

Final Report

Economic impact assessment for Hort Frontiers: An evaluation of *Australian protected cropping RD&E strategy 2030* (AS19005)

Project leader:

Michael Clarke

Delivery partner:

AgEconPlus

Project code:

HA20000

Project:

Economic impact assessment for Hort Frontiers (HA20000)

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 across industry research and development levies 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

© Copyright 2023 Horticulture Innovation Australia

Contents

| | |
|---------------------------------|----|
| Public summary | 5 |
| Technical summary | 6 |
| Keywords | 7 |
| Introduction | 8 |
| Methodology | 9 |
| Background and Rationale..... | 10 |
| Project Details..... | 11 |
| Project Investment | 13 |
| Impacts | 14 |
| Case Study | 16 |
| Valuation of Impacts..... | 18 |
| Results | 20 |
| Conclusions..... | 23 |
| Recommendations..... | 24 |
| References | 25 |
| Acknowledgements | 26 |
| Abbreviations and Acronyms..... | 26 |
| Glossary of Economic Terms..... | 27 |

List of Tables

| | |
|--|----|
| Table 1: Hort Frontiers Project Sample for Impact Assessment | 8 |
| Table 2: Logical Framework for Project AS19005 | 11 |
| Table 3: Annual Investment in Project AS19005 (nominal \$) | 13 |
| Table 4: Triple Bottom Line Categories of Principal Impacts from Project AS19005..... | 14 |
| Table 5: Australian Government Research Priorities..... | 15 |
| Table 6: Summary of Assumptions for Impact Valuation | 19 |
| Table 7: Investment Criteria for Total Investment in Project AS19005 | 20 |
| Table 8: Sensitivity to Discount Rate (Total investment, 30 years) | 21 |
| Table 9: Sensitivity to Value of RD&E Projects Guided by the AS19005 Strategy (Total investment, 30 years) | 21 |
| Table 10: Sensitivity to Efficiency Dividend Delivered by AS19005 Strategy (Total investment, 30 years)..... | 21 |
| Table 11: Confidence in Analysis of Project..... | 22 |

List of Figures

| | |
|--|----|
| Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs | 20 |
|--|----|

Public summary

Hort Frontiers invests funds from a wide range of co-investors including businesses, research agencies, government departments, education institutions, the Australian Government and horticulture levies. Economic impact assessment of these investments is required to meet Hort Innovation obligations under its Organisational Evaluation Framework, its Statutory Funding Agreement, and to demonstrate a return to a diverse set of co-investors and other stakeholders.

This economic impact assessment of the Hort Frontiers program addresses these requirements through the completion of a series of project-specific, ex-post, independent impact assessments of the program. The economic impact assessment was completed using guidelines prepared by the Council of Rural Research and Development Corporations (CRRDC 2018).

The project assessed in this impact assessment was *AS19005: Australian Protected Cropping Strategy 2030*. The Hort Frontiers project has delivered an Australian protected cropping RD&E strategy for the period through to 2030. The strategy's goal is to enhance the profitability of vegetable, berry, nursery, and tree fruit value chains. It will do this through 1) the development of markets, 2) increasing capacity, and 3) optimising technology. The strategy has already been used to inform a number of Hort Innovation investments.

Technical summary

This report presents the results of an impact assessment of a Hort Frontiers Advanced Production Systems Fund project *AS19005: Australian Protected Cropping RD&E Strategy 2030*. The project was funded by Hort Innovation over the period June 2020 to June 2021.

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 2021/22-dollar terms and were discounted to the year 2022/23 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).

The project (AS19005) has delivered an Australian protected cropping RD&E strategy for the period through to 2030. The strategy's goal is to enhance the profitability of vegetable, berry, nursery, and tree fruit value chains. It will do this through 1) the development of markets, 2) increasing capacity, and 3) optimising technology. The strategy has already been used to inform a number of Hort Innovation investments.

Total funding from all sources for the project was \$0.18 million (present value terms). The investment produced estimated total expected benefits of \$0.39 million (present value terms). This gave a net present value of \$0.20 million, an estimated benefit-cost ratio of 2.1 to 1, an internal rate of return of 28.4% and a modified internal rate of return of 7.7%.

Investment returns may be underestimated given that one economic and two social benefits were not quantified.

Keywords

Impact assessment, cost-benefit analysis, protected cropping, RD&E, strategy, vegetable, berry, melon, nursery, tree fruit, apples, cherry, peaches, plums, nectarines.

Introduction

The Hort Frontiers program facilitates collaborative cross-industry investments that are focused on high-risk, transformative research, development, and extension (RD&E) with the potential for significant impact. Investments are longer-term, complex, and focus on traditionally underinvested themes.

Hort Frontiers invests funds from a wide range of co-investors including businesses, research agencies, government departments, education institutions, the Australian Government and horticulture levies. Economic impact assessment of these investments is required to meet Hort Innovation obligations under its Organisational Evaluation Framework, its Statutory Funding Agreement, and to demonstrate a return to a diverse set of co-investors and other stakeholders.

