

Industry-specific impact assessment program: Banana

Impact assessment report for project *National banana development and extension project* (BA13004)

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Project code:

MT19012

Date:

18 December 2020

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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

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www.horticulture.com.au

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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 project BA13004 titled “*National Banana Development and Extension Project*”. The project was funded by Hort Innovation over the period September 2013 to June 2017.

Methodology

The investment was first analysed qualitatively within a logical framework that included activities and outputs, outcomes and impacts. Actual and/or potential impacts then were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation in monetary terms (quantitative assessment). Past and future cash flows were expressed in 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 BA13004 has produced a better informed banana industry with improved access to information needed to make better decisions for their businesses. The project also contributed to enhanced communication of RD&E project results and sharing of knowledge between all levels of the banana industry, researchers, government and other industry stakeholders and played a key role in supporting activities to improve biosecurity practices given the detection of Fusarium wilt TR4 in 2015. Consequently, BA13004 is likely to have contributed to increased productivity and profitability for some banana producers as well as increased efficiency of resource allocation for future RD&E investments.

Investment Criteria

Total funding from all sources for the project was \$1.96 million (present value terms). The investment produced estimated total expected benefits of \$5.98 million (present value terms). This produced an estimated net present value of \$4.02 million, a benefit-cost ratio of 3.05 to 1, an internal rate of return (IRR) of 53.17% and a modified IRR of 12.26% over 30-years at a discount rate of 5% and a reinvestment rate of 5%.

Conclusions

A number of environmental and social impacts 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 BA13004 investment.

Keywords

Impact assessment, cost-benefit analysis, BA13004, banana, development, extension, national banana development and extension

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 BA13004: *National Banana Development and Extension Project* 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.

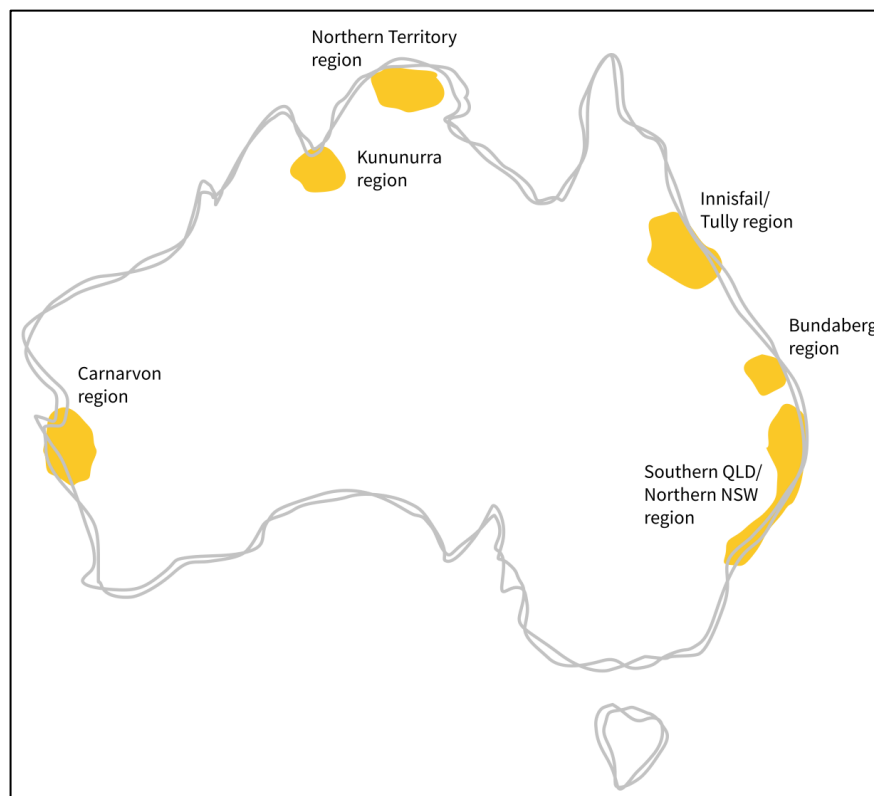
Background & Rationale

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 average¹). 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>

¹ 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)

Australia											
Year ended 30 June	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	10yr Avg.
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 ^(a) (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
QLD											
Year ended 30 June	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	10yr Avg.
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 ^(b) (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.

