Hort Innovation

Final Report

Fund Impact Assessment 2020/21 for cherry, vegetables and small tropicals: Evaluation of PI12008

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Project code:

MT21013

Project:

Fund Impact Assessment 2020/21 for cherry, vegetables and small tropicals (MT21013)

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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 *PI12008 Integrated pest, disease and weed management system for pineapple (Pineapple Industry Technical Officer)*. The project was funded by Hort Innovation over the period Jun 2013 to Nov 2016.

Methodology

The investment was analysed qualitatively within a logical framework that included activities and outputs, outcomes, and impacts. Actual and potential impacts 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 2021-22 dollar terms and were discounted to the year 2021-22 using a real (inflation-adjusted), risk free, pre-tax discount rate of 5% to estimate the investment criteria.

Key findings

With the decline in Australian pineapple processing (which had traditionally driven research, development and extension RD&E), the industry experienced a period of limited RD&E until the levy was established in 2009-10. PI12008 aimed to re-invigorate the industry's R&D culture, with a particularly focus on developing contemporary integrated pest and disease management systems for the Australian pineapple industry. Informed by a review of pest management issues and strategies in Australian pineapple production, PI12008 conducted research on a range of pests and management options.

Through the logical framework process, informed by stakeholder consultation and document review, this assessment concluded that direct industry outcomes and therefore impacts were limited for the RD&E activities undertaken through PI12008:

- Weed management and mealybug management. While the project supported knowledge of products metribuzin and isoxaflutole (per-emergent herbicides), and sulfoxaflor (mealybug pesticide), these were made available to the industry through separately funded work, and have largely not been adopted by industry due to a lack of confidence in the efficacy, the continued availability of alternative product options (diuron and bromacil for weeds, and diazinon and chlorpyrifos for mealybug). As such, the direct impact of PI12008 on pineapple production is assessed as limited.
- Other areas of research (control of root-knot nematodes; monitoring symphylid populations; pre-plant dipping with root growth stimulants; and plastic and living mulch) did not generated conclusive industry recommendations, and have not resulted in practice change.

A clearer attribution can be seen for PI12008's contribution (in conjunction with the *industry development* projects PI12002 and PI15000) to re-establishing a consolidated pineapple industry RD&E focus and culture that also engages a broader stakeholder base. This in turn has informed a more effective and efficient pineapple RD&E program, including ongoing projects such as *Pineapple integrated crop protection program (PI17001) (*stakeholders pers comm), thereby providing support to achieving sustainable long term economic, social, and environmental impacts. However, this impact was unable to be quantified due to a lack of data relating to specific impacts.

Investment criteria

Total funding from all sources for the project was $1.10 million (2021-22 equivalent value). As potential project impacts could not be quantified, a full set of investment criteria could not be produced.

Keywords

Impact assessment, cost-benefit analysis, pineapple, Integrated Pest Management, pre-emergent herbicides, root-knot nematodes, mealybugs, symphylids, root growth stimulants, plastic mulch, living mulch.

Introduction

Evaluating the impacts of levy investments is important to demonstrate to levy payers, Government and other industry stakeholders the economic, social and environmental outcomes of investment for industry, as well as being an important step to inform the ongoing investment agenda.

The importance of ex-post evaluation was recognised through the Horticulture Innovation Australia Limited (Hort Innovation) independent review of performance completed in 2017, and was incorporated into the Organisational Evaluation Framework.

Reflecting its commitment to continuous improvement in the delivery of levy funded research, development and extension (RD&E), Hort Innovation required a series of impact assessments to be carried out annually on a representative sample of investments across a cohort of Funds in its RD&E portfolio. The assessments were required to meet the following Hort Innovation evaluation reporting requirements:

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

As part of its commitment to meeting these reporting requirements, Ag Econ was commissioned to deliver the *Fund Impact assessment 2020/21: Cherry, Sweetpotato, Vegetables, Small Tropicals (MT21013)*. This program consisted of a once-off impact assessment series of randomly selected Hort Innovation RD&E investments (projects) within each of the nominated Funds.

Project *PI12008 Integrated pest, disease and weed management system for pineapple (Pineapple Industry Technical Officer)* was randomly selected as one of the 3 investments in the 2020-21 sample for the small tropicals Funds. This report presents the analysis and findings of the project impact assessment.