This economic impact assessment of the Hort Frontiers program addresses these requirements through the completion of a series of project-specific, ex-post, independent impact assessments of the program. A total of eight (8) RD&E investments (projects) were selected through a stratified, random sampling process. The projects, and the total life-of-project (LOP) value of their Hort Innovation managed investment in nominal terms are described in Table 1.

Table 1: Hort Frontiers Project Sample for Impact Assessment

| Hort Frontiers Fund | Project Code | Project Title | Total LOP Investment ^(a) (nominal \$) |
|---------------------------------|--------------|--|--|
| Advanced Production Systems | AS19005 | Australian Protected Cropping RD&E Strategy 2030 | 140,322 |
| Fruit Fly | HG14033 | SITplus: Raising Qfly Sterile Insect Technique to World Standard | 20,502,806 |
| Green Cities | GC15002 | Which plant where when and why database | 10,573,638 |
| Health, Nutrition & Food Safety | AS19005 | Innovative Cold Plasma for Horticultural Industries | 5,080,321 |
| International Markets | AM15007 | Market Development Program - Almonds | 925,499 |
| International Markets | AM17001 | Developing a national systems approach for meeting bio-security requirements to access key Asian markets | 4,830,614 |
| Leadership | LP15001 | Global Masterclass Horticulture | 3,235,805 |
| Pollination | AS19005 | Securing pollination for productive agriculture: guidelines for effective pollinator management and stakeholder adoption | 2,182,967 |

(a) Hort Innovation managed investment

The project population for each fund from which the random sample was selected included completed projects where a final deliverable had been submitted and accepted in the three-year period from 1 July 2019 to 30 June 2022.

The projects in the random sample were selected such that:

- (1) The total LOP sample value (in nominal dollar terms) represented at least 10% of the total Hort Innovation managed investment in the overall Hort Frontiers project population, and
- (2) The total Hort Innovation managed investment in each project was greater than, or equal to, \$100,000 (to exclude 'trivial' projects).

Further, the random sample was stratified first by Hort Frontiers Fund, to ensure all relevant Funds were represented, and then by LOP value range.

The final stratified random sample shown in Table 1 included the required eight (8) projects. At least one project from each Hort Frontiers Fund was selected and at least one project from each LOP range (as defined by Hort Innovation). The final random sample had a total nominal LOP value of \$47.47 million (Hort Managed investment) equivalent to approximately 51.6% of the overall total nominal LOP value in the population. Also, the final random sample included one project completed in 2019/20, two completed in 2020/21, and five completed in 2021/22 (all relevant years represented).

Project AS19005: *Australian Protected Cropping RD&E Strategy 2030* was one of the investments randomly selected and is analysed in this report.

Methodology

The impact assessments followed general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres, State Departments of Agriculture, and some universities. The approach includes both qualitative and quantitative assessment components that are in accord with the impact assessment guidelines of the Council of Rural Research and Development Corporations (CRRDC) (CRRDC, 2018).

The evaluation process followed an input to impact continuum and involved identifying and briefly describing project objectives, activities, outputs, actual and expected outcomes, and any actual and/or potential impacts associated with project outcomes. The principal economic, environmental, and social impacts then were summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were then valued in monetary terms. The decision to value an impact identified was based on:

- Data availability and information necessary to form credible valuation assumptions,
- The complexity of the relevant valuation methods applicable given project resources,
- The likely magnitude of the impact and/or the expected relative value of the impact compared to other impacts identified, and
- The strength of the linkages between the RD&E investment and the impact identified.

Where impact valuation was exercised, the impact assessment used cost-benefit analysis (CBA) as a principal tool. 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 the individual investment evaluated are likely to represent an underestimate of the true performance of the investment.

Background and Rationale

Funding from the Hort Frontiers Advanced Production Systems Fund was used to support the project *AS19005: Australian Protected Cropping Research, Development and Extension (RD&E) Strategy 2030*¹.

Protected Cropping (PC) typically involves the growing of crops under a structure such as a fully enclosed room, glasshouse, greenhouse, poly-tunnel, shade house or screen house. PC can take many forms and integrate a range of technology levels. It should be cost effective and “fit-for-purpose”. PC systems combine technology and agronomic practices to address climate variability, crop biology and market opportunity.

PC is used to grow high yielding crops of consistent quality. Compared to field production, crops grown with PC can have marketable yields 5 to 10 times greater per unit of cropped area, with increased efficiencies in the use of irrigation water and fertilizer per unit of marketable weight. The supply season can be better planned, and it can be extended, providing an increased level of assurance to buyers and consumers. PC is often adopted to access markets with specific supply schedules for novel or differentiated commodities. Most commonly, PC is used to produce vegetables, berries, nursery (including cut flowers), and some tree fruit (apples, cherries, peaches, plums, and nectarines).

PC also has its challenges. The ability to manage production risks comes with a high capital investment and high operational costs. PC is an intensive production system with a steep learning curve. Under or over investment in technology and a lack of management skills will lead to financial failure.

