1	9.0	8.1

(a) See footnote one for explanation as to why the PVC at year zero is different to the PVC for years 5 to 30.

Table 10: Overall Aggregate Investment Criteria (All Three Sample Years) (Hort Innovation Investment, 5% Discount Rate)

Investment Criteria	Years after last year of Hort Innovation investment (2019/20)						
	0	5	10	15	20	25	30
PVB ($m)	15.87	51.44	91.76	126.40	149.57	167.82	181.57
PVC ($m)	51.52	51.52	51.52	51.52	51.52	51.52	51.52
NPV ($m)	-35.65	-0.08	40.24	74.88	98.05	116.29	130.05
BCR	0.31	1.00	1.78	2.45	2.90	3.26	3.52
IRR (%)	negative	5.0	14.8	17.3	18.1	18.3	18.5
MIRR (%)	negative	4.0	11.4	11.0	9.7	8.7	7.8

The 45 individual RD&E projects evaluated had a total investment of $75.62 million (present value terms) and generated estimated total expected benefits of $269.49 million (present value terms). This gave a NPV of $193.87 million, a weighted average BCR of 3.56 to 1, an IRR of 19.1% and a MIRR of 8.1% over 30 years using a 5% discount rate.

The aggregate investment criteria were positive from a period of five years after the last year of aggregate Hort Innovation investment (2019/20). Based on the consistent random sample selection process across the three evaluation samples, the aggregate results are considered to be largely representative of the performance of the Hort Innovation RD&E investment portfolio for investments completed in the years ended June 2018 to 2020.

Other Findings

Leverage

Leverage is expressed here as the ratio of non-Hort Innovation investment to Hort Innovation investment. Across the 45 projects, leverage ratios varied from 0 to 2.63 (nominal terms). In total, 20 projects had a leverage ratio of 0, that is, no external funding (seven in the 2017/18 sample, seven in the 2018/19 sample, and six in the 2019/20 sample). The highest leveraged project was the project MC15005 (*Benchmarking the macadamia industry 2015-2018*) with a leverage ratio of 2.63.

The aggregate, nominal leverage ratios for each of the three evaluation sample years and for all three years combined are provided in Table 11. The weighted average leverage ratio for all 45 projects was 0.52 (nominal dollar terms). The leverage ratios presented in Table 11 indicate that average project leverage has declined from the 2017/18 sample to the 2019/20 sample.

Table 11: Nominal Weighted Average Leverage Ratio by Evaluation Sample Year

Evaluation Sample Year	Leverage Ratio[(a)]
2017/18	0.95
2018/19	0.41
2019/20	0.39
Aggregate (all three years)	0.52

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

Top Performing Projects

The top five projects ranked by NPV, based on the individual, project level impact assessments across all three sample years, are presented in Table 12. Table 13 then presents the top five projects ranked by BCR.

Table 12: Top Performing Projects by Net Present Value (All Three Samples)

Project Code and Title	NPV ($m)	Sample Year
BA14014: *Fusarium wilt Tropical Race 4 Research Program*	85.71	2019-20
BS12021: *The National Strawberry Varietal Improvement Program*	18.33	2017-18
MC15005: *Benchmarking the Macadamia Industry 2015-2018*	10.35	2018-19
VG13004: *Innovating new virus diagnostics and planting bed management in the Australian Sweetpotato Industry*	7.12	2017-18
VG15009: *Improved soilborne disease diagnostic capacity for the Australian Vegetable Industry*	6.82	2019-20

Table 13: Top Performing Projects by Benefit-Cost Ratio (All Three Samples)

Project Code and Title	BCR	Sample Year
BA14014: *Fusarium wilt Tropical Race 4 Research Program*	10.24	2019-20
NY15001: *Evaluation of Nursery Tree Stock Balance Parameters*	6.81	2018-19
MC15005: *Benchmarking the Macadamia Industry 2015-2018*	5.88	2018-19
VG15009: *Improved soilborne disease diagnostic capacity for the Australian Vegetable Industry*	4.94	2019-20
MU17005: *Identify and evaluate the potential in adding value and monitoring the mushroom waste streams*	4.06	2019-20

Conclusions

Over a three-year period (calendar 2019 to 2021), 45 randomly selected Hort Innovation RD&E investments completed in the years ended June 2018 to 2020 (15 each year) were subjected to impact assessment to meet the following Hort Innovation evaluation reporting requirements:

- Reporting against the Hort Innovation's current Strategic Plan and the Evaluation Framework associated with the 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).

The 45 individual RD&E projects evaluated had a total investment of $75.62 million (present value terms) and generated estimated total benefits of $269.49 million (present value terms). This gave a NPV of $193.87 million, weighted average BCR of 3.56 to 1, an IRR of 19.1% and a MIRR of 8.1% over 30 years using a 5% discount rate. Also, across the 45 projects, leverage ratios varied from 0 to 2.63 (nominal terms). The weighted average leverage ratio for all 45 projects was 0.52 (nominal dollar terms).

Aggregate results were estimated by evaluation sample year (2017/18, 2018/19 and 2019/20) and the investment criteria demonstrated that Hort Innovation has produced consistent and positive performance, with weighted average BCRs between 2.81 and 4.07 to 1. Further, investment criteria reported are likely to represent a lower bound for Hort Innovation's RD&E performance. This is because there were two projects of the 45 evaluated where no impacts were valued (project VG16005 in the 2018/19 sample, and project MC15008 in the 2019/20 sample). Also, across the remaining 43 projects where impacts were valued, a number of other impacts were identified that were not valued in monetary terms. The results suggests that the aggregate investment criteria reported for each sample year, and for the total investment across all three years, are likely to be an underestimate of the true performance of the RD&E investments evaluated.

