

## **Impact assessment of the investment cluster:**

Nursery industry natural disaster risk mitigation and recovery plan (NY18008)

*and*

Ensuring business continuity during biosecurity incursions – social and economic research learnings for the production nursery industry (NY18010)

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November 2023*

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## Contents

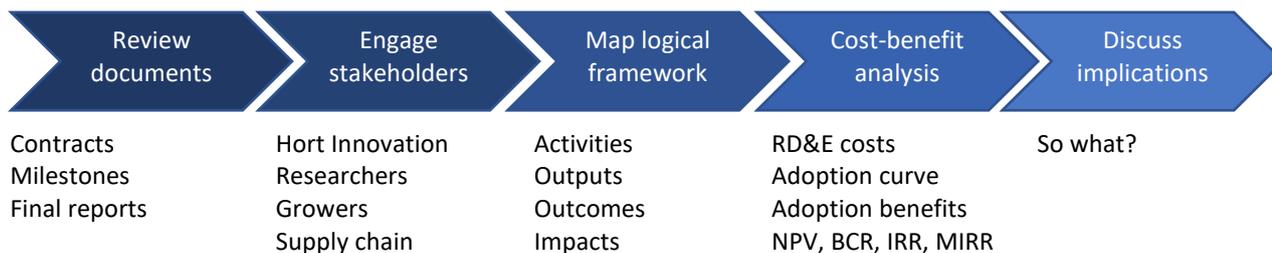
Executive summary.....	4
<i>What the report is about</i> .....	4
<i>Research background</i> .....	4
<i>Key findings</i> .....	4
<i>Keywords</i> .....	5
Introduction.....	7
General method.....	7
Project background.....	8
Project details.....	8
<i>Logical framework</i> .....	9
Project costs.....	12
<i>Nominal investment</i> .....	12
<i>Present Value of investment</i> .....	12
Project impacts.....	12
<i>Adoption data</i> .....	13
<i>Impact data</i> .....	13
Implications and learnings.....	13
Stakeholder consultation.....	15
Glossary of economic terms.....	16
Abbreviations.....	16
References.....	17

## Executive summary

### What the report is about

Ag Econ conducted independent analysis to determine the economic, social, and environmental impact resulting from delivery the nursery projects *Nursery industry natural disaster risk mitigation and recovery plan (NY18008)* and *Ensuring business continuity during biosecurity incursions – social and economic research learnings for the production nursery industry (NY18010)*. Delivered by the Nursery & Garden Industry Queensland Limited (NGIQ) over the period July 2019 to December 2021, these projects were funded by Hort Innovation using the nursery research and development levy and contributions from the Australian Government.

The impact assessment applied a five step analytical process to understand the impact pathway and collect supporting data.



### Research background

NY18008 and NY18010 were undertaken to improve the nursery industries understanding of natural disaster and biosecurity risks (respectively) and enhance the industries ability to reduce the risks through improved preparedness and recovery.

The projects engaged widely with stakeholders including nurseries, industry bodies, and state and federal Government stakeholders, to deliver a range of resources to update industry's existing risk management resources located in the Australian Plant Production Standard (APPS) best management practice (BMPs), particularly EcoHort (including natural disaster management) and BioSecure Hazard Analysis Critical Control Point (BioSecure HACCP) (for biosecurity management).

### Key findings

The combined nominal investment for NY18008 and NY18010 of \$0.54 million was adjusted for inflation (ABS, 2023) and discounted (using a 5% real discount rate) to a present value (PV) of costs equal to \$0.67 million (2022-23 PV). Identified impacts were not able to be quantified due to a lack of data to quantify changes in business risk (likelihood, consequences, and management costs). The identified impact pathway, associated data limitations, and opportunities for future data collection are further discussed below.

Through NY18008, participating nurseries gained direct project support in implementing the Natural Disaster Action Plan in their businesses, including identification, categorisation, and prioritisation of risks and risk mitigation activities.

Beyond the participating nurseries, adoption of the project outputs has been limited to date as the resources are incorporated into the existing APPS BMPs. Resources for the Natural Disaster Action Plan for nurseries are available on the APPS portal, with plans to include them in the EcoHort BMP within the next 12 months. Biosecurity risk resources are also available online (split between the APPS portal and the NGIQ website) but there is less certainty how these will be incorporated into BioSecure HACCP as the project findings largely confirmed the suitability of existing resources.

