Delivery partner resource

# Horticulture Impact Assessment Program

## PS17003 – Research Program for the Australian Pistachio Industry – Impact Assessment

June 2025

Hort Innovation

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# Contents

# PS17003 Research Program for the Australian Pistachio Industry

## Executive Summary

The Australian pistachio industry is a growing industry within the Australian horticulture sector. The industry produces approximately 2,400 tonnes of pistachios annually with an average annual gross production value of $27.3 million over the last 5 years[1]. Industry growth has meant Australian growers are increasingly satisfying domestic demand. The industry continues to seek productivity gains for existing crops to enable Australian farms to be more competitive relative to industry benchmarks in places like California (USA) and Iran.

To enable industry growth, Pistachio Growers Australia Inc. employed an in-house researcher to explore the key issues faced by Australian pistachio growers, this researcher has been active since 2003. This research project tied into their ongoing work to improve yields per hectare across Australian farms.

This investment has a total nominal cost of $976,679, of this $939,179 was funded by Hort Innovation. This impact assessment identified a clear pathway to impact for the research undertaken. Three of the benefits identified were quantified to demonstrate the impacts of Hort Innovation's investment, including:

— Increased productivity of existing pistachio farms – Aspects of the research have demonstrated improvements to the productivity of trees and crops. This has included increases in the nut sets produced by a single tree, improvements in nut retention, and greater nutrient absorption, all of which have positive impacts on the marketable yield of pistachios produced per tree.

— A reduction in import reliance – Increased yields leading to rising domestic production is supporting a faster transition to domestic demand being fully met by domestic supply. This has environmental benefits due to the lower carbon footprint of the domestic supply chain relative to that of international supply.

— The identification of non-viable research pathways – A mid-term project evaluation identified and recommended the cessation of one research pathway. In doing so, the project enabled future industry savings which can be redirected to other viable pathways.

Beyond these, there were 3 additional benefits identified that could not be quantified, including:

— Improved nut quality – Some of the supported projects demonstrated improvements in the quality of pistachios produced, with reductions in blank nuts and unsplit shells. This positively impacts consumer confidence and links to improvements in merchantable yields. Impacts on nut quality are captured in the estimation of increased pistachio farm productivity and are therefore unquantified here to avoid double counting.

— Enhanced effectiveness of oil and polymer use – Findings relating to the timing and method of polymer and oil application are positively impacting yields and helping to reduce the use of ineffective treatments. These improvements will ultimately lead to a reduction in the prevalence and impact of disease on crops. Impacts on yield are captured in the increased productivity benefit and are therefore unquantified here to avoid double counting.

— Knowledge transfer and capability enhancement – The project has disseminated information and knowledge on best practice amongst growers within the industry through benchmark reporting. This information supports growers to make informed decisions when determining methods of crop

[1] Hort Innovation 2024, *Horticulture Statistics Handbook 2023*

management, disease management, and helps them to respond appropriately to climate and seasonal challenges. This impact is already captured in increased crop productivity and is therefore not quantified further to avoid double counting.

The results show that, taking all quantified costs and benefits into account, the investment produced a positive net result. The investment has a net present value (NPV) of $1.45 million and a benefit-cost ratio (BCR) of 2.31 at 30 years after investment completion using a 5% discount rate. This shows that the investment delivers a net positive return to levy payers and the broader community, returning $2.31 for every $1 in investment. Hort Innovation has been attributed 11.5% of the impacts as their investment accounts for 46.2% of the total investment to date and research to date accounts for roughly 25% of the research required to realise these benefits.

## Context, objective, and details of investment

The Australian pistachio industry primarily operates along the River Murray from Swan Hill in Victoria and up into South Australia. Production also occurs in Western Australia and New South Wales.[2] Australian yields have improved 30% in the last 8 years.[3] Australian orchards were achieving an average of about 3,000kg/ha, over the 2-year on/off cycle, peaking at over 5,300kg/ha in an on-crop year.[4] Further improvement was possible – the best Californian orchards produce over 6,000kg/ha in an on-crop year and good Californian orchards average 3,500kg/ha.[5]

The most recent data, in 2018, on Australian consumption (2016-17) was about 3,650 tonnes per annum.[6] This represented a compound growth of about 9% per annum since 2000.[7] There was scope for continued growth. Australian demand was still largely satisfied by imports. In 2018 Australian supply satisfied about 40% of total domestic demand.[8] In 2018 the most recent plantings of between 50 and 100 hectares per year, since 2015, and, announced planting intentions were moving the industry to an export surplus in about 2027-28.[9]

The success of the yield improvements and the increase in new plantings had come off the back of the industry-based research, development and extension undertaken by the Pistachio Research Field Officer.