Worldwide, the share of fresh produce grown in PC systems is growing and Australian horticulture is following this trend. In Australia, market and economic drivers are leading more growers, vertically integrated food businesses and investors to use PC. Australia currently has 1,500 ha of vegetables under a combination of glasshouses, greenhouses, and poly-tunnels. The area of vegetables grown using PC has increased at an annual rate of between 4% and 6%. Berry industries have also established significant areas with PC. For example, 160 ha of blueberries have been established in Queensland in poly-tunnels in recent years. Retractable roof structures (40 ha) are being erected for nursery and cut flower crops. With fruit crops, the need to mitigate high solar radiation, wind, pests, and hail has driven expansion of PC production.

Protected Cropping Australia (PCA)¹ reports that PC is the nation’s fastest growing food production sector. PC farmgate values increased from \$486 M in 2014 to \$1,589 M in 2017. The equivalent of 15% of the value of all vegetable and cut flower production was produced under PC in 2016. The value of fruit typically grown under some form of hail or bird netting including apples, cherries, peaches, plums, and nectarines was \$280 M in 2016. This impact assessment estimates the 2022 value of PC at \$2,028 M². Current and upcoming innovations in automation, robotics, and technologies for increasing input-use efficiencies will have a further positive impact on PC production and growth in industry value through to 2030.

Rationale

Achieving increased use of PC technologies and systems in Australian horticulture will require innovation, coordination, commitment, and the identification of RD&E investment priorities whose delivery will profit the industry. Consequently, a strategy was required to provide horticultural growers, Hort Innovation, and industry stakeholders with clear direction and priorities for PC RD&E investment.

The PC RD&E strategy must align with relevant levy and non-levy programs including industry Strategic Investment Plans (SIPs), Cooperative Research Centres (e.g., the CRC for Future Food Systems), demonstration facilities such as the Agriculture Victoria Smart Farms, and education programs including the University of Western Sydney’s National Vegetable Protected Cropping program. PC RD&E strategy delivery will need to benefit the vegetable, berry, nursery, and tree-fruit value chains.

¹ <https://protectedcropping.net.au/the-protected-cropping-industry/industry-value/>

² Based on an annual growth rate of 5% - “In Australia we’re seeing growth rates around the 5 per cent mark” (Sam Turner, Executive Officer, PCA, ABC News, 19 July 2022).

Project Details

Summary

| |
|--|
| Project Code: AS19005. |
| Title: Australian Protected Cropping Strategy 2030. |
| Research: Queensland Department of Agriculture and Fisheries (QDPI). |
| Project Leader: Elio Jovicich. |
| Period of Funding: June 2020 to June 2021 (final report date). |

Objectives

AS19005 aimed to fill a gap in the horticulture industry. The development of an Australian Protected Cropping RD&E Strategy for the period through to 2030 was a foundational input to future investment in protected cropping. It was to provide Hort Innovation and protected cropping researchers with a plan and priorities for investment.

Logical Framework

Table 2 provides a detailed description of project AS19005 in a logical framework.

Table 2: Logical Framework for Project AS19005

| | |
|------------|--|
| Activities | <p>RD&E activities as described in the final AS19005 project report (Jovicich 2021):</p> <ul style="list-style-type: none"> • Completion of a literature review and development of a snapshot of protected cropping in Australia and overseas. High-level industry information was summarised for Australia, the Netherlands, Canada, Spain, Israel, Mexico, and Japan. • Initial stakeholder consultation to identify desired future states (outcomes) and the role of RD&E in achieving these outcomes. 47 groups made up of more than 100 individuals were interviewed. Groups included state Departments of Primary Industries, industry associations, universities, education centres, growers, consultants, marketers, and input/service suppliers. • Interview transcripts summarised to identify themes in relation to current limitations, future opportunities, challenges to industry growth and RD&E needs. • Further consultation with the PCA Board, CRC for Future Food Systems, and input suppliers. • Development of a draft dynamic systems map “PC within Australia’s horticulture industry”. Review and refinement of the map with industry stakeholders. The map included an understanding of the deeper systemic dynamics shaping Australian horticulture industry. Systemic dynamics identified as key to developing the PC RD&E strategy. • Preparation of Logic Models that addressed what is to be done, how it is to be done, deliverables, changes in knowledge/practice, possible KPIs, outcomes, and impacts. • Completion of a two-day workshop to develop the “nature and direction” for the PC RD&E strategy. This task included development of principles and an RD&E investment conceptual framework. • Documentation of a draft PC RD&E strategy and further consultation to refine the strategy. Consultation to refine the draft strategy included a one-day, round table event in each state/territory (some events cancelled due to COVID19), as well as virtual meetings with industry stakeholders, Hort Innovation managers, and the PCA Board. • Documentation finalisation including a one-page strategy, a six-page strategy (including key desired outcomes, priority investment areas, and investment principles), and a 20-page strategy (added tables with information gathered from logical models). |
| Outputs | <ul style="list-style-type: none"> • An Australian Protected Cropping RD&E Strategic 2030. The Strategy is to guide RD&E for the PC sector for the next ten years. |

