

# **Industry-specific impact assessment program: Banana**

## **Impact assessment report for project *Coordination of banana industry R&D (Panama TR4) (BA14012)***

**Impact analyst:**

Talia Hardaker

**Delivery partner:**

AgEconPlus and Agtrans Research

**Project code:**

MT19012

**Date:**

18 December 2020

**Disclaimer:**

Horticulture Innovation Australia Limited (Hort Innovation) makes no representations and expressly disclaims all warranties (to the extent permitted by law) about the accuracy, completeness, or currency of information in this Final Report.

Users of this Final Report should take independent action to confirm any information in this Final Report before relying on that information in any way.

Reliance on any information provided by Hort Innovation is entirely at your own risk. Hort Innovation is not responsible for, and will not be liable for, any loss, damage, claim, expense, cost (including legal costs) or other liability arising in any way (including from Hort Innovation or any other person's negligence or otherwise) from your use or non-use of the Final Report or from reliance on information contained in the Final Report or that Hort Innovation provides to you by any other means.

**Funding statement:**

This project has been funded by Hort Innovation, using the research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

**Publishing details:**

Published and distributed by: Hort Innovation

Level 7

141 Walker Street

North Sydney NSW 2060

Telephone: (02) 8295 2300

[www.horticulture.com.au](http://www.horticulture.com.au)

© Copyright 2020 Horticulture Innovation Australia

## Contents

Contents	3
Tables	4
Figures	4
Executive Summary	5
Keywords	5
Introduction	6
General Method	6
Background & Rationale	7
Project Details	9
Project Investment	14
Impacts	14
Valuation of Impacts	16
Results	19
Conclusion	22
Glossary of Economic Terms	23
Acknowledgements	25
Abbreviations	25

## Tables

Table 1: Production Statistics for the Australian and Qld Banana Industry (year ended 30 June 2010 to 2019)	8
Table 2: Logical Framework for Project BA14012	10
Table 3: Annual Investment in the Project BA14012 (nominal \$)	14
Table 4: Triple Bottom Line Categories of Principal Impacts from Project BA14012	14
Table 5: Australian Government Research Priorities	15
Table 6: Summary of Assumptions	17
Table 7: Investment Criteria for Total Investment in Project BA14012	19
Table 8: Contribution to Benefits by Source	20
Table 9: Sensitivity to Discount Rate	20
Table 10: Sensitivity to Assumed Reduction in Production for Impacts 1, 2 and 3	21
Table 11: Sensitivity to Attribution of Benefits for Impacts 1, 2 and 3 (Total investment, 30 years)	21
Table 12: Confidence in Analysis of Project	21

## Figures

Figure 1: Australia's Banana Growing Regions	7
Figure 2: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs	20

## 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 project BA14012 titled “*Coordination of Banana Industry R&D (Panama TR4)*”. The project was funded by Hort Innovation over the period August 2015 to August 2018.

### Methodology

The investment was first analysed qualitatively within a logical framework that included activities and outputs, outcomes and impacts. Actual and/or potential impacts then were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation in monetary terms (quantitative assessment). Past and future cash flows were expressed in 2019/20 dollar terms and were discounted to the year 2019/20 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 investment in BA14012 has contributed to the successful commencement of a number of coordinated banana RD&E investments delivering useful strategies for the continued containment and management of Panama disease Topical Race 4 (TR4). The project also has led to enhanced coordination and collaboration between banana industry stakeholders and was instrumental in the establishment of the Quality Banana Approved Nursery transition project to develop and implement a new clean planting materials system for the Australian banana industry. Consequently, BA14012 is likely to have contributed to maintained productivity for some banana producers through avoided production losses and has improved the efficiency of resource allocation for banana RD&E, particularly RD&E associated with Panama TR4.

### Investment Criteria

Total funding from all sources for the project was \$0.72 million (present value terms). The investment produced estimated total expected benefits of \$2.21 million (present value terms). This produced an estimated net present value of \$1.49 million, a benefit-cost ratio of 6.76 to 1, an internal rate of return (IRR) of 25.70% and a modified IRR of 9.82% over 30-years at a discount rate of 5% and a reinvestment rate of 5%.

### Conclusions

A number of environmental and social impacts also were identified but not valued as part of the current assessment. Thus, given the impacts not valued, combined with conservative assumptions made for the principal economic impacts valued, it is reasonable to conclude that the investment criteria reported may be an underestimate of the actual performance of the BA14012 investment.

## Keywords

Impact assessment, cost-benefit analysis, BA14012, banana, Panama disease Tropical Race 4, Fusarium wilt, TR4 research and development, R&D, coordination

## Introduction

All research and development (R&D) 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 current 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 almond (AL), banana (BA), citrus (CT) and onion (VN) research, development and extension (RD&E) investment funds.

Twenty-nine RD&E investments (projects) were selected through a stratified, random sampling process. The industry samples were as follows:

- Nine AL projects were chosen worth \$5.84 million (nominal Hort Innovation investment) from an overall population of 21 projects worth an estimated \$10.78 million,
- Eight BA projects worth \$3.02 million (nominal Hort Innovation investment) from an overall population of 24 projects worth approximately \$16.72 million,
- Eight CT projects worth \$5.40 million (nominal Hort Innovation investment) from a total population of 35 projects worth \$15.78 million, and
- Four VN projects worth \$2.40 million (nominal Hort Innovation investment) from an overall population of 8 projects worth \$3.89 million.

The project population for each industry included projects where a final deliverable had been submitted in the five-year period from 1 July 2014 to 30 June 2019. 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. Four projects had been randomly selected as part of a related Hort Innovation project (MT18011) and were included in the samples for the AL industry (AL14006 and AL16004) and the CT industry (CT15006 and CT15013). This left 25 unique projects randomly selected for evaluation under MT19012.

Project BA14012: *Coordination of Banana Industry R&D (Panama TR4)* was randomly selected as one of the 25 unique MT19012 investments 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 (RDCs), Cooperative Research Centres (CRCs), 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 actual and/or potential 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 used 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.