The absence of any support work by the States' primary industry agencies for many years left a major gap in the detailed agronomy of pistachio growing under Australian conditions. The Pistachio Growers' Association Inc (PGAI) found it necessary to implement a program of 'self-help' and conduct industry-based research that would have been regarded as basic to more established industries.

In 2003, the Australian pistachio industry, after 20 years, had reached a stage of profitability and success. The initial challenge of simply getting the trees to grow and bear fruit had been met. The industry had reached the point that in order to help the industry develop further, there was a need for a person to drive the research work and communicate with growers the benefits of changing production practices. The pistachio industry

[2] Pistachio Growers Association, *Australian Industry*, https://www.pgai.com.au/australian-industry/.

[3] Ibid.

[4] Ibid.

[5] Ibid.

[6] Hort Innovation, 2021, *Pistachio Strategic Investment Plan*, p. 19.

[7] Hort Innovation, 2021, *Pistachio Strategic Investment Plan*, p. 4.

[8] Hort Innovation, 2021, *Pistachio Strategic Investment Plan*, p. 3.

[9] Pistachio Growers Association, *Origins*, https://www.pgai.com.au/the-australian-industry/.

initiated a position, Research Field Officer, utilising pistachio voluntary contributions along with the financial support of the Australian government through Horticulture Australia Ltd.

## Alignment with Strategic Investment Plan

The project closely aligned with the objectives of the Pistachio Strategic Investment Plan (SIP) 2022–2026[10] by addressing the industry's most pressing challenges and priorities. The project's research aimed to improve tree performance and yield consistency directly addressing Outcome 2 of the SIP 'Improve industry productivity (inputs/outputs) to maintain local and international competitiveness, while maintaining viability and sustainability of supply.' The project built on earlier projects to refine pest management strategies and by monitoring for emerging threats. This has helped to reduce crop losses and supported more sustainable production. Further, PS17003 continued efforts to understand and mitigate shell staining, nut defects, and postharvest quality issues. Additionally, the project shared research findings via field days, fact sheets, and grower engagement, thereby encouraging adoption of best practices – this directly aligns with Outcome 3 of the SIP 'Building capability and innovative culture.' Finally, the project produced benchmarking reports enabling better measurement and visibility of performance, and to help inform growers when making decisions, this aligns with SIP Outcome 4 to 'Measure industry supply (production) and demand (consumer behaviour) data and insights to inform decision-making.' Overall, the project aligned with the SIP priorities to improve productivity, build capability and an innovative culture in the industry, and to provide business insights across industry.

**Table 1 Project details of PS17003**

| | |
|---|---|
| **Project code** | PS17003 |
| **Title** | Research Program for the Australian Pistachio Industry |
| **Research organisation(s)** | Pistachio Growers' Association Inc |
| **Project leader** | Trevor Ranford |
| **Funding period** | 2018-19 to 2022-23 |
| **Objective** | Continue to deliver the Pistachio Productivity Improvement Program via on-going field research to overcome challenges inhibiting pistachio yields and industry growth. |

*Source: Hort Innovation*

### Related investments

The project was linked with 7 investments, these are:

— PS16002: Pathogens and other factors contributing to dark staining on pistachio shells – This project investigated dark staining of pistachio shells and nuts, with the aim to understand the causal organism associated with dark staining, evaluate when pistachios are most susceptible to infection, and clarify if there are other associated mechanisms.

  PS17003 built upon the findings of PS16002 regarding shell staining, though it focused on a wider range of research areas. The findings and insights of PS16002 informed the research efforts and objectives of PS17003 enabling a more comprehensive understanding of factors affecting pistachio quality and yield.

— PS06001: Facilitating the technical development of the Australian pistachio industry – This project

[10] Hort Innovation (2021). Pistachio, Strategic Investment Plan 2022-2026.

supported the establishment of a Research Field Officer within the Pistachio Growers Association Inc. This responded to the industry's need for Australian specific information and research to assist growers to expand production and produce higher quality nuts.

The capacity and industry networks developed under PS06001 helped enable the successful planning and implementation of PS17003 by providing a more informed and engaged grower base and a clearer understanding of the industry's technical needs.

PS06002: Challenges to the Australian pistachio industry – bacterial dieback and nut quality – PS06002 is linked to PS17003 through its role in identifying the key constraints and priorities that shaped the direction of later, more targeted R&D investments. PS06002 helped to clarify the knowledge gaps and industry vulnerabilities that needed to be addressed to support long-term growth and sustainability. These insights directly informed the design of PS17003, which was developed to respond to the challenges identified in PS06002 through coordinated research on production optimisation, pest and disease control, tree health, and quality improvement.

