Hort Innovation

Final Report

Industry-specific impact assessment program: Berries

Impact assessment report for project *Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners* (BS12009)

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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 *BS12009: Developing Virus Molecular Diagnostics for Post Entry Quarantine and Certification of Strawberry Runners.* The project was funded by Hort Innovation over the period December 2012 to July 2016.

Methodology

The investment was analysed qualitatively within a logical framework that included activities and outputs, outcomes and impacts. Impacts were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation. Past and future cash flows were expressed in 2019/20 dollar terms and were discounted to the year 2020/21 using a discount rate of 5% to estimate the investment criteria.

Results/key findings

The investment in BS12009 has provided the Australian strawberry industry with improved techniques for detecting biosecurity threats to the industry; beneficiaries include Strawberries Australia, the strawberry industry including strawberry growers, their supply chains, and industry associations, as well as relevant government organisations such as the Australian Quarantine and Inspection Service and the Subcommittee on Plant Health Diagnostics.

Investment Criteria

Total funding from all sources for the project was $0.41 million (present value terms). The investment produced estimated total expected benefits of $2.57 million (present value terms). This gave a net present value of $2.16 million, an estimated benefit-cost ratio of 6.23 to 1, an internal rate of return of 22.9% and a modified internal rate of return of 11.1%.

Conclusions

Project BS12009 was successful in that the investment provided improvements to the biosecurity of the Australian strawberry industry via a strengthening of the protocols for certification of imported strawberry runners. The improvements have been implemented and are providing benefits to the Australian strawberry industry as a whole, including levy payers. Based on the assumptions made in the economic analysis, the investment criteria estimated show a positive return to the investment.

Keywords

Impact assessment, cost-benefit analysis, BS12009, strawberry industry, runners, molecular diagnostics, biosecurity, pathogen

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 (Rubis (RB) + Strawberry (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.

Project BS12009: *Developing Virus Molecular Diagnostics for Post Entry Quarantine and Certification of Strawberry Runners* was randomly selected as one of four unique RB + BS investments under MT20008 and was analysed in this report.

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 strawberry industry is one of Australia's 'traditional' horticultural industries. Strawberries Australia Inc. is the strawberry industry's peak national agri-political organisation representing strawberry growers. All States have a Strawberry Growers Association affiliated with the national body.

Table 1 below shows Australian production and value of strawberries over the past three years.

Table 1: Australian Strawberry Production and Value for Years Ending June 2018 to 2020

Year ended June	Total Australian Production (tonnes)	Fresh Supply (tonnes)	Fresh Supply Wholesale Value ($m)	Fresh Supply Wholesale Value ($/tonne)
2018	93,545	76,514	486.8	6,362
2019	76,605	67,577	434.2	6,425
2020	82,310	68,166	472.6	6,933
Average	84,153	70,752	464.5	6,573

Source: Australian Horticultural Statistics Handbook, 2019/20

The research and development activities of the Australian strawberry industry are guided by the industry's Strategic Investment Plan (SIP). The activities are funded by levies payable on strawberry runners planted in Australia, as well as by matching government funds.

The process of preparing the latest SIP was managed by Hort Innovation in consultation with Strawberries Australia and the Strategic Investment Advisory Panel. The current SIP has been driven by levy payers and addresses the Australian strawberry industry's research and development (R&D) needs from 2017 to 2021.

Project Rationale

Some varieties of strawberries grown commercially in Australia have been bred by Australian strawberry breeders. Also, some new varieties of strawberry are imported into Australia via tissue culture. These imported plants are then grown and tested for the presence of exotic pathogens via a range of biological amd molecular indexing and visual observations in post entry quarantine (PEQ). During PEQ, screening for endemic pathogens is conducted to reduce the time before new varieties are introduced into a nucleus collection. The Victorian Strawberry Industry Certification Authority (VSICA) specifies that testing for endemic pathogens must continue until three growing seasons of negative resullts are retuned.

VSICA is located at Toolangi in Victoria, but serves the national strawberry industry by overseeing the health of runners produced under the Certification Scheme. The certified runners are then available to strawberry growers from all Australian States.