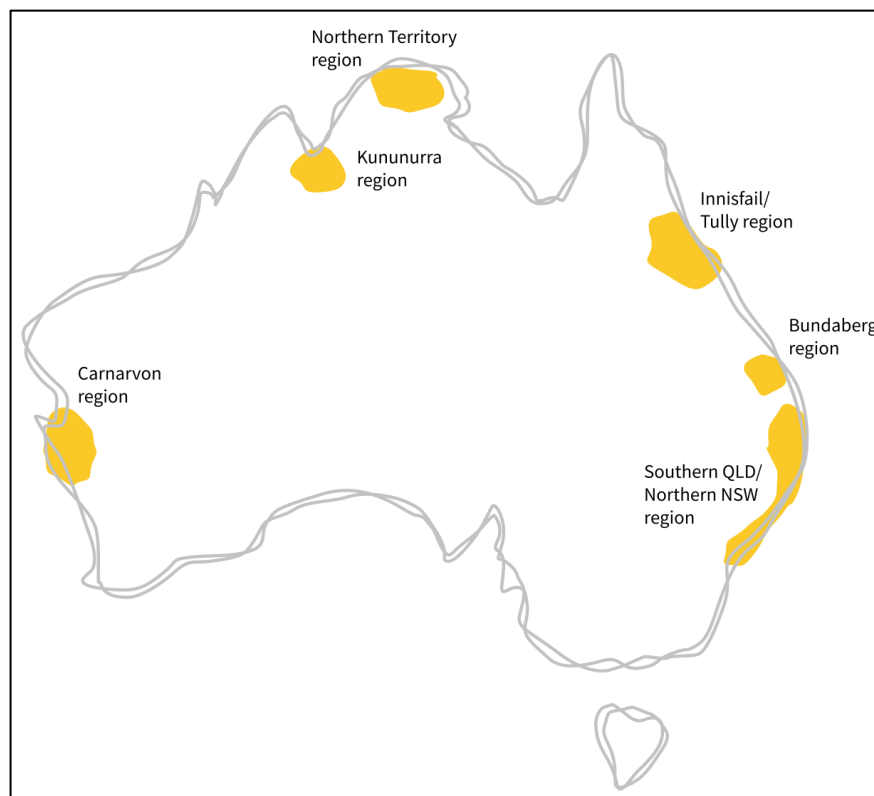
## Background & Rationale

### Background

#### *The Australian Banana Industry*

Bananas have been grown in Australia since the 1880s. Today, bananas are grown in subtropical and tropical regions including in Queensland (Qld), northern New South Wales (NSW), the Northern Territory (NT) and Western Australia (WA) (Hort Innovation, 2020). On average, Qld accounts for approximately 90% of the total area of bananas grown and over 95% of total Australian production (10-year average<sup>1</sup>). Figure 1 shows Australia's banana growing regions and Table 1 provides a summary of the data for production of bananas for both Australia and Qld.

Figure 1: Australia's Banana Growing Regions



Source: <https://australianbananas.com.au/Pages/all-about-bananas/the-banana-story>

<sup>1</sup> Based on area data from the Australian Bureau of Statistics (ABS), series 7121.0 *Agricultural Commodities, Australia* 2009/10 to 2018/19 and production data from the Australian Banana Growers' Council (ABGC)

Table 1: Production Statistics for the Australian and Qld Banana Industry (year ended 30 June 2010 to 2019)

<b>Australia</b>											
<b>Year ended 30 June</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>10yr Avg.</b>
Total area (ha)	12,497	13,296	15,484	15,348	12,879	11,788	16,612	14,021	12,477	11,902	13,630
Area (bearing age) (ha)	11,543	11,196	13,496	14,218	12,085	10,936	15,610	13,274	11,551	10,962	12,487
Production <sup>(a)</sup> (t)	309,505	330,980	202,423	339,922	370,176	370,989	395,878	413,660	388,265	371,915	349,371
Yield (t/ha)	26.8	29.6	15.0	23.9	30.6	33.9	25.4	31.2	33.6	33.9	28.0
Gross value (\$m)	488.1	316.0	466.8	490.7	341.3	455.0	409.0	538.5	487.6	490.9	448.4
<b>QLD</b>											
<b>Year ended 30 June</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>10yr Avg.</b>
Total area (ha)	10,869	11,480	13,576	13,886	11,356	10,101	15,794	13,182	11,502	10,829	12,258
Area (bearing age) (ha)	10,083	9,727	11,810	12,986	10,726	9,446	14,933	12,597	10,693	10,030	11,303
Production <sup>(b)</sup> (t)	270,358	287,553	177,135	310,468	328,548	320,442	378,709	392,562	359,425	340,294	316,549
Yield (t/ha)	26.8	29.6	15.0	23.9	30.6	33.9	25.4	31.2	33.6	33.9	28.0
Gross value (\$m)	448.3	283.1	415.4	456.5	322.8	440.8	401.2	525.8	472.0	468.3	423.4

Source: ABS Series 7121.0 *Agricultural Commodities, Australia* (2009/10 to 2018/19) and ABS Series 7503.0 *Value of Agricultural Commodities Produced, Australia* (2009/10 to 2018/19)

(a) Production data from the ABGC based on compulsory levies.

(b) Derived from ABS area (bearing age plants) and the Australian average yield for each year.



### *Panama Disease Tropical Race 4*

Fusarium wilt, also known as Panama disease, is a destructive fungal disease of banana plants. It is caused by *Fusarium oxysporum f. sp. cubense (Foc)*. It first became epidemic in Panama in 1890 and proceeded to devastate the Central American and Caribbean banana industries that were based on the ‘Gros Michel’ (AAA) variety in the 1950s and 1960s. Once *Foc* is present in the soil, it cannot be eliminated.

There are four recognised races of the pathogen which are separated based on host susceptibility (Pegg, Coates, O'Neill, & Turner, 2019):

- Race 1 (*Foc* R1), was responsible for the epidemics in ‘Gros Michel’ plantations, and also attacks ‘Lady Finger’ (AAB) ‘Silk’ (AAB) and Ducasse (ABB) varieties.
- Race 2 (*Foc* R2) affects cooking bananas such as ‘Bluggoe’ (ABB).
- Race 3 (*Foc* R3) affects *Heliconia spp.*, a close relative of banana, and is not considered to be a banana pathogen.
- Race 4 (*Foc* R4) is capable of attacking ‘Cavendish’ (AAA) as well as the other varieties of banana affected by R1 and R2. Races 1, 2 and 4 have been present on the east coast of Australia for many years and R1 also is present in WA.

R4 is further divided into ‘sub-tropical’ and ‘tropical’ strains. ‘Subtropical’ race 4 (SR4) generally only causes disease in Cavendish varieties growing sub-optimally (cool temperatures, water stress, poor soil). ‘Tropical’ race 4 (TR4) is a more virulent form of the pathogen and is capable of causing disease in ‘Cavendish’ growing under any conditions. TR4 was first identified in Taiwan in 1989 but has spread rapidly.

TR4 is one of the most severe threats facing the banana industry worldwide. TR4 has rapidly spread throughout Southeast Asia since first being reported and is a serious threat to the Australian Cavendish banana industry.

Panama disease TR4 was first discovered in Australia in 1997 in the Northern Territory (NT) where strict quarantine management restricted its spread only to the NT banana industry for almost two decades. However, in March 2015, another outbreak was detected in Tully, North QLD, where a large percentage of Australian bananas are grown (Andre Drenth, pers. comm., 2017).