General method

Hort Innovation's small tropical levy funds include lychee, papaya, passionfruit, persimmon, and pineapple. The 2020-21 population for the small tropicals was defined as an RD&E investment where a final deliverable had been submitted in the five year period from 1 July 2016 to 30 June 2021. This generated an initial population of 140 Hort Innovation small tropical investments, worth an estimated $27.1 million (nominal Hort Innovation investment). Projects in the Frontiers Fund, those of less than $80,000 Hort Innovation investment, multi industry projects where levy funds were less than 50% of total Hort Innovation investment, enabler projects that didn't directly support a small tropicals 2017-2021 Strategic Investment Plan (SIP), and projects that have had a previous impact assessment completed were removed from the sample. A total of 7 projects with a combined value of $1.93 million satisfied these criteria and formed the eligible population. The 7 eligible projects were then stratified using:

- A consolidated set of small tropical 2017-2021 SIP outcomes
  - Supply/productivity
  - Demand
  - Capacity/comms/extension
  - Business insights (data).
- Three project value ranges
  - $80,000 to $160,000
  - $160,000 to $280,000
  - Above $280,000.

A random sample of 3 projects (one each for lychee, persimmon, and pineapple) was selected worth a total of $0.94 million (nominal Hort Innovation investment), equal to 47% of the eligible small tropicals RD&E population (in nominal terms).

The impact assessment followed 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 included both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2018).

The evaluation process involved reviewing project contracts, milestones, and other documents; interviewing stakeholders including Hort Innovation staff, project delivery partners, growers and other industry stakeholders where appropriate (see *Acknowledgements*); and collating additional industry and economic data where necessary. Through this process, the project activities, outputs, outcomes, and impacts were identified and briefly described; and the principal economic, environmental, and social impacts were summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were 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 and rationale

Industry background

The Australian pineapple industry included approximately 70 growing businesses in 2022 (Hort Innovation 2022a). The pineapple industry recorded a five year average production of 72,235 tonnes (to year ending June 2021) decreasing by an average 3% per year (Hort Innovation 2022b). The industry recorded a nominal production value of $11 million in 2020-21 which had increased at an average 0.6% per year from 2016-7. In 2020-21, Queensland accounted for 99% of production and the Northern Territory 1%. Over the five years to 2020-21, approximately 63% of production went to the domestic fresh market, and 37% to processing (Hort Innovation 2022b).

Pineapple growers pay levies to the Department of Agriculture, Fisheries and Forestry (DAFF), who is responsible for the collection, administration and disbursement of levies and charges on behalf of Australian agricultural industries. Levy is payable on pineapples that are produced in Australia fresh consumption (domestic and export) or for processing. Hort Innovation manages the pineapple levy funds which are collected for both R&D and marketing purposes.

Rationale

Up to the early 2000's the pineapple industry has focussed primarily on supplying the processed fruit market. RD&E funding was largely through processors such as Golden Circle. With a steady decline in the processed pineapple sector in the early 2000's, these RD&E resources were cut back with little RD&E conducted for the following 10 years. The industry recognised the need to re-invigorate the industry RD&E program through the industry R&D levy (introduced in 2009).

Pest and disease management was seen as the most pressing issue at the time, so the aim of the project was to develop contemporary integrated pest and disease management systems for the Australian pineapple industry. Some of the pesticides currently used were considered dated, as well as having potential environmental issues, and with some under review by the Australian Pesticide and Veterinary Medicines Authority (APVMA). A review on pest management strategies in pineapple in Australia and overseas was undertaken to identify issues that are affecting the Australian pineapple industry. The findings were widely used to identify key pineapple pests and potential products that may be used to control these pests.

Alignment with the Pineapple Strategic Investment Plan 2017-2021

The pineapple levy investments are guided by a Strategic Investment Plan (SIP). PI12008 undertook a range of RD&E particularly relating to pest management, which aligned with Strategies 1 & 3 of Outcome 1 of the pineapple SIP 2017-2021 (Hort Innovation 2017): *Improved pest and disease management and best practice adoption increases grower productivity, profitability and sustainability*.