PS08000: Minor use permits for the pistachio industry – PS08000 focused on securing and maintaining minor use permits (MUPs) for essential crop protection products not registered for pistachios in Australia. This work ensured that growers had legal access to critical pesticides and fungicides needed to manage pests, diseases, and weeds. This regulatory groundwork supported PS17003's integrated pest and disease management research by providing a framework for trialling and implementing effective chemical controls.

— PS08002: Study tour to 2008 Pistachio Short Course and examine California almond and pistachio production technology – Through PS08002, key Australian pistachio industry representatives and growers participated in a U.S. study tour, gaining insights into orchard management, mechanisation, pest and disease control, irrigation practices, and postharvest handling used in the Californian pistachio industry.

  The knowledge gained during PS08002 helped shape the research priorities and practical focus of PS17003 by introducing concepts and technologies that were later trialled, adapted, or validated under Australian conditions.

— PS16000: Understanding and managing insects on pistachio orchards – This project increased knowledge about pest and beneficial species of insects and mites in Australian pistachio orchards. It looked at pests that currently pose a risk to pistachio production, or that have the potential to move into orchards.

  PS16000 played a foundational role in informing the pest management components explored through PS17003 and ensured the research program was grounded in current, locally relevant entomological knowledge.

— PS14000: Maintaining and expanding the technical development of the Australian Pistachio Industry – This project continues the development of the Australian Pistachio Industry to improve profitability. The project supported the ongoing employment of the Research Field Officer to investigate means by which growers can increase yields and improve nut quality.

  The technical foundation laid by PS14000 and the grower engagement it enabled, directly supported the implementation of PS17003. PS14000 ensured there was an informed and connected grower base, ready to engage with more advanced R&D. It also helped shape the research priorities of PS17003 by identifying ongoing industry needs through consultation and feedback.

## Project governance

The governance structures for the PS17003 research project for the Australian Pistachio Industry involved collaboration between the Pistachio Growers' Association Inc. (PGAI), – Australia's peak body representing pistachio growers – Hort Innovation, and a research team headed by the Pistachio Research Field Officer. PGAI held ultimate responsibility for the project, ensuring that the research activities undertaken by the Pistachio Research Field Officer and their Research Team aligned with industry needs and strategic goals.

Within the PGAI a dedicated Pistachio Research and Development (R&D) Committee was established to guide research priorities, monitor and evaluate progress and facilitate connection between researchers and growers. The Research Team met roughly 3 times per year to review and adjust the research project and ensure research priorities were adopted. The Pistachio Research Field Officer presented reports on interim findings at the same frequency (roughly 3 times a year) to both the Project Team and the Pistachio R&D Committee.

## Impact pathway

A clear pathway from input to impacts can be identified. Overall, the investment produced 6 impactful benefits for both levy payers and the broader communities. Table 2 shows the logical pathway to impact of the investment.

**Table 2 Impact pathway of PS17003**

| Pathway | Description |
|---|---|
| Inputs and Activities | **Existing research**<br>This research builds off existing research papers applying international research to the Australian growing climate.<br>**Data collection**<br>Researchers collected and collated a range of data from growers and the Bureau of Meteorology, this included collecting data on treatment, environmental factors, and indicators of yield and quality including nut retention, blank nuts and nut clusters. Grower data was collated into an industry benchmarking report.<br>**Field research**<br>Throughout the life of the project researchers accessed a range of field trial sites to conduct experiments and research onsite. This included access to private orchards. Combined, this investment funded 13 subset projects.<br>**Staffing**<br>Research funding supported the ongoing employment of a full-time pistachio researcher.<br>**Establishment of steering committee**<br>To support, direct and review the research conducted over the life of the project a project steering committee was established and met roughly 3 times per year over the life of the project.<br>**Problem identification**<br>In the first phase of the project the researchers sought to identify the primary challenges faced by growers that were acknowledged as yield and growth inhibitors. |
| Outputs | **The research enabled the retention of researchers**<br>The project enabled the employment of 1 FTE Pistachio Researcher over the life of the project and the retention of the Pistachio Emeritus Research Fellow.<br>**Mapping of research environment**<br>A map of existing research was created to determine areas for research continuation, expansion, and gap identification.<br>**12 research subsets**<br>The research enabled the completion of 12 research subsets (research projects) covering chill hours, dieback, and disease treatment and management.<br>**Development of planning materials**<br>The project established a program logic framework, a communication and engagement plan, and a monitoring and evaluation plan. |