### **Rationale**

Following the detection of Panama TR4 in Qld, the banana industry and Qld government funded the Panama TR4 Program. Industry and government continue to work together to contain and control the disease through surveillance on farms, compliance on known infested properties and communication and education activities (DAF, 2020). A range of RD&E projects associated with TR4 also had been funded by Hort Innovation and other research funders.

Project BA14012 (*Coordination of Banana Industry R&D (Panama TR4)*) resulted from Hort Innovation seeking expressions of interest from suitably experienced and capable service providers to undertake Phase 2 of the Australian Banana Industry R&D Manager project (BA11027), with a focus on project development, coordination and extension predominately in the area of Panama TR4 R&D.

## **Project Details**

### **Summary**

Project Code: BA14012

Title: *Coordination of Banana Industry R&D (Panama TR4)*

Research Organisation: Australian Banana Growers Council (ABGC) Inc.

Principal Investigator: Jim Pekin

Period of Funding: August 2015 to August 2018

## Objectives

Project BA14012 was funded to ensure Panama TR4 R&D was well coordinated, delivering tangible and adoptable outcomes for growers. The primary roles of the Banana Industry R&D Manager were:

1. Project development and coordination in the area of Panama Tropical Race 4 (TR4) R&D.
2. Extension of Panama TR4 R&D projects.
3. Input to the banana industry R&D program, including membership of project reference groups.
4. Technical advice to the banana industry on key pest and disease issues.

## Logical Framework

Table 2 briefly describes the activities, outputs, outcomes, and actual and potential impacts of project BA14012 in a logical framework.

Table 2: Logical Framework for Project BA14012

Activities	<ul style="list-style-type: none"> <li>• The aim of the project was to coordinate and build knowledge and capacity within the Australian banana industry to manage and contain Panama TR4 fungal disease.</li> <li>• The project developed strong linkages with service providers delivering relevant R&amp;D projects as well as providers that promote the adoption of R&amp;D outcomes within industry.</li> <li>• The ABGC was awarded the three year contract for the project and enlisted ‘Launch Recruitment’ (a specialist recruitment company) to assist in short-listing suitable candidates for the Banana Industry R&amp;D Manager position.</li> <li>• Dr Rosie Godwin was appointed to the role in October 2015.</li> <li>• The project was guided by a Project Reference Group (PRG) that met every six months to discuss project progress and any other relevant issues.</li> <li>• An independent mid-term review was undertaken by consultant John Bagshaw to evaluate project progress and make recommendations for the second half of the project.</li> <li>• The Banana Industry R&amp;D Manager completed the following activities to achieve the project’s aims:             <ul style="list-style-type: none"> <li><u>Project development and coordination in the area of Panama TR4 R&amp;D</u> <ul style="list-style-type: none"> <li>○ Built a full understanding of all banana industry R&amp;D projects including a comprehension of all work being undertaken, its relevance to industry, progress against deliverables, and scientific validity.</li> <li>○ Ensured effective linkages, collaboration, issue resolution, and effective communication for two-way information flow between stakeholders (e.g. industry and researchers, researchers and research funders, etc.).</li> <li>○ Developed and submitted R&amp;D concepts to Hort Innovation based on industry priorities.</li> <li>○ Worked with the Nursery and Garden Industry Australia (NGIA) to collaboratively develop an accredited clean planting material scheme for the banana industry.</li> <li>○ Contributed advice to the Australian Centre for International Agricultural Research (ACIAR) project titled <i>Integrated Management of Fusarium wilt in bananas in the Philippines and Australia</i>.</li> <li>○ Analysed and reviewed documents and strategies relevant to R&amp;D (e.g. in TR4 containment and management, biosecurity matters, and chemical usage).</li> </ul> </li> <li><u>Extension of Panama TR4 R&amp;D projects</u> <ul style="list-style-type: none"> <li>○ Relevant stakeholders were identified and a plan for engagement was developed for the project.</li> <li>○ Effective linkages were formed with the National Extension Project and the Banana Industry Communications project to ensure that they were effective conduits for R&amp;D information.</li> <li>○ Communication materials were developed and distributed to appropriate audiences e.g. fact sheets, magazine articles, and in e-bulletins.</li> </ul> </li> </ul> </li> </ul>
------------	--

	<ul style="list-style-type: none"> <li>○ Organised events or provided assistance to other service providers to run field days, workshops, scientific exchanges or meetings with international experts.</li> <li>○ Oral presentations were given to different forums e.g. meetings, workshops, field days, conferences, growers meetings.</li> <li>○ Developed and organised the scientific program at the 2017 Banana Congress.</li> <li>○ Individual meetings with growers on their farms.</li> </ul> <p><u>Input to the banana industry R&amp;D program including membership of PRGs</u></p> <ul style="list-style-type: none"> <li>○ The Banana Industry R&amp;D Manager was a member of the Strategic Investment Advisory Panel (SIAP) for Hort Innovation.</li> <li>○ Further, the R&amp;D Manager was a member of PRGs of relevant R&amp;D projects including the plant protections program and TR4 research projects.</li> <li>○ The R&amp;D Manager also collaborated and facilitated the establishment and progression of R&amp;D projects by providing assistance to Hort Innovation. For example, work on BA16012 (Revision of the Owner Reimbursement Costs Framework) for the banana industry and the establishment of BA14014, a Panama TR4 research project with Hort Innovation’s Ben Callaghan (Jim Pekins, pers. comm., 2020).</li> </ul> <p><u>Technical advice to the banana industry on key pest and disease issues</u></p> <ul style="list-style-type: none"> <li>○ A wide range of technical advice was provided to the banana industry and Hort Innovation. Frequent topics included: <ul style="list-style-type: none"> <li>i) Pest and disease issues e.g. TR4, Banana Bunchy Top Virus (BBTV), Yellow Sigatoka, coffee bean weevil, Banana Freckle, thrips, and post-harvest diseases,</li> <li>ii) Banana production and supply issues,</li> <li>iii) Biosecurity issues such as emergency plant pests, on farm biosecurity measures, and market access,</li> <li>iv) Pest diagnosis,</li> <li>v) Reform of the Quality Banana Approved Nursery (QBAN) clean planting material scheme,</li> <li>vi) Chemical reviews, permits, and usage requirements, and</li> <li>vii) Technical support to other ABGC projects.</li> </ul> </li> </ul>
<p>Outputs</p>	<p><u>Project development and coordination</u></p> <ul style="list-style-type: none"> <li>● Relationships were fostered and maintained between banana researchers involved in Panama TR4 (and other aspects of banana research), Hort Innovation personnel and members of the Biosecurity Qld (BQ) TR4 response team.</li> <li>● Input to the final stages of the Banana Plant Protection Program (BA10020) and development of new, replacement projects BA16001 (<i>Improved Plant Protection for the Banana Industry</i>) and BA16005 (<i>Strengthening Banana Industry Diagnostic Capacity</i>).</li> <li>● Input into priorities for varietal development.</li> <li>● Input to BA14013 (<i>Fusarium wilt TR4 Biosecurity and sustainable solutions</i>) and input into development, establishment and progress of BA14014 (<i>Fusarium wilt TR4 Research Project</i>) aimed at finding short- to medium-term solutions to prevent and manage TR4 and long-term solutions to TR4 respectively.</li> <li>● Drove the transition and development of the new QBAN scheme.</li> <li>● Developed resources to assist growers to raise awareness of TR4 and implement on farm biosecurity measures.</li> <li>● Technical and industry information provided to researchers in the Philippines.</li> <li>● Input provided to projects associated with the National Development and Extension Program.</li> <li>● Input into other major R&amp;D projects including BA14011 (<i>the National Banana Bunchy Top Virus Program Phase 3</i>), BA12007 and its follow on BA15003 (<i>Management of Yellow Sigatoka and other disease in North Qld</i>), BA15001 (<i>Review of the national biosecurity plan for the banana industry</i>), BA16010 (<i>Alternative Quarantine Treatment for bananas infested with coffee bean weevil</i>), BA16012 (<i>Review of Owner</i></li> </ul>