Rationale

The Australian banana industry includes approximately 388 producers farming across an average area of approximately 12,500 ha each year (ABS, 2019). The industry is spread across three main growing regions: the wet tropics of north-east Queensland (Qld), the humid sub-tropics of the east coast from Bundaberg (Qld) to Nambucca (NSW), and the arid sub-tropics of the west coast based in Carnarvon, Western Australia.

A statutory levy for the banana industry was introduced on 1 July 2008. Bananas that are produced in Australia and sold by a producer attract the levy. The banana levy rate (currently 2.19 cents per kg) comprises Emergency Plant Pest Response (EPPR), marketing, Plant Health Australia (PHA) membership, and research and development (R&D) (Department of Agriculture, Water and the Environment, 2019).

Prior to 2013/14 there was no national extension program to coordinate communication and transfer of knowledge from past, current and future investments in R&D funded by the industry levy. Project BA13004 (*National Banana Development and Extension Project*) was funded to implement a coordinated information development and dissemination program that ensured a focussed and systematic approach to delivering the information and results from industry-funded R&D and other sources.

Project Details

Summary

Project Code: BA13004

Title: *National Banana Development and Extension Project*

Research Organisation: Department of Agriculture and Fisheries Qld²

Principal Investigator: Naomi King (Sept. 2013 to Dec. 2014), Steward Lindsay (Dec. 2014 to Mar. 2015), and Tegan Kukulies (Mar. 2015 to Jun. 2017)

Period of Funding: September 2013 to June 2017

Objectives

The objective of project BA13004 was to implement a coordinated information development and dissemination program that ensured a focussed and systematic approach to delivering information and results from industry-funded R&D and other sources. It was to achieve this by:

1. Developing a project team based on experienced state government extension staff based in the major banana production regions.
2. Working closely with the project reference group to identify the priority actions under the three (3) themes of: farm production & best management practice, farm business & marketing, and supply chain management, as well as identifying the best mix of activities for disseminating the information to relevant industry sectors.
3. Building strong linkages with other key information providers such as consultants, agricultural retailers, banana agents, catchment management groups and working in concert with the Australia Banana Growers' Council (ABGC) communications project.
4. Using a range of extension activities and technologies, including YouTube style videos, to provide relevant information and research results in a timely fashion for a range of banana industry sectors, as well as building an opportunity for these sectors to have input into identifying emerging issues.
5. Conducting a biennial series of technical information updates hosted in the main production centres and focussing on identified national and regionally specific technical issues.

² Formerly the Department of Agriculture, Fisheries and Forestry Qld

Logical Framework

Table 2 briefly describes the activities, outputs, outcomes, and actual and potential impacts of project BA13004 in a logical framework.

Table 2: Logical Framework for Project BA13004

<p>Activities</p>	<p><u>Project Reference Group</u></p> <ul style="list-style-type: none"> • A Project Reference Group (PRG) was established at the commencement of the project to provide on-going support and to help steer the direction of the project. The PRG was responsible for setting the priority development and extension topics for the project along with providing guidance on the strategies for delivery. • The PRG also provided guidance on effective monitoring and evaluation (M&E) techniques, assessed project outputs against requirements and provided evaluation and guidance at the project’s mid-term review conducted in June 2015. <p><u>Development of linkages and networks with key information providers in the banana industry</u></p> <ul style="list-style-type: none"> • <i>Banana grower associations groups:</i> There are two groups in north Qld, the Cassowary Coast Banana Growers’ Association (Tully – Innisfail) and the Mareeba and District Banana Growers’ Association, and three groups in the sub-tropics, the Coffs Harbour Banana Growers’ Association, Nambucca Banana Growers’ Association, and the Tweed/Richmond Banana Growers’ Association. • Members of the project team regularly attended Growers’ Association meetings to keep growers updated on activities in the project and to receive feedback on emerging issues. • <i>Key supply chain member visits:</i> Relationships were built, and regular communication was maintained, with key market suppliers Costa’s, Mackays Marketing, Nutrano, and LaManna. • Throughout the project, extension staff welcomed visits from supply chain personnel when they travelled to north Qld. • Project team members also strengthened relationships with members of the banana supply chain with a visit to Melbourne (ripening facilities and markets) in March 2016 and a visit to a ripening and distribution facility in NSW (Golden Dawn) in conjunction with the 2016 Roadshows. • Facilitating strong networks and linkages with supply chain businesses was a high priority objective of the project to improve communication between growers, R&D providers, and banana supply chain personnel. • <i>NextGen young banana growers’ group:</i> The NextGen group was established at the beginning of project BA13004 and included young growers (typically under 40 years of age) that were proactive, positive, and willing to be innovative and share their experiences. • The project facilitated two to three group meetings each year and also managed logistics for the group to participate in activities. • <i>Service providers:</i> The Banana Agribusiness Managers (BAGMan) group was chaired by the BA13004 project leader. The group is made up of consultants, resellers, agronomists, and service providers in north Qld and was used to communicate the latest R&D updates, discuss topical events, and identify emerging issues. • <i>ABGC:</i> Regular communication was maintained with the ABGC as the banana peak industry body, particularly with the ABGC communications team, the R&D manager, and the industry strategy manager. <p><u>National Banana Roadshow Series</u></p> <ul style="list-style-type: none"> • The flagship activity of project BA13004 was a biennial series of technical information updates (commonly referred to as the ‘Banana Industry Roadshows’) that were hosted in six locations around Australia in 2014 and 2016.
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- The Roadshows were held in alternating biennial years to the Australian Banana Congress and were presented in Innisfail (Qld), Walkamin/Mareeba (Qld), Tully (Qld), Coffs Harbour (NSW), Murwillumbah (NSW) and Carnarvon (WA).
- The one day events showcased the latest information on farm production, environmental practices, farm business management, marketing, Panama disease Tropical Race 4 (TR4), and supply chain management.
- Each event consisted of national information consistent across all production regions as well as information tailored for specific regional priorities.

