Horticulture impact assessment program 2020-21 to 2022-23 (MT21015)

Annex 8: Impact assessment of the project *Developing IPM-compatible controls for spotted winged drosophila (Drosophila suzukii)* (MT18010)

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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 *Developing IPM-compatible controls for spotted winged drosophila (Drosophila suzukii) (MT18010).* The project was funded by Hort Innovation over the period April 2019 to April 2021.

Methodology

The investment was first analysed qualitatively within a logical framework that included activities and outputs, outcomes, and impacts. Actual and/or potential impacts were categorised into a triple bottom line framework. Principal impacts identified were 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

The Hort Innovation investment in Project MT18010 has contributed to the Australian horticultural industry awareness of IPM compatible control measures for Spotted winged Drosophila (SWD) so that the industries can be further prepared should this pest arrive in Australia. MT18010 was assessed to have contributed to the future productivity and profitability for some Australian horticultural industries that are susceptible to SWD. Specific impacts were quantified where possible based on available data:

Quantified impacts

- [Economic] A higher level of knowledge about, and preparedness for an SWD incursion resulting in a faster uptake of current IPM strategies, and thereby reducing the potential crop damage in the event of an SWD incursion.

Additional economic, social and environmental outcomes were identified but could be valued due to a lack of data. These have the potential to provide additional industry impact above what has been identified.

Investment criteria

Total funding from the strawberry, blackberry, and raspberry industries was $0.18 million (2020-21 equivalent value). The investment produced estimated total industry benefits of $0.24 million (2020-21 equivalent value), giving a net present value of $0.06 million, an estimated benefit-cost ratio of 1.34 to 1, an internal rate of return of 12%, and a MIRR of 6%.

Discussion and conclusions

The Hort Innovation investment in MT18010 has improved Australian horticultural industries understanding of SWD by increasing the knowledge and capacity of both industry and government stakeholders along with providing awareness of the IPM controls for dealing with pest should and incursion into Australia occur.

Effective biosecurity risk management requires sustained investment to manage the probability or consequences of a biosecurity incident. The impact of MT18010 was valued in the context of its contribution to long-term risk management, and modelled as a reduction in SWD consequences in the event of an incursion.

Given the wider SWD threat to other Australian horticulture industries including cherry, summerfruit, table grape, and blueberry, the findings of MT18010 would certainly support improved SWD management in those industries, particularly given the coordination between MT18010 and the project MT17005 which focussed on the broader SWD threat. Including these spillover beneficiaries in the modelling generates additional benefits above the funding indusry benefits identified in the analysis. These additional spillover horticulture benefits were estimated at $573,981 (2020-21 equivalent value), which would bring the total present value of benefits up to $812,787, generating an NPV of $646,732, and a BCR of 4.57:1.

Keywords

Impact assessment, cost-benefit analysis, risk, biosecurity, Spotted wing drosophila, blackberry, raspberry, strawberry

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 of 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 *Horticulture Impact Assessment Program 2020-21 to 2022-23 (MT21015)*. This program consisted of an annual impact assessment of 15 randomly selected Hort Innovation RD&E investments (projects) each year.

Developing IPM-compatible controls for spotted winged drosophila (Drosophila suzukii) (MT18010) was randomly selected as one of the 15 investments in the 2020-21 sample. This report presents the analysis and findings of the project impact assessment.

General method

The 2020-21 population was defined as an RD&E investment where a final deliverable had been submitted in the 2020-21 financial year. This generated an initial population of 175 Hort Innovation investments, worth an estimated $101.14 million (nominal Hort Innovation investment). The population was then stratified according to the Hort Innovation RD&E research portfolios and five, pre-defined project size classes. Projects in the Frontiers Fund, and those of less than $80,000 Hort Innovation investment being removed from the sample. From the remaining eligible population of 59 projects, with a combined value of $39.51 million, a random sample of 15 projects was selected worth a total of $9.7 million (nominal Hort Innovation investment), equal to 25% of the eligible 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 relevant Hort Innovation staff, project delivery partners, and growers and other industry stakeholders where appropriate; 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

Australian strawberry, raspberry and blackberry crops have a combined value of $639 million (5-year average to 2021, Hort Innovation 2022a). The industry includes 120 raspberry and blackberry growers, and 200 strawberry growers with production focused primarily in eastern Australia (Hort Innovation 2022b).