Alignment with national priorities

The Australian Government's National RD&E priorities (2015a) and Science and Research Priorities (2015b) are reproduced in Table 1. The PI12008 project outcomes and related impacts were aligned to RD&E Priority 4, and to Science and Research Priority 1.

Table 1. National Agricultural Innovation Priorities and Science and Research Priorities

Australian Government	
National RD&E Priorities (2015a)	**Science and Research Priorities (2015b)**
1. Advanced technology 2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D.	1. Food 2. Soil and Water 3. Transport 4. Cybersecurity 5. Energy and Resources 6. Manufacturing 7. Environmental Change 8. Health.

Project details

Summary

Table 2. Project details

Project code	PI12008
Title	Integrated pest, disease and weed management system for pineapple (Pineapple Industry Technical Officer)
Research organization	Queensland Department of Agriculture and Fisheries (QDAF)
Project leader	John Leonardi
Funding period	Jun 2013 to Nov 2016

Logical framework

A logical framework is shown in Table 3 to highlight the connection between the project activities, outputs, outcomes, and impact.

Table 3. Project logical framework

Activities	PI12008 undertook the following activities to develop contemporary integrated pest and disease management systems for the Australian pineapple industry:
	• The Strategic Agrichemical Review Process (SARP) findings were widely used to identify key pineapple pests and potential products that may be used to control these pests.
	• Regular meetings were held with members of the Project Steering Committee, other industry representatives and chemical registrants to discuss project priorities, project developments and to identify potential new pesticides for use by the pineapple industry.
	• Specific RD&E activities:
	  ○ Pre-emergent herbicides for use in pineapple
	  ▪ Field trials were established at four sites to evaluate the efficacy and crop safety of three potential (unregistered) pre-emergent herbicides and their combinations compared with the current industry standard bromacil and an untreated control.
	  ○ Potential nematicides to control root-knot nematodes
	  ▪ A pot trial was established to test the efficacy and crop safety of a range of nematicides on the root-knot nematode.
	  ○ Evaluation of insecticides for the control of pineapple mealybug
	  ▪ Several products registered to control mealybugs and other insect pests in range of horticultural crops were applied to Smooth Cayenne plants infested with mealybugs. Treatments were applied in a volume equivalent to 3,000 L/ha as a simulated broadcast spray over the top of the potted plants.
	  ○ Methods to monitor symphylid populations in pineapple
	  ▪ Trials were established to identify if trapping methods developed overseas could be successfully used for monitoring populations of symphylids in the field.
	  ○ Effect of pre-plant dipping with root growth stimulants on early crop growth