Based on the consistent random sample selection process across the three annual evaluation samples, the aggregate results are considered to be largely representative of the performance of the Hort Innovation RD&E investment portfolio for investments completed in the years ended June 2018 to 2020.

The results show that Hort Innovation has consistently delivered benefits to Australia's horticultural industries and the broader Australian community. Further, the results are consistent with the performance of the Australian Rural Research and Development Corporations where weighted average BCRs of between 3.3 and 9.1 have been estimated, with aggregate estimated weighted average BCRs of between 4.5 and 5.5 to 1 (Agtrans Research, 2019). The results should be viewed positively by Government, Australia's horticultural industries, other stakeholders, and Hort Innovation management.

Recommendations

This report represents the culmination of a three-year period of annual impact assessments of Hort Innovation RD&E under Project MT18011. As part of a continuous improvement process, the impact assessment project team assessed the evaluation process at the end of each year to identify areas for improvement and to make any reasonable recommendations, to be considered by Hort Innovation management personnel, for any subsequent evaluations of Hort Innovation RD&E investments. The following recommendations have been made within this context.

Ex-ante analyses of key future RD&E investments

It is recommended that Hort Innovation consider the inclusion of independent ex-ante analyses for key areas of future RD&E investment within the Hort Innovation Evaluation Framework. Such ex-ante analyses would support:

- Improved monitoring, evaluation, reporting and improvement processes,
- Development of appropriate impact assessment/cost-benefit analysis frameworks for subsequent evaluations of Hort Innovation RD&E investment(s),
- Identification of information/ data gaps associated with RD&E pathways to impact/ impact assessment,
- Demonstration and estimation of potential impacts of important RD&E that could, in turn, encourage additional investment and/or collaboration and increased adoption of key RD&E outputs, and
- Development of a baseline and framework against which future ex-post impact assessments could be conducted and compared.

Such analyses could be completed at various levels of detail, depending on Hort Innovation requirements, to support project, industry and portfolio level decision making and best management practice from a RD&E resource allocation perspective.

Support for collection of industry data and benchmarking studies

Effective and robust estimation of the benefits of horticultural RD&E investments is highly dependent on the availability of credible data associated with the industries targeted and the expected outcomes and impacts of the RD&E.

It is recommended that Hort Innovation make an increased effort to be involved in, or co-fund, new and/or up-to-date studies that collect key industry production data and/or provide quantitative benchmarks for key industry information and data. A good example of such a useful study is the investment in Hort Innovation project MC15005: *Benchmarking the Macadamia Industry 2015-2018*.

Such studies would be particularly relevant for industries where data are particularly scarce and/or where demonstration of the impacts of RD&E investments would be highly valuable. Benchmarking studies may also contribute to the increased adoption of best management practices as growers become aware of what high-performing producers are doing differently. Further, as the information can be presented as aggregate data, producer privacy and commercial sensitive industry information will be protected.

An assessment of environmental and social impact studies for horticulture RD&E

Many of the impacts/ benefits identified for Hort Innovation RD&E investments are classified as environmental or social impacts. Such impacts are rarely quantified in existing RD&E impact assessments/ evaluations due to the difficulty in assigning monetary values to environmental and social impacts and the potentially limited scope of typical evaluation programs.

Valuation of environmental and/or social impacts often requires the application of complex non-market economic valuation techniques. However, where such studies do exist, it may

be possible to use other, less complex valuation methods, such as benefit transfer, to incorporate existing estimates of environmental or social impacts into the evaluation process.

In 2020, the Fisheries Research and Development Corporation (FRDC) funded a study that assessed and compiled relevant, publicly available, non-market impact valuation studies for potential use in future FRDC RD&E impact assessments. The study also provided an assessment of the major gaps in the available non-market information related to the environmental and social impacts of fisheries RD&E to inform and prioritise potential future non-market valuation (also known as willingness-to-pay) studies. The FRDC study, undertaken by Agtrans in conjunction with NCEconomics, produced a report and a database of non-market valuation studies specific to impacts associated with fisheries and aquaculture RD&E. For further information, see: https://www.frdc.com.au/project/2019-091.

Such a study is distinct from work undertaken to estimate the benefits of current and past Hort Innovation RD&E investments. The study would specifically collate available data on the estimated non-market (environmental and social) impacts of horticultural RD&E and provide a database of the quantitative benefits of such investments.

Given the wide range of industries that Hort Innovation represents, it is recommended that Hort Innovation consider funding a similar assessment and gap analysis of the available non-market information/ literature related to the environmental and social impacts of horticultural RD&E. This would provide input to future evaluations of RD&E investment, and to inform and prioritise potential future non-market impact valuation studies relevant to Hort Innovation RD&E.

It is possible that such a study could be co-funded by multiple interested parties (such as other Rural Research and Development Corporations) so that the scope could be expanded to include collation of non-market valuation studies that address cross-sectoral RD&E impacts.

Economist input for future monitoring and evaluation processes

When Hort Innovation next updates, amends and/or revises the Evaluation Framework and/ or other monitoring and evaluation (M&E) processes, it is recommended that Hort Innovation seek input from an economic consultant familiar with RD&E impact assessment requirements to ensure that the organisation's performance measures (i.e. key performance indicators) and data collection procedures appropriately contribute to future assessment of impacts and/or evaluation of Hort Innovation RD&E investments.

This may involve development of an impact M&E framework within the overall Hort Innovation Evaluation Framework that specifically addresses assessment of impacts and/or end-of-project evaluation data and information requirements.

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

BCR	Benefit-Cost Ratio
CRRDC	Council of Rural Research and Development Corporations
FRDC	Fisheries Research and Development Corporation
Hort Innovation	Horticulture Innovation Australia Ltd
IRR	Internal Rate of Return
LOP	Life Of Project
M&E	Monitoring and Evaluation
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