The pre-2018 operational manual that specified molecular and biological detection for endemic and exotic strawberry pathogens was based on research from previous Hort Innovation projects. This manual underpins the standard operating procedures for certification of Victorian strawberry runners. Certification includes biosecurity at a local level, as well as PEQ at the border and ensures accurate interpretation of molecular and biological indexing for testing pathogens.

The current project addressed a need to update the manual to include:

- The standard operating procedures (SOPs) for both Queensland and Victoria.
- Adaptation of the requirements of the National Diagnostic Network being developed by the Subcommittee on Plant Health Diagnostics (SPHD) which is a subcommittee of the Plant Health Committee and includes representation from the Australian, state and territory governments, Plant Health Australia, CSIRO and the New Zealand Ministry of Primary Industries.
- the SOPs were to support both local and national biosecurity programs.

Project Details

Summary

Project Code: BS12009

Title: *Developing Virus Molecular Diagnostics for Post Entry Quarantine and Certification of Strawberry Runners*

Research Organisation: Department of Environment, Jobs and Economic Development, Victoria (now the Department of Environment, Land, Water and Planning)

Project Leader: Fiona Constable, Research Leader – Microbiology, Agriculture Victoria Research

Period of Funding: December 2012 to July 2016

Objectives

The project aimed to contribute to the biosecurity of the Australian strawberry industry by developing tools to underpin quarantine access to planting material that supported the certification of strawberry runners. Within this broad aim the specific objectives were:

1. To develop a nationally endorsed operational manual that specifies molecular and biological detection of endemic and exotic strawberry pathogens for the Australian National Diagnostic Network.
2. To harmonise diagnostic protocols between United States of America (USA) and Australian laboratories to assist market access to new strawberry runners.
3. To produce characterised positive controls for selected strawberry viruses to support standard operating procedures for biological indexing of diseases associated with strawberry viruses.
4. To develop an on-farm biosecurity plan for VSICA to minimise risk of introduction of pest and diseases to the high health strawberry runner program held at the Toolangi Research Farm.
5. To undertake some basic and fundamental research about little leaf disease and lethal yellows disease in Victoria so that preliminary management strategies for control of the disease could be developed and incorporated into the biosecurity plan, including appropriate diagnostic testing to support the certification/accreditation programs.

Logical Framework

Table 2 provides a description of Project BS12009 in a logical framework format, organised by project activities, outputs, outcomes and impacts.

Table 2: Logical Framework for Project BS12009

Activities and Outputs	**Development of a national operational manual** • SPHD guidelines were used to develop a verified diagnostic operational manual for the National Plant Biosecuriy DIagnostic Network (NPBDN). • The NPBDN links Australian plant diagnosticians and facilitates the efficient and effective diagnoses of plant pests. • The new national operational manual was based on the previous operational manual and incorporated practices to support biological indexing of viruses and fungi, guidance on sampling and testing for both temperate and sub-tropical climates, and provided specific protocols for

	specific viruses, phytoplasms, fungal pathogens, and other exotic pathogens. • The diagnostic operational manual was drafted and submitted for review for endorsement by the NPBDN. • The new manual was to be integrated into the VSICA scheme. • The manual was tabled at SPHD in May 2013; members were able to take the manual back to their jurisdictions for implementation if required (Fiona Constable, pers. comm., 2021). **Harmonisation of protocols between USA and Australian laboratories** • The Principal Investigator (Fiona Constale) visited two diagnostic facilities in the USA to asses the potential synchronisation of protocols between laboratories; the intention was to increase the speed of importation without increasing the risk of unwanted pathogen entry. • As a result, recommendations were made regarding the harmonisation of diagnostic protocols between USA and Australian laboratories. • However, complete harmonisation may not be possible at the quarantine level between Australia and USA. This is due to the USA agency being reluctant to accommodate testing requirements from other countries; however, it was found that the USA level of testing is similar to that in Australia and is adequate to meet the needs of Australian certification programs. Hence, it is likely that newly imported varieties from USA may be able to be introduced directly to the certification scheme after release from PEQ. • If the harmonisation recommendations are followed, it would be possible for newly imported varieties from the USA to be introduced to Australian certification schemes earlier than currently is the case; however, this would be determined within the conditions/rules of the certification schemes or by decisions made by individual importers (Fiona Constable, pers. comm., 2021). **Development of controls for strawberry viruses for disease indexing purposes** • The operational manual includes information on horticultural management practices to support biological indices for viruses and fungi, and gives guidance on sampling and testing procedures for both temperate and subtropical climates. • Specific protocols were provided for seven specific viruses, endemic phytoplasmsa, an endemic Rickettsia, three fungal pathogens, and eight exotic pathogens. **Development of a biosecurity plan for VSICA** • A draft biosecurity plan was submitted to VSICA as part of the final report for BS12009 and it was reviewed and accepted. • Since it was written, Agriculture Victoria maintain many of the high health nucleus plants for industry (other than VSICA), including the Australian strawberry breeding program and other runner growers and certification programs; this plan underpins the management system that is applied by Agriculture Victoria to protect that material held for industry (Fiona Constable, pers. comm., 2021). • The material held by Agriculture Victoria is estimated to represent more than 50% of runner production for Australia. Where Agriculture Victoria