	▪ A pot trial was established to test the effect of pre-plant dipping of Smooth Cayenne crowns in phos-acid, root growth stimulants and their combinations on early plant growth. ○ Effect of plastic and living mulch on weed management, crop growth and yield ▪ A trial was established in June 2014 on Smooth Cayenne at a farm in the Glasshouse Mountains SE Qld to investigate the use of plastic and living mulch to assist in weed management in pineapple production. Two types of black plastic mulch were applied to the planting bed (a standard plastic and a degradable plastic). A grower treatment using standard practices (no plastic or living mulch plus pre-emergent herbicide) and no plastic mulch + living mulch treatment were included for comparison. ○ Communication and extension ▪ The progress and outcomes of the experimental trials conducted in this project were regularly published in the industry newsletter *Pineapple Press*. Updates were also presented to growers at Regional Study Group meetings held in each of the four major growing regions across Queensland twice each year and at the annual Pineapple Field Day. Experimental sites were also used as demonstration plots at these grower field days.
Outputs	• A final report on findings and recommendations. • Efficacy and crop safety data from field and glasshouse trials conducted to evaluate potential pre-emergent herbicides, new nematicides for root-knot nematode control and several insecticides for managing mealybug populations. • Articles updating the progress and outcomes of the project were published two to three times each year in Pineapple Press the industry newsletter.
Outcomes	• Pre-emergent herbicides for use in pineapple. ○ The outcomes of the trials provided additional evidence of the potential of two pre-emergent herbicides— metribuzin (Sencor®) and isoxaflutole (Balance®)— as replacements for diuron. However the registration of these projects reportedly did not draw on findings from PI12008, but on a separate Hort-funded projects PI12004 and ST15029) (Hort Innovation pers comm). In addition, the observed potential for leaf yellowing and the ongoing availability of proven alternatives has meant that the metribuzin and isoxaflutole are not widely used within the industry which instead continues to rely on bromacil and diuron (stakeholders pers comm). • Potential nematicides to control root-knot nematodes ○ Preliminary results in PI12008 identified that fluensulfone (Nimitz®) tended to reduce root-knot nematode egg numbers; however, significant leaf burn was observed in the heart of the plants when applied at later stages of plant growth and further trials to test the efficacy and crop safety of Nimitz® were recommended. Later trials identified that Nimitz® was insufficiently effective against nematodes in pineapple, and the product was not adopted by growers, and is no longer registered or permitted for use (stakeholders pers comm). • Evaluation of insecticides for the control of pineapple mealybug ○ Foliar application of clothianidin (Samurai®) and sulfoxaflor (Transform®) significantly reduced mealybug numbers. These products were not registered for use in pineapple during PI12008 with further work recommended to test the efficacy of these insecticides in the field. Clothianidin had not been registered for use in pineapples as of 2023. Sulfoxaflor was registered in 2016 but this reportedly did not draw on findings from PI12008 but on pre-existing global data for mealybugs and an separate Hort-funded application funded through PI16000. (Hort Innovation pers comm). However, with mealybug being a secondary pest in pineapples, and with the continued availability of previous products diazinon and chlorpyrifos (with proven effectiveness against mealybug), there has been little adoption of Transform® (estimated less than 10% of the industry) (stakeholders pers comm). • Methods to monitor symphylid populations in pineapple ○ Results indicated that burying small plastic pots containing potato slices can be successfully used to trap symphylids. However, this was not seen as being more effective than the previous practice of digging up a plant for visual pest inspection, so little adoption has occurred (stakeholders pers comm). • Effect of pre-plant dipping with root growth stimulants on early crop growth

	○ There was no significant effect of the dipping treatment on plant growth when compared with the untreated control. Further, there has since been little uptake of root growth stimulants (stakeholders pers comm). • Effect of plastic and living mulch on weed management, crop growth and yield. ○ The use of plastic mulch was found to significantly reduced weed populations on the planting bed, increased plant growth and fruit size in PI12008 trials. However, the cost of installation would be substantially greater than existing practices used by pineapple growers. There has since been limited industry adoption due to perceived drawbacks including excessive heat under the plastic stunting roots and retaining excessive moisture that exacerbates phytophthera. • Through PI12008 and other levy investments such as *industry development* projects PI12002 and PI15000, the pineapple industry's RD&E focus and capacity was reinvigorated following the limited RD&E in the early 2000's. PI12008 established the benefits of an industry technical officer conducted consolidated pineapple R&D which directly influenced the follow on project *Pineapple integrated crop protection program (PI17001)*. PI12008 also demonstrated the importance of a consolidated RD&E structure, incorporating the strategic industry advisory panel (SIAP) as a platform to effectively steer RD&E to closely align with the industry's needs, which brought the industry together with a more cohesive RD&E focus, and also helped to attract external RD&E funds as the focus on governance and the environment supported broader stakeholder goals *(*stakeholders pers comm).
Impacts	• [Economic] **Productivity impacts**. The project supported knowledge of products metribuzin and isoxaflutole (herbicides), and sulfoxaflor (mealybug pesticide); however these were made available to the industry through separately funded work, and they have largely not been adopted by industry due to a lack of confidence in the efficacy, and the continued availability of alternative product options (diuron and bromacil). As such, the direct impact of PI12008 on pineapple production is assessed as limited. • [Economic, social, environmental] **Industry capacity impact**. The greater long-term impact from the project (in conjunction with the *industry development* projects PI12002 and PI15000) was to re-establish a consolidated pineapple RD&E focus and culture to address industry issues, with a broader stakeholder base; which has benefited ongoing pineapple RD&E projects including *Pineapple integrated crop protection program (PI17001) (*stakeholders pers comm), providing support to achieving sustainable long term economic, social, and environmental impacts.