| Pathway | Description |
|---|---|
| | **Industry benchmarking report**<br>As part of the project an industry benchmarking report was created enabling growers to compare their crops to the industry benchmark across a range of metrics.<br>**Monitoring and evaluation report**<br>As part of the project a monitoring and evaluation report was created and delivered.<br>**Information dissemination**<br>Information on the research and its findings was regularly distributed to growers and the broader industry to keep stakeholders abreast of relevant findings. |
| Outcomes | **Greater adoption of best practices among growers**<br>The research has led to more growers adopting best practices for disease management, increasing crop productivity and responding to changing environmental and seasonal challenges.<br>**Improved crop yields**<br>The research included multiple project subsets with statistically significant improvements to crop yields.<br>**Enhanced grower knowledge of oil and polymer application**<br>The research has enhanced knowledge of effective oil and polymer application to enhance chill acclimation, positively impact yields and nut retention, reduce blank nuts, and treat disease such as branch die back.<br>**Benchmarked industry performance**<br>The project has resulted in the production and provision of an industry benchmarking report to growers depicting other growers nut yields and quality.<br>**Maintained industry linkages**<br>The research has maintained linkages between researchers and growers, through collaboration and ongoing communications. This has enabled improved communication and knowledge sharing within the industry.<br>**Increased visibility of the pistachio researcher**<br>The project has resulted in the increased utilisation of the Pistachio Researcher by industry stakeholders and increased their visibility among stakeholders.<br>**Improved engagement with other researchers**<br>The research has supported ongoing and improved engagement between the project researcher and other Australian and international researchers, fostering greater collaboration.<br>**Identification of future research pathways and non-viable research pathways**<br>The research has enabled a more targeted approach to future research by identifying both non-viable research pathways to discontinue and research pathways where further research is warranted. |
| Impacts | **Increased tree yields**<br>The research demonstrated improvements to nut retention and nutrient absorption which positively impacted the yield and quality of pistachios produced.<br>**Improved nut quality**<br>The research demonstrated improvements in the quality of pistachios produced, with reductions in blank nuts and unsplit shells.<br>**Enhanced effectiveness of oil and polymer use**<br>The research explored the timing and method of polymer and oil application on pistachio trees. Improvements in this practice identified by the research indicated |

| Pathway | Description |
|---|---|
| | positive yield impacts through reducing the impact and prevalence of diseases such as shoot dieback, reducing the number of blank nuts, and achieving better bud break.<br>**Reduced reliance on imports**<br>By positively impacting yields and industry outputs, the research supports the transition to full domestic production reducing emissions resulting from carbon intensive import methods.<br>**Identified non-viable future research pathways**<br>The research identified at least one non-viable research pathway for which it recommended research be discontinued. By doing so the current research creates future savings.<br>**Knowledge transfer and capacity building**<br>The project disseminated information and knowledge on best practice amongst growers within the industry, facilitating greater uptake of best practice. Further, through the project an annual benchmark report was created and distributed to growers to enable comparison between their crops to others within the industry, supporting growers to make more informed decisions when determining methods of crop management, disease management, and respond appropriately to climate and seasonal challenges. |

*Source: ACIL Allen*

# Cost and benefits

## Costs

### *Cost of the investment*

The investment was a collaboration of Hort Innovation and the Pistachio Growers' Association Inc. Hort Innovation contributed $847,255 in cash and roughly $91,924 in in-kind contributions, while Pistachio Growers' Association Inc contributed around $37,500 (ex. GST). Table 3 below shows the total nominal cash contributions from each partner over the life of the project.

**Table 3 Nominal costs of the investment by contributing partners of PS17003**

| Organisation | 2018-19 | 2019-20 | 2020-21 | 2021-22 | 2022-23 | Total |
|---|---|---|---|---|---|---|
| Hort Innovation – Cash | $121,725 | $207,294 | $138,196 | $138,196 | $241,844 | $847,255 |
| Hort Innovation – Overheads | $16,904 | $25,563 | $16,722 | $2,301 | $30,433 | $91,924 |
| Pistachio Growers' Association Inc | $7,500 | $7,500 | $7,500 | $7,500 | $7,500 | $37,500 |
| Total | $146,129 | $240,357 | $162,418 | $147,997 | $279,777 | $976,679 |

*Source: Hort Innovation*

The total nominal investment of $1.0 million is adjusted for inflation to represent the real value of investment. Adjustment for inflation is meant to present historical costs in today's dollars, by making periods comparable by converting nominal values to real values (adjusted for changes in purchasing power due to inflation).

Costs of the investment, in nominal term and real term, are provided below.