A range of direct and flow on impacts were identified as relating to efforts to reduced natural disaster and biosecurity risk

- [Economic] Reduced costs to nurseries from biosecurity incursions (direct pest damage, and control measures including surveillance, chemical or other control methods, plant destruction, replanting, re-establishing supply chain relationships); or natural disaster events (rebuilding/repairing infrastructure, replanting, and re-establishing supply chain relationships).
- [Social] Reduced costs to nursery and farm staff including psychological stress and strains on business and community relationships (CSIRO, 2020).
- [Economic] Reduced costs to nursery customers from reduced stock availability, and an increased risk of biosecurity spread from nursery to farm.
- [Socio-economic] Reduced costs to local economies and communities where nursery industries provide employment and wider community support.

Some of these impacts were generated throughout the course of project delivery, particularly for nurseries participating in NY18008 to test natural disaster risk mitigation. Broader impacts will be dependent on the ongoing extension of the resources including through their incorporation into APPS BMPs.

For both natural disaster and biosecurity risk there was insufficient data (either collected through the project or available through other resources) to quantify the impacts of risk mitigation. Risk is quantified as likelihood and consequences, which when combined can be shown as an annualised risk figure. Risk management seeks to reduce this risk through investment in preparedness and recovery resources (which might range from staff training to upgraded infrastructure), which again can be shown as an annualised figure. To understand the marginal benefit of risk management projects such as NY18008 or NY18010, data is required on the baseline risk (risk without project outputs) and the risk once project outputs are adopted.

If longer term funding were secured, the Spatial Mapping Portal would provide a useful source of information to understand the trends in the likelihood of risk events occurring across the industry, potentially including any changes in likelihood associated with climate change (as well as supporting industry level risk preparedness and response). However, this dataset would need to be combined with additional data on consequences or management costs to allow a valuation of the industry's risk profile. In the future, collection of this data could be undertaken through the Nursery industry Statistics program (Currently NY21000) or the auditing process for APPS BMPs (EcoHort and BioSecure HACCP). By providing insight into industry risk management costs, the costs of risk events, and the uptake of industry risk management resources through BMPs, this combined data set would support ongoing assessments of the overall industry risk profile, and the success of any projects to reduce industry risk.

The key findings for the NY18008 and NY18010 impact assessment are summarized in Figure 1 below.

### Keywords

Impact assessment, cost-benefit analysis, nursery, natural disaster, biosecurity, risk management

Figure 1. Summary of impact assessment findings

# NY18008 and NY18010 Risk mitigation



### Total RD&E costs:

- \$0.54 million (nominal value)
- 93% R&D levy and Government matching, and 3% NGIQ in-kind.



### Research activities:

From July 2019 to December 2021:

- NY18008 (Natural Disaster Risk)
  - Reviewed existing Government natural disaster response plans to inform nursery industry emergency management, business continuity and disaster recovery.
  - Worked with the Greenlife Industry Australia (GIA) and 21 production nurseries to develop a 3-Tier Natural Disaster Action Plan for industry.
- NY18010 (Biosecurity Risk)
  - Undertook a literature review and empirical research into the social and economic impacts of biosecurity incursions on production nursery businesses, and potential measures to help them respond and recover.



### Research outputs and outcomes:

Increased industry knowledge of natural disaster and biosecurity risk and management options:

- A Glossary of Risk Terminology and Damage Estimate Form to support more efficient communication and coordination of risk management resources.
- A pilot Nursery Industry Spatial Mapping Portal to map the location-based risk likelihood for individual nurseries, no plans for ongoing funding due to cost.
- A Natural Disaster Action Plan located on the Australian Plant Production Standard (APPS) website (up to 51 downloads to date) with plans for incorporation into the industry EcoHort best management practice (BMP) manual in the next 12 months.
- A literature review and empirical report on biosecurity risk on the Nursery and Garden Industry Queensland (NGIQ) website (20 downloads to date).
- A business continuity framework of actions (Decision Guide). Located on the APPS website (5 downloads to date).



### Industry economic impacts:

- Reduced costs of biosecurity incursions (direct pest damage, control methods, plant destruction, replanting, re-establishing supply chains); or natural disaster events (rebuilding/repairing infrastructure, replanting, and re-establishing supply chains).

### Spillover socio-economic impacts:

- Reduced individual stress and strain on business and community relationships.
- Reduced costs to nursery customers from the risk of pest and disease spread.
- Reduced costs to local economies and communities where nursery industries provide employment and wider community support.



### Total impact:

- Present value (PV using a 5% discount) RD&E costs of \$0.67 million.
- Benefits (and impact) unable to be quantified due to a lack of data to quantify changes in business risk (likelihood, consequences, and management costs) resulting from adoption of research outputs.