| | |
|-------------------|--|
| | <ul style="list-style-type: none"> Documents prepared included a project overview, the strategy, a one-page summary, logical models, a “nature and direction” statement, a map of PC RD&E within horticulture, a summary of initial interview feedback and trends in PC use. |
| Outcomes | <ul style="list-style-type: none"> Targeted and efficient RD&E investment in protected cropping. Protected cropping value chain members with improved understanding of their sector and the opportunities within it. Protected cropping industries benefiting from RD&E that has improved their marketplace presence, capacity, and production. |
| Potential Impacts | <ul style="list-style-type: none"> Economic – more efficient protected cropping RD&E expenditure. Economic – in the longer term, a contribution to the profitability of PC sector value chains. Environmental – contribution to more efficient PC production with less risk of waste/pollution of the farm environment through RD&E strategies that provide information on ways to reduce the environmental footprint of PC systems (e.g., water recycling, best practice fertiliser use, environmental systems management, etc.) (Anthony Kachenko, pers., comm., 2023). Social - additional strategic planning and protected cropping research capacity. Social - contribution to improved regional community wellbeing from spill-over income and employment benefits as a result of more productive and profitable protected cropping industries. |

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project AS19005 – all funds were expended in the 2020/21 financial year. The Hort Frontiers managed contribution included both QDAF and Hort Innovation funds.

Table 3: Annual Investment in Project AS19005 (nominal \$)

| Year (ended 30 June) | HORT FRONTIERS (\$) | OTHERS (\$) | TOTAL (\$) |
|-------------------------|---------------------|-------------|----------------|
| 2021 | 140,322 | 0 | 140,322 |
| Total | 140,322 | 0 | 140,322 |

Source: Hort Innovation fully executed letter of variation, 29 April 2021.

Program Management Costs

For the Hort Frontiers investment the cost of managing the Hort Innovation funding was added to the Hort Innovation contribution for the project via a management cost multiplier (1.143). 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, the investment costs of all parties were expressed in 2021/22-dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2022). The AS19005 project included a substantial allocation for consultation and 100 individuals were interviewed across 47 PC stakeholder groups. As a result of this project related activity there is a high level of awareness of the PC RD&E Strategy 2030. Post completion of the project, no additional resources were expended on extension.

Impacts

Table 4 provides a summary of the principal types of impacts delivered by the project, based on the logical framework (Table 2). Impacts have been categorised into economic, environmental, and social impacts.

Table 4: Triple Bottom Line Categories of Principal Impacts from Project AS19005

| | |
|---------------|--|
| Economic | <ul style="list-style-type: none"> • More efficient protected cropping RD&E expenditure. • In the longer term, a contribution to the profitability of PC sector value chains. |
| Environmental | <ul style="list-style-type: none"> • Contribution to more efficient PC production with less risk of waste/pollution of the farm environment through RD&E strategies that provide information on ways to reduce the environmental footprint of PC systems. |
| Social | <ul style="list-style-type: none"> • Additional strategic planning and protected cropping research capacity. • Contribution to improved regional community wellbeing from spill-over income and employment benefits as a result of more productive and profitable protected cropping industries. |

Public versus Private Impacts

The impacts identified from the investment are both private and public in nature. Private economic impacts accrue to PC value chains – efficient RD&E resource allocation and, a longer-term increase in profitability. Public social impacts include additional research and industry capacity, and long-term spill-overs to regional communities from enhanced productivity and profitability in PC industries.

Distribution of Private Impacts

In the first instance, private impacts will accrue to PC growers. Over time impacts will move backward and forward through the value chain to PC input suppliers, transporters, wholesalers, exporters, and retailers. The share of benefit retained by each link in the supply chain will depend on the interplay of both short and long-term supply and demand elasticities. To date, Hort Innovation projects influenced by the PC RD&E Strategy include glasshouse films to reduce energy use (VG21006), a national map of PC systems (AS20003), and alternative growing media for berry production (RB21002) (Adrian Hunt, R&D Manager, Hort Innovation, pers. comm., July 2022).

Impacts on Other Australian Industries

The investment priorities developed and documented in the PC RD&E Strategy 2030 have focussed on vegetables (including cut flowers), berry, nursery, and fruit trees (apple, cherry, peach, plum, nectarine). However, research investment guided by the Strategy may be relevant to other, non-Hort Innovation crops including, but not limited to, the developing medical cannabis industry.

Impacts Overseas

Innovations guided by the Strategy may be relevant to overseas PC industries. It is understood that PC is rapidly expanding the Netherlands, Canada, Spain, Israel, Mexico, and Japan.

Match with National Priorities

The Australian Government’s National Science and Research Priorities and National Agricultural Innovation Priorities are reproduced in Table 5. The project outcomes and related impacts will contribute to National Science and Research Priority 1 and National Agricultural Innovation Priority 1.