	<p><i>Reimbursement Cost Evidence Framework</i>), Banana Industry Strategic Investment Plan (2017-2021), and other non-levy funded projects.</p> <ul style="list-style-type: none"> <li>• Assisted in the development of several requests for funding proposals.</li> <li>• Attended and had input into PRGs for a wide range of R&amp;D projects.</li> <li>• Reviewed ABGC and BQ’s strategy for TR4 containment.</li> <li>• Reviewed Hort Innovations Panama R&amp;D Program.</li> </ul> <p><u>Industry adoption services</u></p> <ul style="list-style-type: none"> <li>• Developed and implemented a stakeholder engagement plan.</li> <li>• Visited a number of farms to discuss R&amp;D issues and built relationships with growers and other supply chain participants.</li> <li>• Built an effective collaborative relationship with NGIA to drive the QBAN transition.</li> <li>• Participated and delivered presentations at field days and roadshow events.</li> <li>• Provided resources for growers whose farms may become infested with TR4 in the future.</li> <li>• Provided input into ABGC training modules and factsheets.</li> </ul> <p><u>Technical advisory services</u></p> <ul style="list-style-type: none"> <li>• Provided advice to Hort Innovation on challenges and opportunities facing the Australian banana industry.</li> <li>• Provided technical advice at twice yearly Hort Innovation SIAP meetings and facilitated development of the Banana Industry Strategic Investment Plan 2017-2021.</li> <li>• Provided advice to the BQ Panama TR4 Response program.</li> <li>• Reviewed and provided feedback on a number of key BQ documents including the new ‘Biosecurity Manual and Regulations’ and ‘Banana Industry Guidelines’.</li> <li>• Participated in the National Consultative Committee for Emergency Plant Pest meetings.</li> <li>• Built relationships with international banana researchers and other stakeholders.</li> <li>• Provided advice to growers on agricultural chemical registration and use.</li> <li>• Wrote and sent a submission to the Australian Pesticide and Veterinary Medicine Authority on behalf of the banana industry in response to their decision to cancel all uses of Omethoate for the banana industry.</li> <li>• Represented the banana industry at a number of industry events.</li> </ul> <p><u>Communication material</u></p> <ul style="list-style-type: none"> <li>• A wide range of communication materials were produced. The Banana Industry R&amp;D Manager also provided input to a number of external communication materials such as ABGC and BQ fact sheets, e-bulletins and media releases.</li> <li>• A number of articles were published in the Australian Banana Magazine.</li> </ul>
<p>Outcomes</p>	<ul style="list-style-type: none"> <li>• The project led to the successful initiation of a number of coordinated banana R&amp;D projects delivering useful strategies to growers for the ongoing containment and management of TR4 and other pests and diseases.</li> <li>• Coordination and collaboration between existing banana industry R&amp;D investments also was improved.</li> <li>• Relationships and communication between service providers, individual researchers, growers and other banana industry stakeholders has been improved.</li> <li>• The banana industry now also has a mechanism to coordinate and develop future RD&amp;E investments.</li> <li>• The project was instrumental in driving the establishment and progress of the QBAN transition project to develop and implement a new clean planting materials system for the Australian banana industry.</li> <li>• QBAN now is entering the end of the transition year (as of October 2020) with the new scheme set to take over from the government run scheme in January 2021. The main QBAN businesses that supply the commercial industry have already transitioned to the new scheme. Small operators that were not serious suppliers have chosen to</li> </ul>

	<p>exit thereby raising the average standard of accredited suppliers to the industry (Jim Pekin, pers. comm., 2020).</p> <ul style="list-style-type: none"> <li>• Industry knowledge has significantly increased on Panama TR4 spread and management, particularly disease background, identifying and reporting, disease risk pathways and on-farm biosecurity practices.</li> <li>• Evaluation data following TR4 grower workshops run by ABGC and DAF extension staff showed that 75% of participants’ knowledge of Panama TR4 was improved (they had a better understanding of the disease risk pathways and understood suitable biosecurity practices).</li> <li>• The project contributed to the containment management strategy in place for TR4 for the Australian banana industry that was developed by BQ in collaboration with ABGC and DAF and to the implementation of effective and appropriate extension strategies for Panama TR4.</li> <li>• A containment strategy still is in place for TR4 with only five farms quarantined over the past five years and only approximately 90 individual plants confirmed positive. R&amp;D projects have since made significant progress towards:             <ul style="list-style-type: none"> <li>i) Identification of resistant/ tolerant varieties and their development,</li> <li>ii) The development of management techniques to assist farmers to continue to grow bananas in the presence of TR4, and</li> <li>iii) effective disease management and containment of other endemic pests and diseases such as leaf spot and bunchy top virus (Jim Pekin, pers. comm., 2020).</li> </ul> </li> <li>• A follow on project, BA17002 (Banana Industry R&amp;D Coordination), was funded and has just completed its second year (Jim Pekin, pers. comm., 2020).</li> </ul>
<p>Impacts</p>	<ul style="list-style-type: none"> <li>• Increased or maintained productivity and/or profitability for some Australian banana growers through the project’s contribution to improved pest and disease management, better on farm biosecurity and earlier or more rapid adoption of key R&amp;D outputs.</li> <li>• Avoided potential production losses for some Australian banana growers from other key endemic banana pests and diseases through the project’s contribution to the new and improved QBAN scheme enabling growers to source certified clean planting materials.</li> <li>• Avoided potential production losses for some Australian banana growers through reduced risk of the spread of Panama TR4 in Qld because of enhanced industry capacity/grower understanding and awareness and improved biosecurity processes both on and off farm.</li> <li>• Increased efficiency and/or effectiveness of resource allocation for banana industry RD&amp;E through improved coordination, collaboration, and priority setting.</li> <li>• Potentially, some contribution to improved environmental outcomes through better on farm use of agricultural chemicals.</li> <li>• Contribution to increased knowledge and scientific capacity through facilitation of better researcher and service provider relationships and two-way communication.</li> <li>• Potentially, increased regional community wellbeing from spill-over benefits from a more resilient and economically and environmentally sustainable banana industry.</li> </ul>