	undertakes relevant activities for VSICA, those activities are underpinned by relevant aspects of the plan (Fiona Constable, pers. comm., 2021). **Development of management strategies and diagnostic testing for little leaf disease and lethal yellows diseases** • An analysis of past lethal yellows/little leaf disease data from the Toolangi Research Farm since 1973 showed there was no association between disease incidence and the environment (temperature or rainfall). • However, some farms were shown to be more susceptible than others. • It was concluded that it was not possible currently to develop management strategies to control these diseases. • Further basic and applied research on these diseases was recommended.
Outcomes	• The new operational manual was integrated into the VSICA and the NPBDN. • Imported strawberry varieties from the USA now can be introduced potentially earlier into the certification scheme than otherwise after release from PEQ. • Improved biosecurity of the Australian strawberry industry has been delivered at the border and at the local regional level due to the nationally endorsed protocols for pathogen detection. • As noted above, Agriculture Victoria has implemented the plan and it underpins all the activities undertaken to maintain high health nucleus material for industry. Aspects of the plan are implemented by the Australian strawberry breeding program.

Impacts	**Economic**
	• Reduced risk of pathogen incursion into the VSICA strawberry certification scheme.
	  ○ It is difficult to estimate the reduced risk; however certification programs for strawberries have been implemented in Australia and globally to minimise the impact of pathogens on fruit and runner production and quality.
	  ○ As an example of losses, strawberry necrotic shock virus can cause up to 75% loss of runner production; also, strawberry motte virus on its own can cause up to 30% yield loss in sensitive varieties.
	  ○ The combination of viruses can exacerbate losses. For example, the rapid spread of pallidosis disease, which is associated with two viruses, caused an estimated US$50million loss to growers in the USA. (Fiona Constable, pers. comm., 2021)
	  ○ Diseases distributed through runners affect fruit growers and subsequently impact runner growers who may need to replace the affected plants. The diagnostic manual and the biosecurity plan have enhanced the ability of the programs to protect Australian strawberry production, through improved detection and surveillance for important pathogens.
	• The project has contributed significantly to the operation of the Australian strawberry breeding program, which develops improved varieties for the Australian industry; for example, the project has contributed to an increased rate of gain in varietal performance over time (yield and quality) due to earlier introduction of improved varieties and a reduction in setbacks due to pathogen detection.
	
	Environmental

	• Potential for reduced chemical use and hence a reduction in chemical export to the off-farm environment. **Social** • Regional community spillovers from the benefits of a more productive national strawberry industry. • Enhanced capability and capacity of scientists associated with strawberry pathogens.

Project Investment

Nominal investment

Table 3 shows the investment made in Project BS12009.

Table 3: Annual Investment in Project BS12009 (nominal $)

Year ended 30 June	Horticulture Innovation Australia	TOTAL
2013	67,510	67,510
2014	67,511	67,511
2015	27,004	27,004
2016	40,506	40,506
2017	27,920	27,920
Totals	**230,451**	**230,451**

Source: Project Research Agreement

Program management costs

For the Hort Innovation investment the cost of managing its funding was added to the Hort Innovation contribution in Table 3 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 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 included as the project itself involved industry and certification authorities.