## Introduction

Evaluating the impacts of levy investments is important to demonstrate the economic, social and environmental benefits realised through investment to levy payers, Government and other industry stakeholders. Understanding impact is also an important step to inform the ongoing investment agenda.

Reflecting its commitment to continuous improvement in the delivery of levy funded research, development and extension (RD&E), Hort Innovation required a series of impact assessments to be carried out annually on a representative sample of investments of its RD&E portfolio. Commencing with MT18011 in 2017-18, the impact assessment program consisted of an annual impact assessment of 15 randomly selected Hort Innovation RD&E investments (projects) each year. In line with this ongoing program, Ag Econ was commissioned to deliver the *Horticulture Impact Assessment Program 2020-21 to 2022-23* (MT21015).

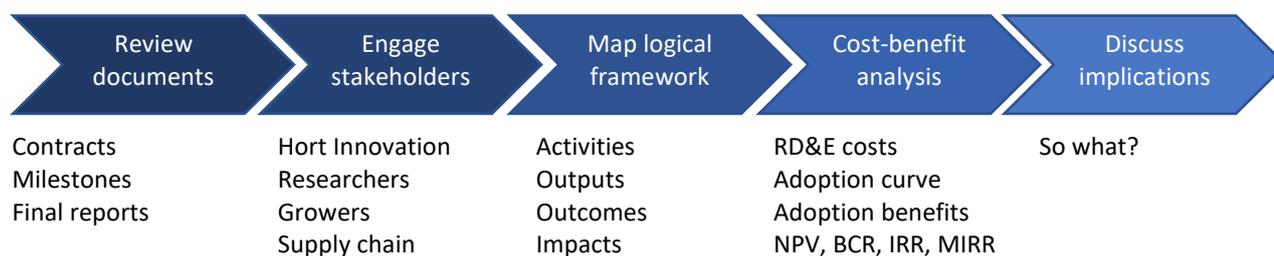
The projects *Nursery industry natural disaster risk mitigation and recovery plan (NY18008)* and *Ensuring business continuity during biosecurity incursions – social and economic research learnings for the production nursery industry (NY18010)* were both randomly selected as two of the 15 investments in the 2021-22 sample. Given the close alignment in activities and outcomes regarding mitigating risks for the nursery industry, the projects were grouped for analysis as an investment cluster. This report presents the analysis and findings of the cluster impact assessment.

The report structure starts with the general method of analysis used, followed by the RD&E background and an outline of the impact pathway in a logical framework, then describes the approach used to quantify the identified costs and benefits including any data gaps and limitations to the analysis, presents the results including from the sensitivity analysis, and finally discusses any implications for stakeholders.

## General method

The impact assessment built on the impact assessment guidelines of the Council of Rural Research and Development Corporations (CRRDC, 2018) and included both qualitative and quantitative analysis. The general method that informed the impact assessment approach was as follows:

1. Review project documentation including project plan, milestone reports, outputs and final report.
2. Discuss project delivery, adoption and benefits with the Hort Innovation project manager, project researcher/consultant, growers and other stakeholders (see *Stakeholder Consultation*).
3. Through a logical framework, qualitatively map the project impact pathway, including activities, outputs, outcomes to identify the principal economic, environmental, and social impacts realised through the project.
4. Collect available data to quantify the impact pathway and estimate the attributable impacts using cost-benefit analysis (over a maximum 30 years with a 5% discount rate) and sensitivity testing of key parameters.
5. Discuss the implications for stakeholders.



The analysis identified and quantified (where possible) the direct and spillover impacts arising from the RD&E. The results did not incorporate the distributional effect of changes to economic equilibrium (supply and demand relationships) which was beyond the scope of the MT21015 impact assessment program. A more detailed discussion of the method can be found in the *MT21015 2021-22 Summary Report* on the Hort Innovation project page [Horticulture Impact Assessment Program 2020/21 to 2022/23 \(MT21015\)](#).

A Stakeholder Case Study was developed to compliment this impact assessment and illustrate how the identified impacts have been realised in a practical setting. The Case Study can also be accessed via the Hort Innovation MT21015 project page.

## Project background

The Australian nursery industry is made up of an estimated 1651 businesses across Australia (Hort Innovation 2022) providing plant products as inputs into other horticultural businesses, or to consumers through retail nurseries.