Demonstration sites

- Four demonstration trials were established on two grower's properties in north Qld and two in NSW.
- The two sites in NSW focussed on management of nematodes and soil health.
- Of the two sites in Qld, one focussed on investigating different soil amendments while the other looked at variety options that may have some level of tolerance to TR4.
- Both of the Qld demonstration sites were closed early due to the biosecurity risk associated with detection of TR4 at a farm at Tully in 2015.

Innovation trials

- A six month extension to project BA13004 enabled the scoping of five innovative practices/activities (four in north Qld, one in NSW). The concepts of the practices then were derived and prioritised from the NextGen group, the Cassowary Coast Banana Growers' Association, and the PRG.
- Five small-scale field trials then were conducted at the South Johnstone research station. The trials investigated:
 - 1) Use of Gibberellic Acid (GA) in desuckering,
 - 2) Novel nitrogen application,
 - 3) Chemical removal of banana flower remnants,
 - 4) Use of RFID (radio frequency identification) technology for yield mapping, and
 - 5) Bagging trial (NSW).

Banana Best Management Practices (BMPs) Environmental Guidelines

- Group grower BMP training was held using an online system.
- The BA13004 project leader trained the ABGC extension staff on how to use the online training system and how to step growers through the process.
- A review of the Environmental BMP was conducted in 2016. The PRG that guided development of the BMP resource was consulted to determine and confirm changes to the content.
- Engagement with other stakeholders, including Freshcare, researchers involved in recent R&D, Coles, Woolworths, and Aldi, also was undertaken to ensure the resources ongoing alignment with current and potentially emerging systems and to ensure that the latest R&D outputs were updated.

Field walks/workshops

- A workshop was held in November of 2014 at the South Johnstone research station. The workshop covered topics including mites and their control, fungicide resistance, and varieties.
- Another series of workshops was conducted between May and August 2015 following the detection of TR4 in Tully. The workshops formed part of a coordinated extension program developed in conjunction with the ABGC and were intended to rapidly educate growers about the disease and guide them to implement effective on-farm biosecurity practices.
- A 'Panama Field Day' took place as part of the ABGC led on-farm biosecurity project. The field day was run with input from BA13004 team members and helped to bring growers and industry stakeholders up to date with the RD&E activities conducted in the eight months following detection of TR4 in Australia and to provide insights into future research on the disease.