Producers in the strawberry, raspberry and blackberry industries 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 strawberries, raspberries and blackberries that are produced in Australia and either sold by the producer or used by the producer in the production of other goods. Hort Innovation manages the raspberry, blackberry and strawberry levy funds. strawberry levy funds are directed to RD&E, while raspberry and blackberry levy funds are directed to R&D and marketing.

Rationale

MT18010 *Developing IPM-compatible controls for spotted winged drosophila (Drosophila suzukii)* was launched as a complementary project to MT17005 *Improving the biosecurity preparedness of Australian horticulture for the exotic Spotted Wing Drosophila*. While MT17005 had funding from and a broader remit across Spotted Wing Drosophila (SWD) susceptible crops including blackberry, raspberry, strawberry, blueberry, cherry, table grape, and summerfruit, the purpose of MT15005 was to provide research-based insights into management options for SWD in Australian strawberry, raspberry and blackberry crops, while coordinating with the other industries through MT17005.

Project MT18010 was contracted in two parts with two separate final reports delivered on 'Exploring IPM compatible methods for Drosophila suzukii in berry crops' (Cesar Australia 2021) and 'Developing IPM compatible controls for Spotted Winged Drosophila' (IPM Technologies 2021).

SWD has a wide plant host range, is highly adaptable to climatic conditions and is particularly invasive. The arrival of SWD to Australia sometime in the coming decade is considered to be almost inevitable and as such an IPM compatible method (or methods) of combating SWD should it arrive in Australia is essential. Originating in Asia, SWD has spread rapidly in the last few years with its potential significance as a production pest only fully realised after incursions into the US in 2008 and Europe in 2010 (IPM Technologies 2022). Losses as high as 80% have been reported in some berry crops although the observed impact of SWD throughout impacted countries is highly variable depending on crop and region. The damage caused by larvae makes fruit unsuitable for markets, meaning there is no practical option for treating infested commodities or redirecting them to alternative markets (Cesar Australia 2022).

Alignment with the Raspberry and Blackberry and Strawberry Strategic Investment Plan's 2017-2021

The research and development activities of the raspberry, blackberry and strawberry industry's levy investments are each guided by a Strategic Investment Plan (SIP). Project addressed two specific outcomes of the 2017-2021 industry SIP's.

These two outcomes were:

- Raspberry and blackberry SIP 2017-2021, Outcome 3 – By 2021, the industry will increase farm productivity (marketable yield per hectare) by an average 10 per cent. Strategy - Protect the high biosecurity status of the raspberry and blackberry industry.
- Strawberry SIP 2017-2021, Outcome 3 – Greater skills, capacity and knowledge in the industry. Strategy - Continual improvement of Integrated Pest Management systems to meet pest and disease threats.

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 project outcomes and related impacts will contribute to RD&E Priority 2, 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	MT18010
Title	Developing IPM compatible controls for spotted wing drosophila (Drosophila suzukii)
Research organization (s)	IPM Technologies & Cesar Australia
Project leader	Dr Paul Horne & Jessica Lye
Funding period	April 2019 to April 2021

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	• MT18010 looked at SWD control options available and suitable for Australian producers, so that a management approach could be established that integrates into existing IPM, thereby avoiding reliance on broad-spectrum insecticides, which had been the approach taken in some parts of the world.
	• The research focussed on berry management options, but generated findings relevant to other industries susceptible to SWD including table grapes, blueberry, cherry, table grape, and summerfruit industries (particularly through its coordination with MT17005).
	• Exploring IPM compatible methods for Drosophila suzukii in berry crops (Cesar Australia) conducted:
	  ○ Predictive modelling of seasonal abundance.
	  ○ Review of biological control options.
	  ○ SWD awareness activities in coordination with MT17005.
	• Developing IPM compatible controls for spotted wing drosophila (IPM Technologies) conducted:
	  ○ Visits to large berry producers in the UK and Denmark to look at current methods of control in order to suggest possible IPM compatible methods to trial.
	  ○ Test the suggested alternative cultural control options on-farm in the UK.
	  ○ Estimate of the costs of dealing with SWD.