## Project Investment

### Nominal Investment

Table 3 shows the annual investment (cash and in-kind) in project BA14012 by Hort Innovation. Hort Innovation provided 100% of the project investment.

Table 3: Annual Investment in the Project BA14012 (nominal \$)

Year ended 30 June	Hort Innovation (\$)	Others (\$)	Total (\$)
2016	177,541	0	177,541
2017	151,390	0	151,390
2018	120,315	0	120,315
2019	48,771	0	48,771
<b>Totals</b>	<b>498,017</b>	<b>0</b>	<b>498,017</b>

Source: BA14012 Project Agreement and Variation documents supplied by Hort Innovation 2020

### Program Management Costs

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

### Real Investment and Extension Costs

For the purposes of the investment analysis, investment costs were expressed in 2019/20 dollar terms using the Gross Domestic Product deflator index (ABS, 2020). No additional costs associated with project extension were incorporated as the project was heavily involved in research and industry coordination and communication.

## Impacts

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

Table 4: Triple Bottom Line Categories of Principal Impacts from Project BA14012

Economic	<ul style="list-style-type: none"> <li>Increased or maintained productivity and/or profitability for some Australian banana growers through the project’s contribution to improved pest and disease management, better on farm biosecurity and earlier or more rapid adoption of key R&amp;D outputs.</li> <li>Avoided potential production losses for some Australian banana growers from other key endemic banana pests and diseases through the project’s contribution to the new and improved QBAN scheme enabling growers to source certified clean planting materials.</li> <li>Avoided potential production losses for some Australian banana growers through reduced risk of the spread of Panama TR4 in Qld because of enhanced industry capacity/grower understanding and awareness and improved biosecurity processes both on and off farm.</li> <li>Increased efficiency and/or effectiveness of resource allocation for banana industry RD&amp;E through improved coordination, collaboration, and priority setting.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>Potentially, some contribution to improved environmental outcomes through better on-farm use of agricultural chemicals.</li> </ul>

Social	<ul style="list-style-type: none"> <li>• Contribution to increased knowledge and scientific capacity through facilitation of better researcher and service provider relationships and two-way communication.</li> <li>• Potentially, increased regional community wellbeing from spill-over benefits from a more resilient and economically and environmentally sustainable banana industry.</li> </ul>
--------	---

### Public versus Private Impacts

The impacts identified in this evaluation are predominantly private. However, some public impacts may be delivered. Private benefits are likely to be realised by north Qld banana growers through increased efficiency of resource allocation for RD&E, increased or maintained industry productivity, and/or avoided production losses through better containment and management of key pests and diseases.

Public benefits also may occur and include increased efficiency of public resource allocation for banana industry RD&E, increased scientific knowledge and capacity, and, potentially, enhanced regional community wellbeing.

### Distribution of Private Impacts

The impacts on the Australian banana industry from investment in project BA14012 will be shared along banana supply chains according to relevant short- and long-term supply and demand elasticities.

### Impacts on Other Australian Industries

No direct or significant impacts to other Australian industries were identified.

### Impacts Overseas

The project may have contributed to impacts associated with RD&E investments for TR4 in the Philippines through input to the ACIAR project titled *Integrated Management of Fusarium wilt in bananas in the Philippines and Australia*.

### Match with National Priorities

The Australian Government’s Science and Research Priorities and Rural RD&E priorities are reproduced in Table 5. The project findings and related impacts will contribute to Rural RD&E Priorities 2 and, potentially 4, and to Science and Research Priority 1.

Table 5: Australian Government Research Priorities

<b>Australian Government</b>	
<b>Rural RD&amp;E Priorities (est. 2015)</b>	<b>Science and Research Priorities (est. 2015)</b>
<ol style="list-style-type: none"> <li>1. Advanced technology</li> <li>2. Biosecurity</li> <li>3. Soil, water and managing natural resources</li> <li>4. Adoption of R&amp;D</li> </ol>	<ol style="list-style-type: none"> <li>1. Food</li> <li>2. Soil and Water</li> <li>3. Transport</li> <li>4. Cybersecurity</li> <li>5. Energy</li> <li>6. Resources</li> <li>7. Advanced Manufacturing</li> <li>8. Environmental Change</li> <li>9. Health</li> </ol>

Sources: (Commonwealth of Australia, 2015) and (Australian Government, 2015)

### Alignment with the Banana Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the banana industry are outlined in the Banana Strategic Investment Plan 2017-2021<sup>2</sup> (2017). Project BA14012 primarily addressed Outcome 2 through Strategies 2.1 (continue to drive adoption of best management practice for on-farm biosecurity to ensure biosecurity risks are minimised) with some contribution to Outcome 1 (Strategy 1.1 and 1.3).

## Valuation of Impacts

### Impacts Valued

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

Four economic impacts were valued, these were:

- Increased or maintained productivity and/or profitability for some Australian banana growers through the project's contribution to improved pest and disease management, better on farm biosecurity and earlier or more rapid adoption of key R&D outputs.
- Avoided potential production losses for some Australian banana growers from other key endemic banana pests and diseases through the project's contribution to the new and improved QBAN scheme enabling growers to source certified clean planting materials.
- Avoided potential production losses for some Australian banana growers through reduced risk of the spread of Panama TR4 in Qld because of enhanced industry capacity/grower understanding and awareness and improved biosecurity processes both on and off farm.
- Increased efficiency and/or effectiveness of resource allocation for banana industry RD&E through improved coordination, collaboration and priority setting.

### Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. In particular, environmental and social impacts were hard to value due to a lack of evidence/data on which to base credible assumptions, difficulty in quantifying the causal relationship and the pathway between BA14012 and the impact and/or the complexity of assigning magnitudes and monetary values to the impact.

The environmental impact identified but not valued was:

- Potentially, some contribution to improved environmental outcomes through better on farm use of agricultural chemicals.