	<ul style="list-style-type: none"> • Project BA13004 also was responsible for grower practice video sessions that included five short videos to ‘bring the farm’ to the Panama field day. • The project leader travelled to a field day held on 17 February 2016 in Burringbar (NSW) that was hosted by the NSW Department of Primary Industries to give a presentation about the principles of on-farm biosecurity. • A condensed workshop was delivered to growers in Coffs Harbour on 4 May 2016. • An interactive field day (the Panama R&D Open Day) was held at the South Johnstone research station on 12 May 2017 to present the latest TR4 related R&D. This field day was the first event held in the paddock since before the detection of TR4 in 2015. Thus, a large effort went into implementing and demonstrating strict on-farm biosecurity practices. • A number of articles were written and published in industry magazines, e-bulletins, and newsletters. • Seven fact sheets also were produced and published on the ABGC website. An additional five fact sheets were given to attendees at the Panama R&D Open Day. • A needs analysis for an electronic industry-specific database was conducted with a representative sample of key industry stakeholder groups within the Australian banana industry.
<p>Outputs</p>	<ul style="list-style-type: none"> • The PRG met six times throughout the project. Two meetings were face-to-face, the other four were via teleconference. These meetings successfully helped steer the direction of the project. • Project team members attended a total of 63 Grower Association group meetings. • Project members also participated in visits to the Melbourne Markets and a ripening facility (Costa’s) in March 2016. Further, during the 2016 Roadshow, team members visited a ripening and distribution business in Coffs Harbour (Golden Daw). These visits strengthened relationships with these supply chain members and resulted in them informing project staff of uncharacteristic post-harvest issues as they arose. • Supply chain relationships also were strengthened with key members of Mackays Marketing, LaManna, and Nutrano who also provided feedback to project members. • The NextGen young banana growers group met on at least 10 occasions throughout the project and there were four key activities in which the group participated. • The BAGMan group, chaired by the BA13004 project leader, met seven times throughout the project. • Six national Banana Industry Roadshow events were successfully delivered in 2014 and 2016. In total 117 and 147 growers and industry stakeholders (excluding researchers) attended the 2014 and 2016 Roadshows respectively. • A 20-page booklet summarising all the banana research projects (including those funded from sources other than Hort Innovation) was produced and distributed at the 2016 Roadshows. • Four demonstration sites provided information on areas of interest to growers and findings were reported through the project’s networks. • Five innovation trials were successfully conducted and findings were reported to industry and stakeholders. • Prior to the commencement of project BA13004, management of 3,742 ha had completed the online BMP training. During the project, eight workshops were conducted with 51 farms (covering an area of 3,085 ha). This took the total area operating under BMP to more than 50% of the total banana production area. • Banana field walks and workshops were successfully held throughout the project. A total of 157 growers and farm managers attended the Panama disease TR4 workshops between May and August 2015, 140 growers and other stakeholders also attended the Panama field day in November 2015, and 109 people attended the Panama R&D Open Day in May 2017. • 37 articles, five case studies and grower testimonials, and 12 factsheets were published and disseminated to industry.

	<ul style="list-style-type: none"> • 17 videos were produced and published on the ABGC website in lieu of personal presentations at field days and seminars. The videos have collectively been viewed over 8,675 times.
<p>Outcomes</p>	<p>Key outcomes of the project include:</p> <ul style="list-style-type: none"> • A better-informed banana industry with improved access to the information needed to make better decisions for grower businesses. • Enhanced communication of RD&E project results and sharing of knowledge and information of technical developments, with all levels of the banana industry and other industry stakeholders. • Improved coordination of information and knowledge generation that creates linkages between related RD&E projects. • More rapid and appropriate adoption of key research outputs. • Improved opportunity for key industry sectors to identify emerging issues. • Improved communication and networking between key information providers in the banana industry. • Improved identification of Australian banana industry information gaps and therefore improved RD&E investment priority setting. • Improved management of pest and diseases, specifically soil borne diseases such as Panama disease. • Improved soil management practices that minimise off site impacts and improve productivity. • The project also played a key role in supporting activities to improve grower knowledge about Panama disease (<i>Fusarium wilt</i> TR4) and facilitating the adoption of on-farm biosecurity practices following the detection of Panama disease in the main growing region in Tully, north Qld.
<p>Impacts</p>	<ul style="list-style-type: none"> • Increased productivity and/or profitability for some Australian banana growers. This impact will be driven by: <ul style="list-style-type: none"> ○ More rapid and appropriate adoption of RD&E outputs, ○ Improved on-farm decision making through a better informed and more connected banana industry, ○ Improved on-farm management practices through increased adoption of BMPs, and ○ Increased linkages and enhanced relationships between banana supply chain participants potentially leading to supply chain efficiencies and/or earlier identification of industry issues/emerging issues. • Reduced risk associated with the incursion, spread and/or establishment of key banana pests and diseases such as <i>Fusarium wilt</i> TR4 as a result of improved biosecurity (understanding and practices). • Improved efficiency of resource allocation for banana RD&E through improved coordination and communication of RD&E project results, better information sharing, earlier identification of information gaps and emerging issues, and improved RD&E priority setting. • Potentially, some contribution to improved environmental outcomes such as reduced nutrient or chemical export off-farm through increased adoption of BMPs and other improved farm management practices. • Increased researcher and industry capacity achieved through training and knowledge sharing. • Potentially, some contribution to maintained or enhanced social licence to operate for some banana producers through increased adoption of Environmental BMPs and other improved on-farm management practices (e.g. soil management). • Potentially, increased regional community wellbeing through spill-over benefits from a more productive and profitable banana industry.