Outputs	• The following articles were published in the Australian Berry Journal
	  ○ Spotted wing drosophila: Exploring biological control (Australian Berry Journal 2021 autumn edition).
	  ○ Spotted wing drosophila: go-to preparedness resources for time poor advisors (re-print from MT17005 into Australian Berry Journal 2020 summer edition).

	○ Spotted wing drosophila: What would management look like (re-print from MT17005 into Australian Berry Journal 2020 summer edition). • An SWD management fact sheet was developed outlining recommended management changes if SWD were to establish in Australia. • Two information videos were that explored: the current status of SWD and its impact (PestCase 1), and; how growers overseas are approaching management of the species (PestCase 2) • An industry Control Plan for implementation if SWD arrives in Australia. • Recommendations and cost estimates of additional measures required to deal with SWD, additional cultural control options (using trap plants) that should be trialled in Australia when the pest arrives, and insecticides to be registered or permitted for use against SWD in berry crops.
Outcomes	• Biological control and seasonal abundance findings progressed collective knowledge of how SWD populations will likely behave and may be managed strategically in Australia. • Industry stakeholders have a greater knowledge of the SWD risk and management options for reducing the risk. • Faster initial trialling of the proposed cultural control "trap and kill" and in turn a potentially faster industry uptake of this strategy to reduce the impact of SWD.
Impacts	• [Economic] A higher level of knowledge about, and preparedness for an SWD incursion resulting in a faster uptake of current IPM strategies, and thereby reducing the potential crop damage in the event of an SWD incursion. • [Economic] Increased efficiency of resource use in combating SWD after incursion by directing them towards the most effective IPM options of control. • [Social] Avoided shocks to the supply of fresh and affordable domestic berry produce, supporting consumption with associated health and wellbeing benefits. • [Social] Avoided loss of industry spillovers from a disrupted berry production sector, supporting a sustainable and important source of employment and economic stimulant to local communities. • [Environmental] Reduced impact of chemicals on non-target insects from the use of IPM, including biological control. • [Economic, social, and environmental] Longer-term improvement in industry IPM and SWD research capacity, supporting ongoing benefits into the future.

Project costs

Nominal investment

Table 4. Project nominal investment

Year end 30 June	Hort Innovation ($)	Cesar and IPM Technologies ($)	Total ($)
2019	30,496	2,481	32,977
2020	45,601	3,709	49,310
2021	59,136	4,810	63,946
Total	135,233	11,000	146,233

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 15.7% for the MT18010 funding period (2017-2021). This figure was then applied to the nominal Hort Innovation investment shown in Table 4.

Real Investment costs

For 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, 2022).

Extension costs

MT18010 extension activities were integrated into the extension and communication plan for MT17005. Integration reduced duplication of efforts as project team members were able to share progress with a SWD industry steering committee set up through MT17005. At the conclusion of MT17005, education on the topic of SWD continued throughout MT18010, using key communication channels such as the Australian Berry Journal and the Urban Plant Health Network. The coordination of extension costs between MT18010 and MT17005 has been taken into consideration as part of the attribution of outcomes (see *Data and Assumptions*).

Project impacts

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.

Impacts valued

The following impacts were valued.

- [Economic] A higher level of knowledge about, and preparedness for an SWD incursion resulting in a faster uptake of current IPM strategies in strawberry, raspberry, and blackberry industries, thereby reducing the potential crop damage in the event of an SWD incursion.

Valuation method

Risk is measured as a combination of probability and consequences. In the event of a pest incursion, the consequences (lost revenue and increased costs) would occur over a period depending on the rate of pest spread. For every year of potential incursion, these consequences are weighted by the probability of incursion giving the annual value of the risk faced by the industry. While preparedness and a better understanding of SWD and its management option is not likely to reduce the probability of its incursion, it would assist in allowing a faster and more targeted response capacity reducing the likely consequences.