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 BS12009

Economic	• Reduced risk of pathogen incursions into the VSICA strawberry certification scheme. • Increased rate of gain in varietal performance over time (yield and quality) due to earlier introduction of improved varieties.
Environmental	• Potential for reduced chemical use and hence a reduction in chemical export to the off-farm environment.
Social	• Increased regional community spillovers from a more productive national strawberry industry. • Enhanced capability and capacity of scientists associated with strawberry pathogens.

Public versus private impacts

The impacts identified from the investment are predominantly private impacts accruing to the strawberry industry through more efficient certification schemes to reduce the incidence of strawberry pathogens. However, some of these impacts will be delivered by government activities via the development of the operational manual and the public sector's increased efficiency in managing biosecurity associated with post-entry quarantine for imported strawberry material.

Distribution of private impacts

The private impacts will be distributed between industry sectors and strawberry growers including businesses involved in the strawberry runner supply chain.

Impacts on other Australian industries

It is likely that most impacts will be mostly confined to the Australian strawberry industry.

Impacts overseas

It is unlikely that there will be any significant spillover impacts from the project to overseas interests.

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 primarily to Rural RD&E Priority 2, and to Science and Research Priority 1.

Table 5: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	**Science and Research Priorities (est. 2015)**
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

Sources: DAWR (2015) and OCS (2016)

Alignment with the Strawberry Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the Australian strawberry industry are outlined in the Strawberry Industry's Strategic Investment Plan 2017-2021[1] (Hort Innovation, 2017). Project BS12009 primarily addressed Outcome 3 through thr project's contribution to development of a framework for improving industry-wide production performance via reducing industry risk. BS12009 also addressed Outcome 1 through it's contribution to the strawberry breeding program and delivery of opportunities for reduced on-farm costs of production and/or increased productivity.

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

Valuation of Impacts

Impacts Valued

The impact valued in the assessment of BS12009 were:

- Reduced risk of pathogen incursions into the VSICA strawberry certification scheme.

Impacts Not Valued

- Several other impacts were identified but not valued; they included:
- Increased rate of gain in varietal performance over time (yield and quality) due to an earlier introduction of some improved varieties. This impact was not valued due to a lack of data on varietal performance of new releases over time with and without Project BS12009.
- Potential for reduced chemical use and hence a reduction in chemical export to the off-farm environment. This impact was not valued due to the difficulty of making assumptions regarding chemical export quantities and the damage they might do to the environment.
- Increased regional community spillovers from a more productive and profitable strawberry industry captured by local families and businesses along the supply chain. This impact was not valued due to the difficulty of making sound linkage assumptions between the project and the impact and the diversity of geographic locations involved, as well as a lack of time and resources.
- Enhanced capability and capacity of scientists associated with strawberry pathogens; this impact was not valued due to insufficient resources/time and the difficulty in assembling appropriate data. Moreover, this impact was already valued in part via its contribution to the lowered risk impact that was valued.

Summary of Assumptions

The specific assumptions used to value the reduced risk of pathogen incursions due to BS12009 are provided in Table 6.

Table 6: Summary of Assumptions for Impact Valued for Project BS12009

Variable	Assumption	Source/Comment
Impact valued: Reduced risk of pathogen incursions		
Proportion of production in Queensland	42%	QLD Strawberries (2020)
Average annual area of strawberry production in Queensland	Agtrans estimate of 450 ha	Based on average of Queensland Strawberries (2020) 300 ha and QLD Govt (2019) 600 ha
Estimated Australian area of strawberries	1,071 ha per annum	450 x 100/42
Average annual gross margin for Australian strawberry production	$81,179 per ha per annum	Department of Primary Industries, Parks, Water and Environment, Tasmania https://dpipwe.tas.gov.au/ May 2018
Proportion of strawberry area likely to be affected due to pathogen (pest and disease) incursions introduced via new	2.5%	Analyst assumptions

varieties into the Australian strawberry industry before Project BS12009		
Proportion of strawberry area likely to be affected due to pathogen (pest and disease) incursions introduced via new varieties into the Australian strawberry industry after Project BS12009	0.5%	
Gross margin reduction due to pathogens	15%	
First year of avoided loss	2019	
Risk and attribution factors		
Probability of outcome (proportion of industry experiencing productivity gains form the project)	75%	Estimates by Analyst
Probability of increase in gross margin due to project (probability of impact)	75%	
Attribution	100%	
Counterfactual	It was assumed that without the investment in BS12009, the impact valued would not have occurred via other industry strategies	