Project Investment

Nominal Investment

Table 3 shows the estimated annual investment (cash and in-kind) in project BA13004 by Hort Innovation and DAF.

Table 3: Annual Investment in the Project BA13004 (nominal \$)

Year ended 30 June	Hort Innovation (\$)	DAF (\$)	Total (\$)
2014	151,542	189,301	340,843
2015	151,542	189,302	340,844
2016	151,542	189,301	340,843
2017	126,869	189,302	316,171
Totals	581,495	757,206	1,338,701

Source: BA13004 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.

For the investment by DAF, it was assumed that management and administration costs already were built into the cost figures shown in Table 3.

Real Investment and Extension Costs

For the purposes of the investment analysis, investment costs of all parties 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 funded as an extension type project and included a high level of communication with industry and other key banana industry stakeholders.

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 BA13004

Economic	<ul style="list-style-type: none"> • Increased productivity and/or profitability for some Australian banana growers. This impact will be driven by: <ul style="list-style-type: none"> ○ More rapid and appropriate adoption of RD&E outputs, ○ Improved on-farm decision making through a better informed and more connected banana industry, ○ Improved on-farm management practices through increased adoption of BMPs, and ○ Increased linkages and enhanced relationships between banana supply chain participants potentially leading to supply chain efficiencies and/or earlier identification of industry issues/emerging issues. • Reduced risk associated with the incursion, spread and/or establishment of key banana pests and diseases such as <i>Fusarium wilt</i> TR4 as a result of improved biosecurity (understanding and practices). • Improved efficiency of resource allocation for banana RD&E through improved coordination and communication of RD&E project results, better information sharing, earlier identification of information gaps and emerging issues, and improved RD&E priority setting.
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Environmental	<ul style="list-style-type: none"> Potentially, some contribution to improved environmental outcomes such as reduced nutrient or chemical export off-farm through increased adoption of BMPs and other improved farm management practices.
Social	<ul style="list-style-type: none"> Increased researcher and industry capacity achieved through training and knowledge sharing. Potentially, some contribution to maintained or enhanced social licence to operate for some banana producers through increased adoption of Environmental BMPs and other improved on-farm management practices (e.g. soil management). Potentially, increased regional community wellbeing through spill-over benefits from a more productive and profitable banana industry.

Public versus Private Impacts

The impacts identified in this evaluation are both private and public in nature. Private benefits are likely to be realised by Australian banana growers through increased productivity and profitability driven by improved on-farm decision making and practices, other supply chain efficiencies, improved resource allocation for industry funded RD&E, as well as maintained or enhanced social licence to operate.

Public benefits also may occur and include increased efficiency of resource allocation for RD&E funded by government, potentially improved environmental outcomes, increased scientific capacity and increased regional community wellbeing as a result of a more productive and profitable banana industry.

Distribution of Private Impacts

The impacts from investment in project BA13004 will be shared along the banana supply chains with input suppliers, growers, processors, transporters, wholesalers, retailers and consumers all sharing impacts produced by the project according to relevant short- and long-term supply and demand elasticities.

Impacts on Other Australian Industries

No direct impacts on industries other than the Australian banana industry were identified.

Impacts Overseas

No significant impacts for countries outside of Australia were identified.

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 Priority 4, with some contribution to Priorities 2 and 3, 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	1. Food
2. Biosecurity	2. Soil and Water
3. Soil, water and managing natural resources	3. Transport
4. Adoption of R&D	4. Cybersecurity
	5. Energy
	6. Resources
	7. Advanced Manufacturing
	8. Environmental Change
	9. Health

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

Alignment with the Banana Strategic Investment Plan 2017-2021

The current strategic outcomes and strategies of the banana industry are outlined in the Banana Strategic Investment Plan 2017-2021³ (2017). Project BA13004 addressed Outcome 2 (Strategies 2.1 to 2.4) with some contribution to Outcome 4 (Strategies 4.1 and 4.3).

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.

Two economic impacts were valued. First was increased productivity/ profitability for a proportion of Australian banana producers. Second was increased efficiency of resource allocation for banana industry RD&E investments.