Effective biosecurity risk management requires sustained investment to manage the risk of an incursion happening in any given year. SWD was not detected in Australia during the project period but to assign no value to the reduced industry biosecurity risk profile during this period would misrepresent the nature of long-term risk-management. As such, the impact of MT18010 was valued in the context of its contribution to long-term SWD risk management, and modelled as a reduced biosecurity risk faced by the strawberry, raspberry and blackberry industries if an incursion was to occur at any point in time from the delivery of key project outputs (2019).

Impacts not valued

Not all of the impacts identified in Table 3 could be valued in the assessment, particularly where there was a lack of data to quantify the identified impact. Identified impacts unable to be valued in monetary terms included:

- [Economic] Increased efficiency of resource use in combating SWD after incursion by directing them towards the most effective IPM options of control.
- [Social] Avoided shocks to the supply of fresh and affordable domestic berry produce, supporting consumption with associated health and wellbeing benefits.
- [Social] Avoided loss of industry spillovers from a disrupted berry production sector, supporting a sustainable and important source of employment and economic stimulant to local communities.
- [Environmental] Reduced impact chemical on non-target insects from the use of IPM, including biological control.
- [Economic, social, and environmental] Longer-term improvement in industry IPM and SWD research capacity, supporting ongoing benefits into the future.

Public versus private impacts

The impacts identified from the investment in MT18010 are predominantly private impacts accruing to soft fruit and berry growers in Australia. However, some public benefits have also been produced in the form of spill-overs to regional communities and local economies from reduced industry risk from SWD.

Distribution of private impacts

The private impacts will have been distributed between growers, processor/packers, wholesalers, exporters, and retailers. The share of impact realised by each link in the supply chain will depend on both short- and long-term supply and demand elasticities in the berry markets. In addition, while the analysis quantified private benefits accruing to the fruit and berry industries, additional spillover of private impacts would be generated in the wider economy from changes in farm input costs (increase or decrease) which would result in spillover changes (increase or decrease) in income for businesses providing those goods and services.

Impacts on other Australian industries

While MT18010 research focussed on SWD management options for raspberry, strawberry, and blackberry production, many of the findings also apply to management of SWD in other industries susceptible to SWD including table grapes, blueberry, cherry, table grape, and summerfruit industries.

Impacts overseas

No specific overseas impacts were identified as the research focussed solely on reduced SWD pest risk to Australian.

Data and assumptions

A summary of the key impact data and assumptions is provided in Table 5.

Table 5. Summary of data and assumptions for impact valuation

Variable	Assumption	Source / comment
Discount rate	5% (± 50%)	CRRDC Guidelines (2018)
Chance of arrival within 10 Years	90% (± 10%)	IPM Technologies (2021) note that "The arrival of SWD sometime in the coming decade is almost inevitable". Using a binomial distribution a 21% chance of arriving annually gives a cumulative probability of arrival of over 90% by year 10.
Potential industry production losses	$17.14 million (± 25%)	Cesar Australia (2021) and PHA (2018) noted that SWD losses can be as high as 80% in some circumstances. PHA (2018) modelled the potential incursion and dispersion of SWD over various simulations with average losses of $34.7 million per year across strawberries, cherries, blueberries, plums, nectarines, peaches, table grapes, apricots, blackberries and raspberries. Value data was based on ABS 2017. These underlying losses were applied to 2021 data (Hort Innovation 2022a), which indicated that due to industry growth, the potential total value of losses had increased to $58 million, with raspberry, blackberry and strawberry losses equal to $17.14 million (29%). This was tested for sensitivity at plus and minus 25%.
Reduced losses from applied management strategies and SWD learnings.	20% (± 25%)	No data was identified on how management of SWD can reduce its impact in comparison to uncontrolled populations across industries and climates. A previous impact assessment of MT17005 (Chudleigh 2021) used 20% as a baseline which has been adopted here with

