

Final Report

**Industry-specific impact assessment
program: Turf**

**Impact assessment report for project *Industry
development services for the Queensland turf
industry (TU13029)***

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Executive Summary

What the report is about

This report presents the results of an impact assessment of a Horticulture Innovation Australia Limited (Hort Innovation) investment in *TU13029: Industry Development Services for the Queensland Turf Industry*. The project was funded by Hort Innovation over the period May 2014 to May 2017.

Methodology

The investment was first analysed qualitatively within a logical framework that included activities and outputs, outcomes, and impacts. Actual and/or potential impacts then were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation in monetary terms (quantitative assessment). Past and future cash flows were expressed in 2020/21 dollar terms and were discounted to the year 2020/21 using a discount rate of 5% to estimate the investment criteria and a 5% reinvestment rate to estimate the modified internal rate of return (MIRR).

Results/key findings

Industry development services include extension, communication, training, capacity building, research design, and delivery of best practice guidelines. Investment in TU13029 delivered these services to the Queensland turf industry between May 2014 and May 2017.

Investment Criteria

Total funding from all sources for the project was \$0.37 million (present value terms). The investment produced estimated total expected benefits of \$0.8 million (present value terms). This gave a net present value of \$0.43 million, an estimated benefit-cost ratio of 2.14 to 1, an internal rate of return of 11.3% and a modified internal rate of return of 7.3%.

Conclusions

The Hort Innovation investment in Project TU13029 has successfully delivered industry development services to the Queensland turf industry. As four environmental and social impacts identified were not valued, the investment criteria estimated by the evaluation may be underestimates of the actual performance of the investment.

Keywords

Impact assessment, cost-benefit analysis, turf, industry development, Turf Queensland, turfgrass, precision agriculture; water sustainability; irrigation; drought; flood; workshops; education, awareness, engagement.

Introduction

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

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

This impact assessment program addresses this requirement through conducting a series of industry-specific ex-post independent impact assessments of the berry (RB + BS), mango (MG), turf (TU) and nursery (NY) RD&E investment funds.

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 16 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, and
- Three 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 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 where possible given the small sample sizes.

General Method

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

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

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

Background & Rationale

Background

The Australian turf industry has a five-year average production volume of 38.9 million square metres and a gross value of production (GVP) of \$250.2 million – Table 1. In 2019/20, turf had an estimated farmgate value (GVP) of \$280.2 million (Turf Australia/Hort Innovation 2021).

Table 1: Turf Industry Performance 2016-2020

Year Ended 30 June	Area (ha)	Production (million m ²)	Gross Value of Production (\$m)	Wholesale Value (\$m)
2016	3,736	42.8	257.5	257.5
2017	3,880	38.5	228.6	270.6
2018	3,863	38.4	240.6	240.6
2019	3,880	36.4	243.9	243.9
2020	3,880	38.5	280.2	280.2
Average	3,848	38.9	250.2	258.6

Source: Australian Horticulture Statistics Handbook 2017/18, 2018/19 and 2019/20.

Turf covers live grass products grown for parks, gardens, residential and commercial properties, sporting venues and for land rehabilitation and landscape improvement purposes. Production occurs in all states and territories of Australia. The majority of production occurs in New South Wales (NSW) and Queensland (QLD). Production is year-round, with a number of different varieties being grown, although there is a peak of production during the spring and summer months. (Australian Horticulture Statistics Handbook 2019/20).

Turf research and development (R&D) activity is guided by the Turf industry's Strategic Investment Plan (SIP). The activities are funded by levies payable on turf produced in Australia; and the R&D levy funds are managed by Hort Innovation.

The recently completed SIP has been driven by levy payers and addressed the Australian turf industry's needs from 2017 to 2021. The SIP focussed on five outcome areas:

- Turf revenue has increased by five per cent plus consumer price index (CPI) from targeted marketing programs.
- Improved strategic decision making by turf growers from increased knowledge of industry data and consumer insights.
- Improved farm practices and profitability from increased awareness and adoption of turf R&D.
- Turf industry leadership program graduates are adopting innovation and using their leadership skills in business and industry decision making.
- Improved industry sustainability from identifying and managing risks.