**Table 4 Real costs of the investment PS17003**

| Organisation | Hort Innovation | Partners | Total |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Nominal costs | $939,179 | $37,500 | $976,679 |
| Real costs ($2024 financial year) | $1,065,932 | $42,954 | $1,108,886 |

*Source: ACIL Allen, modelled using ABS's CPI data*

After converting to real terms, the cost of the investment is $1.11 million, and Hort Innovation's portion of all investments is $1.07 million.

## Benefits

Table 5 below summarises the potential benefits of the investment and categorised them into 3 categories: economic, environmental and social impact. It provides a description of the benefits and how the investment could achieve them. The table also shows the assessment method that was used for each benefit.

**Table 5 Summary of potential impacts of PS17003**

| Type of impact | Assessment | Description |
|---|---|---|
| Economic impact | Quantified | **Increased productivity** – Aspects of the research have demonstrated improvements to the productivity of trees and crops as a result of the research project. This has included increases in the nut sets produced by a single tree, improvements in nut retention, and improvements in nutrient absorption which impact the yield and quality of pistachios produced. |
| | Unquantified | **Improved nut quality** – Some of the supported projects demonstrated improvements in the quality of pistachios produced, with reductions in blank nuts and unsplit shells. A reduction in the occurrence of these nut types would likely increase consumer confidence in the quality of the product they are consuming. It links in with increased productivity, by reducing the amount of non-merchantable nuts produced, however it is unlikely to impact a consumer's willingness to pay or induce more demand. Impacts on productivity are captured in the preceding impact and are unquantified here to avoid double counting. Further, any change in a consumer's willingness to pay is difficult to quantify without extensive data on the increased willingness to pay for consumers for perceived improvements in nut quality. |
| Environmental impact | Quantified | **Reduced reliance on imports** – Currently domestic pistachio production satisfies only 40% of domestic demand, as a result 60% of pistachios are imported. By increasing domestic pistachio production there is reduced reliance on imports which are likely to be more emission intensive due to the distances they are transported and the mechanisms by which they are transported (i.e. container ships). |
| | Unquantified | **Enhanced effectiveness of oil and polymer use** – The project included a number of sub-research topics that explored the timing and method of polymer and oil application on pistachio trees. These sought to positively impact yield by reducing the impact and prevalence of diseases such as shoot dieback, reducing the number of blank nuts, and achieving better bud break. The identification of optimal polymer and oil application timing and method reduces the use of ineffective treatments and reduces the prevalence of disease among crops. Yield impacts are captured in the increased productivity benefit so these are not counted here to avoid double counting. The reduced impact of diseases is difficult to capture due to limited available data on the efficacy of current chemistry and the relative improvements of improved treatment timing. |

| Type of impact | Assessment | Description |
|---|---|---|
| Social impact | Quantified | **Identified non-viable future research pathways** – The research conducted as part of PS17003 has identified at least one non-viable research pathway for which it recommended research be discontinued, and by doing so the current research creates future savings. The identification of non-viable research pathways results in significant savings for the industry which has limited spending power and scope to undertake large research projects. |
| | Unquantified | **Knowledge transfer and capacity building** – The project has disseminated information and knowledge on best practice amongst growers within the industry, facilitating greater uptake of best practice. Further, through the project an annual benchmark report was created and distributed to growers to enable comparison between their crops to others within the industry. This has supported growers to make more informed decisions when determining methods of crop management, disease management, and respond appropriately to climate and seasonal challenges. This impact is captured in increased crop productivity and not quantified further to avoid double counting. |