The social impacts identified but not valued were:

- Contribution to increased knowledge and scientific capacity through facilitation of better researcher and service provider relationships and two-way communication.
- Potentially, increased regional community wellbeing from spill-over benefits from a more resilient and economically and environmentally sustainable banana industry.

### Valuation of Impacts 1, 2 and 3

In general terms, the investment in BA14012 is likely to have contributed to enhanced productivity and/or profitability for a proportion of the Australian banana growers. Three of the primary economic impacts identified contribute to this broad impact type. From Table 4 above, these are:

- 1) Increased or maintained productivity and/or profitability through improved pest and disease management, better on farm biosecurity and earlier or more rapid adoption of key R&D outputs.
- 2) Avoided future production losses through reduced risk of the spread of Panama TR4 in Qld because of enhanced industry capacity/grower understanding and awareness and improved biosecurity processes both

---

<sup>2</sup> For further information, see: <https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/strategic-investment-plans/>



on and off farm.

- 3) Avoided potential production losses from other key endemic banana pests and diseases through the new and improved QBAN scheme.

The valuation for Impacts 1, 2 and 3 was underpinned by the assumption that the investment in BA14012 is likely to have contributed to maintenance of the current total average level of production into the future (avoided loss of production and maintained productivity).

Specific assumptions for the valuation of Impacts 1, 2 and 3 are described in Table 6.

#### Counterfactual

Given the relative significance and potential severity of Panama TR4 to the Australian banana industry, a coordinated industry and government response was essential, and Hort Innovation funded projects were at the crux of the initial response. Thus, it was assumed that without the large investment in RD&E (including BA14012) average total Australian banana production would have declined by a total of 5% over the 10-year period to 2026/27. This decline then would be followed by a period of recover of approximately five years driven by future RD&E investments.

#### Attribution

After the detection of Panama TR4 in QLD, industry and government funded a range of RD&E activities aimed at containing the disease and preventing its spread. BA14012 represents one such project. To recognise the contribution of the range of other, unknown investments that may have contributed to the same impacts, a conservative attribution factor of 2% was applied to the total estimated benefits.

#### Valuation of Impact 4: Increased efficiency of resource allocation for banana RD&E

The investment in the BA14012 contributed to improved coordination, collaboration and priority setting for banana RD&E, particularly with respect to future RD&E directed at the containment and management of Panama TR4. Consequently, it was assumed that BA14012 was likely to have marginally improved Hort Innovation’s investment prioritisation, selection and management for R&D investments, and therefore contributed to increased efficiency of RD&E resource allocation.

Hort Innovation’s total, average annual investment in banana RD&E was estimated to be \$3.65 million (3-year average) (Hort Innovation, Annual Report, 2018 to 2020). It was assumed that the investment in BA14012 contributed to a 2.0% efficiency dividend for the period 2017/18 to 2021/22.

Specific assumptions for the valuation of Impact 4 are described in Table 6.

#### Attribution

Based on conservative assumptions made, it was assumed that 100% of the estimated benefits were attributable to the investment in BA14012.

#### Counterfactual

It was assumed that, without the BA14012 investment, the benefits estimated would not have occurred.

#### Summary of Assumptions

A summary of the key assumptions made for valuation of the impacts is shown in Table 6.

Table 6: Summary of Assumptions

Variable	Assumption	Source/Comment
<b>Key Baseline Data</b>		
Total average Australian banana production area (bearing age)	12,487 ha	10-year average derived from ABS Series 7121.0 <i>Agricultural Commodities, Australia</i> (2009/10 to 2018/19) (see Table 1)
Total average Australian banana production	349,371 t	10-year average, derived from ABGC production statistics based on the compulsory industry levy (see Table 1)

Average yield (derived)	28.0 t/ha	349,371 t / 12,487 bearing ha
Estimated average net return to growers	\$22.00 / 15kg carton	Analyst estimated based on the average net return to grower after marketing and ripening costs reported in the Banana Enterprise Comparison Report 2016/17 (Appendix 1) (Pinnacle Agribusiness, 2018)
<b>Impacts 1, 2 and 3: Increase productivity/profitability for some Australian banana growers</b>		
<b>Valuation Assumptions</b>		
<b>WITHOUT BA14012</b>		
First year of impact	2017/18	Analyst estimate – based on initial adoption/usage of project outputs from year three of BA14012
Proportion of total Australian banana production area experiencing declining production without BA14012 (and associated investments)	80%	Based on the Innisfail/Tully production region and the Northern Banana Pest Quarantine Area contributing approximately 80% of banana production (Cook, et al., 2013)
Decrease in total average annual banana production for affected area	Total reduction of 5% over 10-years (by 2026/27) followed by a 5-year recover back to original (2017/18) average annual production by 2031/32	Analyst estimate – based on an approximately 5% decline in production from 2016/17 to 2018/19 (Table 1)
Note: It was not possible within the scope of the current assessment to appropriately value the relative contribution of each of the three individual impacts (1, 2 and 3) to the overall impact type of improved productivity/ profitability as estimated above. Thus, the estimated benefits are shared across all three impacts described.		
<b>Risk Factors and Other Variables</b>		
Probability of output	100%	Analyst assumption, based on successful completion of BA14012
Probability of outcome	100%	Analyst assumption, based on anecdotal evidence of improved disease control (i.e. containment of TR4) and successful implementation of the QBAN scheme to date
Probability of impact	80%	Analyst assumption, allows for exogenous factors that may affect realisation of impact
Attribution of benefits to investment in BA14012	2.0%	See 'valuation of impacts 1, 2 and 3' above.
<b>Impact 4: Increased efficiency of resource allocation for banana RD&amp;E</b>		
<b>Valuation Assumptions</b>		
<b>WITH BA14012</b>		
Total average annual investment in banana RD&E by Hort Innovation	\$3.65 million	Three year average, Hort Innovation Annual Report 2018 to 2020
Efficiency dividend due to improved prioritisation, selection and management for R&D investments	2.0%	Analyst assumption

First year of impact	2017/18	Analyst estimate – based on initial adoption/usage of project outputs from year three of BA14012
Period of efficiency dividend	5 years (to 2021/22)	Analyst assumption
<b>Risk Factors and Other Variables</b>		
Probability of output	100%	Analyst assumption, based on successful completion of BA14012
Probability of outcome	100%	Analyst assumption, based on anecdotal evidence of improved prioritisation, selection and management for R&D investments
Probability of impact	80%	Analyst assumption, allows for exogenous factors that may affect realisation of impact
Attribution of benefits to investment in BA14012	100%	See 'valuation of impact 4' above.