Turf Australia is the national representative body of the turf industry and comprises levy-paying turf producers and individual members Australia wide. Turf Australia plays a vital role in the dissemination of information on both levy-funded R&D and marketing outputs as well as industry intelligence. Turf Australia works with state associations in NSW, QLD, Western Australia and Victoria. Each of the main Australian turf growing areas has a levy-funded part-time industry development officer (Hort Innovation 2017).

Rationale

Industry development services include extension, communication, training, capacity building, research design, and delivery of best practice guidelines. Reviews of the Australian turf industry have consistently stressed the importance of levy investment in industry development services and

the need to raise levy-payer awareness of R&D and marketing activity (e.g., Independent Industry Development Needs Assessment 2009, and SIP Review 2013). Levy payers in QLD have expressed concerns about the levy program and the demonstrated level of understanding of the program and its achievements needed to be improved.

This project was to deliver industry development services and assist with the implementation of the 2012 to 2017 SIP in QLD. Turf QLD was to deliver industry development services using proven QLD resources and activities. The project was to be completed in partnership with the national project *TU13004 Turf Business & Industry Development* and be guided by an appropriate steering committee.

Most turf is grown in coastal QLD from the far northern tropical regions to the NSW border. Approximately half of QLD's turf production takes place in the state's southeast. The QLD industry consists of approximately 130 turf growers and accounts for 42% of Australia's turf production. QLD is 100% warm season grasses and is affected by heavy seasonal rains and adverse climatic conditions (including cyclones, drought, and bushfires).

Project Details

Summary

Project Code: TU13029
Title: Industry Development Services for the Queensland Turf Industry
Research Organisation: Turf Australia Limited
Project Leader: Richard Stephens
Period of Funding: May 2014 to May 2017

Objectives

The objective of this project was for Turf QLD to work in collaboration with Turf Australia to improve:

- Grower and production sector profitability through improved business best practices.
- Grower Farm Management Quality Systems, communications and extension.
- Producer and community environmental sustainability.
- Industry leadership and use of essential data.
- Industry capacity to respond to biosecurity issues.