Table 5: Australian Government Research Priorities

| Australian Government Strategies and Priorities | |
|---|--|
| National Science and Research Priorities ³ | National Agricultural Innovation Priorities ⁴ |
| <ol style="list-style-type: none"> 1. Food – optimising food and fibre production and processing; agricultural productivity and supply chains within Australia and global markets. 2. Soil and Water – improving the use of soils and water resources, both terrestrial and marine. 3. Transport – boosting Australian transportation: securing capability and capacity to move essential commodities; alternative fuels; lowering emissions. 4. Cybersecurity – improving cybersecurity for individuals, businesses, government and national infrastructure. 5. Energy and Resources – supporting the development of reliable, low cost, sustainable energy supplies and enhancing the long-term viability of Australia’s resources industries. 6. Manufacturing – supporting the development of high value and innovative manufacturing industries in Australia. 7. Environmental Change – mitigating, managing or adapting to changes in the environment. 8. Health – improving the health outcomes for all Australians. | <p>On 11 October 2021, the National Agricultural Innovation Policy Statement was released. It highlights four long-term priorities for Australia’s agricultural innovation system to address by 2030. These priorities replace the Australian Government’s Rural Research, Development and Extension Priorities which were published in the 2015 Agricultural Competitiveness White Paper.</p> <ol style="list-style-type: none"> 1. Australia is a trusted exporter of premium food and agricultural products by 2030 2. Australia will champion climate resilience to increase the productivity, profitability and sustainability of the agricultural sector by 2030 3. Australia is a world leader in preventing and rapidly responding to significant incursions of pests and diseases through futureproofing our biosecurity system by 2030 4. Australia is a mature adopter, developer and exporter of digital agriculture by 2030 |

Alignment with the Hort Frontiers Advanced Production Systems Fund Themes

The Hort Frontiers Advanced Production Systems Fund targets three outcomes (Hort Innovation, 2018):

- 1) Robust information and tools available to growers to make improved production decisions.
- 2) Adoptable advanced production systems that can be deployed by the growers.
- 3) New information and resources generated to assist in greater intensification of production for growers.

This project delivers against outcome 3 but also makes contributions to outcome 1 and 2.

³ See: 2015 Australian Government Science and Research Priorities. <https://www.industry.gov.au/data-and-publications/science-and-research-priorities>

⁴ See: 2021 National Agriculture Innovation Policy Statement. https://www.awe.gov.au/agriculture-land/farm-food-drought/innovation/research_and_development_corporations_and_companies#government-priorities-for-investment

Case Study

The following section provides real world feedback on how the outputs of the investment have benefited growers.

R&D CASE STUDY: GROWER INSIGHTS FROM PC PRIORITY SETTING AND PRACTICAL APPLICATION OF PROJECT RECOMMENDATIONS

THE CHALLENGE

Protected cropping is a diverse and fragmented sector. Synthesis of information of the sector's status and outlook would be advantageous for the PC industry, researchers, and potential investors. Recommendations arising from the PC RD&E Strategy 2030 were needed to guide sector sustainability.

MEET NICKY MANN

At the time the PC RD&E Strategy was being prepared Nicky was Chair of peak industry body, Protected Cropping Australia. Nicky's protected cropping enterprise is Family Fresh Farms, at Peats Ridge NSW. Family Fresh Farms has 5 ha of high-tech glasshouse and produces and packs snacking cucumbers which are supplied to Coles, Woolworths, Aldi, Costco, and the independents. Nicky participated in strategy development workshops and found the process invaluable: "We had all the protected cropping stakeholders in the room sharing information on industry direction and developing the strategies we need for business and industry growth. Industry, government, and investors all pulled together. Elio and his team did a great job interviewing 47 different groups to inform the workshops and deliver strategy for protected cropping investment. It was industry money well spent".



Family Fresh Farms, Peats Ridge NSW has 5 ha of high-tech glasshouse and produces and packs snacking cucumbers for all the major retailers (photo credit Family Fresh Farms)

MEET THE COSTA GROUP

Both Greg Murdoch and Paul Butterworth of Costa Group participated in PC RD&E workshops and strategy formulation. Costa Group is Australia’s largest horticultural company with production operations that include avocado, banana, berry, citrus, table grapes, mushrooms, and tomatoes. Costa’s PC operations include covered avocado production, large scale greenhouse production of truss tomatoes, blackberry, raspberry, and strawberry growing. Waste and cost associated with hydroponic growing media are major issues for Costa Group. With around 240,000 growbags replaced each year at the East Devonport Strawberry Farm alone, research was needed to reduce on-farm waste from the coir growbags, reuse the coir, and reduce plastic waste. Alternatives were needed for current growing media. The PC RD&E Strategy 2030 articulated these priorities and Hort Innovation subsequently funded targeted research investment including “RB21002 Alternative Growing Media for Hydroponic Berry Production – A Desktop Review”.



Costa Berries, Corindi NSW. Costa produces 11,000 tonnes of berries and at peak harvest employs 3,000 people in its berry division (photo credit Costa Group)

THE APPROACH

Industry insight information was assembled to inform PC RD&E workshops. Workshops were convened in each state and territory. Workshop “roundtables” were used to process industry insight and draft the PC RD&E Strategy. Strategy has subsequently been used by PC growers to guide business decision making and Hort Innovation to fund PC research.