		sensitivity testing applied at ± 25%.
Cost of implementation	80% (± 10%)	Analyst Assumption based on calculations from Cesar Australia (2021) and further discussion with researcher. 80% accounts for the very high costs associated with outlined cultural control options.
Peak adoption	90% (± 20%)	It was assumed that in the event of an incursion of SWD, most of the industry either would already be aware of or would seek out the information and learnings for management strategies in dealing with the pest leading to a very high adoption of recommended practices. MT18010's contribution to this is accounted for in attribution.
Attribution of outcome (industry knowledge and preparedness) to MT18010	25% (± 23%)	Attribution is low due to several factors. Project MT17005, which MT18010 built upon and coordinated with for extension, was a larger project in $-value terms. It is likely that in the event of an arrival of SWD, management strategies will be developed from a range of sources including MT17005, MT18010 as well as from overseas learnings where they have current experience dealing with SWD. Sensitivity testing was set for the lower level at 19% which was the relative $ investment of MT18010 compared to the combined MT17005 and MT18010 investment in 2020-21 equivalent values.
Lifespan of attribution	10 years (± 25%)	Attribution lifespan was applied as a straight-line declining scale over 10 years from 2021 as further research provides new knowledge and resources relating to SWD management.
R&D counterfactual	80% (± 10%)	There is a low likelihood that these outcomes would have been achieved from other industry participants or government bodies if MT18010 hadn't been funded.

Results

Investment criteria:

All costs and benefits were discounted to 2020-21 using a real 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 (2020-21) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Table 6 shows the impact metrics estimated for different periods of benefit for the total investment.

Table 6. Impact metrics for total Investment in project MT18010

Impact metric	Years after last year of investment						
	0	5	10	15	20	25	30
PVC ($)	177,732	177,732	177,732	177,732	177,732	177,732	177,732
PVB ($)	11,280	174,124	238,806	238,806	238,806	238,806	238,806
NPV	-166,452	-3,608	61,074	61,074	61,074	61,074	61,074
BCR	0.06	0.98	1.34	1.34	1.34	1.34	1.34

IRR	Negative	4%	12%	12%	12%	12%	12%
MIRR	Negative	5%	8%	7%	7%	6%	6%

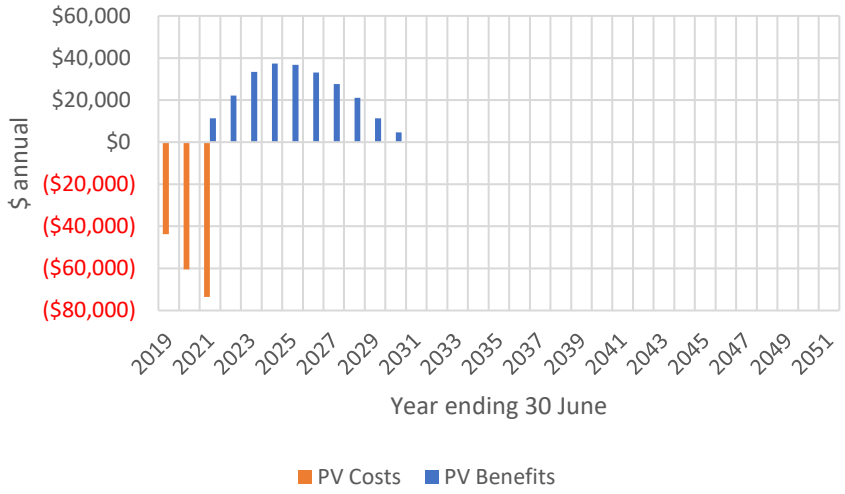
Table 7 shows the impact metrics estimated for different periods of benefit for the Hort Innovation investment.

Table 7. Impact metrics for the Hort Innovation Investment in project MT18010

Impact metric	Years after last year of investment						
	0	**5**	**10**	**15**	**20**	**25**	**30**
PVC ($)	166,055	166,055	166,055	166,055	166,055	166,055	166,055
PVB ($)	10,539	162,685	223,117	223,117	223,117	223,117	223,117
NPV	-155,516	-3,370	57,063	57,063	57,063	57,063	57,063
BCR	0.06	0.98	1.34	1.34	1.34	1.34	1.34
IRR	Negative	4%	12%	12%	12%	12%	12%
MIRR	Negative	5%	8%	7%	7%	6%	6%

Figure 1 shows the annual undiscounted benefit and cost cash flows for the total investment of MT18010. Cash flows are shown for the duration of the investment plus 30 years from the last year of investment.

Figure 1. Annual cash flow of undiscounted total benefits and total investment costs



Sensitivity analysis

A sensitivity analysis was carried out on key variables identified in the analysis where a data range was identified, or there was a level of uncertainty around the data (Table 8). Data ranges and sources are described in Table 5.