Prior to investment in these projects, the industry had established an approach to improving nursery risk management through the Australian Plant Production Standard (APPS) best management practices (BMPs):

- Nursery Industry Accreditation Scheme Australia (NIASA) covering general production.
- EcoHort, the Environmental Management System (EMS).
- BioSecure Hazard Analysis Critical Control Point (BioSecure HACCP), covering pest, disease and weed risks.

However, at the same time, the nursery industry recognised the need to continuously update these resources with regards to industry risk. This ongoing need was incorporated in the Strategic Investment Plan (SIP) 2017-2021 (Hort Innovation 2017):

- Outcome 3: Protection – Improved industry protection from exotic, emerging and endemic pests and diseases.
- Outcome 4: Productivity – Improved productivity, profitability and professionalism through the creation of opportunities through innovation and adoption of industry BMPs.

This industry need was reinforced by the significant impact of tropical cyclones on Queensland nursery businesses in the 2000's and 2010's, with the industry also recognising the likelihood that natural disaster risk would increase with climate change.

While there were existing resources relating to natural disasters provided through state-based organisations (such as cyclone preparedness and management provided by the Nursery & Garden Industry Queensland Limited (NGIQ)) not all natural disasters were covered and there was an inconsistent approach to risk management. In addition, specific inclusion of natural disaster risk in the APPS BMPs was limited. As such, it was identified that an update of natural disaster risk management resources was required, to cover the wide range of natural disaster risks faced by the nursery industry including heatwave, frost, cyclone and severe wind, hailstorm, flood, bushfire, and incorporate the materials into the APPS BMPs (specifically EcoHort).

NY18010 was established to address this need, and provide nursery businesses with resources to enable preparedness, recovery and resilience to natural disasters.

While biosecurity risk management had received more recent attention to date than natural disaster (e.g. *Building the resilience and on-farm biosecurity capacity of the Australian production nursery sector (NY15002)* which had provided input in BioSecure HACCP), the industry identified the opportunity a for a more consistent approach to risk management by reviewing biosecurity risk concurrently with natural disaster risk. As such, NY18010 was contracted to build on existing biosecurity risk management and compliment the delivery of NY18010.

## Project details

Drawing on its existing knowledge and capacity regarding industry risk, NGIQ was selected as the lead delivery partner, with the project running from 2019 to 2021 (Table 1).

**Table 1. Project details**

<b>Project code</b>	NY18008	NY18010
<b>Title</b>	Nursery industry natural disaster risk mitigation and recovery plan	Ensuring business continuity during biosecurity incursions – social and economic research learnings for the production nursery industry
<b>Research organization(s)</b>	Nursery & Garden Industry Queensland Limited (NGIQ)	Nursery & Garden Industry Queensland Limited (NGIQ) (Project Lead) Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Sub-contractor)
<b>Project leader</b>	Kerry Battersby	Kerry Battersby
<b>Funding period</b>	July 2019 to June 2021	May 2020 to December 2021
<b>Objective</b>	Provide levy payers with resources to enable preparedness, recovery and resilience to natural disasters.	Develop a framework of recommended actions that could be quickly actioned during a biosecurity incursion, with the purview of minimising social and/or economic damage and ensuring business continuity.

## Logical framework

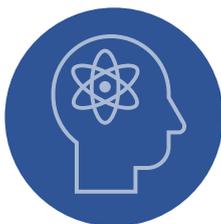
The impact pathway linking the project activities and outputs, and their assessed outcomes and impacts has been laid out in a logical framework (Table 2).