Logical Framework

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

Table 2: Logical Framework for Project TU13029

Activities	<ul style="list-style-type: none"> • Formation of a QLD Industry Development Services project steering committee. Steering committee consisted of the President and Vice President of Turf QLD, Turf Australia's Business & Industry Development Manager, and the QLD Industry Development Officer. • Formulation of Annual Operating Plans (AOPs) and Key Performance Indicators (KPIs) in partnership with the project steering committee. The steering committee subsequently met at six monthly intervals to assess the ongoing performance of the project against the AOP and KPIs and revise priorities where this was required. • Represent and engage with the turf grower and turf maintenance sectors across QLD. The project engaged with regional turf growing groups to garner and collate input into the design and subsequent implementation of national R&D and marketing programs. • Industry engagement included both on-site farm visits and workshops with growers as well as project representation to the turf maintenance sector. Between 50 and 100 farm visits were completed each year of the project covering at least 85% of total QLD turf
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	<p>production. Grower workshops included Turfgrass Profitability Seminars completed in conjunction with Turf Australia. Contact with the turf maintenance sector included meetings with representation from sports turf, golf courses, parks and gardens, and the landscape contractors’ association. Maintenance sector meetings addressed the industry’s Turf Accreditation Program.</p> <ul style="list-style-type: none"> • Collection and collation of industry data to inform decision making by growers, the maintenance sector, industry organisations (e.g., Turf QLD), and policy makers. Data collected had a strong focus on production and best management practice adoption in areas that drained to the Great Barrier Reef lagoon. Multiple meetings held with the QLD government including the Dept of Natural Resources & Mines and Dept of Biosecurity. • Contributions to the development and implementation of national training programs including completion of an industry training needs assessment for QLD and alignment of training needs with SIP priorities. Training programs delivered included classes on the use of the “Staying in the Green Turf Cost of Production Calculator”, OH&S best practice, and updates on the industry’s Erosion Control RD&E investments. • Development and delivery of the QLD Grower and Turf Maintenance Communications program and provision of input into national industry communications (Hort Innovation project TU11024). Publications produced by the project included the Turf QLD website, e-newsletters (Turf Alerts), and Turf QLD Magazine and input into the Turf Australia Magazine. Publications were aligned with state-based education strategies. • Development of QLD best practice strategies and implementation of strategies targeting biosecurity, and energy and water use efficiency within a peri-urban environment e.g., implementation of the variable rate irrigation and fertigation programs. • Promotion and delivery of best practice programs involving nutrient and sediment movement and erosion control surrounding the production and use of turf. • Preparation and dissemination of press releases and journal articles e.g., editorials in the Australian Turf-craft Management Journal. • Reporting of project milestones and delivery of a final report to Hort Innovation.
<p>Outputs</p>	<ul style="list-style-type: none"> • Four QLD industry workshops per year on best practice turf management techniques. • Quarterly QLD newsletters providing R&D, technical reports and other updates. • Four factsheets and case studies per year addressing industry best practice, benchmarking, nutrition, sediment and erosion control in the urban and rural environment. • Production of four QLD focussed You Tube videos for use on websites and at workshops. • Cross QLD industry engagement on industry R&D and marketing programs. • Increased collaboration and engagement with the turf maintenance sector. • QLD industry data to inform decision-making especially in relation to GBR management. • Increased collaboration between Turf QLD and Turf Australia with efficiencies in the delivery of RD&E, marketing and communication measures. • Identification of QLD turf industry training needs and coordination of the industry training program. • Development and implementation of the QLD industry communications plan for both the turf grower and turf maintenance sectors. • Strategies prepared and delivered for improved environmental, biosecurity, sediment and erosion control, and water use efficiency within a peri-urban environment.
<p>Outcomes</p>	<ul style="list-style-type: none"> • Extension delivered to Qld turf growers and the turf maintenance sector in an efficient and effective way through to May 2017. • Increased reach and knowledge of R&D and marketing outputs by turf growers. • Support for the industry with improved data on uptake of best practice especially in the Great Barrier Reef catchment. • Increased awareness of, and potential support for, the national turf industry levy. • Potential positive impacts on turf grower decision-making and adoption of R&D findings. • Potential adoption of R&D findings targeting reduction in cost of production (e.g., application of the cost of production calculator) and market growth opportunities (e.g., supply of turf for the erosion control market). • Adoption of R&D outputs that have the potential to enhance the environmental sustainability of turf farms.

Impacts	<ul style="list-style-type: none"> • Additional turf grower profit (lower costs of production and additional sales) as a result of increased R&D and marketing output adoption. • An improvement in the QLD environment with adoption of research findings and best practice measures that facilitate sustainable turf production. • Additional turf grower capacity and understanding of innovation and the role of R&D outputs in their businesses. Improved grower ability to respond to environmental, biosecurity, and water use efficiency issues. • Additional extension, communication, and training capacity – for both the QLD Industry Development Officer and national Business Development Manager. • Contribution to improved regional community wellbeing from spill-over income and employment benefits as a result of a more profitable and sustainable turf industry.
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Project Investment

Nominal Investment

Table 3 shows the annual investment made in project TU13029 by Hort Innovation. There were no other investors in the project.

Table 3: Annual Investment in Project TU13029 (nominal \$)

Year ended 30 June	HORT INNOVATION (\$)	OTHERS (\$)	TOTAL (\$)
2014	31,864	0	31,864
2015	73,728	0	73,728
2016	63,728		63,728
2017	54,218	0	54,218
Total	223,538	0	223,538

Source: Hort Innovation fully executed letter of variation, 2 June 2014.

Program Management Costs

For the Hort Innovation investment the cost of managing the Hort Innovation funding was added to the Hort Innovation contribution for the project via a management cost multiplier (1.162). This multiplier was estimated based on the share of ‘payments to suppliers and employees’ in total Hort Innovation expenditure (3-year average) reported in the Hort Innovation’s Statement of Cash Flows (Hort Innovation Annual Report, various years). This multiplier was then applied to the nominal investment by Hort Innovation shown in Table 3.

Real Investment and Extension Costs

For the purposes of the investment analysis, the investment costs of all parties were expressed in 2020/21 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2021). No additional costs of extension were incurred, the project was focussed on the extension of research to industry.