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

Tables 7 and 8 show the investment criteria estimated for different periods of benefits for the total investment and the Hort Innovation investment alone. As all investment was made by Hort Innovation, the results in Tables 7 and 8 are the same.

Table 7: Investment Criteria for Total Investment in Project BS12009

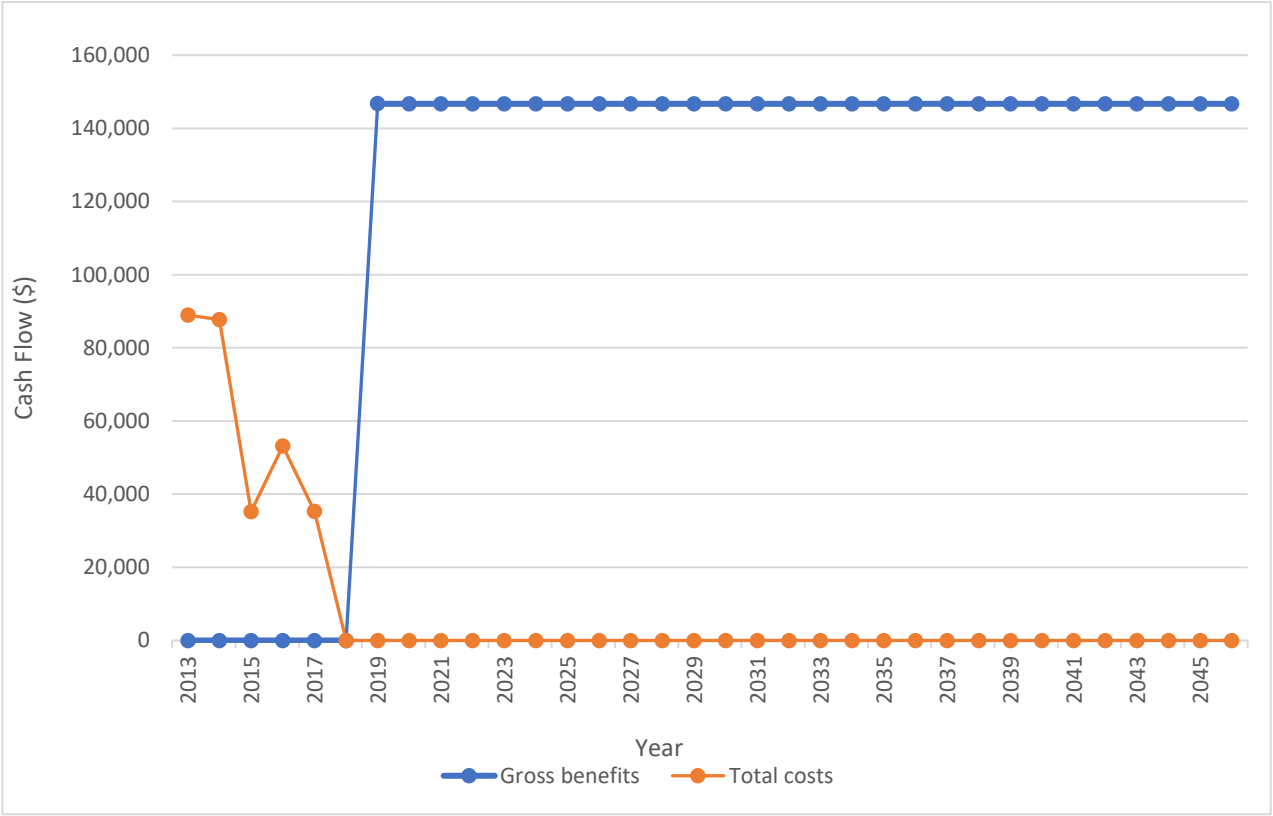
Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	0.60	1.21	1.68	2.05	2.34	2.57
Present Value of Costs ($m)	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Net Present Value ($m)	-0.41	0.19	0.79	1.27	1.64	1.93	2.16
Benefit-Cost Ratio	0.00	1.46	2.92	4.07	4.97	5.68	6.23
Internal Rate of Return (%)	negative	11.79	20.22	22.11	22.67	22.85	22.91
MIRR (%)	negative	10.35	14.30	13.70	12.71	11.81	11.06