Table 8. Impact BCR sensitivity to changes in key underlying variables

Variable		Low	Baseline	High
Discount rate	Variable range	2.5%	5.0%	7.5%
	BCR range	1.51	1.34	1.20
Chance of arrival within 10 Years	Variable range	81%	90%	99%
	BCR range	1.09	1.34	1.89
Potential industry production losses ($m)	Variable range	12.85	17.14	21.42

	BCR range	1.01	1.34	1.68
Reduced losses from applied management strategies and awareness	Variable range	15%	20%	25%
	BCR range	1.01	1.34	1.68
Industry cost of implementation	Variable range	72%	80%	88%
	BCR range	1.88	1.34	0.81
Attribution of impacts to MT18010	Variable range	19.20%	25.00%	30.80%
	BCR range	1.03	1.34	1.66
Period of attribution	Variable range	7.5	10.0	12.5
	BCR range	1.34	1.34	1.34
Peak adoption	Variable range	81%	90%	99%
	BCR range	1.25	1.34	1.44
R&D counterfactual	Variable range	72.0%	80.0%	88.0%
	BCR range	1.21	1.34	1.48

Discussion & conclusion

Work undertaken during MT18010 on cultural and biological control options and seasonal abundance findings have progressed collective knowledge of how SWD populations will likely behave and may be managed strategically in Australia. In addition, the project built on the knowledge of how to manage SWD in the event of an incursion into Australia.

The analysis showed that the quantified benefits were greater than the investment cost for MT18010, with a BCR 1.34:1. The results reflect the benefits a higher level of Australian blackberry, raspberry, and strawberry industry knowledge about, and preparedness for an SWD incursion resulting in a faster uptake of current IPM strategies, and thereby reducing the potential crop damage in the event of an SWD incursion.

To account for the uncertainty in some of the variables, sensitivity testing was conducted that showed a BCR ranging from 0.81 to 1.89. The results were most sensitive to the tested ranges for the cost of implementation, which had the potential to result in a BCR less than 1. The results were also sensitive to the annual chance of arrival, with a higher chance of arrival resulting in higher industry risk, and therefore a greater value in risk mitigation through MT18010.

A lack of underlying data meant that there were economic, social and environmental impacts identified but not quantified which had the potential to provide additional impacts. These included changes in the biosecurity risk faced by nurseries, the risk of increased supply chain regulation and compliance, the risk of a decrease in berry production having flow on community impacts including a loss of jobs, and the environmental risk from increased chemical use to manage the pest spread.

The analysis quantified private benefits (avoided risk) accruing to strawberry, raspberry, and blackberry growers who contributed levy funds to the investment. However, SWD poses a threat to other Australian horticulture industries including cherry, summerfruit, table grape, and blueberry. As these other industries did not contribute funds to MT18010 the benefits to these industries are considered spillovers which have not been included in the analysis to be consistent with other Hort Innovation impact assessments; however, the findings of MT18010 will certainly support improved SWD management in those industries, particularly given the coordination between MT18010 and the project MT17005 which focussed on the broader SWD threat. Including these spillover beneficiaries in the modelling generates additional benefits of $573,981 (2020-21 equivalent value), which would bring the total present value of benefits up to $812,787 generating an NPV of $646,732, and a BCR of 4.57:1.

Additional spillover impacts would also be generated in the wider economy. A loss of production associated with an SWD incursion would result in a subsequent loss of income for both upstream and downstream supply chain participants. As such, improved biosecurity preparedness also generates benefits in the form of reduced risk for these broader industry and supply chain stakeholders.

The CRRDC Guidelines focusses on first round impacts, which calculates shifts in the supply and demand curves with no price effect. When considering these second-round price effects, a biosecurity incursion would result in decreased industry supply, and thereby increase prices. The extent to which this would occur would depend on the slope of the supply and demand curves.

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Greg Chandler, Hort Innovation; Sarah Cumpston, Hort Innovation; Paul Horn, IPM Technologies; Jessica Lye, Cesar Australia.

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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

SIP Strategic Investment Plan