Project costs

Nominal investment

Table 4. Project nominal investment

Year end 30 June	Hort Innovation ($)	QDAF ($)	Total ($)
2013	30,416	33,359	63,775
2014	60,830	66,715	127,545
2015	89,994	98,700	188,694
2016	63,554	69,702	133,256
2017	27,200	29,831	57,031
Total	**271,994**	**298,308**	**570,302**

*Other funds from QDAF were provided in the contract as a lump sum, so have been apportioned yearly based on Hort Innovation cash costs.

Program management costs

R&D costs should also include the administrative and overhead costs associated with managing and supporting the project. The Hort Innovation overhead and administrative costs were calculated for each project funding year based on the data presented in the *Statement of Comprehensive Income* in the *Hort Innovation Annual Report* for the relevant year. Where the overhead and administrative costs were equal to the total expenses, less the research and development and marketing expenses. The overhead and administrative costs were then calculated as a proportion of combined project expenses (RD&E and marketing), averaging 15.8% for the PI12008 funding period (2013-2017). This figure was then

applied to the nominal Hort Innovation investment shown in Table 4. Note that annual reports for 2013 and 2015 financial years were not available online at the time of reporting, so an average of the 2016-2021 financial years of 15.9% was assumed to apply for these years.

Real Investment costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2021-22 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2022).

Extension costs

PI12008 conducted extension activities as part of the project including: presenting to growers at *Regional Study Group* meetings held in each of the four major growing regions across Queensland twice each year, presenting at the annual *Pineapple Field Day* which used PI12008 experimental sites for demonstration plots at these grower field days, and contributing articles to the industry newsletter *Pineapple Press*. These were completed in coordination with industry communication and extension projects PI12002 and PI15000. As PI12008 was the primary R&D project during the period 2013-2017, it was noted that the balance between R&D and extension activities was weighted more heavily towards extension than was ideal, with insufficient funding to conduct actual RD&E (Growcom 2018). Communication and extension costs were estimated at 12% of R&D costs for the duration of the project.

Project impacts valuation

The impact of PI12008 was not able to be quantified. Engagement with stakeholders and a review of available documentation highlighted that direct industry outcomes and therefore impacts were limited for the specific RD&E activities:

- While the project supported knowledge of products metribuzin and isoxaflutole (herbicides), and sulfoxaflor (mealybug pesticide), these were made available to the industry through separately funded work, and have largely not been adopted by industry due to a lack of confidence in the efficacy, the continued availability of alternative product options (diuron and bromacil for weeds, and diazinon and chlorpyrifos for mealybug). As such, the direct impact of PI12008 on pineapple production is assessed as limited.
- Other areas of research (control of root-knot nematodes; monitoring symphylid populations; pre-plant dipping with root growth stimulants; and plastic and living mulch) did not generated findings resulting in industry recommendations, and have resulted in practice change.

A clearer attribution can be seen for PI12008's contribution (in conjunction with the *industry development* projects PI12002 and PI15000) to re-establishing a consolidated pineapple industry RD&E focus and culture that also engages a broader stakeholder base. This in turn has informed a more effective and efficient pineapple RD&E program, including ongoing projects such as *Pineapple integrated crop protection program (PI17001) (*stakeholders pers comm), thereby providing support to achieving sustainable long term economic, social, and environmental impacts. However, this impact was unable to be quantified due to a lack of data relating to specific impacts.

Public versus private impacts

The potential future impacts identified from the investment included private impacts accruing to pineapple growers and supply chain participants as well as public benefits in the form of spill-overs to regional communities and the environment from RD&E driving improved farm practices and industry sustainability.

Distribution of private impacts

The potential private impacts of PI12008 would include direct and flow-on (spillover) impacts. Spillover impacts would include:

- Production-induced effects, which reflect the flow-on changes to the supply chain (upstream and downstream) that result from farm level changes in inputs (chemicals, labour, packaging, transport, marketing) associated with practice change.
- Consumption induced effects, which reflect the flow-on changes generated through the payments of wages and salaries to households and the subsequent expenditure of those incomes of purchasing household goods and services.