## Results

All costs and benefits were discounted to 2019/20 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 (2018/19) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

### Investment Criteria

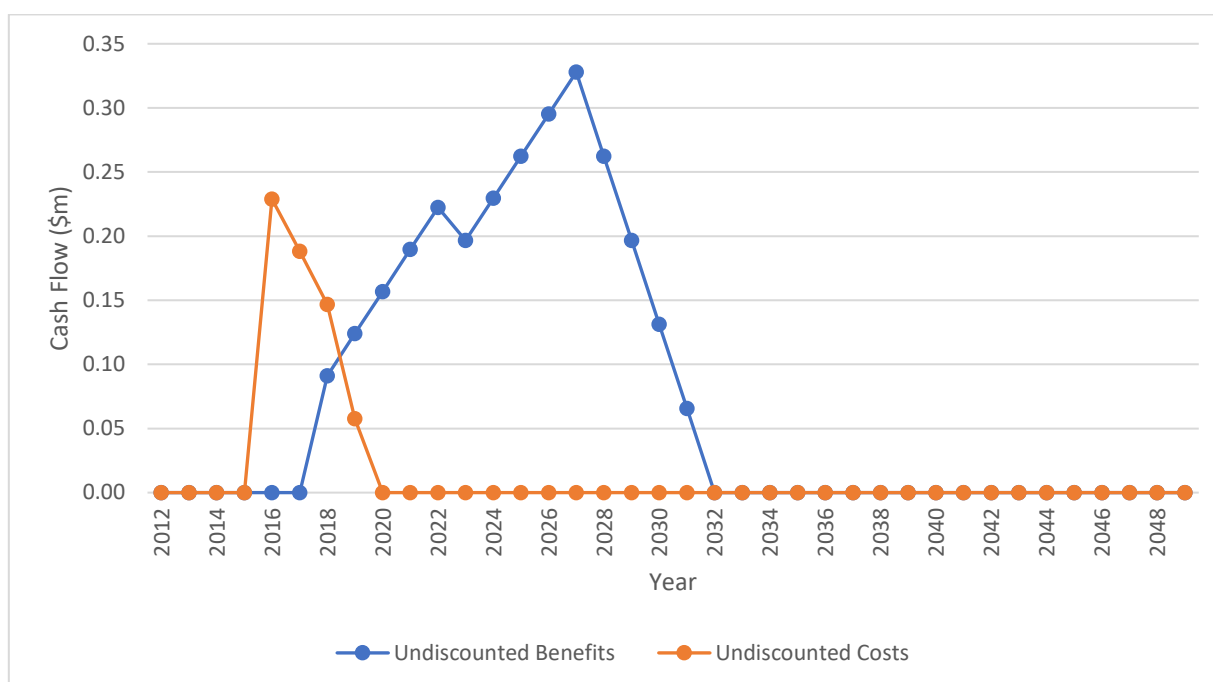
Table 7 shows the investment criteria estimated for different periods of benefit for the total investment. Hort Innovation contributed 100% of project funding, so no other sets of investment criteria were estimated.

Table 7: Investment Criteria for Total Investment in Project BA14012

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.23	1.13	2.09	2.21	2.21	2.21	2.21
Present Value of Costs (\$m)	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Net Present Value (\$m)	-0.49	0.41	1.37	1.49	1.49	1.49	1.49
Benefit-Cost Ratio	0.32	1.57	2.91	3.08	3.08	3.08	3.08
Internal Rate of Return (%)	negative	16.95	25.34	25.70	25.70	25.70	25.70
MIRR (%)	739.93	20.51	20.54	15.22	12.45	10.85	9.82

The annual undiscounted benefit and cost cash flows for the total investment for the duration of BA14012 investment plus 30 years from the last year of investment are shown in Figure 2.

Figure 2: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs



### Contribution of Benefits

Table 8 shows the contribution of each impact to the total Present Value of Benefits (PVB). As noted in Table 6, it was not possible to disaggregate the relative value of the benefits from impacts 1, 2 and 3, therefore the benefits are reported for impacts 1, 2 and 3 together.

Table 8: Contribution to Benefits by Source

Impact	PVB (\$m)	% of Total PVB
Impacts 1, 2 and 3: Maintained productivity (avoided production losses)	1.92	86.8%
Impact 2: Increased efficiency of RD&E resource allocation	0.29	13.2%
Total	2.21	100.0%

### 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. The investment criteria were moderately to highly sensitive to the discount rate. This was largely because the benefits occur into the long-term future and future cash flows are subjected to more significant relative discounting.

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

Investment Criteria	Discount rate		
	0%	5% (base)	10%
Present Value of Benefits (\$m)	2.75	2.21	1.84
Present Value of Costs (\$m)	0.62	0.72	0.83
Net Present Value (\$m)	2.13	1.49	1.01
Benefit-cost ratio	4.43	3.08	2.23

A sensitivity analysis was then undertaken for the reduction in production assumed to occur without the BA14012 investment for Impacts 1, 2 and 3. The results are presented in Table 10 and show a moderate sensitivity to the assumed reduction in production as this assumption was a key driver of the valuation.

Table 10: Sensitivity to Assumed Reduction in Production for Impacts 1, 2 and 3 (Total investment, 30 years)

Investment Criteria	Reduction in production without BA14012		
	1.0%	5.0% (base)	7.5%
Present Value of Benefits (\$m)	0.68	2.21	3.17
Present Value of Costs (\$m)	0.72	0.72	0.72
Net Present Value (\$m)	-0.04	1.49	2.45
Benefit-cost ratio	0.94	3.08	4.41

Finally, a sensitivity analysis was undertaken for the attribution of the benefits from impacts 1, 2 and 3 to the investment in BA14012. The results are presented in Table 11 and show a high sensitivity to the attribution as this was a key assumption in the valuation and the benefits of impacts 1, 2 and 3 combined contribute approximately 96% of the total PVB..

Table 11: Sensitivity to Attribution of Benefits for Impacts 1, 2 and 3 (Total investment, 30 years)

Investment Criteria	Benefits Attributable to BA14012 (Impacts 1, 2 and 3)		
	0.5%	2.0% (base)	5%
Present Value of Benefits (\$m)	1.99	2.21	2.65
Present Value of Costs (\$m)	0.72	0.72	0.72
Net Present Value (\$m)	1.27	1.49	1.93
Benefit-cost ratio	2.77	3.08	3.69

### 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 12). 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 12: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
High	Medium-Low

Coverage of benefits was assessed as High – all four economic impacts were valued; however, three potential environmental and social benefits were not able to be valued within the scope of the current assessment. The environmental and social benefits were considered secondary benefits and were likely small relative to the primary impacts valued.