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 BA13004 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 such as reduced nutrient or chemical export off-farm through increased adoption of BMPs and other improved farm management practices.

The social impacts identified but not valued were:

- Increased researcher and industry capacity achieved through training and knowledge sharing.
- Potentially, some contribution to maintained or enhanced social licence to operate for some banana producers through increased adoption of Environmental BMPs and other improved on-farm management practices (e.g. soil management).
- Potentially, increased regional community wellbeing through spill-over benefits from a more productive and profitable banana industry.

Valuation of Impact 1: Increased productivity/profitability for some Australian banana producers

The investment in BA13004 is likely to have resulted in more rapid and appropriate adoption of RD&E outputs, improved on-farm decision making, improved on-farm management practices through increased adoption of BMPs, reduced risk associated with incursion, spread and/or establishment of key banana pests and diseases from improved biosecurity, and enhanced relationships between banana supply chain participants. This range of positive factors is assumed to contribute to increased average net returns for a proportion of the Australian banana industry.

Specific assumptions for the valuation of Impact 1 are described in Table 6.

Attribution

Banana industry productivity and profitability improvements may be driven by a wide variety of factors including outputs of RD&E investments. However, as the first national extension program to coordinate communication and transfer of knowledge from investments in R&D funded by the banana industry levy, it was assumed that 100% of the estimated benefits were attributable to the investment in BA13004.

Counterfactual

³ For further information, see: <https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/strategic-investment-plans/>

It was assumed that the estimated benefits would not have occurred without the investment in BA13004.

Valuation of Impact 2: Increased efficiency of resource allocation for banana RD&E

The investment in BA13004 contributed to improved coordination and communication of RD&E project results, better information sharing, earlier identification of information gaps and emerging issues, and improved RD&E priority setting. It was therefore assumed that BA13004 was likely to have 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 BA13004 contributed to a 5.0% efficiency dividend for the period 2015/16 to 2024/25.

Specific assumptions for the valuation of Impact 2 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 BA13004.

Counterfactual

It was assumed that, without the BA13004 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
Key Baseline Data		
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 estimate based on the average net return to grower after marketing and ripening costs reported in the Banana Enterprise Comparison Reports published 2014, 2015 and 2018 (Pinnacle Agribusiness, 2018).
Impact 1: Increase productivity/profitability for some Australian banana growers		
Valuation Assumptions		
First year of impact	2014/15	Second year of BA13004 activities
Year of maximum impact	2016/17	Last year of BA13004
Period of maximum impact and last year of impact	5 years at maximum, declining linearly to zero by 2023/24	Analyst assumption – assumes no further investment and allows for the potential for dis-adoption of practices that may have contributed to productivity/profitability impacts driven by BA13004

Proportion of Australian banana production area impacted	25%	Analyst estimate – based on approximately one third of the north QLD production region that represents approximately 80% of total Australian production
Increase in average net grower returns	1.0%	Analyst estimate – conservative estimate of the contribution of extension
Risk Factors and Other Variables		
Probability of output	100%	Analyst assumption, based on successful completion of BA13004
Probability of outcome	60%	Analyst assumption, refers to the probability that the applicable area of potential impact assumed above occurs
Probability of impact	80%	Analyst assumption, allows for exogenous factors that may affect realisation of impact
Attribution of benefits to investment in BA13004	100%	See ‘valuation of impacts 1’ above
Impact 2: Increased efficiency of resource allocation for banana RD&E		
Valuation Assumptions		
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	5.0%	Analyst assumption
First year of impact	2015/16	Analyst estimate – based on influence of outputs of project BA13004 from year three of the investment
Period of efficiency dividend	10 years (to 2024/25)	Analyst assumption
Risk Factors and Other Variables		
Probability of output	100%	Analyst assumption, based on successful completion of BA13004
Probability of outcome	100%	Analyst assumption, based on anecdotal evidence of Hort Innovation’s commitment to continuous improvement of 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 BA13004	100%	See ‘valuation of impact 2’ 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 (2016/17) 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. Table 8 shows the investment criteria estimated for different periods for the Hort Innovation investment only. The present value of benefits (PVB) for Hort Innovation was estimated by multiplying the total PVB by the proportion of Hort Innovation investment in project BA13004 (47.2%).