*Source: ACIL Allen*

## Data and assumptions

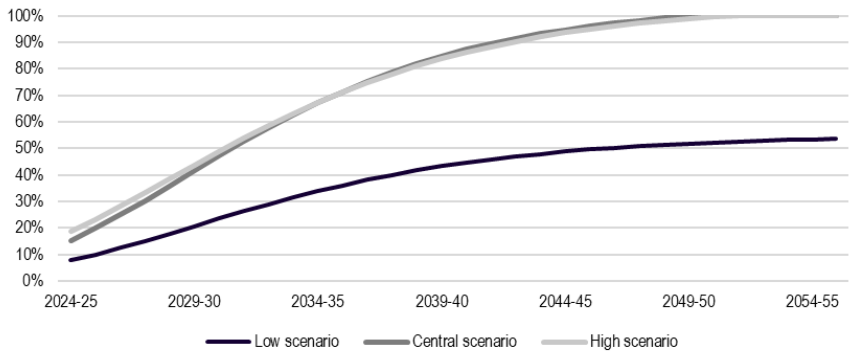
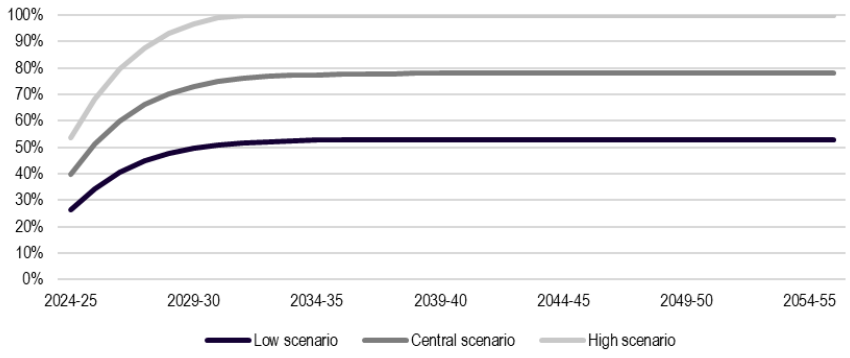
The required data, assumptions and calculations used to estimate the impacts of the investment are presented in Table 6 below. The data were sourced from project data, external sources through literature review, industry data provided by Hort Innovation and other publicly available databases. Assumptions were informed by stakeholder consultations and are designed to be conservative considering the uncertainties underlying the magnitude of the impacts. These uncertainties include the rate and extent of industry uptake, variability in the application of recommendations by growers and the need for further research to be undertaken before benefits are fully realised.

As many projects have a long-term focus and benefits may take years to fully emerge, using conservative assumptions helps avoid overstating expected returns. This cautious approach reflects best practice in economic evaluation where future adoption patterns and external influences cannot be predicted with high confidence.

**Table 6 Data and assumptions used for PS17003**

| Data/Assumption | Value, source and rationale |
|---|---|
| Data | |
| Domestic production since 2020 | Average ($): $28.3 million<br>Average (t): 2,525 tonnes<br>(FY 23 Horticulture Statistic Handbook) |
| Imports since 2020 | Average ($): $33.0 million<br>Average (t): 1,850 tonnes<br>(FY 23 Horticulture Statistic Handbook) |
| Australian pistachio orchards yield per hectare | 3,000 kg/ha<br>PS17003 Research Program for the Australian Pistachio Industry |

| Data/Assumption | Value, source and rationale |
|---|---|
| Increase in rolling 2-year average yield since the research project | 7% increase in yields<br>Data was provided by industry representatives through benchmark reporting. |
| Global food miles (emissions) | 3 Gigatonnes of CO2<br>(https://www.lettusgrow.com/blog/summary-nature-study-food-miles) |
| Reduction in global emissions if fully domestic agriculture production | 0.27 Gigatonnes of CO2<br>(https://www.lettusgrow.com/blog/summary-nature-study-food-miles) |
| Percentage of food-related emissions due to transport | 19%<br>(https://www.sydney.edu.au/news-opinion/news/2022/06/21/fifth-of-global-food-related-emissions-due-to-transport.html) |
| Tonnes of emissions in Australia attributable to food | 31 million tonnes of CO2<br>(https://www.georgeinstitute.org/news-and-media/news/simple-food-swaps-could-cut-greenhouse-gas-emissions-from-household-groceries#:~:text=In%20total%2C%20just%20over%2031,22%2C500km%20per%20year2.) |
| Percentage of per-capita food consumption attributable to Horticultural products | 323.6 grams out of 1,544 per capita per day<br>(https://www.abs.gov.au/statistics/health/health-conditions-and-risks/apparent-consumption-selected-foodstuffs-australia/2022-23) |
| Horticulture fresh supply (average since 2020) | 4,015,745 tonnes<br>(FY 23 Horticulture Statistic Handbook) |
| Pistachio fresh supply (average since 2020) | 5,191 tonnes<br>(FY 23 Horticulture Statistic Handbook) |
| Social cost per tonne of CO2 emissions | $298 AUD ($190 USD) per ton of Carbon emissions<br>(https://www.rff.org/publications/explainers/social-cost-carbon-101/) |
| Number of research projects | 12 |
| Total research costs | $969,481 |
| Assumption | |
| Attribution | Attribution of benefits for this project are estimated to be 11.5%. This is based on Hort Innovation contributing 46.2% of investment costs when accounting for linked research projects. While there were demonstrable improvements in some trials, most research pathways require further research before being implemented by industry, thus the research to date is estimated to account for 25% of total future research required. These 2 values are multiplied by one another to give 11.5%. |
| Counterfactual | This scale of this project and the number of subset research projects undertaken requires significant coordination and direction from a peak body, to ensure appropriate targeting of the research and dissemination of information. Due to cost and time constraints within what is a relatively small industry, the outcomes of this project are unlikely to be achieved by organisations other than Hort Innovation and the Pistachio Growers Association Inc. The counterfactual scenario can be assessed as there is a very low likelihood the project would be undertaken without funding from Hort Innovation. |