Table 2. Project logical framework

 <p>RD&amp;E activities</p>		<ul style="list-style-type: none"><li>• <b>NY18008 Natural Disaster</b><ul style="list-style-type: none"><li>○ Phase 1: National natural disaster risk assessment for the nursery industry.<ul style="list-style-type: none"><li>▪ Reviewed existing Commonwealth, State Government and relevant local Council “Get ready” natural disaster response plans to inform nursery industry emergency management, business continuity and disaster recovery.</li></ul></li><li>○ Phase 2 – Comprehensive Natural Disaster Risk Map for the Australian Nursery Industry, Action Plan and stakeholder engagement and communication activities.<ul style="list-style-type: none"><li>▪ Engaged consultant, Cohga Pty Ltd, to develop an interactive national spatial data map with access to risk assessment tools, live feeds from the Bureau of Meteorology, and incorporating nursery industry addresses. Engaged consultants, Risk Frontiers, to apply the national Address-Based Natural Hazards Risk Ratings to the data map.</li><li>▪ Worked with national nursery body Greenlife Industry Australia (GIA) and production nurseries to develop a 3-Tier Natural Disaster Action Plan for industry that could be introduced into the EcoHort accreditation system.<ul style="list-style-type: none"><li>• Telephone interviews with 21 production nurseries.</li><li>• Follow up interviews (on-site or online) with 18 production nurseries to test and adjust the Action Plan.</li></ul></li><li>▪ Coordinated with NY18010 to support project efficiencies.</li></ul></li></ul></li><li>• <b>NY18010 Biosecurity</b><ul style="list-style-type: none"><li>○ Sub-contract CSIRO to review a broad range of publicly available sources, from Australia and overseas, to identify information on the potential social and economic impacts of biosecurity incursions on the production nursery industry.</li><li>○ Sub-contract CSIRO to undertake empirical research into the social and economic impacts of biosecurity incursions on production nursery businesses, and potential measures to help them respond and recover. The research included qualitative interviews and a quantitative survey with 31 stakeholders, including nursery businesses affected by biosecurity incursions (n=9), government biosecurity responders (n=14), nursery industry responders (n=4), and supply chain personnel (n=4).</li><li>○ Drawing on the above empirical research, and in coordination with NY18008, a business continuity framework of actions was developed.</li></ul></li><li>• <b>Communication and extension</b><ul style="list-style-type: none"><li>○ Both NY18008 and NY18010 delivered resources for nursery, industry bodies, and broader stakeholder audiences. The resources were primarily extended through online channels (Hort Innovation project website and Your Levy at Work communications, the NGIQ website, and the APPS website). Specific details are provided below.</li></ul></li></ul>
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- **NY18008 Natural Disaster**
  - A Glossary of key terminology and definitions. For emergency management services, government agencies and industry groups to use in the initial assessment of a disaster to ensure clear communication supporting efficient and effective outcomes. Located on the NGIQ website.
  - A pilot Nursery Industry Spatial Mapping Portal, listing known nursery sites with a risk rating allocated for natural hazards for each site, and real time data from the Bureau of Meteorology integrated into the Portal.  
<https://ngiq.cohga.com/weave/hip.html>.
  - Four short, instructional videos to accompany the Portal (1-9 views).
  - A Damage Estimate Form distributed to all state-based nursery industry peak bodies and GIA.
  - A Natural Disaster Action Plan for nurseries, with Tiers 1&2 providing an introduction to Natural Hazard risk mitigation, with Tier 3 providing a longer term channel for adoption:
    - Tier 1. Six Nursery Preparation Checklists for nurseries to prepare for and manage priority natural hazards, available on the APPS website: Heatwave (25 downloads to date), Frost (29), Cyclone and Severe Wind (25), Hailstorm (40), Flood (51), Bushfire (42).
    - Tier 2. Nursery Business Continuity and Recovery Plan Template. Not yet extended to industry.
    - Auditable checklists for inclusion in the Ecohort BMP (expected to be included by mid 2024).
  - General communication activities including:
    - Two video case studies of participating nurseries (combined 1160 views to date).
    - One podcast case study of a participating nursery (68 plays to date).
    - One podcast on assessing extreme weather events (132 plays to date).
    - Seven research updates provided through the Hort Innovation communication channel *Your Levy at Work*.
    - One research update provided through the GIA communication channel *Nursery Paper*.
- **NY18010 Biosecurity**
  - CSIRO literature review of social and economic impacts and business continuity. Report located on the NGIQ website (6 downloads to date).
  - CSIRO report on empirical research (qualitative interviews and quantitative survey) into the social and economic impacts of biosecurity incursions on production nursery businesses, and potential measures to help them respond and recover. Report located on the NGIQ website (14 downloads).
  - A business continuity framework of actions (Decision Guide). Located on APPS website (5 downloads).
  - A list of alternate suppliers for inclusion in BioSecure HACCP. Not available online.
  - An online workshop held in October 2021 (number of attendees not identified).
  - Four research updates provided through the Hort Innovation communication channel *Your Levy at Work*.