Table 7: Investment Criteria for Total Investment in Project BA13004

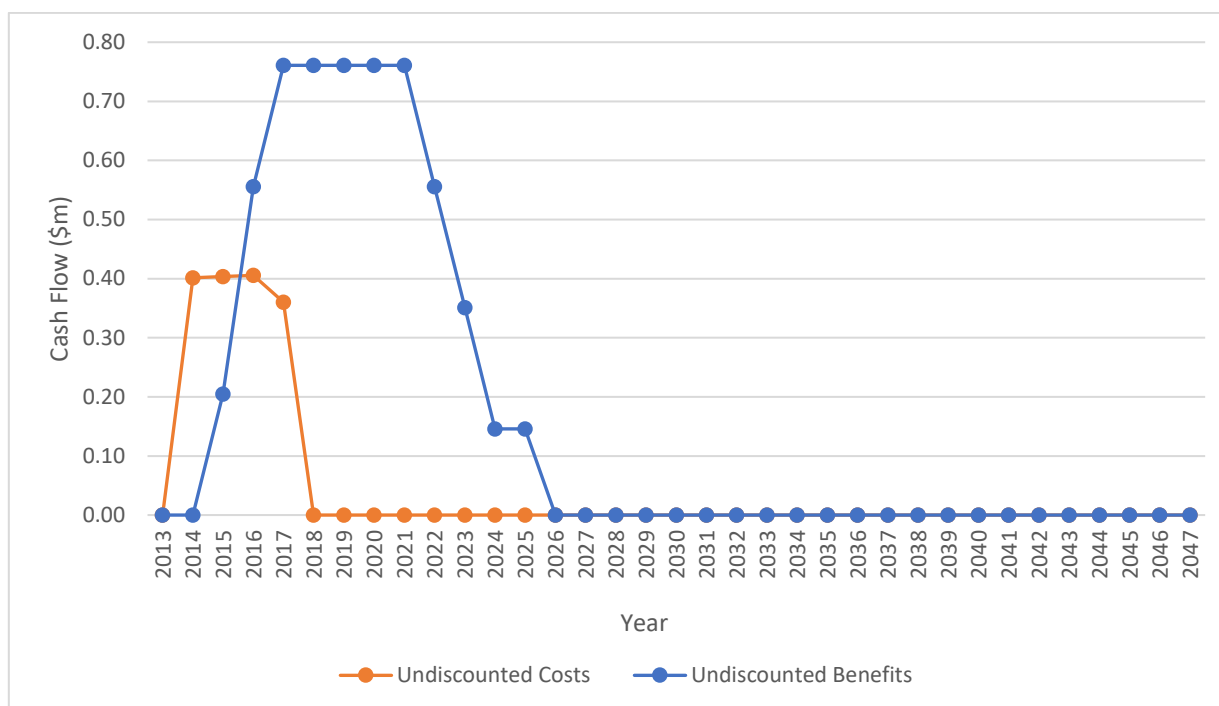
Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	1.82	5.45	5.98	5.98	5.98	5.98	5.98
Present Value of Costs (\$m)	1.96	1.96	1.96	1.96	1.96	1.96	1.96
Net Present Value (\$m)	-0.14	3.48	4.02	4.02	4.02	4.02	4.02
Benefit-Cost Ratio	0.93	2.77	3.05	3.05	3.05	3.05	3.05
Internal Rate of Return (%)	negative	52.38	53.17	53.17	53.17	53.17	53.17
MIRR (%)	12.30	144.09	35.90	22.05	16.77	13.98	12.26

Table 8: Investment Criteria for Hort Innovation Investment in Project BA13004

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	0.86	2.57	2.82	2.82	2.82	2.82	2.82
Present Value of Costs (\$m)	1.96	0.93	0.93	0.93	0.93	0.93	0.93
Net Present Value (\$m)	-1.10	1.64	1.90	1.90	1.90	1.90	1.90
Benefit-Cost Ratio	0.44	2.77	3.04	3.04	3.04	3.04	3.04
Internal Rate of Return (%)	negative	51.64	52.44	52.44	52.44	52.44	52.44
MIRR (%)	12.24	141.22	35.43	21.80	16.60	13.86	12.16

The annual undiscounted benefit and cost cash flows for the total investment for the duration of BA13004 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 9 shows the contribution of each impact to the total Present Value of Benefits (PVB).

Table 9: Contribution to Benefits by Source

Impact	PVB (\$m)	% of Total PVB
Impact 1: Increased productivity/ profitability	4.54	76.0
Impact 2: Increased resource efficiency for banana RD&E	1.44	24.0
Total	5.98	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 10 present the results. The investment criteria showed a low sensitivity to the discount rate. This was because the benefit and cost cash flows occur in the short- to medium-term future and therefore are subjected to less significant relative discounting.