Impacts

Table 4 provides a summary of the principal types of impacts delivered by the project, based on the logical framework. Impacts have been categorised into economic, environmental, and social impacts.

Table 4: Triple Bottom Line Categories of Principal Impacts from Project TU13029

Economic	<ul style="list-style-type: none"> • Additional turf grower profit (lower costs of production and additional sales) as a result of increased R&D and marketing output adoption.
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Environmental	<ul style="list-style-type: none"> An improvement in the QLD environment with adoption of research findings and best practice measures that facilitate sustainable turf production.
Social	<ul style="list-style-type: none"> Additional turf grower capacity and understanding of innovation and the role of R&D outputs in their businesses. Improved grower ability to respond to environmental, biosecurity, and water use efficiency issues. Additional extension, communication, and training capacity – for both the QLD Industry Development Officer and national Business Development Manager. Contribution to improved regional community wellbeing from spill-over income and employment benefits as a result of a more profitable and sustainable turf industry.

Public versus Private Impacts

The impacts identified from the investment are both private and public in nature. Private impacts accrue to turf growers (additional profit as a result of increased R&D and marketing output adoption). Public impacts include improved environmental outcomes from adoption of best practice; additional turf grower and researcher capacity; and spill-over benefits to regional communities from enhanced turf producer profit and sustainability.

Distribution of Private Impacts

Private impacts will be mostly captured by QLD turf growers whose businesses are integrated along the supply chain. Some benefits will be realised by the turf maintenance sector.

Impacts on Other Australian Industries

No impacts on other Australian industries anticipated – the project focussed on QLD turf industry development.

Impacts Overseas

No impacts anticipated in overseas industries.

Match with National Priorities

The Australian Government’s Science and Research Priorities and Rural RD&E priorities are reproduced in Table 5. The project outcomes and related impacts will contribute to all four Rural RD&E Priorities and in particular priority 4. The project will also contribute to Science and Research Priority 2.

Table 5: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	Science and Research Priorities (est. 2015)
<ol style="list-style-type: none"> Advanced technology Biosecurity Soil, water and managing natural resources Adoption of R&D 	<ol style="list-style-type: none"> Food Soil and Water Transport Cybersecurity Energy and Resources Manufacturing Environmental Change Health

Sources: (DAWR, 2015) and (OCS, 2015)

Alignment with the Turf Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the turf industry are outlined in the Turf Industry's Strategic Investment Plan 2017-2021¹ (Hort Innovation, 2017). Project TU13029 addressed all five outcomes.

Valuation of Impacts

Impacts Valued

Analyses were undertaken for total benefits that included future expected benefits. A degree of conservatism was used when finalising assumptions, particularly when some uncertainty was involved. Sensitivity analyses were undertaken for those variables where there was greatest uncertainty or for those that were identified as key drivers of the investment criteria.

A single impact was valued – additional turf grower profit (lower costs of production and additional sales) as a result of increased R&D and marketing output adoption.

Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. Those not valued included:

- An improvement in the QLD environment with adoption of research findings and best practice measures that facilitate sustainable turf production.
- Additional turf grower capacity and understanding of innovation and the role of R&D outputs in their businesses. Improved grower ability to respond to environmental, biosecurity, and water use efficiency issues.
- Additional extension, communication, and training capacity – for both the QLD Industry Development Officer and national Business Development Manager.
- Contribution to improved regional community wellbeing from spill-over income and employment benefits as a result of a more profitable and sustainable turf industry.

These impacts were not valued due to lack of data to support credible assumptions.

Summary of Assumptions

A summary of the key assumptions made for valuation of additional profitable sales into the erosion/stabilisation management market is provided in Table 6.

Table 6: Summary of Assumptions for Impact Valuation

Variable	Assumption	Source/Comment
QLD turf production.	16,650,000 m ² /year.	Australian Turf Industry, 2019/20 Snapshot Report.
Share of QLD turf production aware of TU13029 outputs and making changes to their business.	60%	AgEconPlus assumption - 85% of businesses contacted directly by the project and not all of these businesses will make successful changes to their enterprise.
Average profit on turf sold.	\$0.65/m ² .	Average farm gate price \$6.50/m ² (sourced from the Australian Turf Industry Snapshot, 2019/20) and an assumed profit margin of 10%.