| Data/Assumption | Value, source and rationale |
|---|---|
| Adoption | As the project concluded in 2022-23, adoption is assumed to have already commenced.<br>As most impacts affecting yield require further research prior to grower adoption, it is assumed adoption commences at a low percentage (15%) and grows to 100% over the 30-year observation period. This aligns with ongoing information dissemination to growers through reporting and benchmarking. It is anticipated that by 2031-32 over half of growers will have adopted the research findings into their farming practices.<br>**Figure 1 Adoption curve**<br>  <br>*Source: ACIL Allen*<br>Further, the reduction in emissions is anticipated to be fully realised by 2031-32 as domestic supply grows more on the back of this research to reduce Australia's reliance on imported pistachios.<br>**Figure 2 Estimated proportion of domestic demand satisfied by domestic production**<br>  <br>*Source: ACIL Allen* |
| Calculation | |
| Average % gap to Californian producers (proxy for yield max) | *(Californian pistachio orchards yield per hectare / Australian pistachio orchards yield per hectare) - 1* |
| Increase in tree yield | *Average domestic production (2020-23) x Average gap to US productivity* |
| Reduction in emissions by transition to fully domestic production | *Reduction in global emissions if fully domestic agriculture production / Global food miles (emissions)* |

| Data/Assumption | Value, source and rationale |
|---|---|
| Percentage of Australian food emissions due to transport | *Tonnes of emissions in Australia attributable to food x Percentage of food-related emissions due to transport* |
| Percentage of food consumption attributable to horticultural products | *Per capita horticultural food consumption / Per capita total food consumption* |
| Percentage of fresh horticulture supply attributable to pistachios | *Pistachio fresh supply / total horticulture fresh supply* |
| Percentage of fresh pistachio supply imported | *Average pistachio imports / (Average pistachio imports + Average pistachio domestic production)* |
| Australia emissions attributable to food transport | *Percentage of Australian food emissions due to transport x Tonnes of emissions in Aus attributable to food* |
| Food transport emissions attributable to horticulture (based on consumption) | *Australia emissions attributable to food transport x Percentage of food consumption attributable to horticultural products* |
| Horticulture food transport emissions attributable to pistachios | *Food transport emissions attributable to horticulture x Percentage of fresh horticulture supply attributable to pistachios* |
| Horticulture food transport emissions attributable to imported pistachios | *Horticulture food transport emissions attributable to pistachios x Percentage of fresh pistachio supply imported* |
| Reduction in CO2 emissions from switching imported supply of pistachios to domestic production | *Horticulture food transport emissions attributable to imported pistachios x Reduction in emissions by transition to fully domestic production* |
| $ savings by switching to full domestic production | *Reduction in CO2 emissions from switching imported supply of pistachios to domestic production x social cost per tonne of CO2 emissions* |
| Reduction in future research costs | *Total research costs / Number of research projects (assumed to be a one-off saving)* |

*Source: ACIL Allen*

## Net impact

A summary of the net impact of the investment is presented in Table 7. The results show that, taking all quantified costs and benefits into account, the investment produced a positive net result. The investment has an NPV of $1.45 million and a BCR of 2.31 at 30 years after investment completion.

When taking only costs and benefits attributable to Hort Innovation into account, the investment generated an NPV of $1.26 million and a BCR of 2.31 at 30 years after investment completion. The benefits attributed to Hort Innovation were in proportion to the nominal costs.