Confidence in assumptions was rated as Medium-Low. Data used in the analysis were mostly drawn from published and/or credible sources such as Hort Innovation, published scientific journal articles and the ABGC. However, data required to disaggregate the benefits from impacts 1, 2 and 3 was not readily available within the scope of the current assessment and several key assumptions (e.g. magnitude of impact) were analyst estimates and therefore somewhat uncertain.

## Conclusion

The investment in BA14012 has contributed to the successful commencement of a number of coordinated banana RD&E investments delivering useful strategies for the continued containment and management of Panama TR4. The project also has led to enhanced coordination and collaboration between banana industry stakeholders and was instrumental in the establishment of the QBAN transition project to develop and implement a new clean planting materials system for the Australian banana industry. Consequently, BA14012 is likely to have contributed to maintained productivity for some banana producers through avoided production losses and has improved the efficiency of resource allocation for banana RD&E, particularly RD&E associated with Panama TR4.

Total funding from all sources for the project was \$0.72 million (present value terms). The investment produced estimated total expected benefits of \$2.21 million (present value terms). This produced an estimated net present value of \$1.49 million, a benefit-cost ratio of 6.76 to 1, an internal rate of return (IRR) of 25.70% and a modified IRR of 9.82% over 30-years at a discount rate of 5% and a reinvestment rate of 5%.

A number of environmental and social impacts were also identified but not valued as part of the current assessment. Thus, given the impacts not valued, combined with conservative assumptions made for the principal economic impacts valued, it is reasonable to conclude that the investment criteria reported may be an underestimate of the actual performance of the BA14012 investment.

## Glossary of Economic Terms

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

## Reference List

- Australian Bureau of Statistics. (2020, March 4). *5206.0 - Australian National Accounts: National Income, Expenditure and Product, Dec 2019*. Retrieved June 2020, from Australian Bureau of Statistics: <https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Dec%202019?OpenDocument>
- Australian Bureau of Statistics. (various (2011-2020)). *7121.0 Agricultural Commodities, Australia*. Retrieved from Australian Bureau of Statistics: <https://www.abs.gov.au/statistics/industry/agriculture/agricultural-commodities-australia/latest-release>
- Australian Bureau of Statistics. (various (2011-2020)). *7503.0 Value of Agricultural Commodities Produced, Australia*. Retrieved from Australian Bureau of Statistics: <https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia/latest-release>
- Australian Government. (2015). *Science and Research Priorities*. Canberra: Department of Industry, Innovation and Science. Retrieved from [https://www.industry.gov.au/sites/g/files/net3906/f/2018-10/science\\_and\\_research\\_priorities\\_2015.pdf](https://www.industry.gov.au/sites/g/files/net3906/f/2018-10/science_and_research_priorities_2015.pdf)
- Commonwealth of Australia. (2015). *Agricultural Competitiveness White Paper*. Canberra: Commonwealth of Australia. Retrieved from <https://agwhitepaper.agriculture.gov.au/sites/default/files/SiteCollectionDocuments/ag-competitiveness-white-paper.pdf>
- Cook, D. C., Liu, S., Edwards, J., Villalta, O. N., Aurambout, J.-P., Kriticos, D. J., . . . De Barro, P. J. (2013). An assessment of the benefits of yellow Sigatoka (*Mycosphaerella musicola*) control in the Queensland Northern Banana Pest Quarantine Area. *NeoBiota*, *18*, 67-81.
- Council of Rural Research and Development Corporations. (2018). *Cross-RDC Impact Assessment Program: Guidelines*. Canberra ACT: Council of Rural Research and Development Corporations. Retrieved October 2020, from [https://www.ruralrdc.com.au/wp-content/uploads/2018/08/201804\\_RDC-IA-Guidelines-V.2.pdf](https://www.ruralrdc.com.au/wp-content/uploads/2018/08/201804_RDC-IA-Guidelines-V.2.pdf)
- Department of Agriculture and Fisheries. (2020, September 10). *Panama disease*. Retrieved from Queensland Government - Department of Agriculture and Fisheries: <https://www.daf.qld.gov.au/business-priorities/biosecurity/plant/eradication-surveillance-control/panama-disease>
- Horticulture Innovation Australia Ltd. (2017). *Banana Strategic Investment Plan*. Sydney, NSW: Horticulture Innovation Australia Ltd.
- Horticulture Innovation Australia Ltd. (2020). *The Banana Story*. Retrieved September 2020, from Australian Bananas: <https://australianbananas.com.au/Pages/all-about-bananas/the-banana-story>
- Horticulture Innovation Australia Ltd. (various (2017-2020)). *Annual Report*. Sydney NSW: Horticulture Innovation Australia Ltd. Retrieved June 2020, from <https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/company-annual-report/>
- Pegg, K. G., Coates, L. M., O'Neill, W. T., & Turner, D. W. (2019, December 20). The Epidemiology of Fusarium Wilt of Banana. *Frontiers in Plant Science*, *10*, 1-19. Retrieved September 2020, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6933004/pdf/fpls-10-01395.pdf>
- Pinnacle Agribusiness. (2018). *Banana Enterprise Comparison 2016/17*. Sydney NSW: Horticulture Innovation Australia Ltd. Retrieved October 2020, from <https://www.horticulture.com.au/globalassets/laserfiche/assets/project-reports/ba16009/ba16009---final-report-complete.pdf>



## Acknowledgements

AgEconPlus and Agtrans Research would like to thank all the project and program personnel associated with Horticulture Innovation Australia Limited that were involved in the evaluation process. Their cooperation and feedback throughout the evaluation process contributed significantly to this report.

Specific acknowledgments:

Jim Pekin, Chief Executive Officer, Australian Banana Growers' Council  
Brendan O'Keeffe, Analyst, Horticulture Innovation Australia Ltd

## Abbreviations

ABGC	Australian Banana Growers' Council
ABS	Australian Bureau of Statistics
ACIAR	Australian Centre for International Agricultural Research
AL	Almond
BA	Banana
BBTV	Banana Bunchy Top Virus
BQ	Biosecurity Queensland
CRC	Cooperative Research Centre
CRRDC	Council of Rural Research and Development Corporations
CT	Citrus
DAF	Department of Agriculture and Fisheries (Queensland)
Hort Innovation	Horticulture Innovation Australia Ltd
IRR	Internal Rate of Return
MIRR	Modified Internal Rate of Return
NSW	New South Wales
NT	Northern Territory
PVB	Present Value of Benefits
QBAN	Quality Banana Approved Nursery
QLD	Queensland
R&D	Research and Development
RD&E	Research, Development and Extension
RDC	Research and Development Corporation
SIAP	Strategic Investment Advisory Panel
SIP	Strategic Investment Plan
TR4	Panama disease (Fusarium wilt) Tropical Race 4
VN	Onion
WA	Western Australia