- **NY18008 Natural disaster risk management.**

- New knowledge and resources generated to support decision making in natural disaster risk management.
  - The pilot Nursery Industry Spatial Mapping Portal showed promise for risk management at an industry level to support a more efficient response including engaging with affected nurseries, and coordination with other organisations. The Portal was deemed too expensive for the nursery industry to maintain alone so was proposed as a horticulture multi-industry resource which received limited interest (stakeholder pers comm). As a result there are currently no plans to maintain the portal in the future.
  - The Natural Disaster Action Plan (checklists, continuity and recovery template, and EcoHort auditable checklist) are available on the APPS website, supporting previously developed risk management resources particularly for Cyclone planning and Recovery (which has 425 downloads). In contrast, the checklists have had limited uptake to date (51 downloads or a maximum 3% of total nurseries) (APPS 2023). Inclusion of the auditable checklist in the EcoHort BMP are expected to increase total adoption of the resources; however, adoption through this channel is not significantly larger, with the EcoHort Manual currently distributed to 150 to 200 nurseries (9% to 12% of industry total), with 75 nurseries (5%) having progressed to full EcoHort certification (APPS 2023). Digitisation of the EcoHort Manual within the next 12 months has the potential to support additional uptake of the NY18008 outputs (Stakeholder consultation).
  - Participating nurseries gained direct project support in implementing the Natural Disaster Action Plan in their businesses, including identification, categorisation, and prioritisation of risks and risk mitigation activities. The level of direct benefit varied across the 18 participating nurseries with some being engaged due to their already high level of risk management (to help collect learnings and recommendations for the wider industry).

- **NY18010 Biosecurity risk management.**

- New knowledge and resources generated to support decision making in natural disaster risk management.
  - The two CSIRO reports identifying operational, economic, and social impacts resulting from biosecurity events supports growers, industry and government to better understand the risks and respond with appropriate risk mitigation actions.
  - The Decision Guide was developed to support the continuity of nursery operations during a biosecurity incursion. During the development of the Guide it was identified that there was no need to reinvent the existing management action plan because BioSecure HACCP already provided this in a comprehensive set of protocols and procedures (NY18010 Final Report), as such, the decision Guide focusses on directing growers to certify through BioSecure HACCP. At the time of writing there was uncertainty as to how the resource could best be incorporated into the existing biosecurity resources (i.e. Biosecure HACCP) and as a result, the resource had not been directly extended to growers in a meaningful way (outside of project report and the APPS website, where it has had 5 downloads).
  - The list of alternate suppliers for inclusion in BioSecure HACCP has not been made widely available to individual nurseries and as yet it has not been incorporated into any industry level biosecurity response plans.



The research conducted in NY18008 and NY18010 supports reduced industry risk relating to natural disaster and biosecurity events. A reduction in these risks are associated with the following economic, social and environmental impacts. Some of these impacts have been identified throughout the course of the project, particularly for nurseries participating in NY18008 to test natural disaster risk mitigation. Broader impacts are dependent on the ongoing funding and use at an industry level, or extension through their incorporation into APPS BMPs.

- Impacts associated with reduced natural disaster and biosecurity risk.
  - [Economic] Reduced costs to nurseries from biosecurity incursions (direct pest damage, and control measures including surveillance, chemical or other control methods, plant destruction, replanting, re-establishing supply chain relationships); or natural disaster events (rebuilding/repairing infrastructure, replanting, and re-establishing supply chain relationships) (CSIRO 2020 and CSIRO 2021).
  - [Socio-economic] Reduced costs to nursery and farm staff including psychological stress and strains on business and community relationships (CSIRO 2020 and CSIRO 2021).
  - [Economic] Reduced costs to nursery customers associated with reduced stock availability, and an increased risk of biosecurity spread from nursery to farm (CSIRO 2020 and CSIRO 2021).
  - [Socio-economic] Reduced costs to local economies and communities where nursery industries provide employment and wider community support (CSIRO 2020, CSIRO 2021 and The CIE 2023).

## Project costs

The project was funded by Hort Innovation, using the nursery research and development levy and contributions from the Australian Government, with in-kind funding from research partners NGIQ (Table 3). Hort Innovation overhead costs were added to the direct project cost to capture the full value of the RD&E investment.

### Nominal investment

Table 3. Project nominal investment

Year end 30 June	Hort Innovation project costs (\$)		Hort Innovation overheads <sup>1</sup> (\$)	NGIQ (\$)² project costs	Total nominal (\$) investment costs
	NY18008	NY18010	Combined	Combined	Combined
2020	125,666	0	18,875	15,210	159,751
2021	164,334	56,610	31,078	19,890	271,912
2022	0	92,590	12,911	0	105,501
<b>Total</b>	<b>290,000</b>	<b>149,200</b>	<b>62,864</b>	<b>35,100</b>	<b>537,164</b>

1. The overhead and administrative costs were calculated from the Financial Operating Statement of the Nursery Fund Annual Reports (Hort Innovation 2020-2022), averaging 14.3% for the NY18008 and NY18010 funding period (2019-20 to 2021-22).