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

Increase in profit due to TU13029.	1%	A total increase in profit of 2% is assumed by the analyst. However, 1% of this gain is attributable to the research rather than industry development activities.
Attribution of impacts to this project.	90%	AgEconPlus assumption that allows for some impacts in QLD as a result of the national communications project TU11024.
Year of first impact.	2015/16.	Assumes benefits are realised by turf growers after three years of the project.
Probability of the project generating useful outputs.	100%	Outputs have been delivered to QLD turf growers.
Probability of valuable outcomes.	90%	AgEconPlus assumption.
Probability of impact (assuming successful outcome)	90%	AgEconPlus assumption.
Counterfactual.	90%	In the absence of TU13029 research, it is only 10% likely that the same results would have been generated by another project.

Results

All costs and benefits were discounted to 2020/21 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the Modified Internal Rate of Return (MIRR). The base analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the project investment period plus 30 years from the last year of investment (2016/17) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

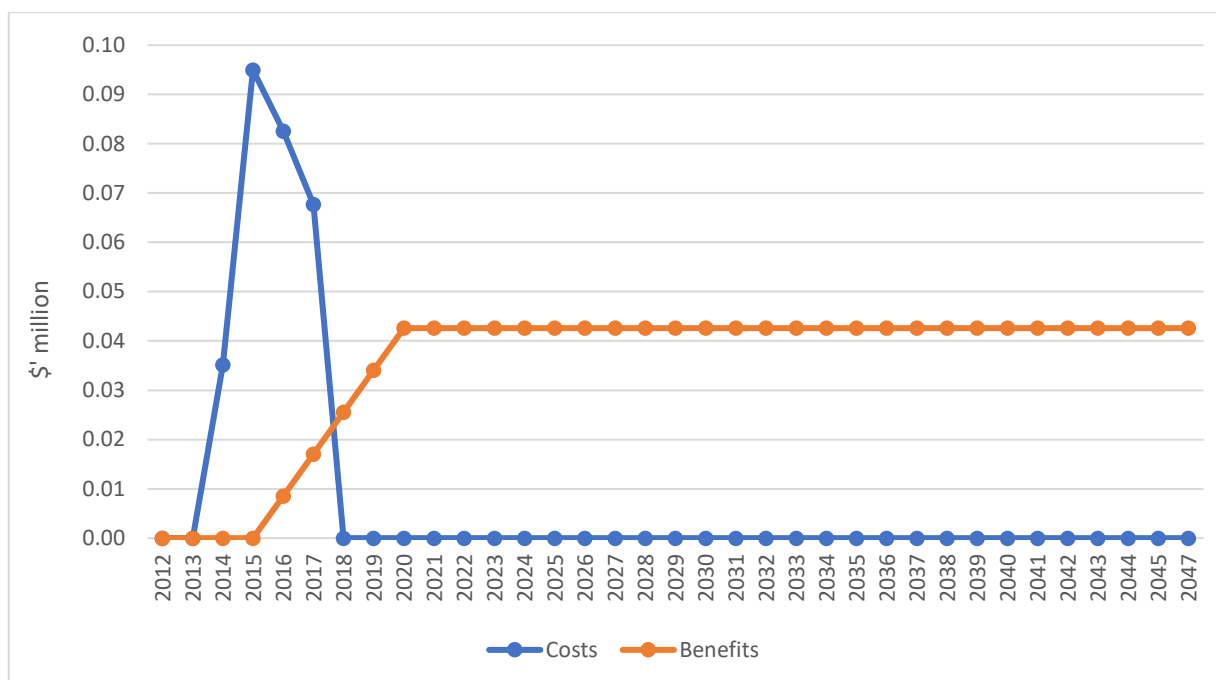
Table 7 shows the investment criteria estimated for different periods of benefits for the total investment. Hort Innovation was the only investor in the project.