**Table 7 Net impact results of PS17003**

| | Years after investment completion | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| Whole investment | | | | | | | |
| PV of Costs ($m) | $1.11 | $1.11 | $1.11 | $1.11 | $1.11 | $1.11 | $1.11 |
| Benefits ($m) | $0.04 | $0.40 | $1.06 | $1.97 | $3.02 | $4.16 | $5.08 |
| PV of Benefits ($m) | $0.05 | $0.38 | $0.87 | $1.40 | $1.89 | $2.29 | $2.56 |
| NPV ($m) | -$1.06 | -$0.73 | -$0.24 | $0.29 | $0.78 | $1.18 | $1.45 |
| BCR | 0.04 | 0.34 | 0.79 | 1.27 | 1.70 | 2.07 | 2.31 |
| IRR | Negative | Negative | 0.5% | 8.5% | 11.3% | 12.4% | 12.8% |
| MIRR | Negative | Negative | 2.2% | 6.9% | 8.1% | 8.3% | 8.0% |
| Attributable to Hort Innovation | | | | | | | |
| PV of Costs ($m) | $0.96 | $0.96 | $0.96 | $0.96 | $0.96 | $0.96 | $0.96 |
| Benefits ($m) | $0.04 | $0.34 | $0.92 | $1.71 | $2.62 | $3.60 | $4.40 |
| PV of Benefits ($m) | $0.04 | $0.33 | $0.76 | $1.22 | $1.63 | $1.99 | $2.22 |
| NPV ($m) | -$0.92 | -$0.63 | -$0.20 | $0.25 | $0.67 | $1.03 | $1.26 |
| BCR | 0.04 | 0.34 | 0.79 | 1.27 | 1.70 | 2.07 | 2.31 |
| IRR | Negative | Negative | 0.5% | 8.5% | 11.3% | 12.4% | 12.8% |
| MIRR | Negative | Negative | 2.2% | 6.9% | 8.1% | 8.3% | 8.0% |

*Source: ACIL Allen*

### *Sensitivity analysis*

Sensitivity analysis was conducted to test the robustness of susceptibility of the analysis to key assumptions and parameters. Given the uncertainty of a number of assumptions used in this CBA, sensitivity testing is important to determine the appropriateness of underlying assumptions.

The results of the sensitivity analysis are presented in Table 8 below.

**Table 8 Sensitivity analysis results of TG19004**

| | NPV ($m) | BCR | IRR | MIRR |
|---|---|---|---|---|
| Under standard assumptions (Central case scenario and 5% discount rate) | $1.45 | 2.31 | 12.8% | 8.0% |
| 3% discount rate | $2.19 | 2.97 | 12.8% | 8.0% |
| 7% discount rate | $0.93 | 1.84 | 12.8% | 8.0% |
| Low adoption – yield increasing practices (starts at 3% and reaches 17.5% in 5 years) | $0.94 | 1.85 | 10.2% | 7.2% |

| | | | | |
|---|---|---|---|---|
| High adoption – yield increasing practices (starts at 8% and reaches28.1% in 5 years) | $1.49 | 2.34 | 13.0% | 8.1% |
| Low adoption – reduction in import emissions (starts at 3% and reaches 41% in 5 years) | $1.44 | 2.30 | 12.7% | 8.0% |
| High adoption – reduction in import emissions (8% and reaches 80%) | $1.46 | 2.31 | 12.8% | 8.1% |
| Low increase in crop yields (Central scenario -20%) | $0.94 | 1.85 | 10.3% | 7.2% |
| High increase in crop yields (Central scenario +20%) | $1.96 | 2.77 | 15.1% | 8.8% |
| Low reduction in import emissions (Central scenario -50%) | $1.44 | 2.30 | 12.7% | 8.0% |
| High reduction in import emissions (Central scenario +50%) | $1.46 | 2.31 | 12.8% | 8.1% |
| Low savings in future research (Central scenario -50%) | $1.45 | 2.31 | 12.8% | 8.0% |
| High savings in future research (Central scenario +50%) | $1.45 | 2.31 | 12.8% | 8.0% |

*Source: ACIL Allen*

## Key findings

The following key findings have been identified for this assessment:

- The research and information produced have demonstrable productivity and yield improvements for pistachio crops. These include increases in the nut sets produced by a single tree, improvements in nut retention, and greater nutrient absorption, all of which positively impact marketable yields.
    - Through yield improvements resulting from the research, domestic producers are satisfying a larger proportion of domestic demand, reducing the reliance on overseas imports which has environmental benefits.
- The research has resulted in significant knowledge and information transfer, and capability enhancement across the industry through the production of new benchmark reporting. The information produced supports growers to make informed decisions when determining methods of crop management, disease management, and helps them to respond appropriately to climate and seasonal challenges.
- The governance structure implemented for these projects has supported the identification of non-viable research pathways resulting in monetary savings and the redirection of this funding to more viable pathways. Further, the governance structure, and imbedded nature of the pistachio researcher with the industry, has ensured that the research continues to target the needs of the industry, ensuring the maintenance of good value for money.
- There were other significant non-quantifiable benefits resulting from this research including increased consumer confidence resulting from nut quality improvements, and improved oil and polymer usage which in turn has led to reductions in the prevalence and impact of diseases on crops.
- The research project has provided a strong base from which benefits can be realised, however, further research and testing is required before these can be fully adopted by industry.

## Consultations

The following stakeholders were consulted on this assessment:

— Tom McCue, Hort Innovation

— Brenda Kranz, Pistachio Growers Association Inc

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