2. Other funds from NGIQ were identified in the contract as a lump figures, so have been apportioned yearly based on Hort Innovation cash costs.

### Present Value of investment

The nominal investment of \$0.54 million was adjusted for inflation (ABS, 2023) into a 2022-23 real investment of \$0.60 million. This was then further adjusted to reflect the time value of money using a real discount rate of 5%, generating a present value (PV) of costs equal to \$0.67 million (2022-23 PV).

## Project impacts

The impact pathway identified in Table 2 was evaluated against available data to determine if it could be quantified with a suitable level of confidence.

## Adoption data

- NY18008 Natural Disaster. Adoption data exists for participation in the project (18 nurseries) and downloads of resources (51 downloads). Data on industry receipt (150 to 200 nurseries) of EcoHort resources, and certification (75 nurseries) provides some indication of potential future adoption if and when project outputs and recommendations are incorporated into these industry resources.
- NY18010 Biosecurity. Adoption of outputs is less clear for NY18010. While 31 stakeholders were engaged, this was part of empirical research into biosecurity impacts and management measures rather than in extending or testing project material and recommendations. Data exists for downloads of NY18010 resources (maximum 14 downloads) indicating a relatively low level of uptake to date. Further, while the project aimed to update BioSecure HACCP, the project findings largely confirmed the suitability of existing resources and there is a relatively high level of uncertainty that they will be incorporated into the BMP (Stakeholder pers comm). In the event that they were to be included, data on industry receipt of BioSecure HACCP resources, and certification (20 nurseries to date) provides some indication of potential future adoption.

## Impact data

- Risk is quantified as likelihood and consequences, which when combined can be shown as an annualised risk figure. Biosecurity and natural disaster risk management seeks to reduce risk (particularly consequences) through investment in preparedness and recovery resources (ranging from staff training to upgraded infrastructure), which again can be shown as an annualised figure. As such, the combined annualised risk figure (\$/year) and risk management figure (\$/year) provides a quantified estimate of a business or industry risk profile, where higher levels of risk management should result in decreased annualised risk and an overall reduction in the risk profile. To understand the marginal benefit of risk management projects such as NY18008 or NY18010, data is required to compare the baseline risk profile (risk without project outputs) and the risk profile once project outputs are adopted.
  - Baseline “without project” risk profile = management cost + risk adjusted disaster cost (likelihood x consequences):
    - Risk management investment (e.g. an annualized figure of \$X to support preparedness and recovery).
    - Likelihood of risk events (e.g. likelihood of severe cyclone event being 1/X years).
    - Consequences of risk events (e.g. at the given level of risk management investment, the consequences of a severe cyclone event are an average business cost of \$X from damage, lost production, etc).
  - With project risk profile = new management cost + new risk adjusted disaster cost (likelihood x consequences).
    - E.g. increased risk management investment to \$X per year.
    - Likelihood of risk events (likely unchanged as they are location based).
    - Consequences of risk events (e.g. at the improved level of risk management investment, the consequences of a severe cyclone event have decreased to an average business cost of \$X from damage, lost production, etc).
- NY18008 (Natural Disaster) collected data on the likelihood of disaster occurrence for registered nurseries with a rating of 1-5 (low to high) for the different natural disasters. E.g. industry average bushfire risk (likelihood) rating of 3.2, Hail 3.8, Tropical Cyclone 1.3, Flood 1.3, Surge 1.3. These can also be filtered by location and certification in EcoHort. This provides a valuable insight into the industry risk profile from a likelihood perspective; however, there is no corresponding data on management costs and consequences to calculate the aggregate risk profile of nursery businesses. When contacted, one of the 18 participating nurseries was able to estimate this full information for cyclone risk; however, given the variation in management costs, likelihood, and consequences across different locations, risks, and business types, this single data point was deemed insufficient to scale up to an industry impact. F
- NY18010 (Biosecurity) presented detailed data on nursery industry likelihood and consequences of biosecurity incidents through the empirical research reports (CSIRO 2020 and CSIRO 2021); however, this was not aligned to existing levels of risk management. As a result, an estimate of the marginal benefit of changes in risk management could not be estimated with any confidence.

Given the uncertainty in adoption (particularly relating to NY18010) and data gaps for adoption impacts (for both projects), it was not possible to quantify the attributable impact for these projects.

## Implications and learnings

The logical framework for NY18008 and NY18010 highlighted varying levels of certainty for the pathway from research to impact.