THE IMPACT

AS19005 funded the production of the Australian Protected Cropping RD&E Strategic Plan for the 10 years to 2030. Plan preparation brought all sectors of the industry together including boutique production of glasshouse grown snacking cucumbers and Australia’s largest horticultural grower. Participants learned from the experience and Hort Innovation used the Plan to fund targeted research projects.

Valuation of Impacts

Impacts Not Valued

Not all the impacts identified in Table 4 could be valued in the assessment. Those not valued included:

- A long-term contribution to the profitability of PC sector value chains.
- Contribution to more efficient PC production with less risk of waste/pollution of the farm environment.
- Additional strategic planning and protected cropping research capacity.
- Contribution to improved regional community wellbeing from spill-over income and employment benefits.

These impacts were not valued due to lack of data to support credible assumptions. Data was not available in the National Accounts on PC specific value chains. Quantification of environmental benefits requires the application of non-market valuation techniques. These techniques are time and resource intensive (i.e., they are costly to implement) and were beyond the scope of the current impact assessment project.

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.

A single impact was valued:

- Efficiency gains in protected cropping RD&E resource allocation.

Impact 1: Efficiency Gains in Protected Cropping RD&E Resource Allocation

In the twelve months since completion of the PC RD&E Strategy 2030, Hort Innovation has invested in three key projects guided by the plan:

- AS20003 - National map of protected cropping systems, total investment value \$692,727.
- RB21002 - Alternative growing media for hydroponic berry production - a desktop review, \$30,320.
- VG21006 - Glasshouse films to reduce energy use and increase resource use efficiency, CRC Future Food Systems, total investment \$4,089,666.

An annual investment of \$4,812,713⁵ has been made using the strategy and this investment is thought to be representative of investment that will be made over the life of the plan. HS19005 has identified key priorities for protected cropping RD&E, and it is assumed that protected cropping RD&E, guided by the strategy developed as a result of HS19005, will be made in a more efficient manner than it would have been without the project being funded. It is further assumed that there will be an efficiency dividend equivalent to 5% of RD&E spending over the life of the plan. That is, the same outcomes and impact will be achieved with a 5% reduction in the RD&E spending that would have occurred without project HS19005.

CSIRO Adopt Model Insights

The CSIRO Adopt Model, with its focus on grower adoption and enterprise returns, is not configured for the assessment of an RD&E Strategy.

Summary of Assumptions

Table 6 contains a summary of assumptions required for estimation of efficiency gains in protected cropping RD&E resource allocation.

⁵ NB: This is just Hort Innovation investment in PC research. Potentially, other PC research projects have been guided by the Strategy e.g., investment by the CRC for Future Food Systems and private investment by growers in the sector.

Table 6: Summary of Assumptions for Impact Valuation

| Variable | Assumption/Value | Source/Comment |
|--|-------------------|--|
| Value of PC RD&E projects guided by the AS19005 developed strategy. | \$4,812,713/year. | See above discussion developed following consultation with Adrian Hunt, R&D Manager, Hort Innovation (pers. comm., July 2022). |
| Efficiency dividend delivered by the PC RD&E Strategy prepared as part of AS19005. | 5%. | Analysts' assumption. |
| Year of first impact. | 2021/22. | At the time of the impact assessment, the strategy had already guided RD&E investment. |
| Year of last impact. | 2029/30. | The strategy targets the period through to 2030. NB: it is possible that the current PC Strategy will also inform investment in the 2030s and have a longer effective "life" than assumed. It is also possible that the current PC Strategy will be abandoned before this time with a reworking of the Hort Frontiers program. |
| Attribution of impacts to this project. | 50% | Other initiatives, including CRC Future Food Systems processes, contribute to investment decision making. |
| Probability of the project generating useful outputs. | 100% | Outputs have been delivered by the project. |
| Probability of valuable outcomes. | 100% | The strategy has already influenced investment. |
| Probability of impact (assuming successful outcome) | 80% | It is not certain that reference to the strategy will deliver the efficiency dividend assumed. |
| Counterfactual. | 80% | In the absence of AS19005 research, it is possible that strategy would have been developed elsewhere e.g., relevant Hort Innovation SIPs. |

Results

All costs and benefits were discounted to 2022/23 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 (2020/21) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