Table 7: Investment Criteria for Total Investment in Project TU13029

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.03	0.23	0.40	0.54	0.65	0.73	0.80
Present Value of Costs (\$m)	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Net Present Value (\$m)	-0.34	-0.15	0.03	0.17	0.28	0.36	0.43
Benefit-Cost Ratio	0.08	0.61	1.08	1.45	1.74	1.97	2.14
Internal Rate of Return (%)	negative	negative	4.1	8.5	10.2	11.0	11.3
MIRR (%)	negative	negative	4.5	6.7	7.3	7.4	7.3

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the TU13029 investment plus 30 years from the last year of investment are shown in Figure 1.

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs



Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 8 presents the results. The results are moderately sensitive to the discount rate.

Table 8: Sensitivity to Discount Rate (Total investment, 30 years)

Investment Criteria	Discount rate		
	0%	5% (base)	10%
Present Value of Benefits (\$m)	1.28	0.80	0.59
Present Value of Costs (\$m)	0.29	0.37	0.48
Net Present Value (\$m)	0.99	0.43	0.11
Benefit-cost ratio	4.47	2.14	1.24

A sensitivity analysis was then undertaken on the assumed share of QLD turf production making profitable changes to their business as a result of TU13029. Results are provided in Table 9. When assumed share of production making a profitable change is reduced to 28%, and all other factors remain unchanged, project benefits are approximately equal to project costs.

Table 9: Sensitivity to Share of QLD Turf Production Adopting TU13029 Outputs (Total investment, 30 years)

Investment Criteria	Share of QLD Turf Making a Change		
	28%	30%	60% (base)
Present Value of Benefits (\$m)	0.37	0.40	0.80
Present Value of Costs (\$m)	0.37	0.37	0.37
Net Present Value (\$m)	0.00	0.03	0.43
Benefit-cost ratio	1.00	1.07	2.14

A final sensitivity analysis tested assumed increase in profit for those adopting TU13029 outputs. The results (Table 10) show that if profit increase is 0.47%, then investment in the project will

approximately breakeven.

Table 10: Sensitivity to Increase in Profit Attributable to Adoption of TU13029 Outputs (Total investment, 30 years)

Investment Criteria	Increase in Profit Attributable to TU13029 Adoption		
	47%	0.5%	1% (base)
Present Value of Benefits (\$m)	0.38	0.40	0.80
Present Value of Costs (\$m)	0.37	0.37	0.37
Net Present Value (\$m)	0.00	0.03	0.43
Benefit-cost ratio	1.01	1.07	2.14

Confidence Rating

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes.

A confidence rating based on these two factors has been given to the results of the investment analysis (Table 11). The rating categories used are High, Medium, and Low, where:

- High: denotes a good coverage of benefits or reasonable confidence in the assumptions made
- Medium: denotes only a reasonable coverage of benefits or some uncertainties in assumptions made
- Low: denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 11: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
High	Medium-Low

Coverage of benefits valued was assessed as High, the key impact (additional turf grower profit as a result of increased R&D and marketing output adoption) was valued. Confidence in assumptions was rated as Medium-Low, key data was estimated by the analyst.

Conclusion

Industry development services include extension, communication, training, capacity building, research design, and delivery of best practice guidelines. Investment in TU13029 delivered these services to the QLD turf industry between May 2014 and May 2017.

Total funding from all sources for the project was \$0.37 million (present value terms). The investment produced estimated total expected benefits of \$0.8 million (present value terms). This gave a net present value of \$0.43 million, an estimated benefit-cost ratio of 2.14 to 1, an internal rate of return of 11.3% and a modified internal rate of return of 7.3%.

As four environmental and social impacts identified were not valued, the investment criteria estimated by the evaluation may be underestimates of the actual performance of the investment.

Glossary of Economic Terms

Cost-benefit analysis: A conceptual framework for the economic evaluation of projects and

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

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Abbreviations

AOP	Annual Operating Plan
CRRDC	Council of Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Australian Government)
GBR	Great Barrier Reef
GDP	Gross Domestic Product
GVP	Gross Value of Production
IRR	Internal Rate of Return
KPI	Key Performance Indicator
MIRR	Modified Internal Rate of Return
OCS	Office of Chief Scientist Queensland
OH&S	Occupational Health and Safety
PVB	Present Value of Benefits
R&D	Research and Development
RD&E	Research, Development and Extension
SIP	Strategic Investment Plan
UQ	University of Queensland