The development of resources that have a low confidence of adoption (e.g. the NY18010 outputs and the Spatial Mapping Portal of NY18007) indicate that the project plan with regards to outputs and outcomes may not have been effectively aligned to industry requirements and resources.

While there is greater confidence in the ongoing adoption of some project outputs (e.g. the Natural Disaster Action Plan from NY18008) through their integration into existing resources (EcoHort), there was a lack of data to quantify this impact.

If longer term funding were secured, the Spatial Mapping Portal would provide a useful source of information to understand the trends in the likelihood of risk events occurring across the nursery industry (and horticulture more broadly), potentially including any changes in likelihood associated with climate change, as well as supporting industry level risk preparedness and response. However, this dataset would need to be combined with additional data on consequences or management costs to allow a valuation of the industry's risk profile. In the future, collection of this data could be undertaken through the Nursery industry Statistics program (Currently NY21000) or the auditing process for APPS BMPs (EcoHort and BioSecure HACCP). By providing insight into industry risk management costs, the costs of risk events, and the uptake of industry risk management resources through BMPs, this combined data set would support ongoing assessments of the overall industry risk profile, and the success of any projects to reduce industry risk.

## Stakeholder consultation

Where possible, Ag Econ sought to engage multiple stakeholders across key areas of the logical framework and impact pathway to augment existing information and data sources, and reduce any uncertainty or bias from individual stakeholders. All stakeholders were engaged through telephone or online meetings, with follow up emails as necessary. Consultation followed a semi-structured approach in line with broad topics relating to the impact pathway and associated data requirements. Table 4 outlines the stakeholders consulted as part of this impact assessment and the topics on which they were consulted.

**Table 4. Stakeholder consultation by theme**

Stakeholder details		Consultation topics						
Stakeholder and organisation	Stakeholder type	Related research	Research inputs	Research outputs	Research immediate outcomes	Follow on research	Stakeholder adoption	Impact areas and data
Kathryn Young, Hort Innovation Head of Sustainability R&D	RD&E process owner / manager	✓	✓	✓	✓	✓		
Greg Chandler, Hort Innovation Head of Biosecurity R&D	RD&E process owner / manager	✓	✓	✓	✓	✓		
Kerry Battersby, QFF (formerly NGIQ)	RD&E practitioner	✓	✓	✓	✓	✓		✓
John McDonald, GIA, Director RDE and Biosecurity	RD&E Stakeholder	✓		✓	✓	✓	✓	✓
Cath Williams, Mount Nathan Nursery	RD&E Stakeholder				✓		✓	✓

## Glossary of economic terms

Benefit-cost ratio (BCR)	The ratio of the present value of investment benefits to the present value of investment costs.
Cost-benefit analysis (CBA)	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.
Direct effects	Impacts generated for the funding industry as a result of adoption of the RD&E outputs and recommendations, typically farm level outcomes relating to productivity and risk.
Discounting and Present Values (PV)	The process of relating the costs and benefits of an investment to a base year (2022-23 in this report) to reflect the time value of money or opportunity cost of RD&E investment. The analysis applies a real discount rate of 5% in line with CRRDC Guidelines (CRRDC 2018) with results sensitivity tested at discount rates of 2.5% and 7.5%.
Economic equilibrium	Due to a market's underlying supply and demand curves, changes in supply will have an impact on price and vice-versa. The Economic Equilibrium is the point at which market supply and price are balanced. Estimating the magnitude of market response to changes in supply or demand is a complex and demanding task that is considered beyond the scope of most CRRDC Impact Assessments (CRRDC 2018).
Internal rate of return (IRR)	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.
Modified internal rate of return (MIRR)	The internal rate of return of an investment that is modified so that the cash inflows generated from an investment are re-invested at the rate of the cost of capital (in this case the discount rate).
Net present value (NPV)	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.
Nominal and real values	Nominal values reflect the actual values in a given year (e.g. contracted RD&E expenses). These are converted to real (inflation adjusted) values using a base year of 2022-23.
Spillover effects	Impacts generated for stakeholders who did not fund the RD&E, including other agricultural industries, consumers, communities, and the environment.

## Abbreviations

ABS Australian Bureau of Statistics	GIA Greenlife Industry Australia
APPS Australian Plant Production Standards	HACCP Hazard Analysis Critical Control Point
BMP Best management practices	NGIQ Nursery & Garden Industry Queensland Limited
CRRDC Council of Rural Research and Development Corporations.	RD&E Research, Development and Extension
CSIRO Commonwealth Scientific and Industrial Research Organisation	SIP Strategic Investment Plan

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Ends.