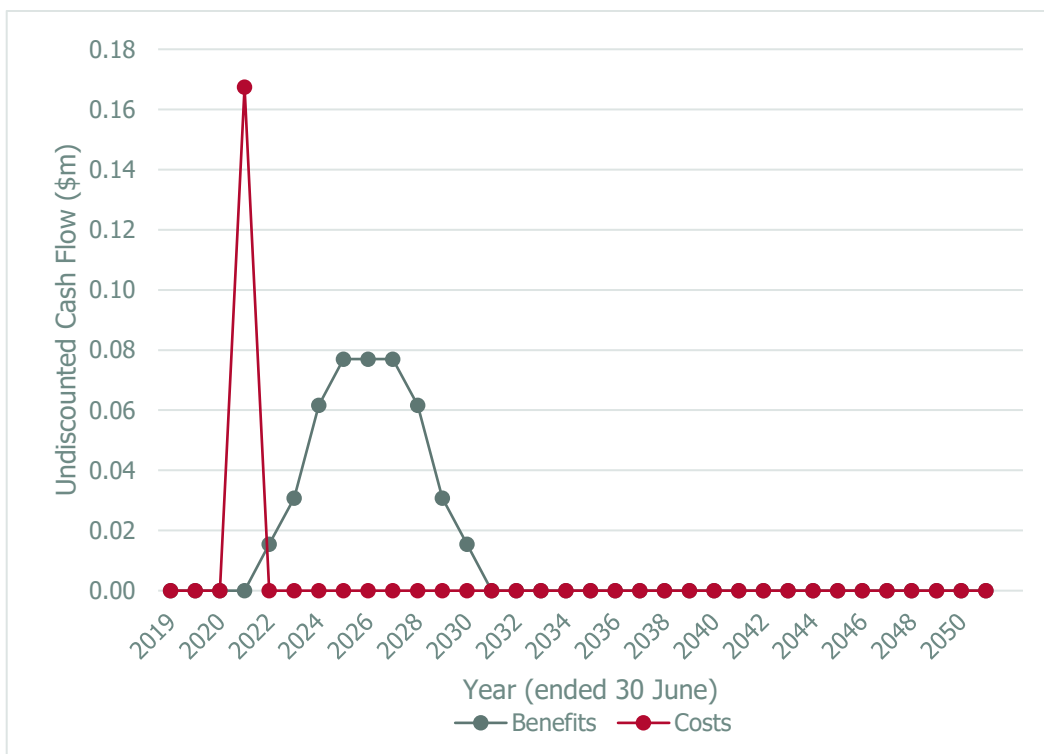
Table 7 shows the investment criteria estimated for different periods of benefits for the total investment. Hort Frontiers managed funds were the only source of investment in the project.

Table 7: Investment Criteria for Total Investment in Project AS19005

| Investment Criteria | Years after Last Year of Investment | | | | | | |
|---------------------------------|-------------------------------------|------|------|------|------|------|------|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| Present Value of Benefits (\$m) | 0.00 | 0.24 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 |
| Present Value of Costs (\$m) | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| Net Present Value (\$m) | -0.18 | 0.06 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Benefit-Cost Ratio | 0.00 | 1.31 | 2.10 | 2.10 | 2.10 | 2.10 | 2.10 |
| Internal Rate of Return (%) | negative | 14.7 | 28.4 | 28.4 | 28.4 | 28.4 | 28.4 |
| MIRR (%) | negative | 11.5 | 14.0 | 10.7 | 9.2 | 8.3 | 7.7 |

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the AS19005 investment plus 30 years from the last year of investment are shown in Figure 1.

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs



Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 8 presents the results. The results have a low sensitive to the discount rate.

Table 8: Sensitivity to Discount Rate
(Total investment, 30 years)

| Investment Criteria | Discount Rate | | |
|---------------------------------|---------------|-----------|------|
| | 0% | 5% (base) | 10% |
| Present Value of Benefits (\$m) | 0.45 | 0.39 | 0.34 |
| Present Value of Costs (\$m) | 0.17 | 0.18 | 0.20 |
| Net Present Value (\$m) | 0.28 | 0.20 | 0.14 |
| Benefit-cost ratio | 2.67 | 2.10 | 1.69 |

A sensitivity analysis was then undertaken on the annual value of RD&E projects guided by the strategy. Results are provided in Table 9. If the assumed value of projects guided by the strategy is reduced 50% to \$2.4 million per annum, then the project approaches breakeven, i.e., project benefits are approximately equal to project costs.

Table 9: Sensitivity to Value of RD&E Projects Guided by the AS19005 Strategy
(Total investment, 30 years)

| Investment Criteria | Value of Protected Cropping Projects | | |
|---------------------------------|--------------------------------------|----------------|---------|
| | \$2.4 M | \$4.8 M (base) | \$9.6 M |
| Present Value of Benefits (\$m) | 0.19 | 0.39 | 0.78 |
| Present Value of Costs (\$m) | 0.18 | 0.18 | 0.18 |
| Net Present Value (\$m) | 0.01 | 0.20 | 0.59 |
| Benefit-cost ratio | 1.05 | 2.10 | 4.20 |

A final sensitivity analysis tested the efficiency dividend delivered by the PC RD&E Strategy prepared as part of AS19005. The results (Table 10) show that if assumed dividend is reduced to 2%, the project fails to breakeven.