Table 10: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	Discount rate		
	0%	5% (base)	10%
Present Value of Benefits (\$m)	5.76	5.98	6.28
Present Value of Costs (\$m)	1.57	1.96	2.43
Net Present Value (\$m)	4.19	4.02	3.85
Benefit-cost ratio	3.67	3.05	2.58

A sensitivity analysis was then undertaken for the banana production area assumed to accrue productivity/profitability impacts. The results are presented in Table 11 and show a moderate sensitivity to the assumed banana production area. This was expected as the applicable production area was a key driver of the economic model.

Table 11: Sensitivity to Assumed Area of Banana Production Impacted
(Total investment, 30 years)

Investment Criteria	Assumed banana production area impacted		
	10%	25% (base)	40%
Present Value of Benefits (\$m)	3.26	5.98	8.71
Present Value of Costs (\$m)	1.96	1.96	1.96
Net Present Value (\$m)	1.29	4.02	6.75
Benefit-cost ratio	1.66	3.05	4.44

Finally, a sensitivity analysis was undertaken for the increase in net returns to growers attributable to BA13004. The results are presented in Table 12 and show a moderate to high sensitivity to the assumed increase in net returns. A break-even analysis indicated that, with all other variables held at their base values, the investment criteria remain positive with an assumed increase in net returns to growers of just 0.12%.

Table 12: Sensitivity to Assumed Increase in Net Returns to Growers
(Total investment, 30 years)

Investment Criteria	Increase in net returns to growers		
	0.5%	1.0% (base)	2.5%
Present Value of Benefits (\$m)	3.71	5.98	12.80
Present Value of Costs (\$m)	1.96	1.96	1.96
Net Present Value (\$m)	1.75	4.02	10.84
Benefit-cost ratio	1.89	3.05	6.52

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 13). 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 13: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
Medium-High	Medium

Coverage of benefits was assessed as Medium-High – the two primary 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. Data used in the analysis were mostly drawn from published and/or credible sources such as Hort Innovation, published scientific journal articles, the ABS and the ABGC. However, the level of adoption over time, the counterfactual and a number of assumptions associated with the magnitude of the likely change in a variable were analyst assumptions and are therefore somewhat uncertain.

Conclusion

The investment in BA13004 has produced a better informed banana industry with improved access to information needed to make better decisions for their businesses. The project also contributed to enhanced communication of RD&E project results and sharing of knowledge between all levels of the banana industry, researchers, government and other industry stakeholders and played a key role in supporting activities to improve biosecurity practices given the detection of *Fusarium wilt TR4* in 2015. Consequently, BA13004 is likely to have contributed to increased productivity and profitability for some banana producers as well as increased efficiency of resource allocation for future RD&E investments.

Total funding from all sources for the project was \$1.96 million (present value terms). The investment produced estimated total expected benefits of \$5.98 million (present value terms). This produced an estimated net present value of \$4.02 million, a benefit-cost ratio of 3.05 to 1, an internal rate of return (IRR) of 53.17% and a modified IRR of 12.26% 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 BA13004 investment.

Glossary of Economic Terms

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

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Acknowledgements

AgEconPlus and Agrtrans 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:

Brendan O’Keeffe, Analyst, Horticulture Innovation Australia Ltd

Abbreviations

ABGC	Australian Banana Growers' Council
ABS	Australian Bureau of Statistics
AL	Almond
BA	Banana
BMP	Best Management Practice
CRC	Cooperative Research Centre
CRRDC	Council of Rural Research and Development Corporations
CT	Citrus
DAF	Department of Agriculture and Fisheries Queensland
EPPR	Emergency Plant Pest Response
Hort Innovation	Horticulture Innovation Australia Ltd
IRR	Internal Rate of Return
M&E	Monitoring and Evaluation
MIRR	Modified Internal Rate of Return
NSW	New South Wales
NT	Northern Territory
PHA	Plant Health Australia
PVB	Present Value of Benefits
PVC	Present Value of Costs
QLD	Queensland
R&D	Research and Development
RD&E	Research, Development and Extension
RDC	Research and Development Corporation
SIP	Strategic Investment Plan
TR4	Fusarium Wilt (also known as Panama Disease) Tropical Race 4
VN	Onion
WA	Western Australia