Furthermore, the true impact would also be influenced by the equilibrium (price) effect, which reflects changes in prices (of inputs and outputs) as a result in changes in supply and demand of those inputs and outputs. The price effect, essentially shifts benefits along the supply chain and between producers to consumers. The extent to which this would occur would depend on the slope of the short and long term supply and demand curves.

Impacts on other Australian industries

The project RD&E primarily focussed on the pineapple industry, but has the potential to inform industries with related pest and disease pressures.

Impacts overseas

PI12008 was focussed on Australian pineapple production, with limited potential for international impact.

Results

All costs were discounted to 2021-22 using a real discount rate of 5%. While no identified impacts were able to be quantified, the results are shown 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).

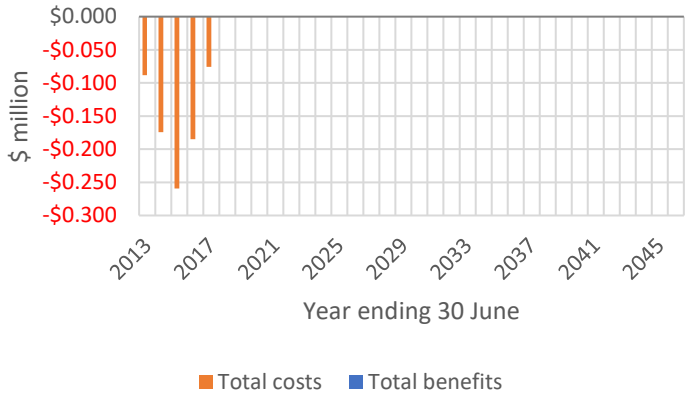
Table 5 shows the present value of costs (PVC) across 30 years. Hort Innovation was the only investor in PI12008.

Table 6. Impact metrics for the total investment in project PI12008

Impact metric	Years after last year of investment						
	0	5	10	15	20	25	30
PVC ($m)	1.1	1.1	1.1	1.1	1.1	1.1	1.1
PVB ($m)	NA	NA	NA	NA	NA	NA	NA
NPV ($m)	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
BCR	NA	NA	NA	NA	NA	NA	NA
IRR	NA	NA	NA	NA	NA	NA	NA
MIRR	NA	NA	NA	NA	NA	NA	NA

Figure 1 shows the annual undiscounted cash flows for PI12008.

Figure 1. Annual cash flow of undiscounted total investment costs



Conclusions

Through a logical framework informed by stakeholder consultation and document review, the project impact pathway was evaluated. This process highlighted that direct industry outcomes and therefore impacts were limited for RD&E activities undertaken through PI12008:

- While the project supported knowledge of products metribuzin and isoxaflutole (per-emergent herbicides), and sulfoxaflor (mealybug pesticide), these were made available to the industry through separately funded work, and have largely not been adopted by industry due to a lack of confidence in the efficacy, the continued availability of

alternative product options (diuron and bromacil for weeds, and diazinon and chlorpyrifos for mealybug). As such, the direct impact of PI12008 on pineapple production is assessed as limited.

- Other areas of research (control of root-knot nematodes; monitoring symphylid populations; pre-plant dipping with root growth stimulants; and plastic and living mulch) did not generated conclusive industry recommendations, and have not resulted in practice change.

A clearer attribution can be seen for PI12008's contribution (in conjunction with the *industry development* projects PI12002 and PI15000) to re-establishing a consolidated pineapple industry RD&E focus and culture that also engages a broader stakeholder base. This in turn has informed a more effective and efficient pineapple RD&E program, including ongoing projects such as *Pineapple integrated crop protection program (PI17001) (*stakeholders pers comm), thereby providing support to achieving sustainable long term economic, social, and environmental impacts. However, due to the ongoing nature of the impact, and a lack of data relating to specific impact areas, this was unable to be quantified.

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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.
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.

Abbreviations

CRRDC Council of Rural Research and Development Corporations

DAFF Department of Agriculture, Fisheries and Forestry (Australian Government)

GDP Gross Domestic Product

GVP Gross Value of Production

IRR Internal Rate of Return

MIRR Modified Internal Rate of Return

PVB Present Value of Benefits

PVC Present Value of Costs

RD&E Research, Development and Extension

SIAP Strategic Industry Advisory Panel

SIP Strategic Investment Plan

Ends.