Table 10: Sensitivity to Efficiency Dividend Delivered by AS19005 Strategy
(Total investment, 30 years)

| Investment Criteria | Efficiency Dividend | | |
|---------------------------------|---------------------|------|-----------|
| | 2% | 2.5% | 5% (base) |
| Present Value of Benefits (\$m) | 0.16 | 0.19 | 0.39 |
| Present Value of Costs (\$m) | 0.18 | 0.18 | 0.18 |
| Net Present Value (\$m) | -0.03 | 0.01 | 0.20 |
| Benefit-cost ratio | 0.84 | 1.05 | 2.10 |

Confidence Rating

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes.

A confidence rating based on these two factors has been given to the results of the investment analysis (Table 11). The rating categories used are High, Medium, and Low, where:

High: denotes a good coverage of benefits or reasonable confidence in the assumptions made

Medium: denotes only a reasonable coverage of benefits or some uncertainties in assumptions made

Low: denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 11: Confidence in Analysis of Project

| Coverage of Benefits | Confidence in Assumptions |
|----------------------|---------------------------|
| Medium | Medium |

Coverage of benefits valued was assessed as Medium, a key impact (more efficient protected cropping RD&E expenditure) was valued but other impacts were not (increase in long-term PC profitability, additional researcher capacity, and spill-over benefits to regional communities). Confidence in assumptions was rated as Medium, some key data were estimated by the analyst.

Conclusions

The project (AS19005) has delivered an Australian protected cropping RD&E strategy for the period through to 2030. The strategy's goal is to enhance the profitability of vegetable, berry, nursery, and tree fruit value chains. It will do this through 1) the development of markets, 2) increasing capacity, and 3) optimising technology. The strategy has already been used to inform a number of Hort Innovation investments.

Total funding from all sources for the project was \$0.18 million (present value terms). The investment produced estimated total expected benefits of \$0.39 million (present value terms). This gave a net present value of \$0.20 million, an estimated benefit-cost ratio of 2.1 to 1, an internal rate of return of 28.4% and a modified internal rate of return of 7.7%.

Investment returns may be underestimated given that one economic and two social benefits were not quantified.

Recommendations

Impact assessment is now a mature process within Hort Innovation. No recommendations are made for further refinement.

References

- Australian Bureau of Statistics. (2022, March 02). Australian National Accounts: National Income, Expenditure and Product Quarterly estimates of key economic flows in Australia, including gross domestic product (GDP), consumption, investment, income and saving. Table 5. Expenditure on Gross Domestic Product (GDP), Implicit price deflators. Retrieved from Australian Bureau of Statistics: <https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-national-income-expenditure-and-product/latest-release#data-download>
- Council of Rural Research and Development Corporations. (2018). Cross-RDC Impact Assessment Program: Guidelines. Canberra: Council of Rural Research and Development Corporations. Retrieved from http://www.ruralrdc.com.au/wp-content/uploads/2018/08/201804_RDC-IA-Guidelines-V.2.pdf
- Department of Agriculture and Water Resources (DAWR). (2015). Agricultural Competitiveness White Paper. Canberra: Commonwealth of Australia. Retrieved from <http://agwhitepaper.agriculture.gov.au/SiteCollectionDocuments/ag-competitiveness-white-paper.pdf>
- Hort Innovation (2018) Co-Investment Strategic Intent: Advanced Production Systems. Accessed at: <https://www.horticulture.com.au/contentassets/17f02b9cb06741d2b2118a39a981ea36/csi-aps.pdf>
- Jovicich, E, Lane, V, and Saliba, G (2021) Australian Protected Cropping RD&E Strategy 2030. Final Report
- Office of the Chief Scientist (OCS). (2015). Strategic Science and Research Priorities. Canberra: Commonwealth of Australia. Retrieved from http://www.chiefscientist.gov.au/wp-content/uploads/STRATEGIC-SCIENCE-AND-RESEARCH-PRIORITIES_181214web.pdf

Acknowledgements

AgEconPlus 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 acknowledgements:

- Sarah Cumpston, Evaluation and Measurement Specialist, Hort Innovation
- Adrian Hunt, R&D Manager, Hort Innovation
- Elio Jovicich, Principal Investigator AS19005, Department of Agriculture and Fisheries
- Nicky Mann, Family Fresh Farms
- Anthony Kachenko, General Manager, Production & Sustainability R&D, Hort Innovation

Abbreviations and Acronyms

| | |
|-------|---|
| CBA | Cost Benefit Analysis |
| CRC | Cooperative Research Centre |
| CRRDC | Council of Research and Development Corporations |
| DAWR | Department of Agriculture and Water Resources (Australian Government) |
| FSANZ | Food Standards Australia and New Zealand |
| GDP | Gross Domestic Product |
| GVP | Gross Value of Production |
| IRR | Internal Rate of Return |
| KPI | Key Performance Indicator |
| LOP | Life of Project |
| MIRR | Modified Internal Rate of Return |
| PC | Protected Cropping |
| PCA | Protected Cropping Australia (industry association) |
| PVB | Present Value of Benefits |
| QDPI | Queensland Department of Primary Industries |
| R&D | Research and Development |
| RD&E | Research, Development and Extension |
| SIP | Strategic Investment Plan |

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. |