Table 8: Investment Criteria for Hort Innovation Investment in Project BS12009

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	0.60	1.21	1.68	2.05	2.34	2.57
Present Value of Costs ($m)	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Net Present Value ($m)	-0.41	0.19	0.79	1.27	1.64	1.93	2.16
Benefit-Cost Ratio	0.00	1.46	2.92	4.07	4.97	5.68	6.23
Internal Rate of Return (%)	negative	11.79	20.22	22.11	22.67	22.85	22.91
MIRR (%)	negative	10.35	14.30	13.70	12.71	11.81	11.06

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the BS12009 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 9 presents the results that show a moderate sensitivity to the discount rate.

Table 9: Sensitivity to Discount Rate (Total investment, 30 years)

Investment Criteria	**Discount rate**		
	0%	**5%**	**10%**
Present Value of Benefits ($m)	4.25	2.57	1.83
Present Value of Costs ($m)	0.30	0.41	0.56
Net Present Value ($m)	3.95	2.16	1.27
Benefit-cost ratio	14.16	6.23	3.26

A sensitivity analysis was then undertaken for the average reduction in gross margin due to pathogen introduction. Results are provided in Table 10.

Table 10: Sensitivity to Assumption of Gross Margin Reduction (Total investment, 30 years)

Investment Criteria	**Reduction in strawberry gross margin due to pathogen introduction**		
	10%	**Base 15%**	**20%**
Present Value of Benefits ($m)	1.71	2.57	3.43
Present Value of Costs ($m)	0.41	0.41	0.41
Net Present Value ($m)	1.30	2.16	3.02
Benefit-cost ratio	4.15	6.23	8.30

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
Medium-Low	Low-Medium

Coverage of benefits was assessed as Medium-Low. While the most important impact from the investment was valued, there were a number of other impacts that were identified but not valued in monetary terms. As a result, the investment criteria as provided by the valued benefit are likely to be underestimated.

Confidence in assumptions for the impact valued was rated as Low-Medium, as some of the key assumptions made were not supported directly by specific data or other forms of evidence of change.

Conclusions

The investment in Project BS12009 focused on improvements to the biosecurity of the Australian strawberry industry via strengthening the protocols for certification of imported strawberry runners. Certification includes biosecurity at a local level, as well as post-entry quarantine at the border and ensures accurate interpretation of molecular and biological indexing for testing pathogens.

The current project addressed a need to update the previous protocols to include:

- The standard operating procedures for both Queensland and Victoria.
- Adaptation of the requirements of the National Diagnostic Network being developed by the Subcommittee on Plant Health Diagnostics; the standard operating procedures will support both local and national biosecurity programs.

Total funding from all sources for the project was $0.41 million (present value terms). The investment produced estimated total expected benefits of $2.57 million (present value terms). This gave a net present value of $2.16 million, an estimated benefit-cost ratio of 6.23 to 1, an internal rate of return of 22.9% and a modified internal rate of return of 11.1%.

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

ABS	Australian Bureau of Statistics
BS	Strawberry
CRRDC	Council of Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Australian Government)
MIRR	Modified Internal Rate of Return
NPBDN	National Plant Biosecurity Diagnostic Network
OCS	Office of Chief Scientist Queensland
PEQ	Post Entry Quarantine
QLD	Queensland
NY	Nursery
R&D	Research and Development
RB	Rubis
RD&E	Research, Development and Extension
SIP	Strategic Investment Plan
SOP	Standard Operating Procedures
SPHD	Subcommittee on Plant Health Diagnostics
TU	Turf
USA	United States of America
VSICA	Victorian Strawberry Industry Certification Authority
$m	Million dollars